The Internet Ecosystem: The Potential for Discrimination

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I. THE PREMISE BEHIND NETWORK NEUTRALITY

The premise behind the current debate in network neutrality was articulated in an FCC policy statement adopted in August 2005[1] that stated four goals for the Internet:

1. "[C]onsumers are entitled to access the lawful . . . content of their choice."[2]

2. "[C]onsumers are entitled to run applications and use services of their choice, subject to the needs of law enforcement."[3]

3. "[C]onsumers are entitled to connect their choice of legal devices that do not harm the network."[4]

4. "[C]onsumers are entitled to competition between network providers, application and service providers, and content providers."[5]

Rules that have been proposed since would extend these four core principles by adding two additional rules:[6]

1. A provider of broadband Internet access service must "treat lawful content, applications, and services in a nondiscriminatory manner."[7]

2. A provider of broadband Internet access service must "disclose such information concerning network management and other practices as is reasonably required for users and content, application, and service providers to enjoy the protections specified in this rulemaking."[8]

Broadly speaking, participants in the network neutrality debate use the same term to conflate two issues—accessing content of their choice

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1. Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, *Policy Statement*, 20 F.C.C.R. 14986 (2005) (including the publication of the original "four rules").

2. *Id.* at para. 4.

3. *Id.*

4. *Id.*

5. *Id.*

6. Preserving the Open Internet and Broadband Industry Practices, *Notice of Proposed Rulemaking*, 24 F.C.C.R. 13064 (2009) (containing two additional rules) [hereinafter Preserving the Open Internet *NPRM*].

7. *Id.* at para. 16.

8. *Id.*

and, more narrowly, enabling the development of a competitive environment for services, applications, and content providers by maintaining "neutral" access to the last link for consumers or the "public" Internet (the "access network").

The two primary concerns have been that access network providers would provide preferential treatment to specific uses of the network and may go so far as to block certain kinds of applications.[9] To support this concern, proponents of regulation point to a small number of documented cases where ISPs have blocked specific services (VOIP[10] and file sharing[11]). There is concern about a lack of transparency in network management and how that might diminish the opportunity for innovation in the Internet or unfairly limit competition. But the ability to limit access to Internet applications is not restricted to access networks. Such restrictions can be imposed by many components used to access Internet content, such as the browser and services or applications within the Internet.

Likewise, there are many ways to enable preferential access. In a 2007 article, this Author, along with Douglas Sicker, discussed aspects of current Internet access network designs that can lead to higher barriers for innovation and new services or can allow subtle forms of preferential network access.[12] We specifically focused on *asymmetric access links* and *content distribution networks* (*CDNs*). Asymmetric access networks make it more difficult for consumers to "self-publish," and commercial content distribution networks[13] can effectively provide "preferential access" to content provisioned on a CDN located within an ISP's network without actually violating "neutral" access network policies.

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9. Formal Complaint of Free Press and Public Knowledge Against Comcast Corporation for Secretly Degrading Peer-to-Peer Applications, *Memorandum Opinion and Order*, 23 F.C.C.R. 13028 (2008) [hereinafter Free Press], *vacated by* Comcast Corp. v. FCC, 600 F.3d 642 (D.C. Cir. 2010).

10. *See* Madison River Comm., *Consent Decree*, 20 F.C.C.R. 4295 (2005).

11. *See* Free Press, *supra* note 9.

12. *See* Dirk Grunwald & Douglas Sicker, *Measuring the Network–Service Level Agreements, Service Level Monitoring, Network Architecture and Network Neutrality*, 1 INT'L J. COMM. 548, 551–52 (2007), *available at* http://www.ijoc.org/ojs/index.php/ijoc/article/viewFile/163/98. The article raised the issue of how "non-discriminatory" attributes such as asymmetric link access could impair expression and competition as much as access network management practices. *Id.* Most broadband access networks have higher download speeds than upload speeds. These communication asymmetries make it difficult for consumers to host services in their home or to generate content.

13. Examples of "Content Distribution Networks" (or CDNs) include Akami, Limelight, and Amazon Cloudcast. These services make multiple copies of content available at multiple physical locations in the Internet, improving the experience of accessing that content under periods of high demand. *See* Christopher S. Yoo, *The Evolution of Internet Architecture: Innovations in the Internet's Architecture that Challenge the Status Quo*, 8 J. TELECOMM. & HIGH TECH. L. 79 (2010).

We argued that these barriers impose as much risk as preferential treatment of access networks, but that network neutrality regulation focused solely on access networks would be unlikely to address these barriers.[14] Instead, the proposed regulations may hamper network innovation at the access network, as well as the core of the network, while still leaving open the door for anticompetitive actions that the regulations are intended to forestall.

This Article explores other parts of the Internet ecosystem and how they affect open and competitive networks. There is broad consensus that layers of the Internet ecosystem other than the access network may impact competition and innovation—the question remains as to whether new rules are needed. In the conclusion of a paper describing the economic history of price discrimination in telecommunications networks,[15] Andrew Odlyzko wrote:

> For telecommunications, given current trends in demand and in rate and sources of innovation, it appears to be better for society not to tilt towards the operators, and instead to stimulate innovation on the network by others by enforcing net neutrality. But this would likely open the way for other players, such as Google, that emerge from that open and competitive arena as big winners, to become choke points. So it would be wise to prepare to monitor what happens, and be ready to intervene by imposing neutrality rules on them when necessary.[16]

Odlyzko's point was that what he termed "cloud computing"[17] would become a more important marketplace for innovation than services integrated into access networks; his implication mirrors that of this Article —focusing on those access networks may distract from anticompetitive behavior in those other markets.

This Article is in agreement with Odlyzko's observation that other parts of the Internet ecosystem are equally powerful in determining the rich, competitive environment of the Internet and show this for past, current, and emerging parts of the Internet. At the same time, this Article argues that regulation and action—either that proposed for the access network or extending beyond those networks (through ambiguity or design)—should be applied only when clear harms are shown. The development of specific technologies coupled with the pace of technology development, the continued innovation of the Internet community, and the use of existing laws has served the Internet well.

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14. Grunwald & Sicker, *supra* note 12, at 555–58.

15. Andrew Odlyzko, *Network Neutrality, Search Neutrality, and the Never-Ending Conflict Between Efficiency and Fairness in Markets*, 8 REV. NETWORK ECON. 40 (2009).

16. *Id.* at 57.

17. By this term, Odlyzko meant software services hosted on computers not located at a person's home or business. *See id.* at 41, 51, 57. Later, this Article will discuss that current common usage has two meanings for this term and will disambiguate those meanings.

