Know Your Limits

Considering the Role of Data Caps and Usage Based Billing in Internet Access Service

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Executive Summary

Usage-based pricing, today most commonly encountered in the form of data caps, is rapidly becoming part of the Internet access landscape. Wired and wireless Internet service providers – most of whom had traditionally operated on an unlimited basis – are evaluating or implementing pricing strategies that limit the amount of data a customer can use, charge customers for using data beyond a predetermined amount, or combine the two.

Although some providers have been quick to embrace these pricing structures, consumers have generally not been enthusiastic, and have often expressed strong protests. For their part, regulators have largely avoided asking even basic questions about this trend.

This whitepaper is an attempt to begin a serious consideration of usage-based pricing. It attempts to move beyond rhetoric and recognizes that usage-based pricing is a tool. As with any tool, usage-based pricing can be used for both productive and destructive ends. Sometimes these ends are intentional. Other times, they are a byproduct of other goals or even a lack of careful consideration.

Regardless of the motivation driving its implementation, usage-based pricing has the potential to significantly impact how networks are designed and used. This, in turn, impacts the innovation that relies on those networks. Before deciding if and when usage-based pricing is desirable, it is critical to fully understand the history of usage-based pricing, how it impacts markets, and both the benefits and harms that such a model can bring.

This paper aims to explain the basic issues surrounding usage-based versus flat-rate pricing. Section I examines the trend towards usage-based pricing in both the wired and wireless markets. Section II then considers the benefits and justifications for using usage-based pricing. This is followed in Section III by a review of the history and economics of flat rate pricing. Since broadband access is central to so many national and societal goals, the penultimate section – Section IV – discusses the problems that might be caused by usage-based pricing. Finally, we end with a series of conclusions and recommendations for responsible implementation of usage-based pricing.

Introduction

Last year, three events drew considerable attention to the burgeoning issue of broadband data caps and usage-based pricing (UBP) for broadband services.

First, the Canadian Radio-television and Telecommunications Commission (CRTC) – the Canadian equivalent of the American Federal Communications Commission (FCC) – reviewed its decision that allowed broadband service providers to implement wholesale usage-based-billing.[1] Although limited to wholesale access to independent ISPs, the hearings have echoed and in some instances presaged issues related to UBP at the retail level in the United States.

Second, Verizon Wireless joined AT&T and T-Mobile in implementing UBP for all new subscribers to its service, leaving Sprint the lone provider among the big four U.S. wireless service providers (AT&T, Verizon, Sprint and T-Mobile) that offers unlimited data plans to its new subscribers. Verizon's move led many commentators to suggest that UBP is inevitable for both wireless and fixed broadband providers.[2]

Third, Comcast shut off the Internet connection of Andre Vrignaud, a Seattle-based gaming consultant who relies on the Internet for a number of personal and professional activities, after he exceeded its 250 GB monthly cap on broadband data transfers.[3] Although several factors

[1] Canadian Radio-Television and Telecommunication Commission, Telecom Notice of Consultation CRTC 2011-77-1, "Review of billing practices for wholesale residential high-speed access services," http://www.crtc.gc.ca/eng/archive/2011/2011-77-1.htm.

[2] See, e.g., John Moe. "The days of unlimited mobile are numbered. Sorry." NPR Marketplace (July 21, 2011), http://marketplace.publicradio.org/display/web/2011/07/21/tech-report-the-days-of-unlimited-mobile-data-are-numbered/?refid=0.

[3] Ryan Singel, "Comcast Bans Seattle Man From Internet for His Cloudy Ways" Wired Epicenter (July 13, 2011), http://www.wired.com/epicenter/2011/07/seattle-comcast/.

contributed to Mr. Vrignaud exceeding Comcast's threshold, his use of cloud-based storage services was significant among them. Vrignaud may not have been the first person to run into the data cap, but the publicity surrounding his case shows the increased attention that UBP is attracting.

Taken together, these three events show that UBP is evolving into an industry standard that raises serious issues for consumers, regulators, and industry participants due to its profound implications for competition, innovation and the role that the Internet plays in the lives of individuals.

This paper explores those implications. The goal of this paper is not to argue for or against UBP. As Public Knowledge and others have stated elsewhere, it is not impossible to implement data caps in a reasonable manner,[4] nor is there anything inherently problematic about offering consumers usage-based pricing *options*. These are merely tools that, like all tools, have legitimate and illegitimate uses. As discussed below, UBP can lead to lower costs for consumers, more efficient use of bandwidth, and other benefits. However, those benefits must be weighed against the potential negative impact UBP may have on the way individuals use the Internet. UBP has the potential to deter the very uses of the Internet that have made broadband adoption a national priority – such as distance learning and telecommuting – as well as to limit growth in emerging Internet businesses such as cloud computing, over-the-top (OTT) video, and music streaming services.

Those potential concerns take on added significance because most Internet access providers that have moved to UBP present it not as one option among many but as the sole means for accessing broadband service. Indeed, by some estimates more than half of the U.S.'s 75 million fixed

[4] See, e.g. Letter from Public Knowledge and New American Foundation's Open Technology Initiative to Sharon Gillett, Chief, Wireline Competition Bureau, FCC, May 6, 2011, http://www.publicknowledge.org/letter-to-FCC-on-ATT-Data-Caps.

broadband subscribers are already subject to some kind of usage cap.[5]

[5] Martin Vilaboy, "The Move to Metered," ChannelVision Magazine, May-June 2011, 22, 24 (2011), http://channelvisionmag.com/documents/CV_MayJune11/.

Discussion

I. THE TREND TOWARD USAGE-BASED PRICING

Although there is some variation in both terminology (UBP is often referred to as "metered," "tiered," or "consumption-based" pricing or billing) and terms of individual plans, UBP plans for fixed and mobile broadband service generally involve a capped allotment of monthly data usage, measured in gigabytes (GB), followed by either a series of overage charges, degraded network performance after the cap is reached, or, in some cases, disconnection from the network entirely. Generally speaking, both upstream and downstream data transfer count toward these limits.

A. Wireline

In a sense, broadband caps are nothing new. Comcast implemented its current 250 GB data cap in 2008, the same year that the FCC concluded its inquiry into the company's throttling of peer-to-peer applications.[6] In a September 2008 filing detailing its then-current and planned network management practices, Comcast announced that it would be implementing the cap as part of its "Acceptable Use" policy, but sought to distinguish the cap from practices aimed at addressing network congestion:

> [C]ongestion management practices are independent of, and should not be confused with, our recent announcement that we will amend the "excessive use" portion of our Acceptable Use Policy, effective October 1, 2008, to establish a specific monthly data usage threshold of 250 GB per account . . . That cap does not address the issue of network congestion, which results from traffic levels that vary from minute to minute . . .

[6] *In re Formal Compl. of Free Press & Public Knowledge Against Comcast Corp. for Secretly Degrading Peer-to-Peer Applications*, 23 F.C.C.R. 13,028 (2008).

> As with the existing policy, a user who violates the excessive use policy twice within six months is subject to having his or her Internet service account terminated for one year.[7]

Although Comcast did not justify data caps or UBP as a congestion management practice, the FCC's earlier Opinion and Order penalizing the company's throttling of P2P traffic did. The Order noted that "Comcast has several available options it could use to manage network traffic without discriminating as it does. Comcast could cap the average users' capacity, and then charge the most aggressive users overage fees."[8]

More recent statements by Comcast have adopted this congestion-related justification for its cap. Responding to press inquiries after Comcast kicked Andre Vrignaud off its network for violating the Acceptable Use Policy, a company spokesman explained that "[i]f someone's behavior is such that degrades the quality of service for others nearby – that's what this threshold is meant to address."[9]

Time Warner Cable also launched UBP on a trial basis in 2008. The two-tier system offered subscribers in Beaumont, Texas a 768 Kbps connection with a data cap of 5 GB for $29.95 per month or a 15 Mbps connection with a data cap of 40 GB for $54.90 per month. Both plans charged $1 per GB over the cap.[10] In justifying the tiered and metered service, a Time Warner spokesman noted that five percent of subscribers accounted for roughly 50

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[7] Letter of Comcast Corp. *In re re Formal Compl. of Free Press & Public Knowledge Against Comcast Corp. for Secretly Degrading Peer-to-Peer Applications*, attachment B at 1 n. 3 (Sept. 19, 2008).

[8] *In re Formal Compl. of Free Press & Public Knowledge Against Comcast Corp. for Secretly Degrading Peer-to-Peer Applications*, 23 F.C.C.R. 13,028 (2008)..

[9] Ryan Singel, "Comcast Bans Seattle Man From Internet for His Cloudy Ways" Wired Epicenter (July 13, 2011), http://www.wired.com/epicenter/2011/07/seattle-comcast/.

[10] Ryan Paul, "40GB for $55 per month: Time Warner bandwidth caps arrive," Ars Technica (June 2008), http://arstechnica.com/old/content/2008/06/40gb-for-55-per-month-time-warner-bandwidth-caps-arrive.ars.

percent of network usage.[11] According to one study of the Beaumont trial, 14 percent of the 10,000 customers enrolled in the trial exceeded their caps, resulting in average overage charges of $19 per month.[12]

In terms of public perception, the trial did not go well. Consumers, advocacy groups and some policymakers criticized the data caps heavily, even after Time Warner Cable raised the GB thresholds and implemented additional pricing tiers for higher-bandwidth users.[13] By April 2009, Time Warner Cable CEO Glenn Britt announced that the company would cease expansion of the Beaumont trial to other market areas, stating that "[i]t is clear from the public response over the last two weeks that there is a great deal of misunderstanding about our plans to roll out additional tests on Consumption Based Billing."[14]

AT&T conducted a similar limited trial of UBP in Reno, Nevada – and, curiously, Beaumont, Texas – from November 2008 until April 1, 2010. Consumers under AT&T's trial plans fared slightly better than under Time Warner's, with caps ranging from 20 to 150 GB and overages charged at $1 per GB. At the conclusion of the trial, AT&T spokeswoman Dawn Benton said the company was "reviewing

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[11] "Time Warner tests billing by Web use," USA Today (Jan. 17, 2008), http://www.usatoday.com/tech/products/services/2008-01-17-time-warner-tiered-web_N.htm.

[12] Subhajyoti Bandyopadhyay, Hsing K. Cheng and Hong Guo, "Usage-Based Pricing and Broadband Users Differentiation," Working Paper for Public Utility Research Center (Nov. 2009) at 4, *available at* http://warrington.ufl.edu/purc/purcdocs/papers/0929_bandyopadhyay_user-based_pricing_and%20.pdf.

[13] http://bits.blogs.nytimes.com/2009/04/09/time-warners-unlimited-bandwidth-plan-150-a-month/

[14] Statement of Glenn Britt, Time Warner Cable Executive Officer, (April 16, 2009), http://www.timewarnercable.com/corporate/announcements/cbb.html.

the data from the trial, and this feedback will guide as we evaluate our next steps."[15]

While AT&T was evaluating its next steps, the FCC gave UBP an unequivocal green light. Industry stakeholders urged the FCC to expressly allow "bandwidth- or consumption-based" billing to address network congestion and some in the public interest community were in agreement.[16] Industry analysts have suggested that the FCC's endorsement of UBP was a necessary precondition of the broadband industry's support for net neutrality rules.[17] Shortly before the FCC adopted its Open Internet Order in December 2010, Chairman Genachowski extolled "the importance of business innovation to promote network investment and efficient use of networks, including measures to match price to cost such as usage-based pricing."[18] The Order itself similarly adopts the reasoning that UBP can be an effective mechanism to ensure that consumers pay for what they use: "The framework we adopt today does not prevent broadband providers from asking subscribers who use the network less to pay less, and subscribers who use the network more to pay more."[19]

With the FCC's tacit approval, AT&T instituted nationwide UBP on May 2 of

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[15] Peter Svensson, "AT&T ends test of data limits for DSL subscribers," USA Today (June 16, 2010), http://www.usatoday.com/tech/news/2010-06-16-att-data-test_N.htm.

