CASTING AN OPEN NET:

A LEADING-EDGE APPROACH TO CANADA'S DIGITAL FUTURE

ACKNOWLEDGMENTS

Like the Internet, this report exists because of the strong community that contributed to making it leading edge. OpenMedia.ca initiated this report and shepherded it to completion, but the process was only made possible by the citizens who submitted comments to the CRTC, spoke at our Town Halls, and shared their insights with us online — they inspired us to keep refining their community-crafted vision. We're equally indebted to the talented people who shared their significant expertise on the issues, either by writing or reviewing the individual sections. Any oversights or errors are in spite, not because, of their best efforts.

We hope this report will spark more informed and imaginative dialogue on our digital future, to do justice to the amazing community that came together to make it happen.

STEVE ANDERSON

Executive Director, Open Media.ca

REILLY YEO

Managing Director, OpenMedia.ca

OUR SINCEREST THANKS TO THE PRINCIPLE WRITERS OF THE FOLLOWING SECTIONS:

CANADIAN VIEWS ON THE OPEN INTERNET

Reilly Yeo

David Waddell

Pierre Campeau

Shea Sinnott

THE TECHNICAL CASE FOR OPENNESS

Tamir Israel

Mark Faassen

Christopher Parsons

Jacqueline Cusack McDonald

THE OPEN INTERNET: INTERNATIONAL COMPARISONS

Christine Larabie

Reilly Yeo

Lindsey Pinto

Jennifer Parisi

Simon Fallick

CANADIAN CULTURE ON THE OPEN INTERNET

Fenwick McKelvey

Albert Brady Curlew

THE OPEN INTERNET: OPEN FOR BUSINESS AND ECONOMIC GROWTH

Christopher Parsons

Alexander Ly

Steve Anderson

Shea Sinnott

FURTHER THANKS TO EDITORS AND REVIEWERS OF INDIVIDUAL SECTIONS AND THE FRENCH TRANSLATION:

Leslie Shade, David Skinner, Tamir Israel, Pierre Campeau, Robin Millette, Christopher Parsons, John Harris Stevenson, Jacqueline Cusack McDonald, Alicia Girard, Leslie Bouillet, Jeremy Addleman, Vojtěch Sedlák, Kevin McArthur, Dwayne Winseck, Andrea Smith, Erin Brown-John and Shea Sinnott.

AND TO THE ORGANIZATIONS THAT PROVIDED FINANCIAL SUPPORT:

koumbit.org

Acanac-Inc.

cippic

As well as those from our amazing community who responded to our requests for additional funds.

LAYOUT AND DESIGN BY:

michael NUN MEI LER

michaelnun.ca

CASTING AN OPEN NET:

A LEADING-EDGE APPROACH TO CANADA'S DIGITAL FUTURE

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This is a community-powered report: Canadians from across the country financially supported this project and many contributed through a series of forums and online consultations. We received and are grateful for input, advice and sometimes major contributions provided by leading academics and digital policy experts.

This report establishes the need for Internet openness to guide digital policy in Canada. The goal of digital policy should be to increase the openness of communications networks and devices, and expand access to those open networks. An open Internet is one where citizens are empowered to decide what practices, content, services and applications gain popularity, capture imaginations, and proliferate. This means a neutral network (governed by the Internet's founding principle, net neutrality), where connections are affordable, found at internationally comparable speeds, within reach of all Canadians and, ideally, ubiquitous. Internet openness is central to the success of our economy, our culture and our society.

Internet openness and access is a spectrum, rather than a binary either/or. Openness and access can be measured in terms of the degree to which firms can act to limit Internet user preference and control. It is our view that Canada has an openness and access deficit. That deficit is primarily expressed through three disturbing practices employed by several of Canada's dominant ISPs:

- Many Canadian ISPs selectively limit access to certain online services in a practice known as "throttling," or slowing down of Internet traffic. This renders certain services almost unusable, as expressed in the recent complaint to the CRTC against Rogers for throttling World of Warcraft, a popular online game.
- Cable television and mobile providers are offering limited and controlled versions of the Internet over television and mobile devices, either by providing special priority access to certain services such as Facebook (in the case of mobile providers) or by providing web services via cable television. These take resources (in the form of either users or bandwidth) away from the open, public Internet that has been the engine of innovation.

- Big ISPs have been imposing usage-based billing (UBB) that features low usage caps and high per-use prices inconsistent with global standards. This discriminates against bandwidth-heavy activities such as online video consumption and distribution, online gaming and web development. When ISPs apply these costs, but exempt their own media services (video-on-demand or IPTV) from the caps, they are stacking the cards in their favour in a way that compromises the open and democratic nature of the Internet.

As we will illustrate below, these practices close the Internet, and stifle cultural expression and economic development — it is the openness of the Internet that has allowed it to be such an incredible platform for new cultural forms and economic innovation and growth. These closed communication practices are technically unnecessary, incompatible with our global competitiveness, and out of step with the wishes of Canadians. Big telecom companies are able to wield this level of control because policy neglect has allowed these dominant players to guide telecommunications development toward their own narrow commercial interests. Taken together, these practices are leading Canada in the wrong direction. While many other countries are rushing to provide ubiquitous open access to the Internet, Canada is moving towards a more circumscribed and inaccessible digital regime dominated by large vertically integrated telecommunications companies (Bell, Rogers, Shaw, Telus, and Videotron)

Canadians understand that this movement towards a closed Internet must be stopped, and they have seized opportunities to speak out about the centrality of an open Internet to a globally connected society. Over 11,000 citizens submitted comments to the CRTC during its 2009 hearings on traffic management — this is an absolutely unprecedented number for a regulatory proceeding. According to public opinion polling, 86% of online Canadians support net neutrality and 76% disagree with CRTC decisions that allow the expansion of metered Internet access (or usage-based billing). An incredible 480,000+ Canadians have signed OpenMedia.ca's StoptheMeter petition against usage-based billing, making it one of the largest online petitions in Canadian history. This should

excite not only supporters of the open Internet: we can all be enthused to see that a policy issue can so thoroughly rouse and galvanize citizen action.

And so it should — the open Internet has become both the symbol and the facilitator of interconnectedness, democratic decision-making, and innovation. By building a network where the decision-making is inherently decentralized, the architects of the Internet created a medium that ensures no single central actor, be it a repressive government, a gatekeeping publisher, or an Internet Service Provider (ISP) will be able to dictate its uses. Now this medium is threatened by the very actors we rely on to provide it to us. Big ISPs are threatening the open Internet on two fronts: through traffic management (throttling); and through billing practices that discriminate against certain uses of the Internet.

In this report we establish that there is no technical reason to discriminate against certain content and services. Big ISPs' arguments about the need for this discrimination are fundamentally flawed: they claim to be overwhelmed by traffic, but in fact, even with the advent of a multimedia-rich web, traffic growth on the Internet has slowed compared to the intense boom years of the late 1990s. When continuing improvements in technological efficiency are factored in with declining growth rates, it is possible for ISPs to meet projected growths in demand with mild and normal infrastructure upkeep reinvestment. There is evidence on the record of CRTC proceedings that confirm through experiments, and testimony of smaller Canadian ISPs, that technological advances make it possible to keep up with 50% traffic growth through normal levels of capital investment. Moreover, by targeting peer-to-peer (P2P) filesharing, big ISPs have targeted a particularly efficient and innovative use of the Internet. Likewise, managing congestion through monthly caps and usage fees is not an effective way to deal with potential network congestion that would only occur during peak periods. To fulfill their duty to the Canadians who have enabled them to make enormous profits, and act within the parameters of a functional marketplace, ISPs need to meet demand with supply and continue investing in a better Internet.

Though big ISPs have enjoyed an incredibly favourable market environment, Internet development in Canada has continued to decline rela-

tive to other countries. Canada has slipped to 12th place in the OECD in the ranking of broadband subscribers per 1000 inhabitants and placed 27th in price for high-speed connections — Canadians pay a whopping $64.72 per month for access, compared to $33.49 in Japan, and $35.92 in the UK. By looking at Japan and the UK, which have faced similar challenges in terms of powerful incumbent providers, we see that the key to a more open Internet market is strong action by decision makers. If Canada wants to stay competitive in the international digital economy, we need to look to other countries such as Sweden and Australia that have turned to public investment in infrastructure as a key strategy for wiring their citizens. Australia is investing over $40 billion AUD in a national broadband network, using it to help provide high-quality access in rural areas. The decision by the Australian government shows the potential for countries like Canada, which has a similar geographic breakdown and the challenges that come along with it, to recognize that significant government investment is not outside the realm of possibility; in fact, if we consider the need to keep pace with our international competitors and close the digital divide, the returns on this investment more than justify the costs.

These returns would include the continued flourishing of the already vibrant digital culture in Canada. To promote Canadian culture for the 21st century, we should expand Internet access and openness. The Internet is the best training ground for budding cultural producers, and we need to do everything we can to lower the barrier to entry to using the Internet as that training ground. Canadians spend more time online than the citizens of any other country; increasingly, they use that time to engage in creative practices. A 2009 survey found that 20% of Canadians engaged in online Creative Practices, like posting videos and photographs, a dramatic increase over previous years.

The digital divide still greatly affects Internet use in Canada: 91% of households earning more than $95,000 connect to the Internet, whereas only 47% of households earning less than $24,000 connect to the Internet; only 84% of rural communities have access to broadband, and access drops below 60% for rural Canadians connecting in the North. Users in these demographics more than any other need an open Internet; neither

their users nor producers can afford to pay higher fees for better quality access. The activities Canadians engage in, cultural creators in particular, like videostreaming and P2P filesharing, rely on fast and fair access. Framing growing bandwidth usage as 'out of control' or 'excessive' devalues the public interest and cultural significance of the Internet.

In today's precarious and fast paced economic environment the role the Internet plays in the economy is increasingly important. The Internet is essential to ground up innovation, job creation and a 21st century economy in general. Economic activity has been steadily moving online. Large and small businesses are benefiting from operational efficiencies and opportunities for innovation. New Internet usage costs and limitations discourage investment and raise the barrier to entry for new entrants. Innovators creating the next key piece of the web, or businesses trying to better integrate ICT systems into their frameworks, shouldn't face such an uphill battle of having to convince a regulator that a discriminatory system is damaging their business. Just as we expect these groups to be innovative in the marketplace, businesses should expect that our regulators ensure that all players are competing in an open market.

Canadians know that the open Internet is about more than technology: the Internet is unique in history for the potential ubiquity and equity of access to a platform that connects us on a global scale. The Internet has the potential to usher in a new era of connectedness and, with it, dramatic changes to social practices and institutions. If we get digital public policy right, Canada could become a leader in communications technology, leading to empowerment, job creation and new forms of democratic decision-making, entrepreneurship, and free expression. Canadians know that we have the potential now to preserve and expand the uniquely open nature of the Internet. The Internet will adapt to us, and enable creativity and connectedness if we ensure that it remains open, that it remains a medium we can all collaboratively shape and define through our daily practices. We aim to go beyond empty rhetoric on the value of a wired society – it's time to protect and expand the open Internet through concrete institutional changes and public policy that prioritize access, choice, diversity and innovation.

AN ACTION PLAN FOR A CONNECTED CANADA

As this report demonstrates, ensuring Canada has an open Internet is essential for our economy, culture, and global competitiveness. The goal of digital policy should be to bring fast, affordable and ubiquitous Internet service to all Canadians. We believe digital policy should be guided by the drive to increase access, choice, diversity, innovation and openness – with openness as the cornerstone both of the network and of the policy-making process.

Digital policy must balance the needs of large urban cities, smaller cities, rural towns, and remote communities. Canadian-made digital policy should recognize regional diversity and employ a variety of tactics to bring affordable Internet to all Canadians. To have a future-oriented Internet, Canada must address both the need to develop the core terrestrial network and complement that network with spectrum management that enables new opportunities for wireless access.

The following recommendations were derived from in-person consultations with Canadians in several cities, online consultations, and input from academic experts. As detailed in "The Open Internet: International Comparisons," the third section of this report, many of the policy recommendations below have been demonstrated to work in countries that have successfully restructured their telecommunication markets after facing similar challenges to those faced in Canada. We can overcome these challenges, if guided by both thorough research and analysis, and the core principles that make us leaders.

ACCESS

Bring fast Internet access to all Canadians and stimulate the economy

- The federal government should invest 2.2 billion (from spectrum auction proceeds) in 21st century Internet infrastructure — investment decisions should be guided by public interest criteria and made in consultation with citizens and, where appropriate, local governments.
- Projects should only be funded if they are open access networks; subsidized providers must guarantee minimum levels of service in the subsidized markets
- Provide incentives for construction to include fibre as a component of any construction process.
- Invest in city-wide open wireless Internet access initiatives
- Support the installation and extension of fibre to public institutions such as schools, libraries, community centres, hospitals, and public housing. Encourage CANARIE to allow these institutions to connect to its network.

CHOICE

Enable Independent ISP autonomy, and Internet access choice

- Functional separation should be adopted to enable ISP competition and choice.

- Users and service providers should be free to develop applications and operate any services without the prior approval of carriers, provided they do not interfere unduly with network operations or violate the neutrality of the network.

DIVERSITY

Allocate spectrum with an aim to diversify mobile access to the Internet

- Reserve from auction a band of no less than 2 contiguous 5 MHz in the 700 MHz band for Canadian innovation and local community services. (example: City of Fredericton's Wifi)
- Make spectrum available to lease rather than to own.
- Impose a use-it-or-lose-it clause that requires the successful bidder to launch the planned service within three years, or give up the spectrum.
- Ensure that a portion of the spectrum available after full digitization of TV signals is available for unlicensed use.
- Set aside one-quarter of the remaining spectrum in the band for auction to carriers with less than 2% of market share in order to enable the development of more carriers and more consumer choice.

INNOVATION

Canadian users and innovators need objective, reliable, open and understandable ISP data to use, plan and invest in new applications.

- Mandate regular ISP openness audits, measuring:
    - Traffic management practices
    - Average speeds (Ofcom in the UK and the FCC in the US do this in various ways)
    - Billing practices as set against costs (there have been stories of overbilling/mis-measuring usage by ISPs etc.).

- Congestion

- Regional broadband speed levels
  (See: http://broadbandmap.gov/)

- The audits should be applied to both wired and wireless access to the Internet.

- Parliament should amend the CRTC Act to permit the CRTC to levy administrative monetary penalties (AMPs) that can be used to enforce transparency requirements and regulations.

- The objective of the audits is to ensure users are able to freely decide which applications they run on their Internet connection, no matter which device or pricing tier they choose.

OPENNESS

Open CRTC: The best guarantee of an open Internet is a policy-making process that is open, citizen-centered, and public-interest oriented.

- The Government should direct the CRTC to ensure the creation of open, accessible and neutral networks and maximize user preference.

- In the interests of accountability and transparency, the government should show how all new appointments ranked in the overall scorecard based on the must-have and should-have criteria listed in the job postings. The criteria should include significant experience in the public interest or consumer advocacy community.

- The Government should include broader stakeholder and citizen participation in the appointment process of CRTC commissioners.

CANADIAN VIEWS ON THE OPEN INTERNET

There is something uniquely powerful about everyday people having access to a globally connected, open platform that allows them to share art, stories, ideas and opinions from almost anywhere. In a country as large and diverse as Canada, the ability to connect instantaneously across literal and metaphorical distances via the Internet is particularly precious.

Canadians are well aware of this, and have taken opportunities to speak out about the need to preserve an open, accessible Internet, notably during the CRTC's hearings on traffic management in 2009. While the open Internet movement in Canada has been slower to assemble than in the US, net neutrality and more recently, usage-based billing have been hotly debated in the press, in parliament, and in public forums across the country. In this section, we survey the diverse groups that have spoken out in favour of net neutrality, in order to give an overview of the depth and breadth of support in Canada.

CANADIAN VIEWS ON NET NEUTRALITY

CITIZEN VOICES DURING THE TRAFFIC MANAGEMENT HEARING

The wider public debate about net neutrality ignited in Canada in mid 2008, when 'throttling' — selected slowing down of certain Internet traffic — by telecommunications giant Bell Canada Inc. limited viewing of the Canadian Broadcasting Corporation's (CBC) hit show "Canada's Next Great Prime Minister." According to the CBC's own story on the issue, users "complained about very long periods required to download the show," reporting download times of several hours through file-sharing application BitTorrent.[1] Throttling by Bell was limiting the CBC's ability to fulfill Section L.vii of its mandate: to serve Canadians using the most "appropriate and efficient means."[2]

The traffic throttling practices of Bell Canada and other large ISPs sparked a national conversation about net neutrality, which started to gain traction when CRTC Chairman Konrad von Finckenstein commented on net neutrality in a speech to the Canadian Telecomm Summit on June 17th 2008, stating: "Fundamental issues of technology, economics, competition, access and freedom of speech are all involved… it is one of the polarizing issues of the day. It will have to be addressed and debated by all of us."[3] The CRTC then announced a review of Internet traffic management practices for July 9th 2009, representing a key opportunity for net neutrality advocates to make their case.

Citizen responses to the net neutrality issue during the 2009 traffic management hearings came overwhelmingly in the form of a letter writing campaign sponsored by OpenMedia.ca, then the Campaign for Democratic Media. Despite the technical nature of the debate, the public at large identified the impact of the changes proposed by telecommunication companies on the foundations of an open Internet. Over 11,000 individuals submitted a

FIGURE ONE

TEXT OF THE LETTER USED DURING OPENMEDIA.CA'S 2009 LETTER-WRITING CAMPAIGN

Dear Commissioners:

I submit that the CRTC should listen to the public and stop Internet Service Providers from discriminatory traffic-shaping practices.

We rely on the CRTC, as the federal communications regulator, to act in the public interest, which in this case means ensuring we have an open and neutral Internet. I don't want ISPs picking winners and losers concerning Internet technologies and applications. It should be up to users, not ISPs, to decide which applications and services we use on the Internet.

If ISPs have network congestion problems, they should invest in building out the network capacity or adopt application-neutral traffic management. Allowing ISPs to selectively slow down content and services should not be an option. Don't reward the ISPs' failure to keep up with other OECD nations by allowing them to control the speed of Internet traffic.

As Canada moves deeper into recession, we must actively support our home-grown social, cultural and economic innovation, not punish it by allowing big telecommunications companies to strangle the open Internet. The CRTC can do its part by enacting and enforcing policies that help build an open, fast, and accessible Internet in Canada.

letter drafted by OpenMedia.ca to voice their concerns (Figure One). The letter focused primarily on the dangers of letting large telecommunication companies make decisions that affect both smaller companies and the individuals who subscribe directly to their services. The letter was primarily concerned with outlining the dangers to free choice and the economy if throttling is used as an Internet traffic management practice.

Over 1,000 concerned citizens felt the need to write their own letter or add additional notes and comments to the OpenMedia.ca's letter. These people came from a variety of backgrounds, including small business owners, CEOs, concerned senior citizens, and young professionals. Of those who provided their location, the two largest voices were from Ontario and British Columbia; however, a broad response was elicited from over three quarters of Canada's provinces and territories.[4]

FIGURE TWO

THEMES FROM LETTERS SUBMITTED DIRECTLY TO THE CRTC

Industry Accountability:	99%
Freedom of Choice and/or Privacy:	68%
Negative Impact of Monopolies:	43%
Democratic Principles Violated:	30%
Innovation At Risk:	18%
Negative Impact on Economy:	13%
Download Caps Inappropriate:	4%

THEMES FROM MODIFIED LETTERS SUBMITTED THROUGH OPENMEDIA.CA

Industry Accountability:	99%
Freedom of Choice and/or Privacy:	98%
Negative Impact on Economy:	80%
Negative Impact of Monopolies:	17%
Democratic Principles Violated:	10%
Innovation At Risk:	9%
Download Caps Inappropriate:	2%

Issues of concern to these citizens rank in order of importance as follows: Industry accountability; freedom of choice and/or privacy; a negative impact on economic recovery; opposition to monopolization; violating net neutrality is undemocratic; cultural and technological innovations may suffer; and download caps are inappropriate (Figure Two).

The letters talked of an open Internet as, broadly speaking, a space where individuals may conduct their business electronically with all information being treated the same regardless of what it is. Reading this information or analyzing it raised privacy, censorship, and monopoly concerns. The definition of an open Internet for many of the writers went beyond traffic throttling, in some cases including the importance of webspace and e-services being equally available to the arts and business communities. Despite various definitions of the

open Internet, all writers shared a growing concern over discrimination against the content of their outgoing information.

The majority of individuals felt that this concern fell within the prerogative of Canadians as consumers, but also that it suggested actions that were potentially undemocratic on a broader scale. While some of the technical aspects of the issue caused a few commenters to show confusion and hesitancy, people spoke very frankly about their commitment to net neutrality, and insisted that the CRTC must act against throttling in order to remain aligned with the best interests of Canadians.

In addition to the letters submitted through OpenMedia.ca, 385 concerned individuals sent letters directly to the CRTC.[5] Given that these letters were entirely unique and not derived from a form letter, the much greater range of themes and opinions found therein is no surprise. Individuals who communicated directly with the CRTC placed more emphasis on the negative impact of monopolies, but agreed in large part with those who submitted through OpenMedia.ca about the need for industry accountability and the risks to freedom of choice and privacy (Figure Two).

PUBLIC OPINION RESEARCH

Public opinion research suggests robust support for an open Internet. Before the issue became a major concern for Canadians, a poll conducted by Leger Marketing in October of 2007 found that Canadians were generally in agreement with the principle of net neutrality. According to the poll, three in five Canadians believed Internet Service Providers (ISPs) should be required to treat all content, sites and platforms equally. Two-thirds disagreed with the proposal that ISPs should be allowed to impose additional fees for access to specific content on the web.[6] This polling work was sponsored by Open Internet Coalition member eBay.

More recent polling carried out by Ipsos Reid reinforces the Leger Marketing findings. When presented with the concept of net neutrality, online Canadians (defined as those who use modems and other devices to access the Internet from home) overwhelmingly supported net neutrality, with 86% agreeing that “the Internet should be kept open

and free from interference and restrictions."[7] This polling work provides concrete evidence of the breadth of support for net neutrality amongst the Canadian public.

> "Consumers are also opposed to traffic shaping and throttling as a means to resolving bandwidth issues. Some participants were willing to accept higher fees for heavy use in order to avoid throttling. As well, the need for high speed Internet is growing, but Canadian consumers have not seen the cost associated with Internet service come down over time. Some focus group participants suggested that ISPs may not be keeping up with the demand by improving their technology and infrastructure. As well, consumers are very opposed to prohibition or throttling of certain targeted applications or protocols. Privacy is also a great concern for Canadian consumers, who want to ensure that their Internet activities are not being tracked by their ISPs or used for marketing purposes. Finally, consumers believe that reseller ISPs should be able to make their own policy decisions about how to manage bandwidth concerns and not be dictated by suppliers."
>
> ~ From *Staying Neutral: Canadian Consumers and the Fight for Net Neutrality,* the report from the PIAC focus groups

Focus group work has attempted to drill deeper into Canadian perceptions around net neutrality. In an effort to "gauge consumer knowledge and reaction to net neutrality issues facing Canadians" the Public Interest Advocacy Centre (PIAC) held qualitative focus groups on the net neutrality issue in January of 2009.[8] These sessions were carried out in combination with the Environics Research Group, with funding from Industry Canada. In total, six groups of ten people met in three different cities across Canada (Toronto, Montreal and Vancouver). In each group, the researchers ensured that the participants had high Internet usage rates (more than 20 hours per week) and that there was a mix of participants using different ISPs. All participants also had a strong interest in policy issues within Canada.

For the purposes of the focus group, net neutrality meant that all users would have the same levels of Internet accessibility, and could use any online application they desired.[9] A neutral Internet also meant that freedom of expression would be maintained, and that a lack of ownership or commercial bias would govern the Internet. Once participants were informed about net neutrality, they became very engaged in the issue. Participants were encouraged to lobby the government for net neutrality legislation, but most participants were unaware of how to do so, or who to approach. Specifically, many of the participants were unaware of the Canadian Radio-television and Telecommunications Commission (CRTC) and how it functions. Given this general lack of awareness of the CRTC, the spectcular participation rates in the Traffic Management hearings later that year are more impressive.

The PIAC focus groups gave some evidence about the specific concerns of Canadians regarding net neutrality: many participants stated they were concerned with a corporatization of the Internet. Users recognized that commercial or financial interests might limit what they could or could not access on the Internet, and saw this as contradictory to the original intent and principles of the web. While some participants could understand that throttling might be beneficial in some cases, most were "strongly opposed to throttling and traffic shaping practices being used to further corporate interests".[10]

Net neutrality has been in the public consciousness for long enough now that we can draw some firm conclusions about Canadian views. Submissions during the traffic management hearings demonstrate that Canadians grasp the link between net neutrality and the potential of the Internet to expand freedom of choice and expression, accelerate innovation, and create a more resilient economy. Public opinion polling work, especially that by Ipsos Reid, makes an undeniable case for broad Canadian support for a free and open Internet.

CANADIAN VIEWS ON USAGE-BASED BILLING

On October 28th 2010, the CRTC made a crucial decision enabling Bell to force smaller, independent ISPs to introduce usage-based billing (UBB). In response, on November 1st, OpenMedia.ca launched StoptheMeter.ca — a petition calling on Industry Minister Tony Clement, the CRTC, and other policymakers to put a stop to UBB. The campaign describes UBB as unfair, anti-competitive, and punitive, and emphasizes how it threatens Canada's social progress, cultural innovation, and global economic competitiveness. Twenty-four hours after the launch, more than a thousand citizens had signed.

On December 16th 2010, the City of Vancouver led by councilor Andrea Reimer adopted a resolution opposing UBB, kicking off political opposition to the measure. Canadians continued to use the web to express their frustration, and to alert their fellow citizens, encouraging them to join the cause. Despite this uproar, the CRTC confirmed its decision on January 25th, 2011. This angered Canadian citizens and independent ISPs alike, who reiterated that the new pricing structure would stifle innovation and media diversity. By the end of January, more than 160,000 people had signed the petition, and it had attracted the attention of national media including the CBC and CTV.

By the end of January, all the major political parties in Canada had publicly condemned UBB. On January 20th, the NDP announced its opposition to UBB and the Liberal party soon followed suit, demanding that the Conservative government reverse the decision. At the same time, Minister Clement broached the subject, saying "these [CRTC] decisions will be studied carefully to ensure that competition, innovation and consumers were all fairly considered."[11] Shortly thereafter, Prime Minister Stephen Harper ordered a review of the decision, and the launch of a review was confirmed by the CRTC on February 7th. By that time, over 400,000 people had signed the StoptheMeter petition – making it one of the biggest online petitions in Canadian history.

As part of its review proceeding for UBB, the CRTC called on Canadians and interested parties to submit comments. In partnership with the Canadian Internet Policy and Public Interest Clinic (CIPPIC), OpenMedia.ca commented on the CRTC's review, calling on the commission to "widen the scope" of its proceeding in order to address the larger structural problems within the Internet service market. Several parties — in particular, PIAC and the Canadian Network Operators Consortium — echoed OpenMedia's demands and reaffirmed this call for an expanded scope and an analysis of the key assumptions that led to the decision; namely, OpenMedia.ca took issue with the CRTC's definition of "heavy" versus "light" Internet use, and the lack of ISP data concerning the correlation between "heavy usage" and congestion.[12] As well, OpenMedia.ca sent letters to all the major parties, requesting they join OpenMedia.ca's call to widen the scope of the UBB proceeding. The NDP and the Liberals joined this call, and each created their own submissions addressing the scope of the UBB review.

On March 11th 2011, the CRTC denied these requests to widen the scope.[13] The commission did, however, announce the introduction of a public hearing and online consultation into its UBB review process. The deadline for formal submissions by interested parties is July 29th, and the CRTC will announce its final conclusions for the review four months after this date.

Though the UBB decisions affect the Canadian Internet service market overall, the three main telecom companies involved in the CRTC decisions and subsequent controversy are Bell BCE, Rogers Communications Inc., and Shaw Communications. Both Bell and Shaw have responded to the social and political fallout of UBB, altering their billing practices and ultimately backing down on UBB to varying degrees. More specifically, on February 8th, Shaw announced its suspension of all UBB until at least the end of the CRTC proceeding, while on March 28th, Bell announced its introduction of an alternative — and slightly fairer — scheme for the imposition of UBB, called "aggregated volume pricing" (AVP). Rogers, unfortunately, has yet to be moved.

As of this writing, 480,000 Canadians have signed the StoptheMeter petition. In addition, according to an Angus Reid/Toronto Star poll,[14] the majority of Canadians oppose the CRTC's UBB decisions. The poll indicates that 76% of respondents (out of 1024) disagree with the CRTC regarding UBB. Canadian views on UBB are therefore very clear: polls and the public outcry confirm that Canadians are strongly opposed to the practice.

Further, the StoptheMeter campaign clearly illustrates that Canadians care about the quality of Internet access in Canada, and are willing to demand that policymakers act to improve that quality and defend an open Internet. Canadian policy-makers are responding to the public's calls; both the Liberal and NDP party platforms directly address UBB and each party's commitment to an open Internet. The NDP platform asserts: "We will prohibit all forms of usage-based billing (UBB) by Internet Service Providers (ISPs)".[15] The Liberals commit to ensuring that Internet traffic management remains "neutral" and claim that: "A Liberal government will issue an Open Internet Directive to the CRTC opposing anti-competitive usage-based billing and ensure a fair, effective wholesale regime to allow smaller Internet service providers to lease broadband infrastructure at fair prices."[16]

In addition, in an online chat with OpenMedia.ca Founder Steve Anderson, Liberal Marc Garneau asserted his support for leading-edge policies like, functional separation, which would separate big ISPs infrastructure control from their retail services.[17]

Conservative Party leaders such as Clement have continued to speak out against UBB, and Bell's new plan for AVP; however, their platform does not directly address the issue.[18]

Finally, the Green Party released a statement addressed to its candidates and supporters, calling on the Greens to "Vote for the Internet" this election, in support of OpenMedia.ca's (VoteNet.ca) online campaign. The Greens noted how "A decade of neglecting the Internet regulatory issue is stifling Canada's economy, global competitiveness, free expression and Canadians' personal budgets."[19]

CIVIL SOCIETY

The SaveOurNet.ca coalition, spearheaded by OpenMedia.ca and consisting of public interest groups, labour, businesses and individuals, has been the primary mechanism for uniting the efforts of civil society groups that support net neutrality. SaveOurNet.ca launched with a well-attended first-of-its-kind net neutrality rally on Parliament Hill in May 2008, which brought out over 400 supporters of net neutrality. Members of the coalition include:

- Businesses — over a dozen small independent ISPs; technology design, development and consulting companies such as Communicopia Internet Inc., Linux Ottawa, HardData and Agentic; and web businesses such as FarmVisit.com (which helps Canadians find local farms), NetVillage (a social dating website) and LeaseorRelease.com (which facilitates the transfer of car leases from one driver to another).

- Not-for-profit organizations — the Canadian Federation of Students, responsible for half a million Canadian students; the World Association for Christian Communication, an ecumenical group promoting communications for social change, with members in 120 countries; the Public Interest Advocacy Centre (PIAC), a non-profit group seeking information and services for consumer interests; The Canadian Internet Policy and Public Interest Clinic (CIPPIC), a public interest law clinic run through the University of Ottawa; the Council of Canadians, Canada's largest citizens' organization, with members and chapters across the country; and others.

- Media organizations — NowPublic, The REAL News Network, the National Campus and Community Radio Association and many others are members of the SaveOurNet.ca coalition.

- Labour — the BC Government and Service Employees' Union; the Canadian Media Guild/CWA Canada; the Canadian Union of Public Employees; the Collingwood and District Labour Council; the Communications, Energy & Paperworkers Union of Canada (CEP); the National Union of Public and General

Employees (NUPGE); and the Saskatchewan Federation of Labour are all members of the SaveOurNet.ca coalition.[20]

SaveOurNet followed the Parliament Hill rally with a series of "Open Internet Town Halls" held in Toronto, Ottawa and Vancouver. An additional town hall was organized by several groups in Halifax. The Town Halls brought together open Internet advocates from a range of backgrounds, including the private sector, labour, government and academia, to interact with the public and raise the profile of the net neutrality issue. Town Hall attendees expressed serious concerns about the lack of competition in Canada's telecommunication sector, the challenges to democracy posed by lack of net neutrality and a free flow of information, and the urgent need for all Canadians to have high-quality access to an open Internet. Attendees at the Ottawa Town Hall produced a list of activites that could support improved Internet access, including supporting net neutrality and reporting preferential treatment of provider-owned content. Participants also provided clear policy recommendations to deal with net neutrality and Canada's falling standing on key internet metrics like speed and cost. Input from these discussions helped inform the Recommendations found at the beginning of this report. The Town Halls demonstrated the broad appeal of SaveOurNet's work, and the ability of Canadians to engage meaningfully with this issue.

CIVIL SOCIETY SUPPORT DURING THE TRAFFIC MANAGEMENT HEARINGS

In addition to the more than 11,000 citizen comments submitted during the traffic management hearings, a wide range of civil society groups sent formal submissions to the CRTC. OpenMedia.ca partnered with the CIPPIC to make a 71-page submission that included support from Dr. David Reed of MIT, one of the original architects of the Internet, and network experts Dr. Andrew Odlyzko of the Minnesota Internet Traffic Studies (MINTS) project, and Bill St. Arnaud, Chief Research Officer for CANARIE Inc., Canada's Advanced Internet Development Organization.[21]

Support for net neutrality during the traffic management hearing was by no means confined to members of the SaveOurNet.ca coalition. Organizations as diverse as the Alliance of Canadian Cinema, Television and Radio Artists (ACTRA), the BC Civil Liberties Association, the Union

des Consommateurs, the Atlantic Provinces Library Association (APLA), the Government of British Columbia, and the OIC (which includes major organizations like Google, Skype, eBay, Amazon, Ticketmaster, Sony Electronics and many others) sent submissions that spoke to the importance of an open Internet. The Government of BC's submission states clearly: "Net neutrality should be accepted as the bedrock upon which the Internet rests."[22] ACTRA President Ferne Downey testified before the CRTC, calling on commissioners "not to hand the keys to the Internet over to a handful of major corporations who control broadband access in Canada" and to "enshrine the principle of net neutrality."[23] Google's Canada Policy Counsel, Jacob Glick, presenting on behalf of the OIC, insisted that the CRTC ought to "regulate in a way that promotes the development of the open Internet...practices that undermine the Internet's openness are bad for innovation...[the Internet] is indispensable infrastructure for our economy, our society and our democracy."[24] Zip.ca, an online video service company, sent its CEO Rob Hall to hearings, where he insisted that CRTC rules "need to be fair and apply to everybody equally"[25]

The traffic management hearings were a success for supporters of net neutrality in Canada, in terms of the volume and diversity of submissions favourable to the net neutrality cause, and the outcome of the hearings. On October 22, 2009 the CRTC issued its ruling concerning Internet traffic management. The CRTC decided to adopt new traffic management guidelines resembling some of the rules put forth by the CIPPIC and OpenMedia.ca, the OIC and others. The traffic management ruling was a huge milestone in the effort to keep Canada's Internet open.

Unfortunately, however, several ISPs continue discriminatory traffic throttling practices,[26] and the new CRTC guidelines put the onus on citizens to file a complaint and prove that ISPs are "unjustly" throttling traffic.

CANADIAN VIEWS DURING THE DIGITAL ECONOMY CONSULTATION

Supporters of net neutrality have been pushing the CRTC to go further in its support for the open Internet by executing mandatory audits of ISPs' traffic management practices to find and stop any examples of unjust discrimination. They have continued to seize key opportunities to push for a more open Internet, including during the government's Digi-

tal Economy Consultation, held from May 10 to July 30, 2010. A consensus submission, signed by 78 individuals including leading experts in media policy, specifically highlights the importance of net neutrality, and SaveOurNet.ca's ongoing efforts around audits:

> "For all sectors to participate and innovate within the digital economy and society, network neutrality is required as a foundational element. Net neutrality refers to the idea that data and information can be transmitted and received on the Internet from every source in non-discriminatory ways. Practices such as filtering and traffic shaping, or throttling, run counter to the principles of network neutrality. In Canada, some steps have been taken through the CRTC to protect network neutrality. Civil society organizations such as SaveOurNet.ca (2009) note that: the onus is on the consumer to file a complaint and to prove that the ISP is throttling traffic. We think that's wrong. When it comes to surfing the web, the Internet user, not big telecom, should be in the driver's seat.
>
> As a possible tactic to address this situation, SaveOurNet suggests that the CRTC could conduct compliance audits. Therefore, it can be said that the realization of network neutrality requires ongoing reviews of legislation, regulation and practice.
>
> Legislating or regulating to protect network neutrality in Canada is essential for innovation...We recommend, regulation must continue to be reviewed and adapted to protect the interests of Canadian citizens and innovators."[27]

FIGURE THREE

FROM THE BRITISH COLUMBIA LIBRARY ASSOCIATION'S SUBMISSION TO THE DIGITAL ECONOMY CONSULTATION

"BCLA's position on Net Neutrality reflects the interests of Canadian libraries, library staff, and library users. Libraries provide millions of Canadians with Internet access through library computers and wireless networks, act as a portal to information on the Internet from home or in the library, and connect people with information in countless ways that depend in one way or another on the Internet.