The FCC's *Notice of Proposed Rulemaking* (*NPRM*), released in October 2009,[18] attempts to ensure a competitive marketplace, but it does so through regulating one subset of providers and certain specific network characteristics such as traffic priorities[19] and managed services (having multiple services use a single physical transport).[20] This focus ignores the fact that the Internet evolves over time and is far from a finished work. In fact, the National Science Foundation (NSF), the national agency that has long funded Internet research, has launched multiple research programs to define the future Internet.[21] Extending the existing Internet is difficult because it has become essential to society, but there are clear reasons to improve on the current design. Would regulation add yet more friction to the process of improving the Internet? Are we doomed to the Internet of today?

Rather than use words like "discrimination," network engineers prefer terms like "network management" and "prioritization."[22] One form of prioritization endemic to the Internet is "congestion control"; congestion occurs in a network when too many packets try to use the same resource (link or router). The Internet Protocol[23] handles congestion by simply discarding packets when resources are limited, but congestion requires that the transmitter slow down, or the network can enter a "congestion collapse" whereby no useful communication takes place.[24] The original Internet

18. Preserving the Open Internet *NPRM*, *supra* note 6.

19. *See id.* at para. 16. The use of the word "nondiscriminatory" in the proposed rules is regrettable. *Id.* From a technical perspective, discrimination can mean any form of differentiation, including simple traffic prioritization designed to improve performance; however, the word is laden with other meanings by events and history external to network engineering.

20. *Id.* at paras. 148–53.

21. The "Future Internet Directions" program (FIND) has funded research to address how parts of the Internet design need to change in response to new demands and technologies. *See NSF NeTS Find Initiative*, NAT'L SCI. FOUND., http://www.nets-find.net/ (last visited Feb. 21, 2011). The NSF Global Environment for Networking Innovations (GENI) program is funding the development of test platforms and new technologies for future Internets. *See* GENI: EXPLORING NETWORKS FUTURE, http://www.geni.net/ (last visited Feb. 21, 2011). Similar efforts are underway in Europe, Japan, and other countries as well through the Future Internet Research and Experimentation program. *See* FIRE, http://www.ict-fire.eu/ (last visited Feb. 21, 2011).

22. An overview of the history and design of congestion control and related network management techniques can be found in Steven Bauer, David Clark & William Lehr, The Evolution of Internet Congestion (2009) (unpublished paper) (on file with the Massachusetts Institute of Technology), http://www.tprcweb.com/images/stories/papers/Bauer_Clark_Lehr_2009.pdf.

23. The Internet Protocol specification is published by the Internet Engineering Task Force as an online document. INFO. SCI. INST., DARPA INTERNET PROGRAM PROTOCOL SPECIFICATION RFC 791 (rel. Sept. 1991), http://www.ietf.org/rfc/rfc791.txt.

24. For example, assume two transmitters are trying to use a single common link that has a capacity of 100 packets per second. Both transmitters want all of their data to be

design principles emphasized "end-to-end" control[25] and assumed that the computers at each end of a transmission would cooperate to prevent congestion collapse. In 1986, the network experienced a series of congestion collapses that reduced useful throughput by factors of 10 to 1000.[26] New congestion control methods were introduced then and have continued to be developed. Different congestion control methods, implemented on devices or working in concert with network routers, affect how competing network flows use the networks to improve the overall efficiency of a complex, distributed, and decentralized system. Would this research and innovation be possible with the proposed FCC rules in place?

Although the Internet is forty years old, the commercial Internet is only fifteen to twenty years old. New applications and an increased number of users change assumptions that network engineers have made and expose the network to new challenges with the concomitant need for new solutions. In an effort to maintain a rich Internet environment, the proposed regulations focus on access networks without considering how anticompetitive pressures can be applied in the remainder of the Internet. They also regulate a mechanism (traffic prioritization) that is used in congestion control, but at the same time is part of the basic Internet design. Likewise, although the FCC's *NPRM* addresses the distinction between the "managed" and "public" Internet, it does so in a limited way that may hamper innovation in "managed" networks or in the interface between private and public networks.

This Article argues that there are better ways to maintain a vibrant Internet. These include: having clear standards and methods for measuring what is actually happening in the Internet, as well as methods for reporting or disseminating policy to consumers; using existing agencies and policies;

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received and will retransmit packets if they are discarded. If one transmitter injects 100 packets per second on to that link while the other injects 10, some packets will have to be discarded. Assuming a random discard policy, ninety-one percent of the discarded packets will be from the higher rate transmitter. If the transmitter determines that those packets were dropped, it would retransmit those packets in addition to the existing 100 packets per second, resulting in increased congestion. As more and more packets from the faster transmitter are dropped, it will increase the sending rate until its access link capacity is reached. This "congestion collapse" ensures that an increasing number of packets are discarded and also negatively affects the slower transmitter, because its packets will make up an increasingly dwindling portion of the packets that traverse the congested link.

25. *See* J. H. Saltzer, D. P. Reed & D. D. Clark, *End-to-End Arguments in System Design*, 2 ACM TRANSACTIONS COMPUTER SYS. 277 (1984). The core point of the paper concerned the engineering flexibility of having "the end points" (computers and servers) control what was communicated and how traffic was managed. *Id.* This was in stark contrast to the existing telecommunications systems that had "dumb end points" (telephones) and a smart network.

26. *See* Van Jacobson, *Congestion Avoidance and Control*, COMPUTER COMM. REV., Aug. 1988, at 314 ("[We] were fascinated by this sudden factor-of-thousand drop in bandwidth and embarked on an investigation of why things had gotten so bad.").

encouraging innovation and competition for access networks; and developing "best practices" that can be clearly understood by network operators, regulators, and consumers.

II. RISKS TO THE INTERNET ECOSYSTEM

The Internet is composed of many parts that make up the "experience" that end users now confront. Just as the phone network is made more useful by 411, white pages, yellow pages, 911, and other services or applications, the Internet is made more useful by domain names, browsers, search engines, and services that are integral to the web. Ensuring competition and a rich Internet environment by *solely* focusing on the local loop, as is being done with the Internet, clearly misses the mark—the entire "ecosystem" that influences either network experience is important.

To understand how applications and services can foster an anticompetitive environment, this Article examines a series of past concerns about Internet exclusion and market dominance, starting with the platforms that enabled web access, and stretching to services that now generate the most debate. These examples illustrate the rapid pace of innovation and demonstrate that the Internet often innovates its way out of anticompetitive markets; they also show that even when that does not happen, existing laws and regulations enforced by the Federal Trade Commission and the Justice Department can level the playing field.