[16] *See* Reply Comments of American Cable Association, GN Docket No. 09-191 (April 26, 2010) at 5. *See also,* Comments of the Center for Democracy and Technology, GN Docket No. 09-191 (Jan. 14, 2010) at 25-26; Comments of the Computer and Communications Industry Association, GN Docket No. 09-191 (Jan. 13, 2010) 14.

[17] Craig Moffett, "Weekend Media Blast: The Pricing Plan," Bernstein Research (May 13, 2011) at 2.

[18] Stacey Higginbotham, "FCC Open the Door for Metered Broadband," GigaOm (Dec. 1, 2010), http://gigaom.com/2010/12/01/fcc-opens-the-door-for-metered-web-access/. (A senior FCC official later clarified to Stacey Higginbotham of GigaOM that "[u]sage-based pricing can create more choice and flexibility for consumers. But practices that are arbitrary, anti-consumer, or anti-competitive would cause serious concern. The FCC will be a cop on the beat for consumers.")

[19] Preserving the Open Internet, GN Docket No. 09-191; Broadband Industry Practices, WC Docket No. 07-52, "Report and Order, " FCC 10-201 (Dec. 23, 2010) at 41 (Open Internet Order).

2011, capping the monthly usage of subscribers to AT&T's DSL service at 150 GB and subscribers to its higher speed U-Verse at 250 GB. Both plans charge users $10 per additional 50 GB after exceeding the caps. In a statement to the website *Ars Technica*, AT&T said that less than two percent of its customers, "those who are using a disproportionate amount of bandwidth," would be impacted by the caps.[20] Customers receive warnings when they reach 65 percent, 90 percent and 100 percent of their monthly caps.

At the time, Bernstein Research Senior Analyst Craig Moffett predicted that AT&T's "move marks the beginning of the end of unlimited broadband."[21] As discussed above, Comcast's Acceptable Use Policy caps monthly broadband usage at 250 GB, with a notice to the customer after the first violation and termination after the second if it is within the same six-month period.[22] Its Acceptable Use Policy aside, Comcast's public statements about whether and when it will move to more fine-grained UBP have been ambiguous. Speaking at Barclays Capital Global Communications, Media, and Technology Conference in May of last year, Comcast CFO Mike Angelakis stated:

> first of all be clear, we're not adopting it. Obviously we are watching it.
> …
> We've deployed the instrumentation that people need to sort of gauge how much they're using, and if we ever wanted to go to usage-based billing or consumption-based billing, we could possibly do that. I don't know why we would disrupt a pretty good run we're having right now. We feel really good about our capacity and our

[20] Nate Anderson, "Is AT&T's new 150GB DSL data cap justified?" Ars Technica (Mar. 2011) http://arstechnica.com/tech-policy/news/2011/03/is-atts-new-150gb-dsl-data-cap-justified.ars. AT&T stated that an average DSL user on its network transfers 18 GB per month.

[21] Craig Moffett, "Weekend Media Blast: The Pricing Plan," Bernstein Research (May 13, 2011) at 1.

[22] "Comcast Acceptable Use Policy for High-Speed Internet" http://www.comcast.com/Corporate/Customers/Policies/HighSpeedInternetAUP.html.

> capability to continue to manage additional bandwidth needs.[23]

In February of 2012 Time Warner Cable took tentative steps towards testing a new UBP scheme in a few test markets in Texas. Conceding that its previous attempt "didn't go so well," this time around Time Warner Cable subscribers will have the option to opt into a metered 5 GB per month plan for a slight discount on their monthly bill.[24]

For its part, Verizon has disavowed any immediate plans to move to UBP but continues to mull over the possibility. In an official statement, the company said that it is "continuing to evaluate usage-based pricing for our wireline broadband customers . . . At this point, we've not implemented any usage controls or broadband caps."[25]

B. Wireless

Compared to wireline service, the move toward UBP among major wireless service providers in the United States has been almost uniform and unequivocal. As noted above, on July 7, 2011, Verizon Wireless transitioned to UBP, with existing customers grandfathered into their unlimited plans. New Verizon subscribers can choose from three monthly tiers: $30 for 2 GB, $50 for 5 GB or $80 for 10 GB. Under all three tiers, subscribers will pay $10 per GB after hitting their cap. Verizon also implemented its "Network Optimization" policy in September of that year. Under this policy, the top 5 percent of users with unlimited 3G data plans (currently defined as those who use more than 2 GB of data

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[23] Mike Angelakis, Comcast Corp at Barclays Capital Global Communications, Media, and Technology Conference, May 24, 2011. Thomson StreetEvents Final Transcript at 3-4.

[24] Jeff Simmermon, "Launching An Optional Usage-Based Broadband Pricing Plan in Southern Texas," TWCableUntangled (Feb. 27, 2012) http://www.twcableuntangled.com/2012/02/launching-an-optional-usage-based-pricing-plan-in-southern-texas-2/.

[25] Richard Mullins, "Your broadband provider may start pay-as-you-go pricing," Tampa Bay Online (June 23, 2011) http://www2.tbo.com/business/tech/2011/jun/23/your-broadband-provider-may-start-pay-as-you-go-pr-ar-239260/#comments. As discussed below, Verizon has imposed UBP on its wireless customers.

per month) may be subject to lower data speeds when connected to a congested cell site.[26] Once a user has been deemed eligible for "optimization," that designation will remain in place for the current and the next billing cycles. Users under tiered data plans are not subject to the Network Optimization policy. Critics, including Public Knowledge, have observed that the policy is an unsubtle means of pushing heavy data users toward metered plans.[27]

AT&T Wireless instituted its UBP plans in 2010, offering three tiers with slightly lower monthly caps and prices than Verizon's: $15 for 200 MB, $25 for 2 GB and $45 for 4 GB.[28] After hitting the cap under the 2 GB and 4 GB plans, subscribers pay $10 for each GB. Subscribers to AT&T's 200 MB plan pay $15 for each additional 200 MB. Although pledging to grandfather existing customers with unlimited data plans, AT&T soon instituted a policy of throttling throughput speeds for the top 5 percent of data users under its legacy plan, in a move similar to Verizon's.[29] After considerably outcry from customers under "unlimited" plans who hit the throttling threshold after just over 2 GBs of data use, AT&T amended the policy to take effect only after customers exceeded a 3 GB cap in a billing cycle[30]. Data-only devices can access AT&T's Long-Term Evolution (LTE) networks in five U.S. markets under a $50 monthly plan, which

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[26] Verizon Wireless, "Network Optimization" http://support.vzw.com/information/data_disclosure.html.

[27] Michael Weinberg, "Verizon Uses Throttling to Push Customers Away from Unlimited Data," Public Knowledge (Sep. 19, 2011) http://www.publicknowledge.org/blog/verizon-uses-throttling-push-customers-away-u.

[28] In January 2012 AT&T changed its cap to $20 for 300 MB, $30 for 3 GB, and $50 for 5 GB.

[29] AT&T, "An Update for Our Smartphone Customers With Unlimited Data Plans," (July 29, 2011) http://www.att.com/gen/press-room?pid=20535&cdvn=news&newsarticleid=32318&mapcode=corporate. The pricing plans cited herein are for the Washington D.C. region but, as noted by the DOJ, "there is little or no regional variation in the pricing plans offered by the Big Four nationwide carriers." Compliant, United States, et. al. v. Comcast Corp. (D.D.C. 2011) at 9, www.publicknowledge.org/comcast-nbcu-complaint (DOJ Complaint).

[30] Peter Svensson, "AT&T relents on 'unlimited data' plan limits," Yahoo (Mar. 1, 2012) http://news.yahoo.com/t-relents-unlimited-data-plan-limits-174637774.html.

entitles users to 5 GB per month, with overages priced at $10 per GB.[31]

T-Mobile instituted new monthly plans with data caps in May of 2011. T-Mobile's can choose from four tiers: $10 for 200 MB, $20 for 2 GB, $30 for 5 GB or $60 for 10 GB. Unlike AT&T and Verizon, T-Mobile does not resort to overage charges for users who exceed their caps. Instead, users will find their connections slowed to 100 kbps.[32]

As of this writing Sprint remains the lone provider among the big four that does not institute any form of data cap or UBP, and in fact advertises itself as such. Many analysts predict that Sprint's holdout position will steer the heaviest users of wireless broadband in its direction, ultimately forcing it, too, to implement some form of tiered or metered data plans.

II. THE BENEFITS OF AND JUSTIFICATIONS FOR USAGE-BASED PRICING

A. Benefits

Usage-based pricing can be used beneficially, especially when usage grows faster than new capacity can be deployed. UBP's chief virtue as a network management tool is its nondiscriminatory nature. As noted above, the FCC tacitly endorsed UBP in its *Comcast* order and Chairman Genachowski cited UBP as an example of "business innovation to promote network investment and efficient use of networks."[33] Although the *Open Internet* order carefully avoids directly endorsing particular network management practices, it endorses seemingly more drastic measures in response to network congestion, recommending, for example, that "if cable modem subscribers in a particular neighborhood are experiencing

[31] Stacey Higginbotham, "AT&T to launch its LTE network Sept 18," GigaOm (Sep. 15, 2011) http://gigaom.com/mobile/att-unveils-lte-network-sunday/.

[32] T-Mobile, "Data speed reduction" (Oct. 14, 2011) http://support.t-mobile.com/docs/DOC-2741.

[33] Julius Genachowski, "Remarks on Preserving Internet Freedom and Openness" (Dec. 1, 2010) http://www.fcc.gov/document/federal-communications-commission-chairman-julius-genachowski-remarks-preserving-Internet-f.

congestion, it may be reasonable for a broadband provider to temporarily limit the bandwidth available to individual end users in that neighborhood who are using a substantially disproportionate amount of bandwidth."[34]

UBP also incentivizes efficient use of bandwidth by both consumers and providers of online content and services.[35] For example, Netflix responded to the imposition of UBP in Canada in part by offering a lower-quality streaming option that used two-thirds less bandwidth than the higher-quality, higher-bandwidth option.[36] Not everyone was pleased that the default option in Canada was the lower-quality feed, but the company pledged to "continue to test and innovate to improve the Netflix experience without high data use."[37] Whatever its other shortcomings, and there are plenty, UBP supplies a strong incentive to innovate and economize when it comes to bandwidth usage.

Fundamentally, the reasonableness of UBP as a network management practice depends on the degree to which it actually addresses network congestion and the way it is implemented. Not every usage-based pricing plan is nondiscriminatory. In Canada, for example, Shaw Communications initially announced that use of its own video streaming service would not count toward a consumer's data cap. The company later clarified that the exemption would only

"Fundamentally, the reasonableness of UBP as a network management practice depends on the degree to which it actually addresses network congestion and the way it is implemented."

[34] Open Internet Order at 51.

[35] The flip side, of course, is that UBP cannot distinguish between inefficient uses and uses that are simply bandwidth intensive.

[36] "Netflix Lowers Data Usage By 2/3 For Members in Canada," Netflix Blog (Mar. 28, 2011) http://blog.netflix.com/2011/03/netflix-lowers-data-usage-by-23-for.html.

[37] *Id.*

apply to video sent to a consumer's set-top box.[38] This clarification does not entirely answer the concern that such exemptions effectively create a "two-tiered" Internet, but at least acknowledges the concern. Any attempt to treat an ISP's own on-demand video service differently from its Internet-delivered competitors will inevitably raise concerns about the motives behind UBP.

Equally troubling are the plans in other countries that exempt specific websites or applications from data caps. For example, one wireless carrier in Asia currently has a usage-based plan that "allows free Facebook usage by recognizing Facebook packets on the network and assigning them a zero value toward the usage quota."[39] Although such wireless plans are discriminatory, they arguably would be permitted under the FCC's Open Internet Order so long as they were disclosed to the consumer. To their credit, and perhaps out of fear of regulatory reprisal, domestic wireless carriers have generally avoided exempting their own services from UBP. As these examples show, the benefits of UBP depend considerably on the specifics of plans offered by service providers.