Net Neutrality rests on the principle that information sent via the Internet, regardless of source or format, should be treated equally. This is a central principle of the creation and evolution of the Internet. From this principle it follows that:

- Internet Service Providers (ISPs) do not have the right to manipulate the flow of web content to consumers.
- All formats should be treated equally by ISPs (i.e. no content is blocked based on the technology used to deliver it).
- Users are free to go where they want on the Internet, accessing the information they choose.

With this definition in mind, BCLA maintains that regulatory enforcement needs to be in place in order to preserve the democratic principles of the Internet. In addition, clear, immediate plans need to be made for enforcing these regulations, with the responsibility for taking necessary action lying with ISPs and not Internet users."

Other parties who submitted pieces specifically mentioning net neutrality include: the Canadian National Institute for the Blind ("The disability community including CNIB strongly supports net neutrality because it ensures a consistency across service providers. [T]he loss of net neutrality [could result in] a huge obstacle to simple usage and affordability for persons who are blind."[28]); PIAC; Telecommunities Canada; the Canadian Association of Internet Providers and the Coalition of Internet Service Providers; the Canadian Library Association, BC Library Association (Figure Three) and the Canadian Association of Research Libraries ("The traffic management practices of the ISPs should be as 'neutral' as possible, not favouring, for purely commercial reasons, some content over other. While some policies have been enunciated by the CRTC, "net neutrality" will be an ongoing concern as ever more Canadians and Canadian companies conduct business online."[29]); the Directors Guild, and the Canadian Film and Television Producers Association ("While the CRTC recently adopted a new net neutrality framework, careful monitoring will be required to ensure that Canada has the rules in place to keep the Internet as an open access content distribution platform."[30]); and, finally, the Saskatchewan Advanced Technology Association ("Canada needs initiatives strongly supportive of network neutrality."[31])

In addition to inviting submissions like the above from interested parties, the consultation included an "Idea Forum" where citizens could submit ideas for advancing the digital economy, and the public could vote either 'plus' or 'minus.' Of the 297 votes on ideas that specifically recommended net neutrality, 231 or

FIGURE FOUR

RESPONSE FROM INDUSTRY MINISTER TONY CLEMENT

Thank you for your email providing your views on the Canadian Radio-television Telecommunications Commission (CRTC) decision on Internet traffic management practices (ITMPs).

As you are aware, on October 21, 2009, the CRTC issued Telecom Regulatory Policy 2009–657, which establishes a framework for analysis that guides Internet Service Providers (ISPs) in their use of ITMPs. The framework allows the Commission to determine whether or not specific ITMPs are in compliance with subsection 27(2) of the Telecommunications Act, which prohibits unjust discrimination and undue preference.

The CRTC, of its own motion or upon the receipt of a credible complaint, can review ITMPs using the established framework. This manner of proceeding is frequently referred to as an ex post (i.e., complaints-based) regulatory approach. The burden of establishing that an ITMP discriminates or results in a preference or disadvantage is on the complainant. However, ISPs must demonstrate that any such discrimination, preference, or disadvantage is not unjust, undue, or unreasonable in their response to complaints, and explain why their ITMPs meet the requirements of the framework. Information on how to file a complaint with the CRTC can be found on its website at http://www.crtc.gc.ca/rapidsccm/register.asp?lang=e.

Access to the Internet is a key issue for Canadians. Industry Canada continues to monitor domestic and international developments to ensure that our legislative and regulatory frameworks remain effective.

Once again, thank you for taking the time to write. I trust that you will find this information helpful.

Yours sincerely,
Tony Clement

78% were 'plus' votes. One visitor to the idea forum commented:

> "Net neutrality is crucial for the maintenance of those aspects of Internet activity which are most beneficial to the public good. That is to say: grassroots organization on an independent basis through message boards, sharing of open source and free software the existence of independent media sources, and many others. While the corporate Internet will continue to be alive and kicking regardless of the outcome of the net neutrality debate, the public Internet's contribution to society and the economy cannot be ignored."[32]

Like public support for net neutrality, civil society support reflects the importance of the issue to all sectors of Canadian society. Unprecedented participation during the CRTC's hearings on traffic management and the diversity of participation during the digital economy consultation demonstrate the depth of engagement by a multitude of actors on this issue.

POLITICAL PARTIES

Following SaveOurNet.ca's rally on Parliament Hill in May of 2008, both New Democratic Party (NDP) and Liberal members of parliament put forward private members' bills in support of net neutrality. Increased support for net neutrality by political parties is a clear demonstration of the increased traction this issue has with Canadians. In this sub-section, we offer an overview of the evolving positions of all major federal parties.

CONSERVATIVES

The Conservative Party has remained unclear on the issue of net neutrality. During House of Commons debates in June of 2009, Liberal MP and industry critic Marc Garneau took the floor and asked the Conservative party to define its own stance on net neutrality. The respondent, Industry Minister Tony Clement, failed to directly respond to the question, instead announcing the launch of the digital economy consultation detailed above.

In response to the Conservative's lack of a clear position, the SaveOurNet.ca Coalition launched a campaign in December 2009 calling on citizens to ask Minister Clement to preserve Canada's open Internet by mandating compliance audits of ISP traffic management practices.

By January 2, 2010, Minister Clement responded with an email, which unfortunately did not address the concerns of the Coalition or Canadians who had written to him (Figure Four). SaveOurNet therefore continued its letter-writing campaign and as of April 2011, over 3,500 citizens had written to Clement.

In November 2010, Pamela Miller, Director General of the Telecommunications Policy Branch of the Canadian Federal Government, sent an email to those who participated in the campaign.[33]

In her message, Miller pointed to the follow-up letters that the CRTC sent to "a number of Canadian ISPs" asking for the increased transparency mandated in Commission's guidelines, but that she felt "it would be premature" to ask the Commission to conduct audits of ITMPs while there has been "no indication from the CRTC that credible complaints have been received". Under the system currently endorsed by the Ministry of Industry, the onus falls solely on the consumer to report non-compliance, yet they have no access to data from the ISPs about their traffic management practices. Consumers either don't know that they need to file a complaint, or don't have access to the data that would make their complaint credible.

LIBERALS

The Liberal Party of Canada has changed its position on net neutrality from ambiguous to supportive. Prior to 2009, the Liberal Party chose not to include net neutrality policy in its campaign platform. However, Liberal MP Marc Garneau's challenge to the Conservative Party (mentioned above) provided the impetus and a forum for the Liberals to meaningfully state their own opinion: after Garneau's comments, the Liberals altered their platform to include net neutrality. This was in response to feedback on the Liberals' website Voice.liberal.ca that indicated net neutrality was the top issue of concern to visitors.[34]

In January 2010, in a direct response to the SaveOurNet.ca coalition, the Liberal Party published a Question and Answer piece outlining its position. The Liberal Party "supports the principles of net neutrality and an open and competitive Internet environment" and "[does] not believe ISPs should be able to throttle wholesale access. If ISPs can

throttle their wholesale customers, this would limit competition and the ability of new entrants to differentiate their services."[35]

SaveOurNet.ca subsequently asked for clarification of the party's stance on ISP audits, and received clarification as follows:

- The Liberal Party of Canada believes the CRTC should conduct regular ISP audits to ensure ISPs are operating in compliance with the traffic management guidelines put forth by the Commission.
- The Liberal Party of Canada believes the government should enshrine net neutrality into law.
- At this time the Liberal Party of Canada does not have a position on the net neutrality bill put forth by New Democratic Party MP Charlie Angus.[36]

Pressure from the Liberals is a key indicator of the raised profile and political relevance of the net neutrality issue.

NDP The New Democratic Party of Canada (NDP) has played a lead role in the promotion of net neutrality. In May of 2008, NDP MP Charlie Angus introduced Bill C-552, based on the following principle: "Network operators shall not engage in network management practices that favour, degrade or prioritize any content, application or service transmitted over a broadband network based on their source, ownership or destination".[37]

The following year, the NDP reintroduced the issue in Bill C-398, which spoke more directly to the issue of throttling. The Bill received First Reading in the House on March 3rd 2010 but, like most private members' bills, it is unlikely to become law. Regardless, the NDP has played an important role through its consistent promotion of net neutrality legislation.

The NDP directly addressed ISP compliance audits in an August 2010 message to the SaveOurNet Coalition, agreeing that the CRTC's failure to mandate those audits "is a huge blow to the future competitiveness of the Internet".[38] The email, which came from Party Leader Jack Layton, clearly states that the NDP is in favour of net neutrality,

and suggests that they will continue to take tangible steps toward ensuring that Canada's Internet remains open.

GREEN PARTY

The Green Party of Canada has also been at the forefront in ensuring that net neutrality policy is included within its mandate. In October of 2007, the Greens released a platform document that included a small section on net neutrality: "The Green Party of Canada is committed to the original design principle of the Internet — network neutrality: the idea that a maximally useful public information network treats all content, sites, and platforms equally, thus allowing the network to carry every form of information and support every kind of application".[39]

In its 2010 platform, the Party moved on to explicitly state how it plans to support the "free flow of information": by encouraging and passing legislation that would promote net neutrality and ensure that Internet service providers could not discriminate against certain types of content.

The converging positions of all major federal opposition parties reflects a growing consensus on net neutrality. Canadians want to see meaningful, robust net neutrality policies that have the full weight of Canada's regulatory system behind them.

CONCLUSION

Public opinion polling, cross-partisan support, and wide participation in relevant CRTC hearings and government consultations all reflect the alignment of Canadian views in favour of a free and open Internet. This free and open Internet requires the CRTC to take a proactive stance, and prioritize the interests of the Canadian public over those who would seek to control or limit access to this new digital commons.

THE TECHNICAL CASE FOR OPENNESS

SUMMARY

The following section describes some of the technical workings of architecture of the Internet within the framework of the open Internet debate. In breaking down the basic anatomy of the network, we challenge typical arguments made by big Internet Service Providers (ISPs) like Bell, Telus, Rogers and Shaw around traffic growth and congestion, and debunk myths that have been created to justify Internet Traffic Management Practices (ITMPs) — any measure an ISP implements to intentionally mediate, or "manage," the flow of data traffic along its network.

ITMPs can be either economic or technical mechanisms: the former is a pricing technique that both discourages users from accessing applications, and profits off Internet-user habits; the latter employs devices that alter the speed at which Internet users can access information and applications online. Some Internet applications, particularly peer-to-peer (P2P)

filesharing where Internet users share files directly with each other, are being unjustly targeted and discriminated against. This is particularly unjust when we consider the inherent benefits and efficiencies of P2P in creating a more seamless flow of network traffic and capacity. P2P has been labeled as a network hog and positioned as the culprit at the forefront of the congestion argument but, as we argue here, evidence shows that http applications, such as video and music streaming sites, produce more traffic.

We explain the nature of traffic congestion on properly provisioned networks and disprove P2P myths around traffic stream directions. We describe how poor throttling approaches such as 'blanket throttling' ignore the true nature of congestion and the fundamental way that the Internet functions.

Lastly, we discuss the ways that the practice of usage-based billling (UBB) as an economic ITMP is unjust; arguments by big ISPs about UBB are misleading and false. We examine Internet user growth rates and trends in Canada, reveal how monthly data caps are actually directed at all users, and illustrate how current UBB implementations unfairly tax off-peak users to subsidize peak usage. We demonstrate that UBB is not about addressing network congestion or paying per use for excessive users, but rather serves as another avenue for ISPs to increase revenues.

We aren't facing a "bandwidth crisis" — we're facing the problems produced by a dysfunctional market. In a functioning market place, demand must be met by an increase in supply, which involves a constant, revolving investment by business. It is the responsibility of ISPs to invest in their networks, rather than punishing users through price gouging; it is the responsibility of decision makers to enact policies that ensure users enjoy fair and affordable access as Internet technology continues to improve and permeate our social and business practices.

THE TECHNICAL CASE FOR OPENNESS

The architecture of the Internet has been central to its empowering capacity.[40] Historically, this architecture has been neutral, a mere vehicle for connecting two points: an article and its reader; an innovative service and its customers; a video and its viewers.[41] The architectural design principle that enabled this neutrality of networks was the end-to-end principle.[42] This principle of network design called for an architecture of 'dumb pipes', where signals are merely carried from one end (the reader) to the other (the online article) and back. The pipes are dumb because they know little about the content of the packages they are carrying from one end to another.

The implications of this simple architectural principle are immense. Without knowledge of what passes through them, the pipes are unable to discriminate between one type of traffic and another — to decide that they like some websites but not others, for example. Without knowledge of their contents, the pipes are forced to leave most of the decision-making at the 'ends', leaving the users and innovators free to design and interact as they wish.[43] It is this freedom that has made the Internet the empowering, innovative, democratic vehicle that it is today.[44]

This fundamental end-to-end neutrality principle is under pressure from a number of sources.[45] Driven by economic and market forces,[46] the companies (ISPs) operating the pipes that embody the Internet have begun building intelligence into their networks to exert greater control over the information passing through them. As current network architecture lacks this 'intelligence', investment in

FIGURE ONE

WHAT IS DEEP PACKET INSPECTION?

When sending email, browsing webpages and exchanging files online, our communications are typically unencrypted. Once intercepted, there is little preventing anyone from examining the content of a communication. In recent years, ISPs have begun implementing a networking technology, called Deep Packet Inspection (DPI), which permits them to examine digital transmissions and discriminate against them based on the unencrypted content they contain. These uses raise competition and privacy concerns.

DPI equipment can read and modify digital transmissions' addressing information and communicative content. By analyzing these elements of transmissions, DPI can identify their key facets and apply rules to them — some are prioritized at the expense of others, some applications' transmissions are blocked, and some data streams are modified in real time. Content and heuristic analysis of packets can identify the application generating the packet, determining whether it originated from a file-sharing program like BitTorrent, an email client like Outlook, or a web browser like Firefox. In some cases, the technology can identify specific files being transmitted — such as a particular song, movie or e-book. DPI can also be used to capture and store Internet communications such as email for later analysis. While many P2P clients now encrypt their file transfers, packet inspection equipment is capable (to varying degrees) of identifying even these types of communications.[47]

While DPI's discriminatory power might let "network providers increase their profits by increasing the controllability of the network", such profits sacrifice the features that make the Internet valuable.[48] DPI threatens users' ability to choose what content to view, unbalances the non-discriminatory nature of networks that enable innovation, and optimizes the network for certain purposes to the detriment of novel uses of the network. In effect, DPI threatens to endanger the spirit of innovation that has thrived since the Internet's inception.

new network technologies such as Deep Packet Inspection (Figure One) is required. DPI allows ISPs to analyze and control traffic in real time, as it passes through their networks.

In Canada, the detrimental impacts of intelligent networks are,[49] to date, most readily evident in the Internet Traffic Management Practices (ITMPs — See Figure Two) adopted by many Canadian ISPs such as Bell, Rogers, Shaw and Cogeco. ITMPs utilize DPI equipment in order to identify and classify traffic as it passes through networks and to slow down or 'throttle' certain traffic types that are deemed less desirable by an ISP. ITMPs are problematic when they become unjustifiably discriminatory, and most ITMPs currently target peer-to-peer (P2P) file-sharing applications (See [Figure Four] in the "Canadian Culture In An Open Internet Age" Section for a description of P2P). To date, as expected, the harms of ITMPs have fallen mostly on those at the edges — those lacking the support of a powerful, centralized distribution network. Independent artists,[50] legitimate innovative services such as the BitTorrent protocol[51] or online video providers,[52] and individual Canadian Internet users are the ones most harmed by discriminatory ITMPs. The broader costs to innovation are more difficult to quantify.[53]

ISPs attempt to justify deviations from the end-to-end neutrality principle and the accompanying harms they bring by claiming that certain types of traffic, predominantly P2P traffic, are overwhelming their networks. They point to the need to slow down P2P to let other traffic pass unhin-

FIGURE TWO

WHAT IS AN INTERNET TRAFFIC MANAGEMENT PRACTICE?

The Commission has not defined the term precisely, but it can be applied to any measure an ISP implements that substantially impacts how traffic is carried through its networks.

ITMPs can be economic or technical.

Economic ITMPs are "pricing mechanisms like usage-based billing, which meters usage after a monthly transfer limit is reached or during certain times of the day" by imposing additional costs on users who exceed bandwidth quotas.[54] The purported rationale behind economic ITMPs is to discourage overuse by tying consumption to price (the more you use, the more you pay). Economic ITMPs are intended to encourage users to use the Internet less.

Technical ITMPs employ a combination or hardware and software mechanisms and network devices that operate to, for example, slow down (throttle) or speed up (prioritize) different types of traffic. Currently, many Canadian ISPs throttle traffic they identify as P2P file-sharing.[55]

The CRTC signaled a clear preference for economic rather than technical approaches, however, in more recent times, economic ITMPs such as monthly bit caps have become increasingly controversial as their impact on legitimate services such as video streaming services is felt more heavily by Canadians.[56]

ITMPs may be used by ISPs as an alternative to costly network investment when attempting to keep up with traffic growths on their networks. They may also be used as a means of offering unique services.[57] ITMPs that impact on Internet traffic for the purpose of network security and integrity (intrusion detection systems targeting viruses or spam or malware, or systems intended to address temporary unpredictable traffic problems) could have ITMP like characteristics, but are excluded from the scope of the framework.[58]

dered. But there is little or no proof of any problems caused by P2P that cannot be addressed by reasonable expansion of existing networks. Throttling is simply a cheaper solution for ISPs. Left to their own devices, there is every reason to assume ISPs will follow basic market incentives and continue to discriminate against any protocol, application, or service where doing so would increase their profit margins.[59] Below, we explore ISP attempts to justify their P2P throttling practices.

FURTHER ISSUES: DPI & PRIVACY

DPI technology also raises privacy concerns, especially given the technology's potential use for covert ISP and state-sponsored surveillance.[60] ISPs assert that DPI is primarily intended to mediate data congestion and is not privacy-invasive; ISPs are uninterested in what people write to one another. They analyze packet payloads — the part of an Internet transmission that contains its content – because this is the only reliable way for ISPs to analyze and control customers' usage of 'data hogging' applications. Inspections (and prioritization/throttling of customers' transmissions) are purportedly intended to improve overall customer experiences.

The catch, of course, is that analyses require examining private elements of transmissions. This has real impacts. Judith Wagner DeCew, an American privacy and legal scholar, argues, "surveillance of the normal, everyday activities can lead one to be distracted and feel inhibited."[61] Julie Cohen corroborates this, warning that "[p]ervasive monitoring of every move or false start will, at the margin, incline choices towards the bland or mainstream." Persistent ISP-level surveillance thus "threatens to chill the expression of eclectic individuality, but also, gradually, to dampen the force of our aspiration to it."[62] While privacy laws, per se, may not be violated, individuals may experience a privacy harm without the corresponding recourse of a legal claim.[63]

In Canada, the CRTC and Office of the Privacy Commissioner of Canada have examined DPI's usage. Given the information DPI could glean about ISPs' customers, the CRTC directs ISPs "not to use for other purposes personal information collected for the purposes of traffic management and not to disclose such information."[64] The Privacy Commissioner required Bell Canada (and, by extension, other ISPs using DPI) to update their privacy and network management policies to reflect the limited association of personal information (IP addresses) with applications used. It is important to recognize that neither of these solutions effectively redress privacy harms, indicating privacy law's potential impotence to address damages arising from massive surveillance technologies such as DPI.

THE CRTC FRAMEWORK

Under its current framework, the CRTC will order an ISP to cease an ITMP if the practice is not only discriminatory, but unjustifiably so. The framework involves a two-step process:

- A CREDIBLE COMPLAINT IS REQUIRED. To begin the process, a complaint against an ITMP is required. This complaint can come from anyone — an individual customer, a public interest organization, even the CRTC itself can initiate such a com-

plaint.[65] For the complaint to be credible, it must prove that the ITMP is discriminatory, as well as provide some preliminary evidence and justification for why the discrimination is unjustified.[66]

- THE ISP MUST JUSTIFY ITS DISCRIMINATORY ITMP. Once a credible complaint is received and the complainant has met its initial burden to prove that the ITMP is discriminatory, it falls to the ISP to justify that discrimination.

WHEN DOES AN ITMP DISCRIMINATE?

The full scope of ITMP activity that may constitute discrimination is presently unknown. The CRTC did suggest that technical ITMPs targeting a specific application or protocol, such as P2P file-sharing, are likely to fall within this category.[67] Economic ITMPs appear to similarly qualify as discriminatory, although economic ITMPs are more likely to be justified.[68] The bottom line is that any ITMP imposed on users that, in effect, delays or prioritizes traffic from one type of user, source, protocol, application, content, service, or destination is likely to be found discriminatory. Technical ITMPs that allow user computers or 'ends' to decide prioritization are less likely to be deemed discriminatory.[69] ISPs must then justify the legitimacy of any such discrimination.

Given that the majority of technical ITMPs employed today by Canadian ISPs target P2P file-sharing applications or protocols and slow them down/throttle them,[70] the main issue in any regulatory hearing is likely to focus on whether these ITMPs are 'justified' or not.

WHEN IS A DISCRIMINATORY ITMP UNJUSTIFIED?

An ISP attempting to justify an ITMP that results in any degree of discrimination must:

- Demonstrate that the ITMP is narrowly designed to address the need in question, and nothing else;
- Establish that the ITMP results in as little discrimination as possible;
- Demonstrate that any harm to end-users or other persons is as minimal 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.[71]

As added guidance, the CRTC stated that ITMPs targeting specific applications or classes of applications such as P2P file-sharing applications are more likely to be unjust and unacceptable.[72] To justify discriminatory throttling of P2P file-sharing applications, ISPs will, essentially, need to prove:

- that the amount of online traffic currently being generated is such that it is not enough merely to build a bigger network to address it; and
- that there are no less discriminatory or less broad alternatives to throttling P2P file-sharing applications to address this issue.

IS THROTTLING JUSTIFIED?

ISPs claim that network traffic is currently growing at phenomenal rates and that the only way to address this exponential growth in network traffic is to slow down some types of traffic (P2P) while letting other types (YouTube) go through unimpeded. There are two issues with this theory. First, traffic is not growing at exponential rates: online traffic growth is slowing down significantly.[73] Internet traffic is, at this point, growing at manageable rates that can be addressed simply by building bigger networks. While this option may reduce profit-margins, it should nonetheless be the primary method of addressing such issues. Second, even if there is a traffic growth problem, targeting and slowing down P2P (or any other type of application) is an arbitrary and over-broad response to that problem. Each of these factors is addressed below.

MYTHS ABOUT "UNMANAGEABLE" TRAFFIC GROWTH AND CONGESTION IN GENERAL

Contrary to ISP claims, current rates of Internet traffic growth can be reasonably addressed without resorting to discriminatory ITMPs. Testimony from experts in the field indicates that technological developments have greatly decreased the cost of equipment necessary to expand network size, and that ISPs can match current traffic growth with reasonable investment.

MYTH NUMBER ONE:

We are currently experiencing a 'bandwidth crisis'

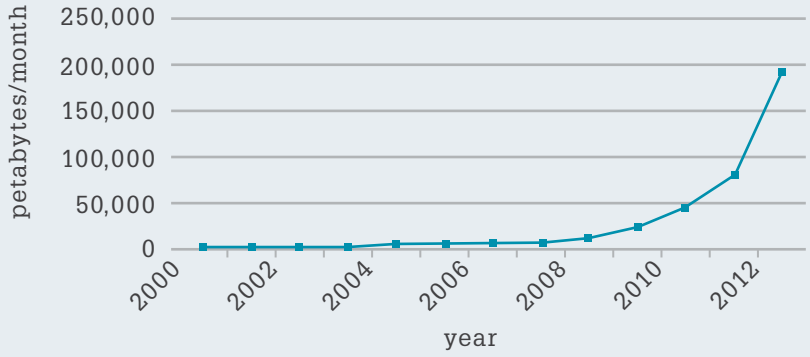
REALITY:

This is just the latest of many unjustified 'panics' over levels of traffic growth.

Every five years or so ISPs warn of monumental increases in Internet usage resulting in unbearable congestion on their networks.[74] One such wave of concern came with the arrival of graphics-rich Web browsing — ISPs complained that their networks could not handle websites with pictures.[75] Another came with the appearance of Napster, the first P2P program, which facilitated a surge in music file-sharing traffic. Now the concern is video streaming and sharing. Yet, in all cases the rise in demand was far more modest than anticipated, and accommodated largely through deployment of improved network technologies.[76] This was when traffic was growing at a rate of 100% per year.

ISPs claim that Internet growth has "greatly surpassed industry projections"[77] and is expected to continue growing at ever-increasing rates. A graphical representation prepared by Bell of commonly cited projected growth rates looks like this:

NORTH AMERICAN — UNITED STATES DEMAND (PETABYTES/MONTH)

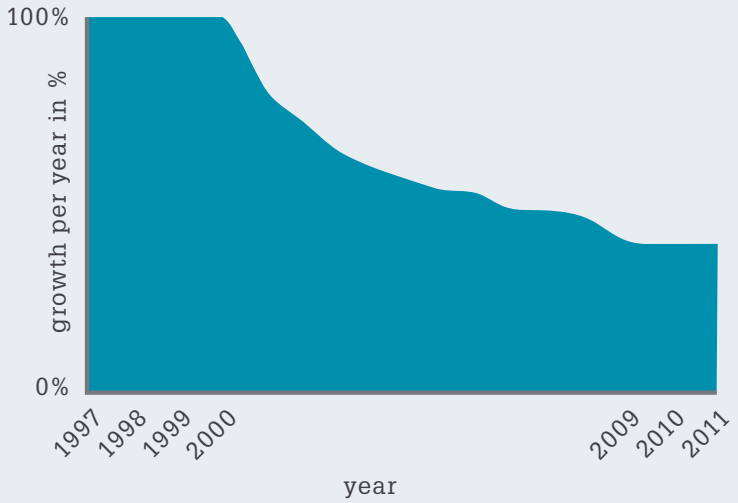


Source: Bell Canada based on Nemertes Research 2007 study predicting exponential growth beginning in 2009[78]

As noted by Odlyzko, ITMPs should not be premised on the assumption that traffic might one day soon reach exponential rates without evidence it may actually do so.[79] Such projections have been proven wrong time and again. Indeed, growth rates have actually decreased in recent years. Whereas in the late 1990s Internet traffic was doubling about every year, current annual growth rates have slowed significantly to 40–50%.[80] Relative to other periods in the short history of the web, this can hardly be characterized as "phenomenal growth of consumer Internet traffic".[81]

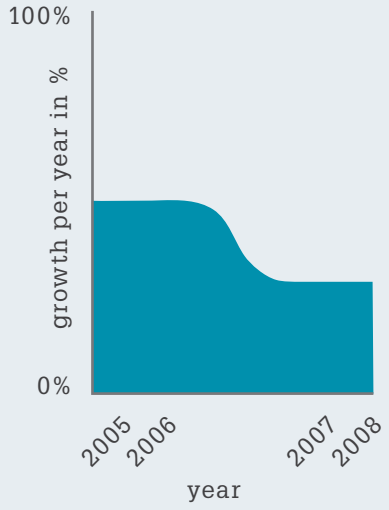
This trend is seen the world over and is corroborated by multiple independent studies.[82] Statistics provided by seven Canadian carriers in the CRTC hearings suggest that Canada is no exception to this trend, and that traffic growth rates in Canada are similarly declining and averaging no more than about 43% annual growth:[83]

TRENDS IN WORLDWIDE INTERNET TRAFFIC GROWTH RATES



Source: Summary of Estimates From MINTS [Minnesota Internet Traffic Studies] Report of Dr. Andrew Odlyzko

TRENDS IN CANADIAN INTERNET TRAFFIC GROWTH RATES



Source: Report of Dr. Odlyzko and TRP CRTC 2009-657

MYTH NUMBER TWO:

Traffic growth demands cannot be met with reasonable levels of network investment alone.

REALITY:

Typical levels of network investment are enough to address current growth rates.

ISPs argue that it is impossible to meet current traffic growth rates with network investment alone — one ISP executive has gone so far as to state that "You can never build your way out of this problem."[84] Really, building is not impossible, but simply more costly to ISPs. The incentive for ISPs is to find other, cheaper ways to decrease traffic. In fact, some have pointed out that the greatest benefit of throttling is its ability to "save millions of dollars in capital expansion costs that would [otherwise] be necessary in order to meet growing bandwidth demands".[85]

Functional marketplaces meet demand by increasing supply — not by squashing demand. This is how the Internet has always worked. Nor does Canada benefit from a degraded Internet. Historically, other "bandwidth crises" have been met by building larger networks, and this ongoing investment has better prepared Canadian networks for today's traffic loads.

Even when acknowledging it may be physically possible to meet traffic growth with greater network investment, ISPs argue that the cost of doing so would be phenomenal. According to internet traffic expert Dr. Andrew Odlyzko, however, when continuing improvements in technological efficiency are factored in with declining growth rates, it is possible for ISPs to meet projected growths in demand with mild and normal infrastructure upkeep reinvestment:

> While there is still vigorous traffic growth, it is at levels that can be accommodated with approximately the current levels of capital expenditure. Just as the computers that we buy provide increased processing power and storage each year for the same price as earlier machines, due to technology progress, telecommunications networks can handle higher levels of traffic each year at the same cost as before.[86]

Indeed, Coffman and Odlyzko argue that network technology developments in speed and efficiency have historically matched any growths in network traffic.[87] There is evidence on the record of CRTC proceedings that confirm, through experiments,[88] and testimony of smaller Canadian ISPs,[89] that technological advances make it possible to keep up with 50% traffic growth through normal levels of capital investment. ISPs complain that, as broadband adoption rates have leveled off, they are now investing the same amount to keep customers instead of investing to get customers, meaning a lower rate of return for the ISPs.[90] Yet this is typical — much as IBM must continue to replace its old processors with new ones in order to continue selling computers to its customers at roughly the same rate of return, so must ISPs continue to invest in networks in order to keep their existing customers.

In sum, there is little support for the proposition that networks are facing unprecedented and unmanageable levels of traffic growth. ISPs should meet growth in demand with investments in their networks, just as they have always done, instead of trying to rely on ITMPs.

P2P IS THE CULPRIT! MYTHS ABOUT P2P AS THE NATURAL TARGET FOR THROTTLING

Regardless of general traffic growth rates and contrary to many claims, P2P is not an 'ideal' target for throttling. It is neither the primary source of network traffic, nor is it able to function effectively under the weight of throttling.

MYTH NUMBER ONE:

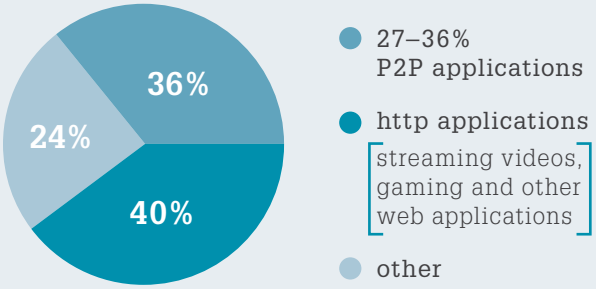
P2P generates immense amounts of network traffic

REALITY:

HTTP applications generate more traffic and P2P usage is steadily declining

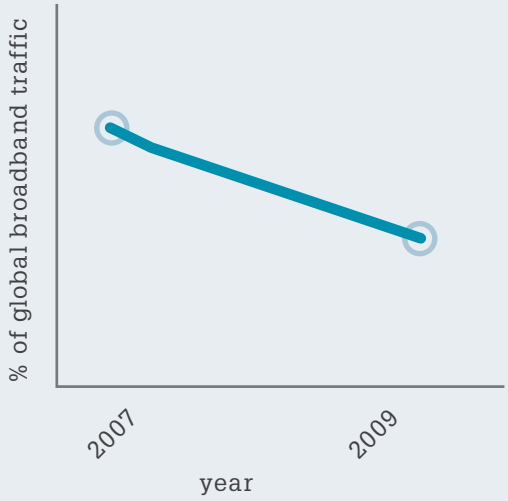
First, if there is a traffic growth problem, P2P is not the present source of it, nor likely to be in the near future. Statistics provided by Canadian ISPs show that, from 2005–2008, 40% of all traffic on Canadian networks came from HTTP applications such as video and music streaming sites, gaming and other web-based applications. Only 27–36% is generated by P2P applications.[91]

% OF ALL BANDWITH USAGE IN CANADA



As more services migrate to the web and people stream more media instead of downloading it onto their computers, P2P traffic will steadily decrease as a percentage of overall traffic. This trend is mirrored worldwide and corroborated by more recent independent Internet traffic research from Arbor Networks,[92] Sandvine,[93] and Cisco,[94] all of which show that P2P traffic comprises an increasingly marginal and rapidly shrinking percentage of overall network traffic:

TREND IN WORLDWIDE P2P USAGE



Source: Cisco Visual Networking Index: Usage Study, October 2009

MYTH NUMBER TWO:

27–36% traffic has symmetrical impact — it does not matter whether it is up or down stream

REALITY:

Upstream and downstream traffic are not the same; ISPs cannot justify throttling downstream traffic by pointing to upstream figures

The 27–36% figure cited by Canadian ISPs mistakenly conflates upstream and downstream traffic. While it may be true that P2P, by its decentralized nature, generates more upstream traffic than the average web application or service, this justification cannot be applied to downstream traffic.[95] Breaking down the 27–36% figure into its downstream and upstream components will reveal that P2P comprises very little downstream traffic — far less than even the 27–36% attributed to it monthly (18% is likely more accurate).[96] Yet some ISPs, most markedly Bell and, more recently, Rogers,[97] use this figure to justify equal throttling of upstream and downstream P2P traffic without any regard for this distinction.

While some ISPs, and particularly cable providers such as Rogers, Shaw, and Cogeco, may have problems handling upstream P2P traffic,[98] the solution to this problem is to invest in greater upstream capacity, not to throttle an entire class of applications.[99] The reason such ISPs see P2P upstream traffic as a challenge is because, historically, such providers have dramatically underinvested in upstream capacity on their networks.[100] Yet, even at its worst, P2P does not generate significant amounts of upstream traffic when counted in net bits of data per second.[101] Nonetheless, instead of improving network architecture so as to meet symmetric demand, ISPs decide to throttle upstream P2P as an alternative.[102] And the P2P upstream traffic component is declining even more rapidly than its downstream component, when measured as a percentage of net upstream traffic.[103] The "problem" then does not lie with P2P per se, but rather in the historically inadequate provisioning of upstream bandwidth by ISPs.

FIGURE THREE

WHY IS P2P SUCH A TEMPTING TARGET FOR ISPS?

One of the great benefits of P2P is that it decentralizes bandwidth consumption and computational costs. This means that individuals can distribute their content (their movies, their songs, etc.) without buying an expensive server and significant bandwidth from an ISP. As those P2P users who download a file typically will upload it at the same time, any individual can use P2P and capitalize on those downloaders to create a robust distribution network.

As explained above, while P2P traffic rates are far exceeded overall by HTTP and even more so when measuring downstream traffic alone, with respect to upstream traffic. P2P does tend to generate more traffic than other applications. This is because of how it decentralizes uploading away from a single high-bandwidth server and spreads it across numerous individual P2P users (clients). Given that each downloader adds to the net amount of available upload bandwidth, P2P is inherently scalable — upload capacity grows alongside download demand. In his specification for the BitTorrent protocol, Bram Cohen explains it as such: "This redistributes the cost of upload to downloaders...thus making hosting a file with a potentially unlimited number of downloaders affordable."[104] Bell Canada describes it in this way: "As each user joins [the P2P application in question], they essentially bring along more storage, more bandwidth and more resiliency."[105] This enables P2P users to utilize a higher proportion of the upstream bandwidth connection they have purchased — instead of using 15% of their allotted 1mbps connection, they use 25%.

While adoption of P2P technologies is steadily growing (an estimated 50% of Canadians now use P2P to some extent, but a smaller proportion do so routinely),[106] the protocol remains in its infancy in terms of the scope of applications that utilize it.[107] As, particularly in its earlier days, P2P generates higher upstream bandwidth costs and is routinely used by a smaller proportion of ISP customers, it is an attractive target for ISPs to throttle.

But this is precisely why it is not wise to leave such decisions to ISPs. P2P is extremely efficient from a user's perspective and has proven more robust under difficult network conditions than other, more centralized, client-server protocols.[108] Only from an ISP's perspective may it be viewed as potentially 'problematic' and primarily because of the historical asymmetry of ISP networks described above. But the ISP perspective should not determine which applications are 'good' or 'bad' or which are 'winners' or 'losers'.[109] Their role is to provide neutral infrastructure so that innovators at the 'ends' can create and users at the opposite 'ends' can decide what is best.