A. Access to the Web—the Browser

The web browser is an application that has had almost total market dominance by multiple companies at different times. One of the earliest graphical Internet web browsers was Mosaic, developed by students and staff at the University of Illinois.[27] The Mosaic developers founded Netscape to commercialize the browser.[28] Although other companies, particularly Microsoft, developed other browsers in the mid-1990s, Netscape maintained approximately an eighty- to ninety-percent share of the browser market until Microsoft bundled its own product, Internet Explorer, with Windows 98.[29] Netscape's fortunes quickly soured as

27. The National Center for Supercomputing Applications at Illinois maintains a history of the development of Mosaic. *About NCSA Mosaic*, NCSA, http://www.ncsa.illinois.edu/Projects/mosaic.html (last visited Feb. 21, 2011).

28. See Jim Clark's book documenting the rise of the Netscape company. JIM CLARK, NETSCAPE TIME: THE MAKING OF THE BILLION-DOLLAR START-UP THAT TOOK ON MICROSOFT (1999).

29. *Id.* Other reports of browser market share are collected and referenced at the Wikipedia article, *Usage Share of Web Browsers*, WIKIPEDIA, http://en.wikipedia.org/wiki/Usage_share_of_web_browsers (last visited Feb. 21, 2011).

Internet Explorer reached a ninety-percent share of the browser market; Internet Explorer now has sixty-three-percent market share, having lost share to browsers developed in the last five years.[30]

It is rare for a market to switch from total domination by one product to another so quickly. However, as Netscape discovered, the problem with marketing a browser was how to monetize the product. Most businesses were hoping to use the browser to steer users to specific web properties.[31] Open standards allow rapid substitution of one product for another and can equally favor the adoption of software that "extends" those standards. Internet Explorer enabled Microsoft to launch protocols that favored other Microsoft products (either Windows desktops or Windows server). Chief among these were "ActiveX controls," a mechanism to embed software unique to Windows in a web page. Many of these "controls" provided mechanisms missing in the web (such as audio or video); because ActiveX only worked with Microsoft clients, the use of such controls drove many to rely on Microsoft software. The combined control of the most common operating system and the pre-installed browser brought on antitrust actions and an initial finding of monopoly power.[32]

Although Internet Explorer still dominates the browser market, alternate services and new technologies and standards eliminated much of the threat of Internet Explorer. AOL eventually purchased Netscape and much of the code-base was spun off into the popular open-source "Mozilla" and later "Firefox" browser platform.[33] Additional vendors, primarily Apple, Opera, and now Google, produced other competitive browsers. Increased broadband speeds and better software installation and update processes made it easier to install competing browsers. At the same time, browsers became ubiquitous, emerging as a universal way to access and control devices ranging from printers to alarm clocks—manufacturers wanted those controls to be universal. A widespread "open standards" effort ensued to identify browser techniques that limited users to Windows-based computers; lobbying and branding by the World Wide Web Consortium (W3C) led governments and many companies to eschew IE-specific mechanisms to focus on a "works with any browser" standard.[34] At

30. Browser adoption rates are highly regional at an international level. *See* Gregg Keizer, *See Google's Chrome Grabs No. 3 Browser Spot from Safari*, COMPUTERWORLD (Jan. 2, 2010), http://www.computerworld.com/s/article/9142958/Google_s_Chrome_grabs_No._3_browser_spot_from_Safari. There are few longitudinal academic studies of browser shares, but the Wikipedia article provides referenced studies from a variety of international website and Internet service provider measurements. *See Usage Share of Web Browsers*, *supra* note 29.

31. *See* CLARK, *supra* note 28.

32. *See, e.g.*, United States v. Microsoft Corp., No. 98-1232 (D.D.C. Nov. 12, 2002).

33. *See* CLARK, *supra* note 28.

34. *See* Tim Bresnahan, *A Remedy That Falls Short of Restoring Competition*,

the same time, the development of "Web 2.0" technologies such as Ajax around 2004,[35] coupled with increased broadband speeds, meant that many of the Microsoft-specific "ActiveX controls" could be replaced by software that worked across all browsers. The impetus for a standards-based browser has become particularly important as web browsers have become an integral part of mobile phones that are unable to use Windows-specific features, such as the iPhone.

Although Internet Explorer still dominates the browser market, that dominance connotes little economic advantage to Microsoft at this point; the majority of Microsoft profits are still generated from sales of Windows and Office rather than online products.[36] However, without the development of alternative software and open standards by organizations such as W3C, the present situation might not have come about and could rapidly change. It is arguable that the antitrust investigation of Microsoft was what led to the current situation. It is equally plausible that the development of mobile phones and the demands of that emerging non-Windows ecosystem, or the deployment of broadband and more interactive web pages using Ajax, forestalled the dependency on Microsoft-specific features. One thing is certain: competition, innovation, and existing legal recourse opened access to the Internet without the need for additional regulation.

B. Rich Internet Applications, Video, and the New Content Companies

Less well known than the "browser wars" is the (ongoing) battle for

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ANTITRUST, Fall 2001, at 67. Similarly, in 1996, Tim Berners-Lee stated in the July issue of the MIT Technology Review "[a]nyone who slaps a 'this page is best viewed with Browser X' label on a Web page appears to be yearning for the bad old days, before the Web, when you had very little chance of reading a document written on another computer, another word processor, or another network." Herb Brody, *The Web Maestro: An Interview with Tim Berners-Lee*, TECHNOLOGY REV., July 1, 1996, at 33.

35. Ajax is a term used to describe one way in which "rich" web applications are developed using nothing more than standard web browser protocols. Gmail, released by Google in 2004, was one of the first widely known Ajax applications. Jesse James Garrett coined the term while working at Adaptive Path. *See* Jesse James Garrett, *Ajax: A New Approach to Web Applications*, ADAPTIVE PATH (Feb. 18, 2005), http://www.adaptivepath.com/ideas/essays/archives/000385.php for a readable description of the technology.