B. Justifications

UBP has been suggested as necessary to allow telephone and cable companies to recover their costs and provide revenues and incentives to make sufficient investment in their broadband infrastructure in order to meet the tsunami of data that supposedly threatens to overwhelm the Internet. It has also been proposed as an economic "Internet traffic management practice" intended to reduce network congestion by controlling heavy users. These justifications are closely related, insofar as providers insist that UBP is necessary to reimburse them for necessary investments made to address network congestion. Both contentions are highly questionable.

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[38] "Shaw clarifies position on Netflix rival, eases net neutrality concerns," Financial Post (July 15, 2011) http://business.financialpost.com/2011/07/15/shaw-clarifies-position-on-netflix-rival-eases-net-neutrality-concerns/.

[39] Fierce Wireless, "Do Usage-Based Pricing Models Work?" (Sep. 2011) at 18.

1. Cost-Recovery (The Internet is Not Eaten by Bandwidth Hogs)

Before considering the existence of bandwidth hogs, we should examine the nature of Internet access as a service. For starters, bits are not physical goods, and therefore cannot be "consumed" in any meaningful sense. Absent network congestion, one person's use of bandwidth does not interfere with another's. This is because the Internet is largely a "non-rivalrous" technology: one's use or consumption of the Internet does not impede or deprive anyone else from enjoying it as well. Furthermore unlike, for example, vehicular traffic, bits do not "wear out the road." Maintenance costs for networking equipment are not directly related to the volume of traffic they process.

"Maintenance costs for networking equipment are not directly related to the volume of traffic they process."

The rhetoric behind the cost-recovery rationale for data caps is heavily charged with notions of equity, scarcity, and unjust subsidization. It begins with the intuitively appealing notion that users of a resource should "pay for what they use."[40] In making this point, allusions to traditional utilities abound. For example, in expressing his mystification that metered billing was not already a broadband industry norm, Federal Trade Commission Chairman Jon Leibowitz stated:

> I don't quite understand why something like metering hasn't really taken off yet. There's not a product in the world where you don't pay for what you consume. That's true for essential facilities and utilities like electricity. You don't pay $50 and turn on every light for as long as you want. It seems to me (that one way of closing the broadband gap) is letting people pay for what you use.[41]

The idea of consumption is central to this equitable notion. Unlimited data plans are commonly referred to as "all-you-can-eat" pricing while metered plans are often

[40] See, eg, Richard Bennett "What's Holding Netflix Back?" Innovation Policy Blog (July 27, 2011) http://www.innovationpolicy.org/whats-holding-netflix-back.

[41] "Leibowitz says metering could help broadband growth," Politico's Morning Tech, (June 6, 2011) http://dyn.politico.com/members/forums/thread.cfm?catid=24&subcatid=78&threadid=5569178.

referred to as "consumption-based" billing. Finally, there is the language of subsidization, the notion that "average" or "light" users are unfairly paying for costs imposed by heavier users in something like a digital tragedy of the commons. Verizon Wireless CTO Dick Lynch made this point succinctly:

> The problem we have today with flat-based usage is that you are trying to encourage customers to be efficient in use and applications but you are getting some people who are bandwidth hogs using gigabytes a month and they are paying something like megabytes a month . . .. That isn't long-term sustainable. Why should customers using an average amount of bandwidth be subsidizing bandwidth hogs?"[42]

This, then, is the picture of the cost problem that UBP will cure: rapacious and unrepentant bandwidth hogs devouring an unsustainable number of GBs of data while paying for only megabytes of data, leaving unwitting average users to pay the difference. This picture is entirely inaccurate.

The Internet is based on a technical concept called "statistical multiplexing" where multiple users can share the same bandwidth that previously would be consumed by one user making a single phone call. In theory, with statistical multiplexing there is no limit on how many users can share the bandwidth represented by the circuit for a single phone call.[43] Unlike other utilities such as water, electricity, gas or oil, where the product is actually "consumed" by end users, network bandwidth is never truly "consumed": bandwidth is infinitely reusable and therefore only temporarily in use (or "consumed") at any given time.

a) Realities of Marginal Costs

Broadband service does resemble certain utilities in that it is capital intensive with low marginal costs. In capital-intensive industries, the consumption of raw material input is only a small part of the

[42] Cecilia Kang, "Chat with Verizon Wireless CTO Lynch on end of all-you-can-eat pricing," Washington Post (Jan. 8, 2010) http://voices.washingtonpost.com/posttech/2010/01/chat_with_verizon_wireless_cto.html#.

[43] Practically there are limitations, especially with time-sensitive services. One way to conceptualize this that the bits are nearly infinite, but bits needed specifically at a single moment in time can be constrained by the nature of the pipe.

overall cost. For example, nuclear power plants have a very small fuel consumption cost, as compared to gas powered or coal fired plants. Most of their cost is paying down the debt of the capital infrastructure. However, the output of the nuclear power plant – electricity – is priced on a consumption basis as if it were coming from a coal or gas plant. But the cost to operate a nuclear plant hardly changes regardless of whether it is operating at 100 percent or 10 percent capacity. If a nuclear power plant is not operating at 100 percent utilization, an increase in demand incurs almost no material cost to the plant owner.

"Determining the actual cost of using a broadband network is exceedingly difficult."

Managing and operating an Internet network is very similar to the nuclear power industry in the sense that the input costs of Internet transit are very small compared to the amortization of the capital costs of the network itself. As explained by Craig Moffett of Bernstein Research:

> Companies in the broader telecom sector tend to have relatively high fixed operating costs and investment requirements, and low incremental costs (that is, they have high incremental margins). The costs of building and maintaining a network – whether it consists of wires strung from telephone poles and buried under streets, cellular base stations hoisted high up in the air, or a satellite constellation orbiting 22,236 miles above the Equator – are substantial. However, the costs of letting a customer consume service on

that network once it is in place are low.[44]

Determining the actual cost of using a broadband network is exceedingly difficult. Estimates put forward by different interests and individuals during the Canadian CRTC hearings into wholesale usage-based billing varied wildly, ranging from 7 to 19.5 cents (Canadian) per GB,[45] with some third parties listing costs as low as 1.4 cents per GB for wholesale delivery.[46] And those prices appear to be going down, at least in the Internet transit market, where the per-Mbps prices are falling by about 30 percent per year and most ISPs offer volume discounts.[47]

The disconnect between usage and pricing is unsurprising given the nature of the broadband business. For capital-intensive industries like broadband, investors must be assured there is sufficient cash flow to pay for the interest on the capital over the coming years. The US cable industry alone spent $12.4 billion on infrastructure cost in 2010.[48] Often, these investment costs, including interest, are passed on through prices linked to consumption so the consumer has the impression that there is a direct correlation between consumption and costs. While this may be a convenient pricing model for the supplier, in reality, as with most other capital-intensive industries, there is very often little correlation between consumption and the cost to deliver the

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[44] Craig Moffett, et. al., "U.S. Telecommunications and Cable & Satellite: Capital Punishment," Bernstein Research (Dec. 9, 2010) at 11 (Capital Punishment).

[45] Michael Geist, "What Does a Gigabyte Cost, Revisited," (July 29, 2011) http://www.michaelgeist.ca/content/view/5952/125/.

[46] Lemay-Yates Associates, Inc. "The Cost of Incremental Transit Bandwidth in the Local Access Cloud,", Report presented to Netflix, Inc. (March 28, 2011) at 3, http://ecfsdocs.fcc.gov/filings/2011/05/10/6016484809.html.

[47] Valancius et al, "How Many Tiers? Pricing in the Internet Transit Market" (Aug. 2011) www.cc.gatech.edu/fac/Vijay.Vazirani/tier.pdf. Extensive data on network costs and the degree to which technological progress allows service providers to accommodate higher traffic without any increase in the level of capital investment is available, for example in a September 2011 report from WIK-Consult, J. Scott Marcus and A. Monti, "Network operators and content providers: Who bears the cost?," WIK-Consult, September 2011 white paper, http://ssrn.com/abstract=1926768.

[48] Paul Budde Communication Pty Ltd, "USA - Fixed and Wireless Broadband Market - Analysis, Statistics and Forecasts" at 8 (2011).

product. Rather, UBP exists primarily as a mechanism to increase the return on invested capital for broadband service providers.

b) Connecting Usage and Real Cost

Craig Moffett and his colleagues at Bernstein Research have put together impressive analyses of returns on invested capital (ROIC) in the telecommunications, cable and satellite industries. While their overriding conclusion is that "building networks is a tough way to make a living,"[49] results vary across industries and platforms. Keeping in mind that all of these companies provide more than just broadband service, Moffett's research is helpful in framing arguments over cost and congestion.

"Particularly for cable providers, there is little substance to idea that 'bandwidth hogs' are imposing costs that are either unpaid or borne by other users."

Particularly for cable providers, there is little substance to idea that "bandwidth hogs" are imposing costs that are either unpaid or borne by other users. Moffett finds that cable operators are enjoying rising ROICs due in part to falling capital intensity, strong pricing power and increased invested capital turnover from additional services like broadband.[50] The bulk of cable's capital investment in recent years has been on items like digital set-top boxes and other customer premises equipment, rather than major physical construction projects impacted by the presence of "bandwidth hogs" on the network. Regional upgrades to DOCSIS 3.0 are either completed or ahead of schedule.[51] As Moffett states, "[a] business model with rising revenue, falling capital investment, and growing margins is generally a pretty good place to start."[52]

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[49] Craig Moffett, et. al., "U.S. Telecom: Capital Punishment, Redux. Trends, Returns, and Projections … and Implications for Valuation," Bernstein Research (May 25, 2011) at 3 (Capital Punishment, Redux).

[50] *Id*., at 3-4.

[51] Robert C. Atkinson and Ivy E. Schultz, "Broadband in America," Columbia Institute for Tele-Information (Nov. 11, 2009) at 40-41, www.broadband.gov/docs/Broadband_in_America.pdf.

[52] Capital Punishment, Redux at 6.

Moffett sees AT&T and Verizon failing – just barely – to earn back the cost of capital in the wireline segment, largely due to access line losses and low returns on their fiber projects. Moffett also observes that Verizon and AT&T's fiber rollouts amounted to answering the problem of an underutilized "factory" (their copper-based network which lacked the capacity to handle high volumes of high speed data traffic) by building a second one.[53] These fiber projects also allowed Verizon and AT&T to offer IPTV services to customers, thus allowing them to compete with cable's "triple-play" of voice, data, and video. While that investment is unquestionably very expensive, contending that "bandwidth hogs" necessitated these upgrades overlooks the prominent, if not dominant, role that AT&T Verizon's own IPTV services played in prompting those roll-outs. As with cable, there is little evidence that congestion concerns necessitated these upgrades.

Wireless is a different story. There, Verizon and AT&T have posted modest but favorable ROICs while T-Mobile and Sprint have struggled.[54] Data usage unquestionably necessitates capital investment that simple "connectivity" services – voice, text and email – do not. In this respect, the growing consensus that the major wireless providers will eventually move to some form of UBP is unremarkable.

Spectrum and capacity are and will continue to be concerns. However, it is one thing to look to usage-based pricing as a way to improve ROIC. It is quite another to look to UBP as a *substitute* for ongoing investments in network infrastructure. In Moffett's distinction between UBP in the wireline and wireless sectors, this emerges as a possibility because wireless operators are using UBP in part to curb usage:

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[53] Capital Punishment at 25.

[54] In his May 2011 update to *Capital Punishment* for the telecommunications sector, *Capital Punishment, Redux*, Moffett et al describe the wireless sector as one bifurcated between "haves" and "have nots," with AT&T and Verizon posting ROICs considerably better than Sprint and T-Mobile and "suck[ing] up all of the excess returns in the wireless space." Capital Punishment, Redux at 9-10.

