

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

In the Matter of

Petition for Rulemaking to Establish Rules  
Governing Network Management Practices by  
Broadband Network Operators

Petition for Declaratory Ruling Regarding  
Internet Management Policies

Broadband Industry Practices

WC Docket No. 07-52

**COMMENTS OF VERIZON AND VERIZON WIRELESS**

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February 13, 2008

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**I. INTRODUCTION AND SUMMARY**

Network management practices are an essential tool long used by broadband providers to ensure that consumers receive high quality, reliable, and safe broadband Internet access services. In providing consumers with broadband services used to access the public Internet, broadband providers employ a variety of practices, with goals ranging from the mundane – such as provisioning the service at the level that the subscriber selected – to the vital – such as protecting networks and subscribers from security threats traveling over the Internet. Some broadband providers also face an increasing need to use network management to safeguard the performance and quality of their subscribers’ services by minimizing the network congestion that can degrade the usefulness of their services. The Commission should encourage – not restrict – broadband

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<sup>1</sup> In addition to Verizon Wireless, the Verizon companies participating in this filing (“Verizon”) are the regulated, wholly owned subsidiaries of Verizon Communications Inc.

providers' ability to engage in these pro-consumer practices to respond to evolving challenges that threaten consumers' services. Competition and innovation will best protect consumers.

**1. The network management practices required to provide consumers with safe, reliable, and high quality broadband services to access the public Internet are complex and evolving, and these practices are best left to network engineers who must respond to real world concerns.** The arguments asking the Commission to prospectively restrict providers' network management practices fail to account for the complexity, and importance, of these practices. In fact, the two petitions giving rise to the Commission's request for comment principally focus on allegations concerning a single provider's practices in one particular context – *i.e.*, Comcast's alleged handling of certain peer-to-peer traffic.<sup>2</sup> Based on this single episode, these parties ask the Commission to establish the metes and bounds of reasonable network management for all broadband providers and in all contexts. While Verizon is not in a position to address the particular facts, circumstances, or reasonableness of Comcast's network management practices, the petitioners' sweeping arguments ignore the real world need for broadband providers to manage their networks in a wide range of contexts and using a variety of methods in order to deliver high quality and safe broadband services to their consumers. In fact, there appears to be a broad consensus – including the expert government agencies that have studied these issues and even many of the parties that favor heavy-handed net regulation – that network management is both appropriate and necessary. Indeed, both the Department of Justice (DOJ) and the Federal Trade Commission (FTC) exhaustively studied broadband providers'

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<sup>2</sup> See Petition for Declaratory Ruling of Free Press, Public Knowledge, *et al.*, WC Docket No. 07-52 (Nov. 1, 2007) (“*Free Press Petition*”); Petition for Rulemaking of Vuze, Inc., WC Docket No. 07-52 (Nov. 14, 2007) (“*Vuze Petition*”).

practices and recognized the harm to innovation and to consumers' services of adopting prospective regulation limiting network management.

“Network management” is a simple term, but it implicates a broad range of practices aimed at myriad legitimate goals.<sup>3</sup> For example, in response to ever-increasing demands on network capacity and the proliferation of bandwidth-intensive applications, some broadband providers use network management practices to ensure that all subscribers get a fair shot at the network's available bandwidth. Without such practices, in some situations, the services of the vast majority of customers could be degraded by a handful of heavy users whose applications take up all available network capacity. Along the same lines, network management could be used to improve the functioning of the Internet, such as by providing prioritization to latency-sensitive applications like telemedicine, voice, or streaming video, over other traffic less sensitive to such concerns.

Likewise, network management practices have long been used, with little controversy, to protect subscribers and the network from the relentless and evolving threats that exist on the Internet. In order to ensure security and protect the performance of their networks, providers actively seek to identify threats – such as viruses, spam, Trojan horses, botnets, zombie computers, denial-of-service attacks or all manner of malware and spyware – and stop them *before* they harm subscribers or the provider's network. And providers also use network

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<sup>3</sup> “Network management refers to the activities, methods, procedures, and tools that pertain to the operation, administration, maintenance, and provisioning of networked systems.” See “Network Management,” wikipedia.org, [http://en.wikipedia.org/wiki/Network\\_management](http://en.wikipedia.org/wiki/Network_management) (last visited Feb. 13, 2008) (citing A. Clemm, *Network Management Fundamentals*, CiscoPress (2006)). “Functions that are performed as part of network management . . . include controlling, planning, allocating, deploying, coordinating, and monitoring the resources of a network, network planning, frequency allocation, predetermined traffic routing to support load balancing, cryptographic key distribution authorization, configuration management, fault management, security management, performance management, bandwidth management, and accounting management.” *Id.*

management practices to address routine operational issues, such as enforcing the capacity limits for the tier of service that the consumer selects.

Although all providers engage in some forms of network management, the magnitude of particular concerns facing a provider, and the alternatives available to address those concerns, vary considerably. For example, broadband providers with shared network resources closer to the end user – such as wireless networks and cable modem networks – may face bigger challenges in ensuring that the activities of some users do not unreasonably degrade the services of other users competing for the same capacity. Likewise, differing technological and practical constraints mean that not all broadband providers have the same menu of options for addressing particular concerns. And innovation in network management practices – including efforts by industry groups – continue to develop new solutions to more effectively meet the various challenges that threaten the quality and safety of consumers’ broadband services.

**2. Robust broadband competition encourages network management practices that benefit consumers.** As with other broadband provider practices, existing and growing competition – not innovation-stifling regulation – is the most effective check on providers’ network management practices. Broadband providers are engaged in intense, intermodal competition across a number of dimensions, including speed, price, service quality, and features. Given this dynamic and working marketplace, any provider that engages in network management practices that harm consumers will be identified and punished, while those that employ practices that benefit subscribers’ broadband experience will be rewarded. The efficiency of this market-based approach is furthered by the meaningful information that broadband providers, by competitive necessity, provide subscribers about their service plans, including information concerning the parameters of, and any material limitations on, subscribers’ services. Armed with

this information, consumers are able to choose the broadband services that best meet their needs. And, as recent events prove, the vigilant and vocal online community provides additional scrutiny of the practices of broadband providers, thus effectively eliminating any possibility that providers could surreptitiously engage in practices that harm their subscribers, even if they wanted to.

**3. Regulation of network management practices would inhibit innovation and would lower the quality and safety of services used by consumers to access the public Internet.** Given the central role of network management in providing consumers with reliable, safe, and high quality broadband Internet access services, and the complex variety of concerns addressed by these practices, and the evolving array of practices used to address those concerns, regulation in this area would be particularly harmful to consumers. In order to effectively manage their networks and meet consumers' demands, broadband providers require flexibility to address the ever-changing challenges that arise. These practices also may also be essential to furthering national security interests, given the increasing reliance of government agencies and emergency responders on the Internet and broadband networks.

Regulation in this dynamic area would constrain broadband providers' ability to address those challenges effectively and would remove alternatives that could prove effective – or even essential – in providing high quality services. Regulation limiting available network management practices also would undermine the industry-led efforts to develop innovative, new approaches to better address challenges and serve consumers. Therefore, as the DOJ and the FTC already recognized, the complex, dynamic, and evolving practices aimed at providing safe, reliable and high quality broadband Internet access services is particularly ill-suited for *ex ante* regulation, and limiting the alternatives available to broadband providers would harm consumers.

\* \* \*

Thus, any consideration of providers' network management practices must account for the multiplicity of reasons for network management, the various forms of existing and potential network management practices, the technological and practical constraints limiting the practices available to broadband providers, and the costs and potential harms of adopting regulations in the context of the dynamic and evolving broadband marketplace. Foremost, the Commission must take into account that network management practices serve *subscribers'* interests in receiving high quality and safe broadband services, and thus help them to take advantage of the full range of content, applications, and services available on the Internet. Given these considerations, there is no reason for the Commission to adopt prospective regulation in this evolving area.

## **II. BACKGROUND**

Over two years ago, the Commission adopted its Broadband Policy Statement committing to incorporate various principles "into its ongoing policymaking activities" in order "to preserve and promote the vibrant and open character of the Internet."<sup>4</sup> At the same time, these principles, which by their terms apply to wireline services used by consumers to access the public Internet, also expressly recognized, consistent with long standing industry practices, that "[t]he principles we adopt are subject to reasonable network management." *Id.* n.15. From that time until the recent filings, no party complained to the Commission concerning any broadband provider's network management practices, and indeed most recognized their benefits to consumers.<sup>5</sup>

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<sup>4</sup> Policy Statement, *Appropriate Framework for Broadband Access to the Internet over Wireline Facilities*, 20 FCC Rcd 14,986, ¶ 5 (2005) ("Broadband Policy Statement"). The Commission noted that it was "not adopting rules in this policy statement." *Id.* n.15.

<sup>5</sup> The focus of these comments is on consumer broadband Internet access networks, as compared to networks or services designed and constructed to offer Internet access or other data transport services to business and enterprise customers. The scope and nature of those networks and services may be very different from networks implemented to provide last-mile consumer broadband Internet access, and the

When the Commission initiated its inquiry into “broadband industry practices,” the Commission again focused on network management practices in broadband services used to access the public Internet and asked for comment on the types and purposes of “packet management” employed by providers, as well as comment on which practices should be considered “reasonable or unreasonable” and whether current network management practices are “helpful or harmful to consumers.”<sup>6</sup> The Commission’s notice of inquiry alluded to, and asked about, the broad range of legitimate justifications for network management, including:

[D]uring times of congestion, do providers prioritize packets for latency-sensitive applications such as voice calls, video conferencing, live video, or gaming? Do providers prioritize packets for safety- and security-related applications such as health monitoring, home monitoring, and emergency calls? Do providers block packets containing child pornography, spyware, viruses, or spam? Do providers offer parental controls that block packets containing sexually explicit material? Do providers manage packets to improve their network performance, engineering, or security? . . . Are any of these packet management practices in place to implement other legal requirements?<sup>7</sup>

In response, proponents of broadband regulation did not mount an attack on most network management practices, but instead conceded their legitimacy as a general matter. In fact, in light of the substantial record amassed by the Commission in response to the Broadband Industry Practices NOI, the DOJ remarked that “commenters provided scant evidence that consumers are being harmed by the business practices of Internet industry participants.”<sup>8</sup>

Recognizing that “[r]egulatory restraints in this dynamic and evolving sector of the economy

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types of network management required to provision those networks and services may also differ from the context of residential broadband Internet access services. Thus, for purposes of this proceeding, the Commission should maintain its focus on consumer broadband services used to access the public Internet.

