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May 16, 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:

Attached is a presentation and speech made by Richard Woundy, Senior Vice President of Software and Applications, Comcast Cable Communications, to the Distributed Computing Industry Association's ("DCIA") 3d Annual P2P Media Summit held on May 5, 2008.

In his presentation and speech, Mr. Woundy detailed Comcast's continuing efforts to work collaboratively with leaders in the Internet community to provide ever-improving services to consumers. Mr. Woundy also highlighted Comcast's current transition to DOCSIS 3.0, which will allow Comcast to provide downstream wideband speeds of up to 50 Mbps and greater in the long term. Mr. Woundy made clear, however, that even with the introduction of DOCSIS 3.0, Comcast will still need to manage its network to prevent congestion from degrading our subscribers' broadband experience. As AT&T pointed out in its ex parte presentations to the Commission, wireline broadband networks, cable broadband networks, and wireless broadband networks all "Are Inherently Shared Networks That Must Be Managed" and "[i]ncreased bandwidth is not the solution because the need to manage shared networks doesn't go away as bandwidth increases."[1]

Comcast's participation in the P2P Media Summit and in the upcoming P2P Infrastructure Workshop under the auspices of the Internet Engineering Task Force (IETF) are key components of Comcast's continuing dialogue with other stakeholders in the Internet community to ensure that, working together, we can meet the needs and demands of Internet users. Comcast is just one of many broadband service providers who have joined with the DCIA and others in the P2P

[1] AT&T Ex Parte Statement, WC Docket No. 07-52, at 3-5, 10 (Apr. 7, 2008).

industry to try and resolve concerns about congestion and network management. To that end, the DCIA has taken the organizing role in developing a P2P Best Practices initiative that will include the broad P2P and broadband industry participation that Comcast and Pando Networks contemplated in the announcement of their collaborative efforts in mid-April.

It is in the interest of everyone in the Internet community to resolve congestion issues caused by P2P protocols in a consumer-friendly manner. There are important non-governmental venues for industry collaboration to address these challenges, which is consistent with the long and successful history of Internet self-governance. We will continue to dedicate as much time and resources as possible to pursuing these efforts and would hope that the Commission continues to encourage such constructive endeavors as it has done in the past.

If you have any questions, please feel free to call me.

Sincerely,

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

cc: Amy Bender
Scott Bergmann
Amy Blankenship
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Comcast Technical Engagement with the P2P Community

P2P Media Summit – LA

Richard Woundy
SVP, Software & Applications
May 5, 2008

Technical Engagements with the P2P Community

- Comcast network modifications
  - Migrating to a capacity management technique that is protocol agnostic by year end
  - Deploying DOCSIS 3.0 and adding upstream capacity as needed
- Engagement with BitTorrent
  - Collaboration to optimize P2P content delivery over broadband networks
  - Working with the industry on optimal client-side and network management techniques
- Engagement with Pando
  - Participation in Pando trial of P4P control plane
- Engagement with the P4P Working Group and DCIA
  - Participation as a P4PWG core participant
  - Support for the DCIA Best Practices initiative
- Engagement with the IETF
  - Participation in the IETF Workshop hosted by MIT on May 28

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Recent DOCSIS Specifications and Updates

- DOCSIS 3.0 “Bronze” qualification phase
  - Downstream channel bonding (DCB)
  - Basic IPv6 support (IPv6 for cable modem management)
- DOCSIS 3.0 “Silver” qualification phase
  - Upstream channel bonding (UCB)
  - Multicast improvements (IGMPv3, MLDv2)
  - IPDR enhancements (streaming, additional data)
  - AES encryption, S-CDMA support, …
- DOCSIS 3.0 “Full” qualification phase

- Comcast update
  - April 3: Initial DOCSIS 3.0 CMTS production deployment in Minneapolis including 50/5 tier

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P4P Control Plane Benefits

- Enables backbone bandwidth optimization
  - Reduction in ISP “hop count”
  - Increased traffic localization within ISP backbone
  - Increased traffic localization within ISP metro regions
- Improves P2P download performance
  - Improvement in data delivery speed
  - Increased file transfer rates for P2P customers

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Current Technical Limitations of P4P