> In the calculus of revenue per megabyte, wireline operators are attempting to manage the *numerator* – that is, they are trying to use price as a mechanism to increase [Average Revenue Per User] and align their business with a new delivery model as video moves to the web – while wireless operators are focusing on the *denominator*, and are trying to reduce runaway growth to prevent being crushed by capital spending. For wireless, it's simply a matter of rationing.[55]

No one wants to see wireless operators crushed by capital spending. At the same time, no one wants to see them stop investing in their networks so that consumers can actually use those networks in the manner advertised.

As explained in the Public Knowledge white paper, *4G + Data Caps = Magic Beans*, a consumer can enjoy AT&T's widely advertised speed of 6 Mbps for about 45 minutes before hitting the 2 GB data cap.[56] Further, as a recent article in *Slate* observed, the new iPad's 4G connection could theoretically burn through a typical 2 GB data plan in about four minutes.[57] If the point of overage charges is to give service providers the revenue needed to make continuous network upgrades, so be it. However, if the point of UBP is to provide both a steady flow of profits and a mechanism to ration network usage in a way that obviates the need to make consistent improvement in the network, then the cost recovery rationale is being abused. Running and maintaining a network has always required an ongoing capital expenditure. Therefore, UBP cannot be justified simply because networks need to be maintained and upgraded. Instead, UBP plans must be justified in terms that explain why the circumstances motivating them are unique.

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[55] Craig Moffett, "Weekend Media Blast: The Rationing Impulse… For Straws in the Wind," Bernstein Research (June 10, 2011) at 1 (emphasis in the original, footnotes omitted).

[56] Michael Weinberg, "4G + Data Caps = Magic Beans," Public Knowledge (Aug. 2011) at 5, http://www.publicknowledge.org/4g-data-caps-magic-beans.

[57] Will Oremus, "Gone in Four Minutes," Slate (Mar. 7, 2012) http://www.slate.com/articles/technology/technology/2012/03/ipad_3_launch_is_apple_s_4g_lte_mobile_data_service_too_fast_.html.

c) Managing Cost with Network Architecture

Even acknowledging that data usage does increase costs on some networks, it is important to note that content providers are now bearing some of those costs through the deployment of Content Distribution Networks (CDNs). As new multimedia content such as video and network applications have evolved, so too have the forms of delivering the content. Broadcast and content providers are now taking advantage of a constellation of new infrastructure, including data centers, CDNs, distributed computing, and storage services (aka "clouds"). This infrastructure is then connected with the public Internet at major Internet Exchange (IX) points to the last-mile ISPs, rather than carried across the Internet through backbone providers.

"CDNs are but one of the technical solutions overlooked when providers make the contention that 'bandwidth hogs' are imposing costs on network operation that can be recovered only through 'consumption-based' pricing mechanisms."

CDNs reduce operating costs for telephone and cable network operators because the traffic is not carried on their backbone or internal networks. Instead, the traffic from a content provider is carried over the CDN's private network to the IX nearest to the customer or right to the last mile operator's headend or central office, and in many cases to the network node closest to the consumer.

CDNs will not entirely relieve service providers of the need to sustain investment in their networks, but they do show that there are ways to shift the capital investment needed for emerging uses of broadband – such as streaming video – to content and service providers. CDNs are but one of the technical solutions overlooked when providers make the contention that "bandwidth hogs" are imposing costs on network operation that can be recovered only through "consumption-based" pricing mechanisms. Indeed, a recent Sandvine report on network usage in North America notes a leveling off of monthly bandwidth usage and questions

the idea of investment in additional capacity: "In an world in which per-subscriber usage is relatively flat from month-to-month, investing in delivering increased bandwidth no longer makes sense."[58]

2. Congestion

Cisco's Visual Networking Index estimates that consumer IP traffic in the US grew by 45 percent in 2010.[59] Much of that growth is due to the increased popularity of real-time entertainment services, which now account for 49.2 percent of all Internet traffic in North America during peak evening hours, compared to 29.5 percent in 2009.[60] In its Fall 2011 report, Sandvine states that real-time entertainment makes up 60 percent of peak-period downstream traffic.[61] However, that growth does not lead inescapably to congestion for fixed networks, particularly given that the rate of growth of consumer fixed Internet traffic appears to be slowing. According to Cisco, the annual rate of growth projected from 2010 to 2015 will be 29 percent, significantly lower than the 46 percent increase in consumer fixed Internet traffic growth in 2010.[62] Even the higher growth rate in 2010 does not appear particularly aberrant compared to the historical rate of growth in communication network traffic.[63]

a) Technical causes of, and solutions for, congestion.

Importantly, congestion issues can arise as much from design decisions made by network operators as from increases in

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[58] Sandvine, "Global Internet Phenomena Report," (Fall 2011) at 1 (Sandvine Fall 2011 Report).

[59] Cisco, "VNI Forecast Highlights," http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html#~Country.

[60] Sandvine, "Global Internet Phenomena Report," (Spring 2011) at 5 (Sandvine Spring 2011 Report). Netflix is "the unquestioned king of North America's fixed access networks." According to Sandvine's Fall 2011 report, Netflix now makes up 32.7 percent of peak period downstream traffic and 27.6 percent of downstream traffic overall.

[61] Sandvine Fall 2011 report at 1.

[62] Cisco, "VNI Forecast Highlights," http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html.

[63] See, K.G. Coffman and Andrew Odlyzko, "Internet growth: Is the a 'Moore's Law' for data traffic?" (July 11, 2000) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=236108.

network traffic. Fixed networks have a number of ways to address any congestion. Telephone and cable companies both deploy what is called a trunk and branch architecture where the trunk is usually a high-speed fiber network to nodes scattered throughout the serving area. At the nodes the high-speed optical signal is converted to an electronic signal for delivery over the last mile infrastructure – coaxial cable in the case of cable companies and copper wire for telephone companies. It is at these nodes where the cable and telephone companies usually locate Customer Aggregation Equipment (CAE) to convert the signals carried on the copper or coax infrastructure into digital optical signals and vice versa. Telephone networks employ a Digital Subscriber Line Access Multiplexer (DSLAM). In cable systems, a Cable Modem Termination System (CMTS) is used to aggregate and convert Internet traffic from the coaxial cable facility to the fiber trunk back to the head end.

It is common practice for last mile operators to sell more aggregate bandwidth to their customers at the CAE point than their networks are capable of handling at any one moment in time. This is efficient and acceptable, because no customer uses his or her full allotment of bandwidth all the time. The ratio between how much bandwidth a service provider sells to its customers and how much it actually provisions for in its network is referred to as its "oversubscription ratio." This telephone and cable company practice of "oversubscription" (i.e., selling more bandwidth that it can actually provide at any given time) is a key factor underlying traffic management that can cause congestion.

A typical example of an oversubscription ratio would be as follows: Assume that 50 customers in a neighborhood share a single CMTS or DSLAM port, and that each customer has been sold a 1 Mbps service and has the physical capacity to send 1 Mb of traffic towards the CAE port in any given second. This arrangement would potentially allow for 50 Mbps of inbound traffic to that CMTS or DSLAM port. However, since it is unlikely that all 50 customers will be using their

connection at full capacity at the same time, the ISP may only provision that CMTS or DSLAM port so as to handle 10 Mbps at any one time without congestion occurring. This would result in an oversubscription ratio of 5:1. If the total traffic generated by the 50 customers at any given time is generally less than 10 Mbps, then the last mile operator has set a reasonable oversubscription ratio. If, however, the 50 customers regularly produce 15 Mbps, then congestion will occur at that CAE, and may possibly impact on the experience of the 50 customers.

Generally, this type of congestion problem is easily managed. The last mile operators regularly measure utilization at any given link in their network as a proxy for congestion. For each such link on its network, the network operator will have calculated a provisioning threshold. This threshold is typically based on the level of utilization a given link experiences, which in turn is presumably based on an estimate of what would lead to an unacceptable level of congestion at that link. In theory, once the provisioning threshold of a link is reached, the telephone or cable company responds to reduce congestion on that link so as to ensure that the 50 customers connected to it do not experience inferior service. This response typically involves an expansion of capacity at the link in question or reducing the number of subscribers on a given port. Although not wholly without cost to the ISP, the costs associated with addressing congestion – a one-time small port charge to add an additional CAE port and perhaps add incremental bandwidth to the upstream bandwidth from the CAE to the head end – are relatively minor.

As mentioned above, network operators also have the option to shift the costs of congestion management on to third-party content and service providers. As new multimedia content such as video and network applications have evolved, so too have the forms of delivering the content. Broadcast and content providers are now taking advantage of a constellation of new infrastructure, including data centers, CDNs, and distributed computing and storage services. This infrastructure is then connected with the public Internet at

major IX points to the last-mile ISPs, rather than carried across the Internet through backbone providers. There are a wide variety of CDNs that offer many different services to third-party application and content providers. For instance, Akamai, Limelight, Voxel, and CDNetworks are among the many providers of CDNs. In addition, some large companies like Google and Amazon have built and operate their own infrastructure to deliver these services.

"Ironically, improved wireless network efficiency and speed itself leads to increased bandwidth requirements in what the FCC terms a 'virtuous cycle' of bandwidth co-dependence"

Many CDN providers have extended their networks deep within last mile providers' own networks, at no cost to the last mile provider. This improves the user experience by bypassing any congestion that might occur in the telephone or cable company's network. It also relieves the last mile provider of the necessity of upgrading its own internal network to meet increased demand for video streaming and other applications.

CDNs are particularly important for wireless applications, where congestion is a legitimate concern, particularly as we move to the more data-intensive uses of wireless networks made possible by the advancements in wireless technology grouped under the "4G" moniker. According to Cisco's *Visual Networking Index Forecast*, mobile data traffic increased 159 percent in 2010, an increase that is 3.3 times larger than the corresponding increase in fixed broadband traffic.[64] The FCC forecasts a need of an additional 300 megahertz by 2015.[65] Ironically, improved wireless network efficiency and speed itself leads to increased bandwidth requirements in what the FCC terms a "virtuous cycle" of

[64] Marguerite Reardon, "Cisco sees 26-fold wireless data increase in 5 years," CNET (Feb. 1, 2011) http://news.cnet.com/8301-30686_3-20030291-266.html. CTIA's own industry survey results showed an 110 percent increase in mobile data traffic between the last six months of 2009 and the last six months of 2010. http://www.ctia.org/media/press/body.cfm/prid/2062.

[65] FCC, "Connecting America, The National Broadband Plan," (Mar. 2010) at 84 (National Broadband Plan).

bandwidth co-dependence: "More bandwidth begets more data-intensive applications which begets a need for more bandwidth. Indeed, it is this virtuous cycle that has made broadband an innovation growth engine over the past decade – but also makes forecasting difficult."[66] Given that many of the data-only mobile devices that are driving that increase, particularly tablet computers, didn't even exist a few years ago, that increase is likely to continue. That being said, Cisco projects the rate of growth in mobile traffic to slow over the next five years.[67]

b) UBP is an ineffective means to address network congestion.

Even assuming efficient use of licensed and unlicensed spectrum and an aggressive deployment of CDNs, it is unlikely that these measures will entirely address congestion on wireless networks. Neither is it clear, however, that the UBP plans currently in place for either fixed or mobile broadband will meaningfully address network congestion.

While UBP may change the behavior of heavy users to reduce traffic volume, it may not have any impact on congestion issues. Network congestion, where the number of packets entering or exiting the network exceeds the capacity of the network, is a temporal phenomenon much like traffic jams that occur on expressways at rush hour. Charging drivers an extra monthly fee if they drive an excess number of miles per year does not guarantee that these drivers will still not use the freeway at rush hour. Unless UBP contains a time-of-day billing feature and some immediate feedback on congestion it is hard to imagine how it can be used as a congestion management tool.

An instructional example of the use and failure of UBP is the typical consumption of electricity, where consumers pay a flat fee of a few cents per kilowatt-hour. As their consumption goes up, their monthly

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[66] *Id.* at 84.