<sup>6</sup> Notice of Inquiry, *Broadband Industry Practices*, 22 FCC Rcd 7894, ¶ 8 (2007) (“Broadband Industry Practices NOI”).

<sup>7</sup> *Id.*

<sup>8</sup> Ex Parte Filing, Antitrust Division, U.S. Department of Justice, *Broadband Industry Practices*, WC Docket No. 07-52, at 3 (Sept. 6, 2007).

could perversely stifle innovation and investment, reduce consumer choice, and increase prices to consumers,” the DOJ noted in particular the risks that regulation “could unreasonably limit the ability of broadband providers to manage their network efficiently.” *Id.* at 4. The DOJ noted that “[o]wners of network facilities have legitimate reasons to manage their facilities in ways that lessen congestion and address public safety issues.” *Id.*

Similarly, in its own review of broadband provider’s practices, the FTC considered broadband providers’ practices, including network management employed to address the problem of “Internet congestion.”<sup>9</sup> In particular, the FTC noted that “the use of bandwidth-intensive applications like certain peer-to-peer file-sharing protocols by even a small minority of users is already consuming so many network resources as to be worrisome . . . . [and] even a small portion of Internet users may effectively degrade service for the majority of end users.” *Id.* As a general matter in considering both current and potential practices of broadband providers, the FTC recommended that policymakers “proceed[] very cautiously,” stating that “[i]ndustry-wide regulatory schemes – particularly those imposing general, one-size-fits-all restraints on business conduct – may well have adverse effects on consumer welfare, despite the good intentions of their proponents.” *Id.* at 157, 160.

Rather than waiting for the Commission to conclude its own review in the voluminous record in the Broadband Industry Practices proceeding, several parties now seek to short-circuit that review and ask the Commission, based on a single provider’s alleged practices in one particular context, to summarily prohibit a broad range of network management practices. *See Free Press Petition; Vuze Petition.* Specifically, the petitioners’ sweeping arguments ask the

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<sup>9</sup> *See* FTC Staff Report, “Broadband Connectivity Competition Policy,” Federal Trade Commission, <http://www.ftc.gov/reports/broadband/v070000report.pdf> at 28-29 (June 2007) (“*FTC Report*”).

Commission to “declare that an Internet service provider clearly violates the FCC’s Internet Policy Statement” any time that a practice “degrades, ‘delays,’ or blocks an application or class of applications,” and that “[d]egrading an application cannot be considered reasonable network management.”<sup>10</sup> Although, the petitioners concede the general propriety of engaging in network management to ensure high quality services for consumers and address the network congestion that can degrade consumers’ broadband services, they fail to take into account the broad range of legitimate network management practices that could be disrupted by their proposed regulation or the harm that would result to consumers. *Free Press Petition* at 30-31.<sup>11</sup> For all of the reasons described below, the petitioners’ approach is not only unnecessary but would be affirmatively harmful to consumers, making broadband services used to access the public Internet less reliable, less safe, and less useful.

### **III. DISCUSSION**

There is no real dispute that broadband providers should be permitted, and even encouraged, to engage in reasonable network management practices where they provide broadband services that are used by consumers to access the public Internet. Yet, on the basis of a single provider’s alleged practices to address concededly valid congestion concerns in a single context, the petitioners ask the Commission to tie the hands of all network engineers by limiting the range of permissible network management practices. For two reasons, the Commission should reject such requests.

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<sup>10</sup> *Free Press Petition* at 14, 28; *see also Vuze Petition* at 1 (asking Commission to adopt rules “to establish that [reasonable] network management does not permit network operators to block, degrade, or unreasonably discriminate against lawful Internet applications, content or technologies”).

<sup>11</sup> While less specific than the *Free Press Petition* concerning what should be permissible in its view, the *Vuze Petition* also “recognize[es] that network operators must be able to manage their networks.” *Id.* at 4; *see also id.* at 14 (“network operators certainly should have the ability to engage in reasonable network management.”).

First, the vigorous competition among broadband providers protects consumers from practices that would harm, rather than safeguard the quality and safety of, their broadband services. As providers compete for customers, they must offer robust broadband services that enable customers to access and use their choice of content, applications and services available on the Internet; otherwise, those providers will lose in the marketplace. In addition to preventing any practices that harm, rather than benefit, consumers' services, this competition also will encourage all providers to innovate and develop improved practices to better serve their subscribers – something that would be inhibited by regulations restricting the options available to broadband providers. Given this working marketplace, there is no need for regulation.

Second, network management practices are complex and multifaceted, and, given the high potential for harm to consumers if effective network management practices are restricted, these practices should be left to network engineers. In the context of this dynamic and evolving area, regulation would be unworkable and would undoubtedly inhibit effective network management and innovation, thus degrading consumers' broadband services.

A. Robust Competition Ensures that Network Management Practices Benefit Consumers.

In the case of network management, as with other broadband industry practices that are the subject of this proceeding, the Commission should continue its pro-competitive, deregulatory approach. Because network management practices overwhelmingly benefit consumers and safeguard the quality of their services, the case for prospective regulation of these practices has not been made. Existing and growing competition will encourage innovation and ensure that providers' practices continue to benefit consumers.

1. Robust Competition Ensures that Network Management Practices Benefit Consumers.

As the record in this proceeding already documents, broadband competition is robust and growing, and innovation at all levels of the Internet is occurring rapidly. A study released last summer indicated that, as of that time, approximately 53 percent of all United States households subscribed to broadband.<sup>12</sup> At the same time, broadband accounted for about 72 percent of all home Internet subscriptions – up from 60 percent in the previous year. *Id.* Those numbers were even higher for “active Internet users,”<sup>13</sup> and have only increased since that time. And the Commission’s most recent broadband data report confirm this rapid growth in broadband adoption: “For the full twelve months ending December 31, 2006, high-speed lines increased by 61% (or 31.3 million lines).”<sup>14</sup>

The Commission, courts, and state regulators have all recognized that the market for present and future broadband subscribers is vigorously competitive.<sup>15</sup> The broadband

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<sup>12</sup> Press Release, Leichtman Research Group, *Over Half of U.S. Households Subscribe to Broadband Internet* <http://www.leichtmanresearch.com/press/060707release.html> (June 7, 2007) (last visited Feb. 13, 2008),.

<sup>13</sup> Simon Flannery, *et al.*, Morgan Stanley, *Cable & Telecom; As Broadband Matures, Speeds (and CapEx) Rise* Exh. 21 (Apr. 23, 2007) (1Q07 estimate).

<sup>14</sup> “High-Speed Services for Internet Access: Status as of December 31, 2006,” Industry Analysis and Technology Division, Wireline Competition Bureau, [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/DOC-277784A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-277784A1.pdf) at 1 (Oct. 2007) (“*Broadband Data Report*”).

<sup>15</sup> See *EarthLink Inc. v. FCC*, 462 F.3d 1, 11 (D.C. Cir. 2006) (upholding as “reasonable” the Commission’s determination that “[t]he broadband market is still an emerging and changing market, where, as the [Commission] previously has concluded, the preconditions for monopoly are not present. In particular, actual and potential intermodal competition informs rational competitors’ decisions concerning next-generation broadband technologies.”) (internal quotation marks omitted); *United States Telecom Ass’n v. FCC*, 359 F.3d 554, 582 (D.C. Cir. 2004) (“agree[ing]” with Commission’s determination that “intermodal competition in broadband, particularly from cable companies,” ensures “vigorous competition” in the broadband market); see also Cal. Pub. Utils. Comm’n, *Broadband Deployment in California*, Ch. 2, at 6 (May 5, 2005), [http://www.cpuc.ca.gov/word\\_pdf/final\\_decision/46428\\_d0505013\\_bbreport\\_2of9.pdf](http://www.cpuc.ca.gov/word_pdf/final_decision/46428_d0505013_bbreport_2of9.pdf) (“All four broadband technologies surveyed . . . (Wireless, DSL, Cable and Satellite) are available in 26% of California zip codes, and 39% of California zip codes have DSL, Cable and Satellite broadband technologies available.”); N.Y. Dep’t of Pub. Serv. Staff, *Telecommunications in New*

marketplace is generally characterized by increasing transmission speeds, multiple competitors, large new investments, and rapidly developing content and applications. *See* Comments of Verizon, WC Docket No. 07-52, at 3-20 (June 15, 2007) (“Verizon Comments”). The Commission’s data confirmed that this broadband competition comes from several competing technological platforms, including cable modem, DSL, fiber, fixed wireless, mobile wireless, satellite, and broadband-over-powerline. *Broadband Data Report* at Table 1. The reach of this intermodal competition is also widespread and continuing to expand. For example, the Commission’s report shows that as of the end of 2006, more than 80% of zip codes were served by four or more broadband providers, up from approximately 50% just two years earlier. *Id.* at Table 15.

As the National Telecommunications and Information Association (NTIA) recently concluded in reviewing developments in the broadband marketplace:

The last several years have witnessed substantial growth in the broadband marketplace punctuated by increases in capital investment, innovation, and market entry. Relative to other countries, the United States has experienced superior productivity over the past several years. Americans today enjoy an increasing array of broadband services, available from a growing number of service providers, using a variety of technologies. Penetration continues to grow, and prices continue to fall.<sup>16</sup>

This progress is a direct result of the Commission’s “pro-investment, deregulatory policies.” NTIA, *Networked Nation* at ii. The evidence previously submitted by Verizon in this proceeding confirmed this fact, demonstrating the increased competition, investment, and

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*York: Competition and Consumer Protection*, Case 05-C-0616, App. E (Sept. 21, 2005), [http://www3.dps.state.ny.us/pscweb/WebFileRoom.nsf/Web/C76443168615205885257083006ADF64/\\$File/05c0616.coverltr.09.21.05.pdf](http://www3.dps.state.ny.us/pscweb/WebFileRoom.nsf/Web/C76443168615205885257083006ADF64/$File/05c0616.coverltr.09.21.05.pdf) (“As noted above, 93% of Verizon NY’s customers have two alternative platforms available to them.”).