- Focuses on backbone bandwidth optimization
- Assumes a simple split of customers
  - e.g. DSL/FTTH split by subnet or AS
- Currently considers only P2P bandwidth usage
- Currently assumes cooperative iTrackers
  - How to avoid ‘hot potato routing’ by independent iTrackers?
- Focuses on control plane, not data plane

Potential P4P Technical Improvements

- Enable P2P tracker awareness of per-user bandwidth variation
  - Bandwidth tiers and network management
  - Should local congestion or outages be reported?
- Enable P2P cache discovery
- Enable multiple cooperative iTrackers
  - Potentially through a clearinghouse
- Extend P4P to data plane
  - Leverage multiple network traffic priorities
  - Extend consumer priority control and visibility through P2P client

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<slide 1>

Hello, I'm Richard Woundy, SVP of Software & Applications in the Comcast CTO Office. As a member of the Comcast engineering team, I'm pleased to speak with you this morning about Comcast's technical plans related to the P2P vendor community.

While I will talk about Comcast's specific challenges and engineering responses, I think it's important to point out that all ISPs (cable and telcos, wireline and wireless) face similar technical challenges with broadband traffic engineering, and we're all looking for the best ways to meet the challenges, mindful of the differing architectures of our networks.

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Comcast has a number of technical projects and coordination efforts underway which we believe will benefit our customers and the P2P vendor community.

In one internal engineering project, Comcast will be migrating to a new network management approach, which will be agnostic to any protocol or application, by the end of 2008. In short, during times of peak congestion, our new network management system will focus on the traffic of individuals who are using a disproportionate amount of bandwidth and are creating congestion that degrades the experience for other users. The goal of this network management technique is that all customers will have a good online experience, even during periods of network congestion. And we intend to completely replace our current protocol-specific management system by the end of this year.

In another internal engineering project, Comcast is working hard to deploy DOCSIS 3.0 technology in up to 20% of its markets by the end of 2008. This will make available downstream wideband speeds of up to 50 Mbps, and greater in the long term. Comcast will also more than double the upstream DOCSIS capacity in a number of markets before the end of 2008. I will describe these DOCSIS technologies in more detail in upcoming slides.

In the last two months, Comcast has announced external technical collaboration efforts with two P2P vendors: BitTorrent and Pando. With BitTorrent, Comcast has started technical discussions about optimizing P2P content delivery over broadband networks, and over cable networks in particular. The end result of these conversations is that the optimal client-side and network management techniques will be shared with the rest of the P2P community. Some of the suggestions for P4P improvements in this presentation originated from some of these early technical discussions.

Comcast will also conduct a P4P control plane test of Pando's software across its network. The test is designed to measure things such as average hops across

the network, and average user download speeds, associated with bulk file distribution optimized by the P4P control plane. The test methodology and results will be shared with the P4P Working Group so that all P2P companies and ISPs can benefit from them.

Comcast is also collaborating on P2P-related technical issues with two important organizations: the DCIA and the IETF. With respect to the DCIA, Comcast is already a core participant in the P4P working group. Comcast also fully supports the recently announced P2P Best Practices initiative, an effort led by the DCIA to establish widely accepted business practices for safe and efficient use of P2P services. The Best Practices initiative is an outgrowth of the commitment by Comcast and Pando to work together on what we had originally called a “P2P Bill of Rights and Responsibilities,” and we’re very pleased that DCIA has stepped forward to organize this important effort.

The IETF has initiated a technical discussion about the proper approaches to P2P application development and ISP network management. The Real-time Applications & Infrastructure Area Directors, Jon Peterson and Cullen Jennings, have announced a P2P Infrastructure Workshop, to be hosted by MIT in Cambridge MA on May 28. The Workshop intends to discover whether additional IETF standards work is needed, or whether existing work might be reapplied. Both Comcast and BitTorrent plan to present their technical perspectives at this Workshop.

A key objective of all these efforts is to promote collaboration among broadband ISPs, other technical companies in the P2P community, content providers, independent subject matter experts, and the DCIA and the Internet Engineering Task Force to find the best approaches. As these various collaboration efforts mature, the solutions will be published for everyone to benefit from them.

