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The Never-Was-Neutral Net and Why Informed End Users Can End the Net Neutrality Debates

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The article outlines a policy of categorized, detailed, and uniform disclosures about Internet and content providers' non-neutral traffic policies. The disclosures would enable the market to choose technologies and business models dynamically, yet still provide regulators with a potential enforcement mechanism.

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* Director of Business Development, ImageStream Internet Solutions, Inc. Thank you to BethAnn Whelchel for inspiring this idea, Mike Ott for his thoughts on my proposed remedy, and the many industry friends who helped jog my memory about ancient Internet history. Special thanks to Professors Joshua Fairfield at Indiana, Christopher Yoo at Vanderbilt, and Lawrence Lessig at Stanford for their invaluable input and suggestions. All errors and oversights are solely attributable to the author.

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INTRODUCTION

Internet service providers and their customers have understood and debated the concepts of network neutrality, tiered access, and limited "unlimited" services since the beginning of the era of dial-up bulletin board systems. The legal and regulatory communities have only joined the debate in earnest, though, since the Supreme Court's decision in *National Cable & Telecommunications Association v. Brand X Internet Services*[1] empowered the FCC to create regulatory structures to govern telephony, broadband Internet services, and cable television as necessary.

Proponents of network neutrality regulation generally argue that network service providers threaten the innovative, largely regulatory-free Internet, and that government action is necessary to prevent the destruction of the global network's benefits. Opponents tend to argue that regulations would ruin innovation, fail in practice, or are doomed in principle. While commentators have alternately argued for or against the nebulous "net neutrality" concept, the vast majority have done so from theoretical perspectives rather than technical ones. As a result, the debates have discussed nonexistent "end-to-end" network models[2] or made value judgments about whether non-neutrality or government intervention causes the most "harm" to Internet consumers.[3]

Relatively few treatments come from technical perspectives that explain the history of non-neutrality on the Internet, or the enduring power of end users. This paper does not attempt to answer every question or address every point in the net neutrality debate. Such an ambitious

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[1] 125 S. Ct. 2688 (2005).
[2] *See* Lawrence Lessig, *The Architecture of Innovation*, 51 DUKE L.J. 1783, 1789 (2002) ("First articulated by network architects Jerome Saltzer, David Reed, and David Clark, [end-to-end] says to build the network so that intelligence rests in the ends . . . . The fundamental feature of this network design was neutrality among packets.")
[3] *See* Christoper S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 GEO. L.J. 1847 (2006). Nearly all of these treatments take a uniformly U.S.-centric view of Internet networks, an enforcement problem that is outside the scope of this discussion.

undertaking would require a series of books, and not a journal article. This article refocuses the net neutrality debate on end users, rather than networks. By analyzing Internet history and important economic arguments, I will attempt to illuminate the value of a uniform disclosure solution that protects provider innovation yet leaves market power in the hands of consumers.

Professor Christopher Yoo's recent economic analysis[4] provides an excellent foundation for this article, and many of his points raise important justifications for reactive, rather than proactive, regulatory responses on net neutrality. I agree with Professor Yoo's analysis that net neutrality requirements are increasingly irrelevant in a competitive, dynamic last mile provider market.[5] Legislators and administrative agencies have no way to predict future technologies or their impacts. However, asking Congress or the FCC to regulate network architecture practices to prevent any "specific harm[s] to competition,"[6] as he advocates, or even enforcing antitrust law principles, as others have suggested,[7] may prove similarly futile. Regulatory approaches that aim to stifle particular practices or network architectures often make little technical sense, and are unacceptably subject to political whims. Instead of adopting specific neutrality regulations—whether narrowly tailored to last mile networks or broadly viewed from the perspective of overall consumer welfare—I advocate a uniform disclosure regime. Categorized, detailed disclosures would enable the market to choose technologies and business models dynamically, yet still provide regulators with a potential enforcement mechanism.

This article proceeds in three parts. Part I provides a brief overview of the current network neutrality debate. It highlights both the history of past neutrality and tiered access debates and the current technical operation of last mile and backbone networks. Part II discusses

[4] *Id.*
[5] *Id.* at 1854.
[6] *Id.* at 1855.
[7] Alfred E. Kahn, *Telecommunications: The Transition from Regulation to Antitrust*, 5 J. TELECOMM. & HIGH TECH. L. 159 (2006) (advocating deregulation and antitrust oversight of the Internet service provider market).

how commentators often overestimate congestion and transaction costs, leading to solutions premised on theoretical markets, rather than the real-world Internet. Part III outlines a uniform disclosure approach that encourages rather than discourages innovation and helps to mitigate the problem of imperfect information that sits at the core of net neutrality proponents' concerns.

I. THE HISTORY OF NETWORK NEUTRALITY AND RELATED DEBATES

The broad concept of net neutrality covers a range of issues over a longer period than most commentators recognize.[8] While the FCC may have only joined the debate in recent years, the Internet community, its standards bodies, and market participants have debated these issues for over two decades. Decisions made before regulators took notice impact today's debate in many ways. Standards bodies built non-neutrality into networking protocols long before the commercialization of the Internet. Discussions about acceptable use, user restrictions, tiered access plans, and pay-by-usage are at least as old as the pre-Internet bulletin board systems that flourished during the 1980s and early 1990s. By the mid-1990s, the burgeoning Internet service provider industry had largely replaced the offline BBS as the focal point of neutrality and content filtering debates. The Internet community's successful—and regulation-free—resolution of these difficult neutrality issues not only requires reframing today's discussions about network neutrality, but provides important lessons for legislators and regulators considering new regulatory regimes.

[8] Professor Yoo, for example, traces net neutrality's history to February 2002, when the FCC first issued a ruling about the classification of DSL services. Yoo, *supra* note 3, at 1855-56.

A. The beginnings of net neutrality debates

By 1995, Internet providers had begun testing a variety of service and pricing models. Skye/net, an Internet provider in northern Indiana, for example, prevented users from running "programs designed to keep a connection up by sending regular amounts of data through the dial-up connection," and banned practices from the use of servers or mailing list software on dial-up connections to the display of business information on personal Web sites.[9] The company offered a range of tiered access plans from 100 hours of dial-up access to dedicated modems and high bandwidth leased lines such as T1s and DS3s. Leased line customers received both higher speed connections and preferred access to Skye/net's network and Skye/net's multipoint backbone.[10]

At the same time, the fight to keep the Internet deregulated appeared in earnest for the first time. In 1996, John Perry Barlow published his "Declaration of the Independence of Cyberspace."[11] Barlow argued that the Internet was an empty space that should be free of commercial exploitation and government regulation. Barlow's paper was one of the first to apply Saltzer, Reed, and Clark's argument about "dumb" TCP/IP networks to the Internet. Saltzer, Reed, and Clark argued that networks' primary function was to pass raw data from source to destination without inquiring as to that data's actual content.[12] In a "dumb" TCP/IP network,

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[9] Skye/net Network Servs., Inc., Skye/net Account Guidelines Overview, http://web.archive.org/web/19980109033327/support.skyenet.net/Use_Policy.html. The author, who headed operations for Skye/net, owned the company along with two partners until 1998.

[10] Skye/net Dedicated Internet Services, http://web.archive.org/web/19971224192532/skyenet.net/Dedicated.html.

[11] John Perry Barlow, A Declaration of the Independence of Cyberspace, http://homes.eff.org/~barlow/Declaration-Final.html (1996) ("[Y]ou weary giants of flesh and steel . . . you have no sovereignty where we gather.").

[12] Jerome H. Saltzer et al, *End-to-End Arguments in System Design*, 2 ACM TRANSACTIONS IN COMPUTER SYS. (1994) 277-88, *available at* http://web.mit.edu/Saltzer/www/publications/endtoend/endtoend.pdf. *See also* Lessig, *supra* note 2 (summarizing the end-to-end theory).

only the servers and workstations at the edges (ends) of the network perform intelligent functions.

Unfortunately, the concepts of a free, deregulated Internet and a dumb TCP/IP network did not exist even then. The debates about Department of Commerce control and influence first over InterNIC[13] and later ICANN,[14] and FCC debates about common carrier requirements for DSL services, and network neutrality itself illustrate that the Internet has faced the same regulatory pressures as any other telecommunications service.

The TCP/IP specification, despite Saltzer's theory, was never dumb. IP packets, the data "envelopes" that carry pieces of actual content, contain reserved space in their headers that help identify how network devices should process those packets. Prepared for a Defense Advanced Research Project Agency (DARPA) project, the original standards "treat[ed] high precedence traffic as more important than other traffic" and defined informational flags for prioritization of packets traveling on TCP/IP networks.[15] The standards document outlined the process for automatically enforcing one of several separately defined policies including minimizing delays in transmission, maximizing throughput, and maximizing reliability.[16] Expanded by subsequent Internet Engineering Task Force (IETF) standards documents,[17] the "smart" traffic filtering and

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[13] *See, e.g.*, *Internet Domain Names, Part I: Hearing Before the H. Subcomm. on Basic Res. of the H. Comm. On Sci.*, 105th Cong. (considering domain name system reform).

[14] *See, e.g.*, *Internet Domain Names and Intellectual Property Rights Hearing Before the H. Subcomm. on Cts. and Intell. Prop. of the H. Comm. on the Judiciary*, 106th Cong. 51 (testimony of Andrew J. Pincus, General Counsel, Dep't of Comm.) (stating that the Department of Commerce's goal for cession of power to ICANN was to create a private body that "would operate according to the policy principles that the United States Government felt were important."); Joe Wilcox, *House Subcommittee Gives NSI a Grilling*, CNET NEWS, Jul. 22, 1999, http://news.com.com/House+subcommittee+gives+NSI+a+grilling/2100-1023_3-228906.html.

[15] Information Sciences Institute, Request for Comment (RFC) 791: Internet Protocol DARPA Internet Program Protocol Specification (Jon Postel ed., 1981), *available at* http://www.ietf.org/rfc/rfc791.txt.

[16] Internet Assigned Numbers Authority (IANA), IP Option Numbers, http://www.iana.org/assignments/ip-parameters (last visited Jan. 15, 2007).

[17] Steven Blake et al., IETF Network Working Group, RFC 2475: An Architecture for Differentiated Services (1998) [hereinafter RFC 2475], *available at* http://www.ietf.org/rfc/rfc2475.txt; Kathleen Nichols et al., IETF Network Working Group, RFC 2474: Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers (1998), *available at* http://www.ietf.org/rfc/rfc2474.txt.

prioritization system predated Saltzer "dumb" design suggestion by several years. The Internet Assigned Numbers Authority (IANA), the body that administers common numeric value standards, still describes the standard type of service values as ways to enforce different standards for different types of content. IANA suggests "[g]enerally, protocols which are involved in direct interaction with a human should select low delay, while data transfers which may involve large blocks of data are [sic] need high throughput. Finally, high reliability is most important for datagram-based Internet management functions."[18]

The 1990s also saw the first major carrier and consumer skirmishes over network neutrality issues. The battles tread familiar ground: disputes over equal access and arbitrary consumer content restrictions. With the continued rapid growth of the number of Internet-connected networks, major providers started to balk at passing traffic for smaller providers and carriers. In the major content battle of the day, providers often restricted access to the bandwidth-hogging "alt.binaries" Usenet newsgroups or refused to carry those groups altogether.[19]

A short technical and history lesson well help explain the debate over access to the major backbone provider networks, and the birth of tiered access.[20] Every device connected to the Internet must have an associated IP address to communicate with other networks, servers, and devices. In the days before widespread use of firewalls helped to conserve the limited IP address space available, every connected device needed one of roughly 4 billion addresses. IANA and its sister regional registries originally allocated addresses to providers, universities, and even

[18] IANA, *supra* note 16.
[19] *E.g.*, Banned Newsgroups, CNN, Dec. 29, 1995, http://www.cnn.com/TECH/9512/compuserve/pm/banned_list.html (listing Usenet newsgroups censored by Compuserve, a leading national Internet provider).
[20] This summary omits certain technical details and vastly simplifies others. A detailed technical explanation of Classless Inter-Domain Routing (CIDR) and its impact on IP address allocations and routing table growth would not be possible here. Since the early 1990s, noted Internet networking engineer Hank Nussbacher has maintained a detailed explanation of CIDR, and the discussion in this section draws from that document. Hank Nussbacher, CIDR FAQ Version 7.1 (Nov. 2006), http://www.interall.co.il/cidr.html.

individuals in large, contiguous blocks. Before the IETF developed new standards for address allocation,[21] IANA and its regional authorities could only allocate addresses along "classful" IP address boundaries: Class A (approximately 17 million addresses), Class B (65,536 addresses), or Class C (256 addresses). For many providers, Class C allocations were insufficient, but Class B allocations were far too large. The IETF resolved this inefficiency by creating a system of classless IP subnetworks that created allocations not just along the traditional byte boundaries of Class A, B, and C, but ones of virtually any size.[22] While this addressed a major source of allocation inefficiency, it also further accelerated the growth of address allocations, triggering a round of predictions that the Internet would soon melt down.[23] The creation of variably sized IP address allocations dramatically increased the number of different IP subnetworks that Internet-connected devices had to store in memory, creating the first major network neutrality debate.[24]

B. History lesson #1: The genesis of tiered access

By 1991, the "privatization" of the former National Science Foundation NSFnet had spawned commercial services on the nascent Internet. Along with commercialization came the tiered access structure that defines the Internet today. Founded in 1991 to manage commercial