MYTH NUMBER THREE:

It's the application that is responsible for the amounts of traffic it generates

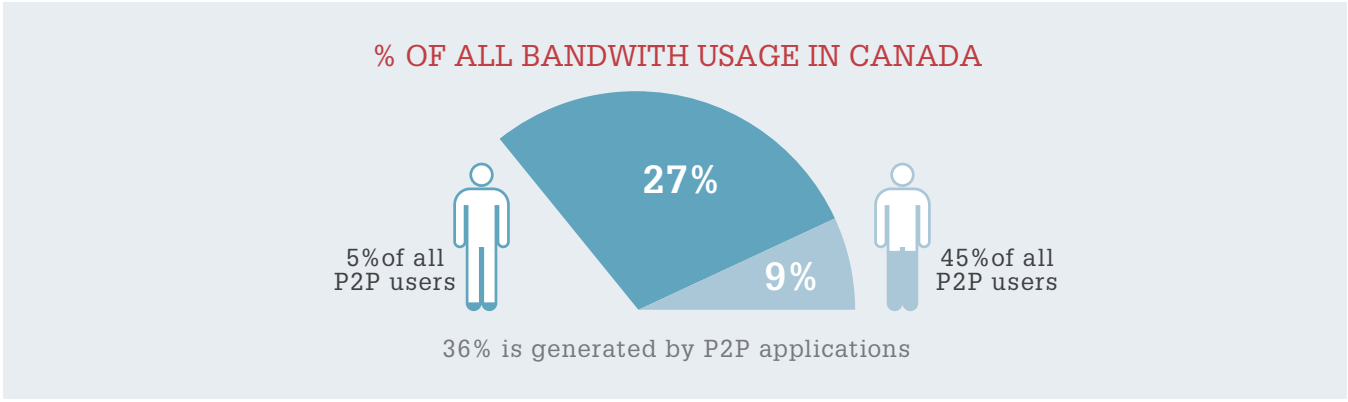
REALITY:

It is how an application is used, not the application itself, that determines how much bandwidth will be generated

Application-specific throttling misses the point: it is individual users, not classes of applications that determine how much bandwidth will be used. There is a very small subset of individual users that arguably use a disproportionate amount of bandwidth. Sandvine, for example,

estimates that 'heavy users' (what it classifies as top 1% bandwidth generators) generate approximately 200 times the total number of bytes as an average user.[110]

So, to use the P2P example, while 50% of all Canadian Internet users are P2P users,[111] 90% of these P2P users generate a negligible and proportionate amount of P2P traffic. Ten percent of P2P users (5% of all Internet users) generate 75% of all P2P traffic.[112] By targeting all users of P2P file-sharing applications, ISPs discriminate against the 45% of Canadians (90% of P2P users) that use P2P but do not generate excessive amounts of bandwidth.



Moreover, Canadian ISPs estimate that 50% of their customers use P2P, yet all P2P traffic taken together amounts to less then 36% of net traffic.[113] Fifty percent of users generating 27–36% of traffic is not disproportionate. The problem is not P2P file-sharing applications. Rather, if there is a problem at all, it is the top 5% of bandwidth users who are its cause. This higher echelon of users generates an estimated 60% of all traffic on Canadian networks.

By throttling all P2P file-sharing, ISPs are discriminating not just against those top 5% users, but against the other 45% of Canadian users as well. While, as noted below, there is little justification for targeting top 5% users,[114] the harm that results from targeting P2P applications, or any applications, as a class is great. It deprives all users of the benefits of that application. It imposes a serious competitive disadvantage on that particular class of applications.[115] In this sense, any

application-specific throttling will have a serious impact on innovation, as it selects one application over another. In fact, throttling top 5% users is likely to have the same detrimental impact on innovation, as it will punish early adopters and push them away from protocols such as BitTorrent. Such steps must be taken with great caution, and only where justified as necessary.

MYTH NUMBER FOUR:

P2P is not time-sensitive, so throttling P2P applications does no harm

REALITY:

Throttling P2P is harmful regardless of sensitivity; P2P can and is employed for time-sensitive uses

ISPs will claim that P2P applications are prime and reasonable targets for ITMPs since many P2P applications are not time sensitive. Time sensitivity is essentially ISP code meaning that users do not care when their transactions are completed. Therefore, throttling these transactions will have little experiential harm as opposed to, say, throttling video streaming applications such as YouTube. First, it is not accurate that P2P file-sharing applications are not time-sensitive. A user may be willing to wait a few extra minutes for YouTube clips to download into her browser rather than waiting an extra day for a purchased P2P movie.

Indeed, throttled P2P protocols such as BitTorrent are commonly used for streaming applications that are 'real-time' to the same extent as YouTube, and are only distinguishable at the ends, not within the network itself.[116] The ISP has no way of determining what priority a user attaches to a P2P download as opposed to a web-based HTTP transfer (YouTube). The only truly time sensitive applications (those that must operate in real time or fail — VoIP, video-conferencing, online gaming), do not consume significant amounts of bandwidth.[117] The most efficient way to ensure these few, truly time sensitive applications have enough bandwidth to function is to enable users at the ends to prioritize whichever applications they need to operate the fastest.[118] Indeed, if time sensitivity were the only criterion, ensuring Quality of Service would require the throttling of most web-based (HTTP) traffic as well.

Regardless, even in the absence of time-sensitivity, throttling of specific P2P protocols or file-sharing applications undermines the viability of these applications as a whole.[119] If proprietary applications such as BitTorrent cannot compete because they are subjected to a disadvantage, then all users will be deprived of both current uses of these applications and any potential, as-yet-unknown uses as well — no one would attempt to invent a BitTorrent-based VoIP application knowing it will be throttled.[120]

Overall, P2P as a protocol or class of file-sharing applications is not a source of excessive or disproportionate bandwidth. P2P is a highly efficient protocol and its utility for transfers of large files is significant. Even so, the extent of traffic it generates is not disproportionate and is, in fact, being outpaced by web streaming media and other forms of traffic. Where P2P does generate more significant amounts of traffic, this is attributable only to a small proportion of its users and not to the application as a whole. Even in those cases, however, the impact of P2P on congestion is greatly overstated and the response to this impact greatly overbroad.

CURRENT ITMP TECHNIQUES AND CONGESTION: ARE THEY NARROWLY TAILORED?

ISPs often claim that there is something inherently unfair about the underlying design of P2P protocols. In reality, however, the amount of monthly traffic generated by P2P is deceptive as a measure of actual congestion. Congestion is an issue where there is so much traffic at particular nodes of a network that it significantly impacts on usage of Internet applications.[121] In developing and justifying their ITMPs, ISPs function under a number of misconceptions with respect to the disruptive nature of P2P as well as to its actual impact on the ability of end-users to enjoy other services. This leads ISPs to adopt overbroad ITMPs — overbroad in their specific targeting of P2P, and overbroad in their method of throttling.

MYTH NUMBER ONE:

P2P users are 'bandwidth hogs' because of the constant operation of their P2P clients

REALITY:

Most P2P traffic occurs in off-peak periods and contributes only minimally to network congestion

ISPs point to the fact that many users operate their P2P file-sharing applications all the time, even when sleeping ("P2P file-sharing can sustain continuous maximum network traffic load, 24 hours a day, 7 days a week and 365 days a year") as indicative of P2P's detrimental impact on their networks.[122] But this assertion ignores the fact that networks are built for peak period usage. Networks typically experience significantly heavier traffic loads during peak periods, when everyone is online at the same time.[123] What this means is that a properly functioning network is built to handle daily traffic peaks. Traffic occurring at off-peak hours is synonymous with a handful of trucks driving down empty highways at 4am. Such traffic costs ISPs little, since it is traveling through equipment built to handle significantly heavier traffic.

Attributing 27–36% of all network traffic to P2P is deceptive. This figure is based on monthly usage rates.[124] It does not attempt to differentiate between peak period usage and off-peak period usage. In fact, P2P usage occurs primarily at off-peak periods,[125] meaning that much if not most of that 27–36% P2P traffic is being generated at a time when Internet usage is low and there are few competing services for it to interfere with. Indeed, it appears that P2P traffic measured at any given point of the day is significantly lower than the 27–36% figure cited by Canadian ISPs.[126] The monthly figures, then, are deceptive, in that P2P traffic is typically accumulated 24 hours a day, 7 days a week, and not merely at peak periods as with most other traffic. But whatever portion of the 27–36% monthly usage rate that occurs at off-peak hours will not typically contribute to network congestion at all.

MYTH NUMBER TWO:

Congested periods last for 10 hours at a time or are ever-present

REALITY:

Congestion on a properly provisioned network will typically last only for a few minutes at a time at any given network point and cannot justify 10 hour/perpetual throttling

Many Canadian ISPs, such as Rogers and Cogeco, throttle P2P traffic 24 hours a day. Others, such as Bell, confine its throttling to what it terms 'peak period' — a 9.5 hour block of time running from

4:30 pm to 2:00 am.[127] During these periods, any and all P2P traffic is throttled regardless of whether it is actually causing network congestion.

This blanket throttling approach, however, ignores the nature of congestion on networks. On a properly provisioned network, congestion should only occur for brief periods (measured in seconds or minutes) at localized points in the network.[128] By throttling all P2P all the time, ISPs with adequately provisioned networks are discriminating far in excess of what is necessary to address any potential congestion problems.

In the U.S., for example, a major ISP began throttling all P2P traffic in an attempt to address purported out of control congestion on its networks. After a U.S. regulator forced this ISP to develop a more tailored solution, the ISP was able to apply an application-agnostic ITMP that operated only in the presence of actual congestion, throttled only those specific users who were disproportionately contributing to that congestion, only for as long as necessary. This ISP found in trials that addressing the 'widespread problem of congestion' requires throttling that impacts on less than 1% of its customers and rarely for more than 15 minutes at a time.[129] Not only does this solution avoid categorical discrimination against an application, its impact on the user experience is as minimal as possible while still addressing ISP congestion worries.

Canadian ISPs have not produced such a solution because to date, they have had no incentive to do so. Even in the U.S., this solution was only invented in response to regulations forcing an ISP to better target its throttling activities. There is no market incentive to push ISPs towards adopting such solutions on their own. While the CRTC has put in a framework requiring this type of tailoring, it has not yet initiated the necessary complaints process with respect to Canadian ISP practices.

MYTH NUMBER THREE:

Because P2P targets the fastest nodes, investing in network capacity does not help

REALITY:

P2P routes around congested points — this makes it more efficient and reduces its impact on properly provisioned networks

ISPs point out that some P2P protocols are designed to target the fastest points on a network and state that, because of this, adding network capacity will not help. The claim is that any capacity added at one single point will get 'eaten up' instantaneously.[130] This, again, misunderstands both the nature of network congestion and of P2P protocols and applications.

First, it is a mistake to say that any P2P protocols are designed to target the fastest network links. Some, but not all, P2P protocols such as BitTorrent are calibrated so that, when choosing users from which to download, those with the fastest upload speeds are preferred.[131] Those with the fastest upload speeds will typically be located in areas of the network with 'fast' or 'underutilized' network links or they would not be capable of generating the upload speeds in question. So it is true that, if a network link in a heavily congested area of the network is upgraded, that upgrade will make nearby BitTorrent uploaders more attractive to other BitTorrent clients. But this is only assuming the user's connection was already extremely congested. Otherwise it would be operating at near-full capacity before the upgrade.

This is not limited to P2P protocols, however. Capacity added to a congested area of a network will get 'eaten up' rapidly by any traffic, not just P2P, unless sufficient capacity is added to address the traffic loads on that area of the network.[132] Even if there are no P2P uploaders present at all, that added capacity will be eaten up if it is not sufficient to meet existing demand on that node. Indeed, where P2P is present, the node will distribute added bandwidth amongst all existing applications, not just P2P file-sharing. Further, once the newly (but inadequately) provisioned link becomes saturated, a BitTorrent client will, by the same mechanism, direct further uploads far away from the congested area of the network.

This is the true benefit of BitTorrent and other similar P2P protocols built to select the fastest uploaders. The idea of decentralizing uploading capacity means that no individual is essential to the upload. BitTorrent is calibrated to seek out the 'fastest' uploaders, and these will typically be located in the least congested areas of a network since,

in network congestion terms, 'empty' means 'faster'.[133] This is part of P2P's great benefits — it has the effect of using network resources in a highly efficient manner by preferring network areas that are being underused.[134] A network that is properly provisioned, on both the down and the up streams, should have no serious problems dealing with P2P traffic.[135] Network operators are averse to fixing the historical lack of upstream capacity on their networks to meet P2P demand. They do not believe their customers value such capacity.[136] But one of the basic underlying objectives of BitTorrent is to permit users to trade off upstream for downstream, upload for download.[137] Indeed, BitTorrent has noted that throttling in Canada, which most heavily targets on upstream capacity for most ISPs, impacts on its commercial services more heavily than "any major network worldwide".[138]

MYTH NUMBER FOUR:

P2P is a 'killer of networks' that exploits existing protocols and is inherently disruptive

REALITY:

P2P's capacity for disruption is grossly exaggerated

ISPs claim P2P is designed to 'overwhelm' networks by exploiting a basic mechanism used to convey information through the Internet: the Traffic Control Protocol (TCP). TCP is a lower level protocol and governs, among other things, the rate at which a computer or server at one end of a network will transmit data to another computer at another end. TCP has built-in mechanisms that will slow down the rate of transfer from one computer when a congested network link is encountered, in order to reduce the load of traffic on that network link. The majority of P2P applications and BitTorrent use TCP to transfer files across the network and are subject to its congestion control mechanisms, as is all other traffic.

In order to instill fairness, TCP was designed to treat all data more or less equally and to allocate bandwidth by 'connection'. A 'TCP connection' is merely a flow of data from one computer to another. When Outlook seeks to download an email from your email server, it uses one TCP connection to do so. When your browser attempts to download

a webpage from a commercial server it will typically use 4 TCP connections to do so.[139] At any given network link [Link A, hereinafter], all bandwidth will be distributed equally among active connections. So, if there are 80 TCP connections at a network link with 10 Gbps of capacity, an individual using 4 connections to download a website will receive 4/80 * 10 Gbps of bandwidth, or a 20th of all capacity.

Some P2P protocols such as BitTorrent open multiple TCP connections — as many as 40 or more — purportedly until it "consumes all bandwidth".[140] There are a number of factors to explain why P2P, even with its 'multiple' connections, does not swallow up all bandwidth everywhere. First, the following is a worst case BitTorrent scenario as presented by Dr. Reed.[141] Say the 80 connections operating on Link A (a 10 Gbps link from above) were all operating at full capacity. Each connection would receive 1/80 of bandwidth or 125 Mbps. The user opening a website would receive four times that, or 500 Mbps. Now along comes a BitTorrent user, adding her 40 TCP connections. The total number of TCP Connections increases to 120, meaning that each connection at Link A will receive 83 Mbps. This means the P2P 'bandwidth hog' will receive 3.3 Gbps, while the individual attempting to view a website will only receive 332 Mbps, and anyone trying to read an Email will receive a measly 83 Mbps. Notice that here, in this highly theoretical worst-case scenario, the website and Email still get significant amounts of bandwidth. In downloading an Email, a drop from 125 Mbps to 83 Mbps is not significant and is unlikely to be noticed by the end user at all.

In reality, however, this scenario will rarely if ever occur. First, as noted above, most P2P protocols such as BitTorrent are designed to target the 'fastest' nodes. This means the ones with the greatest capacity.[142] So, to begin with, a network link with plenty of unutilized capacity will be selected.[143] It also means that, since with each added BitTorrent TCP connection, Link A fills up and returns less bandwidth per added connection to the BitTorrent user, Link A is likely to be abandoned for a different, less heavily saturated link before anywhere near 40 connections are added.[144] So the impact on any given link, whether

Link A or otherwise, is likely to be proportional to :

- the amount of capacity at that link and
- the amount of capacity at other links on the network

There is another, more significant impediment on any BitTorrent attempt to 'overwhelm' a network. As noted above, networks strictly limit the rate at which individual customers can generate upstream data.[145] This means that, when downloading from an individual client or peer as opposed to from a server, the amount of bandwidth that can be received per user is relatively low. Moving back to our Link A scenario: the BitTorrent user has added 40 TCP connections to Link A, but the average upload speed of these connections is 10 Mbps — an upload speed far higher than that available to the majority of Canadian ISP customers.[146] This will reduce the capacity of the link in question by 400 Mbps, leaving 9.8 Gbps to be divided amongst the remaining connections. This can only have a significant impact on other services if it is added to a network link already heavily congested due to lack of adequate network investment.

Further, BitTorrent argues that its employment of multiple TCP connections has been misunderstood. While it does employ many connections per downloading file, it claims the majority of these connections are used for administrative purposes and carry very small amounts of data. Such connections will not detract significantly from the overall amount of bandwidth available at Link A.[147] Further, as each added 'connection' represents another user that is simultaneously uploading/downloading a file, this scalability appears fair — perhaps even more fair than a website that attempts to use 4 connections to speed up data transfer.

Finally, users are given strong incentives to monitor their own P2P activity during peak periods, as their own ability to Email or web browse will be impacted by any excessive P2P usage before any downstream network point will. This perhaps contributes to accounts that P2P usage decreases during peak periods and peaks when no one, including P2P users, is actively using the Internet.[148]

ECONOMIC ITMPS: UBB AND THE METERED INTERNET

Economic ITMPs raise many of the same concerns as technical ITMPs and are supported by many of the same myths. Whereas technical ITMPs mediate some applications' data transmission and reception speeds, economic ITMPs impose financial costs based on the amount of data an ISP's subscriber sends to, or receives from, the Internet. These costs are meant to discourage subscribers from excessively using bandwidth or, where they refuse to curb their usage, provide revenues to the ISPs for investment in infrastructure.

Given that economic ITMPs rely on price incentives, the line between such practices and basic pricing mechanisms is blurry. ISPs cannot rely on substantially increasing customer bases to raise profits, and so differentiating between economic ITMPs meant to manage 'bandwidth hogs' versus those acting as covert attempts to capture additional revenue from emerging content uses (such as video-streaming) is challenging. There are several indicators suggesting that Canada's ITMP landscape is primarily aimed at increasing ISP revenues; Bell's CEO has largely attributed UBB to their revenue growth,[149] and Shaw's January 13, 2011 Annual General Meeting confirmed that the company saw UBB as further monetizing their Internet business.[150] Given that the CRTC developed its ITMP framework to adjudicate the legitimacy of discriminatory traffic management practices resulting from network congestion, we must evaluate economic ITMPs using the CRTC's ITMP framework.

Monthly data caps, as currently implemented in Canada, cannot be justified under the ITMP framework because they are not narrowly tailored to reduce congestion. An examination of UBB as it has been implemented in Canada and some of the myths and failed justifications for this implementation will show that ISPs have not attempted to tailor their economic ITMPs to effectively address network congestion.

THE UBB LANDSCAPE IN CANADA

One indicator that the Canadian UBB situation is out of hand emerges by comparing trends in monthly cap allowances and general traffic growth. Internet traffic in Canada has grown at a decreasing rate of approximately 45% annually.[151] As UBB purports to target excessive users, monthly usage allowances should increase over time to reflect this 45% regular annual growth in usage and affect those who use bandwidth significantly in excess of these annually grown caps. Instead, we see the average amount of non-penalized monthly usage decreasing in Canada. For example, in 2008, the average monthly usage allowance on a 1.5–4 Mbps connection was 43.25 GB/month. If caps really targeted excessive usage, the average 2009 allowance cap for the same connection category should be about 45%, or 62.71 GB/month, to reflect the growth in average consumer bandwidth usage. Instead, the actual 2009 average allowance decreased by about 26%. This average allowance is now 48.7% lower than where it should be:

FALLING MONTHLY CAPS[152]

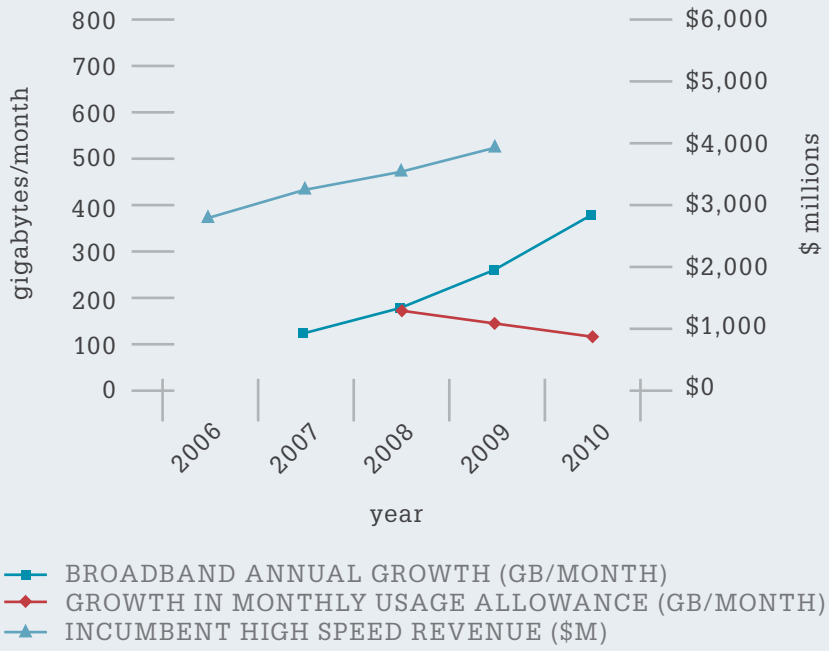
DOWNSTREAM SPEED (AVG UPSTREAM)	2008 CAP GB/MONTH	2009 GROWTH (2008 CAP+45%)	ACTUAL 2009 CAP	2009 SHORTFALL (ACTUAL/GROWTH)
1.5 – 4 Mbps (809 Mbps)	43.25	62.71	32.20	48.7%
5 – 9 Mbps (744 Mbps)	54.18	78.56	42.80	45.5%
10 – 15 Mbps (862 Mbps)	80.81	117.17	69.53	40.1%
Total Broadband:	178.24	258.44	144.53	44.0%

THE BIG PICTURE

The overall picture is not rosy for Canadians. ISPs are experiencing lower growth rates than in previous years, the Internet equipment routing traffic can handle data for lower costs every year, and yet investment in Internet provisioning has hardly increased in the past four years. Revenues continue to increase at a modest but steady rate while monthly usage allowances are plummeting and alternative options to monthly

UBB are non-existent, in stark contrast to other OECD countries (see "The Open Internet: International Comparisons" in this report for a fuller discussion of the global context).

GROWTH IN BROADBAND USAGE vs.
GROWTH IN MONTHLY CAPS vs.
GROWTH IN REVENUES (2010 PROJECTION)



In addition, it is fairly clear that consumers prefer unlimited plans and are willing to pay for them. Overall, the UBB landscape in Canada appears to indicate quite compellingly that some regulatory action is required.

MONTHLY UBB: MYTHS AND FAILED JUSTIFICATIONS

The CRTC put the ITMP framework in place after recognizing that ISPs' techniques to reduce congestion and manage traffic could have unjustly discriminatory effects on customers and service and goods providers who operate, or rely on, the Internet. Given that economic ITMPs are meant to curb usage, and thus congestion, it is important to understand whether current UBB practices actually address 'excessive usage'.

MYTH NUMBER ONE:

Like your gas bill, usage-based billing is about paying for what you use

REALITY:

The connection between usage and actual ISP costs is tenuous at best

Internet is not like natural gas. There is no finite number of gigabytes that are depleted each time you open YouTube. The Internet is more like a road. Each car, while it is on the road, adds to traffic and, during rush hour, marginally decreases the speed at which the other cars can travel. The ISP's job in this scenario is to build a road that can accommodate rush hour traffic so that everyone can drive at reasonable speeds and not need to wait for unreasonable periods of time in line. Usage only translates into ISP cost where it triggers a provisioning action.

Bell, for example, monitors its network equipment in fifteen-minute increments. If a particular network link is utilized at 90% or more during a 'check-in', Bell will note that the link has exceeded its utilization threshold.[153] A link that exceeds its utilization threshold at least once on 5 or more different days in any given 14 day period is deemed 'congested' and will be monitored more closely.[154] It may, if it remains congested, eventually warrant a 'provisioning action', meaning that Bell will replace it with newer equipment that can carry more traffic or add another link to reduce load on the congested link.

Any usage that does not contribute directly to this process does not cost an ISP anything. The more traffic Alice generates, the more she is likely to contribute to cost, but the relationship is unclear and indirect. In contrast, every cubic metre of gas used decreases a finite stock of gas. Further, the overage charges ISPs impose on customers who exceed their monthly caps are far in excess of actual ISP costs. ISPs charge between $2.50 to $10 /GB in excess of usage allowance, but it is estimated that the actual cost for an ISP to produce is not much higher than $0.08/GB.[155]

MYTH NUMBER TWO:

UBB is about making excessive bandwidth hogs pay

REALITY:

Current UBB implementations in Canada are not aimed at excessive users

As noted above, UBB is often justified as a mechanism that forces excessive users to pay for their excess or, alternatively, as a deterrent against such excessive usage. A closer examination of current UBB implementations, however, demonstrates that this is not the case. For an example, let's turn to Bell's current Ontario 2.8 Mbps connection.[156] This connection's monthly fee is approximately $29.95/month. A customer (Alice) signing up to this service reaches her first use disincentive at the 2 GB/month mark. Every additional 100 MB used over that amount will cost $0.25, until the 24 GB mark. At that stage, the customer has added an additional $60 to her initial monthly fee of $29.95, for a monthly total of $89.95 — roughly a 300% increase in her monthly bill. She is then free to use as much additional bandwidth as she pleases until she reaches the 300GB mark, at which stage a second disincentive begins in the form of an additional $0.10/100 MB.

To put such usage in perspective, we can examine some usage patterns. Netflix.ca is a popular online streaming subscription service. Monthly Netflix fees are approximately $7.99/month. Streaming one hour of highest quality video on Netflix will generate anywhere between 1 to 2.3 GB. Alice will hit her monthly allowance of 2 GB near the beginning of her second film on Netflix. Steam is an online video game store that lets users purchase games and download them directly to their PCs and Macs. PC games range in size and price. Buying two recent popular games in a month can cost as little as $65 in actual fees and an additional 12 GB in usage (adding $25 to Alice's monthly Internet bill, a 40% markup on her gaming purchase).[157]

Yet the usage patterns described above do not appear 'excessive'. Alice will be forced to seriously curb her usage of these services, pay extravagant overage fees, or buy into one of the 'usage insurance'

schemes Bell offers. For an extra $5/month (an 18% markup on Alice's initial $29.95 plan), Alice may purchase an additional 40 GB of usage per month for a total of 42 GB/month. It is not clear, however, why such 'insurance' should be required as 2 GB is by no measure 'excessive' usage. Even with the 40 GB insurance package factored in, Bell's UBB cannot be considered as targeting bandwidth hogs. Few would consider the following usage pattern as 'excessive':

ISP SERVICE MARKUPS

ALICE'S USE (GB/MONTH)	ACTUAL SERVICE CHARGE	ISP MARKUP
4 x 1.5 hour movies/week (~40 GB/month)[158]	Netflix: $7.99/month	40 GB insurance scheme @ 5$/month
6 x 0.5 hour TV shows/week (~20 GB/month)[159]	Netflix: 0 (see above)	
One game purchased (~7 GB)[160]	Steam: $49.95	
Total :	$57.94	$65.00[161]

Yet this is not 'excessive usage' of these services. Indeed, this is modest in light of the intended use of such services. The average Canadian, for example, views approximately 26 hours/week of television, far more than the 9 hours per week attributed to Alice in the usage pattern above.[162] Additionally, the price and size of a single game is reasonable. There are cheaper games that require significantly more bandwidth.[163]

MYTH NUMBER THREE:

UBB is 'fundamentally fair'

REALITY:

Current UBB implementations in Canada tax off-peak users to subsidize peak usage

Many have argued that UBB is about 'fundamental fairness' — about preventing normal average users from subsidizing heavy excessive

users. Current UBB is fundamentally unfair because it forces off-peak users to subsidize peak usage. There are significant differences between peak period and off-peak period traffic. Estimates demonstrate that peak period usage can be 72% to 332% higher than off-peak times[164] and ISPs must build their networks to accommodate peak period traffic. This means that off-peak usage is unlikely to contribute to a 'provisioning action'. But ISPs' UBB is based on monthly usage rather than peak period usage. That is, in calculating Alice's monthly overage charges, ISPs do not differentiate between usage during peak periods and off-peak periods. In this sense, the off-peak usage of customers is subsidizing peak period use. ISPs justify this subsidization by arguing that they do not wish to immunize the majority of their customers from the more egregious impact of UBB.[165] While it is important to note that, from a public policy perspective, peak period pricing is extremely problematic and will have serious impacts on innovation, this type of discrimination against a minority of customers is fundamentally unfair. It can hardly be justified because it ignores the minimal impact non-peak usage has on ISP costs, as well as the excessive costs that relatively more moderate peak-period usage will tend to impose.

In sum, at a time when Internet usage is growing at an extremely modest historical annual rate, monthly caps are dropping at an extremely rapid pace. Moreover, UBB as it is currently implemented in Canada is not remotely tailored to its stated objective: making so-called 'excessive users' pay. Because it is reliant on a highly imprecise metric for congestion — monthly usage — its incentives and costs are blunt and capture far more than their stated objective. They do not appear narrowly tailored to 'excessive users', but rather act as a disincentive to use at all levels. It is adding additional costs onto innovative new platforms and services, in ways that will have a serious impact, not only on the manner in which new services are developed in Canada, but also on the ability for Canadians to access services that are available in other countries.

CONCLUSION

As this section of the report demonstrates, ISP claims about the need for ITMPs lack stable factual foundations. There are no technical bases for discriminatory traffic management, including both technical and eco-

nomic ITMPs. 'Benefits' claimed for certain users are simply non-congested networks, but ISPs must already provide this through investments in network capacity. The true 'benefit' is enhanced profits for the ISP that are made by deferring essential infrastructure investments in exchange for the capacity to throttle, degrade and overcharge for 'unwanted' traffic. Further, by discriminating against newer, innovative applications and pratices, all Internet users are robbed of developments whose future potential ISPs cannot know.

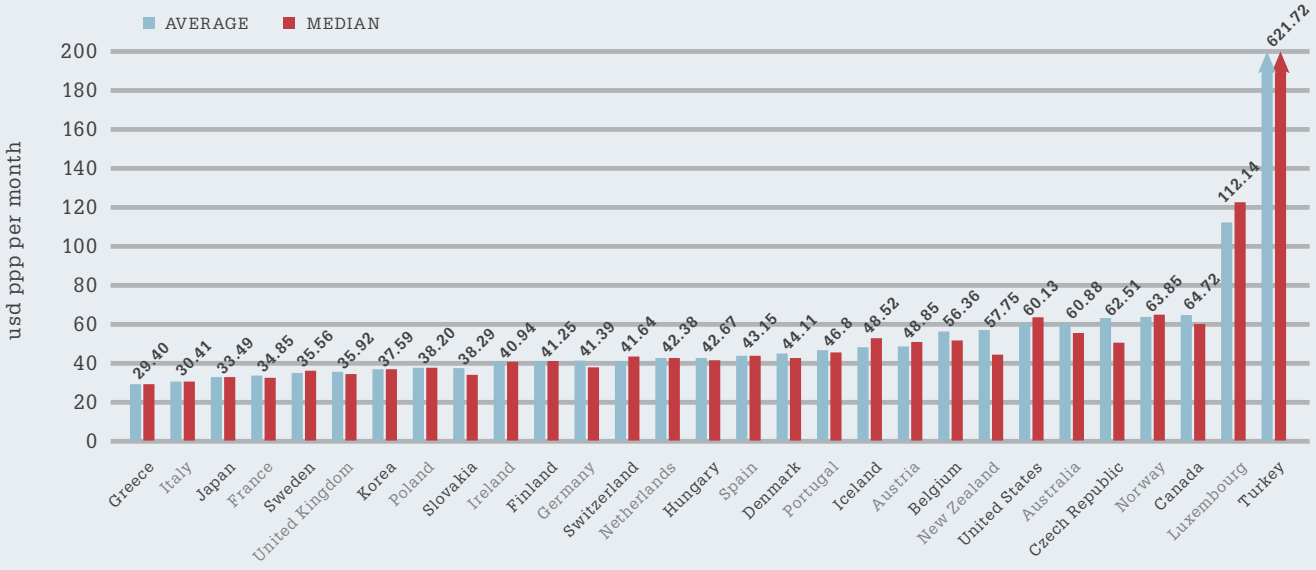
THE OPEN INTERNET: INTERNATIONAL COMPARISONS

Internet development in Canada has significantly declined over the past decade. Compared to other developed nations, broadband penetration has stagnated, and Canadians continue to pay some of the highest prices for comparatively slow speeds.

The Organization for Economic Co-operation and Development (OECD) reports on a range of Internet data from thirty-four developed nations worldwide. The most recent of this data from 2010 shows Canada slipping to 12th place in the rankings of broadband subscribers per 100 inhabitants, a considerable decline since 2002 when it ranked second place.[166] In terms of pricing, Canada placed 27th with average monthly subscription rates of $64.72.[167] Only Turkey and Luxembourg pay more. Despite these telling statistics, "Canada continues to see itself as a high performer in broadband, as it was early in the decade, but current benchmarks suggest that this is no longer a realistic picture of its comparative performance".[168]

FIGURE ONE

OECD AVERAGE MONTHLY SUBSCRIPTIONS PRICE FOR HIGH-SPEED CONNECTIONS, OCTOBER 2009



High pricing and low speed, as well as other problems associated with the broadband market, stem from the way our market is structured. While five companies dominate the telecommunications landscape in Canada, they are comprised of two major groups: incumbent telephony companies (Bell and Telus) and incumbent cable companies (Rogers and Shaw, and Vidéotron in Quebec). This structure is referred to as inter-modal competition, where in order to enter the market, entrants must be able to 1) build their own infrastructure, or 2) have fair (regulated) access to incumbents' infrastructure. Thus, high barriers to entry exist, which are only exacerbated by the government's unwillingness to support competition through either of these requisites. Instead of safeguarding against anti-competitive behaviour and ensuring a level playing field through regulatory measures, the government has relied heavily on this market structure for sufficient competition.

It is essential to call attention to how this affects the quality of Internet service and the issue of net neutrality. With inter-modal competition, telecommunications markets are less open, and incumbent carriers are less inclined to provide competitive services. Indeed, "the majority of companies that offer the highest prices for the lowest speeds… operate in countries that rely on inter-modal competition: the United

States and Canada … ".[169] Furthermore, they have the power to carry out unfair traffic management practices, give preferential treatment to certain content, and perform other discordances with net neutrality.

The U.S. is not unlike Canada when it comes to its market structure and regulatory approach to telecommunications. Since we increasingly follow the path of the U.S. on many regulatory issues, we begin here by exploring the trajectory of net neutrality in the U.S. to get a better picture of the potential future of net neutrality in Canada.

UNITED STATES: A GRADUAL DECLINE OF REGULATORY POWER

In autumn 2005, leading telecom and cable company executives suggested that website and application providers should pay network owners to guarantee service quality over their networks. Shortly after, the U.S. Supreme Court issued their Brand X case, confirming a ruling by the American communications regulator, the Federal Communications Commission (FCC), that cable broadband providers were not required to open their networks to competitor services. The Supreme Court stated that the principle of common carriage — the principle that owners of the infrastructure must allow all traffic to flow through that infrastructure without discrimination, which, until then, had guided U.S. telecommunications policy — did not necessarily apply to cable services.

The FCC reacted by dropping telephone carriers' obligation to connect competing broadband service providers. Stakeholders immediately responded to these decisions, mobilizing to support network neutrality. Meanwhile, the U.S. Congress debated a number of network neutrality bills and legislative amendments. This issue affected the outcome of the November 2006 congressional elections, which resulted in the election of many net neutrality advocates to office.

These debates did not go unnoticed by major U.S. telecommunications and cable companies, who announced plans to charge extra fees for preferred treatment of Internet traffic. Network providers argued that popular Internet and new media applications have unfairly benefitted from unfettered access to the network. They also suggested that high-bandwidth applications, such as peer-to-peer file sharing, would lead to increased traffic congestion, degrading consumers' online experience

(see "The Technical Case For Openness" sections of this report for a fuller discussion of specific issues related to peer-to-peer file sharing).