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Now I will turn attention specifically to DOCSIS 3.0 CMTS qualification and Comcast deployment.

There are three CableLabs “qualification phases” for DOCSIS 3.0 CMTS equipment, known as “Bronze”, “Silver”, and “Full”. In the “Bronze” phase, the CMTS is qualified by CableLabs to support downstream channel bonding and IPv6. In the “Silver” phase, the CMTS is qualified by CableLabs to support upstream channel bonding, improvements to multicast and IPDR, AES encryption, and enhanced support for S-CDMA. The “Full” qualification phase includes the remaining features of the DOCSIS 3.0 specification, mostly CMTS operational measurement capabilities.

With respect to increased DOCSIS network capacity, the key features are downstream channel bonding and upstream channel bonding.

Here's how downstream channel bonding works. When a typical cable Internet customer downloads something over the Internet, that data is delivered over a portion of a single 6 MHz channel. That is the amount of spectrum that we dedicate to deliver a single analog broadcast video channel, or to deliver multiple digital video programs. In general, the equivalent of a single 6 MHz channel is what we have dedicated for all high-speed data downloads on our systems.

With DOCSIS 3.0 "Bronze", the CMTS can bond up to four downstream channels. And similarly with DOCSIS 3.0 "Silver", the CMTS will support the bonding of up to four upstream channels. Future versions of DOCSIS equipment will support bonding of eight or more channels.

Think of channels like lanes of a highway. When downstream or upstream channels are bonded together, the effect is similar to an upgrade from a two-way highway to a multilane freeway.

In April, Comcast announced its first production deployment of DOCSIS 3.0 CMTS equipment in the Twin Cities region, and the concurrent launch of a new extreme high-speed Internet service, with download speeds of up to 50 Mbps and upload speeds of up to 5 Mbps. Going forward, DOCSIS 3.0 technology will enable Comcast to offer even faster download and upload speeds in the future.

Let me emphasize that the deployment of DOCSIS 3.0 will not by itself solve the challenge of meeting the ever-increasing Internet bandwidth demand of consumers. Broadband ISPs cannot simply build their way out of network congestion. Every U.S. broadband network faces periods of congestion. Even some of the largest broadband access networks in the world with very high consumer bandwidth speeds – in Japan and Europe – face similar congestion challenges every day. The Comcast engineering approach is to adopt smart and fair network management practices while also expanding broadband access capacity, in order to deliver the optimal experience to our Internet customers.

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I will focus the remainder of this presentation on the P4P Working Group technology, specifically concerning some early feedback on how P4P technology might evolve to benefit cable and other broadband access networks.

Previously published test results show benefits of the P4P control plane, for both broadband ISPs and P2P vendors. With respect to broadband access networks, the P4P control plane enables optimization of P2P traffic over the ISP's backbone, in that it reduces the "hop count" over the backbone. The P4P control plane helps influence the P2P vendor trackers to choose a larger proportion of peers within the ISP's backbone footprint, and a larger proportion of peers within the same metropolitan region of the ISP's network.

One benefit of this P2P traffic optimization is potentially slower growth of inter-ISP traffic, which may help to limit network costs to connect to peer ISPs, as well as to connect to the ISP's upstream transit providers. Another benefit of this optimization is potentially slower growth of traffic on ISP backbone links, which may help to slow the number of backbone link upgrades that will be required.

With respect to P2P distribution systems, the P4P control plane also appears to improve the P2P download performance, through the influence of the ISP's network topology on the P2P tracker's peer selection process. The improvement in average data delivery bandwidth for the P2P distribution system, as observed in previous P4P control plane field tests, would imply faster file distribution to P2P consumers.

Comcast is interested in collaboration to find optimal solutions for both broadband ISPs and P2P vendors. Given the promising results from recent field testing, Comcast has agreed to conduct a P4P control plane test across its network within the next few months.

While the initial field test results of the P4P control plane technology are promising, from Comcast's perspective, it would be helpful for P4P technology to consider other optimizations as well.

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Perhaps the most obvious limitation in the current P4P technology is the focus on optimization of the backbone bandwidth. Comcast network engineers would like to discuss P4P optimizations that could also apply to last mile broadband access networks, such as DOCSIS networks, in addition to optimizations on ISP backbone networks.