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[21] IETF Network Working Group, RFC 1517: Applicability Statement for the Implementation of CIDR (Robert M. Hinden ed., 1993), *available at* http://www.ietf.org/rfc/rfc1517.txt; IETF Network Working Group, RFC 1518: An Architecture for IP Address Allocation with CIDR (Yakov Rekhter & Tony Li eds., 1993), *available at* http://www.ietf.org/rfc/rfc1518.txt; Vince Fuller et al., IETF Network Working Group, RFC 1519: CIDR: an Address Assignment and Aggregation Strategy (1993), *available at* http://www.ietf.org/rfc/rfc1519.txt; Yakov Rekhter & Claudio Topolcic, IETF Network Working Group, RFC 1520: Exchanging Routing Information Across Provider Boundaries in the CIDR Environment (1993), *available at* http://www.ietf.org/rfc/rfc1520.txt.
[22] CIDR identifies a block of contiguous addresses based on the number of bits, out of 32 possible, that the particular subnetwork contains. This allows allocations of variably sized subnetwork blocks from a single IP address to an entire Class A. For a table of all possible subnetworks and an explanation of the conversion from binary to IP addresses, see WIKIPEDIA: THE FREE ENCYCLOPEDIA*, Classless Inter-Domain Routing*, http://en.wikipedia.org/wiki/Classless_Inter-Domain_Routing (as of Jan. 11, 2007, 00:20 GMT).
[23] *E.g.*, David L. Wilson, *Internet's Shallow Pool*, AUSTIN AMERICAN-STATESMAN, Aug. 23, 1997, at D4.
[24] For an historical view of the growth of Internet routes, see Geoff Huston, BGP Routing Table Analysis Reports, http://bgp.potaroo.net/ (last visited Jan. 15, 2007).

access to the former NSFnet, the Commercial Internet eXchange ("CIX") provided a peering site where its members agreed to exchange network traffic free of charge.[25] Internet providers that connected at CIX's interchange benefited from increased interconnectivity that today's providers—not to mention legal scholars—take for granted. As commercial Internet services expanded over the next three years, the CIX peering point produced a tiered access hierarchy. The largest of the backbone providers, including Sprint, UUNET, Advanced Network Services (ANS), BBN Planet, and later MCI and AT&T, banded together to form the core Internet backbone, agreeing to exchange traffic ("peer") with each other, and resell services to small providers.[26] These decisions quickly created a tiered network.

The top tier providers built national networks interconnecting with other national networks at CIX and at a handful of other traffic exchanges that around the country. Each of these national "Tier 1" providers agreed to peer with each other and pass traffic on behalf of downstream customers that used them for Internet connectivity.[27] "Tier 2" providers typically maintained smaller national or super-regional networks and agreed to peer with the major Tier 1 providers and, sometimes, each other. Unlike other Tier 1 providers, Tier 2 providers often had to pay to connect and peer with Tier 1 providers.[28] Local and regional Internet providers who purchased bandwidth from Tier 1 providers and found themselves a step removed from the "backbone" of the Internet.

Price and service level agreements differentiated the tiers. Providers with the desire and money to build large national networks or negotiate expensive peering agreements with CIX or

[25] FRED GOLDSTEIN, THE GREAT TELECOM MELTDOWN 65-67 (2005).
[26] *Id.* at 67-68.
[27] The definition of a "Tier 1" provider proved nebulous even then. Discussions and publications at the time typically cited the six providers above as the "Tier 1" providers. Numerous other providers joined the ranks of "Tier 1" providers with national peering agreements over the next decade.
[28] Dozens of providers, including the author's own company, qualified as Tier 2 providers under this definition during the mid-1990s. The Tier 2 distinction tended to be transitory. Super-regional and small national networks often either grew into Tier 1 providers or became acquisition targets.

Tier 1 providers could receive guarantees about traffic and connectivity unavailable to smaller providers. The price of Internet service depended on capacity, though with fewer pricing models than today. In the early 1990s, providers typically paid a flat price per megabit or per physical interface (DS1, DS3, Ethernet, etc.).

Warning that "access tiering will create an obvious incentive [among broadband providers] . . . to restrict the opportunity to compete in providing new Internet service,"[29] Professor Lawrence Lessig argues that tiered access charges represent a fundamental change in the Internet networking environment.[30] Network neutrality proponents, such as Lessig, ignore the long history of tiered access when arguing for stringent net neutrality regulations. Today's providers, while enjoying other niche options, still follow the same tiered access model created by CIX and backbone providers in the early 1990s. Providers that want better service guarantees or direct peering arrangements pay for this added service, just as they have since the U.S. government privatized the NSFnet.

Today, consumers, local providers, and businesses can choose from a host of broadband options and dozens of providers of bandwidth and other niche services. A 10 Mbps co-located connection that cost $7,500 annually in the heart of Silicon Valley in 1997,[31] is available in smaller markets like South Bend, Indiana for less than half that cost today.[32] Consumers who need broadband connectivity are no longer limited to private line T1 service, but can choose from among DSL, cable, satellite, cellular, and fixed wireless options at vastly reduced prices. A

[29] *Net Neutrality: Hearing Before the S. Comm. on Commerce, Science & Transportation*, 109th Cong. 2 (2006) (testimony of Prof. Lawrence Lessig) [hereinafter Lessig Testimony], *available at* http://commerce.senate.gov/pdf/lessig-020706.pdf. Professor Lessig prefers the term "access tiering," but the term has essentially the same meaning as the less-awkwardly phrased "tiered access."

[30] *Id.* at 5-10.

[31] CIX Router Information, http://web.archive.org/web/19980130083449/cix.org/CIXInfo/router-services.html.

[32] Colostore.com, Colocation Services, http://www.colostore.com/colocation.shtml (last visited Jan. 15, 2007).

market once in *actual* danger of domination by a handful of founding players has evolved into an innovative marketplace replete with services and players of all types and sizes.

However, Professor Lessig's testimony repeats a common refrain. Various pundits and experts have offered similar doomsday warnings for years. In 1997, a group of Internet providers argued that termination of peering agreements "may be just the opening . . . skirmish in the long-predicted move [by Tier 1 providers] acting as a closed cartel to change the fundamental economics of the Internet . . . [that] will cascade down to the pocketbooks of all users and smaller . . . ISPs."[33] In 1994, Internet journalist Gordon Cook warned that Tier 1 providers would soon dominate the market, with higher measured usage pricing and the elimination of free peering points like CIX.[34] Legislators, too, have fanned these fears. Senator Ron Wyden (D-Ore.) used similar language in 2006, claiming that "[c]reating a two-tiered system could have a chilling effect on small mom and pop businesses that can't afford the priority lane, leaving these smaller businesses no hope of competing against the Wal-Marts of the world."[35]

Tiered access, present from the commercial foundation of the Internet, does not represent a fundamental change to business models or Internet economics. Cook and others in the mid-1990s may not have foreseen the power of individuals to shape Internet governance, given the comparatively limited scope of the commercial Internet at the time. However, both Professor Lessig and Senator Wyden have the benefit of history. Neither of their scenarios explains clearly how the "Wal-Marts of the world" could hope to buy discriminatory access on thousands of provider networks around the world to create a priority lane, or why a meshed, worldwide

[33] Postings of Dennis Brumm et al. to ba.internet (May 4, 1997), *available at* http://groups.google.com/group/ba.internet/browse_thread/thread/99c7a3a80b74d0de/.
[34] COOK Network Consultants, *Executive Summary: IX Board Enforces Routing – Path Routing Filters to Go Up Nov. 1, 1994*, THE COOK REPORT, Aug. 1994, at 23, *available at* http://cookreport.com/backissues/august94newsletter.pdf.
[35] Press Release, Senator Ron Wyden, Wyden Moves To Ensure Fairness of Internet Usage With New Net Neutrality Bill (March 6, 2006), *available at* http://wyden.senate.gov/media/2006/03022006_net_neutrality_bill.html.

network would eschew opportunities to circumvent any discriminatory “lanes” that individual carriers tried to build.[36] As the next section recounts, organizations like CIX have found that creating a discriminatory lane leads to irrelevance, not dominance. Professor Lessig’s warnings of impending domination by a telecommunications oligopoly have not materialized at any point in the existence of the tiered access model. Despite almost two decades of dire predictions,[37] the tiered access model has arguably fostered—or at worst failed to hinder—innovation in Internet networking.

C. History lesson #2: The absence of monopoly power

As with tiered access, fears that monopoly powers would block access to content have endured despite historical evidence. The relatively few attempts to impose blocks have had no measurable effect on innovation and growth of Internet networks, services, and content. Three events illustrate this absence of power: CIX’s 1994 attempt to isolate non-members, and the 2006 decision by AOL to eliminate its walled garden content, and separate panic over a technical glitch at Craigslist.

In 1994, CIX decided that the rapidly expanding size of routing tables—lists of instructions stored by routers and other Internet-connected devices about the available paths to

[36] University of Colorado Law School Professor Phil Weiser suggests that a nondiscriminatory priority lane already exists with companies such as Akamai, and that lack of competition, not tiered access, is the problem. Posting of Phil Weiser, to Public Knowledge, http://www.publicknowledge.org/node/646 (Sept. 22, 2006, 15:15 EST).

[37] This article looks at Internet history after the debate about commercialization of the Internet had run its course. Similar Armageddon scenarios were commonplace in the days before the NSF relinquished control of NSFnet, too. The haunting chimera back then was the innovation-destroying force of commercialization. In the software world, fears of commercialization in the 1980s and early 1990s gave rise to the Free Software Foundation and the open source software community, another powerful individual-led movement. Like the Internet access debate, the open source community is rife with dire, but unsubstantiated, predictions of dominance by commercial companies. *See generally* Douglas A. Hass, *A Gentlemen’s Agreement: Assessing the GNU General Public License and its Adaptation to Linux*, 6 CHI.-KENT J. INTELL. PROP. (forthcoming Spring 2007).

different networks—would soon overwhelm the capacity of their routers to store them. CIX provided a few basic services for its Internet provider members: lobbying efforts, public forums, policy committees to propose legislation or regulation, and other information services.[38] Most importantly, though, CIX provided connectivity for its members. All members were required "to interconnect with all other CIX members . . . directly or indirectly through the CIX router - at no additional cost to member networks."[39] Prior to November 1994, non-CIX members could still exchange routing tables at the CIX router and with other CIX members without paying CIX's $7,500 annual membership fee.[40]

After considering filtering proposals during the summer, CIX members voted against filtering non-CIX members' routing information at their September 1994 meeting. Despite the vote, the CIX Board of Directors decided to impose route filtering for unspecified legal reasons. CIX President Bob Collet announced on November 1st that CIX would impose filtering beginning on November 15th.[41] A key member of CIX resigned in protest on the same day, and the announcement fueled a significant debate.[42] Cook Report editor Gordon Cook warned providers that failing to pay CIX's membership fee to avoid the filtering amounted to "a double

[38] About the Commercial Internet eXchange, http://web.archive.org/web/19970413033334/cix.org/CIXInfo/about-cix.html. Without reading this section further, readers can deduce from this citation's URL the result of CIX's routing policy decision. The only available link to this information about CIX comes from archive.org, a non-profit archive of historical Web pages and other digital collections, and not a current CIX site.
[39] *Id.*
[40] COOK Network Consultants, *CIX on Again off Again Filtering: What's at Stake?*, THE COOK REPORT, Dec. 1994, at 4, *available at* http://cookreport.com/backissues/dec4newsletter.pdf.
[41] Posting of Gene Hastings to North American Network Operators Group (NANOG) Mailing List (Nov. 2, 1994, 12:15:35 EST), *available at* http://merit.edu/mail.archives/nanog/1994-11/msg00020.html (forwarding a copy of Collet's e-mail to the NANOG list); Ellen Messmer, *IP Service Providers Face Traffic Shutdown*, NETWORK WORLD, Aug. 22, 1994, at 5. Bob Collet was also an Internet product manager for Tier 1 provider Sprint.
[42] Postings of Rich Braun et al., to ne.org.neci.general (Nov. 1, 1994), *available at* http://groups.google.com/group/ne.org.neci.general/browse_thread/thread/f02eec7dd620501b/ (a Usenet newsgroup thread debating the decision and including the text of key CIX member Net99's resignation).

barreled round of Russian roulette. . . . Joining the CIX is obvious [sic] the safest thing for non member ISPs to do."[43]

The commercial Internet community in 1994 was miniscule compared to today's global network of providers. As the primary exchange point for commercial Internet traffic, customers and backbone providers depended on CIX. However, CIX learned quickly that it had little power to impose filters, despite its market power as the primary facilitator of the commercial Internet in the United States.[44] On November 16th, one day after the supposed imposition of the filters, a member of the network user group mailing list Com-Priv noted that nothing had changed, and that the CIX router was still sharing routing information for both CIX and non-CIX members. Bob Collet admitted that CIX had encountered trouble implementing its filter, and the Cook Report's December issue described the filtering as "on again off again."[45]

CIX quickly faded into obscurity. Their decision served to encourage the major backbone providers to build new platforms and offer downstream customers ways to interconnect and bypass CIX's network altogether. As the Cook Report explained, "with the CIX router foundering and seen as a place to avoid, many providers began to get interested in MAE-East [another routing information exchange point] as an alternative."[46] By 1997, CIX membership had stalled at approximately 150 members, and faced defections by major founding members

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[43] COOK Network Consultants, *supra* note 34, at 7.
[44] *See Management of NSF Network Hearing Before the H. Subcomm. on Sci. of the H. Comm. On Sci., Space, & Tech.*, 102nd Cong. (testimony of Mitchell Kapor, Pres. of Electronic Frontier Foundation and Chairman of CIX) (discussing NSFNET and CIX's roles), *available at* http://www.eff.org/Infrastructure/NREN_NSFNET_NPN/nsfnet_hr_sst-s_920312.testimony. A testament to CIX's pivotal early role, the Smithsonian Museum of American History in 2006 acquired the router that once powered the CIX network along with documents and private notes from CIX's inception. Farooq Hussain, Projects, http://www.farooqhussain.org/projects (last visited Jan. 15, 2007).
[45] COOK Network Consultants, *supra* note 40. Sadly, the debate on the popular com-priv mailing list operated by Internet provider PSI was never archived publicly, and most of the original discussions are no longer available online.
[46] *Id.* at 4.