36. See MICHAEL CUSUMANO, MICROSOFT SECRETS: HOW THE WORLD'S MOST POWERFUL SOFTWARE COMPANY CREATES TECHNOLOGY, SHAPES MARKETS, AND MANAGES PEOPLE (1998) for details on Microsoft business strategy. The 2002 Annual Report for Microsoft indicates that Desktop and Enterprise Software (mainly Office and Word) contributed $23.8 billion to revenue in 2002 resulting in a $14.7 billion income while all Consumer Software Services Devices (web properties, ISP and game systems) revenue was $3.5 billion, resulting in a loss of $1.8 billion. MICROSOFT CORP., FORM 10-K, ANN. REP. (June 30, 2002).

"rich Internet applications" (RIAs).[37] The RIA is now a fundamental part of the Internet ecosystem. These environments provide extended usability to systems like Google Mail (Gmail), Netflix, Hulu, Microsoft Live, Yahoo! News, and many other websites—RIAs allow conventional "desktop" applications to be replaced by web-based applications. The features that made Internet Explorer indispensible in many areas were for "rich web applications"; RIA environments make that approach work across different operating systems. Microsoft sought to use the Windows infrastructure to allow developers to use existing Windows code in web applications. The primary alternative approach was Java, developed by Sun Microsystems, by which programmers could develop "applets," or programs that ran within a web browser. Although the Java language found extensive use in business software, applets experienced limited success, largely because the process of installing software was relatively complex. Macromedia Flash was introduced in 1996 and rapidly became the primary RIA tool; it is currently installed in more than ninety-percent of browsers and is used to power many video and online game sites.[38] Later entrants were Microsoft Silverlight (similar to Flash and Java) and Adobe AIR (developed as an extension to Flash when Adobe acquired Macromedia).[39]

Surprisingly, there has been little concern to date that any of these alternatives would preclude effective competition. In large part, this is because there are "open source" implementations of the dominant platform (Flash) and any one system is largely substitutable for the other (although not always on the same device). More importantly, existing and new standards-based technologies are replacing many of the functions for which developers turn to RIA frameworks. Microsoft argued this point in a 2007 response[40] to a motion by the State of California and several other states,[41] which argued that Microsoft's development of Silverlight should extend the

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37. *See* Jim Rapoza, *RIA War Is Brewing*, EWEEK EMERGING TECH. (Apr. 11, 2008, 3:07 PM), http://etech.eweek.com/content/application_development/ria_war_is_brewing.html.

38. Adobe maintains statistics on the adoption or "penetration" of Adobe Flash at *Flash Player Version Penetration*, ADOBE, http://www.adobe.com/products/player_census/flashplayer/version_penetration.html (last visited Feb. 21, 2011).

39. The adoption rate of competing tools is collected by several online measurement forums; the reports at StatOwl.com show historical trends for the three main technologies, Flash, Java, and Silverlight. *Rich Internet Application Market Share*, STATOWL.COM, http://www.statowl.com/custom_ria_market_penetration.php (last visited Feb. 21, 2011).

40. Microsoft's Report Concerning the Final Judgments, United States v. Microsoft Corp., No. 98-1233 (D.D.C. Aug. 31, 2007), http://www.microsoft.com/presspass/download/legal/SettlementProceedings/08-30MSFTReportConcerningFinalJudgments.pdf.

41. Plaintiff States' Motion to Extend the Modified Final Judgment Until Nov. 12, 2012, New York v. Microsoft Corp., No. 98-1233 (D.D.C. Oct. 16, 2007), http://blog.seattlepi.com/microsoft/library/califfiveyears.pdf.

earlier antitrust actions.[42] Some Microsoft web services (such as Bing 3-D maps) still require Silverlight and ActiveX controls. Others argue that the required use of Silverlight for specific high-profile events (such as Olympic events and presidential inaugurations) and bundling of Silverlight with Windows 7 will raise the same anticompetitive issues that Netscape faced in the 1990s.[43]

The argument that "open" alternatives suffice is compelling. Applications developed by Google, such as Gmail, Maps and "Instant Search," only rely on JavaScript, a programming language that has long been a standard tool embedded in web browsers.[44] Rather than develop a new programming environment, Google, Apple, and Firefox have worked to greatly increase the usefulness of JavaScript, making that standard tool more suitable for many "rich" applications. The web standards community also developed HTML5,[45] the latest variant of the *lingua franca* of web browsers. That standard supplants many of the reasons RIA frameworks were needed, such as high performance video playback, access to geographic location, and support for storing and accessing data via the browser. These individual components allow large changes to applications—for example, using HTML5, Gmail can function more like a standard e-mail client allowing access to e-mail even when not connected to the Internet.

This analysis of RIA environments serves to show how regulation decisions are interconnected by past technology. Had Microsoft "won" the browser wars, most of this innovation would not have occurred—developers would have used Microsoft components rather than adopt a new RIA framework. This would have also altered the landscape of devices,

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42. *See generally id.*; *see also* Todd Bishop, *Antitrust Filing Cites Microsoft Silverlight Concern*, *The Microsoft Blog*, SEATTLE POST INTELLIGENCER BLOG (Oct. 17, 2007, 11:57 AM), http://blog.seattlepi.com/microsoft/archives/123837.asp (offering an analysis of the filing).

43. *See* John Markoff, *Microsoft Leveraging Silverlight and Riling Critics*, N.Y. TIMES, Aug. 11, 2008, *available at* http://www.nytimes.com/2008/08/11/technology/11iht-stream11.1.15135139.html?_r=1 (arguing that there was significant evidence that Microsoft was pursuing such a strategy). Although Silverlight has notable successes including streaming Netflix videos, the concern that Silverlight would dominate the other technologies appears to be waning in 2011.

44. It should be noted that the development of JavaScript was not without contention. Netscape initially developed JavaScript; Microsoft developed a competing version and submitted that version for standardization. Rather than splintering web standards, JavaScript came to unify them through standardization efforts.

45. HTML5 is the fifth major revision to the core "language" used to describe web pages. The primary changes in HTML5 compared to earlier versions are standards for video, storing information at the browser, and a better way of drawing or displaying text and drawings. For a full specification, see *HTML5: A Vocabulary and Associated APIs for HTML and XHTML*, W3C EDITOR'S DRAFT, http://dev.w3.org/html5/spec/Overview.html (last visited Feb. 21, 2011).

such as the iPhone, that are used to access the web. The competitive alternatives are so diverse and rich that government intervention is not needed; rather, the past experience of the "browser war" shows that existing methods for intervention are possible and effective when needed.

