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July 10, 2008

VIA ECFS

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: **In the Matter of Broadband Industry Practices, WC Docket No. 07-52;**
Ex Parte Communication

Dear Ms. Dortch:

In the five months since Comcast originally filed comments in the above-captioned proceeding, we have continued to take measures to effectively address the concerns raised by some in the Internet community with regard to our network management practices concerning peer-to-peer ("P2P") protocols. The purpose of this letter is to further update the Commission on these efforts and related matters.

Comcast is working bilaterally and, in a variety of industry fora, multilaterally to develop and deliver better solutions for consumers.

- In March, Comcast and BitTorrent, Inc. announced a joint effort to address issues associated with network capacity management and content distribution.[1]

- In April, Comcast and Pando Networks, Inc. announced plans to lead an industry-wide effort to develop a P2P Users' Bill of Rights.[2] This latter effort is now progressing as the P2P Best Practices Initiative under the aegis of the Distributed Computing Industry Association ("DCIA").[3]

- In May, Comcast and dozens of other interested parties, including users, P2P developers, and network engineers, participated in the Internet Engineering Task Force's ("IETF") P2P Infrastructure Workshop to discuss some of the technical issues arising in the context

[1] *See* Ex Parte Letter of David L. Cohen, Comcast Corp., to Chairman Kevin J. Martin *et al.*, FCC, WC Docket No. 07-52 (Mar. 27, 2008) ("Cohen March 27 Letter").

[2] *See* Ex Parte Letter of Kathryn A. Zachem, Comcast Corp., to Marlene H. Dortch, Secretary, FCC, WC Docket. No. 07-52 (Apr. 16, 2008).

[3] *See* Ex Parte Letter of Kathryn A. Zachem, Comcast Corp., to Marlene H. Dortch, Secretary, FCC, WC Docket No. 07-52, at 2 (May 16, 2008).

of P2P applications and services.[4] This meeting has paved the way for additional sessions at this month's IETF gathering in Dublin.

- Yesterday, Comcast and Vonage announced a collaborative effort to ensure that any network management technique Comcast chooses to deploy effectively balances the need to avoid network congestion with the need to ensure that VoIP services like Vonage work well for consumers.[5] As Vonage CTO Louis Mamakos noted, "this understanding helps our two companies work together to balance the needs of network management with consumers' ability to freely access the services, applications and content of their choice."[6]

All along the way, Comcast has conferred regularly with leaders in academia and the private sector and has benefited from their insights.

Comcast continues to deliver a world-class broadband service that empowers and enables consumers to access *any* content and use *any* application or service they choose. In March, as part of its agreement with BitTorrent, Comcast announced that, by year-end, it will migrate all of its systems to a protocol-agnostic network management technique to address network congestion issues.[7] In June, Comcast began trialing several protocol-agnostic techniques, and Comcast has developed a webpage on Comcast.net that provides information to consumers regarding Comcast's network management policies, including our progress in deploying a protocol-agnostic management technique.[8] *We reiterate here that the entire Comcast network will be migrated to that new protocol-agnostic management technique by December 31, 2008.*

In April, Comcast announced that it had taken the first step in the evolution from broadband to wideband -- rolling out DOCSIS 3.0 in the Twin Cities Region.[9] In this market, Comcast is now offering consumers download speeds of up to 50 Mbps and upload speeds of up

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[4] *See id.* at 1.

[5] *See* Press Release, Comcast Corp., *Comcast And Vonage Form Collaboration To Address Network Management And Better Meet Customer Needs* (July 9, 2008), *available at* http://www.comcast.com/About/PressRelease/PressReleaseDetail.ashx?PRID=774. A copy of the press release is attached to this letter.

[6] *Id.*

[7] *See* Cohen March 27 Letter at 1.

[8] *See* Comcast Corp., *comcast.net Network Management Policy*, *at* http://www.comcast.net/terms/network/ (last visited June 18, 2008); Comcast Corp., *comcast.net Frequently Asked Questions About Network Management* (including answers to the questions of "What is Comcast's new network management technique?"; "How is Comcast planning to implement this new network management technique?"; and "If I live in one of these cities, how will this new Network Management technique impact my high-speed Internet service?"), *at* http://help.comcast.net/content/faq/Frequently-Asked-Questions-about-Network-Management#technique (last visited June 18, 2008).