MCI and UUNET.[47] By 2001, CIX had decommissioned its router and exchange point.[48] CIX needed content and customers to survive, a network truth as important today as it was then.

Broadband providers would face a similar public relations and economic disaster if they attempted to completely block or even severely restrict access to sites or services that their customers desired. Researchers Anton Wahlman and Brian Coyne of Needham & Company, a private asset management firm, argue "[c]onsumers will gravitate to pipe providers that do not restrict their activities. . . . Any pipe provider who tries to restrict uses of the pipe to favored services (voice, video or data) in a 'walled garden' will likely be at a severe or impossible disadvantage, with consumers leaving for other pipes."[49]

While Wahlman and Coyne make their argument in the context of the value of a "dumb pipe" in the broadband market, their argument applies equally to any pipe: smart or dumb, edge or core. Broadband networks exhibit strong direct and indirect network externalities[50] and bandwagon effects.[51] Under these theories, a network's value increases proportionally with the number of its users.[52] The increased interconnectivity of the Internet generates substantial benefits for users, broadband providers, and content providers.

Time Warner's AOL unit exemplifies the disadvantages of Wahlman and Coyne's "walled garden." AOL, after peaking at 27.7 million subscribers in 2002, slid to under 18 million

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[47] Kenneth Cukier, *CIX Unfazed as ISPs Shun its Router*, COMMUNICATIONS WEEK INT'L (March 10, 1997).
[48] E-mail from Farooq Hussain, CIX, to Randy S. Whitney, UUNET (Jan. 11, 2002, 09:36:02 EST), *available at* http://www.farooqhussain.org/projects/Shutdown%20email.pdf. Farooq Hussein was Sprint's Internet services product manager during the early and mid-1990s, and maintained the CIX router until its decommissioning.
[49] ANTON WAHLMAN & BRIAN COYNE, EQUITY RESEARCH NOTE: THE DUMB PIPE IS THE ONLY MONEY PIPE 5 (Needham & Co. Inc., 2003), *available at* http://www.vonage.com/media/pdf/res_12_15_03.pdf.
[50] Brett Frischmann, *An Economic Theory of Infrastructure and Commons Management*, 89 MINN. L. REV. 917, 971-72 (2005) (describing network effects as applied to infrastructure).
[51] JEFFREY H. ROHLFS, BANDWAGON EFFECTS IN HIGH-TECHNOLOGY INDUSTRIES 30-31 (2001).
[52] As Professor Yoo explains, network neutrality proponents tend to overlook portions of this theory. Yoo, *supra* note 3, at 1891.

in 2006.[53] The company, famous for its proprietary, subscriber-only content, abandoned its pay-for-content model as its former users increasingly migrated to other dial-up and broadband providers. By jettisoning its Internet access business and releasing its content freely, AOL has built a business model better positioned to succeed on an increasingly large and interconnected Internet. AOL's decision perfectly illustrates the substantial benefits to users, broadband providers, and even AOL itself, that increases in users provide.

D. History lesson #3: Why CIX could never happen today

Restricting access to content, rather than creating proprietary content, has traditionally fared no better. Professor Lessig worries that a lack of competition among broadband providers threatens neutrality. In testimony before Congress, Lessig argued that an "effective duopoly" controlled broadband access in the United States, and that the duopoly "has now led network owners to openly advocate changes in network policy designed to vest new control in the network owner over the applications and content that flow over their network."[54] Lessig relies on FCC statistics as the basis for his duopoly argument.[55] Professor Yoo cites his own competing research and statistics to refute Lessig's argument.[56] Rather than sorting through vairous statistical analyses and market definitions,[57] regulators can again turn to history. The fate of

[53] Anick Jesdanun, *AOL Shifts Strategy with Free Offerings*, ASSOCIATED PRESS, Aug. 2, 2006, *available at* http://abcnews.go.com/Technology/wireStory?id=2264677.
[54] Lessig Testimony, *supra* note 29, at 5. Part II, *infra*, will further illustrate that providers have long exercised the detailed level of control over applications and content that Lessig fears as being new.
[55] FCC, HIGH-SPEED SERVICES FOR INTERNET ACCESS: STATUS AS OF DECEMBER 31, 2005 (2006), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-266596A1.pdf.
[56] Yoo, *supra* note 3, at 1892 ("It is a common misperception that the broadband markets are sufficiently concentrated to justify regulatory intervention. On the contrary . . . the concentration levels fall short of those traditionally associated with anticompetitive concern.") (internal citations omitted).
[57] A process that only serves to illustrate the old maxim that 97% of all statistics are made up on the spot.

erstwhile Internet giants CIX and AOL provide two concrete examples, but the market has swiftly addressed even the *hint* of restriction as well.

In early June 2006, writer Tom Foremski wrote on his popular SiliconValleyWatcher blog that Cox Cable—one of Professor Lessig's "duopoly" providers—had blocked access to popular classified advertisement site Craigslist.[58] Other online net neutrality activists immediately jumped on the story to criticize both Cox for their alleged actions and lawmakers for failing to protect net neutrality.[59] Senator Wyden, a sponsor of net neutrality legislation,[60] went even further. He penned a Wall Street Journal article on net neutrality, and cited Cox as an example of why legislation was necessary.[61] He claimed, as bloggers had, that Cox was blocking access to Craigslist to boost its own classified advertising business.[62] Cox had not blocked Craigslist, though, and quickly announced the real reason for the inaccessibility: a technical glitch in the way Craigslist served data from its Web site coupled with a bug in third-party security software distributed by Cox to its customers.[63] The Cox/Craigslist incident was one of several protests over allegedly discriminatory behavior in 2006.[64]

[58] Posting of Tom Foremski to SiliconValleyWatcher, http://www.siliconvalleywatcher.com/mt/archives/2006/06/craigslist_is_b.php (Jun. 6, 2006). Foremski originally claimed that Cox was using a purposefully configured "blacklist" to block access to Craigslist. He retracted his statement in an update to the post, admitting that he had no information about why Craigslist was inaccessible.
[59] *E.g.*, Posting of Matt Stoller to MyDD, http://www.mydd.com/story/2006/6/14/214831/479 (Jun. 14, 2006, 09:48:31 EST); Save the Internet.com, http://www.savetheinternet.com/blog/2006/06/14/discrimination-in-disguise/ (Jun. 14, 2006, 23:07 EST).
[60] Wyden, *supra* note 35.
[61] Sen. Ron Wyden, *Why We Must Protect Internet Neutrality*, WALL STREET JOURNAL, Jun. 17, 2006, at A11.
[62] *Id.* ("Cox Communications, a broadband provider that also has a large classified advertising business, is currently blocking access to craigslist.org, a large, free classified Web site that competes with Cox.").
[63] *See* Posting of Richard Bennett to The Navel of the Internet, http://bennett.com/blog/index.php/archives/2006/06/17/know-nothing-claims-about-site-blocking/ (Jun. 17, 2006, 22:20 EST).
[64] *E.g.*, Mark Hachman, *BellSouth Says It's Not Blocking MySpace*, PC MAGAZINE, Jun. 2, 2006, http://www.pcmag.com/article2/0,1895,1971082,00.asp; Caroline McCarthy, *Did Comcast Really Sensor the 'Sleepy Repairman' Video from 'Nightline'?*, CNET NEWS, Jul. 18, 2006, http://news.com.com/2061-10802_3-6095431.html.

Unwanted regulatory attention aside, even the hint of inaccessibility or overly restricted access would create a firestorm of negative publicity. As it did with CIX and threatened to do with Cox, the market would correct or bypass any discriminatory practice. Faced with an inability to deliver content to customers, major content providers would seek alternate delivery avenues. No statistics or predictions are necessary to demonstrate the market's innovative flexibility. Largely blocked by regulatory hurdles from directly entering cable TV markets, Verizon and AT&T have both released IPTV services to compete with entrenched cable TV service.[65] Google has bypassed both cable and DSL technologies to invest in a broadband over power line provider.[66] Verizon Wireless and AT&T's wireless arm (formerly Cingular) market 3G voice and data technologies,[67] and HughesNet offers satellite broadband.[68] Fixed wireless technologies have gained increasing traction in many urban and rural markets, often aided by government grants in rural areas with limited broadband choices.[69] While today's dominant content providers depend on broadband providers for content delivery to customers, broadband providers could not survive without content from Google, eBay, or Yahoo. Companies like Cox and Verizon today have far less market power and influence than CIX or other early commercial

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[65] Marguerite Reardon, *Verizon's TV Dreams*, CNET NEWS, Oct. 13, 2005, http://news.com.com/Verizons+TV+dreams/2100-1034_3-5894645.html; Marguerite Reardon, *Laying a New Path to Your TV*, CNET NEWS, Dec. 28, 2006, http://news.com.com/Laying+a+new+path+to+your+TV/2100-1034_3-6146207.html (describing AT&T's plans "to deliver its TV service en masse in 2007.").

[66] Dawn Kawamoto, *Google Invests in Power-Line Broadband*, CNET NEWS, Jul. 7, 2005, http://news.com.com/Google+invests+in+power-line+broadband/2100-1036_3-5777917.html.

[67] Verizon Wireless BroadandAccess, http://solutions.vzwshop.com/bba/ (last visited Jan. 15, 2007); Cingular EDGE, http://www.cingular.com/learn/why/technology/edge.jsp (last visited Jan. 15, 2007).

[68] HughesNet Services, http://www.hughesnet.com/ (last visited Jan. 15, 2007).

[69] The USDA's Rural Utilities Service program has funded numerous fixed wireless deployments in markets underserved or unserved by incumbent cable and DSL providers. *See, e.g.*, USDA Rural Utilities Service, http://www.usda.gov/rus/ (announcing recent grants and loans); Press Release, Wireless Communications Association, Closing the Gap on the Digital Divide (Sept. 2003), *available at* https://secure.wcai.com/pdf/2003/rural_mtvernonnetSept.pdf (announcing USDA Rural Utilities Service grant to Mt. Vernon Net, a rural Illinois Internet provider). *See also* Gerry Blackwell, *A WISP with a Vision*, ISP-PLANET, Jan. 5, 2007, http://www.isp-planet.com/fixed_wireless/business/2007/mt.vernon.net.html ("We can't build [fixed wireless] fast enough to serve everyone." (quoting Mt. Vernon Net CEO John Scrivner)).

providers did. Markets have adequately addressed, and will continue to address, harmful provider actions without regulator intervention.

II. STRUCTURAL NON-NEUTRALITY ON THE MODERN INTERNET

Nevertheless, the concept of creating a free and unfettered Internet by regulating incumbent common carriers and cable providers with has persisted, even as technologies have changed considerably. More recently, commentators have turned to prioritization of particular applications or types of traffic as the primary neutrality problem.[70] Under this theory, network neutrality advocates worry that providers will prioritize preferred traffic or applications to the detriment of non-preferred content. As with tiered access, the prioritization debate has raged for years, and has had a similar non-effect on innovation and growth of Internet networks, services, and content.

In 1998 and 1999, network access providers expanded the tiered access concept to applications and individual traffic flows within networks. Using the Linux operating system, manufacturing startup ImageStream released a line of router products[71] that provided service differentiation tools for network administrators.[72] The individual open source software developers of the Linux Differentiated Services (commonly called "DiffServ") tools did not create them in a surreptitious attempt to eliminate competition or destroy Internet growth and innovation. The DiffServ utilities for Linux merely implemented an existing standards document

[70] Yoo, *supra* note 3, at 1880-81 (discussing net neutrality proponents' criticisms of discrimination against applications).
[71] ImageStream Internet Solutions, Inc. - Products & Services, http://www.imagestream.com/Products.html (last visited Jan. 15, 2007).
[72] The word "discrimination" carries very negative connotations. Differentiation of network services may create significant positive externalities or have plausible justifications. Rather than use a word with pejorative meaning, this article uses the industry standard term "service differentiation" whenever possible.

that created a framework to allocate "traffic streams by service provisioning policies which govern how traffic is marked and conditioned upon entry to a differentiated services-capable network, and how that traffic is forwarded within that network."[73] With this suite of tools, network administrators could easily prioritize favored, or de-emphasize disfavored, applications or traffic. Far from Lessig's neutral network of innovation,[74] the Internet of the late 1990s had increased its focus on tiered access and service differentiation from end-to-end on Internet networks, without harming innovation or growth.