THE FCC AND NET NEUTRALITY: 2006 TO 2010

The FCC has since been active but ambivalent towards network neutrality. While the FCC degraded common carrier and non-discrimination rules for broadband, it also made commitments to ensuring a more neutral Internet. In spring 2006, the FCC announced the merger between AT&T and BellSouth, on the condition that AT&T guarantee it would operate the new combined network in a neutral fashion for two years.[170] A broad coalition of activists in the U.S. worked against a Congressional vote on net neutrality, which forced AT&T to operate its expanded network. The SavetheInternet Coalition was a non-partisan strategy involving insiders such as policymakers, lobbyists, and experts, as well as outsiders including activists and citizens, among others.[171]

A series of bills addressing network neutrality was considered by the U.S. congress in 2006 and 2007. This included the 2007 Internet Freedom Preservation Acts.215, and the 2008 Internet Freedom Preservation Act H.H. 5353.[172]

In 2007, Comcast was discovered blocking BitTorrent Internet traffic. Public interest groups acted quickly, and requested that the FCC step in to stop Comcast's activities. The FCC attempted to take steps to stop this behavior; however, Comcast appealed the FCC's ruling at the U.S. Court of Appeals for the District of Columbia.[173]

On October 22, 2009, the FCC issued their Notice of Proposed Rulemaking in the Matter of Preserving the Open Internet Broadband Industry Practices,[174] which on January 14, 2010, was condemned in a joint comment from open Internet advocacy groups including the Computer & Communications Industry Association, the Consumer Electronics Association, the Electronic Frontier Foundation, the Home Recording Rights Coalition, NetCoalition, and Public Knowledge. These groups disagreed with the proposed 'copyright loophole' that allowed ISPs to discriminate against lawful content and lawful transfers with undisclosed mechanisms. The proposed rules would allow ISPs to throttle Internet traffic based on application, protocol, or content using unknown methods, as long as they claimed the content was likely unlawful.[175]

The U.S. Court of Appeals for the District of Columbia overrode the FCC in April 2010, after the FCC ordered Comcast to stop blocking subscribers of the peer-to-peer application, BitTorrent. The ruling stipulated that the FCC had overstepped its regulatory authority to ensure network neutrality.[176]

In August 2010, after weeks of talks with major phone, cable, and Internet companies, the FCC announced that it would stop its efforts to rule on issues surrounding network neutrality. The FCC called off negotiations on the grounds that the discussions had not resulted in a robust framework for network neutrality. In response, Google and Verizon, concerned that broadband providers could slow down or block content, or charge priority service, proposed their own policy solution.[177]

GOOGLE AND VERIZON'S JOINT POLICY PROPOSAL

The Google/Verizon proposal, published by Google in a blog post entitled "A Joint Policy for an Open Internet", has been widely criticized by U.S. public interest groups for the overt exclusion of wireless devices in its net neutrality framework. This would allow ISPs to divide the Internet into two pipes, wired and wireless, with the latter devoted to "managed services", in which major industry players would pay Internet providers to prioritize their content or services by speeding it up, packaging it with other popular content, or blocking competing services. Mobile ISPs would also be permitted to support only a limited selection of applications or services on their networks, and to charge users additional premiums for access to certain applications. With the increasing proliferation of "smart" mobile phones and other non-traditional devices that access the Internet, this would serve to undermine the open Internet in general.

Media reform group FreePress also argued that industry groups should not be allowed to regulate the Internet as they could not be held accountable to the public and would propose policy based on their own financial interests. The FCC also criticized the Google/Verizon proposal, issuing a response that stressed the need to reassert regulatory authority and serve citizens rather than corporations.

DECEMBER 2010 NET NEUTRALITY RULING

On December 21, 2010, the FCC voted to instate new rules that would frame net neutrality in the United States. These rules would prohibit broadband providers from blocking customer access to legal online content, require providers to disclose their network management practices to consumers, and bar wireline-based broadband providers from "unreasonable discrimination" against Internet traffic. These rules would be enforced by way of a complaints-based process.

Like the Google/Verizon framework, the FCC's net neutrality regulations did not include provisions for Internet content accessed through wireless devices. Mobile Internet providers in the U.S. are currently allowed to fully block any applications and services, with the notable exception of those that directly compete with their own voice and video products. The regulations do not prohibit ISPs from engaging in "paid prioritization", which offers some content creators faster loading speeds for a fee.

The December ruling also omitted the reclassification of cable broadband companies currently under Title II of the Communications Act, which would have given the FCC the legal authority to regulate them as Internet providers. As previously discussed, in matters related to online traffic management, the FCC can only exercise full regulatory authority over telecommunications services, which do not include cable Internet providers currently classified as "information services".

2011: FCC "OVERSTEPS ITS REGULATORY AUTHORITY" AGAIN

Despite the FCC's light-handed attempt to instill net neutrality, Verizon and MetroPCS, a mobile service provider, have reacted callously to the FCC's December ruling. Verizon and MetroPCS individually filed lawsuits against the FCC to overturn their Internet access ruling and challenge their legal authority to impose such regulations.[178] In January, the FCC requested that the U.S. Court of Appeals dismiss the lawsuits filed by Verizon and MetroPCS on the basis that the lawsuits had been filed too early. Since the new net neutrality rules had not taken effect yet, the companies did not follow the procedural guidelines, which dictate that before parties can file suits, the ruling must be published in the Federal Register.[179] The same U.S. Court of Appeals for the District of Columbia overrode the FCC in April 2010, accusing the FCC of overstepping its regulatory authority for ordering Comcast to stop blocking BitTorrent.

Republican members of both the House and Senate are determined to keep the telecommunications sector free from government interference, and argue that "the controversial Internet regulations stifle innovation, investment and jobs".[180] They maintain that the FCC's moves toward net neutrality illustrate regulatory overreach and economic interference.[181] In fact, the House passed an amendment to a pending budget bill that would prohibit the FCC from spending any money to implement the new net neutrality rules.[182] Further, a proposed Resolution of Disapproval would serve to invalidate the FCC's net neutrality regulations.[183] The Resolution of Disapproval, under the Congressional Review Act, gives lawmakers a limited amount of time to try to overturn federal regulation after they are issued, and would inhibit the FCC from enforcing any further rules related to net neutrality.[184]

LESSONS FOR CANADA

In order for Canada to avoid the adverse situation seen in the U.S., a shift in the regulatory landscape needs to take place. The FCC has lost nearly all of its regulatory power on the issue of net neutrality as a direct result of its inadequate attempts to mandate Internet openness and the clout of companies like Google and Verizon. In addition, the inclination of U.S. courts to side with major corporations also poses a major challenge for the FCC, despite the legal setbacks behind the FCC's attempts at regulation. Currently, incumbent ISPs in Canada hold substantial power with regards to the regulation of the Internet. Incumbents like Bell argue that regulatory measures will stifle their ability to innovate and invest in new infrastructure, and government and the CRTC largely comply with their demands.

Though Canada does have some net neutrality guidelines for the Internet accessed through both wired and wireless devices, there is no enforcement of net neutrality in actual practice. Former Industry Minister Tony Clement has been called on to demonstrate the initiative, leadership, and follow-through that U.S. policymakers have been lacking. Clement's replacement, Industry Minister Christian Paradis could enforce net neutrality by mandating that the CRTC perform regular audits of ISPs compliance with net neutrality guidelines, and create proactive policy that makes the open Internet a reality.[185] Not doing so seriously

threatens the open internet, and negatively impacts Internet service for citizens in Canada.

NET NEUTRALITY ELSEWHERE

Many other countries have experienced a similar market structure, dominated by a small number of incumbents with high levels of concentration and limited competition. Yet other countries have faced these issues head on by implementing different regulatory mechanisms to ameliorate the situation. Not only have these regulatory mechanisms helped to reduce barriers to entry and ensure sufficient competition, but they strip incumbents of excessive power and reallocate this power to government, regulators, and the public at large.

In 2010, Yochai Benkler and researchers at Harvard's Berkman Centre built on data provided by the OECD to formulate a major report, "Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world". In this report, they highlight the relationship between high-quality, low-cost Internet access and the deployment of regulatory power. Examples show that in markets where incumbents are reluctant to allow competition, "the degree to which a regulator is professional, engaged, and effective",[186] and focuses on implementing open access policies plays a crucial role (see Figure Two).

FIGURE TWO

OPEN ACCESS AND FUNCTIONAL SEPARATION

OPEN ACCESS POLICIES: regulations that attempt to ensure fair access to an incumbent Internet service provider's (ISP) network infrastructure – i.e. the pipes used to bring the Internet to users' homes.[187] A prominent example of this type of regulation is local loop unbundling (LLU), or unbundling — the local loop, also called the "last mile," which connects individual users' home to the Internet, is opened up to many different ISPs. In many cases, incumbent providers own this kind of infrastructure through a complex series of transactions, usually including the move from being a Crown corporation or public sector entity to a privately owned business.

FUNCTIONAL SEPARATION: separates the incumbent's infrastructure from its retail operations. Open access defines the terms of service under which access should be provided, but incumbents can still discriminate against competitors by exploiting their control of the infrastructure. Functional separation attempts to curb discrimination against entrants and "promotes competition based on retail and value-added services supplied over a common infrastructure".[188] Functional separation has been adopted in countries like the UK, Sweden, Italy, the Netherlands, New Zealand and Australia.

By examining successful Internet deployment in other countries, we can discover conditions and policies that lead to greater competition, better choice, and a more open, neutral Internet. We can also see how this directly impacts Internet quality, penetration, price and speed. Ultimately, It helps us to further understand how different regulatory measures work together to serve the public interest.

Generally speaking, other countries have been more proactive in implementing policies that address problems related to competition

and broadband growth. These policies have in turn helped to tackle some of the issues involving net neutrality. These include measures such as unbundling, functional separation, public-private partnerships, government investment in infrastructure, and net neutrality legislation. Overall, a robust strategy that combines these approaches appears most effective, and a shift toward open access and shared infrastructure is apparent among the strongest performers.

JAPAN: A STRONG, ENGAGED REGULATOR

Japan leads the OECD on many of the key indicators of high-quality, affordable Internet access.[189] In addition to having the fastest commercially available speeds in the world,[190] Japan ranks third in affordability of monthly high-speed broadband subscriptions with an average monthly rate of $33.49 — just over half of what Canadians pay (see Figure One). The Berkman Center report singles out Japan as a performance outlier along with South Korea, and points to the role of smart regulation in its success.

Since the privatization of the previously government-owned Nippon Telegraph and Telephone (NTT) in 1985, the Japanese government took measures to ensure competition in the telecommunications market in order to create an environment that fostered innovation and growth.[191] While this was done largely in light of Information and Communications Technology (ICT) development, this vigorous approach resulted in a level playing field for competitors and transferred much of the power NTT held during its monopoly reign into the hands of Japan's regulator.

Beginning in the 1990s, the Japanese government became involved in broadband development by offering low-interest loans and tax deductions[192] to help independent ISPs build network infrastructure and encourage facilities-based competition (see Figure Two). By the late 1990s, the Ministry of Internal Affairs and Communications (MIC) took steps to further impose regulation on NTT. In particular, the creation of an IT Strategy Headquarters, an "e-Japan" strategy, and the development of a Basic IT Law gave the MIC substantial regulatory powers.

In 2000, when NTT was suspected of carrying out anti-competitive behaviour, the Japanese Fair Trade Commission intervened by issuing a

FIGURE THREE

FACILITIES-BASED COMPETITION VS. SERVICE-BASED COMPETITION

FACILITIES-BASED COMPETITION: when entrants compete in the market by building their own infrastructure. This type of competition is much more difficult, as major upfront costs and bureaucratic red-tape serve as a high barriers to entry. As a result, telecommunications markets are often highly consolidated with limited competition. However, competition at the level of infrastructure is seen as a necessary component for long-term efficiency,[194] particularly with regards to investment in new infrastructure. When more facilities-based competition exists, governments are not forced to rely solely on incumbents for investment, and incumbents consequently hold less power with regards to restricting new entrants in the market.

SERVICE-BASED COMPETITION: when entrants use the facilities of the incumbent, either through resale or unbundled access. Through resale, incumbents are usually required to lease infrastructure to competitors at wholesale prices. Unbundling serves as an important regulatory measure that ensures entrants access to incumbents' infrastructure. It is essential for government to play a role in fostering this type of competition, as unfair or unregulated pricing for network infrastructure prevents entrants from entering the market. When regulatory measures do encourage service-based competition, the public has much more choice for ISPs.

warning for NTT's unfair treatment of competing ISPs.[193] As a result, the MIC forced NTT to unbundle its last mile infrastructure to new entrants and lease out its dark fiber at low, regulated rates. By the late 2000s, NTT's infrastructure was opened to independent ISPs, allowing for fierce service-based competition and the development of a thriving broadband market (see Figure Three).

In response to public concern regarding traffic management practices, the MIC released a report in 2007 instilling three guiding principles for net neutrality: free access to the content/application layer, free connection with any terminal that meets technical standards, and use of networks at a reasonable price without discrimination. Further discussion about these issues took place again in 2008 in, "ISP Guideline for Packet Shaping", produced through a collaborative effort of four telecommunications carrier organizations — the Japan Internet Providers Association (JAIPA), the Telecommunications Carriers Association (TCA), the Telecom Services Association (TELESA), and the Japan Cable and Telecommunications Association (JCTA).

One of the main tenets of the ISP Guideline was that the first response to network congestion should be increasing network capacity.[195] Traffic shaping should only be used in "exceptional circumstances" when excessive use of bandwidth degrades the quality of service for general users. Furthermore, data used to justify shaping must show that the quality of service is otherwise diminished for all users, and this should be examined on an individual basis.[196] In addition, traffic shaping must respect individual user privacy, implying that Deep Packet Inspection (DPI) is unusable in Japan (see Figure in "The Technical Case For Openness" for an explanation of DPI).[197]

As well as instilling net neutrality and traffic management principles, these consultations created a standard for transparency. The MIC affirmed that users must be informed about traffic shaping policies through their contract terms and conditions, and that this information should also be made available online to the public. This built on previous measures taken in 2001, when the MIC created a public forum to resolve disputes between entrants and incumbents.[198] With the purpose of informing the public about complaints within the sector, this helped users be more informed in their selection of ISPs, and moved the sector away from closed-door negotiations.[199]

According to the Berkman Center report, "the critical insight here is that the Japanese approach sees a highly competent and intensely engaged regulator as an enabler of competition, rather than a weak and removed regulator".[200] Indeed, soon after the privatization of NTT, the government worked towards fostering both facilities-based and service-based competition through a combination of incentives and policies. While Japan mainly utilized a market-based approach, the safeguarding of regulatory power was equally imperative to its success.

Japan effectively addressed net neutrality by instilling guiding principles and setting a standard for the disclosure of traffic management practices. This complemented the fact that there was enough competition to allow users to switch ISPs if dissatisfied with their practices. Furthermore, the government sees no evidence that these policies have affected growth or diminished NTT's incentives to invest in infrastructure.[201] The result of Japan's aggressive strategy, which has remained fervent and robust over time, has been an Internet service that excels beyond most others worldwide, ultimately serving the public interest.

UNITED KINGDOM: A MODEL FOR FUNCTIONAL SEPARATION

As of 2009, the United Kingdom (UK) is ranked 4th out of 21 OECD countries for average monthly subscription for very high-speed Internet (speeds of over 35,000 kbit/s).[202] As well, of the larger European countries, the UK is the steadiest performer on broadband penetration.[203] Increasing access and speed and decreasing price have characterized broadband development in the UK over the past few years. The cur-

rent situation in the UK can be seen as increasingly market-based, yet their strategy continues to provide strong competition and quality broadband services, likely the result of a series of strategic steps taken throughout the decade.

Most notably, since the privatization of telecommunications sectors worldwide, the UK was the first country in the world to implement functional separation. This represented a major shift in terms of government regulation. While unbundling was widely adopted by the European Union (EU) in 2001, British Telecom (BT), the incumbent carrier in the UK, had not been fully cooperating with this move to increase competition. By late 2005, unbundling still had not had much of an impact on the market. As a result, Britain's regulator, Ofcom, forced BT to undertake functional separation. This meant that an independent arms-length organization, Openreach, would manage the wholesale[204] operations of BT and provide competing ISPs access to BT's infrastructure at regulated rates.

The introduction of functional separation had major impacts on competitive entry, penetration, Internet pricing, and speed.[205] Regulated access to BT's infrastructure led to a huge influx of service-based competition. In late 2005, there were only 200,000 unbundled loops, but by the end of 2008, there were 5.5 million unbundled loops,[206] indicating massive growth in the market. Ofcom's decision to create Openreach spurred widespread broadband use across the country, lowered broadband prices, and offered a much wider range of choices for Internet service. Certainly, the public benefitted from this move.

Competition has also had positive effects on investment in infrastructure. BT has recently announced that it will be removing current caps on usage due to increased investment in their networks and network bandwidth.[207] As a result, BT claims that there is no need to cap usage and aims to optimize their user experience. However, a "traffic management" policy will still remain, and in extreme cases where heavy users are degrading service for others, BT may still reduce Internet speeds.[208]

As such, the EU holds that there is insufficient evidence to justify formal regulation that would prohibit certain forms of traffic management. In general, the role of the EU is to enact guiding policies of liberalization and harmonization, which aim to create one large market that transcends national boundaries and embodies open competition. Harmonization is key here as EU regulators tend to enact policies that adopt the lowest common dominator of regulatory practices. Thus, it can be expected that any EU policy will promote free market competition and shy away from any regulating policies or processes, despite the fact that they may actually secure higher levels of competition like Ofcom's forced functional separation.

Problems surrounding net neutrality have been relatively absent due to strong competition, however, conversations about the issue have recently gained momentum in the UK. According to an article on TechEye.net, BT has "openly welcomed the prospect of giving commercial partners preferential bandwidth on their networks, effectively creating a two-tier Internet".[209] Thus, it appears as though problems surrounding net neutrality may potentially materialize in another form. Although this news has yet to unfold, the EU is set to release its new telecoms package in May 2011, which will likely take a pro-competition approach to the issue, diverting from any type of actual net neutrality legislation for reasons previously discussed.

In addition, while the UK is reluctant to impose net neutrality legislation, they are mandating transparency as a way to safeguard competition. Much like Japan, the issue of transparency is being promoted as a key component to minimizing the risk of anti-competitive behaviour. As long as ISPs are clear about traffic management practices, the public should, in theory, have choice in which provider they wish to purchase Internet access from. It is important to note here that even when sufficient competition exists and ISPs are open about their practices, the process by which users are able to switch ISPs must be as simple and straightforward as possible in order for this to serve as a viable solution.

While the positive impacts of functional separation may have only spurred a relatively short, but intense period of competition, the main

point is that promoting and maintaining competition remains at the forefront of the EU's strategy. Ofcom took the necessary steps to foster more competition and create a level playing field for competing ISPs when unbundling policies were shown to be ineffective in the UK. The effects of functional separation were much more profound than the introduction of formal unbundling, since unbundling was not effectively enforced or adopted by the incumbent — one of the risks of settling for open access policies like unbundling over functional separation. Furthermore, the UK's approach has now shown to have positive affects on investment in infrastructure.

Similarly, in Canada, unbundling was formally adopted in 1993, but weakly implemented by the government. As a result, competition was limited to facilities-based entrants, with much weaker results.[210] If Canada aims to take a market-based approach, then it must be committed to actively pursuing and maintaining competition within the telecommunications sector through regulatory measures like functional separation when necessary. As long as the EU continues to instill mechanisms to ensure competition, and Ofcom is able to maintain its regulatory power despite the overarching free market ethos of the EU, the UK model remains a useful point of analysis for Canada.

SWEDEN: OPEN ACCESS AND PUBLIC-PRIVATE PARTNERSHIPS

Sweden's all encompassing approach to fostering a strong broadband market has positioned it as a top player next to South Korea and Japan. With a very high level of penetration, Sweden ranks second place overall behind South Korea on various penetration measures. In addition, they rank fourth overall on various speed measures,[211] and first place overall based on weighted average aggregates from OECD data, including penetration, speed, and price.[212] Open access policies have been fundamental to Sweden's success, in addition to extensive government funding, public-private partnerships, and functional separation.

Open access policies have largely shaped the current structure of the broadband market. Local loop unbundling in 2001 allowed incumbents from neighbouring countries to enter the market in Sweden by buying out smaller competitors. Specifically, Norway's Telenor moved into Sweden to become the second largest broadband provider, com-

peting with the incumbent, TeliaSonera. Telenor did this by buying several independent ISPs over the course of four years from 2003 to 2007, who had initially relied on unbundling to enter the market.[213] Other competitors followed similar paths of consolidation and investment, leading to powerful competition in the market. As a result, the four largest competitors compete across several different platforms, including copper, cable, fiber, and wireless.[214]

According to the Berkman Centre report, large, long-term public investments have played an important role in the highest performing countries.[215] In particular, public-private partnerships have been a critical component of Sweden's strategy for investment in infrastructure. Beginning in the 1990s, the Swedish government made major investments in national network infrastructure. On the municipal level, Sweden has subsidized both large and small municipalities to build their own network infrastructure, who then lease them out to private ISPs. Of Sweden's roughly 290 municipalities, over 200 have been subject to some form of public funding for broadband deployment.[216]

Much like the rest of Europe, Sweden holds similar views with regards to the importance of competition in mitigating problems related to net neutrality. The Swedish telecommunications regulator, PTS (Swedish Postal and Telecoms Authority), argues that the degree of competition in Sweden allows users to switch operators easily if they are opposed to a certain ISP's traffic prioritization.[217] PTS holds considerable regulatory power since the 2003 Electronic Communications Act was put into place, and has since imposed functional separation on the incumbent TeliaSonera, who willingly complied. Consequently, according to the Berkman Center report, TeliaSonera can be grouped in the category of highest-speed lowest-price offerings.[218]

Several lessons can be drawn from the case of Sweden. First, incumbents in Canada have convinced the government and the CRTC that having a closed market is necessary in order for them to invest in in-

frastructure. This has allowed them to exclude competitors and reject open access policies. The Swedish market shows that open access policies, when deployed effectively, lead to increased competition, innovation, and investment. This was achieved, "not by explicit regulation, but by agreement between the incumbent and its competitors, backed by the threat of regulatory solution if no such agreement was reached".[219] Canada must leverage the threat of further regulation in order to open up effective communication and negotiation with incumbents.

As well, as mentioned previously, Canada's efforts to impose unbundling were weakly implemented, and our market offers an example of heavy reliance on inter-modal competition. On the contrary, competition in Sweden exists nationally, and crosses several different platforms. This is a direct result of independent ISPs being able to enter the market and eventually consolidate through open access policies. Accordingly, "the lowest prices and highest speeds are almost all offered by firms in markets where, in addition to an incumbent telephone company and cable company, there are also competitors who entered the market, and built their presence, through use of open access facilities".[220] Thus, if Canada is committed to competition and a market-based approach, then we must consider policies in the vein of the Swedish model: open up competition as widely as possible, and consider public investments in infrastructure.

USAGE-BASED BILLING WORLDWIDE

All big ISPs in Canada currently employ some form of usage-based billing (UBB), though as of February 2011, Shaw had suspended plans to implement overage charges.[221] According to the OECD, Canada is the only country in the world aside from Australia where all major plans surveyed do not offer the option of unlimited Internet service.[222] UBB in Canada customarily places a cap on monthly Internet use, and charges additional fees when users exceed this cap. Big ISPs have argued that charging overage fees is the most popular approach in addressing so-called network congestion; however, research suggests that network growth rates are not historically high,[223] and that UBB is largely an additional form of revenue for incumbent ISPs (see "A Technical Case For Openness" for a fuller discussion of network growth rates).

Other countries that implement caps on Internet usage are markedly different from Canada. They offer a range of options to users. For example, Australia, New Zealand and India "rate limit" users who exceed monthly caps by slowing down additional service. Likewise, the UK provider BT has recently eliminated data caps, but still maintains the option to reduce speeds of heavy Internet users during peak times.[224] Similar approaches taken include differentiating between peak time and off-peak time usage in Australia, between upstream and downstream traffic in Japan, and by imposing domestic and international data caps, as seen in Iceland.[225] All of these methods are based on the assumption that heavy users need to be "disciplined", an assumption we challenge throughout this report.

Countries that employ UBB also enjoy more competition in their markets, allowing users the option to choose between capped or unlimited Internet service plans. Indeed, German and U.S. markets both offer capped and unlimited service plans with costs reflecting the size of the data plan.[226] In Michael Geist's recent report on UBB internationally, he explains, "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".[227] In other words, big ISPs in Canada are using UBB as a way to increase profits, and are able to carry out such business practices because of the closed nature of our telecommunications market.

AUSTRALIA: MAJOR PUBLIC INVESTMENT IN NETWORK INFRASTRUCTURE

Australia has recently made a major move with plans to invest an unparalleled amount of government money into network infrastructure. In 2009, the Australian government announced that it would invest $43 billion AUD in a fiber to the premises (FTTP) network, delivering high speed Internet to 90 percent of Australians.[228] This is the largest amount of public money invested in network infrastructure to date. The plan is expected to take eight years, and after five years of completion, the National Broadband Network (NBN) is to become privatized to a fully open access carrier.

Australia's decision to invest such a large sum is likely in response to the substandard state of the broadband market. While Australia has been relatively slow in broadband development, its speeds are now above the OECD average. Internet pricing is also quite high, and this can be attributed to the fact that Australia uses volumetric pricing, or

usage-based billing. This means that all Internet use is currently capped in Australia, where usage above monthly plans is throttled or charged at a pre-determined rate.[229]

AUSTRALIA OECD RANKINGS, BERKMAN CENTER

PENETRATION METRICS	RANK AMONGST OECD 30 COUNTRIES	SPEED METRICS	RANK AMONGST OECD 30 COUNTRIES	PRICE METRICS	RANK AMONGST OECD 30 COUNTRIES
Penetration Per 100, OECD	16	Max. Advertised Speed, OECD	14	Price Low Speeds, Combined	28
Household Penetration, OECD	13	Avg. Advertised Speed, OECD	7	Price Med Speeds, Combined	27
3g Penetration Telegeography	3	Avg. Speed, Akamai	24	Price High Speeds, Combined	19
Wi-fi Hotspots Per 100,000, Jiwire	17	Median Download, Speedtest.net	22	Price Very High Speeds, Combined	N/A

This system has made users aware of their usage rates and has led to more conservative usage of the Internet in Australia. As Australia is an island, content must travel through undersea cables to leave the continent. This form of data transmission is a much more expensive method than what is found in North America.

In the context of net neutrality, it is argued that usage-based billing reduces the incentive for ISPs to block or throttle content, since any use of additional content would result in increased profit for ISPs. On the contrary, it would make sense that ISPs would promote the use of content from any source. As it turns out, however, "rather than negatively discriminating against particular content, some ISPs are positively discriminating by offering unmetered access to some content".[230] This unmetered access is likely granted to affiliated content, leaving competitors' content and services at a disadvantage.[231] Thus, not only does usage-based billing limit Internet use, it appears to add an additional layer of problematic behaviour for ISPs and to be no guarantee of net neutrality.

While it is unclear how the NBN may affect usage-based billing, it is certain that this investment will result in an increase in social services, ranging from education to healthcare, and employment across the country. It should also help to address the digital divide between urban and geographically isolated areas, reaching a larger portion of the population.[232] Furthermore, functional separation of Australia's incumbent, Telstra, should aid in the rollout of the NBN and strip the incumbent of remaining excess power. With Telstra under new regulation, competition will likely flourish in the broadband market.

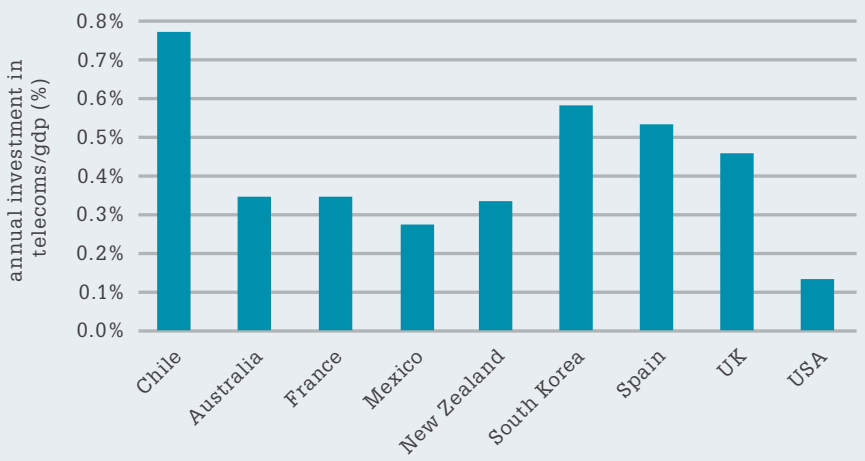
The main lesson to be taken from Australia is that large government investment is not beyond the scope of possibility. The decision made by the Australian government shows the potential for countries like Canada, which has a similar geographic breakdown and the challenges that come along with it, that investment in infrastructure could be a valuable strategy. Although Canada's broadband performance is not as weak as Australia's, there is considerable room for improvement. To date, Canada has relied heavily on private sector spending to upgrade their Internet networks. As we have seen, this reliance has allotted far too much power to incumbent carriers. Government investment in infrastructure within Canada would alleviate some of the abuses of market power as a result of infrastructure ownership, open doors for public-private partnerships, and provide more accountability to the general public.[233]

CHILE: A LEADER IN NET NEUTRALITY LEGISLATION

Chile is the leading country for Internet and broadband penetration in Latin America. While Chile's success can be attributed to its relatively high GDP rate, it is also the result of a highly competitive telecommunications market supported through a combination of government and private investment. Indeed, relative to other nations, Chile has seen a significant amount of investment in the telecommunications sector. Most notably, however, Chile has been the first country in the world to implement net neutrality legislation.

In July 2010, in a nearly unanimous decision of one hundred votes to one abstention, the Chilean Congress passed a set of amendments

INVESTMENT IN TELECOMMUNICATIONS IN PROPORTION TO GDP[234]



to the General Telecommunications Law: "'No [ISP] can block, interfere with, discriminate, hinder, nor restrict the right of any Internet user of using, send, receive, or offer any content, application, or legitimate service through the Internet, as well as any activity or legitimate use conducted through the Internet'. The law also has articles that force ISPs to provide parental control tools, clarify contracts, guarantee users' privacy and safety when surfing, and forbids them to restrict any liberty whatsoever".[235]

One of the most significant and meaningful factors in passing this law was the role of the citizen-organized group, Neutralidad Sí. For years, Neutralidad Sí petitioned representatives from Congress about the importance of having such a law in place to guarantee the rights of users. Prior to this, they "worked to reveal that major ISPs were performing acts contrary to the principle of net neutrality, like blocking ports that allow the exchange of P2P files".[236] Through a campaign facilitated by social media tools such as Facebook, Twitter, and other forums, Neutralidad Sí was the primary force behind passing this legislation. This speaks to the potential of not only grassroots organization, but the strength of the public voice. It is considered a major feat for net neutrality advocates worldwide.

In order to further position Chile as a compelling point of comparison, it is useful to consider the steady growth of their telecommunications market. Internet use follows a revealing pattern in the months prior to the passing of the law: "Connections with speeds higher than 2 Mbps saw more growth in the first half of 2010 than other connections, which would explain the proliferation of video transmissions and other applications that demand broadband. The number of mobile broadband connections grew by 40 percent over the first six months of 2010".[237] When considering this data, it makes sense that net neutrality legislation was encouraged by citizens — the spreading use of peer-to-peer file sharing in particular illuminated the importance of having a neutral network.

In response to the new legislation, Felipe Morandé, Minister of Transportation and Telecommunications stated: "It is a concrete step toward having greater transparency in the broadband market, stimulating competition for quality of service, which is the pillar of our public policy in telecommunications … [the law] placed our country at the forefront in the world in terms of net neutrality".[238] Unlike other Latin American countries, Chile's Fondo de Desarrollo de Telecomunicaciones (FDT) is a telecommunications development fund financed from the national budget rather than through levies on telecommunications operators.[239] It offers subsidies to private companies willing to invest in special projects.[240] Needless to say, government support is a fundamental component to Chile's broadband deployment.

Chile is not unlike Canada when it comes to broadband strategy. In addition to government support, Chile is "viewed as a role model by the international business community for its competitive free market approach".[241] Still, in the name of developing broadband, Chile saw the importance of mandating net neutrality. Chile's broadband market is still quite underdeveloped, and major upfront investment is needed in order for the telecommunications sector to grow. Given the country's market-based approach, this will likely come in the form of private investment from incumbents, in addition to measures like the FDT. Thus, it will be useful for Canada to see how the telecommunications sector develops and grows in the context of this new net neutrality regulation.

What Canada can also learn from Chile is the potential for citizens to call attention to net neutrality. Chile's strong civil society enabled them to apply pressure to government to make changes to telecommunications regulation. This is proof that grassroots organizing by citizens can influence government and shift power away from corporate interests. This type of action is also possible in Canada if we continue to apply pressure through advocacy. According to Morandé, the net neutrality law "shows that there is the political will in Chile to modernize the regulation of telecommunications and empower consumers. That is the path that we are following for the benefit of the citizens".[242] This political will can also be exerted in Canada through further organization and coordination.

CONCLUSION

By investigating international approaches that have resulted in strong broadband markets and fewer problems with net neutrality, Canada can become better equipped to deal with problems in our market. As a highly developed nation and economic leader, Canada's broadband performance is disconcerting. Other comparable nations, and even less developed nations like Chile, are being far more proactive in tackling key issues related to broadband. Telecommunications markets worldwide share a similar historical development, beginning with incumbent carriers who eventually became privatized and later subject to competition. Yet, if we share almost the same historical development, where did Canada go wrong, and what did other countries do to foster a strong market? Several lessons can be drawn from exploring Japan, the UK, Sweden, Australia, and Chile.

First, open access policies played a critical role in most of the countries explored. In particular, unbundling, when effectively implemented, served as a critical juncture in telecommunications regulation by significantly opening up competition. In Canada, unbundling was formally adopted, but did not facilitate competitive entry into the market as it did in countries like Japan and Sweden. Instead, Canada weakly implemented unbundling, and now has the highest monthly charge for access to an unbundled loop of any OECD country.[243] This is a fundamental element of telecommunications regulation that needs to be further addressed.

The extent of service-based competition is also highly dependent upon the effectiveness of unbundling policies. As well, facilities-based competition became more accessible when governments offered incentives for investment in infrastructure. Without offering low interest loans or tax incentives, it becomes more challenging for entrants to compete against incumbent carriers who dominate the market. The introduction of functional separation also had immediate impacts on competitive entry, and major effects on broadband penetration, price, and speed. However, in order for any of these measures to work successfully, it appears as though they must be used in conjunction with one another and imposed at opportune times.

The principle of transparency, as a complementary measure to strong competition, is also a popular approach to address problems surrounding traffic management practices and net neutrality. However, it should be noted that mandating principles such as transparency may set important industry standards, but will also place more responsibility upon individuals to switch ISPs if they disagree with traffic management practices. In Canada, where most areas only provide the option of two ISPs, we must take into consideration the feasibility of switching. The technical and financial barriers to switch providers cannot be ignored, so more accountability for ISPs must accompany new standards of transparency.

When looking at these international contexts, particularly in the EU, it is important to remember that competition does not always mitigate problems surrounding net neutrality. Even with strong competition, incumbents often still hold considerable power, and can exercise this power through anti-competitive behaviour. Consequently, some form of regulation must be used in conjunction with pro-competitive measures. This is especially true when considering the importance of maintaining a healthy balance of regulatory power. As seen in the case of Japan, even though strong competition existed, and the government took steps to empower entrants to compete against NTT, NTT still carried out anti-competitive practices that Japan's regulator was forced to address. This shows the importance of maintaining regulatory power and the ability to manage incumbent carriers. As the Berkman Centre report

notes, “an engaged regulator practically enforcing open access policy is more important than the formal adoption of the policy”.[244] Indeed, government and regulators need to maintain power in order for regulatory threats to seem realistic and plausible.

Thus, we must consider the range of strategies adopted by other nations, rooted in smart regulation. Most countries worldwide are also shifting towards open access policies, especially when considering plans for future investment and upgrades in infrastructure. The government and the CRTC must reaffirm their regulatory power in order for us to implement the strategies seen in other countries. Continued public engagement, as exemplified through the case of Chile, that pushes the regulators into a more active role will be crucial to an open Internet in Canada.

CANADIAN CULTURE IN AN OPEN INTERNET AGE

Culture is a way of life. It is made up of the knowledge, beliefs, understandings, art, customs, laws, and ideas that comprise a particular society. It is a product of the histories and institutions that frame and animate that society, and it is realized in the capabilities and habits of a society's members. Media play a key role in the production and transmission of culture. In a large, complex, and dispersedly populated country like Canada, media are the central means for developing an understanding of our culture and our place within it. They are key for appreciating the ideas and concerns of other groups and members of our society. They provide both windows on it and doorways to it; means of both producing culture and participating in it.

From this perspective culture is both sublime and ordinary. It is both professionally produced and homemade, created by teenagers, adults, and families on Internet websites and message boards just as readily as it is by television companies and filmmakers in professional studios. Increasingly, the Internet is the primary medium for creating, sharing, and

experiencing Canadian culture. It encompasses both traditional media such as television, film, radio, magazines and books, as well as new forms of interactive media where people can share their understandings and concerns and create new ways of seeing and experiencing the world. The Internet fosters creative production, facilitates the sharing of cultural content, and allows Canadians greater opportunities to experience and participate in cultural life.

Internet Services Providers (ISPs) have traditionally sold access to the Internet to all people willing and able to pay for their services, leaving how to use that access up to their customers. Such open usage fosters myriad types of cultural experiments, as people work and play with the technology in ways that expand both their understanding and enjoyment of the fruits of Canadian culture and the world beyond. However, ISPs have begun stepping beyond the confines of simple service provision — they have been intervening in shaping how their services are used through bandwidth caps, usage-based billing, and the throttling of content. Open Internet policies would prevent ISPs from discriminating against certain cultural practices and favouring others — particularly the cultural practices of the media that they own.

In this section, we make the case that the interests of private telecommunications companies do not align with the public interest of Canadians — therefore, strong regulation is needed to ensure that the Internet stays open to the experiments and creativity that make our culture flourish. To better understand the relationship between Canadian culture and the Internet, we address three intersecting areas of culture here: Making Culture, Sharing Culture, and Interacting with Culture. The first section explores cultural production online, the second section addresses the distribution of culture using the Internet, and the last section highlights the exciting new ways Canadians can interact with cultural goods and practices online.

MAKING CULTURE

An open Internet benefits the production of cultural goods in Canada. The cultural industries are a vital part of the Canadian economy; however, cultural production involves all Canadians, even those who do not sell their creations or consider themselves professional producers. Creating

culture involves user-generated production and amateur production, as well as the more traditional sense of professional cultural production.