<sup>16</sup> NTIA, “Networked Nation: Broadband in America 2007,” [http://www.ntia.doc.gov/reports/2008/NetworkedNationBroadbandin America 2007.pdf](http://www.ntia.doc.gov/reports/2008/NetworkedNationBroadbandin%20America%202007.pdf), at i (Jan. 2008) (“*Networked Nation*”).

consumer welfare that have resulted from the Commission’s deregulatory steps. *See* Verizon Comments at 20-25. For example, at the time that the Commission substantially removed unbundling obligations on next-generation fiber networks back in 2003 and 2004, fewer than 200,000 homes were passed by fiber. As of the end of 2007, Verizon alone passed 9.3 million homes with its all-fiber network. Similar consumer benefits have flowed from the Commission’s deregulatory steps with respect to other broadband services, including DSL, wireless, and cable modem broadband services. *See id.*; *see also* NTIA, *Networked Nation* at 32-34. Likewise, other broadband providers continue to invest heavily in order to meet consumers’ ever-increasing demand for more robust broadband services, with spending on broadband facilities projected to “rise over the next four years from \$15.2 billion in 2007 to \$23 billion in 2010.” *Id.* at 32.

Under these circumstances, any proponents of regulation must bear a heavy burden – a burden that the petitioners here cannot carry. Regulation – and especially blanket prohibitions on certain business practices – is warranted only in clear cases of demonstrated market failure, and, even then, only when the benefits of government intervention outweigh the costs.<sup>17</sup> When those conditions are absent, directing markets is a job best left to competitive forces, which consistently prove themselves better than regulators at maximizing consumer welfare. In nascent

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<sup>17</sup> *See, e.g.*, Statement of Commissioner Robert M. McDowell, FCC, Before the H. Subcomm. on Telecommunications and the Internet, H. Comm. on Energy and Commerce, [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/DOC-271487A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-271487A1.pdf), at 3 (Mar. 14, 2007) (“*McDowell March 14, 2007 Statement*”) (“There are circumstances, however, when the government should address market failure to further the public interest so new entrepreneurial ideas have a chance to compete in the marketplace . . . . Any remedies applied to market failure should be narrowly-tailored, and sunsetted, to maximize freedom for all market players.”); Cable Services Bureau, *Broadband Today: A Staff Report to William E. Kennard, Chairman, Federal Communications Commission, on Industry Monitoring Sessions Convened by Cable Services Bureau*, <http://www.fcc.gov/Bureaus/Cable/Reports/broadbandtoday.pdf> at 41 (Oct. 1999) (“The Commission’s public interest mandate requires it to forbear from regulation and allow market forces to flourish, but to intervene in the event of market failure.”); Jerry Hausman, *Internet-Related Services: The Results of Asymmetric Regulation, in Broadband: Should We Regulate High-Speed Internet Access?* 139 (Robert Crandall & James Alleman, eds., Dec. 2002) (“Regulation should be used only in the situation of market failure”).

industries that are undergoing rapid technological change, it is particularly difficult for even the most capable regulator to keep up with the market's evolution.<sup>18</sup>

Under those settled regulatory principles, there is no basis for the type of regulation that the petitioners propose. Network management overwhelmingly benefits consumers by improving the quality and reliability of their broadband services, and this management – with its various uses, complex technical and practical considerations, and evolving methods – is particularly ill-suited to *ex ante* regulation.<sup>19</sup> In these circumstances, competition will continue to encourage innovation and practices that benefit consumers.

2. Information Available to Consumers Allows Them to Select the Broadband Internet Access Services That Meet Their Needs.

Complementing and furthering the protections that broadband consumers receive from existing competition is the information available to subscribers concerning the nature of, and limitations on, providers' various broadband Internet access services. This information facilitates the Commission's market-based approach to broadband by allowing consumers to make informed decisions about the service options available to them and to select the services that will best satisfy their intended uses. Of competitive necessity, broadband providers will

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<sup>18</sup> See Christopher S. Yoo, *Beyond Network Neutrality*, 19 Harv. J.L. & Tech. at 67 (“*Beyond Network Neutrality*”) (“[S]cholars from across the political spectrum have warned of the dangers of regulatory lag in industries that are technologically dynamic”); Stephen Breyer, *Regulation and Its Reform* 286-87 (1982) (“[B]ecause regulation, once in place, is hard to dismantle, one would like to know whether future technological change is likely to transform an industry that is now a natural monopoly, making it structurally suited to competition.”); Alfred E. Kahn, *The Economics of Regulation* 127 (1971) (“In the presence of such rapid change, the natural monopoly of yesterday may be transformed into a natural arena of competition today; and vice versa.”).

<sup>19</sup> See generally Howard A. Shelanski, *Adjusting Regulation to Competition: Toward A New Model for U.S. Telecommunications Policy*, 24 Yale J. on Reg. 55, 103 (2007) (“[T]he mere possibility of vertical discrimination does not automatically imply the need for *ex ante* network neutrality rules. In the absence of evidence that harmful economic discrimination is occurring and without a clearer understanding of the implications of placing all internet access charges on end-user consumers, the better policy may be to enforce *ex post* against specific conduct that is discriminatory and that is harmful to competition and to consumers.”).

respond to those consumer choices and only engage in practices that benefit consumers and protect the quality of their services.

In a competitive market, broadband providers have strong incentives to provide consumers the type of meaningful information about their services that will allow them to understand the options available to them and understand what it is they are buying. Nearly five years ago, Verizon, along with a wide range of other members of the broadband industry, endorsed the High Tech Broadband Coalition's "Connectivity Principles." These principles, which were a predecessor to the Commission's Broadband Policy Statement, included as their first principle that "[c]onsumers should receive meaningful information regarding their broadband service plans."<sup>20</sup>

Most broadband providers attempt to do just that, and they routinely provide consumers with meaningful information concerning the nature and limits of their services, including in their detailed terms of service and generally in their marketing materials.<sup>21</sup> As a result, consumers generally receive information concerning any material and foreseeable limitations on their services, including a general description of providers' network management practices that could have such an effect. So, for example, if a provider places material limits targeted at certain classes of applications, such as peer-to-peer file-sharing applications or other bandwidth-intensive applications, information concerning those limitations will be provided to subscribers – at least at a general and understandable level that does not confuse customers or compromise sensitive information. Armed with that information, the consumer is empowered to decide whether it prefers such an approach – *i.e.*, whether the consumer is more concerned about

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<sup>20</sup> High Tech Broadband Coalition Letter to Chairman Martin, CS Docket No. 02-52; GN Docket No. 00-185; CC Docket Nos. 02-33, 95-20 & 98-10 (Aug. 2, 2005).

<sup>21</sup> Verizon lacks knowledge about, and takes no position on, whether Comcast's disclosures to its customers were adequate to inform them of its alleged network management practices.

degraded service resulting from a neighbor's file-sharing than his or her own ability to use peer-to-peer applications – and make service choices accordingly. And, of course, consumers' choices in this regard will drive broadband providers' decisions in their own choice of network management practices.

While being informed is an important aspect of consumer choice, providing consumers “meaningful” information requires some balancing and judgment as to what should be disclosed. It is neither possible nor desirable to provide consumers with an avalanche of information concerning every possible eventuality that could affect their services. In fact, overly detailed disclosures may result in more confusion for consumers, rather than more meaningful information.

Likewise, the level of detail that the petitioners seem to demand of providers would also undermine the effectiveness of the network management practices being described. For example, identifying in detail every step that a network provider takes to defend its network from outside threats such as spam or denial of service attacks could well facilitate the ability of criminals and the ill-intentioned to evade those protections and inflict harm on the network or subscribers' services, or to steal personal data from subscribers' computers. Indeed, Vuze candidly admits that it uses “counter-measures” to work around network management practices.” *Vuze Petition* at 11. While the “‘cat and mouse’ game” that Vuze describes may be inevitable, *id.*, network providers should not feel compelled to disclose information so detailed that they have no chance of effectively managing the traffic that travels over their networks or protecting the safety or quality of their services. After all, application providers typically do not consult with network operators concerning the parameters of their applications in order to minimize the impact of their applications and to ensure that their applications consume no more network

resources than are necessary for their applications to run effectively – often, just the opposite is true. Therefore, providers’ disclosures should be at a level and of a type that is meaningful to *consumers* as they select among available service alternatives.

Even if a provider failed to inform customers of practices that could materially limit subscribers’ services, the vigilance and volume of the online community – as demonstrated by the attention to the Comcast-BitTorrent episode – provides additional protection for consumers and shows that it would be a fool’s errand for a provider to attempt to sneak material service limitations by their subscribers. For example, the Electronic Frontier Foundation (EFF) has initiated the “Test Your ISP” Project, complete with analytical tools to test broadband providers’ services to identify broadband providers’ practices,<sup>22</sup> and other savvy online users are also on the lookout for practices that they find objectionable. These users are ready, willing, and able to spotlight broadband providers’ practices. As the FTC noted in its report, consumers have a “heightened awareness” of broadband providers’ practices, and “online consumers [] have a powerful collective voice that should not be ignored by businesses.” *FTC Report* at 161. Indeed, given robust competition in the broadband marketplace, no provider can afford to ignore that “collective voice.”

Likewise, although the Commission should not adopt *ex ante* regulation of network management, given its benefits to consumers and the complex and varied purposes for and methods of network management, that does not mean that the Commission could do nothing if concrete problems arose that are not effectively addressed by market forces. Indeed, the Commission’s Broadband Policy Statement indicates the Commission’s intention to address

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<sup>22</sup> “EFF ‘Test Your ISP’ Project,” <http://www.eff.org/testyourisp> (last visited Feb. 13, 2008) (“EFF is developing information and software tools intended to help subscribers test their own broadband connections.”).

broadband providers' practices that harm consumers or competition, if concrete facts ever develop showing a market failure and the need for rules. *See* Broadband Policy Statement ¶ 4.

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As with other types of broadband provider practices, the Commission should continue to encourage innovation and increased competition as the best way to ensure that consumers receive high quality broadband services. Market forces will ensure that network management practices make broadband services better and safer for consumers, thus removing any need for regulation in this complex and evolving area.

B. Network Management Practices Are Complex and Evolving, and Rules Limiting Providers' Flexibility to Manage Their Networks Would Be Unworkable and Would Harm the Quality and Safety of Consumers' Broadband Services.

“Network management” is a term that applies to a wide range of practices that broadband providers employ to address various challenges in operating their networks efficiently and ensuring that subscribers' demands are met. Although their application and methods change, network management practices have long been essential tools for broadband providers.

In their most basic form, these practices may relate to relatively mundane matters associated with the provisioning of services, such as ensuring that subscribers receive the services that they signed up for. In the case of Verizon's FiOS services, for example, network management practices are necessary to distinguish between the 5 Mbps service selected by Customer A, the 50 Mbps service chosen by Customer B, and the 20 Mbps symmetrical service purchased by Customer C.