A. Technological non-neutrality

Non-neutrality extended far beyond emerging companies, open source operating systems, and esoteric standards documents. Cisco, the largest networking equipment manufacturer, followed the DiffServ RFC with its own offering in 1999. Cisco's more advanced successor technologies provide the same ability to "identify a subscriber, classify an application, apply application-level performance, and meter and charge for the application or service bundle" offered by Linux-based solutions.[75] The IETF has continued to innovate and improve the ability to control access from end-to-end on a network, with multiple active working groups[76] and dozens of refined standards for tiered network access.[77] Today, the ability to control data for

[73] RFC 2475, *supra* note 17.
[74] *See* Lessig *supra* note 2.
[75] Cisco Sys. Inc., Creating New Broadband Tiers of Service Using Cisco Service Control Technology, http://www.cisco.com/en/US/products/ps6135/prod_brochure0900aecd8024525f.html (last visited Jan. 15, 2007).
[76] MPLS-RC, MPLS Standards, http://www.mplsrc.com/standards.shtml (last visited Jan. 15, 2007) (listing related IETF Working Groups and other industry forums).
[77] IETF Multiprotocol Label Switching (mpls) Working Group, Charter, http://www.ietf.org/html.charters/mpls-charter.html (last visited Jan. 15, 2007).

policy or business reasons is a central feature of ImageStream[78] and Cisco[79] products. Other successful companies have emerged to market products designed solely to control and prioritize traffic,[80] and the open source software community maintains a powerful suite of free tools for service differentiation.[81]

Providers can easily implement access control policies on their networks. Companies, Web sites, and mailing lists offer assistance with implementation. The techniques used to implement tiered access and service differentiation are frequent topics at industry trade shows.[82] Content filters and prioritization schemes on Internet networks are nearly universal, and generally focused on the last mile between the provider's equipment and the consumer.

Providers are not the only actors, either. Vonage, with over 2 million subscribers,[83] offers branded equipment for use with its Voice-over-IP (VoIP) telephony service. On its technical support Web site, Vonage details a configuration using equipment that prioritizes voice traffic for Vonage services over other data traffic, including data destined for other VoIP providers.[84] While the site touts how the configuration will provide "high-quality [Vonage] telephone

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[78] *See* ImageStream Internet Solutions, Inc. - Implementing Quality of Service with iptables CLASSIFY rules, http://support.imagestream.com/QOS_with_iptables_CLASSIFY.html (last visited Jan. 15, 2007).
[79] *See* Cisco Sys., Inc., *supra* note 75.
[80] *E.g.*, *Insider: P2P Drives Use of DPI*, LIGHT READING, Sept. 6, 2006, http://www.lightreading.com/document.asp?doc_id=103020 (discussing report comparing quality of service products from Allot Communications, Caspian Networks, Ellacoya Networks, Narus, and Sandvine).
[81] Bert Hubert et al., Linux Advanced Routing & Traffic Control, http://www.lartc.org/ (last visited Jan. 15, 2007). For additional information on the definition of "open source" and the reach of the leading open source operating system, Linux, *see* Hass, *supra* note 37, at ___.
[82] *E.g.* John Bartlett, Vice Pres., NetForecast, Inc., Address at Interop New York 2006: WAN Acceleration Technologies: Which One Is For Me? (Sept. 20, 2006); Douglas A. Hass, Dir. of Bus. Dev., ImageStream Internet Solutions, Inc., Address at the LinuxWorld Conference & Expo: Quality of Service & Firewalls (Apr. 5, 2006); Cristophe D. Masiero, Head of IP VPN Prod. Mgmt., Equant, Address at the MPLScon 2004: MPLS VPNs: Drivers & the Road Ahead (May 25, 2004) (discussing emerging application and service differentiation technologies).
[83] Vonage Holdings Corp., About Us, http://www.vonage.com/corporate/index.php?lid=footer_corporate (last visited Jan. 15, 2007) ("Vonage is a leading provider . . . with over 2 million subscriber lines as of September 30, 2006.").
[84] Vonage Holdings Corp., Linksys WRT54GP2: Installation with Multiple Computers, http://vonage.com/help.php?article=61&category=43&nav=3 (last visited Jan. 15, 2007).

service," it does not mention that the configuration could degrade other services.[85] Even though Vonage openly advocates configuration settings that prioritize its own traffic without informing customers of the consequences, the company has been welcomed to the forefront of net neutrality advocacy.[86]

Another example from the ranks of content providers is Google. The company markets its Image Search as the "most comprehensive image search on the web."[87] However, the search's default setting is a "moderate" filter that "excludes most explicit images."[88] Although the search results page contains the innocuous statement that "Moderate SafeSearch is on," users only learn about the filter *after* the search, and must click on the "Preferences" link to learn its function.[89] Despite Professor Lessig's concerns, content providers continue torrid growth, and innovative new converged voice/video/data equipment and services have proliferated since the introduction of advanced traffic control tools.

Lessig claims "innovation has come primarily from the 'edge' or 'end' of the network through application competition."[90] In making this claim, he overlooks innovation on the network, and ignores the Internet's historic lack of net neutrality. In a 2003 joint filing to the FCC, Lessig and Professor Tim Wu presented another example of edge-focused reasoning in justifying their position in favor of net neutrality regulation:

> The question an innovator, or venture capitalist, asks when deciding whether to develop some new Internet application is not just whether discrimination is

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[85] *Id.*
[86] *See, e.g.*, *Net Neutrality: Hearing Before the S. Comm. on Commerce, Science & Transportation*, 109th Cong. 2 (2006) (Jeffrey Citron, Chairman & CEO, Vonage Holdings Corp. among witnesses testifying).
[87] Google Image Search, http://images.google.com/ (last visited Jan. 15, 2007).
[88] Google Help: Search Preferences, http://images.google.com/intl/en/help/customize.html#safe (last visited Jan. 15, 2007).
[89] Google Image Search, http:// images.google.com (follow hyperlink to "preferences") (last visited Jan. 15, 2007). Users also cannot avoid decisions that Google has made to exclude content due to political pressures or other exclusions. *See* Michael Liedtke, *Google Agrees to Censor Results in China*, ASSOCIATED PRESS, Jan. 24, 2006, *available at* http://www.breitbart.com/news/2006/01/24/D8FBCF686.html.
[90] Lessig Testimony, *supra* note 29, at 3.

> occurring today, but whether restrictions might be imposed when the innovation is deployed. If the innovation is likely to excite an incentive to discrimination, and such discrimination could occur, then the mere potential *imposes a burden on innovation today* whether or not there is discrimination now. The possibility of discrimination in the future dampens the incentives to invest today.[91]

Lessig and Wu would impose regulations on existing providers in the name of protecting innovation, but their justification depends on overlooking innovations like service differentiation and the historical lack of neutrality on the Internet from edge to edge. Defining the market in terms of a broadband duopoly[92] ignores the future as well.[93] Lessig's conclusions about the lack of Internet network innovation are unwarranted. Fifteen years ago, most consumers had never heard of the Internet, much less demanded the ability to share their homemade videos, publish daily journals, or communicate via voice and video online. No commentator, legislator, or regulator can be certain how networks and technologies will evolve over the next decade, especially when they misunderstand how those networks evolved over the last one.

Even commentators who oppose regulatory intervention assume away network innovation and structural non-neutrality in favor of other, weaker justifications. Professor Christopher Yoo argues for restraint until regulators can demonstrate a "concrete harm to competition."[94] His position ultimately differs little from those of Lessig and Wu. Because of potential unforeseen consequences of regulation and the "economics of congestion," Yoo urges a

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[91] Tim Wu & Lawrence Lessig, Ex Parte Submission in CS DOCKET NO. 02-52, FCC APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER CABLE FACILITIES, DECLARATORY RULING & NOTICE OF PROPOSED RULEMAKING (Aug. 22, 2003) (emphasis in original), *available at* http://faculty.virginia.edu/timwu/wu_lessig_fcc.pdf.

[92] Lessig Testimony, *supra* note 29; Coalition of Broadband Users and Innovators, Ex parte Communication in CS DOCKET NO. 02-52, FCC APPROPRIATE FRAMEWORK FOR BROADBAND ACCESS TO THE INTERNET OVER CABLE FACILITIES, DECLARATORY RULING & NOTICE OF PROPOSED RULEMAKING, (Jan. 8, 2003), *available at* http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6513401671 (calling for regulation of the "broadband duopoly" that will "define the Internet for some time").

[93] *See infra* note 204 and accompanying text.

[94] Yoo, *supra* note 3, at 1851.

policy that requires regulators to demonstrate concrete harms to competition before acting.[95] However, by relying on congestion and transaction costs—and overlooking imperfectly informed consumers—he leaves regulators with the power to define "concrete harms" broadly according to current political tastes.

B. Overemphasizing Congestion

In his recent article, Professor Yoo focused on network congestion and related economic concepts to explain why he favors less proactive neutrality regulation. Yoo argued that "flat-rate pricing results in excessive consumption of club resources" claiming that the "thirty-year old suite of protocols around which the Internet is currently designed . . . [is] an increasingly obsolete technology" that cannot address the bandwidth demands of today's broadband users.[96] Yoo relies in part on his own research[97] and on the statement of the FCC's former chief technologist, David Farber.[98]

Yoo, Farber, and others overlook the market's technological response to the inadequacies of first-in, first-out networking technologies, as the previous section describes. More importantly, Yoo also overestimates the effect of congestion on the Internet. Usage, traffic, and demand for service guarantees are growing, making network management more complex. However, complexity does not equate to difficulty or impossibility. Because of innovation at the network edge, both in service differentiation schemes and in the variety of last mile technologies,

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[95] *Id.* at 1907-08.
[96] *Id.* at 1863.
[97] Daniel F. Spulber & Christopher S. Yoo, *On the Regulation of Networks as Complex Systems: A Graph Theory Approach*, 99 NW. U. L. REV. 1687 (2005).
[98] Carol Wilson, *Point of No Return*, TELEPHONY, Apr. 3, 2006, *available at* http://www.encomm.org/eca-alert/eca-alert-june-06/industry_perspectives_5.html (quoting former FCC Chief Technologist and Carnegie Mellon Professor David Farber that the current Internet architecture is "getting old" and is increasingly unable to satisfy the demand for new functionality and services).

the Internet does not neatly fit either economist James Buchanan's "club goods" definition or economists' definition of pure public goods.[99]

Using an example that follows the network path of downloading a Web page, Yoo implies that increases in complexity have led to increases in congestion.[100] However, as network use has grown, providers have addressed those needs throughout the network. While transient latency undoubtedly exists in certain places from time to time, widespread, significant congestion of the type that would "give rise to a number of important policy implications"[101] has decreased, not increased, over the past decade. At Senate hearings in 2006, the Internet2[102] project's Gary Bachula explained how expansion relegates congestion to largely isolated incidents. He testified that Internet2 engineers assumed originally that their new network would need advanced tools to differentiate among various types of data. However, "all of [their] research and practical experience supported the conclusion that it was far more effective to simply provide more bandwidth."[103] Broadband technologies from fixed and mobile wireless to broadband over power lines to technologies not yet on the market may well render the debate about congestion moot in the future.

Future technological advances aside, though, other current measures debunk the myth of increased congestion in today's broadband era. Several organizations have undertaken long-term end-to-end performance measurement of Internet connectivity since the mid-1990s.[104] The longest running and most comprehensive of these studies is the Stanford Linear Accelerator

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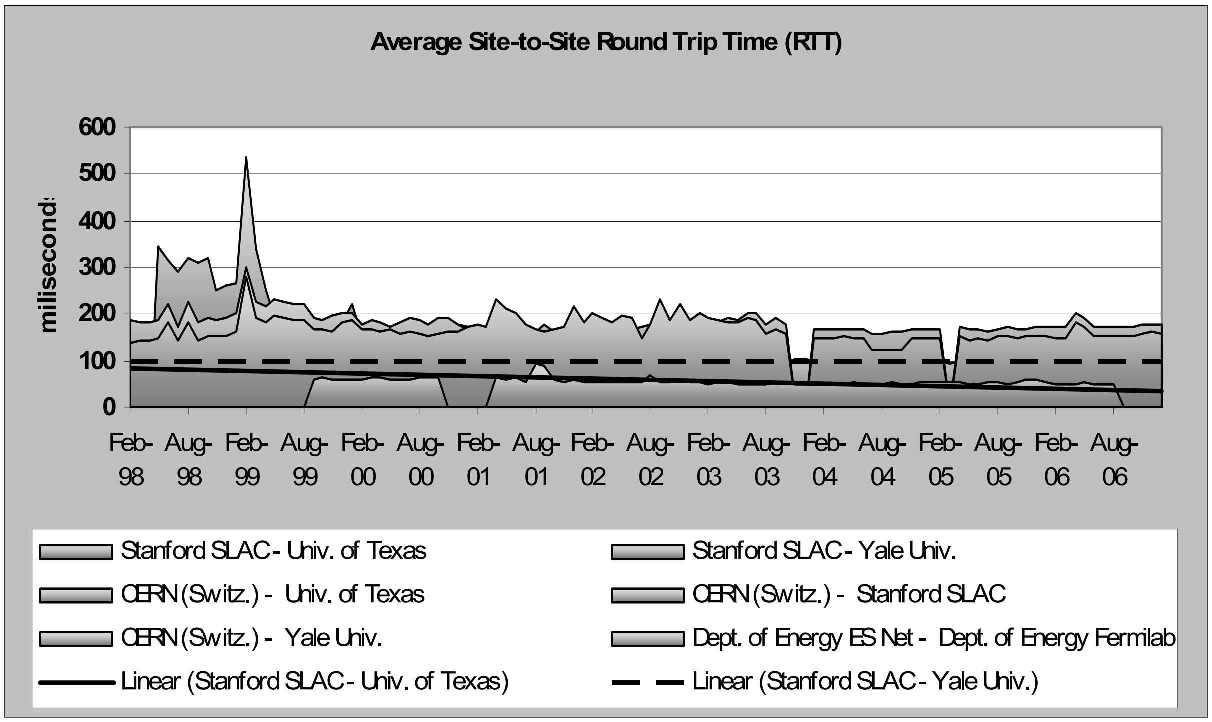
99 *See* Yoo, *supra* note 3, at 1863-64.
100 *Id.* at 1861-63.
101 Yoo, *supra* note 3, at 1863.
102 Internet2 is a non-profit, advanced networking consortium of universities, commercial vendors, and government agencies. Internet2, About Internet2, http://www.internet2.edu/about/ (last visited Jan. 15, 2007).
103 *Net Neutrality: Hearing Before the S. Comm. on Commerce, Science & Transportation*, 109th Cong. 2 (2006) (testimony of Gary R. Bachula), *available at* http://commerce.senate.gov/pdf/bachula-020706.pdf.
104 Les Cottrell et al., Comparison of Some Internet Active End-to-end Performance Measurement Projects, http://www.slac.stanford.edu/comp/net/wan-mon/iepm-cf.html (last visited Jan. 15, 2007).