Comcast engineers have identified additional technical limitations with the current P4P technology, for which we would like to initiate conversations with engineers in the P4P working group and general P2P community.

The P4P control plane currently assumes that it is easy to split P2P customers into distinct bandwidth groups, such as DSL customers versus FTTH customers, based on the IP subnet or autonomous system identification of such customers. The reason why this is a concern is related to how cable networks are evolving. While other broadband ISPs are launching new access networks and deploying new customer premise devices, DOCSIS evolution emphasizes backward compatibility with earlier versions of the DOCSIS specification. In some cable networks, it will be quite possible for consumers with DOCSIS 1.0 or 1.1 cable modems to be located within the same IP subnet as other consumers with DOCSIS 2.0 or 3.0 cable modems. Note that there are significant differences in the maximum bandwidth capability among those cable modem types.

In addition, the current P4P software considers only P2P bandwidth usage, rather than all Internet bandwidth usage. It is well known among broadband network engineers that there are often significant time-of-day variations in aggregate network traffic. For example, the amount of aggregate broadband network traffic is typically lower at 4am in the morning, and is typically higher at 7pm in the evening. Furthermore, bandwidth consumption patterns for P2P distribution tends to be different than for other Internet applications; a typical consumer may run their P2P application all night for content downloads, but the same consumer may not browse the web all night.

The current assumption of the P4P control plane is that there is implied cooperation among the iTrackers. iTrackers are the P4P component that supply peer preferences to the P2P trackers based on ISP topology. Part of that preference information is the proportion of peers that the P2P tracker ought to choose from outside the ISP's network. The fundamental concern is a theoretical ISP, whose iTracker suggests that a high proportion of peers should be selected from outside the ISP's own network. Network engineers call this the "hot potato routing" issue. As a result, this theoretical ISP is pushing its network transport costs for P2P content distribution to other ISPs. We want to address this issue.

Lastly, it may be worthwhile to look at the "data plane" as well as the "control plane" in the P4P architecture. While the control plane focuses on the selection of peers by the tracker, the data plane focuses on the marking of actual P2P protocol traffic as it crosses the Internet.

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Let me finish my presentation with some early suggestions for P4P technical improvements.

Perhaps the P2P tracker should be made aware of the variation in downstream and upstream bandwidth for customer broadband access, even for customers collocated on the same DOCSIS network or other broadband access network. This information may enable the P2P tracker to choose a more appropriate set of peers for a swarm. The P2P tracker may also want to be aware of customers that have become subject to "protocol agnostic network management", to benefit both the uploading and downloading consumers. Some network engineers have suggested that local network congestion and/or outages should also be reported to the P2P tracker, but it is not clear if this information might somehow be shared with competitor ISPs, which would be a significant business concern.

It may make sense for the P2P clients to be directed to one or more P2P content caching servers, as a further optimization. P2P caching is of particular technical interest, because P2P content downloads from caching servers can displace P2P traffic on broadband access upstream networks.

Another concept is to evolve the P4P architecture to support multiple cooperative iTrackers explicitly, and avoid the “hot potato routing” problem I mentioned earlier. One potential approach is for iTrackers to feed peer preferences into a clearinghouse, and the clearinghouse would feed aggregate peer preferences into P2P trackers. The clearinghouse may also be able to ensure that ISPs suggest a similar proportion of off-net and on-net peer preferences to the P2P trackers.

Finally, P4P could be extended from the control plane to the data plane, through marking of the P2P traffic within the IP headers. One Internet technology, called Differentiated Services or DiffServ, allows IP traffic to be marked for priority handling. Another Internet technology, called Explicit Congestion Notification or ECN, allows IP traffic to be marked based on congestion experienced within the ISP network. It may even be worthwhile to consider application and direct consumer visibility into these standard Internet mechanisms.

At Comcast, we think that serious collaboration among broadband network providers, P2P vendors, content providers and other key stakeholders can yield a better Internet experience for everyone. I’ve appreciated the chance to tell you more about how we’re contributing to that collaboration. Thank you very much.