C. Naming and Information Discovery

Names play a central role in the Internet—people need to be able to access websites and services. The Domain Name System (DNS), which translates names to IP addresses, is central to naming in the Internet. Naming is one of the clearest cases of regulation applied to Internet services, and a number of national and international laws, rules, and bodies have been created to address names, particularly as applied to commercial interests. With the rise of the commercial Internet, the Internet Corporation for Names and Numbers (ICANN) devised a Uniform Dispute Resolution Policy for the ownership of domain names clearly related to existing trademarks and properties.[46]

Today, search has taken on the importance originally attributed to DNS names. No part of the Internet Ecosystem would appear to be as important as search, as search is now a universal way for finding new information, even supplanting the common use of domain names. Many of the most common search terms on Google are the names of (often competing) web services, indicating that users rely on search for even trivial or well-known information.[47]

Should search be regulated? Recently, there have been calls for such regulation often based on the dominance of a single search engine.[48] While this rationale is similar to that of DNS, there is a distinct difference—DNS was a single system essential to the core operation of the Internet, while Google (for example) is one of many search services. Moreover, search services were not originally intended to identify commercial interests—they were intended to "discover information."

Although Google dominates current search services, there have been numerous popular search services over time—AltaVista, GoTo.com, Ask.com, Yahoo!, and different Microsoft systems. The current dominance of Google (currently estimated at approximately sixty-five- to eighty-five-

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46. The ICANN policies are described at *Domain Name Dispute Resolution Policies*, ICANN, http://www.icann.org/en/udrp/#udrp (last visited Feb. 21, 2011).

47. The Google Trends service provides statistics on current and historical popular search terms. *Trends*, GOOGLE, http://www.google.com/trends (last visited Feb. 21, 2011). That information is collected into the Google Zeitgeist to give a yearly summary of search trends. *Zeitgeist 2010: How the World Searched*, GOOGLE ZEITGEIST, http://www.google.com/intl/en/press/zeitgeist2010/ (last visited Feb. 21, 2011).

48. *See generally* Oren Bracha & Frank Pasquale, *Federal Search Commission? Access, Fairness, and Accountability in the Law of Search*, 93 CORNELL L. REV. 1149 (2008).

percent of U.S. market share)[49] coupled with the consolidation of online advertising, has led some to call for regulation of search engines and search-based advertising to make it "neutral."[50] The key objection is that search (and Google specifically) is so influential on the way people find information that it constitutes a "gatekeeper" on the Internet.[51] In one *New York Times* Op-Ed article,[52] Adam Raff, founder of a company promoting an alternative search engine, describes how Google has promoted its own products (e.g., maps, shopping services) over that of other companies in search results.[53] It is difficult to know why a specific Internet tool falls from favor—for example, Google Maps is now preferred over MapQuest. Clearly, advertising a service is one reason, but so are features and usability. It is difficult to simultaneously argue that customers are unlikely to flock to a new search engine, but would rapidly switch to new mapping software simply because it is well advertised. Advertising drives the substantial growth of Google; existing antitrust measures would seem to govern and appear to have been successfully applied in specific instances, such as to counter the proposed joint Yahoo!-Google advertising pact[54] and exclusive licensing of digital books.

Many of the arguments for regulating search are based on the difficulty of effective competition.[55] Search is composed of three main components—crawling, indexing, and presentation. Crawling is the traversal of web pages—bringing the content of those pages to be indexed. Indexing records the information in the pages so that specific web pages can be quickly identified. Retrieval and presentation transform search requests into queries that search the indices and present the results to the users. Oren Bracha and Frank Pasquale argue that creating search engines is costly, but as with much of the infrastructure of the Internet, the software

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49. *See, e.g.*, *Search Engine Market Share*, NETMARKETSHARE, http://marketshare.hitslink.com/search-engine-market-share.aspx?qprid=4 (last visited Feb. 21, 2011) (85%); Nathania Johnson, *comScore Shows Bing Growing in December 2009 Search Rankings*, SEARCHENGINEWATCH.COM (Jan. 19, 2009, 7:54 AM), http://blog.searchenginewatch.com/100119-075446 (65%). As with web browser choices, different search engines are popular in different markets. *See, e.g.*, *Search Engine Market Share*, NETMARKETSHARE, http://marketshare.hitslink.com/search-engine-market-share.aspx?qprid=4 (last visited Feb. 21, 2011).

50. *See* Bracha & Pasquale, *supra* note 48.

51. *See id.*

52. Adam Raff, Op-Ed, *Search, But You May Not Find*, N.Y. TIMES, Dec. 28, 2009, at A27.

53. *Id.*

54. Press Release, U.S. Dep't of Justice, Yahoo! Inc. and Google Inc. Abandon Their Advertising Agreement (Nov. 5, 2008), *available at* http://www.justice.gov/opa/pr/2008/November/08-at-981.html.

55. Pasquale makes this point specifically. Bracha & Pasquale, *supra* note 48, at 1179–81.

to develop effective and scalable search engines is now free. The Apache Foundation, an organization that manages the development of the free Apache web server, also distributes Nutch, an open source search engine,[56] and Lucene, a free indexing mechanism.[57] Yahoo! has also donated Hadoop, software designed to rapidly index large numbers of web pages.[58]

Although the software is free, adoption of new search engines depends on the utility they provide to users. This is usually based on the effectiveness of presenting the results of a search query. Ranking determines the order in which the most important search results are displayed. The GoTo.com search engine pioneered the "money talks" policy of paid search rankings and Google "AdWords" expanded that base with an auction-based scheme.[59] In many ways, the barriers presented by search engines and ad rankings are similar to the yellow pages. Businesses were at a disadvantage if they did not place paid advertisements in yellow page directories. One of the complexities that search companies face is that the variables governing advertisement (for example, placement, frequency, relation to search) are more complex than those used in static print media. Defining and communicating those characteristics and having customers understand them are complicated tasks. There is always a need for transparency so that advertisers understand what they are purchasing, particularly when competing "house brands" are also advertised, as Adam Raff argued.[60] This situation is similar to grocery stores that present their own house brand and a diverse array of competing brands whose placement is governed by a combination of consumer demand and "slotting fees."[61] Slotting fees have received much discussion as well as government scrutiny and enforcement actions at state and national levels.[62] It seems likely that

56. *About Nutch*, NUTCH, http://nutch.apache.org/about.html#Overview (last visited Feb. 21, 2011).

57. *Apache Lucene–Overview*, LUCENE, http://lucene.apache.org/java/docs/index.html (last visited Feb. 21, 2011).

58. *Hadoop at Yahoo!*, YAHOO! DEVELOPER NETWORK, http://developer.yahoo.com/hadoop/ (last visited Feb. 21, 2011).

