

Before the
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WC Docket No. 17-108

In the Matter of

Restoring Internet Freedom

Caching and DNS in Broadband Internet Access Services

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Author Qualifications

Jon Peha is a Full Professor at Carnegie Mellon University, with experience in industry, government, and academia. In government, he served at the FCC as Chief Technologist, in the White House as Assistant Director of OSTP, in the House Energy & Commerce Committee, and at USAID for the Telecommunications Leadership Program. In industry, he has been Chief Technical Officer for three high-tech companies, and member of technical staff at SRI International, AT&T Bell Labs, and Microsoft. At Carnegie Mellon, he is a Professor in the Dept. of Electrical & Computer Engineering and the Dept. of Engineering & Public Policy, and former Associate Director of the Center for Wireless & Broadband Networking. Dr. Peha holds a PhD in electrical engineering from Stanford. He is an *IEEE Fellow* and an *AAAS Fellow*, and was selected by AAAS as one of 40 Featured Science and Technology Policy Fellows of the last 40 years ("40@40"). Dr. Peha has received the FCC's "Excellence in Engineering Award," the IEEE Communications Society TCCN Publication Award for career contributions to spectrum management, and the Brown Engineering Medal. He consults on a wide range of technical and policy issues related to information and communications technology.

Disclaimer

In writing this comment, Dr. Peha represents no one but himself.

Overview

In November 2017, the Federal Communications Commission (FCC) released a draft of its Declaratory Ruling, Report and Order, and Order in the Matter of Restoring Internet Freedom (henceforth referred to as the “Declaratory Ruling”), which concluded that a Broadband Internet Access Service (BIAS) is an information service, and not a telecommunications service. That conclusion is based in part on several misrepresentations of how Internet technology works. This has resulted in a tentative ruling that violates the Communications Act as amended by the Telecommunications Act of 1996.

Caching

Some of those misrepresentations relate to caching. The Commission incorrectly concludes

- that caching provided by BIAS providers is an information service, (Paragraph 40)
- that DNS and web caching are “part and parcel of the broadband Internet access service,” (Paragraph 41)
- that BIAS providers offer caching because “broadband Internet access service would be a significantly inferior experience for the consumer” without caching, (Paragraph 42)
- that caching is more similar to Bell Operating Company provision of “storage space in their gateways for databases created by others” such as “information service providers and end users” than to “store and forward technology [used] in routing messages through the network as part of a basic service.” (Paragraphs 43 and 44)

To understand this issue, we must first distinguish between two somewhat similar services: content distribution network (CDN) services, and transparent caching. In both cases, information is stored in servers so it is available to users upon request. In both cases, benefits accrue when those servers are “closer” to users than the next-best source of the same information. When information stored in such a server is requested, this information can be delivered to the requester at lower transmissions cost and more quickly. Despite these similarities, these services do differ, and the FCC seems to mix the two in its draft Declaratory Ruling.

These two services differ in how it is determined which information will be stored. In a CDN service, information is stored at the request of the information provider, regardless of how frequently or infrequently that information is accessed. Information providers can benefit significantly from this arrangement, and as a result, these information providers are willing to pay for the service. A CDN service within an ISP’s network is similar to the provision of “storage space in their gateways for databases created by others” such as “information service providers” within a telephone network, in that both allow third parties to pay for the ability to place information in storage space that is accessible through the network. CDN service is not a core part of BIAS service, so even if CDN service is an information service, that does not make BIAS an information service. Today’s CDN services are separate from today’s BIAS. There are a number of companies (such as Akamai) that offer highly successful CDN services today and that do not offer an Internet access service, telephone service, or any other telecommunications service.

The FCC may very well intend for this paragraph to address transparent caching, and not CDN service. In transparent caching, information is kept in storage if there is reason to believe that the system will be

asked to forward that information some time soon, regardless of the nature of that information or who produced it. For example, a web cache might keep those web pages in storage that have been requested many times in the last hour, while a web page that is requested only once will eventually be discarded. When a web page is requested, it is both stored in the web cache and forwarded to the end user who requested the page. If there are more requests, then this web page will be forwarded multiple times, without the need to retrieve it again from some distant server. Contrary to what the Declaratory Ruling asserts, this is similar to the “store and forward technology [used] in routing messages through the network as part of a basic service” which has been found to be part of a telecommunications service. A major difference is that a store-and-forward router will store a packet once and forward it once, whereas a web cache will store once and sometimes forward many times.