Center's Internet End-to-end Performance Monitoring (IEPM) project.[105] The IEPM project maintains monitoring stations in nearly a dozen different countries, and many of the monitors have observed Internet connectivity twice an hour since 1998. IEPM averages these readings together over the course of a month. While some monitor sites show significant, but transient, variability, the sites trend toward less congestion, not more.[106] Samples from the longest running monitor-to-monitor measurements illustrate the lack of increased congestion:



[107]

European non-profit Internet infrastructure organization RIPE NCC also maintains a similar project, called Test Traffic Measurements (TTM). RIPE's TTM project reports similar results

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[105] Stanford Linear Accelerator Center Internet End-to-end Performance Monitoring Project [hereinafter IEPM], IEPM Home Page, http://www-iepm.slac.stanford.edu/ (last visited Jan. 15, 2007).

[106] *See* IEPM, PingER Site-by-monthly History Table, http://www-iepm.slac.stanford.edu/cgi-wrap/pingtable.pl (last visited Jan. 15, 2007) (select "WORLD" from the "From" drop-down box, and retain other default form settings to replicate data set).

[107] *Id.* The graph draws its data from the raw dataset provided by the IEPM project's data reporting engine. *Id.* The Microsoft Excel spreadsheet used to generate the graph is on file with the author.

between various worldwide sites,[108] whether testing between U.S. sites[109] or from European to U.S. sites across the heavily trafficked trans-Atlantic connections.[110] U.S.-based Internet traffic analyst Keynote Systems maintains Web site performance indices of popular consumer and business sites. Keynote's performance ratings of these major consumer[111] and business sites[112] have barely budged since their 2005 inception, despite the added textual and graphic complexity of most of its index sites over that same period.[113]

Despite staggering growth in users and bandwidth demands,[114] the deteriorating club good has yet to materialize. Professor Yoo mistakenly dismisses service differentiation as a provider response "to mitigate the problems of congestion and latency on the Internet."[115] While differentiating between applications can mitigate some congestion, no amount of reshuffling of

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[108] *See, e.g.*, RIPE NCC, TTM summaries for tt01.ripe.net: RIPE NCC at AMX-IX, Amsterdam, NL, http://www.ripe.net/ttm/Plots/summary.cgi?sortfield=marked+cells&sortkey=relative+change&sortorder=descending&format=html&threshold=+40.0&unit=percent&boxname=tt01&file=summary.xml (last visited Jan. 15, 2007) (displaying detailed latency, throughput, and transit times from RIPE NCC's monitor in Amsterdam to various worldwide sites). Each site has 6-month trend data available automatically and long-term data available from a search form.

[109] *See, e.g.*, RIPE NCC, Test Traffic Delay Plots: TT87 – CERN at Starlight [Networks, a Chicago-based Internet provider], Ill. to TT84 – XO Comms., Inc. Reston, Va., http://www.ripe.net/ttm/Plots/plots.cgi?ipv=4&url=map_index.cgi&base=tt84&src=tt87&dst=tt84#trends (last visited Jan. 15, 2007) (displaying detailed monitor data between test sites in Chicago and Reston). Note that the 6-month trend line is flat-to-declining.

[110] *See, e.g.*, RIPE NCC, Test Traffic Delay Plots: TT84 – XO Comms., Inc. Reston, Va. to TT01 – RIPE NCC at AMX-IX, Amsterdam, NL, http://www.ripe.net/ttm/Plots/plots.cgi?ipv=4&url=map_index.cgi&base=tt01&src=tt84&dst=tt01#trends (last visited Jan. 15, 2007) (displaying detailed monitor data between test sites in Reston and Amsterdam). Again, the 6-month trend line is flat-to-declining.

[111] *Compare* Keynote Consumer 40 Internet Performance Index [hereinafter KC40]: Week of 08-15-2005, *available at* http://www.keynote.com/solutions/performance_indices/consumer_index/consumer_40-081505.html (reporting a KC40 Index of 30.98 seconds) *with* KC40: Week of 09-26-2006, *available at* http://www.keynote.com/solutions/performance_indices/consumer_index/consumer_40-092506.html (reporting a KC40 Index of 33.98 seconds). From October 2005 through October 2006, the KC 40 Index rarely moved outside the range of 32 to 34 seconds.

[112] *Compare* Keynote Business 40 Internet Performance Index [hereinafter KB40]: Week of 12-26-2005, *available at* http://www.keynote.com/keynote_competitive_research/performance_indices/business_index/business-010206.html (last visited Jan. 15, 2007) (reporting a KB40 Index of 1.8 seconds) *with* KB40: Week of 01-01-2007, *available at* http://www.keynote.com/solutions/performance_indices/consumer_index/consumer_40-092506.html (last visited Jan. 15, 2007) (reporting a KB40 Index of 1.84 seconds).

[113] *See generally* Internet Archive Wayback Machine, http://www.archive.org/web/web.php, and dated archives of sites used in the KC40 and KB40 indices.

[114] Yoo, *supra* note 3, at 1862-63.

[115] *Id.* at 1881.

traffic priorities can substitute for adequate bandwidth capacity. At the same time, Yoo notes that networks often "maintain a certain level of excess capacity" that can make networks always appear slack.[116] Given this network engineering maxim, long-term evidence that belies sustained congestion problems may be less surprising. Yoo's focus on congestion does not explain decisions to implement application differentiation policies on networks with a surplus of bandwidth.

Internet users instead owe the remarkable stability of end-to-end performance to innovations in service differentiation and management[117] and in last mile technologies. Companies announce new technologies for delivering content[118] and expansions of non-cable, non-DSL broadband platforms[119] on an almost daily basis. Supply keeps pace with demand due to investment in additional bandwidth capacity, such as Verizon's recent announcement of a $500 million capacity expansion from the U.S. to China.[120] As capacity demands increase in China, bandwidth providers like Verizon and AT&T, who "is in talks with Telekom Malaysia and . . . StarHub" race to take advantage.[121] Providers repeat this network investment spree all

[116] *Id.* at 1870.
[117] *See supra* Part II.A.
[118] *See, e.g.*, Jefferson Graham, *Verizon Wireless Goes Prime Time with TV Simulcasts via Cellphone*, USA TODAY, Jan. 8, 2007, at 1A (noting that Qualcomm, who provides the chipsets to Verizon Wireless for its TV service, "has invested more than $800 million in its ambitious cell phone TV network."); Li Yuan, *Cellphone Video Gets On the Beam: Samsung's New Technology Enables Reception Of Digital TV Broadcasts*, WALL STREET JOURNAL, Jan. 4, 2007, at B3 (describing Samsung's new chipset enabling digital TV signal broadcasts to cellular telephones).
[119] *See, e.g.*, *Broadband via power lines to be offered in Onondaga*, WATERTOWN DAILY TIMES, Jan. 8, 2007, at B2 ("National Grid and a Syracuse company announced an agreement Thursday that will provide for a high-speed broadband over-the-power-line connection in some Syracuse suburbs."); Press Release, Sprint Nextel, Sprint Nextel Cites WiMAX Network Progress for 2007 (Jan. 8, 2007), *available at* http://www2.sprint.com/mr/news_dtl.do?id=15000 (announcing intention "to launch Mobile WiMAX broadband services in initial markets by year-end 2007 with a larger roll-out encompassing at least 100 million people by year-end 2008."); Press Release, Wisper Communications, WisperTel Brings Wireless High-Speed Internet to Summit County [Colo., near Breckinridge] (Jan. 9, 2007), *available at* http://biz.yahoo.com/prnews/070109/latu126.html?.v=50 (announcing broadband wireless service expansion) (alteration added).
[120] *See, e.g.*, Reuters, *Verizon teams with Asian companies for high-speed cable to China*, USA TODAY, Dec. 19, 2006, at 3B.
[121] *Id.*

over the world, further undercutting Yoo's theory of a congested Internet suffering from an "excessive consumption of club resources."[122]

C. Overemphasizing Transaction Costs

Buchanan's theory of club goods holds that flat-rate pricing will induce club members (Internet users in this case) to maximize personal consumption, since the marginal cost of another unit of usage is zero. Taken together, these individual decisions increase overconsumption of the club good, building an economic case for usage-sensitive pricing.[123] Economists Jeffrey MacKie-Mason and Hal Varian first applied Buchanan's congestion pricing model to the Internet, proposing a market-priced approach to resource allocation on congested networks.[124]

In MacKie-Mason and Varian's model, each packet on a network would carry a bid value indicating how much the packet owner would pay to pass the packet through a congested device. The router would compare the values of all incoming packets in an auction format, admitting the highest bidders.[125] Provided the bids accurately reflected owner preferences, the congestion market would theoretically internalize the congestion externalities.

The system devised by the two economists has several practical shortcomings, though. Bids need updates to avoid packet loss when bid "money" runs out after traversing several congested networks successfully. While computing power and programming ingenuity could

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[122] Yoo, *supra* note 3 at 1864.
[123] *See generally* James Buchanan, *An Economic Theory of Clubs*, 32 ECONOMICA 1 (1965); RICHARD CORNES & TODD SANDLER, THE THEORY OF EXTERNALITIES, PUBLIC GOODS, AND CLUB GOODS 351-52 (1996).
[124] Jeffrey K. MacKie-Mason & Hal R. Varian, *Pricing the Internet*, *in* PUBLIC ACCESS TO THE INTERNET, (Brian Kahin & James Keller eds., 1995), 269-314.
[125] *Id.*

overcome some of the transaction costs of processing messages in such a system, the signaling required to notify packet owners would further burden the already congested links and result in additional delays for packet delivery. Worse, network operators would effectively lose control of their network operations under a protocol-based congestion resolution mandate.

Instead, as discussed in Part II.A., providers have approximated a congestion solution at the network's edges (likely inflaming the network neutrality debate in part). This split-edge pricing framework[126] attempts to solve the problems created by settling payments for each individual packet in MacKie-Mason and Varian's model.[127] Instead of forcing packet owners to make individual payments at each congested network device, owners in a split-edge priced network pay only at the network's edge. Each edge provider sets the cost of delivering packets across its network based on its internal costs, the costs of transferring traffic to other networks, and "one of possibly many classes of service."[128]

In the split-edge pricing framework, both senders and receivers pay a charge for transmissions, with potentially different prices in each direction.[129] Briscoe's framework presents several models for payments, advocating the use of third-party clearinghouses that iteratively

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[126] The term "split-edge pricing," and the theory behind its modified congestion model first appeared in a paper presented by British Telecom researcher Bob Briscoe in 1999. Bob Briscoe, Chief Researcher, British Telecom Networks Research Centre, The Direction of Value Flow in Connectionless Networks: Address before the First Annual Workshop on Networked Group Communication (Nov. 19, 1999), *in* NETWORKED GROUP COMMUNICATION, *available at* http://www.cs.ucl.ac.uk/staff/bbriscoe/projects/charging/qos-based/e2char/valflow_ngc99.html (last visited Jan. 15, 2007).

[127] Several technical approaches exist in addition to split-edge pricing. IP packet headers include, though rarely use, an explicit congestion mechanism (ECN) to signal network congestion explicitly to end users. On frame relay networks, devices regularly use similar notifications (Forward and Backward ECN, or FECN and BECN) to signal congestion. ATM networks offer built-in classes of service that can allow congestion (unspecified bit rate, or UBR), reserve bandwidth for a particular ATM user (constant bit rate, or CBR), or provide a way to eliminate congestion by allowing the ATM network to recapture unused bandwidth (variable bit rate, or VBR). As built-in features of standard protocols and data encapsulations, their use does not result in transaction costs. These technical approaches are beyond the scope of this article.