Broadband providers have also long engaged in network management practices aimed at protecting the security and integrity of their network, as well as the protection of their subscribers. These practices include identifying and stopping security threats, such as viruses,

spyware, botnets, zombie computers and the like, before they cause harm to consumers or the provider's network. Similarly, with wide support from the Internet industry, broadband providers have long sought to prevent spam from overwhelming their subscribers' services and their networks. Given the resourcefulness of those responsible for these threats, broadband providers' tactics in protecting their subscribers and their networks must constantly evolve.

Yet another challenge that some providers address using network management is the performance and quality of their broadband services. In particular, a variety of methods – including some endorsed by the petitioners – may be used to address network congestion and to ensure that all subscribers receive a reasonable amount of bandwidth, rather than allowing certain heavy users with bandwidth-intensive applications to take all available capacity.

Just as there are many reasons *why* providers use network management practices, so too is there much diversity in *how* providers go about managing their networks. Given technological and practical limitations, differently situated providers often have very different alternatives available to them for addressing a particular concern. Also, the nature and magnitude of the issues requiring network management vary widely among different types of providers or services. Among other things, a provider's particular network architecture (*e.g.*, the location of likely "choke points" at times of congestion), capacity constraints, and the provider's mix of services will affect both its need for network management and the available alternatives.

Likewise, the Commission must reject arguments in favor of codifying and locking in place – through the guise of restrictions on network management – the current best-efforts version of the Internet, and should instead encourage broadband providers to experiment with different practices and business models to serve consumers. As David Farber and Michael Katz have explained:

The current Internet supports many popular and valuable services. But experts agree that an updated Internet could offer a wide range of new and improved services, including better security against viruses, worms, denial-of-service attacks and zombie computers; services that require high levels of reliability, such as medical monitoring; and those that cannot tolerate network delays, such as voice and streaming video. To provide these services, both the architecture of the Internet and the business models through which services are delivered will probably have to change. . . . Based on experience in similar markets, we expect that, if left alone, pricing and service models will probably evolve.<sup>23</sup>

Given the myriad legitimate and pro-consumer purposes for network management practices and the large variety of continually evolving approaches that providers may use to further these purposes – some of which are discussed below – the Commission should recognize that regulation in this complex and evolving area would be unworkable and would discourage the continued development of innovative practices that benefit consumers.<sup>24</sup>

1. Network Management Includes Provisioning Subscribers’ Services and Enforcing the Parameters of Those Services.

Broadband providers routinely engage in network management for the mundane purpose of provisioning their services and enforcing the parameters of subscribers’ services. In essence, these practices seek to ensure that subscribers get what they paid for. But ill-considered regulation could threaten even these routine practices.

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<sup>23</sup> Farber and Katz, *Hold Off on Net Neutrality*, The Washington Post, Jan. 15, 2007 at A19 (“*Hold Off on Net Neutrality*”).

<sup>24</sup> As former FCC Commissioner and current California Public Utilities Commissioner Rachelle Chong recently noted: “A reasonable question to ask is which entity is best positioned to ensure an efficient and safe flow of information over a network: a regulatory agency or the company that actually built the network?” Rachelle B. Chong, *31 Flavors of the Net Neutrality Debate*, New York Law School Advanced Communications Law & Policy Institute, <http://www.nyls.edu/pdfs/Rachelle%20Chong%20-%20Net%20Neutrality%20Essay%20-%20December%202007.pdf> at 2 (Dec. 2007) (“*31 Flavors of the Net Neutrality Debate*”). After considering the need for regulation, Commission Chong concluded: “[A]ny efforts to legislate *ex ante* are premature and anticipatory. However, network operators do currently face a number of challenges that support their need to have absolute freedom to manage their networks.” *Id.* at 13.

For example, network management is required in order to provision a customer's 15 Mbps Internet access service, and to distinguish that service both from slower and faster services offered over the same network. Depending on the provider's service offering, this task could be more or less complicated. With Verizon's FiOS network, for example, Verizon currently offers Internet access services ranging from 5 Mbps to 50 Mbps – including both asymmetrical (i.e., more downstream than upstream capacity) and symmetrical services – in addition to its other private network services. Network management practices coordinate and provision these various services over the network.

Other business models may require even more intensive network management. For example, the petitioners endorse “capacity based billing” as a potential approach to managing traffic. *Free Press Petition* at 31. With this approach, customers pay for a certain amount of capacity, and are either billed for overage or throttled down to a slower speed after meeting that threshold. The provisioning and billing of more complex service offerings such as that would also require more intensive management by the provider to enforce the parameters of the subscriber's service.

While these operational functions of network management were not the focus of the petitioners' arguments in favor of regulation, restrictions on broadband providers' network management practices could interfere with these necessary practices for provisioning and delivering subscribers' services. For example, based solely on the parameters of the service that the subscriber selected, certain classes of bandwidth-intensive applications may not, as a practical matter, be available to the subscriber, and the provider would be forced to consider whether its standard practices in provisioning its services runs afoul of regulatory constraints.

## 2. Network Management Protects Consumers and Networks from Threats and Spam.

Another long-standing purpose for engaging in network management practice that could be undermined by regulation is to protect subscribers and broadband networks from security threats and spam. “It . . . makes sense to allow network operators to restrict traffic that is downright harmful, such as viruses, worms and spam.” Farber and Katz, *Hold Off on Net Neutrality*. As one network engineering professor notes, “[p]erhaps the greatest danger from . . . overly broad” net regulation “is that it could undermine security.”<sup>25</sup> Indeed, given the increasing reliance on IP services by government agencies, including emergency first responders, guarding the security and integrity of networks also serves a significant national security role.<sup>26</sup> Particularly given the need to respond to new and evolving threats, any regulations that limit broadband providers’ flexibility could result in substantial harm to consumers, to broadband networks, and even to public safety.

Broadband providers’ networks and services face numerous and evolving threats over the Internet. Among other things, broadband providers must take steps “to protect their users from viruses and spam” by “block[ing] such antisocial applications,” and must enforce “acceptable use policies to prevent spammers and other ‘bad guys’ from using their networks to launch attacks on others.” Chong, *31 Flavors of the Net Neutrality* at 7. For example, providers attempt to identify and address the threats posed by zombie computers – computers compromised by hackers, viruses, or Trojan horses – that are used to spread spam, viruses, worms, or other

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<sup>25</sup> Jon M. Peha, *Benefits and Risks of Mandating Network Neutrality*, [http://web.si.umich.edu/tprc/papers/2006/574/Peha\\_balanced\\_net\\_neutrality\\_policy.pdf](http://web.si.umich.edu/tprc/papers/2006/574/Peha_balanced_net_neutrality_policy.pdf) at 18 (Sept. 2006) (“*Benefits and Risks of Mandating Network Neutrality*”).

<sup>26</sup> See Joint Advisory Committee on Communications Capabilities of Emergency Medical and Public Health Care Facilities, Report to Congress, at 53-54 (Feb. 4, 2008) (“*Report on Emergency Communications*”).

malware or mischief.<sup>27</sup> Similarly, “[b]otnets, which can include as many as 100,000 individual ‘zombie’ computers, can distribute spam e-mail, spread viruses, attack other computers and servers, and commit other kinds of crime and fraud.”<sup>28</sup> Broadband providers also guard against denial of service (DOS) attacks – many spread by zombie computers and botnets – that flood a network or particular site with traffic in order to make it crash.

Along these same lines, most broadband providers also take steps to limit the spam that can clog their network and frustrate or harm their subscribers. The industry-led Messaging Anti-Abuse Working Group, which includes both broadband providers (including Verizon and Comcast) as well as other Internet providers (including Google and Yahoo), recognizes the significance of addressing spam and protecting customers “from online exploits and abuse.”<sup>29</sup> This group has developed a set of best practices for combating the threat to networks and subscribers posed by spam, including recommended actions to prevent viruses and spam from entering a provider’s network.<sup>30</sup> This collaborative industry effort continues to develop additional approaches to addressing spam and related threats.

Broadband providers routinely engage in various practices in order to identify and address these types of threats. “While rarely controversial, ISPs routinely filter and block certain traffic – based on source address, port number, and/or payload profile, for example – in order to stop the egress and ingress of abusive and malicious Internet traffic such as spam, viruses, and

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<sup>27</sup> See, e.g., Daniel Tynan, “Zombie PCs: A Silent, Growing Threat,” *PC World*, <http://www.pcworld.com/article/id,116841-page,1/article.html> (July 9, 2004) (last visited Feb. 13, 2008).

<sup>28</sup> Microsoft, “Zombies and Botnets: Help Keep Your Computer Under Control,” <http://www.microsoft.com/protect/computer/viruses/zombies.aspx> (Jan. 3, 2007) (last visited Feb. 13, 2008).

<sup>29</sup> See Messaging Anti-Abuse Working Group, <http://www.maawg.org/home/> (last visited Feb. 13, 2008).

<sup>30</sup> See *id.*, “Managing Port 25 for Residential or Dynamic IP Space,” at 2 (recommending that broadband providers “[b]lock incoming traffic to your network from port 25.”).

network-based attack.”<sup>31</sup> For example, broadband providers seek to trace identified threats to particular port numbers, or even sometimes to specific IP addresses, that appear to be the source of the threat, and then filter traffic coming from that location. This approach focuses on stopping a threat before it enters the provider’s network because “it is much more effective to keep a dangerous worm out of the network entirely, rather than let it in and merely try to protect some of the users.”<sup>32</sup>

Another common practice aimed at fending off threats to users is to look for and address parties that are engaged in “port scanning.” Port scanning refers to the use of a computer to scan IP addresses to determine which are in use, and “is similar to a thief going through your neighborhood and checking every door and window on each house to see which ones are open and which ones are locked.”<sup>33</sup> In addition to identifying potential vulnerabilities, port scanning can be used to profile subscribers – such as determining which subscribers are using which ports – in order to launch a virus or other attack or to invade a user’s privacy. Therefore, some providers monitor their networks for activities suggestive of “port scanning” in order to head off security threats before bigger problems arise.

Given the evolving nature, and proliferating number, of online threats, security-related network management practices must continue to evolve. Indeed, “experts agree that an updated Internet could offer a wide range of new and improved services, including better security against

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<sup>31</sup> Craig McTaggart, *Was the Internet Ever Neutral?* <http://web.si.umich.edu/tprc/papers/2006/593/mctaggart-tprc06rev.pdf> at 9 (Sept. 30, 2006) (“*Was the Internet Ever Neutral?*”).

<sup>32</sup> Peha, *Benefits and Risks of Mandating Network Neutrality* at 18.