An open Internet is vital to the success of Canadian content producers, and successful content producers make a substantial contribution to the Canadian economy. The Canadian online marketplace accounted for $62.7 billion in sales in 2007.[245] Over 27% of firms in Information and Culture industries, and 24% in the Arts, Entertainment, and Recreational industries conducted online sales in 2007 — a number that is surely higher today.[246] Statistics Canada reports that in 2010 the Arts, Entertainment and Recreation industries contributed $11.3 billion to the Gross Domestic Product, while the Information and Cultural industries added $45.6 billion.[247] They also add well-paying jobs to the Canadian economy; Information and Communications Technology (ICT) workers, for example, earn on average $62 000 per year, 47 percent more than the average wage nationally.[248]

Content producers depend on the Internet to function as an open marketplace for promoting and profiting from their work. The Canadian science fiction show Sanctuary, for example, depended on an open Internet during its launch as a series distributed and sold online. The show attracted enough attention online that the SyFy channel acquired the rights to show the program on television. Sanctuary is now entering its fourth season. In a closed and controlled Internet, where users would have to worry about bandwidth caps, usage-based billing, and the throttling of content from producers who could not secure guarantees of fast access by ISPs, the chance for Sanctuary to succeed would be greatly limited. As Ferne Downey, President of ACTRA, the union of more than 21,000 professional performers in Canada, points out, cultural "work usually comes in big fat video files, it is the most likely target for being throttled by ISPs concerned about traffic."[249]

For this reason, high-profile cultural content creators and media entrepreneurs clearly understand that an open Internet is in their best interest and have urged policy makers to enshrine the principle of net neutrality in legislation. John Levy, Chairman and CEO of Score Media

Inc., an online sports entertainment firm, told the Report of the Standing Committee on Canadian Heritage that,

> We are very concerned about the ability of Internet and wireless service providers to act as gatekeepers, either because they are vertically integrated and have an incentive to prioritize their own content, or because they are partnering with major media players and providing preferred access. If we seek diversity of Canadian voices in new media, the Internet cannot become a pay-to-play zone[250]

A pay-to-play Internet refers to an Internet where providers create tiers of Internet service and then sell access to them. To play online, emerging content providers, independent producers, and users generating content, would have to pay more for access, promotion, or even fair treatment. This would limit diversity by incentivizing Internet users to consume certain types of content over others — namely, content for which they would not pay additional fees, or face slowed or stalled downloads or loading times. With many websites now incorporating news, information and entertainment content in video and other streaming formats, pay-to-play will necessarily limit Canadians' access to the fruits of our own culture.

Concern for a pay-to-play Internet comes from all parts of the Canadian cultural industries. At the CRTC's 2009 Internet Traffic Management proceedings, creator groups like ACTRA, the Canadian Film and Television Production Association (CFTPA), the Writers Guild of Canada, Directors Guild of Canada, Canadian Conference of the Arts, the Documentary Organization of Canada and Media companies such as Score Media Inc. and Pelmorex (owner of the Weather Network and MétéoMédia) all came out in support of enforceable net neutrality rules. An open Internet is vital for "our shared culture and our ability to have free and unfettered access to the most powerful tool for communication, information and entertainment we have ever known," stated Downey during the hearing.[251]

Outside of professionally produced content, Canadians increasingly contribute content to the Internet. Contributors of online content rose from 20.3% in 2007 to 26.7% in 2009 among Canadians who use the Internet.[255] In 2004, the Canadian Internet Project found only 1% of Internet users engaged in Creative Activities. Their 2009 survey found 20% of Canadians engaged in Creative Practices, like posting videos and photographs. This trend is likely to continue, as youth ages 12–17 were nearly twice as likely to post a video online and half had posted a photograph during the survey period.[256] These trends indicate the growing importance of user-generated-content to Canadian culture.

Internet openness accelerates these new forms of cultural production, such as digital video creation, podcasting, wiki writing, blogging, citizen journalism, social networking, and game modification. Creative participation functions as a key aspect of our social and cultural experience with digital media. User-generated websites allow citizens, audiences and consumers to use outlets of cultural expression and social communication that have reach and influence comparable to traditional mass media channels controlled by industries and professionals.

The Internet is an indispensable incubator for Canada's non-professional cultural producers. Indeed, websites like YouTube have functioned as training grounds for amateur cultural producers to transition into the professional world. Many contemporary Canadian celebrities have come to the forefront of pop culture through such UGC channels. Justin Bieber went from being a YouTube celebrity to a multi-million dollar pop artist (see the case of Pinicface from Figure One). The next

FIGURE ONE

USAGE-BASED BILLING AND CULTURAL PRODUCTION

Streaming web video is an emerging market for Canadian producers. Statistics Canada reports that in 2009 24.7% of Canadians used the web to access television shows and 19.8% accessed movies online.[252] The growing field has attracted a number of existing and new producers to start developing for the web. Picnicface, a sketch comedy group based out of Halifax, Nova Scotia, is one example of the size and possibilities of the new market. The group is a worldwide sensation and their videos have attracted over 20 millions views. The group has worked to cultivate its online fan-base, an approach that resulted in fans donating to help produce the group's first feature film movie, called Rollertown. The group has begun a sketch comedy series for the Comedy Network.[253] The success of this group and others depends on an open Internet with a growing audience for their shows and videos.

Usage-based billing, however, could stifle the success of Canadian Internet producers by shrinking the market and revenue. Zoom Communications, a film and web production company based in Alberta, writes on its blog, "from our perspective, the key concern is how the increased usage fees might curtail the audience for web-based video content. If users are forced to pay extra for every gig of data they use to stream or download video, it's a safe bet that they'll drastically cut back their video viewing habits."[254] Zoom Communications worries that the audience might tune out of web video just as the market emerges because usage fees might be too high or they might just not want to pay the cost to discover an unknown artist.

generation of media makers and cultural contributors will emerge through such channels. A limit on UGC resulting from closed Internet policies would put Canada at a disadvantage compared to countries that actively support non-professional cultural innovators.

FIGURE TWO

BRIDGING CULTURAL DIVIDES USING THE OPEN INTERNET

Poverty prevents Canadians from going online: 91% of households earning more than $95,000 connect to the Internet, whereas only 47% of households earning less than $24,000 connect.[257] Nevertheless, a number of innovative Canadian websites have begun reaching out and hosting content produced from typically underserved communities. Homeless Nation bills itself as "the only website in the world created by and for the street community."[258] The website allows members of the street community in Montreal, Saint John's, Toronto, Vancouver, and Victoria to post news, events, and videos online. Its outreach has earned a World Summit Award for e-Inclusion and Participation in 2009 and the site continues to be a powerful voice for the homeless in Canada.[259]

Location also prevents Canadians from going online: only 84% of rural communities have access to broadband Internet. Quebec, British Colombia, and Newfoundland also have rural broadband access levels well below the national average, and access drops below 60% for rural Canadians connecting in Canada's North.[260] But these rural and remote communities have also benefitted from new websites. The producers of the critically acclaimed Inuit-language *The Fast Runner* film trilogy have launched IsumaTV to "enable Indigenous people to express reality in their own voices: views of the past, anxieties about the present and hopes for a more decent and honorable future".[261] The site hosts over 2,000 web videos uploaded by First Nations telling their own stories. The site encourages First Nations youth growing up in rural and remote communities to learn and play with digital media. With any luck, it will be their stories we download in the future — but only if their content is given the same equitable treatment that is offered to bigger producers with deeper pockets. The Canadian Internet will not foster diversity if high-speed Internet access becomes an even greater privilege. We need a neutral Internet to ensure that these websites have a fair chance to reach a large audience of Canadians.

Given the centrality of the Internet to current and future cultural production by Canadians, it is vital that people have access to an open Internet that provides the foundation on which culture can be created, distributed, modified and enjoyed by content creators, media entrepreneurs and general audiences without the threat of discrimination by service providers.

SHARING CULTURE

The role the Internet plays in the distribution and sharing of content magnifies its importance to culture. The Internet is quickly becoming an important marketplace for Canadian content as Canadians use it as a source of knowledge and entertainment, accessing television programs, movies, radio shows and games online. But apart from accessing online content itself, consumers increasingly use the Internet to plan, schedule

and purchase offline cultural goods and services, with 48.8% purchasing travel arrangements, 35.4% ordering books, magazines, or online newspapers, 25.9% buying music, and 32.5% buying other entertainment products like concert tickets.[262]

Canadians are also becoming more comfortable with accessing media in digital-only forms. It is estimated that 57% of Canadians use the Internet to buy digital music, 8% of Canadians buy digital-only copies of video games, and 7% buy digital-only copies of software.[264] The success of popular avenues for accessing music (see Figure Three) supplemented by artists hosting (selling or gifting) music directly to fans and peer-to-peer sharing (Figure Four) attest to the increasing importance of digital distribution. Other media forms have followed suit: in Canada, movies can be rented

FIGURE THREE

ARTIST-LEAD MUSIC DISTRIBUTION

The Internet has been a boon for emerging Canadian musicians trying to promote and sell their work. CBC Radio has branched out with its Radio 3 channel that promotes up-and-coming Canadian artists. Beyond just the CBC, Canadian-owned online music stores have launched to connect emerging artists with fans. Zunior has been selling digital editions of Canadian music since 2005. The store uses the web to sell music and to promote new artists using free downloadable samplers, podcasts, and videos. Dave Ullrich, founder of the site and member of the band The Inbreds states, "[W]ith Zunior, the goal has been and still is to be fully representative of Canada and fully digital... It's been tough for a lot of people to understand why they should buy digitally but I think that's changing in the music marketplace, for sure... Music is a business even at the most modest level. Digital is a model that allows artists to get paid right from the first sale"[263] Zunior is just one example of how an open Internet helps emerging artists by connecting them with new fans and new revenue streams.

FIGURE FOUR

PEER-TO-PEER (P2P)

Peer-to-peer is a model of Internet communication where users share information directly with each other. The name comes from the defining principle of connecting all users as equal contributors, or "peers". The model differs from a traditional client-server approach, where a number of home users or "clients" download from one centralized server. P2P, on the other hand, distributes content among users and encourages them to share information. P2P applications are applications where users upload the same content that they download, creating a greater pool of shared content at a lower cost. This means that when Alice is downloading a file from Bob, Bob is simultaneously downloading a different file from Alice. A number of P2P protocols, or sets of standardized rules that govern communication exchanges over the Internet, have been developed.

Perhaps the most widely used P2P protocol is currently the BitTorrent protocol. This protocol facilitates inherently decentralized information exchanges. Clients use the BitTorrent protocol to download small parts of files from multiple sources and assemble them back into the original file. While downloading these bits of files, computers also share the bits they have downloaded with other users. An intermediary entity called a 'tracker' is used by the BitTorrent protocol to help clients searching for parts of a file find other clients who have those parts. The decentralized nature of the BitTorrent protocols makes it an extremely efficient method for individuals to distribute large files without incurring the heavy costs associated with hosting a server. In a client-server model, the host server must bear the entire bandwidth cost of transferring the file to a client. With BitTorrent, each client will take a small portion of that bandwidth cost.

or bought in digital form via the Cineplex Store, and Rogers On Demand, or streamed via Netflix. In turn, the producers of digital games are increasingly eschewing the packaged-goods retail model (and the costs of physical manufacturing) in favour of digital-only online distribution.

The reality of digital distribution is apparent in the breakdown of downstream data transfers in North America, which suggests that "Real-Time Entertainment" (which includes streaming video) accounts for 45.7% of downstream traffic, the largest category featured. When joined with P2P filesharing, with 13.2% of data consumption, 58.9% of total downstream traffic is based primarily on accessing audio and (real-time) visual media. That figure jumps to 83% when general web browsing (with its emphasis on written and static visual content) is added to the mix. This is before other practices of online cultural engagement are included, such as downstreamed social networking traffic and multiplayer gaming, at 2.4% each.[265] Digital distribution will only become more important as Canada moves away from analog over-the-air television broadcasting to digital and Internet broadcasting.[266]

Yet as more and more cultural goods get distributed digitally online, bandwidth threatens to become harder to access and afford. Major ISPs could target competitor's offerings by selectively slowing or stalling data transfers that compete with the online stores or even traditional broadcast offerings (See Figure Five on Vertical Integration). Such arrangements would create a two-tiered Internet, where ISPs would be able to prioritize their own network traffic or content over a competitor's.[267] Digital game developer Dan Scherlis, who worked on Massively Multiplayer Online (MMO) game Asheron's Call, suggests that such third-party intrusions can affect the viability of new ventures: "without net neutrality guidelines your ISP is free to shake down developers with access fees, stalling innovation and pushing smaller games out of the market entirely."[268]

FIGURE FIVE

VERTICAL INTEGRATION 2.0

Internet Service Provision has remained highly concentrated in Canada among incumbent telephone and cable companies. These companies have realized that the Internet will be the place most Canadians will go to find cultural content in the future, and they have begun to integrate special content offerings as value-added and managed services with their regular service provision. The move amounts to a new wave of vertical integration, where a few firms control crucial points of the supply chain of Internet content.

Vertical integration is where one company owns or controls a set of companies that supply each other products, such as where cable or satellite television distributors also own the television channels they distribute. The concept has a long history in the culture industries. For instance, for many years Canadian theatres were owned by American and British film production companies, making it almost impossible for Canadian feature filmmakers to get screen time in Canada. Because of the possibility of broadcast distribution companies favoring their own content over that of competitors, vertical integration between cable and television companies or telecommunications and television companies was illegal in Canada.[269]

Due to changes in ownership regulations in the 1990s, cable companies such as Shaw and Rogers became telecommunications providers and began offering telephone service. And telecommunications providers, such as Bell Canada and Telus, now distribute television programming. The next step in this concentration of ownership is vertical integration between these telecommunications content distributors and content providers such as television networks and newspaper chains.

Bell Canada's recent reacquisition of CTV and Shaw's purchase of the Global Television Network both illustrate this trend. Internet Service Providers like Bell and Shaw have a stake not just in what kind of Internet service Canadians have access to, but also in what kinds of content get distributed over their networks. There is concern that these big telecom companies might use their control over the Internet to prioritize and favour their own content, including their video-on-demand or IPTV services. Favouritism may take the form of de-prioritizing competing broadcast companies such as the CBC and independent video producers or transmission technologies such as BitTorrent and P2P, either through throttling or through charging additional usage-based fees for these services. Business moves like these stifle an open market for the next generation of content delivery, and hurt smaller producers who can more easily get access to an open distribution platform than to one controlled by big telecom.

ISP interference not only involves traffic shaping, but also bandwidth caps and usage-based billing. Since music, movie and video game downloads can frequently be large data files, it is not uncommon for a single high-definition film or video game to consume between 10–20 GBs, a large percentage of the monthly bandwidth allocation under some Canadian ISPs. Excessive charges on top of existing access costs discourage emerging competitors, like Netflix and the CBC's own on-demand video website. Their subscription fees could be compounded by added metered-billing overcharges should a user's film consumption patterns differ from the determined limits of Internet service providers. Other over-the-Internet service providers could suffer as well.

Shaping the traffic flowing through BitTorrent threatens its efficiency as a distribution channel, especially a channel that competes against ISPs' services. Speaking at the 2010 Canadian Telecom Summit, David Purdy, Vice-President of TV/Video Product Management for Rogers Communications admitted, "there is some benefit in managing our networks just in terms of cutting down P2P traffic."[270] Traffic shaping, in other words, stifles BitTorrent, and BitTorrent competes with Roger's video services. This discrimination threatens to impede P2P streaming before it can be brought to market (see Figure Five).

Groups such as ACTRA, the Documentary Organization of Canada (DOC) and the CFTPA spelled out the importance of P2P to creators at the CRTC's Traffic Management hearing (CRTC 2008-19). DOC noted that,

> The Internet has already become an integral component of the way documentary and independent film is distributed. This includes both the emerging or activist filmmaker utilizing the Internet to self distribute their work, as well as the established or veteran filmmaker employing the Internet to supplement traditional methods of distribution, including DVD sales, as a mechanism for self promotion, word-of-mouth advertising, and to reach as broad an audience as possible. The technology most often used to realize these goals includes peer-to-peer (P2P) file sharing, using a distribution protocol known as BitTorrent[271]

BitTorrent allows the transfer of huge amounts of data at a low cost yet it has been especially targeted by ISPs because, according to Bell Canada, it generates a "disproportionate amount of bandwidth compared to other types of traffic" [272] (See the Technical Section for an in-depth discussion of Application Bandwidth Usage)

FIGURE SIX

REAL-TIME P2P STREAMING

Traffic shaping threatens Canadian participation in and access to future innovations in cultural distribution. Currently, much of the content download by P2P users consists of archived music, videos and software — users download a complete copy of an archived work before they begin enjoying it. As a result, download speed and time can be of arguable importance. Most major ISPs deprioritize BitTorrent traffic under the premise that the timely delivery of your BitTorrent content is not as important as the timely delivery of media content that they own. While arguments premised on the assertion that ISPs can appropriately decide for consumers what is time sensitive are controversial (see the Technical Case for Openness section), P2P content is now just as time sensitive as other streaming content.

The P2P-Next consortium, a group including Wikipedia, has produced a working "swarmplugin player" for Real-Time P2P streaming of audiovisual content.[273] This content, unlike archived content, does not need to be downloaded before it can start playing — rather, it streams to the user's computer and begins playing within moments. This technology can also be used to stream live events, like a college basketball game, in real time without the need for the team to set up their own streaming facilities.

Each participant in the 'swarm' of users provides an amount of upload capacity to other users also watching the same stream. What previously required a centralized distribution system, much like a call centre, now becomes much more like a phone tree, with each user passing along information to the next as it is received. The originating source only needs to talk to a few computers directly, and the swarm will then replicate the data to all those watching – and all within a very reasonable delay.

Indeed, Wikipedia hopes to use P2P streaming to deliver video content[274] — this may become the standard video distribution protocol on the Internet if ISPs do not interfere.

Real-time use of P2P runs into problems when some P2P usage is degraded and deprioritized by ISPs. The degraded bandwidth for P2P use provided by ISPs often has limits that can fall below the minimum bandwidth required to maintain a live stream. The user perceives this as a stuttering of video and may blame the content provider, and the technology — changing the competitive differential between this peer-distributed video and traditional or "facilities-based" distribution methods.

Unfortunately, while Canadians wait for the enforcement of net neutrality, the ISPs degradation of BitTorrent traffic is preventing online service innovators and content producers from successfully developing and deploying P2P live-streaming technologies.

Not only does throttling BitTorrent affect new forms of film distribution, the practice also contradicts public policy. Public funds support online independent media and, at the same time, telecommunications policy allows ISPs to prevent media makers from using distribution tools, like BitTorrent. CBC's hit show Canada's Next Great Prime Minister, for instance, attempted to distribute episodes over BitTorrent. The distribution model ended in disappointment as home users complained that their ISP throttled their downloads. In short, Canada's public broadcaster could not innovate because of the traffic management practices of the major Internet Service Providers.[275]

Such content prioritization practices have drawn the ire of online retailers, creators and cultural groups who argue that all traffic management should be transparent; there should be no discrimination between wholesale and retail clients, between end users, or between different applications or content; and the only exception for preferential access should be for any emergency service authorized by public authorities. Professional content creators are especially concerned about the potential for ISPs to discriminate against content that competes with the ISPs' own content services. They do not want to take the open platform of the Internet and turn it into something that replicates the model currently found in television broadcasting, where a few large companies control access to the medium. During the CRTC's "Diversity of Voices" proceedings, which examined media consolidation in Canada, opponents of the current media structure argued that vertical integration and overall market concentration are threats to diversity and homegrown cultural production. The Canadian Conference of the Arts (CCA), Canada's oldest and largest arts advocacy and cultural policy development organization, spoke directly to the challenges of concentrated media ownership, and particularly concentrated distribution. In its final submission to the proceedings, the CCA writes "we have over the years heard many promises about the positive benefits that more concentrated ownership will bring to our broadcasting system. Unfortunately, almost a century after radio broadcasting began in Canada, and half a century after television broadcasting began, we are no closer to a broadcasting system that is truly predominantly Canadian"[276] In additional comments to the proceedings, the CCA notes "[a] marketplace that is not competitive because it is dominated by a small oligopoly of owners, cannot and will not achieve society's goals of diversity in programming…The CRTC's regulations and policies must address the non-competitive nature of our broadcasting 'marketplace' by introducing and enforcing measures to ensure there are diverse owners, strict rules on larger players, and limits to cross-ownership interests."[277] Though moving distribution online to a totally open platform will challenge those producers who have benefited from the traditional broadcast system, the alternative — an Internet that is pruned or curated by a few large

companies — raises even more troubling questions about who will decide what to include and exclude.

Pruning the web will kill the roots of the current distribution ecosystem that provides an exciting alternative to the traditional model, which, as groups like the CCA point out, has failed Canadian culture. In 2009, Canadian broadcasters spent over $596.6 million on foreign drama and comedy, more than five times the $77.4 million spent on Canadian-produced drama and comedy.[278] Clearly, allocating the decision about what to broadcast to big private Canadian media companies has not resulted in the prioritization of Canadian content. At the very least, an open Internet might provide a "long-tail" distribution model that maintains space for small, Canadian producers.

The question of an open Internet comes at a time of great diversity in the means of distribution over the Internet. People-to-people networks co-exist with emerging artist-run distributors, which in turn compete with traditional distributors going online. An open Internet celebrates this diversity and choice. Yet this diversity may be undervalued or lack support in the future in Canada as ISPs increasingly develop their own ways to regulate the "sharing" of Canadian culture — ways that put their interests above those of Canadians.

INTERACTING WITH CULTURE

Online spaces and tools are not only used to create and share culture, but also to interact with it. The Internet has proven to be one of the central ways Canadians engage with all sorts of cultural goods and practices, and an important social tool for Canadians, who rely on it to communicate with friends and family. Email is popular among 93% of Canadians online and 13.8% have used the Internet to make a phone call.[279] Recent immigrants to Canada are even more likely to communicate online than people born in Canada — Internet communication reached 56.0% for recent Canadian immigrants 25–54 years old, compared with 48.1% for Canadian-born individuals. The Internet is an essential resource for keeping in touch with distant family and friends. Senior Canadians most frequently use email to communicate with family members, and most report that this has improved their connections with family. Just over half of seniors also search online for

health information. And online games are also a popular online activity for seniors.[280]

Framing growing bandwidth usage as 'out of control' or 'excessive' devalues the public interest in the Internet. This is true on an interpersonal level, where Skype and other video chat applications are increasingly helping transform long distance communication. This is also true for consuming cultural products like films and games, where video streaming services help transform the way audiences access movies and television shows, and online multiplayer games add new interactivity and community-building potential to gaming. Bandwidth intensive innovations such as video-conferencing, streaming, and cloud-computing are likely to become staples of the Canadian Internet experience in the near future, but will require an open and fair Internet policy to function in an equitable manner.

Heavy Internet users are knowledge trendsetters that have learned a variety of ways to use the Internet to interact with culture. As people gain more experience with the Internet, their usage rises. People who have been online for more than five years engage in twice as many kinds of Internet activities as those who have only been online for one year, from 6.2 activities to 12.6 activities.[281] ISPs should recognize the trends toward greater bandwidth usage and begin to put forward sensible solutions that do not penalize advanced users.

It is important to keep in mind that the expanding use of the Internet not only includes new kinds of interactions, but also new means for connection. 41% of Canadian households now have more than one computer, 71% of households have a cell phone, and 41% of households also have at least one gaming console.[285] Each of these devices now connects to the Internet, which, in turn, changes regular online interactions. For example, net-enabled

FIGURE SEVEN

OPEN SOURCE MOVIE PRODUCTION?

Brett Gaylor illustrates how the Internet fosters new forms of cultural production. His film Rip!: A Remix Manifesto attracted international acclaim, not only for its engaging discussion of copyright, but also for its innovative audience engagement.[282] Gaylor invited the audience to help collaborate to produce the film and then invited fans to remix their own versions of the film. Remixes were made possible through the Open Source Cinema website that allowed users to submit more footage and mixes.[283] He continues to promote the web as a new platform for creators with the Web Made Movies project. It brings together Mozilla, the National Film Board, and the School of Computer Studies at Seneca College in Toronto to build open tools for the production of rich media experiences using the web and video.[284] These made-in-Canada developments for video production and audience interaction will wither if incumbent media firms are able to throttle them, re-wiring the web to function like a television, where audience interaction is limited to the clicks of a remote control or a keyboard.

digital games exemplify the changing nature of Canadians' online interactions. It is estimated that 85% of youth 12–17 play digital games in general, while 43% of Canadians play games online.[286] This multiplayer online play (where players use Internet connections to play with or against others) is a significant part of the contemporary gaming experience, and while the amount of data transferred is variable, network conditions are all important, given that "the fast-paced nature of online gaming renders even a momentary traffic disruption or data loss blatantly obvious to a player."[287] Internet traffic shaping that trivializes such content challenges not only individual users of game products, but also the potential social interactions that often accompany online play.

Traffic shaping already hampers Canadians' ability to play online. Rogers Internet, for example, admitted to throttling the popular MMO World of Warcraft (WoW). WoW is an Internet phenomenon with more than 12 million subscribers as of October 2010,[288] and it uses BitTorrent to deliver content (yet another example of the potential offered by the protocol). In March 2011, Rogers admitted to throttling WoW. The issue arose because the game uses the BitTorrent protocol, and is thus affected by Rogers's ITMPs that target P2P traffic. It claimed that such throttling was accidental, only active when P2P was enabled in WoW's control panel, and that the issue should be resolved within months. However, Rogers' filters ended up affecting the quality of the gaming experience itself even when P2P was disabled, making the game all but unplayable for many WoW users who had Rogers as their ISP, as they experienced too much in-game delay.[289] In her letter of complaint to the CRTC, WoW user Teresa Murphy argues that "By the time Rogers gets around to fixing this issue in June [2011], it'll have been active for 7–9 months depending on the customer's area. This is completely unacceptable." According to the letter, Rogers's ITMPs are also affecting other online games and applications and, as a result, impeding Canadians' ability to enjoy online gaming.[290]

Opaque usage-based pricing schemes would stifle experimentation. In a rapidly changing media environment, our daily interactions with digital culture are an experiment in how to use the Internet. People try new applications, download new programs, and learn from a variety of

sources. Current access does not charge people when they try something different. A move to usage-based billing would charge people for experimenting. “If you don't know whether your next click will cost you,” noted Canadian science fiction author and copyright activist Cory Doctorow (2009) points out, “you will become very conservative about your clicks.” It is difficult to know how much bandwidth one will use in advance. Usage-based billing penalizes people trying something different. Billing for usage is particularly problematic because bandwidth, such as megabytes and gigabytes, mystifies the average users and appears as an arbitrary pricing model. Doctorow continues, “Imagine if a restaurant billed you by the number of air-molecules you displaced during your meal, or if your phone bills varied on the total number of syllables you uttered at 2dB or higher.”[291] Usage is not simply the sum of downloads, but the result of a rich and unpredictable interaction with many cultural goods and cultural practices.

Greater complexity in Internet service and billing may discourage low-income Canadians from connecting to the Internet. Dailey et al. interviewed 171 community members and others in chronically underserved communities for the FCC. They found that although price for broadband service is the dominant obstacle to adoption in low-income households, it is not the only factor limiting home broadband adoption. Multiple, overlapping challenges confront users, including skill, language, problems with providers, and overburdened public access points. This is of critical importance where the Internet is needed for employment, as well as other activities such as shopping, education, engaging with government and community services, and communicating with family.[292] Costs for premium Internet service may further disadvantage those who already encounter obstacles to participating online.

The public interest lies in a neutral, open Internet. Only an open Internet can adapt to the ways Canadians interact with culture, rather than forcing Canadians to adapt to artificial limitations in the speed or accessibility of certain types of online culture. Use of the Internet has changed dramatically since its introduction in the late 1990s, often in ways that could not be predicted. Change has often come without the support of established industries. An open Internet facilitates the dy-

namism of Canadian digital culture, dynamism that is now, more than ever, essential to its survival and flourishing.

CONCLUSION

An open Internet policy ensures that Internet access does not unduly influence Internet usage, especially if this influence favours private business interests over the public interest. Arguments against an open Internet may frame traffic shaping as a technological or business necessity — we challenge such arguments in the other sections of this report, and also assert that the social, cultural and political consequences of that throttling must be paramount in the minds of regulators and policy-makers.

For ISPs and Internet regulators to discriminate against certain avenues for accessing cultural content or participating in online social practices, for them to influence or determine a "proper" method for culture to circulate, contravenes the freedom of expression, diversity, and innovation that are necessary to enable Canadian culture to flourish. The goal of Canada's digital policy should be to build and expand networks that facilitate the content and practices of contemporary online culture, not attempt to shape, prevent or punish emerging behaviours that do not fit with old market directives. Let citizens drive the structure of services supplied, let them freely create and share content, as they engage in the kind of cultural practices that are increasingly central to Canadian life.

THE OPEN INTERNET: OPEN FOR BUSINESS AND ECONOMIC GROWTH

The Internet is widely regarded as one of the modern era's greatest engines of economic growth and innovation. Ensuring ubiquitous, affordable, and open access to the Internet across all social sectors supports and promotes economic growth. By providing a reliable platform for applications development, communications improvements, and content distribution, we create the potential for greater efficiencies and growth in business-to-business, business-to-consumer, peer-to-peer, and consumer-to-business transactions.

In this section, we delve deeper into the essential role that the open Internet plays in the Canadian economy as an engine of innovation and growth. The unique characteristics of the Internet have allowed Canadians to create some of the world's leading websites and applications. We argue that when businesses and citizens are forced to pay more for Internet access in Canada, or face other restrictions on use — espe-

cially compared to our global counterparts — we have fewer opportunities to invest in and develop the kind of innovations that make our economy flourish.

In Section One, we argue that co-invention and web-based entrepreneurship flourish best in neutral networks and that the Internet's innate openness enables a democratization (i.e. of access and success) that fosters creativity, competition, and innovation. In Section Two, we argue that Canadian Internet Service Providers (ISPs) are transitioning towards technical architectures that discriminate against and seek to control certain applications, and we warn that this gradual enclosure of the Internet threatens to restrict user access, choice, and innovation, and thus threatens to reduce the value of the Internet overall. In particular, we discuss how ISPs use the practice of bandwidth throttling of specific applications (e.g. P2P file sharing) and usage-based pricing to discriminate against certain types of online activities in an effort to centralize control. Finally, we conclude by emphasizing that ISP interference undermines the core values of equality and neutrality operating at the heart of the Internet and that this interference threatens the Internet's invaluable role as an engine of innovation and economic growth.

The ability for Canadians to innovate is more and more central to our economic well-being and competitiveness. As we explain below, the open Internet is an essential engine of innovation; without a fast, ubiquitous, and open Internet, Canada will continue to fall behind in economic productivity. E-commerce, the information and communications technologies (ICT) sector, and increasingly, traditional businesses, depend heavily on open access to the Internet. Any barrier to Internet use is a barrier to business development in general.

THE INTERNET AS AN ENGINE OF INNOVATION

CO-INVENTION & WEB-BASED ENTREPRENEURSHIP

The rate at which the Internet can contribute to the economy is generally dependent upon the rate of co-invention, the development of novel content, applications, and transit techniques. If such co-invention is limited through forms of centralized control that discriminate against innovative uses of the Internet, then the Internet's general positive impact on economic growth will slow.[293]

Many of the most celebrated online innovators driving the co-invention that has contributed to the pervasive economic impact of the Internet were not well resourced from the outset. These innovators succeeded because they could rely on a neutral platform to launch and further develop their services. As World Bank researchers Qiang, Rossotto, and Kimura note, the Internet enables "individuals outside the boundaries of traditional institutions and hierarchies to innovate to produce content, goods, and services."[294] The structures of the Internet are what have created this potential for innovation: its decentralized and modular architecture means that developers can work with a single component without needing to coordinate with, or get permission from, network operators. The ability to develop modularly is possible with the Internet because power is diverted away from those who operate the network to the developers of different modular components, like individual applications and services.

To date, the Internet has predominantly operated as an open, non-discriminatory platform — otherwise known as a neutral network — that grants full access to everyone. This framework possesses an 'edge orientation,' enabling complex operations to occur at the edges of the network while maintaining the relative simplicity of the Internet core itself. Those working at the edges of the network have been able to innovate without permission; Tim Berners-Lee, a pioneer in the development of the Internet, did not have to ask network operators whether he could create and release his software that enabled the World Wide Web (HTTP protocol). Berners-Lee is now a vocal supporter of maintaining this basic architecture.[295] Other examples of innovation enabled at the edges of the Internet include search engines — most notably, the one created by college-aged inventors that has since become Google. Two prominent Canadian projects that benefit from the Internet's edge orientation are NowPublic, one of the world's leading citizen journalism websites, started in Vancouver, and Hootsuite, one of the world's most successful Twitter applications, created by the Canadian startup Invoke Media.

First-generation Internet applications, such as Google, competed and succeeded based on their ability to satisfy a user need. Bound by common carrier provisions — which require ISPs to charge fair prices, serve their customers without unreasonable discrimination, and provide service "with adequate care, skill, and honesty"[296] — network owners could not discriminate against this first-generation of new services. Emerging Internet businesses have relied on a neutral network to lower start-up costs and compete with older, larger, and more established companies online. An economy of digital abundance and platform neutrality — where the marginal costs of service delivery and copying content border on zero — encourages exploration and experimentation. Such an environment has allowed businesses like Google, Facebook, and Canada's Hootsuite to become hugely successful.

LEADING USERS AND STICKINESS

For Canadians to be leaders in the global digital economy, the Internet must enable and facilitate the actions of 'leading users.' Eric Von Hippel, Professor of Management of Innovation and Head of the Innovation and Entrepreneurship Group at the MIT Sloan School of Management, recognizes such users as possessing two key characteristics:

> They are at the leading edge of an important market trend(s), and so are currently experiencing needs that will later be experienced by many users in that market. (2) They anticipate relatively high benefits from obtaining a solution to their needs, and so may innovate.[297]

The Internet enables a democratization of innovation by reducing the costs of entry and extending the possibilities of success. There is a wider diversity of leading users than there are large companies, and their addition to the pool of potential innovators extends prospective research portfolios. If the neutrality of the network is reduced and discrimination widely embedded throughout the Internet core, then ISPs will be in a privileged position. In turn, innovation will suffer because those most capable of innovating will be at a disadvantage.

A key reason why large firms and ISPs are less apt than small businesses and innovators to detect new trends and opportunities is related to 'information stickiness.' A unit of information that is sticky is one that is hard for an information collector to transfer from its point of origin to a specified location in a usable manner. Information is also sticky when it is hard to absorb into existing knowledge pathways. In other words, firms may have neither the technical expertise to understand the information, nor the required channels to disseminate information to corporate divisions that can act on it.[298]

Stickiness creates information asymmetries — asymmetries that innovators often draw upon more efficiently and at lower costs than large companies. In the case of innovative Internet technologies, stickiness is often related to an awareness of which application or content end-users desire (or will desire) and this awareness — for example, the realization that people will love YouTube, eBay, and/or Facebook — is largely dependent upon localized knowledge resources that the intelligence and R&D structures of large firms lack.[299] Those who innovate to create the next Big Thing are often leading users or individuals who push the envelope and think outside the box. If large companies' parochial understandings of market desires limit imagination in certain countries — not only by limiting access to capital but also by restructuring the very nature of the Internet as an imaginative platform — other countries that discourage such technical and cognitive restrictions are more likely to become the birthplaces of future Big Things.[300]

Since its inception, the Internet's guiding values have been based on its openness to accept almost any kind of application and device, and its guarantee of neutrality for all traffic transmitted between ends of the network.[301] The engineers and regulators responsible for maintaining the Internet have historically safeguarded these values.

As we will argue in the following sections, in order to be competitive in this novel and revolutionary technological space, Canadian innovators must know that they can compete on the same playing field as their international counterparts.

CURRENT THREATS TO INNOVATION: CENTRALIZING CONTROL AND THROTTLING

Infringing upon the ability of leading users and innovators to decide how to use the network would significantly reduce the value of the Internet.[302] Integrated architectures are characterized by the ability to identify and control applications, protocols, and physical connections to the network.[303] As incumbent ISPs transition towards integrated architectures, they challenge the decentralized nature of the Internet and threaten the capacity for users to choose how to use the network. And this centralized architecture is what ISPs in Canada are undoubtedly moving towards as they deploy technical subsystems that discriminate between different applications.

In the absence of an open Internet (bolstered by strong network neutrality protection) the battle for success over the next generation of Internet applications threatens to be reduced to a bidding war. Network owners can pick and choose winning applications and communications standards based on their developers' ability to pay for transit rather than market competition. For example, the dominant online phone provider (using Voice Over Internet Protocol, or VOIP; see Figure One), operating in a discriminatory Internet regime could become the market leader not because of its competitive or inventive offerings, but because it has paid the network owner for stable Internet access to consumers.