[9] *See* Press Release, Comcast Corp., *Comcast Unleashes New 50/5 Mbps Extreme High-Speed Internet Service Using DOCSIS 3.0 Technology in the Twin Cities* (Apr. 3, 2008), *available at* http://www.comcast.com/About/PressRelease/PressReleaseDetail.ashx?PRID=741.

to 5 Mbps.[10] More recently, Comcast doubled, and in many cases tripled, the upload speeds for almost all of its existing broadband customers, at no additional charge.[11] Comcast plans to make wideband available to up to 20 percent of its footprint by the end of the year, and to many more systems in 2009.

The marketplace response to Comcast's service continues to be very positive. Even as the debate over Comcast's network management practices has proceeded before the Commission, *Comcast added almost half a million new high-speed broadband customers in the first quarter of 2008*.[12] Those customers are using their service more and more to access the full panoply of content, applications, and services the Internet has to offer, including applications and services that utilize P2P protocols.

Data collected recently from the Comcast network demonstrate that Comcast's network management practices are minimally intrusive. Comcast has never managed customers' downloads, and the data show that, even with the current management of P2P uploads, P2P traffic continues to comprise *approximately half* of upstream traffic transmitted on the Comcast network -- and, in some locations, P2P traffic is as much as *two-thirds* of total upstream bandwidth. The data also show that, on a typical day, an estimated 9 billion P2P TCP flows traverse Comcast's network,[13] and, even for the most heavily used P2P protocols, more than 90 percent of these flows are unaffected by Comcast's network management. Given the vast amounts of P2P traffic carried on Comcast's network, and the small percentage of total uploads that are delayed, it is clear that Comcast's customers are able to (and do) use any application or service they choose, including those that utilize P2P protocols.

The data also suggest that, even in a cable system with heavy P2P usage, when a P2P upload from a particular computer was delayed by a reset packet, that same computer successfully initiated a P2P upload within one minute in 80 percent of the cases. In fact, most Comcast customers using P2P protocols to upload never experienced any delay at all. Thus, even when a subscriber's computer encounters a so-called "busy" signal when it attempts to upload a file, the busy condition generally causes only brief delays before that computer is able to effectuate its next upload. In other words, as Comcast has consistently maintained, this current network management technique delays a relatively small number of P2P uploads and only delays them temporarily.

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[10] *See id.*

[11] *See* Press Release, Comcast Corp., *Comcast Increases Upstream Speeds for Its High-Speed Internet Customers for No Additional Charge* (June 12, 2008), *available at* http://www.comcast.com/About/PressRelease/PressReleaseDetail.ashx?PRID=765.

[12] *See* Press Release, Comcast Corp., *Comcast Reports First Quarter 2008 Results* 2, 9 (May 1, 2008), *available at* http://library.corporate-ir.net/library/11/118/118591/items/291108/1Q08PR.pdf.

[13] If one includes both P2P TCP and UDP flows, the numbers are even more compelling: the data suggest that over 85 billion P2P TCP and P2P UDP flows traverse Comcast's network on a given day.

The individual user experience in any particular situation is subject to numerous variables, many of which are outside the network operator's control. One telling example of this was the recent episode involving researchers at the University of Colorado who concluded they were receiving reset packets sent by Comcast's network equipment. In fact, they subsequently discovered that they were actually receiving reset packets generated *by their own network equipment*.[14]

This episode provides two important lessons -- first, without extensive analysis of any particular situation, it is very difficult to determine exactly what happened to cause the observed behavior of the network and applications;[15] and, second, even some of the most highly credentialed and experienced computer scientists are not immune from improperly diagnosing a situation on the network.

The record in this proceeding clearly evidences that consumers experience a wide variety of problems with their computers and with Internet applications and services that are *in no way* related to Comcast's network or network management practices. Drawing conclusions about Comcast's network management practices based on the isolated and undocumented experiences reported by less than a handful of Comcast's 14.1 million subscribers would be the antithesis of sound policymaking.

Over the past seven months, much has been written and said about Comcast's network management practices by other parties. The substance of some of this commentary suggests that there is still some confusion about Comcast's current practices. *Although, as we have stated repeatedly, these practices will be phased out on all of our systems by year-end,* Comcast wants to take the opportunity to ensure that the record is clear as to what it does today.