[128] Briscoe, *supra* note 126, at § 5. Briscoe notes that this model is general enough to include specific tools such as "RSVP and diffserv." *Id.* The latter term refers to the technical name for the open source Linux tools described at notes 72-73, *supra*, and accompanying text.

[129] Briscoe, *supra* note 126, at §§ 5, 9.

settle interdomain charges between providers. He notes, however, that there is "nothing to stop providers or customers [from] assuming the clearinghouse role."[130] The third party clearinghouse has never materialized on Internet networks, as providers have instead entered into pairs of financial agreements at each point: end-users with last mile providers, last mile providers with backbone providers, etc.[131]

While theoretical models preferred usage-based pricing, they traditionally assumed that any metering carried no costs.[132] Later research relaxed this assumption, finding that competitive sellers could achieve the same equilibrium by offering a flat-rate price that equaled the base price in a usage-sensitive model plus the unit costs at the Pareto optimal consumption.[133] As Yoo notes, under this relaxed model, providers can "choose the pricing regime that imposes the fewest transaction costs."[134]

In this sense, engineering concerns have a significant effect on a provider's choice to price discriminate. If the Internet suffers from transient and isolated congestion, then high transaction costs would theoretically explain the pervasive flat-rate prices in broadband and dial-up Internet access. Yoo turns to traditional telecommunications metering regimes in an attempt to explain Internet pricing mechanisms.[135] However, parties in the net neutrality debate should avoid equating the evolution of service and pricing in the largely unregulated Internet sector with that of the highly regulated telecommunications sector. As Yoo notes later, "Internet-based

[130] *Id.* at § 7.

[131] Briscoe describes this system in one of his example scenarios: "A price needs to be set and settlement made between each pair of parties. If this is achieved, end-to-end, between the parties involved there are no further engineering implications - the pairs of parties clearly trust each other enough to enter into a financial arrangement and are willing to accept the cost of the transaction." *Id.* at § 9.1.

[132] Robert W. Helsley & William C. Strange, *Exclusion and the Theory of Clubs*, 24 CAN. J. ECON. 888, 889, 895-96 (1991) (noting that earlier research found Pareto efficiency only if exclusion or metering were costless).

[133] Robert J. Barro & Paul M. Romer, *Ski-Lift Pricing, with Applications to Labor and Other Markets*, 77 AM. ECON. REV. 875, 876-79 (1987).

[134] Yoo, *supra* note 3, at 1866.

[135] *Id.* at 1866-70.

communications operate on fundamentally different principles."[136] However, he still assumes that "the transaction costs associated with metering Internet traffic are likely to be even more significant than those associated with local telephone service."[137]

The underlying reasons for price discrimination and usage-based pricing help illustrate why the reverse is increasingly true. Studies have long held that "generally, discriminatory prices [are] required for an optimal allocation of resources in real life situations."[138] Internet providers' attraction to service and price discrimination will likely increase for two reasons. Just as a pharmaceutical drug costs millions to develop but dramatically less to manufacture and distribute, the total cost of providing Internet service consists increasingly of capital expenditures and one-time expenses rather than marginal costs.[139] At the same time, technology has made price discrimination simpler and less costly. In 2000, Amazon created a stir when it experimented with dynamic pricing.[140] Brick-and-mortar booksellers had few tools in the pre-Internet days to create similar schemes. Internet service providers, too, benefit from advancements in technology that enable detailed levels of control over traffic.

The overemphasis on transaction costs may stem from the rapid advancement in technologies. A decade ago, commentators differentiated between the connection-oriented telephony network and a "connectionless" Internet. MacKie-Mason and Varian wrote that "if telephone-style accounting were implemented [for the Internet], the equivalent of a one-minute

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[136] *Id.* at 1875.
[137] *Id.*
[138] LOUIS PHLIPS. THE ECONOMICS OF PRICE DISCRIMINATION 1 (1983) (emphasis omitted).
[139] *See, e.g.*, *supra* notes 31-32 and accompanying text. The advent of fixed wireless technologies, the widespread availability of co-location and shared Web hosting facilities, and the emergence of niche application providers have lowered the variable costs of providing Internet service.
[140] David Streitfeld, *On the Web, Price Tags Blur; What You Pay Could Depend on Who You Are,* WASH. POST, Sept. 27, 2000, at A1. Customers reported similar activity in the spring of 2000, and a summer 2000 academic study found evidence of dynamic pricing on Amazon's site. Coca-Cola also reportedly experimented with soda machines that could dynamically price drinks based on the temperature. *Id. See also* Robert M. Weiss & Ajay K. Mehrotra, *Online Dynamic Pricing: Efficiency, Equity, and the Future of E-Commerce*, 6 VA. J. L. & TECH. 11 (2001).

local phone call would generate about 2500 accounting records, and a ten-minute call would require 25,000 records."[141] The authors used the analogy of Web server logs recording an accounting record or "hit" for each individual file accessed on a Web page. If usage analysis required examining a "hit" in a log for every packet, then providers attempting usage analysis would struggle under a deluge of data. With incredulity, MacKie-Mason and Varian wrote that low-quality compressed video required "about 45 Mbs-which is the entire capacity of the NSFNET backbone."[142] Today's users can watch compressed video feeds from YouTube, of professional sports, and video blogs with considerably lower speed connections, just as traffic accounting technologies have improved.

The Internet, even in 1995, was not "connectionless." The path between a particular source and destination can change dynamically, but the source and destination remain the same regardless of the particular network path selected. An end-user that connects to a particular Web site will create a distinct, connection-oriented stream of communication between their computer and the Web server hosting the site. The user-to-server connection, regardless of the number of files actually downloaded from the site, has a distinct, recognizable "signature."[143] Even at the time of MacKie-Mason and Varian's article, the free Linux operating system supported rudimentary filtering.[144] Modern tools allow providers to identify traffic based on any portion of

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[141] Jeffrey K. MacKie-Mason & Hal R. Varian, *Some FAQs About Usage-Based Pricing*, 28 COMPUTER NETWORKS & ISDN SYS. 257, 263 (1995).
[142] *Id.* at 260.
[143] More technically, the "signature" of a TCP or UDP connection consists of a wealth of potential information: IP addresses, port numbers, connection "states," packet sizes, types of information, and more. *See* Information Sciences Institute, RFC 793: Transmission Control Protocol (TCP) DARPA Internet Program Protocol Specification (Jon Postel ed., 1981), *available at* http://www.ietf.org/rfc/rfc768.txt; Jon Postel, RFC 768: User Datagram Protocol (UDP) (1980), *available at* http://www.ietf.org/rfc/rfc768.txt. The discussion that follows draws primarily from those two technical standards documents.
[144] Mark Stone, *A Linux Firewall Primer*, LINUX.COM, Oct. 14, 2004, http://security.linux.com/security/04/10/11/2030249.shtml?tid=100&tid=35 (last visited Jan. 15, 2007) ("Firewall code has been included in standard Linux distributions from early on.").

the data stream's signature, without inspecting every packet.[145] Those same tools permit providers to classify, police, mark, and re-queue packets for delivery based on their service differentiation policies.[146]

Providers can now generate reports and bill based on bandwidth usage as well, something virtually impossible in 1995. Cisco's NetFlow software enables providers to perform "network traffic accounting, *usage-based network billing*, network planning, security, Denial of Service monitoring capabilities, and network monitoring."[147] The company touts its NetFlow software in customer usage-based billing case studies.[148] Popular Internet provider billing software supports not just Cisco's NetFlow, but other service differentiation products on the market as well.[149] Internet providers with more technical knowledge than available capital can download less expensive, or free, utilities to provide similar functionality.[150]

Game theory research applied to Internet protocol design may obviate any debate about high transaction costs for usage-based billing. Existing solutions described above, while low-cost compared to MacKie-Mason and Varian's packet-by-packet accounting, carry infinitely higher costs than a future pricing protocol would. When used to remove adverse user incentives,[151] the

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145 *See* Rusty Russell, Linux 2.4 Packet Filtering HOWTO: Using iptables, http://www.netfilter.org/documentation/HOWTO/packet-filtering-HOWTO-7.html (last visited Jan. 15, 2007).
146 *See generally* Hubert et al., *supra* note 81.
147 Cisco IOS Netflow, http://www.cisco.com/en/US/products/ps6601/products_ios_protocol_group_home.html (emphasis added) (last visited Jan. 15, 2007).
148 Cisco Sys., Inc., GTE Internetworking, http://www.cisco.com/en/US/products/ps6601/products_case_study09186a00800a8115.shtml (last visited Jan. 15, 2007).
149 Rodopi Software, Inc., Bandwidth Management Devices, http://www.rodopi.com/index.php?page=20701 (last visited Jan. 15, 2007).
150 *See, e.g.*, ntop.org – network top, http://www.ntop.org/ (last visited Jan. 15, 2007); NetUP Inc., UTM 5: Universal ISP Billing System, http://www.netup.biz/utm5-billing.php (last visited Jan. 15, 2007); FreeSide, Open-source billing, ticketing and automation for ISPs and online businesses, http://www.sisd.com/freeside/ (last visited Jan. 15, 2007). The ntop project also includes a lightweight probe called "nprobe" that uses Cisco's NetFlow protocol, and therefore integrates with any commercial and non-commercial billing package that supports NetFlow. ntop.org – nProbe, http://www.ntop.org/nProbe.html (last visited Jan. 15, 2007).
151 *See infra* Part III.A.

theory of mechanism design could allow a new Internet protocol to capture usage automatically without the need for external billing systems or analysis software.

Several researchers have reported their practical experiences applying mechanism design and game theory to Internet networking.[152] While some of these researchers encountered difficulties applying theory to networking models,[153] any application that improves upon the current external reporting schemes could lower transaction costs dramatically. Harvard researchers Jeffrey Shneidman and David Parkes have made more progress. In a 2004 symposium paper, Shneidman and Parkes presented methods to prove, given certain assumptions, that an implementation of a mechanism in a real-world system will match a designer's specification.[154] Just as MacKie-Mason and Varian scoffed at the idea of accounting for traffic flows in real time in 1995, the currently implausible idea of an Internet protocol that manages usage-based pricing natively may prove simplistic by 2015.

Commentators outside of Internet service provider and engineering research circles, unfortunately, have not always kept pace with these technological advances, and sometimes rely on outdated research[155] or misunderstandings of technical issues.[156] The innovative Internet market does not wait for theoretical research, though. With transaction costs for service differentiation low, capacity problems transient at worst, and Internet providers free from

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[152] *E.g.*, Elgan Huang, et al. *Rethinking Incentives for Mobile Ad Hoc Networks, in* PROC. ACM SIGCOMM WORKSHOP ON PRAC. AND THEORY OF INCENTIVES IN NETWORKED SYS., 191–96 (2004); Ratul Mahajan et al., *Experiences Applying Game Theory to System Design*. *Networks, in* PROC. ACM SIGCOMM WORKSHOP ON PRAC. AND THEORY OF INCENTIVES IN NETWORKED SYS., 183–90 (2004).
[153] *Id.*
[154] Jeffrey Shneidman and David C. Parkes. *Specification Faithfulness in Networks with Rational Nodes*, *in* PROC. 23RD ACM SYMP. ON PRINCIPLES OF DISTRIBUTED COMPUTING (2004) 88-97, *available at* http://www.eecs.harvard.edu/econcs/pubs/podc04.pdf.
[155] *See* Yoo, *supra* note 3, at 1908 n.24 (citing MacKie-Mason & Varian, *supra* note 141), *Id.* at n.95 (citing an article about telecommunications billing practices in January 1998), *Id.* at n.125 (citing MacKie-Mason & Varian, *supra* note 141).
[156] *See, e.g.*, *Id.* at 1875. Drawing from MacKie-Mason & Varian, *supra* note 141, Yoo writes that "multiple records are required to account for every Internet-based communication," when networking equipment today no longer inspects data in this way.

common carrier regulation or legacy billing practices of telephony providers, usage-based pricing already should have emerged. However, despite a myriad of possible pricing schemes,[157] flat-rate prices still dominate the broadband access sector.[158] This pricing phenomenon has a decidedly non-economic explanation: the power of end users. End users also hold the key to a uniform disclosure solution that neither promotes nor impedes economic welfare but encourages the market to use arbitrage or public pressure to bypass discriminatory burdens on new innovators.[159]

III. THE HUMAN ELEMENT

A. *End user effects on pricing and service*

All Internet service pricing schemes share a common element: end users. Especially in the United States, end users view unlimited, flat-rate Internet access as the standard.[160] As Andrew Odlyzko of the University of Minnesota's Digital Technology Center notes, "[p]eople react extremely negatively to price discrimination. They also dislike the bother of fine-grained pricing, and are willing to pay extra for simple prices, especially flat-rate ones."[161] Judging from pervasive flat-rate wireline and wireless telephone service in the United States,[162] users appear

[157] Yoo, *supra* note 3, at 1870-72 (describing the various pricing schemes used in telecommunications, including peering exchanges and wireless telephony service).
[158] *See, e.g.*, Consumers Union of U.S., Inc., *Internet Service: Fiber Joins the Fray*, CONSUMER REP., Feb. 2007. The report lists a flat-rate price for all 29 providers rated.
[159] This addresses a central concern of net neutrality proponents like Professor Lessig. *See* Lessig Testimony, *supra* note 29, at 2 ("The incentives in a world of access-tiering . . . will only burden new innovators.").
[160] Adam Thierer, *Are "Dumb Pipe" Mandates Smart Public Policy? Vertical Integration, Net Neutrality, and the Network Layers Model*, 3 J. ON TELECOMM. & HIGH TECH. L. 275 (2005) ("[T]he web-surfing public has come to view 'all you can eat' buffet-style, flat-rate pricing as a virtual inalienable right.").
[161] Andrew Odlyzko, Pricing and Architecture of the Internet: Historical Perspectives from Telecommunications and Transportation 6 (last revised Aug. 29, 2004) (unpublished manuscript), *available at* http://www.dtc.umn.edu/~odlyzko/doc/pricing.architecture.pdf.
[162] Yoo, *supra* note 3, at 1868, 1870.

willing to avoid complex pricing schemes, even if they pay a premium for a simple, more predictable plan.