Unlike CDNs, transparent caches do not allow third parties to choose which content is stored. Indeed, the FCC makes a misleading assertion in paragraph 42 that ISPs who use caches are “storing third party content they *select* in servers in their own networks to enhance access to information.” If any ISPs are literally selecting content to place in caches, then those ISPs are in legal jeopardy. Selection implies curation. Transparent web caches will sometimes contain child pornography and phishing attacks, and if ISPs were actually “selecting” this content for storage, then ISPs could be held liable. In reality, liability is probably not an issue because ISPs can use web caches that employ algorithms with content-neutral criteria, such as how long it has been since the last time that web page was requested. Thus, neither the ISP nor the information provider nor the end user “select” specific content to be stored in a cache. Caching of this sort has little in common with a phone company’s provision of “storage space in their gateways for databases created by others” such as “information service providers and end users.” In those cases, information service providers or end users are making the selection, and paying for the service. In contrast, caching is an automated function that is not even visible to either information service providers or end users.

As for DNS and web caching being “part and parcel of the broadband Internet access service,” it should first be noted that even if BIAS providers did not employ web caching, web browsing would still work, and even if BIAS providers did not employ DNS caching, DNS would still work. Indeed, as discussed below, even if BIAS providers did not employ DNS services of any kind, DNS would still work.

The primary reason that a BIAS provider would choose to employ transparent caching for web pages is to reduce the BIAS provider’s costs. If a web page is stored close to the end user, then the BIAS provider can sometimes avoid transferring the web page more than once over a congested backhaul link, and/or avoid paying the transit cost to receive the web page more than once from a Tier 1 backbone ISP. This is true particularly with customers in remote areas where the BIAS provider’s backhaul costs are significant. BIAS providers do not have incentive to employ caching to attract or retain customers, because customers have no way of knowing which BIAS provider offers better caching. Indeed, most customers don’t know what caching is. Even for those who do, caching does not affect traditional “speed” tests that measure the quality of an Internet service, and end users can never tell how many of the web pages they receive came from an ISP-operated cache, if any. That means any impact of caching on the end users is unlikely to affect the market share or revenues of BIAS providers. Thus, a rational profit-maximizing BIAS provider will decide whether to use caching based primarily on whether the reduction in the BIAS provider’s transmission costs exceed the costs of caching, and not on whether this affects the customers’ service.

Given that BIAS providers employ caching to reduce their own costs, and BIAS customers have no way of knowing whether caching has ever occurred, it is reasonable to conclude that caching falls within the management exemption, and is not an information service to consumers in its own right.

Domain Name System (DNS)

In paragraph 33, the draft Declaratory Ruling claims that the “Domain Name System (DNS) is an indispensable functionality of broadband Internet access service,” and that “DNS is a core function of broadband Internet access service.” If these assertions were true, it would show that a “core” and “indispensable” element of a BIAS is an information service.

As shown in my previous comments in this proceeding, and the comments of many others, these assertions are simply incorrect. If DNS were an indispensable functionality of broadband Internet access service (BIAS), then BIAS customers could not get adequate service if DNS functions were removed from the BIAS service entirely. In reality, if a BIAS provider does not offer any DNS functions, its customers could simply make DNS requests to someone else. The change would be trivial. Indeed, this happens every day. For example, Google has been providing this service to all Internet users since 2009, and as of 2014, they were receiving 4 *billion* DNS requests per day.¹ Every user making those requests to Google’s Public DNS knows that the DNS functionality is entirely dispensable for BIAS providers.

Internet architects deliberately created the DNS to be entirely independent from the *IP packet transfer* function, whereby IP packets are moved from sender to recipient without change in form or content, and it is *IP packet transfer* that is the core function of broadband Internet access service.² Given that DNS is neither indispensable nor a core function of BIAS, the fact that a BIAS provider might choose to offer this service for free along with BIAS could not make BIAS into an information service.

Moreover, DNS is to the Internet what the 411 directory assistance service is to the telephone network. In both cases, users provide the name of the entity they want to communicate with, and the service responds with the corresponding number that the network requires. Both are information services. Both services make the network more valuable to users, but do not affect the transfer of information from sender to recipient without change of form or content. Both services could be offered by third parties who have nothing to do with the network. Nevertheless, most telephone companies have offered this information service to their customers for many decades. If the FCC rules that a BIAS service is an information service because that BIAS service includes DNS, and the FCC does not simultaneously rule that every telephone service that includes 411 directory assistance is also an information service, then the FCC’s decision would be arbitrary and capricious.

¹ Google, “Google Public DNS and Location-Sensitive DNS Responses,” Dec. 15, 2014.
<https://webmasters.googleblog.com/2014/12/google-public-dns-and-location.html>

² J. M. Peha, “Fallacies Behind Reclassifying Broadband Internet Access Service as an Information Service,” Comments in the Matter of Restoring Internet Freedom, Federal Communications Commission WC Docket No. 17-108, July 2017. J. M. Peha, “The Network Neutrality Battles that will Follow Reclassification,” *I/S: A Journal of Law and Policy for the Information Society*, 2016. B. A. Cherry and J. M. Peha, “The Telecom Act of 1996 Requires the FCC to Classify Commercial Internet Access as a Telecom Service,” Comments in the Matter of Protecting and Promoting the Open Internet, Federal Communications Commission GN Docket No. 14-28, Dec. 22, 2014.