<sup>33</sup> Tony Bradley, “Introduction to Port Scanning,” <http://netsecurity.about.com/cs/hackertools/a/aa121303.htm> (last visited Feb. 13, 2008).

viruses, worms, denial-of-service attacks and zombie computers.”<sup>34</sup> For example, providers may engage in a “broader examination of traffic patterns [that] may reveal that a given source is participating in a denial of service attack on another user.” *Id.* Or providers may “prevent customers from using equipment that will operate in ‘promiscuous mode’ to observe their neighbors’ traffic.” *Id.*

For the most part, even the proponents of net regulation admit that “Internet providers should be able to block spam e-mails, as well as viruses that could harm their networks and their customers’ computers.”<sup>35</sup> At the same time, some of the measures espoused by net regulation proponents – including the petitioners’ proposal to prohibit all application-based distinctions – would limit providers’ flexibility that they need to defend their network, services, and subscribers from ever-changing threats, even though “it is entirely possible that application, service, and content, allow the operator to conclude that a stream contains a dangerous virus or worm.”<sup>36</sup> Likewise, other proposals would permit a provider to engage in network management only with the “opt-in” permission of subscribers, notwithstanding the potential harms that could result to the network, services or other subscribers from subscribers who decide not to grant such permission.<sup>37</sup>

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<sup>34</sup> Farber and Katz, *Hold Off on Net Neutrality*.

<sup>35</sup> See Common Cause, “Net Neutrality Fact Sheet,” <http://www.commoncause.org/site/pp.asp?c=dkLNK1MQIwG&b=1234951> (last visited Feb. 13, 2008); see also Peha, *Benefits and Risks of Mandating Network Neutrality* at 18 (noting that “[m]any staunch network neutrality advocates have agreed that discrimination for network security should not be prohibited”).

<sup>36</sup> Peha, *Benefits and Risks of Mandating Network Neutrality* at 18 (citing *Internet Freedom and Non-Discrimination Act of 2006*, H.R. 5417 (May 18, 2006)).

<sup>37</sup> *Id.* (citing *Internet Non-Discrimination Act of 2006*, S. 2360 (March 2, 2006); *Internet Freedom Preservation Act*, S. 2917 (May 19, 2006)).

Although security-related network management practices can and do sometimes result in “false positives and false negatives,”<sup>38</sup> the stakes are too high and potential dangers too great – particularly given the increasing reliance of government agencies on broadband networks and the role of the Internet to disseminate information during times of emergency – to impose restrictions on broadband providers’ ability to manage their networks to minimize security threats. Given the continuing evolution of threats and the sophisticated nature of some wrongdoers intent on outsmarting the broadband providers and overcoming security measures, providers need substantial flexibility to guard their networks, respond to new threats effectively, and act in the best interest of their subscribers. For the same reason, broadband providers should not be required to provide detailed disclosures concerning their network security practices, because such disclosures could themselves undermine the effectiveness of particular approaches and facilitate attacks designed to overcome the network providers’ practices.

Continuing to allow providers flexibility to engage in network management practices and to work with industry to develop new and improved network management practices will most effectively protect the security and integrity of their networks, services, subscribers, and the public. Regulations – including, in particular, regulations that tie a provider’s hands by making them turn a blind eye to particular applications or content that may pose a threat – would harm consumers and the public interest, and would threaten the security and integrity of broadband networks and services.

3. Network Management May Be Used to Address Congestion That Could Degrade Consumers’ Broadband Internet Access Services.

In addition to provisioning services and defending against threats to subscribers and networks, another reason for engaging in network management practices is to ensure that

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<sup>38</sup> See Peha, *Benefits and Risks of Mandating Network Neutrality* at 18.

subscribers receive high quality services in the face of network congestion. For some providers, network congestion is a growing concern that, if left unchecked, may result in degraded service for many subscribers. As capacity demands on broadband networks continue to grow – and in particular as the popularity of bandwidth-intensive applications grows – the risk that network congestion will impair users’ broadband services also increases. The magnitude and source of challenges facing different network providers as a result of network congestion vary considerably, as do the available alternatives for alleviating congestion. The Commission should encourage continued innovation and encourage industry-led efforts to develop solutions that protect the quality of subscribers’ services rather than restraining providers’ flexibility to address this real world concern.

Indeed, network management solutions to congestion not only benefit individual end users, but also are increasingly important to ensure reliable services for government agencies and emergency responders that increasingly rely on both the Internet and other managed-IP networks. The Joint Advisory Committee on Communications Capabilities of Emergency Medical and Public Health Care Facilities recently reported to Congress, for example, the significance of the fact that “[u]tilizing network management technologies can lessen congestion on broadband networks.”<sup>39</sup> The Committee recognized that network management is vital for ensuring that networks remain reliable during times when they are needed the most, and in particular that they serve the interests of emergency personnel:

While congestion could impact communications over the open Internet, managed networks help ensure communications reliability. Whatever the cause of traffic congestion, managed networks and traffic prioritization can help maximize the likelihood that all traffic will be delivered and that time-sensitive applications will operate in a satisfactory manner despite unusual network conditions. As networks grow in importance, it is critical

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<sup>39</sup> *Report on Emergency Communications* at 53.

to enable innovative network technologies that maximize the likelihood that mission critical applications won't be impacted by congestion.

*Id.* at 54. Therefore, encouraging the development of network management practices to respond to network congestion concerns may not only prevent degradation of the quality of end user's broadband services, but may also prove important in protecting the public during times of emergency.

**a. Without Network Management, Growing Demand for Capacity and Network Congestion Could Degrade Other Users' Services.**

By any measure, the demand for ever more robust broadband services is skyrocketing. “[T]here are legitimate, growing and seemingly insatiable demands by the consumer – both households and firms – for information.”<sup>40</sup> Consumers are increasingly using their broadband services for more bandwidth-intensive online services, including for video, gaming, and peer-to-peer file-sharing services. As the availability of even more advanced applications like online video increases, so too will the pressure on network resources.<sup>41</sup> For example, the video-sharing website YouTube alone consumes as much bandwidth today as the entire Internet consumed in 2000. *See* Mehlman & Irving, *Bring On The Exaflood!*, *The Washington Post*, May 24, 2007 at A31. In 1999, the total volume of information generated equaled one exabyte – or 1.074 billion gigabytes. *Id.* Today, the Internet handles one exabyte of data each hour. *Id.* Tomorrow's Internet will handle an exponentially greater amount of traffic with the proliferation of advanced online video offerings – “from high definition TV and future iterations of YouTube-type video-

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<sup>40</sup> John Mayo, *Net Neutrality: The Prequel*, AEI Brookings Joint Center on Policy Matters 07-12 <http://www.aei-brookings.org/policy/page.php?id=283&PHPSESSID=bc49f49e893d4413b66890d751af769f> (March 2007).

<sup>41</sup> *See* Christopher S. Yoo, *Would Mandating Broadband Network Neutrality Help or Hurt Competition? A Comment on the End-to End Debate* at 35 (Vanderbilt University Law School Law & Economics Working Paper No. 04-04, 2004) (“Bandwidth-hungry applications, such as music downloads, on-line gaming, and streaming video, are placing increasing pressure on network capacity, as has the growth in telecommuting and home networking.”)

sharing sites to sophisticated online gaming and video phone calls” – that have the potential quickly to turn “your average U.S. home into a 50Mbps bandwidth hog.” Arik Hesseldahl, *More Bandwidth Than You Can Use?*, Business Week, May 29, 2007. In fact, one recent study by the Discovery Institute estimated that the “U.S. Internet of 2015 will be at least 50 times larger than it was in 2006,” and “could reach an annual total of one zettabyte ( $10^{21}$  bytes), or one million million billion bytes.”<sup>42</sup>

Not only is there more traffic traveling over the Internet, but the challenges for network operators – and potential risks to consumers’ services – are compounded by the mix and nature of that traffic, including the attitude of certain applications towards sharing limited network resources. As the FTC explained as it considered network management practices, addressing congestion has always been an issue with Internet services and the “TCP component of the TCP/IP suite” – one of the building blocks of the Internet – even attempts to address congestion by “monitor[ing] delays and slow[ing] the packet-transmission rates accordingly.” *FTC Report* at 29. But many applications that are popular today do not necessarily play by those same rules, and some seek to take full advantage of network resources without regard to the impact on competing users or applications. As one recent IETF working group paper recently recognized, “now the Internet has to support a jostling mix of different attitudes to resource sharing: carelessness, unwitting self-interest, active self-interest, malice, and sometimes even a little

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<sup>42</sup> Bret Swanson & George Gilder, *Estimating the Exaflood: The Impact of Video and Rich Media on the Internet*, Discovery Institute, <http://www.discovery.org/a/4428> at 2-3 (Jan. 29, 2008) (“*Estimating the Exaflood*”).

consideration for others. So although TCP sets an important baseline, it is no longer the main determinant of how resources are shared between users at run-time.”<sup>43</sup>

One particular driver of increased demands on broadband networks comes from peer-to-peer applications – the types of applications allegedly subject to Comcast’s network management practices that are the focus of the *Free Press* and *Vuze Petitions*. With peer-to-peer file-sharing applications, “files are stored on and served by personal computers of the users,” with “[m]ost people . . . both provid[ing] (upload) files and receiv[ing] files (download).”<sup>44</sup> By design, these applications utilize the “cumulative bandwidth” of participating peer-to-peer users by treating individual users’ computers as “nodes” from which files can be downloaded, rather than relying on the traditional server-based model.<sup>45</sup> As the FTC noted in its report, for some network operators, the use of peer-to-peer applications “by even a small portion of Internet users may effectively degrade service for the remaining majority of end users.” *FTC Report* at 28-29. As the FTC explained, part of the reason for this is that some peer-to-peer applications react to network congestion in a manner that may exacerbate the problem:

The TCP component of the TCP/IP suite . . . monitors delays and slows the packet-transmission rates accordingly. Some applications, however, such as certain peer-to-peer file-sharing protocols, operate in a different manner. When congestion occurs, these applications do not slow their rates of data transmission. Rather, they aggressively take advantage of TCP’s built-in reduction mechanism and, instead, send data as fast as they can.

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<sup>43</sup> B Briscoe *et al.*, “Problem Statement: We Don’t Have to Do Fairness Ourselves,” IETF Transport Area Working Group, <http://www3.tools.ietf.org/html/draft-briscoe-tsvwg-relax-fairness-00> at 2 (Nov. 12, 2007) (last visited Feb. 13, 2008) (“*We Don’t Have to Do Fairness Ourselves*”).