Actual usage-based pricing studies of broadband Internet access are few, since users have generally insisted on flat-rate pricing. Instead, economic theory and applied mathematics have helped to explain the market's adoption of flat-rate pricing. Rather than provider transaction costs or Internet congestion, small-scale economic studies and game theory research have found that users *themselves* have the greatest effect on the market's pricing choices.

In an early study from the late 1990s, the Internet Demand Experiment (INDEX) project studied user responses to usage-based pricing for access to different levels of service.[163] The project tested approximately 70 users, giving them access via ISDN at speeds up to 128 Kbps. Users could select a free low-speed connection, or pay per-minute and per-byte for higher speed connections. The project's results supported the idea that users preferred flat-rate pricing, even when researchers required users to pay a premium for it. The study had a limited scope, given the small sample size and the tendency of users to be early adopters and heavy users of the Internet.[164] The INDEX project did not test service differentiation within a broadband connection. However, other studies of user responses to application differentiation indicate that users prefer stable service levels, even when variable bandwidth would result in more average bandwidth over time.[165]

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[163] Richard J. Edell & Pravin P. Varaiya, *Providing Internet Access: What We Learn from the Index Trial*, 13 IEEE NETWORK, Sept./Oct. 1999, at 18-25.
[164] Hal R. Varian, The Demand for Bandwdith: Evidence from the INDEX Project (last revised Feb. 7, 2002) (unpublished manuscript), *available at* http://www.ischool.berkeley.edu/~hal/Papers/brookings/brookings.html ("This is indicated by the following statistics: 91% had used the Internet for more than 3 years [in 1998], 86% had used computers for more than 5 years, 58% characterized their Internet use as 'above average,' 56% considered themselves 'computer professionals') (alteration in original).
[165] *E.g.*, Anna Bouch et al., *Of Packets and People: A User-centered Approach to Quality of Service*, *in* PROC. 8TH INT'L WORKSHOP ON QUALITY OF SERVICE 189-97 (2000).

Game theory research suggests that congestion or usage-based pricing mechanisms may encourage users to "cheat" to gain better access. A 2005 study by Michael Afergan applied game theory to theoretical multi-user networks modeled after the Internet's tree and node architecture.[166] His research showed that users found greater utility as they moved closer to the data source.[167] Steven Bauer and Peyman Faratin's analysis applied game theory to Internet networking directly. Their results showed that usage-based pricing created incentives for users to implement strategies to increase overall network capacity and decrease their long-term costs:

> [U]sers can lower their own overall long-term contribution to a capacity expansion cost by paying smaller penalties (i.e. smaller congestion charges) earlier . . . thereby enabling their later and larger amounts of traffic to enjoy the benefit (i.e. a congestion free expanded network capacity). By causing congestion in earlier time periods a selfish user can induce other players that would have been "free riders" – sending traffic while there was no congestion – to now contribute to the capacity expansion cost.[168]

By using congestion-creating strategies earlier, users could force providers to increase capacity, making congestion-based charges unlikely in the future. While Bauer and Faratin doubted that users would be sophisticated enough to execute congestion avoidance strategies, "the capability of classes of applications to exhibit strategic behaviors makes understanding the incentives created by congestion pricing a very relevant issue."[169]

Despite Bauer and Paratin's doubts, users have employed strategies in the past to defeat usage-based pricing or force providers to increase capacity. When faced with insufficient capacity, dial-up users often used programs that sent periodic traffic across a modem to avoid provider-imposed limits on inactivity or connection duration. Dial-up service providers regularly

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[166] Michael M. Afergan, Applying the Repeated Game Framework to Multiparty Networked Applications (Aug. 31, 2005) (unpublished Ph.D. dissertation, Mass. Inst. of Tech.), *available at* http://www.afergan.com/research/thesis/main.pdf.
[167] *Id.* at 97 (describing that the "tree structure" of a multiparty network significantly affected a user's utility).
[168] Steven Bauer & Peyman Faratin, *Analyzing Provider and User Incentives Under Congestion Pricing on the Internet*, *in* PROC. CSAIL STUDENT WORKSHOP (2005), *available at* http://atlas.csail.mit.edu/papers/csw2005.pdf.
[169] *Id.*

banned any "programs designed to keep a connection up by sending regular amounts of data through the dial-up connection" in standard terms of service agreements with users.[170] One popular software download site still lists 44 different dial-up Internet service tools to prevent connection terminations or to reconnect automatically to a provider.[171]

Studies and empirical evidence suggest that users are reluctant to accept complex, usage-based pricing schemes. As recent research indicates, they may prefer a simpler, more predictable mechanism, even if that flat-rate mechanism allocates resources less economically or fairly. Judging by user awareness of terms such as "spam," "firewall," "spyware," "Internet cookies," and "adware" in a recent Pew Research study,[172] and the proliferation of spam, virus, and spyware filtering appliances for Internet providers, users may actually *expect* certain types of non-neutrality from their providers. Historical lessons of user power also point to a market solution without government regulation. While a regulation-free environment may avoid certain consequences, inaction may result in other, less desirable ones.

B. Why doing nothing now, or acting post-harm, could fail

The network neutrality issue is not a simple two-sided coin. The Internet's tumultuous history, the economics of congestion, Coase's lighthouses, and macroeconomic theories of libertarian government, among others, provide justification for embracing network competition and avoiding regulation. Net neutrality advocates, however, are right to rely on those same justifications in worrying that network providers will discriminate against users at the first

[170] Skye/net Network Servs., Inc., *supra* note 9.
[171] Free Downloads Center, Free Keep Alive Tools Downloads, http://www.freedownloadscenter.com/Network_and_Internet/Keep_Alive_Tools/ (last visited Jan. 15, 2006).
[172] Data Memo, Pew Internet & Life Project (Jul. 2005), *available at* http://www.pewinternet.org/pdfs/PIP_Data_Techterm_aware.pdf.

opportunity. If game theory produces an Internet protocol that pushes the balance of power in favor of providers, discrimination may be both difficult to identify and difficult to stop. As Lemley and Lessig wrote: "To say there is no reason to use a seatbelt because there is always the care of an emergency room is to miss the extraordinary cost of any ex post remedy."[173] Antitrust law or alternative regulatory remedies that can address concrete harms to competition have the same intuitive appeal as regulations "guaranteeing" a nondiscriminatory Internet. In either case, even game theorists—not to mention legislators or FCC commissioners—would struggle to identify and measure the effects of innovation that never happened, whether due to the unintended effects of regulatory mandates or laissez-faire approaches to net neutrality.

A simple hypothetical illustrates the difficulty that legislators would face applying either net neutrality regulations or ex post enforcement. Any regulatory enforcement would need to separate actual discrimination that harms the market from inevitable transient performance issues that users encounter online daily. Assume that regulators discover that Sinister Cable's customers can no longer access Internet television service from NetTube, a popular upstart content provider, due to excessive jitter.[174] Among partisan regulatory commission members, two theories emerge. One side believes that Sinister Cable has configured software on their set-top boxes to inject network delay with the goal of derailing NetTube's service in favor of its own. If true, Sinister Cable's actions would violate the net neutrality regulations and cause a concrete harm in the market.

Other regulators argue that Sinister Cable is not behind the problems for NetTube subscribers. They point to evidence that Sinister Cable's service configurations are

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[173] Mark Lemley & Lawrence Lessig, *The End of End-to-End: Preserving the Architecture of the Internet in the Broadband Era*, 48 U.C.L.A. L. REV. (2001) 925, 956.

[174] In lay terms, jitter simply refers to the gaps in delivery times between data packets. Services such as IP voice and video are sensitive to delays between packet deliveries. Repeated half-second pauses in packet delivery, for example, would render video streams unwatchable.

nondiscriminatory, and that a bug in third party software licensed by Sinister Cable caused unforeseen problems with NetTube's unique IP television protocol. Sinister Cable, in fact, has worked for months with the third party and posted software patches long before any of its customers complained to regulators. The company and some of its cable provider brethren present the agency with a wealth of peer-reviewed scientific evidence showing that, while its shared cable architecture offers higher speeds, it suffers from more variability in packet delivery as a result. With the software problem fixed, the jitter problems appear to dissipate enough for the NetTube service to function. These regulators argue that net neutrality and concrete harm regulations should not hold Sinister Cable liable for software bugs beyond its control.

The debate quickly devolves into a political power struggle, a non-neutral outcome that could result in significant concrete harm of its own. Worse yet for policy makers, Sinister Cable's motives remain private. While the company might not have taken any deliberate or obvious steps to create the problem, it did not fret over NetTube's service problems. The company took several months to release a patch, and then did so without fanfare, leaving NetTube customers without service until media attention revealed the patch's existence. Sinister Cable could return to quietly managing its cable network so that jitter remains a problem.

Astute readers will recognize that this situation closely mirrors the Cox/Craiglist situation described earlier.[175] Craigslist configured their servers in a non-standard way, exploiting a third party's software bug. Cox released a full patch months after its third party provider found the bug,[176] and Cox customers have not reported similar problems. For its part, Cox denied that it had ever considered interfering with Craiglist, just as Comcast claimed that its selective edit of a

[175] *See supra* notes 58-62.
[176] The original fix was just an unsupported beta patch. The full release came out several months later. *See* Foremski, *supra* note 58.

Nightline broadcast was an encoding error by ABC.[177] A network provider that wants to cause network disruptions to gain an advantage over competitors can easily do so and present plausible reasons for its decisions. Laws and regulations cannot act as divining rods, locating the true intentions of an Internet service or content provider.

On the other hand, providers who choose an entirely "neutral" policy and perform no service differentiation could easily violate net neutrality regulations. For example, a company with no policy could degrade VoIP by allowing that traffic to intermingle with other data. VoIP packets are typically small (often 64 bytes) to minimize the effects of any potential data loss on a conversation.[178] Web or e-mail servers typically optimize for efficiency and break data down into the largest packet size possible (often between 1400 and 1500 bytes). In a network that does nothing to differentiate between VoIP streams and other packets, the 64-byte packets could be queued for transmission behind larger 1500-byte packets. On slow or congested networks, the delay caused by the time to transmit larger 1500-byte packets introduces jitter. The delays caused by commingling data would have a similar effect on VoIP as a purposely-induced transmission delay. To regulators, Sinister Cable and the "neutral policy" provider would look the same.

In some cases, such as the FCC's decision to sanction Madison River Communications for openly blocking VoIP,[179] regulators would easily discern anticompetitive strategies and weak technical justifications. Hard cases, such as the Cox/Craigslist issue and the hypothetical situations posed above, would result in arbitrary—and possibly incorrect—decisions. Regulators would struggle to distinguish between Cox Communications, who had no intention of discriminating but implemented a software update that nonetheless caused discrimination, and

[177] McCarthy, *supra* note 64.
[178] The discussion of VoIP packet sizes, queuing, and quality of service issues in this section is adapted from Douglas A. Hass, Dir. of Bus. Dev., ImageStream Internet Solutions, Inc., Address at the LinuxWorld Open Solutions Summit: Open Source Tools for Quality of Service (Feb. 14, 2007).
[179] *In re* Madison River Comm., LLC, 20 F.C.C.R. 4295 (2005).

"Sinister Cable," who might falsely claim that it follows nondiscriminatory practices, but in fact seeks out reasons to discriminate.

C. *Improving market response to service differentiation by informing end users*

Law and economics theory traditionally found a market failure in one of several general situations, including "when [market] players do not have symmetric and full information relevant to their market activities."[180] State regulators have identified the same need for accurate and complete consumer information about Internet services. The National Association of Regulatory Utility Commissioners (NARUC), which represents state regulatory agencies and officials, adopted a Resolution Regarding Citizen Access to Internet Content at their November 2002 meeting. The resolution recognized the possibility that "some providers of broadband service or facilities may have an incentive to restrict Internet access to favored news sources, and if they chose to do so, it could significantly harm free and open information exchange in the marketplace of ideas."[181] Therefore, NARUC resolved that broadband users should: "1) Have a right to access to the Internet that is unrestricted as to viewpoint and that is provided without unreasonable discrimination as to lawful choice of content (including software applications); and, 2) *Receive meaningful information regarding the technical limitations of their broadband service*."[182]

[180] Niva Elkin-Koren & Eli M. Salzberger, *Law and Economics in Cyberspace*, INT'L REV. OF L. & ECON. 553, 557 (2002).
[181] NAT'L ASS'N OF REG. UTIL. COMM'RS, RESOLUTION REGARDING CITIZEN ACCESS TO INTERNET CONTENT (2002), *available at* http://www.naruc.org/associations/1773/files/citizen_access.pdf.
[182] *Id.* (emphasis added).