First, Comcast has stated that its current network management technique only manages uploads, and that it does not manage downloads. This is true as to all P2P protocols that we manage. Comcast further stated that it does not manage P2P uploads when the user is simultaneously downloading. That is true as to those P2P protocols that utilize a single TCP flow for simultaneous uploading and downloading. When managing those protocols that are

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[14] *See* Sys. Research Lab, Univ. of Colo., *Broadband Network Management* ("A note regarding our findings: Further experiments have led us to believe that our initial conclusions that indicated Comcast's responsibility for dropping TCP SYN packets and forging TCP SYN, ACK and RST (reset) packets was [sic] incorrect. Our experiments were conducted from behind a network address translator (NAT). The anomalous packets were generated when the outbound TCP SYN packets exceeded the NAT's resources available in it's [sic] state table. In this case, TCP SYN, ACK and RST packets were sent."), *at* http://systems.cs.colorado.edu/mediawiki/index.php/Broadband_Network_Management (last visited July 10, 2008).

[15] AT&T recently noted that "a white paper from the Department of Computer Science at the University of Calgary . . . 'show[s] that reset connections arise from local events such as network outages, attacks, or reconfigurations, as well as from global trends in TCP usage.'" Ex Parte Letter from Jack Zinman, General Attorney, AT&T Servs., Inc., to Marlene H. Dortch, Secretary, FCC, at 1 (Apr. 25, 2008) (quoting Martin Arlitt & Carey Williamson, *An Analysis of TCP Reset Behaviour on the Internet*, Univ. of Calgary (2004), *available at* http://pages.cpsc.ucalgary.ca/%7Ecarey/papers/2005/TCP-Resets.pdf). In fact, the same Arlitt & Williamson study (at 1) found that "15-25% of TCP connections have at least one TCP RST."

capable of (and actually are) simultaneously uploading and downloading with a single TCP flow, we do not manage that upload. The reason we do not manage that upload is that it would impact that customer's simultaneous download, which it is our policy not to do. With other P2P protocols that do not have this capability and, as such, are made up of separate and discrete unidirectional flows, these upstream flows are subject to management. It should be pointed out that, in these cases, management does not affect the customer's download. So, *in all cases*, Comcast's current policy does not manage our customers' downloads.

Second, there appears to be some confusion regarding *where* in the network the management takes place. In particular, Comcast has accurately stated that it manages the network at the node, but its citation to the Martin and Westall study may have left the implication that Comcast manages at the *optical node*. To be clear: Comcast's network management is undertaken by equipment typically located adjacent to the cable modem termination system ("CMTS"), which is often referred to as a *data node*. So, to restate, Comcast's network management generally occurs at the data node level, and not at the optical node level.[16]

Finally, there also has been some confusion about whether Comcast's current network management practices are tied to particular hours of the day. They are not. Comcast has explained that its current network management practices are triggered by certain threshold levels of P2P protocol use that could, if unchecked, lead to harmful network congestion. Specifically, Comcast's current P2P management is triggered when the number of P2P uploads in a given area for a particular P2P protocol reaches a certain, pre-determined level, regardless of the level of overall network traffic at that time, and regardless of the time of day when the applicable P2P protocol threshold is reached. Comcast has set these thresholds at levels that are designed to *prevent* congestion that could degrade the online experience of all customers and, in particular, could cause interference with other, more time-sensitive uses of the network.

The study by Martin and Westall that Comcast cited in its initial filings demonstrated that P2P upload traffic alone can significantly degrade VoIP calls and multiplayer gaming, and can cause significant Web browsing delays.[17] Since VoIP and other real-time applications and services are much more time- and latency-sensitive, it is important that those other forms of traffic not be impeded by congestion caused by P2P protocols. Comcast's network management practices have been designed to appropriately balance the needs of these time- and latency-sensitive applications and services with the needs and demands of users of P2P protocols. Comcast's focus is on providing *all* of its customers with the level of service that they expect and deserve. To do so, its network management practices are ready to act 24 hours a day, 7 days a week, at any time when P2P traffic levels threaten to degrade customers' Internet experiences.[18]

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[16] In some circumstances, two small CMTSes located near each other may be managed by a single device.

[17] *See* Comments of Comcast Corp., WC Docket No. 07-52, at 26 (Feb. 12, 2008).

[18] In point of fact, P2P traffic is abundant on some data nodes at all hours of the day and night; it does not reflect the same degree of diurnal usage patterns as does other network traffic.