While the first generation of Internet applications competed on a level technical playing field, network owners today are taking aim at the next generation of user-generated applications on the Internet. ISPs want a slice of content-owner profits and are acquiring technology that will allow them to transition from their

FIGURE ONE

VOIP: ENABLING CANADA TO COMPETE

Canada's Voice Over Internet Protocol industry is made up of large VOIP providers, such as Primus and Vonage, and several small VOIP providers. While the smaller companies lack the developed customer base of larger VOIP providers, they provide competition in pricing and product features. For instance, Unlimitel, an Ontario-based VOIP provider, competes by offering 'no commitment' plans, in contrast to larger companies like US-based Vonage, which requires subscribers to commit to monthly plans.

The open Internet is critical in the VOIP industry. Under a discriminatory communications regime, an ISP could require those who run VOIP services to pay a greater premium for a faster connection or superior Quality of Service. Such a requirement would radically alter the relationship between companies like Vonage and Unlimitel. Rather than competing based on pricing, product features, and customer service, these VOIP companies would compete based on which firm could pay the highest ISP premiums. In such a competitive landscape, the market shift for Unlimitel would be significant; that is, if Unlimitel could not afford the premium connection, it would be forced to remain on a basic connection that could not handle the demands of providing VOIP service. As a result, this pricing would degrade Unlimitel's quality of service, while Vonage's would improve or remain the same.

The threat of a discriminatory Internet puts Unlimitel — as well as other potential small businesses and startups that are reliant on the open Internet — at a disadvantage to existing, better-resourced, and possibly foreign competitors. The open Internet empowers Canadian-based online service providers to compete against their bigger, foreign rivals.

current position as *gateways* to the Internet, into the more powerful and controlling position as *gatekeepers* to digital platforms.

Several Canadian ISPs are actively intruding into the 'value chains' — that is, all of the links in the conceptualization, financing, production, distribution and consumption of a product — of application developers and content providers. At present, network owners are paid for the use of their pipes at both ends — by the consumer for his/her residential connection at one end, and by the content provider's web hosting provider at the other. Network owners are unsatisfied, however, with the return on the straight sale of bandwidth. Instead, they are beginning to create a third revenue stream by withholding or limiting access to Internet subscribers or imposing new Internet usage fees on users. If ISPs are allowed to discriminate, priority access will go to the content provider with the deepest pockets, and the rest will be left to squeeze into whatever remaining bandwidth exists.[304]

Under such a discriminatory access regime, network owners like Bell, Shaw, and Rogers will force content providers like Google, NetFlix, and Wordpress, along with application developers, to pay a fee to access subscribers — a price that has nothing to do with how much bandwidth the content provider uses and everything to do with how much capital they have relative to other content providers. From the ISP's perspective, this service would materialize on the basis of an artificial scarcity of bandwidth where only the very well financed content providers can ride in the 'fast lane.' If this business model were to take off, the current low cost of equal entry into Internet business would cease to exist.

BANDWIDTH THROTTLING AS A THREAT TO INNOVATION

Canadian ISPs currently discriminate against particular applications, instead of behaviors or technical conditions in the network. This means that some application developers and businesses are inherently at a disadvantage — especially those that use maximally efficient means of transmitting data, such as peer-to-peer (P2P) data sharing systems, or, innovative forms of data transmission where users can share data directly with each other instead of going through a centralized server. The bias against services like P2P requires innovators to either invest

FIGURE TWO

WHY DO ISPS WANT TO CENTRALIZE CONTROL AND DISCRIMINATE AGAINST CERTAIN SERVICES?

Incumbent ISPs are motivated to centralize control because of the Internet's transformative economic impacts. ISPs' focus on "pursuing innovations that fit their resources, their capacities, and their economic position" means they do not innovate as fast as the mass of non-incumbent innovators.[305] Because many prospective research portfolios will not align with the big ISPs' own goals and ends, they miss and will continue to miss opportunities.

The past has shown us that big ISPs typically employ excellent network engineers who can broaden the scope of their networks, but that these same ISPs are less apt at identifying how users will adopt the network, the reasons behind that adoption, or the value users find within the network itself.[306] What users, on the other hand, seem to recognize, is that fast data speeds facilitate previously unthought-of applications and content provision types.[307] An incumbent business is more path dependent, and therefore less attentive to technologies and processes that are incompatible with its "capabilities at the technological level, at the organizational level, or with respect to its economic position in the market."[308]

Big ISPs are further threatened as their complementary products and services (e.g. TV content broadcasting, telephone service) are threatened by disruptive Internet services that restructure those product groups' basic profitability (e.g. streaming video services and VOIP reduce costs of business and thus may not generate as much profit for ISPs as their traditional broadcasting/phone services have).

Incumbent ISPs are at a particular disadvantage when they rely on flat-rate pricing strategies. Under flat-rate strategies, significant changes in Internet usage (e.g. adoption and high usage of streaming video) that reduce profitability of complementary products (e.g. broadcast television) are not balanced by increased Internet transmission revenues.[309] In other words, ISPs do not make more money as users increase their bandwidth use. This gives big ISPs an incentive to push for different pricing schemes, such as usage-based billing, where users are charged more for using more bandwidth over a certain monthly cap. This type of billing scheme, however, discriminates against some of the most innovative uses of the Internet that require significant bandwidth.

substantial amounts into bandwidth and server infrastructures, or be resigned to providing goods and services in a delayed fashion that can weaken the overall value of those goods and services.

As discussed in "The Technical Case for Openness," Canadian Internet traffic is widely throttled by ISPs for extended periods of time, with throttles varying in effectiveness and accuracy.[310] The imprecision of these throttles limit businesses' and innovators' knowledge of the actual risks of operating online; it is somewhat unclear whether their data traffic will be throttled or not. As noted by the Free Press in their filing to the FCC, innovators and the investors supporting them want to be confident that their products will not be "stifled by the activities of the network operators (often competitors, through vertical integration of content, applications, and services) who control end-user Internet access service." Investors in innovative products want to know that "the

success or failure of their investments lie in the hands of the developers themselves, and not gatekeepers poised to stand in the way".[311]

The actions of ISPs are especially problematic because the end-users are rarely aware of the sources of slow Internet connectivity — that is, "a network provider can exploit customers' incomplete information about the true source of poor performance."[312] The attitudes of Canada's dominant carriers indicate a callous indifference towards those wanting to use the Internet for innovative content distribution systems. This is perhaps best exemplified in their treatment of P2P technologies. Such technologies grant market entrants a way of disseminating content easily and quickly without the need for expensive servers, expansive data transfer volumes, or other elaborate telecommunications infrastructure. Instead, content distributors can generate content and make it available to prospective consumers, but the discriminatory throttling of the P2P distribution channels hinders these distributors' competitive edge in the market. At the moment, the CRTC has not acted to stop such discriminatory treatment of data.

Under the current regulatory regime, innovators must determine whether their application, content distribution choice, or other innovation is 'time-sensitive' or not, and then determine how ISPs will interpret the CRTC's traffic management ruling. In the e-commerce field, convenience is a key enabler (see the "Special Section on E-Commerce" for more information): when potential customers are prevented from quickly accessing a business's goods, this delay greatly reduces the convenience of the transaction for the customer, and thus threatens the financial success of the offering.[313] As such, timing is of paramount importance for online commercial transactions — the delay of the good(s) decreases the value and the practicality of selling the good(s) in question.

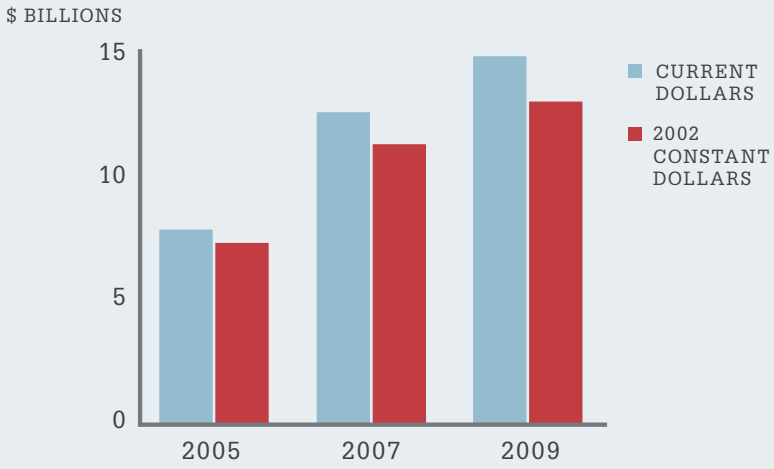
E-COMMERCE AND THE OPEN INTERNET

The value of e-commerce and online shopping is a critical part of the Canadian economy. Since 2001, Internet sales have increased steadily as Canadian businesses and citizens use the Internet more often to sell goods and services, and to obtain product information. In 2009, around 39% of Canadians 16+ used the Internet to place over 95 million orders. This was up 7% and 25 million orders from 2007. Similarly, 51% of Canadians between 16-34 made an online purchase of a product in 2009, equating to $15.1 billion worth of goods and services — an increase of $2.3 billion from 2007.[314] The increase in value of goods and services purchased online was both a result of more shoppers and higher-order volumes.

Further, 69% of those who window-shop online reported that they subsequently made a purchase from a store.[315] Online shopping plays a fundamental role in the sales of many brick and mortar businesses, particularly those selling electronics, appliances, furniture, clothing, jewelry, and accessories.[316]

Ensuring that Canadian businesses are able to utilize online tools to develop high quality customer relationships is critical in an online economy. Constantinides, Romero, and Boria emphasize that Web 2.0 tools permit interaction between e-tailer personnel and customers. Such interactions "can enhance customer confidence and trust (e.g. live agents, virtual communities) and improve customer service (e.g. chat or live agents, VOIP applications). At the same time, the shopping experience is improved both by richer stimuli and by different tools that allow a more enjoyable and easier interaction with the web site."[317]

VALUE OF ONLINE ORDERS



Source: Statistics Canada. (2009). E-commmerce: Shopping on the Internet (2005-2009).

Retrieved from http://www.statcan.gc.ca/daily-quotidien/100927/dq100927a-eng.htm

Yet it is not just the monetary value of e-commerce that makes it a pervasive force in the online environment. E-commerce is not exclusively about sales, but more broadly concerns the exchange of values between businesses and customers, and this exchange is made possible with Internet use. That is, e-commerce successfully acquaints customers with the offerings of brick and mortar businesses (i.e. businesses with a physical presence, like a store) and complements traditional shopping — as demonstrated by the 52% of Canadians who used the Internet to "window shop" in 2009.

Discriminatory practices affect businesses of all types, but educational, cultural, arts, entertainment, and recreational industry sectors may be disproportionately impacted, given their often-limited resources for online commerce and branding. If we

keep in mind that e-commerce is about more than just sales (in that it is about enhancing value propositions across any division of a business using Internet-enabled systems), the e-commerce activities of retail, trade, transportation, warehousing, and manufacturing industries may also be negatively impacted by discriminatory treatment of their traffic. Given the importance of on-demand supply chains, the inability to pay ISPs for rapid data transit pertaining to inventory queries and shipping orders could have adverse consequences for smaller firms within each of these industries.

A tiered Internet, that degrades access to retail goods, customer services, or communication tools, would impact sales, trust, and brand effectiveness. Under a tiered Internet infrastructure, restricted access to content and services will reduce incentives for businesses to transfer their services online, especially when this tiered system discriminates against the key tools they depend on to develop and spread brand awareness and build consumer trust. Such a discriminatory digital communications regime would have the effect of reducing Canadian businesses' productivity in the marketplace and eroding their ability to compete against companies in other jurisdictions that enjoy the benefits of non-discriminatory Internet infrastructure.

Economic activity has been steadily moving online. Businesses large and small have and will continue to benefit from the operational efficiencies and opportunities for innovation that the Internet offers, but any interference with the fast and secure exchange of information online will negatively affect the competitiveness and profitability of Canadian businesses, and the Canadian economy in turn.

Innovators should not have to worry that ISPs will discriminate against their chosen means of making products and ideas available, based on an ISP's identification of these means as 'problematic' (i.e. not cost-effective for the ISP). Small businesses, innovators, and Internet users should be the ones to decide what constitutes non-time sensitive traffic, rather than the ISPs that lack any meaningful investment in the success or failure of Canadian entrepreneurs.

As it stands today, no business of any size is guaranteed fair treatment of their data traffic by Canadian ISPs. Entirely legitimate uses of P2P technologies abound: CNN relied on P2P technologies to stream President Barack Obama's inauguration, and Blizzard Entertainment (the creators of the popular World of Warcraft video game franchise) uses P2P for distributing game patches.[318] One infamous, high-profile example of throttling P2P in Canada occurred when the CBC attempted to disribute episodes of "Canada's Next Great Prime Minister."[319] Even when using P2P in a legitimate manner, businesses cannot guarantee that ISPs will treat their data fairly.

ISP interference undermines the basic networking logic of equal participation operating at the heart of the Internet. The result of such interference is an incremental closing of Canada's Internet, and this

FIGURE THREE

THE OPEN INTERNET AND VIDEO GAME DEVELOPERS

The open Internet plays an important role in the video game industry. The Canadian gaming industry is among the world's largest, placing just behind Japan and the United States.[320] Ubisoft, a Montreal-based company, is a market leader, developing games such as Assassins Creed and Splinter Cell.

For video game developing companies like Ubisoft, latency times are critical to the multiplayer gaming experiences. The multiplayer function is a key element in most games released today and thus traffic delivery is essential to proper functionality. Delays in delivering traffic that result from a discriminatory Internet structure will negatively impact a game's playability and create unfairness between competitors.[321]

Given that degraded or non-functioning multiplayer functionality can significantly threaten a company's ongoing presence in the market, if traffic discrimination were to expand, Ubisoft and other gaming companies would need to divert resources away from the research and development of innovative games to address latency issues — for instance, paying ISPs to maintain present levels of service.[322] Failing to do this would undermine the community-related benefits of online gaming, thereby reducing product attractiveness to consumers and weakening sales in turn.

insidious enclosure endangers innovation and weakens the competitiveness of those small and large businesses that would operate in Canada.

THE WAY FORWARD: PRESERVING THE OPENNESS OF THE INTERNET

In this section, we discuss the lack of competition in the telecommunications market within the context of service discrimination. We argue that the industry's traditional means of securing profit clash with user freedom and subsequently destroy what users value most about the Internet. Next, we argue that a neutral, affordable Internet is key to the success of innovators and entrepreneurs. And lastly, we highlight how Canada has fallen behind in broadband development globally and argue that Canada's weak digital infrastructure is a key challenge to investment. Subsequently, we argue that Canada needs a digital policy agenda that guarantees the neutrality and affordability of the Internet in order to encourage investment and advance economic growth more broadly.

THE SPECIFICITIES OF THE TELECOMMUNICATIONS MARKET: WHY OPEN ACCESS MUST BE PRESERVED

While the term 'discrimination' has negative connotations, in purely economic terms, 'discrimination' or differentiation is not necessarily a bad thing. Future Shop, for example, may choose to offer Apple products at a discount while ordering less Microsoft. In a functioning market, when there is demand for Microsoft, one of Future Shop's competitors will fill that demand at competitive pricing. Discriminatory traffic management practices (ITMPs) that slow one type of traffic (P2P) in order to give Internet users better access to another (YouTube) are simi-

lar in character.[323] In fact, ISPs bill P2P throttling as a 'benefit' to their customers.[324] So, why is discriminatory traffic management so bad?

First, the telecommunications industry is not nearly as competitive as most other industries. Starting a new ISP is far more expensive and onerous than opening a new computer store to sell Microsoft.[325] Indeed, since each ISP will need to build a direct physical line to each customer's home in order to serve them, competition under such a model is not very efficient — it would be like asking a flower delivery company to build its own roads to deliver flowers to its customers' homes. For this reason, other than a very small number of ISPs, most competitors (wholesalers or secondary ISPs) must use the infrastructure of the main ISPs in order to reach their customers. What this means is that if a primary ISP (Bell) chooses to throttle P2P on its networks, it can and will apply the same throttling to any secondary ISPs on its networks.[326] So, in the absence of enlightened digital policy, Internet service markets offer less choice than others.

Second, application-specific throttling is not necessarily an issue that competition may fix. This is because, as noted by Marsden:

> ll network owners have incentives to stop traffic flowing over their networks that is low value, high volume and for which it is technically infeasible or uneconomic to charge — notably non-network affiliated content including user-generated and transmitted content.[327]

Even though ISPs benefit indirectly from P2P and similar traffic, the direct value of such content is to ISP customers and is, in fact, the very reason these customers are willing to pay for Internet access. The incentive for each individual ISP will always be to throttle newly emerging high bandwidth applications.[328] That said, it is difficult to know how a newly emergent service will develop — for example, five years ago, did anyone suspect YouTube would become what it is today? For the Internet to retain its power as a driver of innovation, developers must be free to create without the need to rely on an ISP choosing to employ non-discriminatory practices.[329] If incumbent ISPs successfully secure their traditional lines of revenue by discriminating against competitors'

offerings (while hurting rates of invention at the same time), they will destroy the aspects of the Internet that make it so valuable to inventors, subscribers, and society, all for the sake of maintaining their own traditional means of profitability.[330]

PRESERVING THE OPEN INTERNET FOR INNOVATORS AND ENTREPRENEURS

A neutral and affordable Internet is key to the success of enterpreneurs, innovators, and the emergence of new businesses. There are inherent risks involved in entering a competitive marketplace, but the level technical playing field offered online alleviates some of these risks and allows innovators to start small businesses without being well resourced from the outset. In turn, these businesses can enjoy the ability to reach global markets without high physical infrastructure costs. Internet traffic discrimination would therefore significantly hinder startups, service providers such as VOIP companies, and technological innovation more generally.[331] Venture capitalists investing in these businesses want assurances that broadband providers won't throttle their application in favour of an affiliate's services and applications.[332]

Where larger firms can typically afford higher quality, often more scalable, services, a non-neutral Internet would compound obstacles for small businesses and entrepreneurs by forcing them to pay for a particular level of Internet service. If a startup or a small business has to pay extra for usage or a more reliable connection, they face a greater degree of difficulty coming to market with applications and services that require a higher level of Quality of Service.[333] That is to say, a tiered and discriminatory Internet model makes it very difficult for a startup or a small business to gain market share in the online realm, particularly if they are developing bandwidth or latency-intensive products and services. This small business disadvantage adds to the lack of scalable infrastructure made possible by self-owned server infrastructures that entrenched market competitors often possess, as well as other non-technical resources incumbents can routinely bring to bear (e.g. organizational expertise, advertising buys, cut-throat product costing, etc.).

A non-discriminatory Internet sets the conditions for small businesses to develop a global user-base, but such efforts may be disproportionately affected by high transit fees and tiered services. As

noted in the "Special Section on E-Commerce," convenience is a key enabler of e-commerce. If potential customers are hindered from accessing a businesses' website(s) due to discriminatory traffic handling, these practices reduce the convenience of the transaction (e.g. delaying instant gratification) and thus impact the commerical success of the transaction.[334] By threatening small businesses' ability to market to niche and underserved markets, online discrimination makes the global community of prospective buyers less available, limiting online commercial opportunities.[335] Thus, discriminatory network practices dilute the advantages that e-commerce companies, particularly smaller businesses, receive from conducting business online: these practices erode convenience, delay gratification, and undermine their capacity to reach niche markets.

Stifling online competition through usage fees or access discrimination has numerous detrimental effects, such as delayed product and service innovation, and higher retail prices. In the face of an increasingly discriminatory communications system, the barriers that small companies and startups face in trying to acquire market share may become so prohibitive that entering the market turns into an unreasonable economic proposition.

INVESTING IN CANADA: PRESERVING OPENNESS TO RESTORE CANADIAN COMPETITIVENESS

In a major 2009 report, World Bank researchers Qiang, et. al. found "a robust and noticeable growth dividend from broadband access in developed countries" since

All else equal, a high-income economy with an average of 10 broadband subscribers per 100 people would have enjoyed a 1.21 percentage point increase in per capita GDP growth.[336]

As the researchers further point out, the "availability, quality, and affordability of broadband services are now important factors for international investors when deciding whether to invest in a specific country."[337]

Canada has fallen behind on several key broadband measurements compared to other OECD countries, which makes keeping pace with the rest of the OECD pack highly unlikely for Canada's ICT-related productivity and efficiency metrics. This is not surprising given that the current

regulatory environment in telecommunications does little to address the need for transparency and fair Internet access pricing, and thus inhibits ICT investment. As well, Canada's telecom industry has failed to understand the fact that retail Internet pricing is most efficient when it treats the Internet as inseparable from the content and applications available online (see Figure Four).

FIGURE FOUR

USAGE BASED BILLING IS ECONOMICALLY INEFFICIENT

The OpenMedia.ca/CIPPIC submission to the CRTC for its most recent proceedings on usage-based billing (CRTC 2011-77) includes economic analysis that demonstrates that retail Internet pricing is most efficient when it treats the Internet as inseparable from the content and applications available on it. With that in mind, we note how economists predict that flat rates will lead to more optimal pricing. That is to say, users pay higher rates and receive higher value from flat Internet access rates than they do under a usage-based billing (UBB) regime.

Excerpts From The Submission:

> The reasons [usage-based billing is economically inefficient]...are essentially two fold. First, the value of an Internet access service to a customer does not correlate to 'usage'. Rather, it correlates to the myriad online services the customer can enjoy via that access. In this sense, Internet access is essentially a 'bundling' of a variety of online services. Economists predict that, where marginal costs are low, bundling becomes optimal. Further, recent economic models have developed that demonstrate this holds even where varied usage scenarios (read 'bandwidth hogs' and 'low bandwidth consumers', as well as individuals with low disposable income) are factored in. Second, the much discussed network effects which result from the type of increased network usage that accompany flat rates benefit ISPs as much as any other entity in the telecommunications ecosystem.
>
> It is...the online services that customers value in such transactions, not the number of GB per month that they use. "The economic efficiency of Internet access pricing is best analyzed as a 'bundling' service.[338] Nabipay et. al. explain:
>
> "In telecommunications, flat rates can be viewed as a form of bundling a very large number of goods, such as access to hundreds of millions of websites or phone calls to potentially billions of people."[339]
>
> The economic literature on bundling demonstrates that, where marginal costs are low, flat rate pricing will, in fact, provide higher revenues for ISPs. Nabipay et. al. conclude from their mathematical model that selling 'bundles' will permit a seller to "come close to capturing the maximal possible profit... but separate sales never capture more than half the maximal possible profits."[340] The model concludes that with low marginal costs, optimal ISP revenues will occur in many scenarios even if high and low cost users are charged the same flat fee.

Find the full OpenMedia.ca/CIPPIC (CRTC 2011-77) CRTC submission here: http://openmedia.ca/submission-crtc-reply-comments-ubb-proceeding

In Canada specifically, the Information and Communications Technology (ICT) industry is critical. The ICT services sector contributed over $59 billion to the Canadian GDP in 2009, accounting for approximately

5% of the total GDP.[341] The open Internet has allowed businesses to communicate with customers, organize and mobilize internal resources, and penetrate new markets at relatively low costs.

In their 2010 consultation paper on Canada's digital economy strategy, the Government of Canada noted that Canadian businesses have been reluctant to innovate or quickly adopt new ICT systems and platforms, rightly identifying the "state of our digital infrastructure…[as a] key challenge."[342] The Government also recognized that Canadian firms' underinvestment in ICTs has been linked to slower than expected economic growth more broadly.[343]

Investing in broadband and providing greater regulatory and platform certainty (through net neutrality and price stability) will enable Canadian businesses to more rapidly, and more significantly, integrate rich ICT systems into their routine practices. Such integration will allow businesses to realize efficiency and productivity gains, therefore improving their success in the Canadian and global economy.

Network investment can increase supply and avoid the neccessity to restrict customer access to the network, but it is expensive — thus, there is an incentive for ISPs to find other ways to decrease traffic. In fact, some have pointed out that the greatest benefit of throttling is its ability to "save millions of dollars in capital expansion costs that would [otherwise] be necessary in order to meet growing bandwidth demands."[344] The CRTC also recognizes that network investment is a superior method of dealing with network congestion, followed by economic measures and, as a last resort, technical measures (e.g. throttling).[345]

We know from "The Technical Case for Openness" section that traffic growth in Canada has stayed relatively stable. The question is, have Canadian ISPs fully utilized network investment to deal with that stable growth and to stave off potential network congestion? One way to determine if network capacity investment has been reasonably exausted is to examine the network infrastructure capital expenditures both in absolute terms and in relation to revenues, while at the same time comparing both of these measures to patterns found in other com-

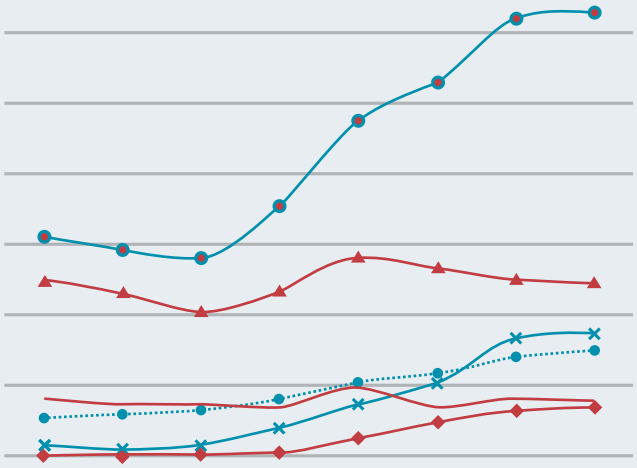
parable nations. We found that Canada's dominant telecommunications companies and ISPs invest less in network infrastructure compared to other industrialized countries (see Figure Five). Thus, network investment is far from exhausted as a means to deal with Internet congestion and Canada's falling status in key Internet metrics.

FIGURE FIVE

HOW MUCH DO CANADA'S DOMINANT TELECOMS AND ISPS INVEST IN DIGITAL INFRASTRUCTURE?

Almost all OECD countries saw a huge surge in capital investment in their telecommunications networks during the Telecom-Media-Technology (TMT) bubble years (1996-2000), followed by a steep decline until roughly 2003, and a steady rise since. Canada saw a similar pattern, with network investment peaking by 2000-2001 as the telecom and cable companies invested between one-fifth and one-quarter of their total revenues back into the public network, followed by a sharp drop thereafter. The difference between Canada and most other OECD countries, however, is that investment levels have stayed relatively flat throughout most of the last decade, with no significant upward swing in recent years to make-up for the 'lost years' following the collapse of the TMT bubble.[346]

NETWORK INFRASTRUCTURE CAPITAL EXPENDITURES VS. REVENUES ($MILLIONS CONSTANT 2010 DOLLARS)



Telecom CapEx
Wireless Telecom
Total "Network Media"Revenues*
Wired Telecom
All TV**
Internet Access

* Consists of wired and wireless telecom services, Internet Access, BDUs, and all Television Services.

** Consists of all conventional, cable and specialty television services and BDUs.

Sources: Statistics Canada. (2010). Capital and repair expenditures: industry sector 51, information and cultural industries, annual (dollars) (Broadcasting and telecommunications) (2001-2009). CAN-SIM table 029-0013. Ottawa, ON: Statistics Canada. Retrieved from http://cansim2.statcan.gc.ca/cgiwin/cnsmcgi.exe?Lang=E&RootDir=CII/&ResultTemplate=CII/CII___&Array_Pick=1&ArrayId=0290013

Statistics Canada. (2010). Capital and repair expenditures on construction and machinery and equipment,by industry, Canada, actual data, annual (dollars) (Broadcasting and telephone (1984-1993). Statistics Canada. CAN-SIM table 029-0033. Retrieved from http://cansim2.statcan.gc.ca/cgiwin/cnsmcgi.exe?Lang=E&RootDir=CII/&ResultTemplate=CII/CII___&Array_Pick=1&ArrayId=0290033

CRTC. (2010). Communications Monitoring Report. Retrieved from http://crtc.gc.ca/eng/publications/reports/policymonitoring/2010/2010MonitoringReportFinalEn.pdf

Organization for Economic Cooperation and Development. (2009). Communications Outlook 2009. Paris: OECD.

Since 2001, investment in the telecoms network infrastructure in Canada as a percentage of revenue has hovered between 16 and 20% and consistently lagged behind the OECD average.[347] In contrast, the OECD points to cable operator ONO in Spain, with "the highest level of investment relative to revenues in 2007 at 33%" as well as to Telstra (22%), Time Warner Cable (22%), Telenor (21%), and Comcast (20%) as examples of other companies with high levels of investment relative to revenues.[348]

The same applies with respect to three other conventional measures of investment: as a percentage of gross fixed capital formation (GFCF); per total communication access path; and on a per capita basis. And in each case, the story of the Canadian telecoms industry is the same: a couple of years during which investment exceeds the OECD average, but on average, investment levels that have failed to keep pace with the OECD average in six or seven of the past ten years for which data is available.[349]

FURTHER READINGS ON INVESTMENT AND PRICING:

- OpenMedia.ca/CIPPIC Reply to Telecom Notice of Consultation CRTC 2011-77
http://openmedia.ca/submission-crtc-reply-comments-ubb-proceeding
- Flat Versus Metered Rates, Bundling, and "Bandwidth Hogs"
http://openmedia.ca/sites/openmedia.ca/files/APPENDIX%20A%20-Odlyzko-BundlingFlatRates-2011.pdf
- Canada's Usage Based Billing Controversy: How to Address the Wholesale and Retail Issues
http://dwmw.files.wordpress.com/2011/04/geist-on-ubb.pdf
- Myths and Fallacies About Usage Based Billing
http://dwmw.files.wordpress.com/2011/04/st-arnaud-myths-and-facts-re-ubb.pdf

A stable innovation framework will enhance the growth of the ICT sector as a whole. This framework requires a digital agenda that includes a provision guaranteeing that the Internet remains neutral. Past innovation depended on the fair treatment of data as it flowed across the networks of Canadian ISPs. If innovation is to fluorish, Canada must safeguard the neutral Internet. Further, as Figure Five illustrates, Canada must encourage the telecommunications industry, and especially incumbent players, to invest more in network infrastructure.

We believe that a stable, non-discriminatory Internet ecosystem is essential to both economic growth and revitalizing and re-invigorating investment in Canadian ICT. Policymakers should quickly reorient regulators and industry alike in order to enable and encourage Canadians to innovate and fully take advantage of the economic and social benefits of the Internet.

CONCLUSION

Innovators creating the next key piece of the web, or businesses trying to better integrate ICT systems into their frameworks, shouldn't have to convince a regulator that a discriminatory system is damaging their

business. Just as we expect these groups to be innovative in the marketplace, so businesses should expect that our regulators will ensure that all players are competing in an open market. It is possible to build on existing regulatory frameworks to level the playing field — thereby enabling innovators to innovate and businesses to invest in R&D and ICT without fearing the imposition of data discrimination.

Forthcoming policy decisions must guarantee the neutrality of the Internet as a platform for innovation, as well as enable leading users and innovators to create and compete in an open market free from throttling and/or usage fees. Neither of these punitive measures will help Canadians succeed in the globalized digital economy, nor will they encourage the local adoption of novel ICT systems. No developer or content provider should enjoy preferential treatment. The vertically integrated, Internet-delivered services of ISPs should abide by the same rules as their non-vertically integrated competitors that are also using Internet technologies to communicate and engage with prospective customers. ISPs should adopt application-agnostic approaches and only apply throttling to those specific users who were disproportionately contributing to that congestion, and only for as long as necessary.

At present, the Canadian system requires ISPs to use network investment as their first response to problems of network congestion and, thereafter, to justify whatever economic and technical Internet management practices they use. The problem with the current situation is that the CRTC does not appear to have adhered to its stated priorities: to make network investment paramount, and to put the onus on ISPs to demonstrate that their methods are necessary and will not harm innovation or business. At the very least, these priorities should be followed in practice, and the onus placed on those ISPs that do discriminate to demonstrate that their solutions are highly targeted to particular points of congestion. Both Bell Canada and Rogers Communications, two of Canada's largest ISPs, acknowledge that they sometimes inadvertently discriminate against non-problematic traffic.[350] Because, however, it is up to end-users and businesses to detect problems, contact the appropriate regulatory officials, and subsequently defend their allegations,

the result is a drawn-out and bureaucratic process, demanding a high level of legislative and technical knowledge.

While some positive work has begun on making Internet discrimination more public, more must be done.[351] Canada must create greater transparency in the Internet service market; ISPs must be forced to explain how and why the infrastructure is designed in a discriminatory fashion and justify discriminatory practices to the public using independently verifiable data, and independent auditors must ensure that ISPs are not exceeding the boundaries authorized by Canadian regulatory bodies. More generally, the government must recognize the ways in which the Internet has democratized innovation, and work hard to keep the costs of entry low, the platform reliable, and the ISPs honest.

Canada has the potential to be a leader in the global digital economy — its citizens are highly educated, enjoy relatively high basic broadband penetration rates, and are avid users of the Internet. If we leverage our existing advantages, the underinvestment in ICT in Canada could be reversed; this in turn could help us enter an era of thriving innovation and robust economic growth.

ENDNOTES

1. CBC News. (2008, March 26). ISPs limit access to CBC download, users say. Retrieved from http://www.cbc.ca/technology/story/2008/03/26/bittorrent-cbc.html

2. CBC/Radio Canada. (1994). Program policies: Policy 1.1.1: CBC/Radio- Canada Mandate. Retrieved from http://www.cbc.radio-canada.ca/docs/policies/program/mandate.shtml

3. Shade, L.R. (2008). Public interest activism in Canadian ICT policy: Blowing in the policy winds. Global Media Journal: Canadian Edition, 1, 107-121. Retrieved from http://www.gmj.uottawa.ca/0801/inaugural_shade_e.html

4. The language used by the 1,112 letter writers varied from essays to point form, so content analysis focused on key words or phrases such as "censorship," "economic impact," etc. to classify any piece of writing within the various categories. Context was then used to verify that an individual had actually committed to a position on that particular category. This approach was chosen for the sake of transparency and fairness, regardless of how the writer chose to express themselves.