<sup>44</sup> “File Sharing,” wikipedia.org, [http://en.wikipedia.org/wiki/File\\_sharing](http://en.wikipedia.org/wiki/File_sharing) (last visited Feb. 13, 2008).

<sup>45</sup> “Peer-to-peer,” wikipedia.org, <http://en.wikipedia.org/wiki/Peer-to-peer> (last visited Feb. 13, 2008).

*Id.* at 29 (citations omitted). Moreover, according to some reports, peer-to-peer applications, such as BitTorrent, “account for between 50 percent and 90 percent of overall Internet traffic,” thus suggesting the potential magnitude of this challenge for providers’ with networks more sensitive to the congestion from these applications.<sup>46</sup>

Other applications may pose similar capacity concerns for certain broadband providers. For example, some “multi-player online games[]” adjust their bandwidth usage to respond to what is available on a given network at a particular point in time. *Id.* These applications typically try to maximize the experience for the application’s user, without regard to other subscribers competing for that bandwidth, and “the highest possible rate is usually chosen whenever possible.” *Id.* Another example of an application that takes this approach to bandwidth is Slingbox – an application which allows users to shift video programming delivered to their home for viewing on multiple devices or in other locations with a broadband connection. Slingbox notes that it “dynamically adjusts your video quality to provide the best possible viewing experience . . . by taking into account a variety of factors, including network bandwidth . . . [and] automatically adjust[ing] compression levels, video bit rate, frame rate, and other settings.”<sup>47</sup>

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<sup>46</sup> Peter Svensson, Associated Press, *Comcast Blocks Some Internet Traffic* (Oct. 19, 2007); see also Christopher H. Yoo, “*Network Neutrality and the Economics of Congestion*,” 94 *Georgetown Law J.* 1847, 1879 n. 145 (collecting estimates, ranging from 37% to 85%, of Internet traffic attributable to file-sharing applications) (“*Economics of Congestion*”); “Internet Study 2007,” ipoque, (“P2P file sharing still is the application class producing, by a wide margin, most Internet traffic. Its share varies, in our observations, between 48% in the Middle East and 80% in Eastern Europe. These percentage numbers are averages calculated over the course of the roughly four week measurement period in August and September. Some measurement points experienced P2P shares of over 95% at certain times.”), [http://www.ipoque.com/media/internet\\_studies/internet\\_study\\_2007](http://www.ipoque.com/media/internet_studies/internet_study_2007) (last visited Feb. 13, 2008).

<sup>47</sup> See Slingbox, *Technology: Our High Tech Secret Sauce*, <http://www.slingmedia.com/go/technology> (last visited Feb. 13, 2008).

With the increased popularity of these bandwidth-intensive applications, the chances of subscribers' services being degraded by the activities of other end users increases.<sup>48</sup> "Network resources such as computer processing power, transmission media, and router buffer memory are finite, like other resources," and "[c]ongestion, therefore, can occur at any point on the Internet." *FTC Report* at 28. "When data packets arrive at a rate that exceeds the capacity of any particular [network] element, they form a queue. The resulting delay in the speed with which the requests are fulfilled causes degradation in the quality of service provided by the network." Yoo, *Economics of Congestion* at 1862. And "[w]hen networks are subject to congestion, one customer's usage of the network can degrade the quality of service that other customers receive." *Id.* at 1852.

Although all networks are subject to potential congestion concerns, applications such as peer-to-peer or other contributors to network congestion have very different impacts on different types of providers because some network configurations are more vulnerable to congestion than others. In particular, any time a single network resource is shared with other users, the risk increases that one user's activities will crowd out other users, thus degrading their service.

The networks most sensitive to these concerns typically are those with shared capacity closer to the end user. So, for example, cable modem networks and wireless networks both have the feature of a shared network resource near the "last mile," and both have particular bandwidth constraints with respect to the shared "uplink" used to upload data to the Internet. With cable modem services, several hundred homes may share a single neighborhood node where the traffic

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<sup>48</sup> Sandvine Inc., "Network Neutrality: A Broadband Wild West?," at 4 (see <http://www.sandvine.com/news/default.asp>) (March 2005) (last visited Feb. 13, 2008) (noting that "80% of the resources are consumed by less than 20% of the uses/applications/content"); McTaggart, *Was the Internet Ever Neutral?* at 14 (noting that 5% of users may account for nearly half of total traffic).

from these subscribers is aggregated before returning to the operator's headend.<sup>49</sup> In fact, "cable modem customers share bandwidth both between the end users' premises and the fiber node as well as between the fiber node and the cable headend," and, "[a]s a result, both segments are subject to congestion." Yoo, *Economics of Congestion* at 1862 n.71. With this configuration, heavy usage by one subscriber – unless addressed – may drain resources that would otherwise be available to other users on the same node (*i.e.*, slows down other users' services). Likewise, in the case of mobile broadband services, the spectrum available from a single cell tower is both limited and shared, thus raising a similar concern: "Because wireless devices use a shared spectrum resource, every device and every site operating on the network has a specific and calculable impact on the aggregate resources available to all consumers attempting to access a given carrier's resources in a given geographic area."<sup>50</sup>

While other types of networks also are subject to congestion concerns, the "sharing" of a resource typically happens somewhat deeper into the network, and the immediacy of the impact of one subscriber's activities on another subscriber's service is tempered. With DSL services, for example, subscribers generally have a dedicated circuit between the provider's central office and a customer's home.<sup>51</sup> Where this is true, a subscriber's service would only be degraded if

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<sup>49</sup> See Yoo, *Economics of Congestion* at 1861-62 (describing the typical network configuration for a cable modem provider: "The packets travel through the coaxial cables connecting the end user's premises to a fiber node located in the neighborhood, which aggregates those packets with other traffic and transmits them to the headend. A cable modem termination system separates the data packets from the video stream and directs them onto a data network maintained at the headend. The router on the data network located in the headend transmits the packets to a middle-mile provider, which in turn transmits the packets to one of the interconnection points served by backbone providers.").

<sup>50</sup> Comments of Verizon Wireless, *Skype Communications S.A.R.L. Petition to Confirm a Consumer's Right to Use Internet Communications Software and Attach Devices to Wireless Networks*, RM-11361, at 34 (April 30, 2007).

<sup>51</sup> In some areas – and particularly more remote areas – DSL lines run to a remote terminal, rather than all of the way to a central office – at which point the traffic is aggregated with other users' and delivered to the central office using fiber. In this situation, the risk of congestion in the last mile is higher. See Yoo, *Economics of Congestion* at 1862 n.71 ("To the extent that [DSL providers] employ

congestion occurred within the central office (or even deeper into the network), but not because of their neighbor's online gaming or file-sharing. Likewise, fiber-to-the-premises (FTTP) networks include dedicated capacity to particular homes – as well as considerably more capacity than other types of networks – thus alleviating some of the risks of congestion. No network, however, is completely immune from congestion concerns.

**b. A Variety of Network Management Practices May Be Used to Mitigate Congestion and Safeguard the Quality of Consumers' Broadband Services.**

In response to these concerns, broadband providers may consider a number of approaches to prevent degradation of the quality of subscribers' services. Although broadband providers are constantly investing in expanded network capacity, as one way of addressing the growth in Internet traffic and related congestion concerns, "given the number of would-be providers of bandwidth-intensive applications that are waiting in the wings and in light of the fact that the number of potential connections increases quadratically as the number of end users connected to the system increases," expanded capacity may not provide a complete solution to network congestion concerns. Yoo, *Economics of Congestion*, at 1883-84. Indeed, as Alfred Kahn has noted, "[t]he only way to avoid unacceptable congestion and degradation of service is to give operators the ability to manage traffic on their networks."<sup>52</sup>

Broadband providers use many different network management practices to protect the quality of their subscribers' broadband services, and industry-led efforts continue to work on additional solutions to these concerns. Yet, the alternatives currently available to a particular

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remote terminals, telephone networks may be subject to congestion effects between the remote terminal and the central office that are similar to those suffered by cable modem systems between the fiber node and the headend.").

<sup>52</sup> Alfred E. Kahn, "Network Neutrality," AEI-Brookings Joint Center for Regulatory Studies, [http://aei-brookings.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/RP07-05\\_topost.pdf](http://aei-brookings.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/RP07-05_topost.pdf) at 4 (March 2007) ("*Network Neutrality*").

provider vary significantly because the causes for network congestion and the associated “choke points” differ depending on, among other things, the technology, platform, or network architecture used by a particular provider. Given the widely varying options currently available to different providers and the continuing development of new and better ways to address congestion concerns, regulation is inappropriate and could prevent practices and continued innovation that would benefit subscribers’ services. Discussed below are some of the various approaches being used or considered for alleviating or overcoming network congestion concerns.

i. *New and Innovative Approaches or Service Models May Safeguard the Quality of Subscribers’ Broadband Services.*

Whenever reasonably possible, broadband providers seek to ensure that their subscribers receive high quality broadband Internet access services without any trade-offs. Among other things, providers continue to invest in expanded capacity and experiment with new service models. In addition, broadband providers and other parts of the industry are working on innovative new solutions to prevent degradation of the quality of subscribers’ services and overcome congestion concerns, without limiting in any way how providers may use their services.

First, the petitioners argue that preferable alternatives to Comcast’s alleged network management practices would include “provid[ing] more bandwidth to all users, or actually offer[ing] high *symmetric* broadband speeds.” *Free Press Petition* at 29. Verizon is doing both those things. As the Commission is aware, Verizon is in the process of rolling out its all-fiber FiOS network to 18 million homes, at a cost of almost \$23 billion. This network, which already passes more than 9.3 million homes, offers broadband Internet access services with speeds of up to 50 Mbps today, and will offer even higher-bandwidth services in the future. And Verizon also continues to upgrade its DSL offerings, and just this month announced the availability of a 7

Mbps DSL service in some communities, more than doubling the previous highest speed among Verizon's residential DSL services. Given the competitive marketplace, such steps by one competitor inevitably lead other broadband providers to respond with increased investment, more capacity, increased speeds for broadband services services, and additional service offerings. Verizon routinely observes this competitive behavior when it enters new areas with its FiOS network or when it otherwise increases the capacity or speed of its services. In addition to prompting localized responses, FiOS has also spurred competitors to look for additional ways to increase the quality of their service offerings in order to better compete.<sup>53</sup>

In addition, Verizon recently introduced a 20 Mbps *symmetrical* service over its FiOS network, thus providing a robust alternative for users interested in bandwidth intensive applications like online gaming and peer-to-peer, without degrading other subscribers' services. This shows that broadband providers *are* responding to the evolving needs of consumers, and are competing to attract their business with high-bandwidth service offerings designed to fit their uses. Therefore, providers continually seek to increase their capacity and improve their broadband offerings in order to meet consumers' demands, as would be expected in a competitive marketplace.