[67] Cisco, "VNI Forecast Highlights," http://www.cisco.com/web/solutions/sp/vni/vni_forecast_highlights/index.html.

bill increases as well. As one would expect from classical economics, states or jurisdictions with high electricity rates do exhibit lower consumption rates.[68] So logically UBP should constrain overall consumption.

Unfortunately this type of flat-rate usage-based billing has not reduced congestion in the consumption of electricity during peak hours. It is the peak electrical usage that causes problems for utilities in terms of capacity planning and stress on the infrastructure. Over the past couple of decades, the ratio of peak power to average power consumption has increased at most utilities.[69] As a result, many electrical utilities have deployed smart meters in order to implement "time of day" billing, where the price of electricity is set beforehand to reflect the historical demand with higher rates during peak periods and much lower prices during the rest of the day. However, it is interesting to note that in some of the largest smart meter deployments in the world – in Ontario, Canada – time of day billing has had very little impact on consumer consumption patterns.[70] It only caused considerable anger by consumers at increased electrical bills. Economists concluded that the price differential between periods of high consumption and low consumption had to be increased dramatically to have any meaningful impact on consumption patterns.[71]

Sandvine's recent report on broadband usage in North America confirms the peak-time nature of broadband congestion. For both fixed and mobile broadband, consumers concentrate an

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[68] Koichiro Ito, "Electricity Prices and Conservation: Do Current Policies Reduce Consumption?" Energy Institute at Haas-Research Review (Spring 2011) http://ei.haas.berkeley.edu/pdf/newsletter/2011Spring.pdf.

[69] Jeff Osborne and Dilip Warrier, "A Primer on Demand Response" (Oct. 16, 2007) http://downloads.lightreading.com/Internetevolution/Thomas_Weisel_Demand_Response.pdf.

[70] Karen Howlett, "Ontario hydro's smart meters give dumb results: critics," Globe and Mail (Sep. 14, 2010) http://www.theglobeandmail.com/news/national/ontario/ontario-hydros-smart-meters-give-dumb-results-critics/article1707808/.

[71] Frances Woolley, "Why Ontarians aren't saving money with smart meters", The Globe and Mail (Oct. 4, 2011) http://www.theglobeandmail.com/report-on-business/economy/economy-lab/frances-woolley/why-ontarians-arent-saving-money-with-smart-meters/article2190147/

overwhelming amount of their broadband usage in the evening hours.[72] From this, the report concludes that "[m]onthly usage quotas have only a limited impact, if at all, on peak network demand."[73] Even if UBP were to include a time-of-day component, there are only certain types of network usage – online backups, for example – that users would be willing to shift to off-peak hours.[74]

c) Congestion versus competition

Turning from electricity back to broadband, Canada's experience with consumption-based billing shows that congestion may not be the primary determinant of whether or to what extent a service provider implements UBP. On the first day of the CRTC hearing on the issue, Mirko Bibic, Senior Vice President for Regulatory and Government Affairs at Bell Canada Enterprises, said "[w]hat we are primarily trying to do is manage congestion here and you manage congestion by either creating incentives for less usage but if that's not going to happen then people should pay for the higher usage."[75]

As noted by the Chair of the CRTC, however, Bell did not apply usage-based pricing models uniformly across its network. Rather, Bell sister companies in some regions maintained flat-rate billing in order to mirror the billing options offered by competitors.[76] As the hearings proceeded, other ISPs disavowed entirely any congestion concerns or need to impose UBP. The witness for Rogers Communications stated that "[t]his is not about a bandwidth crisis," and said he was "disturbed" by the notion that the pricing debate was somehow about congestion.[77]

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[72] Sandvine Fall 2011 Report at 1, 10.

[73] Sandvine Fall 2011 Report at 5, 10.

[74] Sandvine Fall 2011 Report at 5, 10.

[75] Transcription of Proceedings Before the Canadian Radio-Television and Telecommunications Commission, CRTC 2011-77, 2011-771, and 2011-77-2 (July 11, 2011) at ¶ 579, http://www.crtc.gc.ca/eng/transcripts/2011/tt0711.html.

[76] *Id. at* ¶ 349-68.

[77] Transcription of Proceedings Before the Canadian Radio-Television and Telecommunications Commission, CRTC 2011-77, 2011-771, and 2011-77-2 (July 12, 2011) at ¶ 2057-60, http://www.crtc.gc.ca/eng/transcripts/2011/tt0712.html.

This has led University of Ottawa Professor Michael Geist and others to conclude that competition, rather than congestion, determines whether a service provider feels obliged or entitled to impose UBP on its customers:

> Bell's proposed UBB [usage-based billing] pricing for the [Gateway Access Service] similarly demonstrates that it bears little relation to actual costs or network congestion. First, its plan is different in Quebec, where there is a 60 GB cap, and Ontario, where the cap is set at 25 GB. The difference is plainly a function of the competitive environment, where Videotron's 60 GB cap forced Bell to offer a similar cap in order to remain competitive. Moreover, Bell's plan features a 60 GB cap with an overage charge for the next 20 GB. After 80 GB, there is no further cap until the user hits 300 GB. In other words, using 80 GB and 300 GB costs the same thing. This suggests that the plan has nothing to do with pay-what-you-use but is rather designed to compete with similar cable ISP data caps.[78]

This contention is particularly troubling given the concentration of the U.S. broadband market. A number of factors make determining the precise level of that concentration, and even the definition of the market itself, exceedingly difficult. For one, the number of competitors varies from region to region and the degree to which different platforms compete with each other depends in part on the needs and expectations of consumers. Moreover, there is a dearth of publicly available data about market concentration, particularly for fixed broadband. Unlike wireless broadband, the FCC does not aggregate data on market share for wireline service providers and its National Broadband Plan did not attempt to "analyze the market power of specific companies or reach definitive conclusions about the current state of competition for residential broadband."[79]

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[78] Michael Geist, "What Does a Gigabyte Cost, Revisited," (July 29, 2011) http://www.michaelgeist.ca/content/view/5952/125/.

[79] National Broadband Plan at 37.

i. Competition in Wired Internet Access

Regardless of how one defines the market for residential broadband – nationally, regionally, or home-by-home – the market is concentrated. At present, roughly 96 percent of the United States population has access to, at most, two providers for fixed broadband service.[80] And this is unlikely to change. As the FCC has noted, "[b]uilding broadband networks – especially wireline – requires large fixed and sunk investments. Consequently, the industry will probably always have a relatively small number of facilities-based competitors, at least for wireline service."[81] Indeed, some commentators have argued that, if anything, the economics of broadband service point toward further concentration.[82]

Although the FCC does not collect information on individual providers' market share, several private research firms do. According to Paul Budde Communication's March 2011 data, the top four wireline broadband service providers account for 69 percent of the total US market, with the following breakdown: [83]

Provider	Market
Comcast	23% (17.41 million subscribers)
AT&T	22% (16.49 million subscribers)
Time Warner	13% (9.99 million subscribers)
Verizon	11% (8.49 million subscribers)

[80] *Id.* at 37. As Scott Wallsten and other commentators have noted, "[t]he lack of useful data on availability makes it difficult to estimate these figures with precision." Scott Wallsten and Colleen Mallahan, "Residential Broadband Competition in the United States" (March 2010) at 4, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1684236 (Wallsten & Mallahan).

[81] National Broadband Plan at 37. See also Wallsten & Mallahan at 4: "for any foreseeable demand and supply conditions the industry will most likely continue to have only a relatively small number of wireline facilities-based competitors."

[82] Robert Atkinson, "Market Structure for Ultrabroadband," Communications & Strategies, Special Issue 2008 (2008) at 35, 49.

[83] Paul Budde Communication Pty Ltd, "USA – Fixed and Wireless Broadband Market – Analysis, Statistics and Forecasts" (2011). Because of different speeds and bundles, it is somewhat inexact to refer to a single national market for residential broadband service. Moreover, market shares and concentration change dramatically depending on whether one considers wireless broadband a substitute for wireline. The numbers above are based on combined subscriber numbers for cable and DSL providers in the US.

Aside from high capital costs and other intrinsic barriers to entry, wireline broadband service providers have pursued policy initiatives that make competition from new market participants unlikely. In North Carolina, for example, broadband providers pushed legislation through the state assembly that restricts competition from municipal broadband providers. Titled "An Act to Protect Jobs and Investment by Regulating Government Competition with Private Business," North Carolina General Assembly Bill H129 places a host of procedural hurdles and substantive requirements on municipalities seeking to provide new or extend existing broadband service.[84]

Similarly, the Wisconsin state assembly very nearly passed legislation to cut off funding to WiscNet, the state's educational Internet system. Prodded by the Wisconsin State Telecommunications Association,[85] state legislators introduced omnibus legislation that would have severed WiscNet from University of Wisconsin-Madison's Division of Information Technology as well as blocked future funding from the University of Wisconsin system, the National Telecommunications and Information Administration, and other sources.[86]

ii. Competition in Wireless Internet Access

The national wireless broadband market is easier to both define and quantify. There are only four mobile wireless carriers with nationwide networks. The DOJ conducted its review of the proposed AT&T Wireless – T-Mobile merger by considering its impact on competition among "the Big Four" on the national level.[87] No other

[84] H129. Ch. SL 2011-84 (2011).

[85] Wisconsin State Telecommunications Association, Press Release, "UW Competition for Broadband Threatens Local Jobs and Investment," (Oct. 4, 2010).

[86] University of Wisconsin System Omnibus Motion, Introduced by Senator Harsdorf and Representative Strachota, http://wispolitics.com/1006/110603UW_omnibus.pdf.

[87] DOJ Complaint at 11.

carriers' networks cover so much as one-third of the U.S. population.[88] The FCC's Fifteenth Report on Competitive Market Conditions With Respect to Mobile Wireless concluded that by year-end 2009, the top four wireless service providers in the United States accounted for 90.42 percent of all mobile wireless subscriptions and 93.23 percent of all mobile wireless revenues in the United States, with the following breakdown:[89]

Carrier	Subscribers	Revenue
Verizon Wireless	31.94%	33.82%
AT&T	29.80%	30.70%
Sprint Nextel	16.85%	16.58%
T-Mobile	11.83%	12.13%

Accordingly, while individuals have access to more providers for wireless service than fixed broadband,[90] the top four providers for wireless service control a larger share of the overall market than their wireline counterparts. Indeed, the *Fifteenth Report* found that the Herfindahl-Hirschman Index for the mobile wireless market at the end of 2009 was 2811, well above the 2500 benchmark for a highly concentrated market found in the Department of Justice and Federal Trade Commission's 2010 Horizontal Merger Guidelines.[91] The DOJ concluded that AT&T's proposed $39 billion acquisition of T-Mobile would lead to an HHI exceeding that threshold in 96 of the country's 100 largest Cellular Market

[88] *Id.* at 2.

[89] Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services, "Fifteenth Report" FCC 11-103 (June 27, 2011) at 35.

[90] *Id.* at 43. The FCC estimates that 67.8 percent of the U.S. population has access to at least four mobile wireless broadband providers. By the same token, only 32.9 percent of the total area of the U.S. is covered by two or more providers.

[91] *Id.* at 47; U.S. Department of Justice and the Federal Trade Commission, "Horizontal Merger Guidelines" (Aug. 19, 2010) at 19.

Areas ("CMAs") and a national HHI of more than 3,100, numbers which "substantially exceed the thresholds at which mergers are presumed to be likely to enhance market power"[92] and leave AT&T and Verizon in control of the 80 percent of the total market.[93]

Concentration in the market for fixed and wireless broadband service decreases the likelihood that market forces alone will suffice to keep either data caps high or prices low. Even with the widely acknowledged "dearth of consistent, comprehensive and detailed price data,"[94] the available data suggests a negative correlation between the number of providers and monthly prices in given area.[95] There is little reason to think that the effect on data caps will be any different. It is too early to tell whether UBP plans in the United States will be as dependent on a competitor's offerings as those in Canada. However, this would be an unremarkable result given that other factors on which broadband firms compete – price and speed – depend on the number of regional competitors.[96]

III. ECONOMIC AND HISTORICAL PERSPECTIVES

The communications industry in the United States is moving rapidly towards UBP, and is stigmatizing flat rate pricing as unjust and unsustainable. However, much of the rest of the world is moving in the other direction.[97] Even in the United States, the trend is not uniform. AT&T Wireless has eliminated its text messaging

[92] DOJ Complaint at 11-12.