5. These letters are available on the CRTC website, see http://support.crtc.gc.ca/ applicant/applicant.aspx?pn_ph_no=pt2008-19&lang=E

6. CNW Group. (2007, October 1). Canadians rebuff restrictions on their Internet access. Retrieved from http://www.newswire.ca/en/releases/archive/October2007/01/c6961.html

7. IPSOS. (2010). Canadian inter@ctive Reid Report, Q3-2010. Retrieved from http://www.ipsos.ca/common/dl/pdf/Ipsos_InteractiveReidReport_SpecialFeatures2010.pdf

8. Lawford, J., Lo, J., & De Santis, M. (2009). Executive Summary. In Staying Neutral: Canadians and the Fight for Net Neutrality. Retrieved from http://piac.ca/downloads/NN_Report_MASTER_FINAL_website.pdf

9. Ibid., p.17

10. Ibid., p.18

11. Office of the Honourable Tony Clement, Minister of Industry. (2011, January 31). Statement from the Honourable Tony Clement, Minister of Industry [Press Release]. Retrieved from http://www.reuters.com/article/2011/02/01/idUS16562+01-Feb-2011+MW20110201

12. CRTC. (2011, April 8). Section 4a) Correspondence to the Commission. In Review of usage-based billing for wholesale residential high-speed access services (8661-C12-201102350). Retrieved from http://www.crtc.gc.ca/PartVII/eng/2011/8661/c12_201102350.htm

13. CRTC. (2011, March 11). Re: Review of billing practices for wholesale residential high-speed access services, Telecom Notice of Consultation CRTC 2011-77 – Requests to modify the scope and terms of the proceeding [Letter]. Retrieved from http://www.crtc.gc.ca/eng/archive/2011/lt110311.htm

14. Mukerji, J. (2011, February 4). Canadians flatly reject usage-based billing for Internet access. Retrieved from http://www.angus-reid.com/polls/43760/canadians-flatly-reject-usage-based-billing-for-internet-access/

15. New Democratic Party. (2011). Practical First Steps for Leadership in Canada [Political Platform]. Retrieved April 4, 2011 from http://www.ndp.ca/platform/leadership-in-canada#section-5-2

16. Liberal Party of Canada. (2011, April 11). The Liberal Party of Canada Announces 'Digital Canada' [Press Release]. Retrieved April 11, 2011 from http://www.liberal.ca/newsroom/news-release/liberal-party-canada-announces-digital-canada/

17. Geist, M. (2011, April 12). The Liberal Digital Economy Strategy: Extended Edition. Message posted to http://www.michaelgeist.ca/content/view/5738/125

18. Geist, M. (2011, April 8). Conservatives on their Digital Economy Strategy: Wait Until After the Election. Message posted to http://www.michaelgeist.ca/ content/view/5732/125/ See also Geist, M. (2011, April 12, 2011). What To Do About Usage Based Billing: NDP & Liberal Positions Take Shape. Message posted to http://www.michaelgeist.ca/content/view/5737/125/

19. Green Party of Canada. (April 6, 2011). Greens pledge to protect Internet access and open communications [Press Release]. Retrieved April 6, 2011 from http://greenparty.ca/media-release/2011-04-06/greens-pledge-protect-internet-access-and-open-communications

20. The full list of coalition members can be found here http://saveournet.ca/members

21. CIPPIC/OM. Submission to Telecom Notice of Consultation CRTC 2010-43. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029987.zip

22. Network BC for the Government of BC. (2009, February 17). Section 4 b). In Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/partvii/eng/2008/8646/c12_200815400.htm#a4b

23. CRTC. (2009, July 8). Transcript of Proceeding, Review of the Internet traffic management practices of Internet service providers [Transcript]. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0708.htm

24. Open Internet Coalition. (2009, February 23). Comments to Telecom Public Notice 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029708.pdf

25. Hartley, M. (2009, July 7). Zip.ca chief airs his concerns to the CRTC. Financial Post. Retrieved from http://www.financialpost.com/chief+airs+concerns+CRTC/1768429/story.html#ixzz18mhk1XsU

26. Geist, M. (2010, February 16). Net Throttling Hasn't Stopped. The Tyee. Retrieved from http://thetyee.ca/Mediacheck/2010/02/16/GeistThrottlingUpdate/

27. Clement, A. (2010). Submission to Digital Economy Consultation. Retrieved from http://de-en.gc.ca/2010/07/13/consensus-submission-2/

28. CNIB. (2010). Submission to Digital Economy Consultation. Retrieved from http://de-en.gc.ca/2010/07/13/harnessing-the-digital-economy-for-canadians-that-are-blind-or-partially-sighted/

29. CARL (2010). Submission to Digital Economy Consultation. Retrieved from http://de-en.gc.ca/2010/07/13/response-by-the-canadian-association-of- research-libraries-to-the-consultation-paper-on-a-digital-economy-for-canada/

30. CFTPA. (2010). Submission to Digital Economy Consultation. Retrieved from http://de-en.gc.ca/2010/07/16/submission-by-the-canadian-film-and-television-production-association-cftpa/

31. SATA. (2010). Submission to Digital Economy Consultation. Retrieved from http://de-en.gc.ca/2010/07/12/canadas-digital-economy-saskatchewan-speaks-up/

32. hgmorrison. (2010). Comments on Digital Economy Consultation. Retrieved from http://de-en.gc.ca/2010/05/11/build-the-foundation-for-all/

33. Read the full text of the email here: http://saveournet.ca/content/government-confirms-they%E2%80%99re-out-step-rest-canada-Internet-issue

34. Anderson, S. (2009, June 18). Liberals Announce Support for Net Neutrality in Question Period. Message posted to http://saveournet.ca/content/liberals- announce-support-net-neutrality-question-period-0

35. Liberal Party of Canada. (2010, January 7). Our Net Neutrality Q&A [Press Release]. Retrieved January 7, 2010 from http://www.liberal.ca/newsroom/blog/our-net-neutrality-qa/

36. SaveOurNet Coalition. (2010) Internet Openness - Where Do the Parties Stand. Retrieved from http://saveournet.ca/Parties

37. Parliament of Canada. (2007-2008). An Act to Amend the Telecommunications Act (C-552). Retrieved from http://www2.parl.gc.ca/Sites /LOP/LEGISINFO/index.asp?Language=E&Chamber=N&StartList=A&EndList=Z&Session=15&Typ e=0&Scope=I&query=5450&List=toc-1

38. Supra note 36.

39. Green Party of Canada. (2011). Supporting the Free-Flow of Information. In Vision Green, Part 6: Good Government. Retrieved from http://greenparty.ca/vision-green/p6.6

40. Lessig, L. (2006). Code: Version 2.0. NY: Basic Books. Retrieved from http://pdf.codev2.cc/Lessig-Codev2.pdf

41. Wu, T. (2006, May 1). Why You Should Care About Network Neutrality: The Future of the Internet Depends on it! Slate Magazine. Retrieved from http://www.slate.com/id/2140850/

42. Saltzer, J.H., Reed, D.P., & Clark, D.D. (1984). End-to-End Arguments in System Design. ACM Transactions on Computer Systems, 2(4), 277-288. Retrieved from http://web.mit.edu/Saltzer/ www/publications/endtoend/endtoend.txt It should be noted that the initial packet switching end-to-end argument articulated in the Saltzer, Reed, Clark paper cited here was narrower than the principle it finally embodied. In this initial articulation, the argument was intended as a guide to protocol and application design — as a means of distributing functionality between different layers of an interconnected network (p. 285). The paper argues that, in general, functionality should be regulated to the 'edges' of a network as much as possible. This iteration, however, was ambiguous with respect to situations where lower layer (or 'central') functionality would benefit as opposed to hinder higher level ('edge' or 'end') applications. However, the underlying rationale for the end-to-end

principle, which focuses on a concern for detrimental impact on unknowable future applications (pp. 287), later evolved to a stronger restriction on any non-necessary lower level functionality. Further, as ISPs begin to build in network functionality that directly and intentionally undermines types of applications deemed less desirable, preserving end-to-end neutrality has become increasingly important.

43. Ibid., p. 288.

44. Lemley, M., & Lessig, L.(2000). The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era [Abstract]. Retrieved from http://ssrn.com/abstract=247737

45. Geist, M. (2002). Cyberlaw 2.0. Boston College Law Review, 44(2). Retrieved from http://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=2227&context=bclr

46. Marsden, C.T. (2007). Net Neutrality and Consumer Access to Content. SCRIPTed 4(4), 416. Retrieved from http://www.law.ed.ac.uk/ahrc/script-ed/vol4-4/marsden.pdf As noted by Professor Marsden: "[a]ll network owners have incentives to stop traffic flowing over their networks that is low value, high volume and for which it is technically infeasible or uneconomic to charge – notably non-network affiliated content including user-generated and transmitted content".

47. Internet Evolution has done 'apples to apples' tests of some DPI equipment, demonstrating their abilities to detect and apply rule sets to encrypted P2P transmissions. For more, see: http://www.internetevolution.com/document.asp?doc_id=17863

48. Van Schewick, B. (2010). Internet Architecture and Innovation. Cambridge: The MIT Press.

49. In this report, we follow the CRTC's definition of ITMPs and exclude traditional intrusion detection network intelligence aimed at preserving the integrity and security of the network itself (by targeting spam, malware, etc.).

50. Documentary Organization of Canada. (2009). Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1030141.PDF

51. BitTorrent. (2009). Final Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1249945.PDF

52. Zip.ca. (2008). Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/999115.doc

53. Benkler, Y. (2003). The Political Economy of the Commons. European Journal for the Informatics Professional 6, 4(3), 8. Retrieved from http://www.benkler.org/Upgrade-Novatica%20Commons.pdf

54. Abramson, B.D., Buchanan, G., & Intven, H. (2009). CRTC Shapes Canadian 'Net Neutrality' Rules. McCarthy Tétrault. Retrieved August 12, 2010 from http://www.mccarthy.ca/article_detail.aspx?id=4720

55. Parsons, C. (2009). Summary of January 13, 2009 CRTC Filings by Major ISPs in Response to Interrogatory Public Notice 2008-19. Message posted to http://www.christopher-parsons.com/PublicUpload/Summary_of_January_13_2009_ISP_filings_(for_web).pdf

56. Upbin, B. (January 7, 2011). The Netflix Effect: Results from a Revealing Study in Canada. Message posted http://blogs.forbes.com/bruceupbin/2011/01/07/the-netflix-effect-results-from-a-revealing-study-in-canada/ Citing a recent study on the impact of monthly bit caps in Canada (as opposed to the US), Upbin noted that a Rogers customer using Netflix can expect a $12/month increase in monthly broadband rates (compare this to Netflix's $8/month actual rate). At these rates, the extremely restrictive monthly caps imposed by most Canadian ISPs have potential to impact as detrimentally on innovative services. In spite of this, to date, the CRTC has approved usage-based economic ITMPs. See CRTC. Telecom Decision CRTC 2010-255. In Applications to introduce usage-based billing and other changes to Gateway Access Services. Retrieved from http://www.crtc.gc.ca/eng/archive/2010/2010-255.htm

57. CRTC. Telecom Regulatory Policy (2009-657). Retrieved from http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm at paras. 35-36.

58. Ibid., paras. 44-45.

59. St. Arnaud, B. (2010). Report of Bill St. Arnaud, Attachment C. In CIPPIC, Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.cippic.ca/uploads/File/Attachment_C_pt_1_-_St_Arnaud_Report.pdf

60. Private corporations use DPI to monitor employees' data transmissions. In the US, the NSA is strongly suspected of using DPI for massive, illegitimate, surveillance. For more, see Bamford,

J. (2008). The Shadow Factory: The Ultra-Secret NSA from 9/11 to the Eavesdropping on America. NY: Doubleday. See also Geist, M. (2010, November 16). Lawful Access Bills Would Reshape Internet in Canada. Message posted to http://www.michaelgeist.ca/content/view/5451/135/ Canada's Research Chair of Internet and E-commerce law, Michael Geist, worries that the state will use DPI to surreptitiously monitor data transactions.

61. Wagner DeCew, J. (1997). Pursuit of Privacy: Law, Ethics, and the Rise of Technology. Ithaca: Cornell University Press.

62. Cohen, J. (2000). Examined Lives: Informational Privacy and the Subject as Object. Stanford Law Review 52(5), 1373-1438.

63. Calo, R. (2011). The Boundaries of Privacy Harm. Indiana Law Journal (forthcoming 2011).

64. CRTC. (2009). Review of the Internet traffic management practices of Internet service providers. Telecom Regulatory Policy CRTC 2009-657. Retrieved October 21, 2009 from http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm at para. 103.

65. Ibid., paras. 47–48.

66. Ibid., para. 48.

67. Ibid., para. 40.

68. Ibid.

69. Supra text accompanying note 42, pp. 287. What Saltzer et. al. describe as leaving as much of the traffic management calculations to the end user's computer at one end or the web server on which the end-service is hosted on the other. This type of architecture has from the start been recognized as less discriminatory and more conducive to innovation as it allows anyone to build their own service by their own specifications and not need to worry about traversing obstacles within the network itself. The idea being that those who build and operate networks do not know what the next service will be, and should not interfere with its development. P2P offers the perfect realization of this issue. ISPs have decided to throttle P2P arguing it is not time sensitive and a 'bandwidth hog'. But P2P file- sharing applications and the BitTorrent protocol in particular are versatile. They have legitimate uses that are potentially just as time sensitive as any other application available.

70. DeepPacketInspection.ca, particularly "DeepPacketInspection.ca: Privacy in Canadian Digital Networks," documents Canadian ISP ITMP practices. See also Parsons, C. (2009). Summary of January 13, 2009 CRTC Filings by Major ISPs in Response to Interrogatory Public Notice 2008-19. Technology, Thoughts, and Trinkets. Message posted to http://www.Christopher-parsons.com/PublicUpload/Summary_of_January_13_2009_ISP_filings_(for_web).pdf

71. CRTC. Telecom Regulatory Policy CRTC 2009-657. Retrieved from http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm at para. 43.

72. Ibid., para. 40.

73. Minnesota Internet Traffic Studies (MINTS). (2007, August 30). MINTS pages updated, many new reports, further slight slowdown in wireline traffic growth rate. Retrieved from http://www.dtc.umn.edu/mints/news/news_22.html

74. Odlyzko, A. (2010). Report of Andrew Odlyzko, Attachment A, to CIPPIC, Initial Comments to Telecom Public Notice CRTC 2008-19, Retrieved from http://www.cippic.ca/uploads/A-Odlyzko2008-19.pdf at para. 6.

75. Coffman K.G., & Odlyzko, A. (2000). 4 – Disruptive Innovations: browsers, Napster" In Internet Growth: Is there a 'Moore's Law' for data traffic? Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2361084 at pp. 21-27.

76. Supra text accompanying note 74, para. 6.

77. Bell. (2008). Response to Interrogatories in CRTC Telecom Public Notice 2008-19. The Companies(CRTC)4Dec08-9 PN 2008-19, Abridged Supplemental, 5-7. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1006810.zip

78. Bell. (2009). Figure 7. Initial Comments to PN CRTC 2008-19 [Image] Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029804.zip at 29-30. Citing data from Nemertes Research. 2007. The Internet Singularity, Delayed: Why Limits in Internet Capacity Will Stifle Innovation on the Web. Retrieved from http://www.nemertes.com/internet_singularity_delayed_why_limits_internet_capacity_will_stifle_innovation_web

79. Supra text accompanying note 74, para. 25.

80. Supra text accompanying note 73, para. 5. By year-end 2009, MINTS concluded that wireline internet traffic growth was 40 to 50 percent per year, down from previous estimates of 50 to 60 percent only one year earlier.

81. Bell. Network Management. Bell Sympatico Internet – Troubleshooting. Retrieved August 2, 2010 http://service.sympatico.ca/index.cfm?method=content. view&content_id=12119 Indeed, Coffman & Odlyzko concluded, in 2000, that barring a few isolated periods of more rapid growth spurts in the mid-90s where annual growth rates of 1000% were reached, "the average growth rate in [Internet] traffic has been very close to 100% a year for the entire 30-year history of the Internet and its predecessors." K.G. Coffman & A. Odlyzko (2000, July 11). Internet Growth: Is there a 'Moore's Law' for data traffic? SSRN. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=236108 at pp. 2-5.

82. See ATLAS Internet Observatory 2009 Annual Report, North American Network Operators' Group (NANOG). Retrieved from http://www.nanog.org/meetings/nanog47/presentations/Monday/Labovitz_ObserveReport_ N47_Mon.pdf A study of Internet traffic prepared by Arbor Networks, Merit Networks, and the University of Michigan estimates that the current annual Internet growth rate is about 45 percent. Other independent studies include the Cisco Visual Networking Index project that predicted annual growth at 46 percent through to 2012. CISCO. (2008, June 16). Cisco Visual Networking Index Projects Global IP Traffic to Reach Over Half a Zettabyte in Next Four Years. CISCO News Room. Retrieved from http://newsroom.cisco.com/dlls/2008/prod_061608b.html And market research firm TeleGeography found that Internet traffic grew 53% between mid-2007 and mid-2008, down from 61 percent the preceding year. Teleography. (2008, September 3). Internet traffic is growing fast — but capacity is keeping pace. Retrieved from http://www.telegeography.com/cu/article.php?article_id=24888

83. As noted by the CRTC in Telecom Regulatory Policy CRTC 2009-657 at para. 5, annual traffic growth rates among Canadian ISPs from the period of 2005-2008 averaged 43 percent.

84. Comcast V.P. Joe Wax (2008, March 27). Cited in Bell, Answer to CAIP Application. In CRTC File #8622-C51-200805153, The Canadian Association of Internet Providers' application regarding Bell Canada's traffic shaping of its wholesale Gateway Access Service. Retrieved July 11, 2008 from http://www.crtc.gc.ca/public/partvii/2008/8622/c51_200805153_1/926702.zip at para. 63. Bell similarly argues that: The nature of the growth of Internet traffic is that as network capacity expands, new user applications invariably also grow to utilize that capacity. As a result, Internet service providers have begun to manage network data flow through the use of various network management tools in order to mitigate network congestion due to increased traffic by consumers, particularly during peak periods. The issue of increasing network congestion is not one that is faced solely by Bell Canada. It is an issue that is faced by network providers around the world: as a Comcast executive was recently quoted as saying, "You can never build your way out of this problem."

85. Arbor Networks, Inc. (2009). Comments to Telecom Public Notice 2008-19. Retrieved February 23, 2009 from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1032115.PDF at response to PN question 2(d). Arbor claims such savings are justified because per-user bandwidth consumption is increasing and thus ISPs are forced to upgrade on their networks just to maintain current customer bases. As Professor Odlyzko has noted, however, this requirement of reasonable levels of continued expenditure is no different than what is required in any other industry where product developers must continually improve their product in order to maintain their existing consumer bases (Odlyzko, supra note 74, para. 1). See also CIPPIC/CDM. (2009, April 30). Reply Comments. Telecom Public Notice CRTC 2008-19. Retrieved from http://www.cippic.ca/uploads/File/CDM%20Reply%20-%20CRTC-PN2008-19%20-%2030April2009.pdf at para 37.

86. Supra text accompanying note 74, para. 1.

87. A derivation of Moore's law designed for network infrastructure. See K.G. Coffman, K.G., & Odlyzko, A. (2000, July 11). Internet Growth: Is there a 'Moore's Law' for data traffic? SSRN. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=236108

88. Open Internet Coalition. (2009). Comments to Telecom Public Notice 2008- 19. Retrieved February 23, 2009 from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029708.pdf at para. 21.

89. Geist, M. (2009, July 9). CRTC Network Management Hearings, Day Four: CAIP, CIPPIC for CDM, Execulink, Primus. In Net Neutrality. Message posted to http://netneutrality.michaelgeist.ca/crtc-network-management-hearings-day-four-caip-cippic-cdm-execulink-primus

90. TELUS Communications Company. (2009). Reply Comments. Telecom Public

Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1110432.pdf at paras. 21-22.

91. The 36 percent figure is derived from a straight mathematical average of anonymized data provided by Canadian ISPs. See CRTC. (2009). Letter to Interested Parties in Telecom Public Notice CRTC 2008-19 [Letter]. Retrieved from http://www.crtc.gc.ca/eng/archive/2009/lt090211.htm). (CRTC) 04Dec2008-1 (b). But the 27 percent found on Bell's (Canada's largest ISP) networks in 2009 is likely far more recent and representative of P2P traffic, when unthrottled, as it was in 2008. See Condon, C. (2009, July 14). Bell - Oral Testimony. Telecom Public Notice CRTC 2008-19 [Transcript]. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0714.htm. at line 6042. 27 percent of our traffic is peer-to-peer throughout the day, but at peak that number reduces to 14 percent as a result of our shaping of that traffic.

92. Labovitz, C. (2009, August 24). The Internet After Dark (Part 1). Security to the Core: The Arbor Networks Security Blog. Message posted to http://asert.arbornetworks.com/2009/08/the-internet-after-dark/ Arbor Networks places P2P usage currently at approximately 15%-20% of all traffic. In what may perhaps be termed the most comprehensive study of global network traffic to date, Arbor Networks points out that non-server based "mechanisms for video and application distribution like P2P (peer-to-peer) have declined dramatically in the last two years". See also Arbor Networks. (2009, October 13). Two Year Study of Global Internet Traffic Will Be Presented at NANOG47 [Press Release]. Retrieved August 2, 2010 from http://www.arbornetworks.com/en/arbor-networks-the-university-of-michigan-and-merit-network-to-present-two-year-study-of-global-int-2.html

93. Sandvine. (2009).Global Broadband Phenomena 2009. Retrieved from http:// www.sandvine.com/downloads/documents/2009%20Global%20Broadband%20Phenomena%20-%20Executive%20Summary.pdf at pp. 2. This recent and comprehensive global study from Sandvine notes a 25% drop in P2P usage, down to about 20% of all traffic. Sandvine attributes this drop to "a dramatic shift in consumer behavior towards real-time "experience now" applications and away from bulk download "experience later" behavior.

94. Cisco. (2010). Cisco Visual Networking: Usage Study – Highlights. October 25, 2010, Retrieved October 21, 2009 from http://cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/Cisco_VNI_Usage_WP.html A less comprehensive global study from CISCO's Visual Networking Index also points to a dramatic decrease in P2P file sharing - 38% of global broadband visual and file-sharing traffic, down from over 60% two years ago. While still growing in absolute terms, P2P is growing more slowly than visual networking and other advanced applications.

95. P2P, by its nature, generates more upstream traffic than other types of web-based applications. This is because P2P utilizes a client-to-client model of data transfer, as opposed to the traditional client-server model. In traditional client-server models much of the upstream bandwidth load is generated by servers owned by companies with expansive business Internet connection plans external to a local ISP's network. This means that, while traveling within the ISP's network, such traffic will be primarily downstream. In a client-to-client P2P model, traffic comes from a client (any Canadian individual with a standard Internet connection) located within an ISP's network and passes over it in the upstream direction.

96. There are no Canada-specific numbers for this breakdown, but numbers from North America suggest that while P2P may generate disproportionate upstream network traffic, downstream traffic is negligible. Sandvine, for example, reported that, in 2008, while overall P2P traffic in North America amounts to approximately 30% of all bandwidth, P2P accounted for only about 18% of all downstream bandwidth. See CIPPIC/CDM (2009). Reply Comments. Telecom Public Notice CRTC 2008-19. Retrieved from http://www.cippic.ca/uploads/File/CDM%20Reply%20-%20CRTC-PN2008-19%20-%2030April2009.pdf at footnote 50.

97. Fancy, L. (2011, January 13). Re: Complaint Regarding Rogers' Internet Traffic Management Practices [Letter]. CRTC Ref. No.: 503207. Retrieved from http://www.michaelgeist.ca/component/option,com_docman/task,doc_download/gid,38/ See also Geist, M. (2011). CRTC Says Rogers Not Complying with Net Neutrality Disclosure Requirements. Message posted to http://www.michaelgeist.ca/content/view/5574/125/

98. Office of the Privacy Commissioner of Canada. (2009). Report of Investigation into Rogers Communications Inc.'s use of Deep Packet Inspection Technology (OPC File #6100-03064) [On record with author] at para. 10: In the course of our investigation, Rogers stated that the cable network was initially designed for the downstreaming of a

television signal—not for the high capacity P2P uploading, which causes disruptions to the network.

99. BitTorrent. (2009). Final Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1249945.PDF at para. 23.

100. Supra note 98.

101. While Sandvine estimates that, in 2008, P2P generated 58.64% of all upstream peak traffic in North America, given the disparity between upstream and downstream usage overall, this does not amount to a significant net amount. That is, in that same period, total upstream peak usage in North America amounted to about 9,000 bps, meaning that P2P generated about 5,277 bps (58.64% * 9,000 bps). In comparison, downstream peak usage amounted to approximately 28,000 bps and net peak period usage was about 38,000 bps. See Sandvine. (2009, February 23). Global Broadband Phenomena 2008. Appendix A to Sandvine, Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029527.pdf at pp. 14–16 of Appendix A.

102. The reason that P2P upstream bandwidth amounts to only a relatively small amount of actual data is that ISPs have historically placed significant limits on upload speeds of user modems. The latest standard for ADSL (ADLS2+), for example, allots a maximum 24Mbps of last mile downstream capacity, but only 1.4 Mbps for upstream. See Aware. (2006). ADSL2 and ADSL2+: The New ADSL Standards, Revision 3. Aware, Inc. Retrieved from http://www.aware.com/dsl/whitepapers/WP_ADSL2_Plus_Rev3_0505.pdf With respect to cable architecture, see supra note 98. This means that any individual user is only capable of generated a minimal amount of upstream data from their home computer. P2P users generate a larger percentage of allotted speed, but still can never surpass built-in modem connection limits. So, if ISPs were to keep the modem limit at the same rate, it should not take a vast amount of investment to build upstream capacity to meet the added stress of P2P at network aggregation points.

103. Supra text accompanying note 93, p. 4 demonstrates that P2P upstream consumption as a percentage of total upstream consumption is now at approximately 31%, down from about 60% a year earlier (compare to Sandvine. (2009, February 23). Global Broadband Phenomena 2008. Appendix A to Sandvine, Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029527.pdf at pp. 15 of the Appendix, which cites the figure as 58.64% of all upstream bandwidth in 2008).

104. Cohen, B. (2003). Incentives Build Robustness in BitTorrent. Retrieved from http://www.bittorrent.org/bittorrentecon.pdf at p. 1.

105. Bell. (2009). Initial Comments to PN CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029804.zip at para. 30.

106. Daniels, J. (2009, July 14). Bell - Oral Testimony in Telecom Public Notice CRTC 2008-19. [Transcript of Proceeding] Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0714.htm at line 6829.

107. St. Arnaud, B. (2010). Report of Bill St. Arnaud, Attachment C. to CIPPIC Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.cippic.ca/uploads/File/ Attachment_C_pt_1_-_St_Arnaud_Report.pdf See also Daniels, J. Bell - Oral Testimony in Telecom Public Notice CRTC 2008-19 [Transcript of Proceeding]. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0714.htm at line 6829, where Daniels notes that only a small proportion of those who use P2P use it rigorously and ubiquitously.

108. See, for example, National Science Foundation. (2009). Keeping an Eye on the Inauguration. National Science Foundation News. Retrieved February 4, 2009 from http://www.nsf.gov/news/news_summ.jsp?cntn_id=114128 which documents the resilience of a Skype-like communications tool (VSee) that employs a P2P protocol. Because of its low bandwidth costs and decentralized architecture, law enforcement officers were able to use VSee as a communication and monitoring tool during President Obama's inauguration in spite of the heavy online traffic loads witnesses on most networks at the time. See also Baset, S.A, & Schulzrinee, H.(2004). An Analysis of the Skype Peer-to-Peer Internet Telephony Protocol. Department of Computer Science: Columbia University. Retrieved from http://www1.cs.columbia.edu/~library/TR-repository/reports/reports-2004/cucs-039-04.pdf

109. As noted by Parsons, citing O'Donnell, S. (2001). Broadband Architectures, ISP Business Plans, and Open Access. In B.M. Compaine & S. Greenstein (Eds.), Communications Policy in Transition. Mass.: The MIT Press. Even subtle shifts

in speed and efficiency may impact detrimentally and subconsciously on user adoption of a given protocol. See also Parsons, C. (2011, January 6) Review of Telecommunications Policy in Transition. Technology, Thoughts and Trinkets. Message posted to http://www.christopher-parsons.com/blog/copyright/review-of-telecommunications-policy-in-transition-2/

110. Supra text accompanying note 93, p. 7.

111. Supra text accompanying note 106, line 6829.

112. CRTC. (2009, February 11). Letter to Interested Parties. Telecom PN CRTC 2008-19 [Letter]. Retrieved from http://www.crtc.gc.ca/eng/archive/2009/lt090211.htm (CRTC) 04Dec2008-2 (d).

113. Condon, C. (2009, July 14). Bell - Oral Testimony in Telecom PN CRTC 2008-19 [Transcript of Proceeding]. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0714.htm. 27 percent of our traffic is peer-to-peer throughout the day, but at peak that number reduces to 14 percent as a result of our shaping of that traffic.

114. In fact, it is questionable whether these users even contribute in any significant degree to congestion.

115. BitTorrent. (2009, July 28). Final Comments to Telecom Public Notice CRTC 2008-19. Retrievd from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1249945.PDF at paras. 23-24 points out that the degree of throttling its protocol receives in Canada has made it extremely difficult for it to compete in the Canadian marketplace.

116. Ibid., para. 21.

117. Odlyzko, A. (2010). Report of Andrew Odlyzko, Attachment A, to CIPPIC, Initial Comments to Telecom Public Notice CRTC 2008-19, Retrieved February 23, 2010 from http://www.cippic.ca/uploads/A-Odlyzko2008-19.pdf at para. 24.

118. D.P. Reed (2010, February 23). Report of David P. Reed, Attachment B, to CIPPIC, Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.cippic.ca/uploads/File/Attachment_B_pt_1_-_Reed_Report.pdf at para. 31 describes a number of techniques such as Diffserv that ISPs can implement in order to empower user-driven quality of service.

119. Supra text accompanying note 115, paras. 23-24.

120. Ibid., paras. 10-15.

121. CRTC. (2008, November 20). Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/eng/archive/2008/pt2008-19.htm at footnote 6. Network congestion is broadly defined to mean a situation whereby the amount of traffic transiting the network may lead to a deterioration in service for some end users.

122. Supra text accompanying note 105, para. 35. Because of the possibility of queuing file requests, P2P file-sharing can sustain continuous maximum network traffic load, 24 hours a day, 7 days a week and 365 days a year, as long as there are queued requests.

123. Cisco. Cisco Visual Networking: Usage Study – Highlights. October 25, 2010, Retrieved from http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/Cisco_VNI_Usage_WP.html places average peak period usage at approximately 72% higher than average non-peak period usage. See also Sandvine. (2009). Global Broadband Phenomena 2009. Retrieved from http://www.sandvine.com/downloads/documents/ 2009%20Global%20Broadband%20Phenomena%20-%20Executive%20Summary.pdf at pp. 3 and Labovitz, C. (2009, August 24). The Internet After Dark (Part 1). Security to the Core: The Arbor Networks Security Blog. Message posted to http://asert.arbornetworks.com/2009/08/the-internet-after-dark/ points to a gradual shift from 30% of peak usage to 100% peak usage over the course of a day while Arbor notes a slightly more gentle shift from 50% of peak usage to 100% peak usage over the course of a day.

124. CRTC, Letter to Interested Parties in TPN CRTC 2008-19, February 11, 2009, online: http://www.crtc.gc.ca/eng/archive/2009/lt090211.htm (CRTC) 04Dec2008-1 (b). See also CRTC interrogatory questions that generated this data at CRTC, Letter to Interested Parties in TPN CRTC 2008-19, December 4, 2008, here http://www.crtc.gc.ca/eng/archive/2008/lt081204a.htm at question 1(b): For the traffic on these networks, provide the percent composition of various types of Internet traffic (e.g. HTTP, P2P, UDP, etc.) for each year from 2006 to 2008 by month.

125. Labovitz, C. (2009, August 24). The Internet After Dark (Part 1). Security to the Core: The Arbor Networks Security Blog. Message posted to http://asert.arbornetworks.com/2009/08/the-internet-after-dark/

126. Ibid. Arbor, using more recent data, demonstrates that while P2P currently generates

approximately 15-20% of all traffic over a given period (a month or a year), it rarely rises above 12% of all traffic at any specific point in the day, month or year – significantly less! While these figures do not differentiate Canadian traffic from North American traffic at large, the differential is telling.

127. Bell. Network Management. Bell Sympatico Internet – Troubleshooting. Retrieved August 2, 2010 from http://service.sympatico.ca/index.cfm?method=content. view&content_id=12119 that most define a significantly narrower period of time as 'peak'. See supra text accompanying note 93, pp. 3: refers to 'peak period' as spanning a 3 hour period from 7 pm to 10 pm and notes a marked and recent decrease in the peak period span. Arbor (supra note 123) appears to indicate consumer peak times run from about 11 pm to 3 am, while CISCO's study concludes peak periods are 9 pm to 1 am. See also supra text accompanying note 123.

128. CIPPIC/CDM. (2009, April 30). "Reply Comments" to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.cippic.ca/uploads/File/CDM%20Reply%20-%20CRTC-PN2008-19%20-%2030April2009.pdf at para. 45.

129. Ibid.

130. Supra text accompanying note 105, para. 24 [citations omitted]: Finally, it is not enough to simply add capacity. Some P2P file-sharing applications constantly look for the fastest node, and thus, any increase in capacity to one network node will attract increased P2P file-sharing upload requests from other P2P file-sharing applications resident on other networks. As described by Rogers' Chief Strategist at last year's Telecom Summit in Toronto, Rogers' tests have indicated that an increase of capacity at a node could be eaten up by P2P file-sharing applications within 24 hours. Indeed, the Companies' own testing shows that in some cases the increase in capacity could be eaten up in as little as 30 minutes. Additional capacity cannot, on its own, resolve this issue.

131. D.P. Reed (personal email correspondence with author, April 30, 2009) ["Reed Email"]) describes the phenomenon, with respect to the operation of BitTorrent, as such: "[T]he individual connections made by BitTorrent tend to go through less-currently-congested paths, because those complete their work faster." See also BitTorrent. (2009, July 28). Final Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1249945.PDF at para. 19 describes it in this manner: "By finding areas of the network and peers in the system that are free to deliver pieces of the file, the resulting solution is fast for users and efficiently utilizes the overall resources of the network by making many connections to a diverse collection of peers".

132. Supra text accompanying note 128, paras. 50-53. Supra

133. Supra text accompanying note 131: "any given BitTorrent client would tend to be using more bandwidth on less congested paths, and less on more congested paths." Reed confirms that this tendency has not been empirically tested, but states it as a logical result of the manner in which the protocol is designed.

134. BitTorrent. (2009, July 28). Final Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1249945.PDF at para. 19.

135. Supra text accompanying note 131 points out that, as elaborated below, P2P impact on congestion is minimized when passing through non-congested points with no bottlenecks.

136. O'Carroll, D. (2009, July 13). Testimony of Rogers Communications Inc. Telecom Public Notice CRTC 2008-19 [Transcript of Proceeding]. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0713.htm at lines 4978-4988: "…these are not my customers, and for me to build capacity, to give them an even better experience, would be detrimental to my customer base." While it may be true that customers of a particular Canadian ISP may not directly benefit from upload traffic of other customers of that same Canadian ISP, these customers are benefiting from the upload capacity of customers of other ISPs to operate their BitTorrent clients. If all ISPs adopted this aversion to provisioning for upstream capacity used by other ISPs' customers, P2P and, in fact, the entire web will crawl to a standstill – a true tragedy of the commons.

137. Supra text accompanying note 104, para. 20: "Some parties to this proceeding have claimed that consumers do not care about the upload performance of their service, since they extract no value from assisting with something they have already consumed. However, when you consider that the uploading of others enables the download in the first place, the systemic value of the upload is obvious to most consumers who use P2P".

138. Supra text accompanying note 134, para. 24.

139. Supra note 131.

140. Supra text accompanying note 105, para. 34 [citations omitted]: As stated by Rogers' Chief Strategist, Mike Lee, P2P is "actually designed to overwhelm other traffic." A P2P application, rather than opening up only one stream or session, will open up 40 to 100 TCP sessions in an effort to transfer data as fast as possible using multiple sources and can therefore grab dozens to 100s times more bandwidth than a traditional single-stream application such as email or Internet banking applications. By initiating more and more P2P applications on powerful computers, the user will continue to expand the number of active streams eventually consuming all bandwidth. To begin with, it is clear this is not the case the P2P 'consumes all bandwidth' as, on Bell's own networks, it does not consume more than 27% of available bandwidth.

141. Supra note 131.

142. Ibid. See also supra text accompanying note 134, para. 19.

143. Ibid.

144. Ibid. Again, this is not verified by empirical research on the operation of BitTorrent, but on the logical operation of the protocol.

145. Ibid.

146. Supra text accompanying note 134, para. 19. BitTorrent explains that each BitTorrent TCP connection used for downloading is dedicated to one uploading peer or user. This means that, unlike a commercial website, where the site being viewed will open 4 upstream connections to maximize speed, a BitTorrent uploader will only open 1 connection per file being uploaded. Indeed, it is unlikely that a user will be able to ever generate 10 Mbps even if that were available to her, as her data will need to travel through several other links before reaching Link A, and each of these are likely to slow her down to some extent.

147. Ibid. More importantly, perhaps, each connection actually employed for file transfer (to download a file) is unique to a single uploader. This means that, contrary to a typical commercial website, where 4 connections are established between the user-client (at one end) and the server hosting the website server (at another end) in order to maximize the speed of the download, BitTorrent will rely on multiple user-clients (ends), but will only establish one functioning connection to each. This means that each connection represents another user who is interacting with the network. The 'disruptive' impact of such activity is, as explained above, minimal and, moreover, it appears a more 'fair' and equitable distribution than utilized by commercial websites, which attempt to quadruple their TCP bandwidth allocation.

148. Supra note 125.

149. Cope, G. & Vanaselja, S. (2010, November 4). BCE q3 2010 Results Conference Call. Retrieved from http://www.bce.ca/data/documents/reports/en/2010/q3/BCE_TRANSCRIPT_q3_10.pdf

150. Shaw Communications Inc. (2011, January 13). "Annual General Meeting". Retrieved from http://www.shaw.ca/uploadedFiles/Corporate/Investors/Presentations_And_Meetings/AGM%20Presentation%20-%20January%2013%202011.pdf Shaw has since moved away from UBB and held consultations on this economic ITMP.

151. See Telecom Regulatory Policy CRTC 2009-657. Retrieved from http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm at para. 5. The figure is actually 43% for Canadian ISPs from 2005-2008.

152. CRTC. (2010). Communications Monitoring Report. Retrieved from http:// www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2010/cmr51.htm#t533 at Table 5.3.3. (part 2 of 2) Note that monthly caps are applied to NET usage–downstream and upstream combined.

153. Bell. (2008, July 11) "Answer to CAIP Application" in CRTC File #8622-C51-200805153, The Canadian Association of Internet Providers' application regarding Bell Canada's traffic shaping of its wholesale Gateway Access Service. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8622/c51_200805153_1/926702.zip at para. 70.

154. Ibid.

155. Geist, M. (2011, March) "Canada's Usage Based Billing Controversy: How to Address the Wholesale and Retail Issues". Retrieved from http://www.michaelgeist.ca/component/option,com_docman/task,doc_download/gid,53/ at pp. 38-40.

156. Bell. "Essential Plus". Retrieved March 27, 2011 from http://www.bell.ca/shopping/en_CA_ON.Essential-Plus/DSLTIEPlusNCOONNewMass.details The service offers speeds of up to 2 Mbps downstream and 800 Kbps upstream. Customers are provided a $5/month discount from the base rate

of $34.95 and additional discounts for bundling.

157. The current 'top seller' on Steam is a game called 'Portal 2'. The game itself costs $44.95 and is over 7 GB. See http://store.steampowered.com/ app/620/ Topping Steam's 'New Releases' category is a game called 'Dino D-Day', priced at $19.99 and requiring approximately 5 GB of hard drive space. See http://store.steampowered.com/app/70000/ An alternative game purchasing scenario: Blizzard.com will sell the digital version of its 'World of Warcraft II' game for $19.99. The game itself is 15 GB. See http://us.blizzard.com/store/details.xml?id=110000034

158. Six hours of highest quality streaming x an average of 1.65 GB/hour per week x 4 weeks = 39.6 GB/month

159. Three hours highest quality streaming x average 1.65 GB/hour per week x 4 weeks = 19.8GB/month

160. The purchase price for Portal 2, as noted above, is $44.95 and it is approximately 7 GB in size.

161. Total usage for scenario is 66.4 GB. The ISP markup is comprised of a 5$/month 40 GB 'insurance' scheme fee plus an additional 24.4 GB in overage charges at $0.25/100 MB, or $65.