In addition to expanding capacity or increasing service offerings to accommodate subscribers' evolving demands, Verizon also is actively engaged in other efforts, working together with the industry, to develop efficient solutions to the network capacity challenges, including, in particular, congestion concerns surrounding peer-to-peer applications. For

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<sup>53</sup> See, e.g., R. Nakashima, *Comcast CEO Shows Off Super Quick Modem*, Associated Press, [http://www.usatoday.com/tech/products/2007-05-09-comcast-modem\\_N.htm](http://www.usatoday.com/tech/products/2007-05-09-comcast-modem_N.htm) (May 9, 2007) (At the May 2007 NCTA show, Comcast demonstrated cable modem technology that enables download speeds of up to 150 Mbps, approximately 25 times faster than today's standard cable modems. "The new cable technology is crucial because the industry is competing with a speedy new offering called FiOS.").

example, Verizon is working together with Pando Networks – a peer-to-peer technology provider – and researchers from Yale University “to figure out a way to put the file-sharing technology to better use.”<sup>54</sup> The P4P Working Group, which was organized through the Distributed Computing Industry Association, is seeking to find ways to reduce the strain on networks from peer-to-peer applications, while simultaneously increasing the efficiency of such applications. “Using basic subscriber information from ISPs, researchers claim to have developed a solution that can reduce provider’s P2P bandwidth consumption on their networks by about 60 percent, while also speeding up P2P downloads by nearly a third.” *Id.* In contrast to current peer-to-peer practices, “[t]he P4P solution adds network intelligence to the peering process, so that P2P applications can make smarter decisions about where they get content.” *Id.* By “sharing information about the network topology” and the location of customers,<sup>55</sup> “a P2P service can understand how the network is configured to request the file at the closest peers rather than arbitrarily getting it from a peer across the country or around the globe,” thus saving significant network resources. *Id.* Verizon and Pando are starting a test of this new approach this month. *Id.* Other companies, including AT&T, Telefonica, Cisco Systems, and Verisign are also part of this effort, and several cable companies, including Comcast, Time Warner Cable, Cox Communications, and Cablevision, are observers of the working group. *Id.* Such efforts belie the petitioners’ claim that providers are trying to snuff out peer-to-peer, and shows that they are instead still grappling in good faith with network congestion concerns while exploring efficient approaches to managing peer-to-peer or other bandwidth-intensive applications.

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<sup>54</sup> Marguerite Reardon, “Harnessing the Power of P2P,” CNet News, [http://www.news.com/Harnessing-the-power-of-P2P/2100-1034\\_3-6227406.html](http://www.news.com/Harnessing-the-power-of-P2P/2100-1034_3-6227406.html) (Jan. 24, 2008) (last visited Feb. 13, 2008).

<sup>55</sup> “And because the information shared is not detailed enough to identify individual subscribers, consumers shouldn’t fear that their privacy is being violated.” *Id.*

In addition to these efforts, as discussed in earlier comments in this proceeding, broadband providers may also develop innovative new services that allow prioritization or a heightened quality of service in order to facilitate latency-sensitive services or other services that are incompatible with the current, best-efforts Internet. Those efforts also are a direct response to network congestion concerns. While network congestion can degrade the quality of broadband services more generally, congestion can be fatal to latency-sensitive applications or services. Although the parties who seek to restrict providers' flexibility to engage in network management also tend to oppose broadband providers' ability to develop innovative, differentiated services that may travel over the Internet, the Commission should encourage these innovative approaches to meeting consumers' needs and expanding the universe of services offered over the Internet. Indeed, "network operators should have the ability to develop solutions on their own without having to conform to statutorily-imposed requirements, which would likely lead to inefficient allocations and a net decrease in consumer welfare."<sup>56</sup> This innovation and experimentation will increase the choices available to consumers, and protect the quality of their broadband services.

ii. *Usage-Based Billing May Also Be One Possible Way to Address Overuse of a Shared Resource*

Another possibility for some broadband providers to address congestion is to shift to usage-based billing. Usage-based billing, which the petitioners endorse, can take a number of forms. In a pure form, subscribers could pay a "metered" rate, which tracks subscribers' usage and charges per bit based on throughput. Another usage-based approach, however, could involve the offering of different tiers of capacity (*i.e.*, a bucket of bits) for different prices, much like many wireless carriers offer buckets of minutes at various price points. When a customer

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<sup>56</sup> Chong, *31 Flavors of Net Neutrality* at 14.

exceeds the designated “bandwidth cap” that he or she chose, the customer could incur additional charges on a metered basis or have the option of upgrading to a plan with more capacity assigned. Alternatively, the provider could “throttle” the customer’s service to a slower speed (and thus limiting throughput) for the remainder of the usage period, and then reset it at the higher speed when the next period begins. “[U]sage-sensitive pricing aligns incentives by bringing private costs in line with the true social costs of consuming an additional unit.” Yoo, *Economics of Congestion* at 1864. Thus, “[a]s a theoretical matter, usage-sensitive pricing has thus been regarded as a critical mechanism for promoting the efficient allocation of resources.” *Id.* at 1864-65.

Although usage-based billing is common in some parts of the world, broadband providers in this country have generally offered “flat rate” plans, without a usage cap. Given this established practice, “U.S. high-speed Internet subscribers have come to expect a fixed monthly charge . . . . [that] typically only varies based on the speed of the consumer’s Internet access.”<sup>57</sup> Moreover, factors ranging from consumer preference<sup>58</sup> to the transaction costs of the usage-based approach may limit the attractiveness of this option for addressing congestion.

Broadband providers in this country are beginning, however, to experiment with usage-based billing. For example, Time Warner Cable recently announced that it will conduct a trial later this year of usage-based billing that will include “four tiers of service at different prices,”

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<sup>57</sup> Yinka Adegoke, “Time Warner to Test Internet Billing Based on Usage,” Reuters, <http://www.reuters.com/article/idUSN1721882120080117> (Jan. 17, 2008) (last visited Feb. 13, 2008) (“*Time Warner to Test Internet Billing Based on Usage*”).

<sup>58</sup> At least some individuals have already expressed a strong preference for the current flat-rate model. See George Ou, “EFF Wants to Saddle You with Metered Internet Service,” ZDNet.com, <http://blogs.zdnet.com/Ou/?p=914> (Dec. 3, 2007) (last visited Feb. 13, 2008) (“*EFF Wants To Saddle You With Metered Internet Service*”).

based on consumers' "bandwidth usage."<sup>59</sup> Time Warner Cable acknowledged that the reason for this shift is to respond "to the increasing use of bandwidth-intensive applications, particularly peer-to-peer networks," which can "impede overall network performance."<sup>60</sup> Time Warner has said that "the billing system will impact only heavy users, who account for around 5 percent of all customers but typically use more than half of the total network bandwidth." Adegoke, *Time Warner to Test Internet Billing Based on Usage*.

Thus, broadband providers are in the process of testing usage-based pricing models, and, if that approach proves effective at both protecting the quality of users' services and otherwise meeting consumers' demands, they could become more common. In response to market demands, "if left alone, pricing and service models will probably evolve."<sup>61</sup>

- iii. *In Some Instances, Providers Can Address the Overall Service Quality for Consumers by Limiting Particular Classes of Applications or Devices.*

Another approach to address network congestion concerns could be to address directly certain types of activities, applications, or devices to the extent they degrade the quality of other subscribers' services. Providers' actions in this regard have varied substantially over time, and the need to take this approach also varies by service and technology. But, notwithstanding the petitioners' apparent view that differentiation based on classes of applications should be wholly prohibited, this approach to network management is not new and plays an important role for some providers. Indeed, the FTC noted in its report that "the use of application-based prioritization algorithms to improve delivery of certain types of applications (*e.g.*, latency-

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<sup>59</sup> Stephen Lawson, "Time Warner to Try Tiered Cable Pricing," *PC World*, <http://www.pcworld.com/article/id,141500-page,1/article.html> (Jan. 18, 2008) (last visited Feb. 13, 2008) ("*Tiered Cable Pricing*").

<sup>60</sup> Kenneth Corbin, "Time Warner to Test Usage-Based Pricing," *InternetNews.com*, <http://www.internetnews.com/infra/article.php/3722516> (Jan. 17, 2008) (last visited Feb. 13, 2008).

<sup>61</sup> Farber and Katz, *Hold Off on Net Neutrality*.

sensitive ones) or to deprioritize others (*e.g.*, P2P) purely as an internally defined traffic-management tool has not raised significant controversy.” *FTC Report* at 89.

Broadband providers have long sought to ensure the overall quality of service to their users by restricting certain uses that are inconsistent with the parameters of a particular broadband service. In the case of the mass market broadband services used by most consumers, for example, many providers have traditionally restricted, through their terms of service, subscribers’ ability to use their service to host a server. The reason for this limitation is that, “[b]ecause most end users download a larger volume of traffic than they upload, network operators typically allocate bandwidth asymmetrically by devoting more bandwidth to downloading.” Yoo, *Economics of Congestion* at 1879. But when users operate a server, this changes, if not reverses, the typical usage pattern, thus “plac[ing] particular pressure on a system designed for different usage patterns, which will degrade the quality of service for other users.” *Id.* Of course, most providers have also offered alternative services with different parameters that would support such uses.

Similarly, some providers address particular types of applications that raise significant network congestion concerns. Comcast’s alleged actions to limit the impact of peer-to-peer applications may be one such example, but, as the FTC recognized, the need for network management practices to address congestion in various circumstances is both well recognized and unobjectionable in principle. For example, after discussing the potential congestion concerns raised by some peer-to-peer applications that “take advantage of TCP’s built-in reduction mechanism” and consume all available bandwidth, the FTC recognized that “some networks have actively restricted . . . these kinds of applications, on the grounds that the

networks need to preserve an equitable level of service for the majority of their end users.”<sup>62</sup>  
*FTC Report* at 29.

Under some circumstances, employing network management practices to address congestion issues may be the most efficient way to ensure that all subscribers receive a high quality service, in light of a limited and shared network resource. Among other things, addressing congestion in this manner – particularly to the extent that certain types of applications are a fair “proxy for usage” – can avoid the potentially high transaction costs associated with usage-based pricing or other, more active methods of network management such as “dynamic quotas,” while still effectively addressing the same concern. *Id.* at 1853. These include not only the costs of developing and administering those practices, but also the potential negative reaction of customers who would prefer a different approach to controlling congestion. Many consumers may gladly accept certain limitations on their services in exchange for being assured of an overall higher quality experience that better meets their needs.