59. A brief history of paid search is included in Andrew Sinclair, Note, *Regulation of Paid Listings in Internet Search Engines: A Proposal for FTC Action*, 10 B.U. J. SCI. & TECH. L. 353 (2004).

60. Raff, *supra* note 52.

61. "Slotting fees are fees manufacturers pay to retailers in order to obtain shelf-space." Robert J. Aalberts & Marianne M. Jennings, *The Ethics of Slotting: Is This Bribery, Facilitation Marketing or Just Plain Competition?*, 20 J. BUS. ETHICS 207, 207 (1999).

62. For Aalberts & Jennings's study of the issue, see *id.* In November of 2003, the FTC Staff released a study that examined when slotting occurred. FED. TRADE COMM'N, SLOTTING ALLOWANCES IN THE RETAIL GROCERY INDUSTRY: SELECTED CASE STUDIES IN FIVE PRODUCE CATEGORIES (2003). Lastly, Gregory T. Gundlach testified before the California State Senate Standing Committee on Business, Professions and Economic Development on February 9, 2005, detailing the problem slotting fees cause for businesses. *Slotting Fees–Fees Charged by Grocery Retailers for Shelf Space: Are They Stifling*

anticompetitive behavior in search would encounter similar scrutiny, and the FTC has already asked companies to disclose paid search results.[63]

Despite the dominance of Google in the search-based advertising market, the search market itself has seen considerable innovation, in part because there are many *corpora* over which to search and many methods to rank or present results. Real-time search, personalized search, social search, and peer-to-peer search tools are in active development. OneRiot is a start-up that recently partnered with Yahoo! to develop "real-time" search (or search about breaking events rather than historical documents)[64] and Lijit is a search engine focused on blogs and social networking.[65] Ask.com and Aardvark focus on casting questions that are understandable to people into search queries.[66] It may be that no search engine could compete with Google in the sense of becoming a multi-billion-dollar company; many will be acquired by existing search companies—indeed, Google acquired Aardvark in February 2010. It is also important to recognize that Google, as a company, is little more than ten years old.[67] Given the low barriers to entry (other than customers), there should be continued innovation in search.

It is clear that search has become as important as naming in the Internet; it also influences the experience that users have because they have come to rely on the speed and accuracy of search to locate services. What is not clear is whether additional mechanisms beyond current laws are needed to ensure a competitive and innovative Internet.

D. Content Distribution and Cloud Computing—the Invisible Ecosystem

The Internet has visible components, such as the browsers, rich application frameworks, and search engines, as discussed. Equally important is the invisible infrastructure that defines how the web and web services are implemented. This Section will describe services that

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Competition?: Statement Before the Cal. State S. Standing Comm. on Bus., Professions and Econ. Dev., 2005 Sess. (Cal. 2005) (statement of Gregory T. Gundlach, Senior Fellow, American Antitrust Institute), http://www.antitrustinstitute.org/files/386.pdf.

63. The FTC responded to a complaint filed by Commercial Alert, a consumer advocacy group. The details of the response to the Commercial Alert case were disclosed by a publically available response. *Commercial Alert Letter*, FED. TRADE COMM'N, http://www.ftc.gov/os/closings/staff/commercialalertletter.shtm (last visited Feb. 21, 2011).

64. *About*, ONERIOT, http://www.oneriot.com/about (last visited Feb. 21, 2011).

65. *Company: Who Is Lijit?*, LIJIT, http://www.lijit.com/company (last visited Feb. 21, 2011).

66. *About Ask.com*, ASK.COM, http://www.ask.com/about (last visited Feb. 21, 2011); *About Aardvark*, AARDVARK, http://vark.com/about (last visited Feb. 21, 2011).

67. *Google History*, GOOGLE, http://www.google.com/corporate/milestones.html (last visited Feb. 21, 2011).

dramatically lower the barriers for creating new web services. Just as open-source tools such as Nutch, Lucene, and Hadoop reduce the technical barriers for developing a new search engine or service, new business models and technology reduce the operational barriers to deploying and scaling those services.

Content distribution networks (CDNs), co-location, and peering arrangements are some of the most critical elements of the Internet ecosystem that affect the web as it is used today. A CDN is an organized network of computers that are often placed "close" to Internet users. Commonly accessed content is then stored on those computers and requests by web users are directed to "nearby" or lightly loaded computers. Content distribution networks can be used to save bandwidth since the content for a popular item does not need to be fetched from a distant location; this was the basis for the concern that focusing solely on the access network would not prevent performance discrimination.[68] However, with the drop in price for Internet bandwidth, CDNs have become useful primarily because they provide a way to provide *scalable* service. The canonical example for this is the success that Victoria's Secret (a retailer) had in hosting online content before and after using a commercial CDN.[69] In the initial offering, demand for the retailer's content exceeded the capabilities of its own web services, but successive offerings using a CDN were much more successful.[70]

The web would present a very different experience without CDNs, but the use of a CDN provides as much opportunity to discriminate performance as subtle packet differentiation or "traffic shaping" on an access network. Indeed, comments in FCC filings indicate that ISPs in China market their own content networks and hosting services as providing better access to their own clients.[71] In a competitive marketplace, the difference in performance is less a conspiracy than the result of innovative network architectures. Different combinations of CDNs and network management lead to differing degrees of efficiency, but efficient network architectures can still enable competition.[72] At the same time, CDNs

68. *See* Grunwald & Sicker, *supra* note 12.

69. A case study is available from Akamai, a cloud-based service provider. *Victoria's Secret Web Site Raises the Bar on Customer Experience with Content Delivery from Akamai and IBM*, AKAMAI, http://www.akamai.com/html/customers/case_study_victoria.html (last visited Feb. 21, 2011).

70. *Id.*

71. Comments of Daniel Scherlis, Notice of Ex Parte Communication, FCC GN Docket No. 09-191 (rel. Jan. 15, 2010). It should be clear that his comments concern the Chinese Internet market where two large companies dominate, but his experience serves as a cautionary note on the importance of competition.

72. Researchers are only recently beginning to study the economic benefit of different CDN organizations. *See* Wenjie Jiang et al., *Cooperative Content Distribution and Traffic*

enhance the ability of a web company or organization to successfully connect with readers without having to invest huge sums in capital infrastructure.