[93] Juliana Gruenwald, "Senate Hearing on AT&T-T-Mobile Merger Focuses on Competition," National Journal (May 11, 2011) http://www.nationaljournal.com/tech/senate-hearing-on-at-t-t-mobile-merger-focuses-on-competition-20110511.

[94] National Broadband Plan at 38.

[95] Wallsten & Mallahan at 33. See also, "Next Generation Connectivity," Berkman Center for Internet & Society at Harvard University (Feb. 2010) at 58, http://cyber.law.harvard.edu/pubrelease/broadband/ (finding that prices in areas served by only one provider are 139 percent of the price reported in areas with competitive services) .

[96] National Broadband Plan at 38; Wallsten & Mallahan at 33 (finding a positive correlation between number of competitors and advertised speeds).

[97] The OECD overview of the communications industry mentions, for example, that "[t]he share of fixed charges paid by customers through telecommunications bills has increased in recent years, while usage-based charges have decreased," OECD, "OECD Communications Outlook 2011" (2011) at 250, http://www.oecd.org/document/44/0,3746,en_2649_34223_43435308_1_1_1_1,00.html.

tiers, and offers only a flat rate option (with a la carte pricing for those who do not sign up for monthly plans). The cable industry, while it is imposing UBP for Internet access, practices a form of flat rate pricing for its core video services. Subscribers to a channel pay the same fee irrespective of how many shows they watch. Further, the cable industry has so far been adamant in selling channels only in bundles, which, as will be discussed below, is similar to flat rate pricing in its economic fundamentals.

Although there are occasional comments about the positive effects of flat rates on the spread of new technologies (as in the 2011 OECD report, which stated that the growth in mobile broadband "has been fueled by inexpensive, flat-rate mobile data plans"[98]) the essentially uniform consensus among service providers, regulators, and outside experts has been hostile to them.

The recent endorsements of UBP by the chairmen of both the FCC and the FTC continue a long tradition. For example, a study of phone service in New York City in 1905 concluded "that, so far as large cities are concerned, unlimited service is unjust to small users, favors large users unduly, impedes expansion of the telephone business, tends to inefficient service, and that, as a financial proposition, is unsound,"[99] while a 1999 lecture by a prominent Internet researcher claimed that "[a]lthough flat-rate continues to be the predominant form in which Internet access is sold, that form of pricing is unviable. Flat-rate pricing encourages waste and requires 20 percent of users who account for 80 percent of the traffic to be subsidized by other users and other forms of revenue. Furthermore, flat-rate pricing is incompatible with quality-differentiated services."[100]

The complaints about unfairness of flat rates have often been accompanied by the predictions they would lead to

[98] *Id.* at 22.

[99] Andrew Odlyzko, "The history of communications and its implications for the Internet," (2000) http://ssrn.com/abstract=235284.

[100] *Id.*

unsustainable growth in demand. In the last few years, there have been repeated warnings about coming exafloods that would swamp the networks. Before that, in the late 1990s, ILECs mounted a concerted campaign to persuade regulators to allow them to levy access charges on modem connections to the Internet. Their argument was that allowing such calls to take advantage of flat rate local calling plans disrupted regular voice services and led to demands for additional capacity that required charging for Internet access. The FCC rejected these pleas, flat rate access for the local transmission link to the ISPs remained in place, and the ILECs prospered. Usage did indeed skyrocket, but technology improved, and, perhaps even more importantly, customers by the tens of millions signed up for second lines primarily for use in accessing their ISPs.

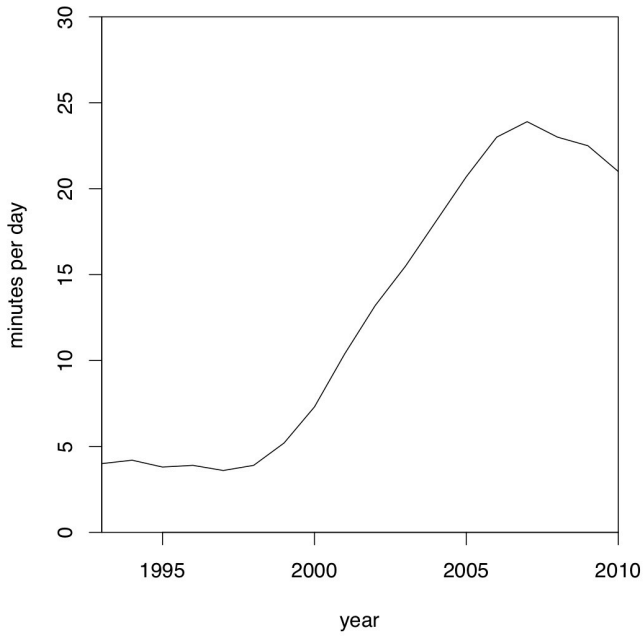
The persistence, and even spread, of flat rates in the face of such strong opposition suggests that instead of being treated as an embarrassingly ugly orphan, flat rates should be considered more systematically. In particular, it should be recognized that they often played key roles in major industry developments – roles that are seldom mentioned. An outstanding example is that of U.S. wireless service providers. As a proof of its competitive and technologically advanced nature, this industry frequently produces figures that show U.S. customers pay far less per minute of wireless voice calls than users in other countries, and that these prices have been declining. These claims are echoed in official government reports, such as the 2010 GAO study which declared that "consumers have ... seen benefits, such as generally lower prices, which are approximately 50 percent less than 1999 prices . . . ."[101] These claims are factually correct, but ignore the reason for these developments.

The rapid growth in usage and resulting drop in revenue per minute stem from the spring 1998 introduction of the AT&T Digital One-Rate, which offered an approximation to flat rate pricing with

[101] U.S. Government Accountability Office, "Telecommunications: Enhanced data collection could help FCC better monitor competition in the wireless industry" (July 2010) http://www.gao.gov/new.items/d10779.pdf.

large blocks of minutes for a fixed price, and with no roaming or long distance charges. Offered with very modest expectations for its uptake, it was received enthusiastically by the public, was widely imitated by other service providers, and changed the dynamics of the U.S. wireless industry, as is shown in Figure 1 which presents average daily voice usage per subscriber. [102]

Figure 1: Average Daily Voice Usage Per Subscriber



The lower prices cited by the industry and the GAO were the byproduct of the new dynamics, as is seen by comparison with other countries, where usage and per-minute pricing have more often been stagnant. Yet revenues per user have remained roughly stable, and it is hard to argue that U.S. wireless carriers are less profitable as a result.

Competition does appear to have been a key element in this transformation of the U.S. wireless industry. In this instance it did not work through the classical mechanisms of limiting profit margins or forcing greater efficiency. Instead, in the fragmented industry structure of 1998, one player reacted to the competitive incentives to attempt a pricing innovation that went against common wisdom. This is but one of many historical examples where the communication industry stumbled to success.

The standard economic models, which feature completely rational actors

[102] David Matthew Levinson and Andrew Odlyzko, "Too expensive to meter: The influence of transaction costs in transportation and communication," Phil. Trans. Royal Soc. A, vol. 366, no. 1872, (2008), pp. 2033-2046, http://ssrn.com/abstract=1735657. Data also partially drawn from CTIA, "Background on CTIA's Semi-Annual Wireless Industry Survey," (2011) http://files.ctia.org/pdf/ CTIA_Survey_Year_End_2010_Graphics.pdf.

optimizing fully understood goals, generally suggest that the profit-maximizing policy for sellers is to engage in very fine-scaled pricing, sometimes with extensive use of auctions. On the other hand, users strongly prefer simple, ideally flat, rates. The history of communications abounds in examples of the conflict between these two contrasting incentives. In these conflicts, service providers have almost invariably appreciated neither the strength of user preferences for simple rates, nor the reasons for them, nor the advantages to the service providers themselves of such simple rates. This has been true of government owned and operated service providers as well as of private ones.

A. The Standard Economic Model and Flat Rates

Even in the conventional economic models, flat rates can often be shown to be advantageous for service providers and/or consumers. There are certainly advantages of lower costs, in that the sellers do not have to build an expensive billing and complaint resolution infrastructures. More fundamentally, flat rates are a form of bundling: selling several goods or services in a single package. In communications, this bundling might mean access to all the web sites and content distribution services, as well as email, chat, and other services. It can also mean access to all the shows on a video channel or bundle of channels. Bundling as a tool for sellers dates back to the very dawn of commerce, and its underlying rationale has been explored in the economics and management science literature over the last half a century. What bundling does is to smooth out the uneven preferences that people have for different items in the bundle.[103]

Most of the extensive literature on

[103] As a simplistic model, consider a pushcart vendor at a sports event who sells soda and hot dogs, and has 500 fans who might walk by and consider dealing with him. Suppose also that 250 of the people are willing to pay $1 for a soda, but $1.50 for a hot dog, while the other 250 have the opposite preferences, and are willing to pay $1.50 for a soda, and $1 for a hot dog. If he sells them separately, then at the revenue-maximizing price of $1 for both the soda and the hot dog he will receive $1,000. If his cost (including compensation of his labor) is $1.10 for each item, he will give up the business, and the sports fans will go hungry and thirsty. However, if he sells only the combination of a soda and hot dog for $2.50, then all 500 people will buy, for revenues of $1,250, which will provide him with a profit and his customers with goods at prices they are willing to pay.

bundling is concerned with a small number of goods being bundled, and explores how the advantages of bundling vary depending on whether the goods are substitutes versus complements of each other. However, there are also some papers that discuss bundling of a very large number of goods. The best-known ones show that when marginal costs are negligible, bundling is often substantially more profitable than selling the goods separately.[104]

A limitation of the models in those papers is that while they do provide variation in preferences for different goods among consumers, consumers are rather homogeneous, in that most have approximately the same willingness to spend on all of the goods. A recent paper applies this basic method in more general and more realistic settings, in which budgets vary substantially, even according to the frequently encountered Pareto distribution (in which the top 20 percent of the users have 80 percent of the income, say).[105] The paper shows that even for this setting, in the presence of zero marginal costs, bundling still provides higher revenues and profits than selling separately.

These economic models have to be treated with caution (along with all other economic models), as they ignore many important elements of pricing, involving market power, strategic positioning, and the like. However, they do appear to provide useful insights that reflect actual market incentives and behavior. For example, these models show that the advantages of bundling for sellers are greatest when marginal costs are low. What we observe in the market is extensive use of bundling in cable, where all the channels are sent to all the homes, and so there is no extra cost in having a customer watch a particular video. Similarly, the recent move by AT&T Wireless towards flat rate SMS services

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[104] Yannis Bakos and Erik Brynjolfsson, "Bundling information goods: Pricing, profits, and efficiency," Management Science, vol. 45, no. 12 (1999) at 1613-1630; Xianjun Geng, Maxwell. B. Stinchcombe, and Andrew. B. Whinston, "Bundling information goods of decreasing value," Management Science, vol. 51, no. 4 (2005) at 662-667.

[105] Papak Nabipay, Andrew Odlyzko, and Zhi-Li Zhang, "Flat versus metered rates, bundling, and 'bandwidth hogs,'" Proceedings of NetEcon 11: 6th Workshop on the Economics of Networks, Systems, and Computation (2011) http://ssrn.com/abstract=1829784.

most likely reflects the extremely low costs of the SMS service for providers.