In fact, in some circumstances, directly addressing the sources of congestion may, for technical or practical reasons, be the only effective method of overcoming network congestion issues. As explained above, “cable broadband is fundamentally a shared network where cable customers in the same network share a single network connection.”<sup>63</sup> This network architecture

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<sup>62</sup> See also Yoo, *Economics of Congestion* at 1879-80 (“Still others have responded to reports that file-sharing programs are consuming an overwhelming share of the Internet’s capacity by requiring those who wish to file share to pay a higher charge or by barring the use of file-sharing programs altogether.”); Peha, *Benefits and Risks of Mandating Network Neutrality* at 7 (“Network operators may therefore wish to give traffic from those applications lower scheduling and dropping priorities, or limit the amount of traffic they can send per day, or charge them more for consuming more network resources. This discrimination benefits the applications that might otherwise be starved of network resources.”).

<sup>63</sup> George Ou, “A Rational Debate on Comcast Traffic Management,” ZDNet.com. <http://blogs.zdnet.com/Ou/?p=852> (Nov. 6, 2007) (last visited Feb. 13, 2008) (“The only way to stop this problem is to get the users to reduce the number of transmissions and there simply is no other mechanism that can manage this type of a network other than forcing overly aggressive clients to reduce the number of simultaneous connections with forged TCP reset packets. . . . This isn’t the prettiest solution in the

– and the protocols used by cable broadband networks – may limit the options available to address the congestion caused by some peer-to-peer applications, leaving no other practical choice than to address a type of applications.<sup>64</sup>

Wireless network operators sometimes face similar choices, given the shared nature of network resources, and also find that the overall quality of subscribers’ broadband services is furthered by directly addressing uses or practices that result in the degradation of services to others. While only a small percentage of wireless customers are heavy users of high-bandwidth applications, that tiny percentage consumes a disproportionately high amount of available capacity. Wireless broadband networks typically operate with far less bandwidth capacity than many wireline networks, thus making the potential problems resulting from bandwidth-intensive applications more acute. For many wireless carriers, this fact increases the importance of managing traffic through one or more of the mechanisms discussed above to ensure that the vast majority of customers are able to enjoy a high-quality broadband experience. For example, several currently available “place-shifting” products, such as Slingbox, support streaming media transmissions from a home PC or television to a wide array of devices connected to a wireline or wireless network. These software- and hardware-based home media devices offer end-users the capability to view streaming content (*e.g.*, video, music, photos) from the home location over the Internet at a remote location with a PC, laptop or handheld device loaded with the application software.

But these applications also use substantially more capacity than typical Internet surfing or e-mail because they require more bandwidth and for longer and continuous periods of time.

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world but there is nothing pretty about a shared collision domain network topology and there aren’t any other solutions other than active network management”).

<sup>64</sup> *Id.*; see also Richard Bennett, *DOCSIS vs. BitTorrent*, <http://bennett.com/blog/index.php/archives/2007/11/09/docsis-vs-bittorrent/>.

Moreover, as discussed above, some of these applications – like peer-to-peer applications – have the capability of determining, and then consuming, all available radio capacity. Thus, while the user of such devices and applications may enjoy watching his home TV in the waiting lounge of an airport over a wireless broadband connection, such usage can result in the other subscribers to that broadband service in the waiting area having degraded access because of the capacity consumed by the disproportionate use of the video place-shifting applications.

A similar challenge that wireless providers sometimes face - though not related to heavy bandwidth usage - comes from devices or applications that obtain and hold onto “MAC addresses” for extended periods of time, even when the user is not actively using the network to send data. MAC addresses, or Media Access Control addresses, are individual radio channels assigned to each active user connected to a particular cell site. The EvDO radio technology has a limited number of addresses. When all of these addresses are assigned at a particular time, other users are unable to establish additional connections.

By analogy: consider a large office building with 8 elevator banks, each of which services all of the floors and all of the people in the building. If a receptionist on the 8<sup>th</sup> floor stands at the elevator door, preventing it from moving just in case the boss may need it, that strategy denies the use of the elevator by everyone else in the building. And the elevator sits unused by anyone for most of the day. If receptionists on multiple floors employed the same strategy, there would be long waits at the elevators for everyone in the building.

Unfortunately, some applications and devices have been designed to do the equivalent of holding the elevator. They hold onto a MAC address, once assigned, even though there are a limited number available and when the particular device or application is not actively being used to transmit data to the network. For example, some of these applications will periodically trickle

out a few bits, simply to hold onto the address. As a result, when a sufficient number of these applications or devices are located in one area, they can dramatically and inefficiently tie up the network resources, thus blocking other users from getting the MAC address that they need to send and receive data. Imposing restrictions on network management in this context would limit the ability of a carrier to provide connectivity when users need it, and would perversely preserve the right of some users to consume network resources unnecessarily.

The petitioners' assumption – that addressing particular types of applications is not a legitimate form of network management – is wrong, and ignores the technical and practical realities faced by some broadband network operators. Of course, as providers and industry develop additional solutions to congestion concerns, the need for some of these practices in order to alleviate congestion may lessen.

iv. *Active Traffic Management Can Also Be Used to Limit Degradation to the Quality of Consumers' Broadband Services as a Result of Congestion.*

To overcome congestion issues and ensure the overall quality of their services, broadband providers may also use innovative practices that allow more active management of traffic. Here again, the options available to a particular provider to address congestion concerns vary, and additional alternatives continue to be developed, but regulations along the lines proposed by the petitioners would undermine these emerging approaches.

As Verizon explained in its earlier comments in this proceeding, the best-efforts nature of most Internet services has traditionally worked well for activities like e-mail and basic web surfing, but presents challenges for latency-sensitive applications – such as online gaming or streaming video – that benefit from a heightened quality of service. *See Verizon Comments at 42-47.* The same developments that may be used to offer prioritization or quality-of-service for such applications also may be used to address congestion more generally and to protect the

quality of broadband services. As David Farber, one of the pioneers of the Internet, has explained, “[t]raffic management is a prime example” of continued innovation that should be encouraged by broadband providers, stating:

When traffic surges beyond the ability of the network to carry it, something is going to be delayed. When choosing what gets delayed, it makes sense to allow a network to favor traffic from, say, a patient’s heart monitor over traffic delivering a music download.<sup>65</sup>

Likewise, Alfred Kahn has recognized the need to encourage traffic management in order to address congestion, stating that providers should have “the ability to manage traffic on their networks, expediting some data (phone calls, streaming video, or remote medical monitoring, diagnoses and treatment) over less time-sensitive data (such as ordinary e-mail).” Kahn, *Network Neutrality* at 4.

One such approach is “traffic shaping.” Traffic shaping requires network equipment, sometimes called “traffic shaping boxes” or “policy-based routers,” that can be placed at various locations within the network in order to analyze and/or differentiate different packet streams within the traffic. With technological advances, “router manufacturers have refined packet-inspection technologies to provide network operators with a wide range of information about the data traffic on their networks.” *FTC Report* at 30.

Traffic shaping equipment can be used passively to “analyze and classify the traffic that’s flowing on a subnet,” thus yielding information that can be used for “network planning or resolving performance issues.”<sup>66</sup> Alternatively, using this equipment, a provider can apply various traffic control algorithms, routing algorithms, scheduling algorithms, admission control

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<sup>65</sup> Farber and Katz, *Hold Off on Net Neutrality*.

<sup>66</sup> Joe St Sauver, “Basics of Traffic Shaping,” <http://cc.uoregon.edu/cnews/winter2002/traffic.html> (Winter 2002) (last visited Feb. 2, 2008) (“*Basics of Traffic Shaping*”).

algorithms, or dropping algorithms to manage the traffic or to ensure quality of service or prioritization for certain packet streams. *Id.* at 5-6.

Using these various algorithms, broadband providers could actively manage traffic in a number of different ways in order to alleviate congestion and protect the quality of subscribers' services. For example, traffic shaping equipment could be used to implement "per-user rules" or "per-user traffic limits," like the dynamic quotas endorsed in the *Free Press Petition*.<sup>67</sup> With this technique, "a per-user rule . . . limits traffic to or from each user to" a determined speed, and rather than using all of the available capacity on the network. *Id.*

Traffic shaping techniques can also be used to distinguish between different types of applications in order to ensure that no application consumes a disproportionate amount of network capacity, thus degrading other users' services. For example, "[t]raffic shapers can identify and categorize specific types of network traffic, constraining each particular category of traffic to use no more than a specified amount of bandwidth." *Id.* For example, "policy-based routers" can be used to "give a higher priority to traffic based on the application with which it is associated," such as by giving "traffic associated with time-sensitive applications, such as streaming media or VoIP, a higher priority than traffic associated with less time-sensitive applications, such as e-mail and web browsing." Yoo, *Economics of Congestion* at 1880.

The use of active traffic shaping or traffic management has, so far, been relatively limited, given the complexity, the required processing power, and the associated expense. *See Peha, Benefits and Risks of Mandating Network Management* at 6. But these practices promise to facilitate more efficient and "smarter" networks that could improve the overall quality of

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<sup>67</sup> St Sauver, *Basics of Traffic Shaping*; see also *FTC Report* at 32 (noting that traffic management can "limit the bandwidth available to an end user").

subscribers' services and ensure that each subscriber gets a fair share of network capacity – something that may not happen on some networks without the use of network management.

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As this discussion shows, “network management” is a simple term that refers to a complex array of practices serving many different legitimate purposes. In fact, these practices can be essential to providing consumers and the public with high quality, dependable, and safe broadband services. Given the technical complexity of these practices, the variety of challenges facing broadband providers, the range of alternatives available to different broadband providers, and the ongoing industry efforts to develop new and better methods of managing networks, any *ex ante* regulation that limits providers' flexibility to manage their networks will miss the mark. The result would undermine innovation and degrade the quality, reliability and security of consumers' broadband services received by consumers.

#### IV. CONCLUSION

The best way for the Commission to promote consumer welfare is to continue procompetitive, deregulatory policies that encourage investment and deployment of broadband infrastructure, and continued innovation at all levels of the Internet. Network management practices overwhelmingly benefit consumers by increasing the quality and safety of their broadband services, and there is no reason to interfere with the use or continued development of these pro-consumer practices.

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February 13, 2008