In a *Wall Street Journal* article in 2008, Vishesh Kumar and Christopher Rhoads noted arguments that such "fast-track" access violates net neutrality.[73] The fact is that *most commercial content* on websites is distributed using CDNs and that there is significant competition in CDNs in the United States.[74] The proposed FCC rules do not seem to address the importance of content distribution systems within the Internet ecosystem. This omission is arguably good, because no concrete harms have been shown—indeed, the existing "fast-track" access has enabled more companies to scale to meet web demand. But the omission highlights the rather arbitrary nature of the proposed FCC rules. The proposed rules would arguably also prohibit new services or offerings by "network operators" that could achieve the benefits of CDNs using different technical means, thus increasing competition in this segment of the Internet ecosystem.

Peering relationships between different ISPs, application providers, and Tier-1 network providers also enable "fast tracks" for information.[75] Most of those peering relationships have been historically "settlement free" because they benefit both parties and because traffic demands were symmetrical.[76] Increasingly, the line between "backbone," application, and edge network provider have blurred. Google and large CDN companies

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Engineering in an ISP Network, SIGMETRICS/PERFORMANCE 2009: PROCEEDINGS OF THE ELEVENTH INTERNATIONAL JOINT CONFERENCE ON MEASUREMENT AND MODELING OF COMPUTER SYSTEMS (2009).

73. *See* Vishesh Kumar & Christopher Rhoads, *Google Wants Its Own Fast Track on the Web*, WALL ST. J., Dec. 15, 2008, at A1.

74. Dan Rayburn maintains a list of current CDN vendors; as of August 11, 2010, it listed around fifty companies. *See* Dan Rayburn, *Updated List of Vendors in the Content Delivery Network Business*, CDNLIST.COM (Aug. 11, 2010, 12:01 AM), http://www.cdnlist.com. While this market is currently very competitive, a history of significant price decreases indicates that consolidation may occur. It is often difficult to find authoritative pricing for Internet services, but a history of CDN pricing is published at a website called *The Business of Online Video*. *See Q4 CDN Pricing Detailed, Down 20% in 2010, Expected to Remain Stable Next Year*, BUS. ONLINE VIDEO, http://www.cdnpricing.com (last visited Feb. 21, 2011). The prices for delivered data declined twenty percent in 2010, although pricing is expected to remain more stable in 2011.

75. Christopher Yoo has published a very readable, accurate, and timely article concerning the rapidly evolving world of peering. *See* Yoo, *supra* note 13.

76. Peering is a complex subject that straddles engineering, law, and business. William Norton, a peering consultant, runs an education site and pricing data repository. His articles on the history of peering are available at *The Evolution of the U.S. Internet Peering Ecosystem*, DRPEERING INT'L, http://drpeering.net/white-papers/Ecosystems/ Evolution-of-the-U.S.-Peering-Ecosystem.html (last visited Feb. 21, 2011).

such as Limelight now run some of the largest Internet backbones.[77] At the same time, "edge" network companies such as Comcast, AT&T, and Verizon also carry considerable corporate or "non-public" network traffic.[78] Amid the consolidation in networking companies, "paid peering" has emerged as a way to enable content providers or other co-location companies to reduce the *cost* of access while improving performance for their hosted partners.[79] Content distribution networks (and peering) improve performance; being excluded from such interaction would raise costs or limit competition. Reaching a sizable population would be possible, but would require significant investment to be "scalable."

The proposed FCC rules do not clearly indicate whether peering and content distribution relationships constitute "neutral" access or in what situations they constitute "discriminatory" access. Again, this is arguably good, because there are few instances in which concrete harms have been demonstrated. In the past, the Internet has been "partitioned" because Internet providers could not agree on pricing for transit or peering relationships,[80] and more consumers have experienced network problems from these business disputes than those affected by the rules in the proposed FCC regulations. Is regulation needed to cover peering? History indicates that existing dispute resolution mechanisms (for example, lawsuits, agreements, and contracts) can resolve these problems. This lends credence to the argument that those same mechanisms will ensure competition in other Internet services such as CDNs.

Just as CDNs developed out of a need to replicate and distribute "static" content, a new market, "cloud computing," has emerged as a technology that subsumes CDNs and facilitates even faster changes in technology. Cloud computing providers such as Amazon EC2, Rackspace, AT&T, IBM, Microsoft, and several others run warehouse-sized data centers on which customers can lease and run customized software. Combined with "virtualization technology," which lets users capture the

77. Detailed reports of data collected at a major Internet exchange are reported in the *ATLAS Internet Observatory 2009 Annual Report.* C. LABOVITZ ET AL., ATLAS INTERNET OBSERVATORY 2009 ANNUAL REPORT (2009), http://www.nanog.org/meetings/nanog47/presentations/Monday/Labovitz_ObserveReport_N47_Mon.pdf.

78. *Id.*

79. Despite the rather arcane history of peering arrangements, some access network providers (such as Comcast) have clearly articulated rules for how peering relationships are established. *See, e.g.*, *Comcast Settlement-Free Interconnection (SFI) Policy*, COMCAST, http://www.comcast.com/peering/ (last visited Feb. 21, 2011).

80. For example, in 2008, Sprint and Cogent networks "de-peered" their networks, causing service disruptions between Sprint and Cogent customers. *See* Om Malik, *Cogent, Sprint Disconnect Networks, May Cause Web Slowdown*, GIGAOM (Oct. 30, 2008, 10:50 PM), http://gigaom.com/2008/10/30/cogent-sprint-un-peer-may-cause-web-slowdown.

entire configuration of a computer in a form that can be shipped off to a remote data center, cloud computing has changed the economics of establishing Internet services. Cloud computing systems can typically be leased by the hour and new online services can be launched quickly. For example, in early 2010, Amazon's EC2 (a service that popularized the cloud computing model) rented individual "machines" for $0.02 per hour to $2.48 per hour depending on the machine resources.[81] More importantly, since the leasing is "per hour" and because machines can be "turned on" quickly, software can be designed to use resources as needed.

Cloud computing has accelerated the deconstruction of monolithic software systems into components of a "service-oriented architecture" that can be used in multiple services. Examples include Twilio, which integrates the legacy telephone network and provides voice-guided phone services.[82] Such services, coupled with the ability to rapidly deploy systems using cloud computing, allow developers to innovate in a select part of the software systems. But all these components—CDNs, cloud computing, software as a service (SaaS) systems—are rapidly becoming integral to the way that applications and services are deployed on the Internet. How will they be affected by regulation?

III. THE RISKS OF REGULATION IN THE INTERNET ECOSYSTEM

There are several risks to the proposed network neutrality rules. These concerns include the lack of clarity as to whether "neutral" networks even exist or are beneficial, the uncertainty concerning how services and applications should be treated, and the risks of mandating monitoring for legal content and innovation in network management. This Section addresses a general concern about the ability or wisdom of applying regulation in an era of fast-paced technology development by examining a particular Internet application regulated by the FCC.