162. CRTC. (2010). Communications Monitoring Report. Retrieved from http://www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2010/cmr41.htm#n24 at Section 4.3 "Television at a Glance". This does not include movies, theatre visits, DVD rentals, etc.

163. The popular Blizzard game World of Warcraft can be downloaded for $19.99, and requires approximately 15 GB of space. See http://us.blizzard.com/store/details.xml?id=110000034

164. Supra note 123.

165. Bell. (2009, November 13). Disclosure of Confidential Information Provided in Confidence to the Commission. The Companies (CRTC) 20Aug09-1, Abridged, Supplemental, File Nos.: 8740-B2-200904989 & 8740-B54-200904971. Retrieved from http://www.crtc.gc.ca/public/8740/2009/b2/1315236.zip at pp. 16. Bell explains its rationale for discriminating against minority users: "...peak period pricing would require peak charges to occur at the time that customers wanted to use the Internet the most. Peak pricing would therefore require the majority of users, who do not necessarily use the most bandwidth, to stop using the Internet when they want to use it the most, or, in the alternative, they would actually be incurring price increases."

166. OECD. (2010, June). Fixed and Wireless Broadband Subscriptions Per 100 Inhabitants June 2010. OECD Broadband Portal. Retrieved from http://www.oecd.org/dataoecd/21/35/39574709.xls

167. OECD. (2009, October). Average Monthly Subscription Price for High-Speed Connections October 2009. OECD Broadband Portal. Retrieved from http://www.oecd.org/dataoecd/33/4/43922216.xls

168. Benkler, Y., Faris, R., Gasse, U., Miyakawa, L., & Schultze, S. (2010). "Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world." Harvard University: The Berkman Center for Internet & Society.

169. Ibid.

170. Longford, G. (2007). 'Network neutrality' vs. 'network diversity': A survey of the debate, policy landscape and implications for broadband as an essential service for Ontarians. Retrieved from http://openmedia.ca/sites/openmedia.ca/files/longford_paper2.pdf

171. Shade, L.R. (2008). Public interest activism in Canadian ICT policy: Blowin' in the policy winds. Global Media Journal - Canadian Edition, 1(1), 107-121.

172. Public Knowledge. (2010). Network Neutrality. Retrieved from http://www.publicknowledge.org/issues/network-neutrality

173. Ibid.

174. FCC. (2009, October 22). In the Matter of Preserving the Open Internet Broadband Industry Practices (GN Docket No. 09-191, WC Docket No. 07-52). Retrieved from http://hraunfoss.fcc.gov/edocs_public/ attachmatch/FCC-09-93A1.pdf

175. Public Knowledge. (2010). Joint Comments of Computer and Communications Industry Association, Consumer Electronics Association, Electronic Frontier Foundation, Home Recording Rights Coalition, NetCoalition, and Public Knowledge on the Matter of Copyright Infringement in the Open Internet Rules. Retrieved from http://www.publicknowledge.org/pdf/joint-comments-copyright-nn-20100113.pdf

176. Tessler, J. (2010, April 18). FCC Abandons effort at net neutrality compromise. The Huffington Post. Retrieved from http://www.huffingtonpost.com/2010/08/05/fcc-

net-neutrality-effort_n_672472.html

177. Ibid.

178. Downes, L. (2011, February 23). Congress zeroes in on FCC's Net neutrality. CNet News. Retrieved from http:// news.cnet.com/8301-13578_3-20035056-38.html?tag=mncol;mlt_related

179. Reardon, M. (2011, January 31). FCC moves to dismiss Net neutrality lawsuits. CNet News. Retrieved from http://news.cnet.com/8301-30686_3-20030087-266.html

180. Supra text accompanying note 178, p. 15.

181. Ibid.

182. Ibid.

183. Eggerton, J. (2011, March 7). E&C Democrats Seek To Amend Net Neutrality Resolution. B&C Mobile. Retrieved from http://www.broadcastingcable.com/article/464885-E_C_Democrats_Seek_To_Amend_Net_Neutrality_Resolution.php

184. Gruenwald, J. (2011, March 3). Hearing on Net Neutrality Resolution Set. National Journal, Tech Daily Dose. Retrieved from http://techdailydose.nationaljournal.com/2011/03/hearing-on-net-neutrality-reso.php

185. OpenMedia.ca. (2010, August 9). US Internet Debacle a Wakeup Call for Canada [Press Release]. Retrieved from http://openmedia.ca/node/2819

186. Supra note 168.

187. Hervas-Drane, A. (2010, July 22). Non-Cost-Raising Discrimination: A Rationale for Functional Separation in Broadband Open Access. SSRN. Retrieved from http://ssrn.com/abstract=1647020 at pp. 2.

188. Ibid.

189. Stevenson, J.H., Clement, A. (2010). Regulatory lessons for Internet traffic management from Japan, the European Union, and the United States: Toward equity, neutrality, and transparency. Global Media Journal - Canadian Edition, 3(1), 9-29. Retrieved from www.gmj.uottawa.ca/1001/v3i1_stevenson%20and%20clement.pdf

190. Ibid.

191. Larabie, C.L. (2010). Net Neutrality and the Public Interest: A Comparative Analysis of Canada, the UK, Australia and Japan. Digital Commons@McMaster, Paper 7. Retrieved from http://digitalcommons.mcmaster.ca/cmst_grad_research/7 at p.38

192. Benkler, Y., Faris, R., Gasse, U., Miyakawa, L., & Schultze, S. (2010). Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world. Harvard University: The Berkman Center for Internet & Society.

193. Supra note 191.

194. Bourreau, M., & Dogan, P. (2004). Service-based vs. Facility-based Competition in Local Access Networks. Information Economics and Policy, 16, 287-306.

195. Supra text accompanying note 189, p. 13.

196. Ibid., p. 14.

197. Ibid.

198. Supra text accompanying note 191, p. 39.

199. Kushida, K., & Oh, S. (2007). The Political Economies of Broadband Development in Korea and Japan. Asian Survey, 47(3), 481-504.

200. Supra text accompanying note 192, p. 141.

201. Ibid.

202. OECD. (2009, October). "Average Monthly Subscription Price for Very High-Speed Connections". OECD Broadband Portal. Retrieved from http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html

203. Supra note 192.

204. Wholesale arms lease infrastructure and bandwidth to competing ISPs, while retail arms provide regular Internet access for homes, businesses, etc.

205. Supra text accompanying note 192, p. 84

206. Ibid.

207. Lasar, M. (2011, March 14). BT to UK Infinity subscribers: no more usage caps! Ars Technica. Retrieved from http://arstechnica.com/telecom/news/ 2011/03/bt-to-uk-fiber-subscribers-no-more-usage-caps.ars

208. Ibid.

209. Petrou, A. "Ofcom should wait before it pushes net neutrality rules". Techeye. net, Retrieved from February 2011 http://www.techeye.net/internet/ofcom-should-wait-before-it-pushes-net-neutrality-rules

210. Supra text accompanying note 192, p. 84

211. Ibid, p. 66.

212. Ibid., p. 81.

213. Ibid., p. 146.

214. Ibid., p. 306.

215. Ibid.

216. Band, A., & Cymru, E. (2005). Sweden Broadband Market Report 2005. Retrieved from www.broadbandwalesobservatory.org.uk/broadband-3045

217. Wallsten, S.J., & Hausladen, S. (2009, March). Net Neutrality, Unbundling, and their Effects on International Investment in Next-Generation Networks. Technology Policy Institute. Retrieved from http://www.techpolicyinstitute.org/files/wallsten_unbundling_march_2009.pdf

218. Benkler, Y., Faris, R., Gasse, U., Miyakawa, L., & Schultze, S. (2010). "Next Generation Connectivity: A review of broadband Internet transitions and policy from around the world." Harvard University: The Berkman Center for Internet & Society. 246.

219. Ibid., p. 150.

220. Ibid., p. 15.

221. Shaw, G. (2011, February 8). Shaw backs away from usage based Internet billing. The Vancouver Sun. Retrieved from http://www.vancouversun.com/Shaw+backs+away+from+usage+based+Internet+billing/4246226/story.html

222. OECD. (2009, October). Prevalence of explicit bit/data caps among surveyed offers, by country. OECD Broadband Portal. Retrieved from http://www.oecd.org/dataoecd/11/38/39575261.xls

223. Coffman, K.G., & Odlyzko, A. (2011, March). "Internet Growth: Is There a 'Moore's Law' for Data Traffic?" in Geist, M. Canada's Usage Based Billing Controversy: How to Address the Wholesale and retail Issues. Retrieved from http://www.michaelgeist.ca/component/option,com_docman/task,doc_download/gid,53/ at pp. 38-40.

224. Lasar, M. (2011, April 4). It could be worse: data caps around the world. Ars Technica. Retrieved from http://arstechnica.com/tech-policy/news/2011/04/how-internet-users-are-disciplined-around-the-world.ars

225. Geist, M. (2011, March) Canada's Usage Based Billing Controversy: How to Address the Wholesale and Retail Issues. Retrieved from http://www.michaelgeist.ca/component/option,com_docman/task,doc_download/gid,53/ at pp. 11-12.

226. Ibid.

227. Ibid.

228. Larabie, C.L. (2010). Net Neutrality and the Public Interest: A Comparative Analysis of Canada, the UK, Australia and Japan. Retrieved from Digital Commons@McMaster, Paper 7 http://digitalcommons.mcmaster.ca/cmst_grad_research/7 at p. 30.

229. Marsden. C.T. (2007). Net Neutrality and Consumer Access to Content. SCRIPTed – A Journal of Law, Technology & Society, 4(4), 407-435.

230. Supra text accompanying note 218, p. 246.

231. Supra text accompanying note 225, p. 30.

232. Ibid.

233. Ibid.

234. Borrell, L., Gomez, I., Fernandez, G., Kende, M., & Allen, J. (2010, January 11). Strategic review of broadband regulatory policy in Chile. Analysys Mason. Report for the Susecretaria de Telecommunications (Subtel).

235. Thinq_. (2010, July 14). Chile first to enact network neutrality law. Thinq_ Web News. Retrieved from http://www.thinq.co.uk/2010/7/14/chile-first-enact-net-neutrality-law/

236. Vinas, S. (2010, September 4). Chile: First Country to Legislate Network Neutrality. BHRP. Retrieved from http://www.humanrightsblog.com/blog/2010/09/10/chile-first-country-to-legislate-net-neutrality?

237. Bibolini. L. (2010, February). Chile – Telecoms, Mobile, Broadband and Forecasts (9th ed.). Paul Budde Communications Publishing Ltd.

238. Supra note 236.

239. Supra note 237.

240. Ibid.

241. Ibid.

242. Supra note 236.

243. Supra text accompanying note 218, p. 168.

244. Ibid.

245. Digital Economy Consultation. (2010, May 9). Consultation Paper: Improving Canada's Digital Advantage. Retrieved from http://de-en.gc.ca/consultation-paper/consultation-paper-6/

246. Statistics Canada. (2008, April 24). The Daily: Electronic Commerce and Technology. Retrieved from http://www.statcan.gc.ca/daily-quotidien/080424/dq080424a-eng.htm

247. Statistics Canada. (2011, February 2). Gross domestic product at basic prices, by industry. Retrieved from http://www40.statcan.gc.ca/l01/cst01/ECON41-eng.htm

248. Digital Economy Consultation. (2010, May 9). Consultation Paper: Improving Canada's Digital Advantage. Retrieved from http://de-en.gc.ca/consultation-paper/consultation-paper-8/

249. Alliance of Canadian Cinema, Television and Radio Artists. (2009, July 9). Proceedings of CRTC on Decision: 2008-19. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0708.htm.

250. Standing Committee on Canadian Heritage, Emerging and Digital Media: Opportunities and Challenges. (2009, February 9). Retrieved from http://www2.parl.gc.ca/HousePublications/Publication.aspx?DocId=4838683&Language=E&Mode=1&Parl=40&Ses=3

251. Supra note 249.

252. Statistics Canada. (2010, May 5). Internet use by individuals, by type of activity. Retrieved from http://www40.statcan.gc.ca/l01/cst01/COMM29A-eng.htm

253. The Hollywood Reporter. (2010, December 2). Comedy Network Orders Picnicface TV Series. The Hollywood Reporter. http://www.hollywoodreporter.com/news/comedy-network-orders-picnicface-tv-55995

254. Zoom U. (2011, February 3). Usage Based Billing Stifles Innovation. Retrieved from http://zoomu.zoomwebvideo.com/index.php/2011/02/usage-based-billing-stifles-innovation/

255. Supra note 252.

256. Zamaria, C., & Fletcher, F. Canada Online! The Internet, media and emerging technologies: Uses, attitudes, trends and international comparisons. Canadian Internet Use Project. Retrieved from http://www.canadianinternetproject.ca/ at pp. 181.

257. Statistics Canada. (2010, March 3). Information and communications technology. Retrieved from http://www41.statcan.gc.ca/2009/2256/cybac2256_000-eng.htm

258. For more details about the project, see http://www.homelessnation.org/

259. Aung-Thwin, C. (2009, October 31). Celebrating HomelessNation.org. Message posted to http://www.homelessnation.org/en/node/17016

260. CRTC. (2010, October 12). Communications Monitoring Report. Retrieved from http://www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2010/cmr51.htm#f536

261. quoted from the IsumaTV mission statement, see the complete document here: http://www.isuma.tv/hi/en/about-us

262. Statistics Canada. (2010, September 27). Internet use by individuals, Internet shopping, by type of product and service. Retrieved from http://www40.statcan.gc.ca/l01/cst01/comm24-eng.htm

263. McKechnie, M. (Interviewer) & Ullrich, D. (Interviewee). (2008, April 28). "Dave Ullrich" [Interview] Retrieved from http://www.burnsidewriterscollective.com/reviews/music/u/dave_ullrich_interview0408.php

264. Supra text accompanying note 256, pp. 201.

265. Sandvine. (2010) Global Internet Phenomena Report 2010. Retrieved from http://www.sandvine.com/news/global_broadband_trends.asp

266. For more details about the transition to digital television, see: http://www.pch.gc.ca/eng/1282842415342/1282825604404

267. See Geist, M. (2008). Network Neutrality in Canada. In M. Moll & L.R. Shade (Eds.) For Sale to the Highest Bidder: Telecom Policy in Canada (73-82). Ottawa: Canadian Centre for Policy Alternatives. See also Barratt, N., & Shade, L.R. (2007). Net Neutrality: Telecom Policy and the Public Interest. Canadian Journal of Communication, 32(2), 295-305.

268. Wawro, A. (2010, August 9). Analysis: Is net neutrality good for gaming? UPDATE. Gamepro. Retrieved from http://www.gamepro.com/article/news/213652/analysis-is-net-neutrality-good-for-gaming-update/

269. Skinner, D., & Gasher, M. So Much by So Few: Media Policy and Ownership in Canada. In D. Skinner, J. Compton, & M. Gasher (Eds.) Converging Media, Diverging Politics: A Political Economy of News in the United States and Canada (51-76). Lanham, Maryland: Lexington Books.

270. Comments made by David Purdy, Vice President Video & Entertainment Products at Rogers Communications Inc. (2010, June 7). Canadian Telecom Summit

2010 on the Business Models 3.0 panel.

271. Documentary Organization of Canada. (2009, January 23). Initial Comments to Telecom Public Notice CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1030141.PDF at p. 1.

272. Bell. (2009, February 23). Initial Comments to PN CRTC 2008-19. Retrieved from http://www.crtc.gc.ca/public/partvii/2008/8646/c12_200815400/1029804.zip at p. 5.

273. For more about the SwarmPlayer, see its website http://swarmplayer.p2p-next.org/

274. Unknown. (2010, September 27). Video Labs: P2P Next Community CDN for Video Distribution. Wikimedia Technical Blog. Message posted to http://techblog.wikimedia.org/2010/09/video-labs-p2p-next-community-cdn-for-video-distribution/

275. CBC. (2008, March 26). ISPs limit access to CBC download, users say. CBC News. Retrieved from http://www.cbc.ca/technology/story/2008/03/26/bittorrent-cbc.html

276. Canadian Conference of the Arts. (2007, April 13). Final Submissions to CRTC, Diversity of Voices Proceeding, Reply Phase. Broadcasting Notice of Public Hearing CRTC 2007-5. Retrieved from http://support.crtc.gc.ca/applicant/docs.aspx?pn_ph_no=2007-5&call_id=57637&lang=E&defaultName=Canadian%20Conference%20of%20the%20Arts&replyonly=&addtInfo=&addtCmmt=&fnlSub=true

277. Ibid.

278. CRTC. (2010, October 12). Communications Monitoring Report. Retrieved from http://www.crtc.gc.ca/eng/publications/reports/PolicyMonitoring/2010/cmr51.htm#f536 See Table 4.3.16 and Table 4.3.17.

279. Supra note 252.

280. Statistics Canada. (2008, Deceber 12). Socio-demographic factors influencing use of the Internet. Retrieved from http://www.statcan.gc.ca/pub/56f0004m/2008016/findings-resultats/socio-eng.htm

281. Middleton, C., Veenhof, B., & Leith, J. (2010, March). Intensity of Internet Use in Canada: Understanding Different Types of Users. Ottawa: Statistics Canada. at pp. 17.

282. For more details about the Rip! project, see http://ripremix.com/

283. The project has closed, but an archive of the site is online, see http://www.opensourcecinema.org/project/rip2.0

284. For more details about Web Made Movies, see http://webmademovies.org/about

285. C. Zamaria, C., & Fletcher, F. (2008). Canada Online! The Internet, media and emerging technologies: Uses, attitudes, trends and international comparisons 2007 at pp. 101.

286. Ibid., pp. 194-195.

287. Supra note 268.

288. Blizzard Entertainment. (2010, October 7). WORLD OF WARCRAFT® SUBSCRIBER BASE REACHES 12 MILLION WORLDWIDE. Retrieved from http://us.blizzard.com/en-us/company/press/pressreleases.html?101007/

289. Anderson, N. (2011, March 28). Oops: major Canadian ISP admits throttling World of Warcraft. Ars Technica. Retrieved from http://arstechnica.com/tech-policy/news/2011/03/oops-major-canadian-isp-admits-throttling-world-of-warcraft.ars/

290. Murphy, T. (2011, March 29). Complaint Regarding Rogers' Internet Traffic Management Practices (File No. 522253 and File No. 517209) Retrieved from http://openmedia.ca/sites/openmedia.ca/files/Rogers%20ITMP%20Complaint%20March%2029%202011.pdf/

291. Doctorow, C. (2009, March 19). We must ensure ISPs don't stop the next Google getting out of the garage. The Guardian. Retrieved from http://www.guardian.co.uk/technology/2009/may/19/we-must-ensure-google-garage

292. Dailey, D., Bryne, A., Powell, A., Karaganis, J., & Chung, J. (2010). Broadband Adoption in Low-Income Communities. Social Science Research Council.

293. Van Schewick, B. (2010). Internet Architecture and Innovation. Cambridge, Mass.: The MIT Press.

294. Qiang, Z, Rossotto, C., & Kimura, K. (2009). Information and Communications for Development 2009: Extending Reach and Increasing Impact. The World Bank (p. 37). Retrieved from http://issuu.com/world.bank.publications/docs/9780821376058

295. Berners-Lee, T. (2010, November 22). Long Live the Web: A Call for Continued OpenStandards and Neutrality. Scientific American, Retrieved from http://www.scientificamerican.com/article.cfm?id=long-live-the-web

296. Lawford, J., Lo, J., & De Santis, M. (November 2009). Staying Neutral: Canadian Consumers Fight for Net Neutrality. PIAC. Retrieved from http://piac.ca/downloads/NN_Report_MASTER_FINAL_website.pdf at p.4.

297. Von Hippel, E. (2005). Democratizing Innovation (p. 22). Cambridge, Mass.: The MIT Press.

298. See Ibid., pp. 66-70. For more information, see Cohen, W.M., & Levinthal, D.A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Sciences Quarterly, 35, 569-596. See Henkel, J., & von Hippel, E. (2004). Welfare Implications of User Innovation. The Journal of Technology Transfer, 30(1), 73-87. See Babe, R.E. (1995). Communication and the Transformation of Economics. Boulder, CO: Westview Press.

299. Coase, R. (1937). The Nature of the Firm. Economica, 4(16), 386–405.

300. For more information, see Arora, A., & Gambardella, A. (1994). "Evaluating tecnological information and utilizing it" In Scientific knowledge, technological capability, and external linkages in biotechnology. Journal of Economic Behavior and Organization, 24, 91-114. See Henkel, J., & Von Hippel, E. (2004). Welfare Implications of User Innovation. The Journal of Technology Transfer, 30(1), 73-87. See Melody, W. (1987). Information: An Emerging Dimension of Institutional Analysis, Journal of Economic Issues, 21(3), 1313–39. See also Hayek, F. (1945). The Use of Knowledge in Society. American Economic Review, 35(4), 519–30.

301. Goldsmith, J., & Wu, T. (2006). Who Controls the Internet? Illusions of a Borderless World. Oxford: Oxford University Press.

302. Van Schewick, B. (2010). Internet Architecture and Innovation (p.10). Cambridge, Mass.: The MIT Press.

303. Ibid., p. 217.

304. For an excellent discussion of this kind of anti-competitive practice, where subscribers are held as 'hostages,' see Adam Rothchild's discussion of the peering disputes between Comcast, an American ISP, and Level 3, who is responsible for delivering Netflix traffic to Comcast customers. Rothchild, A. (2010, December 2). Peering Disputes: Comcast, Level 3, and You. Voxel. Retrieved from http://www.voxel.net/blog/2010/12/peering-disputes-comcast-level-3-and-you

305. Van Schewich, B. (2010). Internet Architecture and Innovation (p.323). Cambridge, Mass.: The MIT Press.

306. Anderson, C. (2009). Free: The Future of a Radical Price. New York: Hyperion.

307. For an example of this, see Middleton, C. (2003). "What If There Is No Killer Application? An Exploration of a User-Centric Perspective on Broadband.Ted Rogers School of Information Technology Management Publications and Research. Retrieved from http://digitalcommons.ryerson.ca/trsitm/2

308. Van Schewich, B. (2010). Internet Architecture and Innovation (p.323). Cambridge, Mass.: The MIT Press.

309. B. Van Schewich. (2010). Internet Architecture and Innovation (p.264). Cambridge, Mass.: The MIT Press.

310. Bode, K. (2010, December 14). Rogers' New Throttling System Cripples Speeds - And Inadvertently impacting non-P2P applications. DSLReports. Message posted to http://www.dslreports.com/shownews/Rogers-New-Throttling-System-Cripples-Speeds-111830

311. Scott, B. (2010, December 14). Preserving the Open Internet Broadband Industry Practice. Free Press. Retrieved from http://www.freepress.net/files/Free_Press_09-191_Comments.pdf

312. Van Schewich, B. (2010). Internet Architecture and Innovation (p.260). Cambridge, Mass.: The MIT Press.

313. Grewal, D. Iyer, G.R., & Levy, M. (2004). Internet retailing: enablers, limiters and market consequences. Journal of Business Research, 57, 703-713.

314. Statistics Canada. (2009). E-commmerce: Shopping on the Internet (2005-2009). Retreived from http://www.statcan.gc.ca/daily-quotidien/100927/dq100927a-eng.htm

315. Ibid.

316. Ibid.

317. Constantinides, E., Romero, C., & Boria, M. (2008). Social Media: A New Frontier for Retailers? European Retail Research, 22, 1-28.

318. Blizzard Entertainment. (2011). FAQ. Retrieved from http://us.blizzard.com/en-us/company/about/legal-faq.html

319. Cash, A. (2010, April 3). Bell's Web Choke. Now Magazine. Retreived from http://www.nowtoronto.com/news/story.cfm?content=162439

320. Lasalle, L. (2010, July 16). Canada is among top video game developers with its home-grown titles. The Globe and Mail. Retreived from http://www.theglobeandmail.com/news/technology/canada-is-among-top-video-game-developers-with-its-home-grown-titles/article1642278/

321. Brun, J., Safaei, F., & Boustead, P. (2005). Fairness and playability in online multiplayer games. University of Wollongong: Faculty of Informatics. Retreived from http://ro.uow.edu.au/infopapers/232

322. Wawro, A. (2010, August 9). Analysis: Is net neutrality good for gaming? GamePro. Retrieved from http://www.gamepro.com/article/news/213652/analysis-is-net-neutrality-good-for-gaming-update/

323. CRTC. (2009, July 14). Transcript of Proceeding. Retrieved from http://www.crtc.gc.ca/eng/transcripts/2009/tt0714.htm See line 6825: "in designing and implementing ITMPs to improve the overall experience for the vast majority of users."

324. See Bell. "Network Management" In Troubleshooting FAQ here http://service.sympatico.ca/index.cfm?method=content.view&content_id=12119. Bell explains throttling to its customers as such: Bell is using the latest, state-of-the-art technology to improve the customer experience for a vast majority of our customers' favourite applications (such as Internet Browsers, E-mail, Instant Messaging, Streaming Video, etc.) as required during peak periods on the Internet, while ensuring all customers receive fair use of the network when there is heavy Internet traffic.

325. Noam, E.M. (1992). Network Tipping and the Tragedy of the Common Network: A Theory of the Instability of Public Telecommunications Systems. In C. Antonelli (Ed.), The Economics of Information Networks, (107-127). North-Holland: Elsevier. Retreived from http://home.himolde.no/~molka/in765/network-tipping-noam.pdf

326. CRTC. (2009). Telecom Regulatory Policy CRTC 2009-657. Retrieved from http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm at paras. 74-76.

327. Marsden, C.T. (2007). Net Neutrality and Consumer Access to Content. SCRIPTed, 4(4), 416. Retrieved from http://www.law.ed.ac.uk/ahrc/script-ed/vol4-4/marsden.pdf

328. Ibid.

329. Benkler, Y. (2003). The Political Economy of the Commons. European Journal for the Informatics Professional 6, 4(3), 8. Retreived from http://www.benkler.org/Upgrade-Novatica%20Commons.pdf

330. Van Schewich, B. (2010). Internet Architecture and Innovation (p. 317). Cambridge, Mass.: The MIT Press.

331. Handler, C.E. (2009, February 23). The Struggle Over 'Net Neutrality' - New developments heat up this vital Internet and e-commerce issue. Law Technology News. Retreived from http://www.law.com/jsp/lawtechnologynews/PubArticleLTN.jsp?id=1202428474927

332. Werbach, K. (2010, August 18). Why Network Neutrality Is Good for Business. Harvard Business Review Blog. Message posted to http://blogs.hbr.org/cs/2010/08/why_network_neutrality_is_good.html

333. Internet Business Law Service. (2007, May 21). INTERNET LAW - 'Net Neutrality' Laws Will Cause $70 Billion Loss. Retrieved from http://www.ibls.com/internet_law_news_portal_view.aspx?id=1760&s=latestnews

334. Grewal, D., Iyer, G.R., & Levy, M. (2004). Internet retailing: enablers, limiters and market consequences. Journal of Business Research, 57, 703-713.

335. eBay Main Street. (2010). Public Policy for the E-commerce World - Net Neutrality, eBay. Retrieved from http://www.ebaymainstreet.com/policy-papers/net-neutrality

336. Qiang, Z., Rossotto, C., & Kimura, K. (2009). Information and Communications for Development 2009: Extending Reach and Increasing Impact. The World Bank (p. 45). Retrieved from http://issuu.com/world.bank.publications/docs/9780821376058

337. Ibid., p. 43.

338. Nabipay P., Odlyzko A., & Zhang, Z. (2011). Flat Versus Metered Rates, Bundling, and 'Bandwidth Hogs' (p.1). Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1829784

339. Ibid., p. 6.

340. Ibid., pp. 1- 2.

341. Industry Canada. (2010, November). Information and Communications Technologies Statistical Overview. Retrieved from http://www.ic.gc.ca/eic/site/ict-tic.nsf/vwapj/0105864eng.pdf/$FILE/0105864eng.pdf

342. Government of Canada. (2010). Consultation Paper on a Digital Economy Strategy

for Canada. Retrieved from http://de-en.gc.ca/consultation-paper/consultation-paper-6

343. Ibid.

344. Arbor. (2009, February 23). Comments to Telecom Public Notice 2008-19, Response to PN question 2(d). Retrieved from http://www.crtc.gc.ca/partvii/eng/2008/8646/c12_200815400.htm

345. CRTC. (2009, October 21). Review of the Internet traffic management practices of Internet service providers. Retrieved from http://www.crtc.gc.ca/eng/archive/2009/2009-657.htm

346. Organization for Economic Cooperation and Development (2009). Communications Outlook 2009. Paris: OECD. pp 115.

347. See Ibid. pp 141; and Canadian Radio-television and Telecommunications Commission (CRTC). (2010). Communications monitoring report. Retrieved from www.crtc.gc.ca/eng/publications/reports/policymonitoring/2010/2010MonitoringReportFinalEn.pdf

348. Organization for Economic Cooperation and Development (2009). Communications Outlook 2009. Paris: OECD. pp 116.

349. Ibid. pp. 141-143

350. See "Are there other applications that could be impacted by Rogers'/Bell's traffic management measures?" here http://www.rogers.com/web/content/network_management See also http://service.sympatico.ca/index.cfm?method=content.view&content_id=12119

351. Specifically, Telecom Regulatory Policy 2009-657 requires ISPs to make public their uses of technical and economic traffic management practices – practices that are presently used to discriminate against and delay certain kinds of Internet traffic.

GLOSSARY OF KEY TERMS

BANDWIDTH CAPS: A limit on the amount of data that may be transferred over a network in a defined period of time. This generally limits the amount of data users may upload or download via their Internet connection without paying additional fees, typically over a monthly period.

CLOUD COMPUTING: The usage of remote servers to store, host, process, and manage data as an alternative to performing those operations on a local computer.

COMMON CARRIAGE PRINCIPLE: The principle that owners of infrastructure must allow all traffic to flow through that infrastructure without discrimination. Common carriage provisions require carriers to commit that each customer should have the same opportunity as any other customer to buy the same service, and transmit the same data, on the same terms, as any other customer.

CRTC (THE CANADIAN RADIO-TELEVISION AND TELECOMMUNICATIONS COMMISSION): The independent regulatory organization for broadcasting and telecommunications in Canada. According to its website, the CRTC's mandate is to ensure that broadcasting and telecommunication systems serve the Canadian public.

DPI (DEEP PACKET INSPECTION): A networking technology used by ISPs that controls the flow of network traffic. It examines the headers and payloads of the elements of each piece, or packet, of network traffic. The header contains information necessary for delivery (sender's and recipient's IP addresses, how to reassemble the information, etc.). The payload contains the content of the transmission. DPI raises competition and privacy concerns because it allows for the examination of unencrypted data transmissions and the prioritization or discrimination of transmissions based on their content.

E-COMMERCE (ELECTRONIC COMMERCE): Business transactions that are conducted electronically, especially over the Internet. The term encompasses buying and selling goods and services, as well as advertising, customer service, and marketing.

END-TO-END PRINCIPLE: A principle of network design calling for an architecture of 'dumb pipes', where the ends of the network (sender and receiver) exchange information with minimal interference or interruption by the network. The pipes of a network are 'dumb' because they know little about the content of the packages they are carrying from one end to another and most activity requiring network intelligence, such as reassembling and making sense of packets, resides on devices at the ends of the network.

FACILITIES-BASED COMPETITION: When new entrants compete in the telecommunications market by building their own infrastructure. This type of competition faces barriers to market entry because of the significant sunk capital costs required to develop broad-based competition in national markets.

FCC (FEDERAL COMMUNICATIONS COMMISSION): An American government agency that regulates interstate and international communications by radio, television, wire, satellite, cable, and, by extension, the Internet (though this aspect of its regulatory power has been in dispute).

FUNCTIONAL SEPARATION: Separates the incumbent's infrastructure ownership from its retail Internet access operations. In many cases, incumbent providers own this infrastructure through a complex series of transactions, sometimes including the move from being a Crown corporation or public sector entity to a privately owned business.

ICT SYSTEMS (INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEMS): Communications technology systems consisting of hardware, software, data and the people who use them.

INCUMBENT PROVIDERS: Companies that have been long-term actors in a market and are dominant in terms of their regional market power. In telecommunications, incumbent providers control key elements of the national telecommunications network, such as communications lines entering consumers' homes and businesses. Providers often enjoy natural monopolies or oligopolies, and this gives them considerable market power in comparison to newer, competing providers.

ISPS (INTERNET SERVICE PROVIDERS): An ISP is a company that provides access to the Internet. ISPs connect customers to the Internet using copper, cable, wireless or fiber connections. Big Canadian ISPs include, primarily, Shaw, Bell, Rogers, Videotron and Telus. Independent ISPs include TekSavvy, Acanac, and Telnet Communications. Find more at: <http://www.openmedia.ca/meter/resources#isp>.

ITMP (INTERNET TRAFFIC MANAGEMENT PRACTICE): Any measure an ISP implements to intentionally mediate the flow of data traffic along its network, whether by technical or economic means, in order to address network congestion.

NET NEUTRALITY: The principle that the Internet should be a level playing field for all users. Neutrality infers that ISPs should not discriminate against certain applications or websites by selectively blocking, speeding up, slowing down, or preferencing any web content, services or users.

OPEN ACCESS POLICIES: Regulations that attempt to ensure fair access to network infrastructure – i.e. the pipes used to bring the Internet to users' homes – by enabling competitive, non-incumbent service providers to effectively and efficiently compete with incumbent providers.

OPEN INTERNET: The public Internet where users are empowered to decide what practices, content, services and applications gain popularity, capture imaginations, and proliferate. This means a neutral network where connections are affordable, found at internationally comparable speeds, within reach of all Canadians and, ideally, ubiquitous.

P2P (PEER-TO-PEER): A decentralized model of Internet communication where users share information directly with each other as opposed to through a third-party server. P2P applications allow users to share content directly with other interested peers. The exchange (uploading and downloading) between peers creates a greater pool of shared content without requiring expensive centralized servers to host downloadable content.

QUALITY OF SERVICE: A term that refers to the importance placed on getting a particular data packet to its destination. Internet communications were designed to function on a 'best-efforts' basis. Internet service designers build their applications in a manner that assumes not each and every packet or piece of information will reach its destination. The ISP obligation in this scenario is to make its 'best effort' to deliver all packets to their destination as quickly as possible. Many Internet applications have been designed on this model, including time-sensitive VoIP services such as Skype. Quality of Service protocols permit ISPs to discriminate or privilege certain types of traffic over others. For example, an ISP may prioritize a VoIP conversation to ensure high-quality voice communications while slowing down a P2P session, making the file exchange take longer.

SERVICE-BASED COMPETITION: A measure that ensures entrants' access to incumbents' infrastructure. Entrants use the facilities of the incumbent provider either through wholesale or unbundled access. Through wholesale, incumbents are usually required to lease infrastructure to competitors at wholesale prices. Unbundled access requires incumbents to make available hard-to-duplicate telecommunications infrastructure on a non-discriminatory basis in a manner that is financially fair and technically feasible.

TIERED INTERNET: An Internet business model where ISPs create tiers of service, and charge for access. Tiers refer both to the different levels of Internet sold to home users and to the different delivery models sold to content producers, such as access to video-on-demand.

THROTTLING: The slowing down or blocking of Internet applications in order to make space for other traffic on an ostensibly congested network.

UPSTREAM/DOWNSTREAM: Upstream refers to the outgoing transmission of data from a users' computer. It can be a request from a server to provide a specific webpage, it could be an email sent to email server, a file being uploaded to another user through a P2P client, or a voice communication to another VoIP user, Downstream refers to incoming Internet transmissions that a user's computer receives, such as a web page, a streaming movie, any file download (P2P or otherwise), or an incoming conversation via VoIP,

USAGE-BASED BILLING (A.KA. METERING, UBB): A billing system for Internet use that charges consumers on a per-byte, megabyte, or gigabyte basis. Under this system, users are charged on the basis of how much they upload and download, typically over the course of a monthly period. Usage-based billing is sometimes referred to as an economic Internet traffic management practice because it is meant to reduce Internet congestion.

USER-GENERATED CONTENT (UGC): Content created by the general public and shared on the Internet. Its creators are typically non-professional, non-commercial producers, such as independent bloggers, home video producers or Wikipedia editors.

It differs from content generated by traditional media producers, such as professional television producers, mainstream newspapers and pop artists. User-generated content depends upon the democratization of media production through new technologies that are accessible, affordable, and easily used.

VERTICAL INTEGRATION: An arrangement where one company owns or controls a set of companies that supply each other products, such as where cable or satellite television distributors also own the television channels they distribute. Within the telecommunications industry it typically refers specifically to firms controlling access to Internet content, traditional dissemination systems (e.g. television lines, radio), content acquisition, and content creation processes.

VOICE OVER INTERNET PROTOCOL (VOIP): Technology that allows voice calls to be made over computer networks.

WEB 2.0: A term for Internet services that emphasize interactions between users in often collaborative or participatory ways. This is distinguished from 'Web 1.0', where users visited online sources but were unable to significantly interact with the owner of the source or other visitors. Examples of Web 2.0 services include blogging, social networking services, and social gaming services.