The same year, Internet standards makers also recognized the importance of meaningful information. RFC 3260,[183] released in April 2002, clarified several terms in the original Differentiated Services RFC.[184] Specifically, the RFC noted the importance and function of the Traffic Conditioning Agreement (TCA). "A TCA is 'an agreement specifying classifier rules and any corresponding traffic profiles and metering, marking, discarding and/or shaping rules which are to apply . . . .'"[185] The RFC drafters separated the TCA from other concepts, since the term "implied considerations that were of a pricing, contractual, or other business nature, as well as those that were strictly technical."[186]

The TCA concept, if adopted, would both avoid onerous government regulation and address the concerns of net neutrality advocates that providers could act discriminatorily. Throughout Internet history—squabbles with CIX, the rise of spam filters and antivirus software, complaints about discriminatory actions by providers, and even the net neutrality debate's prominence—users have held the greatest sway over the market. While innovators and entrepreneurs have shaped tastes, users have governed officially and unofficially. Providing detailed information to users about traffic policies that could affect Internet service on their connections would ensure that the balance of power remained on the side of consumers.

Regulators or legislators could model a "Traffic Control Disclosure Act" (TCDA) on the Fair Credit and Charge Card Disclosure Act.[187] That Act emphasizes a "more detailed and

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[183]Dan Grossman, IETF Network Working Group, RFC 3260: New Terminology and Clarifications for Diffserv (2002) [hereinafter RFC 3260], *available at* http://www.ietf.org/rfc/rfc3260.txt.
[184] *See supra* note 73 and accompanying text.
[185] RFC 3260, *supra* note 183.
[186] *Id.*
[187] Fair Credit and Charge Card Disclosure Act, PUB. L. NO. 100-583, 102 STAT. 2960 (1988) (codified at 15 U.S.C. §§ 1610, 1637, 1640 (2000)) [hereinafter Fair Credit Act]; *see also* 12 C.F.R. § 226.5a (disclosures for credit and charge card applications and solicitations). For an argument for FTC enforcement of net neutrality mandates, *see* RAYMOND L. GIFFORD, PROGRESS SNAPSHOT RELEASE 2.12: LET THE FTC DO IT! MAYBE IT ALREADY CAN (2006), *available at* http://www.pff.org/issues-pubs/ps/2006/ps2.12ftc.pdf. FTC action is not without precedent. The FTC has taken action against Internet companies in the past. *See, e.g.*, *In re* Petco Animal Supplies, Inc., Docket No. C-

uniform disclosure . . . with respect to information."[188] A proposed TCDA would strive to provide detailed information about provider practices. Internet service providers and content providers alike would disclose, in a reasonably consistent manner, certain specifics of their service offerings and traffic control policies in a uniform table. If designed to provide relevant information, this disclosure would help consumers more easily compare different service offerings. Given the vociferous and vocal opposition to the most egregious differentiation policies, public disclosures would likely discourage all but a few standard classes of service differentiation.

With public comment and regulatory oversight, the disclosure table can evolve as advancements in technology dictate and consumer tastes change. For example, the proliferation of unsolicited commercial e-mail—spam—has led providers to block external access to the ports used by mail servers,[189] a type of filtering developers of the mail protocols likely did not see necessary years ago. A TCDA must accomplish three primary goals:

1. Notice

The Fair Credit Act provisions provide sensible guidelines for the TCDA framework. Any content or Internet service provider must post their disclosure conspicuously and prominently on their Web site. Any solicitations by Internet service providers for dial-up or broadband access, or by content providers for pay services, must include the data in a tabular

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4133 (Fed. Trade Comm'n Mar. 4, 2005) (final decision and order), http://www.ftc.gov/os/caselist/0323221/00308do0323221.pdf (enforcing the Federal Trade Commission Act, 15 U.S.C. § 45, and resolving FTC claims that Petco had violated federal law and its own stated policies by failing to implement reasonable safeguards to protect customers' personal information); FTC Privacy Initiatives - Unfairness & Deception - Enforcement, http://www.ftc.gov/privacy/privacyinitiatives/promises_enf.html (last visited Jan. 15, 2007) (listing FTC enforcement actions against online and offline companies for violations of consumer privacy).

[188] Fair Credit Act Preamble.

[189] *E.g.*, Declan McCullagh, *Feds to Fight the Zombies*, CNET NEWS, http://news.com.com/Feds+to+fight+the+zombies/2010-1071_3-5715633.html ("The FTC also wants Internet providers to prevent e-mail from leaving their network unless it flows through their own internal servers" by blocking port 25); Cox's War Against Spam, http://www.cox.com/sandiego/highspeedinternet/spamfaq.asp, (last visited Jan. 15, 2007); Univ. of Notre Dame Office of Info. Tech., SMTP (Port 25) Blocking, http://oit.nd.edu/email/port25_block.shtml (last visited Jan. 15, 2007).

format determined by regulators.[190] In any telephone or in-person solicitations for Internet service "the person making the solicitation shall orally disclose the information described" in the table.[191] Any provider offering a service for pay must notify customers of any changes to the policy.

2. Choice

The TCDA must inform consumers of the choices available to discontinue service penalty-free after a short trial period. The provider must also notify customers of their rights to reject any changes in network policy changes and cancel penalty-free, regardless of contract duration or prepayment.

3. Education

TCDA disclosure will give consumers the ability to obtain easily understandable and accurate information about traffic control policies, applications, and technology advancements. Companies that implement service differentiation schemes will have an opportunity to explain the benefits of the technologies to consumers. The regulatory oversight agency can act as a forum for information and education about technologies and consumer options. In addition, regulators can address any market failures to disclose and maintain policies accurately and clearly.

Unlike laissez-faire approaches that attempt to react ex post to market failures, or cumbersome regulations that try to read institutional minds or dictate network policies, a TCDA would embrace openness and transparency. A disclosure regime would compel providers to make public their service differentiation policies and practices. Individuals have a right not to

[190] *See* Fair Credit Act § 2(a) (amending 15 U.S.C. 1637 § 127(c)(1)(A)).
[191] *Id.* (amending § 127(c)(2)(A)).

neutrality, but to the knowledge of how service differentiation policies could affect the services they purchase from Internet service or content providers.

The IETF's Network Working Group has released a document that outlines a disclosure foundation, aimed in part at regulators. RFC 4084[192] attempts to standardize terminology used to describe Internet services. As the abstract to the RFC notes,

> [M]any types of arrangements have been advertised and sold as "Internet connectivity." Because these may differ significantly in the capabilities they offer, the range of options, and the lack of any standard terminology, the effort to distinguish between these services has caused considerable consumer confusion. This document provides a list of terms and definitions that may be helpful to providers, consumers, and, potentially, regulators in clarifying the type and character of services being offered.[193]

The RFC lists five types of Internet connectivity organized by access level.[194] For regulatory purposes, these classifications, when combined with others for content providers and other types of network services, could serve as useful delineations between different types of disclosures. Content providers such as Yahoo or Google would have fewer opportunities to implement service differentiation, and regulators would likely require different disclosures from them than from Internet service providers like AT&T.

More importantly, sections three and four of the RFC list multiple terms "that a service provider might choose to provide to complement those general definitions" about its service differentiation policies.[195] The list focuses primarily on e-mail filtering issues, but a TCDA disclosure should touch on at least four other general service differentiation categories as well:

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[192] John C. Klensin, IETF Network Working Group, RFC 4084: Terminology for Describing Internet Connectivity, (2005), *available at* http://www.ietf.org/rfc/rfc4084.txt.
[193] *Id.*
[194] *Id.* at § 2 (Web connectivity; Client connectivity only, without a public address; Client only, public address; Firewalled Internet connectivity; Full Internet connectivity).
[195] *Id.* at §§ 3-4.

classification, policing, queuing, and shaping.[196] These four categories cover each major aspect of service differentiation by providers.[197]

Classification happens even at basic levels, such as the analysis of a data packet's ultimate destination. For disclosure purposes, though, providers should disclose any policies of identifying and sorting traffic into different classes, whether for monitoring purposes[198] or for actual service differentiation. For example, Professor Yoo notes the "natural response" of network owners to give "time-sensitive applications . . . a higher priority."[199] Classification also couples with traffic queuing. For maximum performance, providers may choose to queue traffic for delay-sensitive VoIP ahead of e-mail or Web traffic, regardless of the actual bandwidth allocated to each service.[200] Niche providers today focus service differentiation policies on gaming performance,[201] application hosting,[202] interactive voice response and call center hosting,[203] and any number of other vertical services.

Policing, as the name suggests, typically involves discarding nonconforming traffic to maintain network integrity. Much of RFC 4084, not to mention the debate over discriminatory provider practices, focuses on this aspect of service differentiation. Disclosure of policing

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[196] These categories adapted from Douglas A. Hass, Dir. of Bus. Dev., ImageStream Internet Solutions, Inc., Address at the LinuxWorld Open Solutions Summit: Open Source Tools for Quality of Service (Feb. 14, 2007).
[197] Cisco uses similar categories in describing its products' quality of service capabilities. *See* Quality of Service Overview, http://cisco.com/univercd/cc/td/doc/product/software/ios121/121cgcr/qos_c/qcdintro.htm (last visited Jan. 15, 2007).
[198] Monitoring and logging traffic with tools such as NetFlow potentially implicates privacy as well as net neutrality, and may require additional scrutiny.
[199] Yoo, *supra* note 3, at 1880.
[200] *See supra* note 178 and accompanying text. For a detailed discussion of service differentiation that arises from business decisions by content and Internet service providers, see Craig McTaggart, *Was the Internet Ever Neutral?*, *in* PROC. 34TH RES. CONF. ON COMMC'N, INFO., AND INTERNET POL'Y 4-14 (2005), *available at* http://web.si.umich.edu/tprc/papers/2006/593/mctaggart-tprc06rev.pdf (last revised Sept. 30, 2006).
[201] *E.g.*, INX-Network, Ltd., About, http://www.inx-gaming.co.uk/about/ (last visited Jan. 15, 2007).
[202] *E.g.*, Connectria, Citrix Hosting Services, http://www.connectria.com/citrix.html (last visited Jan. 15, 2007).
[203] *E.g.*, Voxeo Corporation, VoiceCenter IVR Hosting, http://www.voxeo.com/products/voicexml-ivr-hosting.jsp (last visited Jan. 15, 2007).

policies would encompass a range of practices from spam, virus, and spyware filtering to e-mail traffic blocking, server hosting, or the use of wireless access points.

The shaping step in a service differentiation policy controls traffic bursts and allocates bandwidth to traffic flows according to a provider's business policies. Providers can use bandwidth allocations to guarantee bandwidth for a particular mission-critical application, or to ensure efficient operation of various applications in a multi-service network. As last mile networks change, any of the aforementioned niches could organize vertically. A gaming provider may offer consumers a wireless connection built for maximum performance with every major online gaming network, but otherwise offering degraded performance for other applications or content providers. A TCDA would give consumers clear, concise information about that vertical integration, and the choices they necessarily make when selecting one service over another. Net neutrality regulations banning service differentiation would ban this type of innovation and vertical innovation. [204]

CONCLUSION

The largely academic NSFnet did not evolve into the commercial Internet because of consumer demand, neutrality, or nondiscrimination. Entrepreneurs, scientists, academics, and the wave of early technology adopters drove network expansion and the proliferation of broadband technologies—while discriminating and prioritizing from the earliest days and within the most basic technologies. Both the Internet's history and solid economic evidence suggest that this innovative culture will continue unabated, if regulators resist the urge to tinker. The Internet's

[204] As Thierer writes, net neutrality regulations "seem to ignore market evolution and the potential for sudden technological change by adopting a static mindset preoccupied with micro-managing an existing platform regardless of the implications for the development of future networks." Thierer, *supra* note 160, at 290.

content and service suppliers have developed numerous new technologies and industry sectors over the past 20 years. Innovation has often has required, and customers have increasingly demanded, non-neutrality, tiered access, and other service differentiation. Net neutrality regulation, in the direct form of neutrality mandates or the indirect form of a ban on concrete harms will discourage innovators and strip consumers of their power to shape service offerings.

From the Internet's earliest days, consumers have efficiently balanced providers' levels of service differentiation to foster continued innovation without the heavy hand of regulation. Regulators should create incentives for consumers to continue to govern. Government enforcement, therefore, should focus on disclosure of provider practices. This paper presents the framework for a simple, clear, uniform disclosure modeled on existing law that can address net neutrality proponents' concerns without jeopardizing regulators' agnosticism for the market's direction.

As Andrew Odlyzko concluded in 1999:

> While the Internet should appear as a simple network, it will need sophisticated technical controls . . . as well as the right economic incentives. . . . The future of the Internet will be a competition between simplicity and novelty, and while simplicity will be essential to enable novelty, it is never likely to win completely. The blame for this belongs to us, the users, as we allow our requirements to grow.[205]

Tomorrow's networks will need a combination of simplicity and complexity, openness and differentiation. As they have since the invention of TCP/IP, networks will also need end-users to strike the proper balance between that openness and differentiation. By acting to eliminate imperfect information, government regulators can foster a robust market governed by well-informed consumers.

[205] Andrew Odlyzko, The Stupid Network: Essential Yet Unattainable (last revised Sep. 15, 1999) (unpublished manuscript), *available at* http://www.dtc.umn.edu/%7Eodlyzko/doc/stupid.unattainable.txt.