We believe that it is important that the Commission have reliable information as it pursues its broadband inquiry. We also believe that the Commission should focus on ensuring that broadband can be deployed to more Americans and the Internet can deliver what consumers want -- a vast array of communications, information, and entertainment options that are available anytime, anywhere. That is going to require more investment, more innovation, and more competitive differentiation. It will also continue to require reasonable network management.

In closing, while we continue to believe that the current network management technique implemented by Comcast was reasonable in light of available technology, we remain committed to replace that technique with a protocol-agnostic technique in all of the markets we serve by December 31, 2008.

Please do not hesitate to contact me with any further questions.

Sincerely,

/s/ Kathryn A. Zachem
Kathryn A. Zachem
Vice President, Regulatory Affairs
Comcast Corporation

cc: Amy Bender
Scott Bergmann
Amy Blankenship
Catherine Bohigian
Scott M. Deutchman
Daniel Gonzalez
John W. Hunter

Attachment A:

Comcast-Vonage Press Release

July 9, 2008

Press Releases

Comcast And Vonage Form Collaboration To Address Network Management And Better Meet Customer Needs

Philadelphia, PA and Holmdel, NJ - July 9, 2008

Comcast Corporation and Vonage Holdings Corporation announced today a collaborative agreement to address the reasonable network management of Internet services. Comcast committed to work together with Vonage to ensure that network management techniques are chosen that effectively balance the need to avoid network congestion with the need to ensure that over-the-top VoIP services like Vonage work well for consumers.

“This agreement helps Vonage to ensure that customers have the best possible Internet experience,” said Louis Mamakos, Vonage Chief Technology Officer. “Although we’re competitors with Comcast, this understanding helps our two companies work together to balance the needs of network management with consumers’ ability to freely access the services, applications and content of their choice.”

“This collaboration with Vonage, and our outreach to many key participants in the Internet community, demonstrate that we are committed to provide network management solutions that benefit consumers and competition,” said Tony Werner, Comcast Chief Technology Officer.

This is the latest in a series of announcements related to Comcast’s network management practices that demonstrate the company’s commitment to ensure that its customers’ ability to use any application or access any content they choose while avoiding network congestion situations that could affect the consumer experience. In March, Comcast announced it would move to a protocol-agnostic network management approach by the end of 2008, and tests on this approach have already begun. Comcast has announced other collaborations with BitTorrent, Inc. and Pando Networks, as well as participation in the P4P Working Group organized by the Distributed Computing Industry Association (DCIA). Comcast has also participated in the IETF Workshop on P2P Infrastructure, and will continue to collaborate in the IETF with other ISPs, P2P providers, and others on technologies related to network management and P2P application development.

About Comcast Corporation
Comcast Corporation (Nasdaq: CMCSA, CMCSK) (http://www.comcast.com) is the

nation's leading provider of entertainment, information and communications products and services. With 24.7 million cable customers, 14.1 million high-speed Internet customers, and 5.2 million voice customers, Comcast is principally involved in the development, management and operation of broadband cable systems and in the delivery of programming content.

Comcast's content networks and investments include E! Entertainment Television, Style Network, The Golf Channel, VERSUS, G4, PBS KIDS Sprout, TV One, ten Comcast SportsNet networks and Comcast Interactive Media, which develops and operates Comcast's Internet business. Comcast also has a majority ownership in Comcast-Spectacor, whose major holdings include the Philadelphia Flyers NHL hockey team, the Philadelphia 76ers NBA basketball team and two large multipurpose arenas in Philadelphia.

About Vonage

Vonage (NYSE: VG) is a leading provider of broadband telephone services with 2.6 million subscriber lines. Our award-winning technology enables anyone to make and receive phone calls with a touch tone telephone almost anywhere a broadband Internet connection is available. We offer feature-rich and cost-effective communication services that offer users an experience similar to traditional telephone services.

Our Residential Premium Unlimited and Small Business Unlimited calling plans offer consumers unlimited local and long distance calling, and popular features like call waiting, call forwarding and voicemail - for one low, flat monthly rate.

Vonage's service is sold on the web and through national retailers including Best Buy, Circuit City, Wal-Mart Stores Inc. and Target and is available to customers in the U.S., Canada and the United Kingdom. For more information about Vonage's products and services, please visit http://www.vonage.com.

Vonage Holdings Corp. is headquartered in Holmdel, New Jersey. Vonage(R) is a registered trademark of Vonage Marketing Inc., a subsidiary of Vonage Holdings Corp.