The simple economic models also provide insights on the negative effects of bundling. Unlike the earlier models, the more realistic one cited above shows that allowing only bundling and no other pricing plan can lead to "digital exclusion," with some customers shut out of the market by budget constraints.

"Unlike the earlier models, the more realistic one cited above shows that allowing only bundling and no other pricing plan can lead to 'digital exclusion'"

B. Bundling and insurance

Flat rates can also be justified as a form of insurance, a form of bundling across time. Frequently in insurance pricing, most of the cost is incurred by a small number of customers: say those whose houses have burned down, or whose cars were involved in major collisions. There is evidence, to be discussed below, that communications systems users have often been willing to pay extra for flat rates because of the insurance effect, to protect themselves against high charges in sporadic cases of unusually high usage. The low average utilizations of broadband connections suggest that their main utility is in providing sporadic connectivity.

There is also some evidence (but unfortunately with little solid data) that the heaviest users of a network are not the same from month to month. That also helps explain the attraction of flat rates as similar to insurance.

C. Behavioral economics and psychology of flat rates

The strongest arguments for flat rates are best explained by the concept of "mental accounting costs." As the world gets increasingly complicated, people are overwhelmed by the available choices and the need to devote mental efforts to sorting them out, and therefore search for simplicity. They are willing to pay extra for the peace of mind that flat rates offer them.

While the term "mental accounting costs"

was only coined 16 years ago by Nick Szabo,[106] the basic phenomenon of consumers demanding simplicity (which frequently results in increased profits for service providers as well as other, more general benefits for society) has been explored and explicated in the last few decades in the fields of behavioral economics and psychology. Even earlier, it had been encountered many times in communications, and had in a few cases been studied in detail there.

An early example was the Penny Post reform in Britain in 1840. While its popularity was due to a considerable extent to a general lowering of charges for mail, much of the enthusiasm it aroused was due to the introduction of simple pricing, with a single distance-independent cost for any letter up to a specified weight limit. Before then, rates depended on distance, and many postal employees were occupied holding up letters against candle light, to make sure there were no enclosures, as only a single sheet of paper was allowed for the basic price. The Penny Post reform was widely admired and imitated around the world, including the U.S., where it inspired the "cheap postage" movement which succeeded in forcing through similar reforms. While the initial financial result was a decline in profits for the British postal system, the volume of correspondence started growing vigorously (in contrast to the stagnation that had prevailed before 1840), so that eventually revenues and profits far exceeded their earlier peaks.[107]

The 19th century postal experience, in which service provider managers resisted simple prices, did not understand their advantages, and in the end benefited from them, has been replicated many times. It arose in the early days of telephony, when attempts by the Bell System to force charging for each local call were met by

[106] Nick Szabo, "The mental accounting barrier to micropayments" (1996) http://szabo.best.vwh.net/micropayments.html.

[107] For more information, including detailed statistics, *see* Andrew Odlyzko, "The history of communications and its implications for the Internet," (2000) http://ssrn.com/abstract=235284.

some customer "strikes," in which subscribers boycotted the service.[108]

What is perhaps most striking about those events at the end of the 19th century is that they occurred when the telephone technology had high marginal costs, so that the conventional arguments in favor of metering were overwhelmingly convincing. (Given the early phone technology economics, it is reasonable to conclude that flat rate service was indeed not viable in large cities, and there is evidence that the move to metering in such cities, as well as for all commercial customers, did lead to growth in the number of users).[109]

"Pricing preferences often lead users to pay more for flat rates than they would for UBP."

Pricing preferences often lead users to pay more for flat rates than they would for UBP. The big shift in the U.S. in Internet access took place in 1996 when AOL (by far the largest ISP in terms of residential users), finally introduced unlimited plans after years of stoutly resisting subscriber requests.[110] Although some other small service providers had offered such plans before, AOL's move was forced by the competitive threat of a large new entrant to the industry, the AT&T WorldNet service.

As described by Tom Evslin, who was the head of WorldNet at the time, most of the AT&T customers on the metered plans moved to the $19.95 per month unlimited plan when their usage charges reached $11 or $12 per month.[111] Moreover, their usage (as measured by time online) did not increase, so they were simply paying extra to satisfy their preference. As with many other incidents of this type, AT&T WorldNet managers were not aware of the

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[108] Richard. R. John, "Network Nation: Inventing American Telecommunications," Harvard Univ. Press (2010).

[109] cf. *id*.

[110] Kara Swisher, "Aol.Com: How Steve Case Beat Bill Gates, Nailed the Netheads, and Made Millions in the War for the Web," Times Books (1998).

[111] Tom Evslin, "Subscription pricing," (Feb. 14, 2005) http://blog.tomevslin.com/2005/02/subscription_pr.html.

rich history their parent company had of encounters with flat rates. (The managers at AT&T Wireless Services who introduced the revolutionary AT&T Digital One Rate plan were similarly ignorant of this history.)

In fact, some of the most careful studies of user preferences had been done by AT&T in the 1970s, in attempting to move customers from flat rates to metered ones for local service. To the surprise of AT&T managers, telecom economists, and regulators, these studies revealed that most light users – who would have saved money with UBP – continued with flat rates. Researchers identified several key factors that motivated people's free decisions to pay more.[112] One was the insurance effect mentioned above, in which users wish to protect themselves against occasional episodes of high usage. Another was an overestimate of usage. Most people thought they were spending more time on the phone than they actually did, which naturally made flat rates appear less expensive.

There was also a third factor that turned up in the AT&T studies, closely related to Szabo's mental accounting cost concept, and to more recent research in behavioral economics and psychology. Today we have an extensive literature on related topics that helps explain why people behave the way they do. Perhaps the most relevant is the work on the topic called "decision fatigue".[113] Having to make decision after decision, even if they are minor ones such as to whether calling up Aunt Berta is worth ten cents, or whether downloading a movie will push one uncomfortably close to the monthly cap, drains people's mental energy. It creates especially heavy burdens on the poor (who have to wrestle with more limits on

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[112] J.G. Cosgrove and P.B. Linhart, "Customer choices under local measured telephone service" Public Utilities Fortnightly, (Aug. 30, 1979) at 27-31; L. Garfinkel and P.B. Linhart, "The transition to local measured telephone service," Public Utilities Fortnightly, (Aug. 16, 1979) at 17-21; L. Garfinkel and P.B. Linhart, "The revenue analysis of local measured telephone service," Public Utilities Fortnightly (Oct. 9, 1980) at 15-21.

[113] For a popular account of this work, with references to some of the key results and researchers, *see* John Tierney, "Do you suffer from decision fatigue?" New York Times, Sunday Magazine (Aug. 21, 2011) http://www.nytimes.com/2011/08/21/magazine/do-you-suffer-from-decision-fatigue.html.

what they can do), but it has been shown to affect all people. One striking study showed that even judges in the performance of their duties were not immune, in that their decisions were systematically trending towards default ones as a court session continued.[114]

As our economy advances, the number of goods and services proliferate, and with them choices. Choice is good in general, but it can be overwhelming, and what we observe is consumers flocking towards simplicity and usability. Catering to that desire was a key element in Steve Jobs' achievement of making Apple the most valuable technology company in the world. But such talent for discerning user preferences is rare. More typical among communications managers, policy makers, as well as technologists is the attitude displayed by Steve Case, the founder of AOL:

> "What was the biggest complaint of AOL users? Not the widely mocked and irritating blue bar that appeared when members downloaded information. Not the frequent unsolicited junk e-mail. Not dropped connections. Their overwhelming gripe: the ticking clock. Users didn't want to pay by the hour anymore. . . . Case had heard from one AOL member who insisted that she was being cheated by AOL's hourly rate pricing. When he checked her average monthly usage, he found that she would be paying AOL more under the flat-rate price of $19.95. When Case informed the user of that fact, her reaction was immediate. 'I don't care,' she told an incredulous Case. 'I am being cheated by you.'"[115]

That particular woman was not irrational, as Case thought. Instead, she most likely was reacting to the extra mental cost she had to bear under the metered Internet access plan, a cost that Case could not

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[114] Shai Danziger, Jonathan Levav, and Liora Avnaim-Pesso, "Extraneous factors in judicial decisions," (Dec. 8, 2010) http://www.pnas.org/content/early/2011/03/29/1018033108.

[115] Kara Swisher, "Aol.Com: How Steve Case Beat Bill Gates, Nailed the Netheads, and Made Millions in the War for the Web," Times Books, (1998) at 160-62.

understand.

The willingness to pay more flat rates than metered ones, displayed by the AOL customer cited above, and by the AT&T WorldNet customers described by Tom Evslin, is a frequent phenomenon. It has also been documented in other contexts, such as health club fees.[116]

D. Increased usage: Boon or bane?

AT&T WorldNet customers who switched to flat rates in general did not increase their time online (and thus costs to AT&T); they simply paid more. In general, though, flat rates do lead to increased usage. For AOL, time spent online by the average subscriber tripled in the year after the switch to flat rates. For the U.S. wireless industry the introduction of block pricing by the AT&T Digital One Rate, which was not quite a flat rate but which did eliminate roaming and long distance charges, led to growth by a factor of five over a decade.[117]

"The willingness to pay more flat rates than metered ones . . . is a frequent phenomenon."

There is no hard rule, but it does appear that usage tends to about double when metering is abandoned. There is often an immediate jump, and then a gradual growth. This was observed already with the Penny Post reform in Britain in 1840. The initial increase (almost a tripling) in volume of correspondence was lower than had been predicted by many reform proponents, but it was followed by rapid growth, in contrast to stagnating volumes before.

The major question that needs to be asked is whether usage of various goods and services should be encouraged or discouraged. When there are stringent resource constraints or large negative externalities (as happens with congestion

[116] Stefano DellaVigna and Ulrike Malmendier, "Paying not to go to the gym," American Economic Review, vol. 96, no. 3 (2006) at 694-719; Anja Lambrecht and Bernd Skiera, "Paying too much and being happy about it: Existence, causes and consequences of tariff-choice biases," Journal of Marketing Research, vol. 43 (May 2006) at 212-223.

[117] A variety of other examples are discussed in Andrew Odlyzko, "The history of communications and its implications for the Internet," (2000) http://ssrn.com/abstract=235284.

on urban roads), inconvenient toll collection schemes (like ones that require paying in exact change), might be recommended to minimize usage. On the other hand, if the goal is simply to maximize revenues, invisible electronic monitoring systems that send out a bill at the end of the month might be preferable, as they decrease the visibility of the charge.[118]

For both wireline and wireless Internet, there is overwhelming evidence that increased usage is on balance of great benefit to society and individuals. Much of the benefit of increased Internet usage is indirect. More users, more time online per user, and more activity (as in more traffic) lead to the well-known and extensive network effects, in which developers are attracted to provide new products and services. UBP inhibits this dynamic. This was widely recognized in countries like England, and motivated the campaigns to introduce flat rate Internet access. There does not seem to be anything anywhere as simple and powerful as flat rates for stimulating usage.

IV. CONCERNS

The discussion surrounding UBP for broadband data is more than a theoretical policy debate. The pricing structure of data directly impacts how broadband is used, as well as who uses it. The specific strategies service that providers use to offer UBP to consumers could raise a number of economic and policy concerns.

A. Competition

Proponents often invoke the specter of consumer video consumption, specifically from services such as Netflix, to justify the use of UBP.[119] While video can be a relatively bandwidth-intensive application (and, as discussed below, an important driver of adoption), its use as a justification for UBP raises obvious competitive concerns.

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[118] David Matthew Levinson and Andrew Odlyzko, "Too expensive to meter: The influence of transaction costs in transportation and communication," Phil. Trans. Royal Soc. A, vol. 366, no. 1872, (2008), pp. 2033-2046, http://ssrn.com/abstract=1735657.

[119] *See*, e.g. Holman Jenkins, Jr., "Internet Data Caps Cometh," The Wall Street Journal (May 11, 2011).

Simply stated, in the United States Internet service providers are almost always also in the pay-television business. As such, offerings by companies such as Netflix represent direct competition to a lucrative business. The FCC recognized as much when it issued its Open Internet Order: "Today, broadband providers have incentives to interfere with the operation of third-party Internet-based services that compete with providers' revenue-generating telephony and/or pay-television services."[120]

Until recently, pay-television operators had successfully avoided competition from other wire-based operators. Although there are a number of large cable television companies in the United States, they rarely compete directly in any given market. For perhaps the first time, competitors such as Netflix represent a real threat to many service providers' pay-television business.

However, the service providers are poised as potential barriers between their subscribers and competitors. Imposing UBP on broadband data while maintaining a "separate pipe" free of usage-based charges for its own pay-television offering allows service providers to impose an additional cost on their competitors. Comcast's own estimate for the amount of data required to replace its pay-television offering with an over the top competitor is 288 GB per month.[121] In light of this, it may come as no surprise that Comcast's data cap is set at 250 GB per month.

The nature of the competitive threat posed by UBP flows from the fact that most service providers offer both Internet access services *and* applications such as video and voice that rely upon (or can rely upon) that Internet access. Although flat-fee pricing might help maximize Internet access service revenue, doing so could potentially undermine application revenue.

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[120] Open Internet Order at 12.

[121] Mark Israel and Michael L. Katz, "The Comcast/NBCU Transaction and Online Video Distribution," Submitted by Comcast Corporation, MB Docket No. 10-56 (May 4 2010) at 33, http://fjallfoss.fcc.gov/ecfs/document/view?id=7020448236; http://apps.fcc.gov/ecfs/document/view?id=7020448237.

B. National Priorities

One of the great challenges of broadband pricing is in describing an "average" Internet user. Many usage plans and data calculators are built around assumptions that people will use their connections the same way they have in the past, which has largely been the passive consumption of media. However these "average" uses are unlikely to reflect the future. New applications of broadband will create new usage patterns that are difficult to predict even while they are emerging. UBP stifles this type of dynamic adoption by driving users back towards traditional usage patterns that may be ill suited for innovation. This is reflected in the potentially negative impact that UBP may have on a number of national priorities.

1. Adoption

Perhaps the greatest national priority related to broadband is simply convincing people to use it. The American Recovery and Reinvestment Act of 2009[122] spent $7.3 billion to encourage broadband adoption in the United States. Partially as a result of the associated programs, adoption grew by 8 percent between 2009 and 2010.[123] Last year President Obama announced a National Wireless Initiative aimed at ensuring that at least 98 percent of Americans can access high-speed wireless in five years. These plans notwithstanding, the United States still lags behind in broadband adoption. The United States ranks 15th among OECD nations in terms of wired broadband penetration.[124]

There is a clear link between broadband affordability and adoption. More than

[122] Pub. L. No. 111-5 (2009).

[123] OECD, "OECD fixed (wired) broadband penetration (per 100 inhabitants) net increase since June 2010-2011, by country" (2011) http://www.oecd.org/dataoecd/22/11/39574765.xls.

[124] OECD, "OECD fixed and wireless broadband subscriptions, by technology, June 2011" (2011), http://www.oecd.org/dataoecd/11/20/39575781.xls.

one-third of Americans without broadband cite affordability as a barrier to adoption.[125] However, affordability is not merely a function of cost. It is a function of value. The nation's largest service provider has not changed its data limit in well over three years. Leading analysts are predicting that caps may decrease over time.[126] Inviting individuals who have not yet adopted broadband to track the number of kilobytes they have uploaded and downloaded in a given month – under penalty of overage charge or expulsion – is unlikely to increase interest.

Adoption is not a national priority simply because we want Americans to have broadband connections. Adoption is a national priority because the uses of broadband are so beneficial to individuals and the society as a whole. These uses are often new and ripe for innovative experimentation. Imposing UBP reduces the attractiveness of adopting broadband and disincentivizes this type of experimentation. It also increases the cost of one of the most important hopes for broadband adoption: video.

The National Broadband Plan expressed great hope in the potential for video to drive broadband adoption.[127] UBP undercuts the use of Internet-delivered video because of the data-intensive nature of video. UBP transforms video consumption – traditionally a flat rate all-you-can-eat service – into an exercise in data transfer rate calculation and tracking. Even if over-the-top video offerings manage to compete with traditional pay-television services on a price basis, UBP guarantees that they will lose the battle for peace of mind. This will make broadband-video a less attractive offering to non-adopters, thus potentially slowing the pace of adoption overall.

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[125] 36 percent of consumers that have not adopted broadband cite cost as the main reason for choosing not to subscribe to broadband Internet. On average, non-adopters were not willing to pay more than $25 a month for broadband. John B. Horrigan, "Broadband Adoption and Use in America: OBI Working Paper Series No. 1," FCC (Feb. 2010) http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296442A1.pdf.

[126] Craig Moffett, "Weekend Media Blast: The Pricing Plan," Bernstein Research (May 13, 2011) at 4.

[127] National Broadband Plan, chapter 9.

2. Education

Broadband can help enrich educational opportunities for many types of students. Distance learning allows students to access classes and materials not offered locally.[128] Online systems provide flexibility to students who cannot be at school for health, child care, work, or other reasons.[129] Internet-based resources inject rich sources of information and dynamic presentation methods into class materials.

Online education can also be used to reach students who may have given up on school entirely. In Oregon, the Salem-Keizer school district re-enrolled more than 50 percent of drop-outs and at-risk students through an online bridge program.[130]

As demonstrated by the FCC's recent "Digital Textbook Playbook" initiative, broadband access and networked devices allow educators to incorporate much more than simple text into the educational process. Embedded video, live streaming, and video chatting can work, but they must be accessible to students at home as well as at school. UBP increases the cost – both mental and fiscal – of these types of applications, and therefore serves as a disincentive for both investment in and adoption of them. Educational programs that seek to rely on residential broadband connections can especially be stymied when potential users are forced to carefully track each megabyte uploaded and downloaded during the course of a lesson.

As a result, UBP undermines attempts to create truly innovative ways to integrate broadband and education. Innovative ideas can often work in unexpected ways. Users concerned about their UBP scheme are naturally disinclined towards experimenting with unknown services or adopting unproven methods.

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[128] See, e.g. *id.* at chapter 11.1.

[129] *Id.* at 228.

[130] *Id.*

3. Employment

Broadband can have significant impacts on employment, both in helping people find jobs and in creating jobs. Today, many employers look online first to advertise jobs and search for qualified candidates. Potential employees also turn online to search for new jobs and opportunities.

Once users have a job, broadband can help them do that job better and more efficiently. Telework, which in most case requires broadband access at home, is giving workers unprecedented flexibility in managing their work responsibilities. Telework had increased 43 percent between 2003 and 2008, by which time it was done by 33.7 million people.[131] This type of work flexibility creates opportunities for groups that may have been excluded from the workplace in the past. 14 percent of retirees, 31 percent of homemakers, and 29 percent of adults with disabilities could join the workforce if telecommuting where an option.[132]

As with education, telecommuting is becoming increasingly bandwidth intensive as the workplace becomes more digitally integrated. What once may have involved phone calls and downloading email now includes accessing complex cloud computing applications and remote software packages. This productive innovation is fueled by broadband access, and may be reduced if users are worried about hitting caps or punitive overage fees.

4. Innovation

Specific examples of national priorities like education and employment overlook the general value of a space for innovation and experimentation. Services such as online backups and cloud storage services allow everyone to have access to their information anywhere. New tablet computers rely less on massive internal storage than on the assumption that they will always be connected to a high-speed data network that can access user files and other content. This type of innovation

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[131] *Id.* at 272

[132] *Id.*

creates unexpected applications. The original designers of the iPad may not have anticipated its use in medicine or as a cash register for bands on tour. However, the fact that the iPad is connected to the larger cloud made it a platform for unexpected innovation. This unexpected application is a hallmark of great innovation.

UBP will suppress just this type of open-ended innovation by imposing additional, unpredictable costs on using new services. It creates an additional barrier to experimentation and trying new services online. The current competitive landscape offers little of the meaningful competition required to keep caps high or overage fees low. Ultimately, this exposes experimenters, new adaptors, and innovators to a great deal of uncertainty. The uncertainty will slow just the type of experimentation, adoption, and innovation that has become the great product of broadband connectivity.

Conclusions and Recommendations

Flat pricing schemes should be regarded as an ideal goal, supporting innovation and social and economic welfare, and not as irrational aberrations that promote inefficiency and waste. However, sometimes temporary resource constraints may make flat rates infeasible. Currently, on the wired Internet, that does not appear to be a real concern, as the rate of progress in technology appears to be comparable to the rate at which traffic demand is rising, so that should be possible to support the growth in traffic without increases in the level of investment. On the wireless side, traffic is growing faster than carriers are investing in capacity improvements, so the case for UBP appears far stronger.

In any event, it appears that many service providers have already or are moving towards implementing some form of UBP. In light of this, the following practices will help to minimize (but not eliminate) the negative effects of UBP.

I. TRANSPARENCY

If users are going to be charged on a per-bit basis, or limited to a certain number of bits, there must be straightforward, up-to-date ways for users to measure their network activity. A user must be able to check how much data she has used at any given moment in order to make informed decisions about downloading a new app or watching a video. If these meters are not accurate, users cannot reasonably be held accountable for overage fees.

Transparency should also extend to the underlying justifications for the pricing structures. Service providers must be forthcoming about how caps are set, tiers are created, and pricing is determined. Providers must explain what goals UBP is designed to achieve. AT&T's recent

across-the-board $5 increase for its data plans came with little warning or explanation.[133] It is easy for service providers to manipulate UBP in anticompetitive or counterproductive ways, but transparency and accountability will help to mitigate that threat.

II. IMPLEMENT UBP IN A GRANULAR WAY

Data limits and UBP that does not take time of day into account are ill suited to address service provider concerns about network congestion. As described above, network congestion is not a cumulative phenomenon. Instead, it occurs at specific times of day on specific parts of the network. A UBP scheme that does not recognize that cannot credibly claim to be designed to reduce network congestion.

At a minimum, carriers should restrict UBP to specific times of day that are most likely to be congested. Data sent or received during off-peak hours have no meaningful impact on network congestion and should be excluded from the scheme. Data sent or received during peak hours could be charged at rates that reasonably reflected their impact on network congestion. This practice could encourage users to manage their network usage more efficiently and reduce congestion generally.

III. GOVERNMENT OVERSIGHT TO PROTECT COMPETITION

In today's concentrated landscape, regulators must vigilantly monitor UBP schemes to ensure that service providers do not leverage market power to increase costs and suppress demand for competing services delivered over IP. There are many market forces pushing service providers in this anticompetitive direction, and precious few guarding against it. Until there is robust competition among service providers to discourage network pricing manipulation, regulatory oversight is critical to maintaining a competitive landscape for services delivered over IP.

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[133] David Goldman, "AT&T hikes rates on smartphone plans," CNNMoney (Jan 19, 2012) http://money.cnn.com/2012/01/18/technology/att_rate_hike/index.htm.

IV. PREVENT ARTIFICIAL SCARCITY

UBP should not become a substitute for investments and technical solutions to address congestion and increase broadband deployment and capacity. Network operators have experienced congestion in the past, and always invested and innovated their way out of the problem. UBP can create incentives to monetize network congestion and scarcity, and therefore to create artificial scarcity. If such incentives were to become standard market features, it could further depress the United States' already low broadband deployment and adoption numbers.

V. DOCUMENTATION

Due to the complex nature of the communications market and the dearth of available information, service providers should collect and report detailed information about their offerings and how they affect consumers. This should include, but not necessarily be limited to, the caps and pricing plans in place, how many users go over any caps and how much those users pay (in total and on average) as a penalty for exceeding the cap, procedures for notifying consumers once they are at or near their broadband caps, and the rate of continued investment in network infrastructure. This information will help regulators and the public understand the challenges faced by service providers, as well as the impact that UBP is having on use, adoption, and deployment.