A. Insensible Neutrality

Proponents of network neutrality legislation assume that people could agree on what a "neutral" network is and that any management other than existing prioritization methods will break applications. Is it possible for consumers to spot a "non-neutral" network? If neutrality cannot be measured or sensed, it is difficult to know when it is being violated or if it

81. The listed prices are for machine instances, but any practical use of the service requires network bandwidth and storage, which are priced separately. *See Amazon Elastic Compute Cloud (Amazon EC2)*, AMAZON.COM, http://aws.amazon.com/ec2/#pricing (last visited Feb. 21, 2011).

82. *How It Works*, TWILIO CLOUD COMMS., http://www.twilio.com/how-twilio-works (last visited Feb. 21, 2011).

is even important. In an earlier work, this Author, along with Sicker, detailed how the lack of clearly stated service level agreements for residential service and the multi-party nature of the Internet make it difficult to know what is affecting performance and who is responsible.[83] Studies by networking researchers in 2003[84] (and also more recently in 2007[85]) have shown through careful measurement that the major performance limitations faced by most broadband users (such as latency, bandwidth, and jitter) occur because of the technologies used in the "last mile" access network—the connection to an individual house. At the same time, a study conducted of Internet users in the United States and Europe in 2009 showed that users' *home networks*, and in particular the use of "WiFi" wireless networks, impose more latency and variability than the access network itself.[86] These measurement studies were conducted so broadly (across multiple ISPs in multiple countries) that they indicate that latency limitations and variability exist in most access networks. These limitations are caused by pressing existing infrastructure (cable and phone lines) into service for purposes they were never intended to serve, rather than by anticompetitive actions.

Because the Internet is composed of many pieces made by different parties, it is difficult to understand what causes specific problems. This is true even for experts—in a network measurement study, members of the University of Colorado at Boulder research group (of which this Author is a contributor) initially reported many types of network sessions were being blocked; upon further analysis (and after much embarrassment) we had to retract that report because the problems were caused by a home networking router.[87] This action occurred only when the home router was overloaded, but if the cause was not immediately clear to networking researchers, it is unlikely that an average consumer could identify similar problems.

As is clear by the success of existing applications, Internet protocol

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83. Grunwald & Sicker, *supra* note 12, at 550.

84. Aditya Akella et al., *An Empirical Evaluation of Wide-Area Internet Bottlenecks*, IMC'03: PROCEEDINGS OF THE 3RD ACM SIGCOMM INTERNET MEASUREMENT CONFERENCE 101–13 (2003).

85. Marcel Dischinger et al., *Characterizing Residential Broadband Networks*, IMC'07: PROCEEDINGS OF THE 2007 ACM SIGCOMM INTERNET MEASUREMENT CONFERENCE 43 (2007).

86. Gregor Maier et al., *On Dominant Characteristics of Residential Broadband Internet Traffic*, IMC'09: PROCEEDINGS OF THE 2009 ACM SIGCOMM INTERNET MEASUREMENT CONFERENCE 90 (2009).

87. *See* Karl Bode, *University of Colorado Researchers Retract Claims*, BROADBAND DSLREPORTS.COM (Apr. 7, 2008), http://www.dslreports.com/shownews/Comcast-Now-Forging-Packets-For-All-TCP-Traffic-93388. The issue was traced to a home router—the processors in many inexpensive home routers are too slow and not designed to handle high-traffic loads. When subjected to high loads, those routers also close connections using mechanisms that mimicked the mechanism used by Comcast.

and application designers understand that minor fluctuations in latency and bandwidth go with the territory of the current Internet. Applications and various parts of the broader "Internet architecture" are designed to accommodate those variations; there is good reason to believe that the design principles used in existing applications could overcome "subtle preferential treatment" just as they overcome the highly variable best-effort characteristics of the Internet. For example, video distribution systems came to rely on "faster-than-real-time" downloads to successfully deliver video on the existing Internet.[88] Despite the broad success of VoIP companies such as Vonage, Skype, and the like, highly interactive applications (voice or video communication and interactive gaming) are usually thought to be sensitive to latency. However, comments submitted to the FCC by interactive game developers indicate that the current Internet is suitable for those applications.[89]

All of this indicates that improving the speed of Internet access, rather than fixing current network designs into law, better serves consumers.

B. Fostering a Competitive Ecosystem

The proposed FCC rules affect only one part of the network, but performance and the user experience are affected by many parts of the network. Both content distribution and cloud computing resources are distributed globally and interconnected by private IP networks; since these are not "public networks," these facilities are free to prioritize traffic for payment without violating the proposed network neutrality rules. Singling out one part of the Internet for regulation does not seem to ensure the goal of competitive networks that respond to consumer needs.

There is continued vertical integration of the Internet market wherein "access network" providers also become CDNs, or application companies (like Google) or retailers (like Amazon.com) become cloud computing providers. It is unclear how proposed regulations that distinguish between "public" and "private" networks will apply as those network companies recombine and change form. This requires either greater clarity as to when the proposed network neutrality rules apply, or, better yet, a "wait and see attitude" with action taken when anticompetitive harms actually occur.

C. Regulating Legal Content

The proposed neutrality rules focus on *lawful* content, and there have been both calls and proposals for applying "deep packet inspection" to

88. Andrew Odlyzko, The Delusions of Net Neutrality 4–5 (Aug. 31, 2008) (unpublished paper) (on file with School of Mathematics, University of Minnesota), http://www.dtc.umn.edu/~odlyzko/doc/net.neutrality.delusions.pdf.

89. Comments of Scherlis, *supra* note 71, at 1.

assist in enforcing intellectual property ownership.[90] These efforts pose considerable costs and significant risks, both of misidentifying legal content as illegal and of failing to identify illegal content. Researchers have shown that anyone (including inanimate objects) can be implicated in file sharing.[91] Existing file-sharing systems are far from "stealthy" and are easy to monitor. Illegal file sharing is already hidden using "anonymity overlays"[92] and simple protocol extensions make it much more difficult to decidedly identify illegal file-sharing activity.[93]

At the same time, the rapid commoditization of co-location services, cloud computing, and content distribution networks are also affecting illegal content. Not only can new companies be launched quickly, but less legal Internet services are also possible. One of the many reasons that "peer-to-peer" (P2P) applications are popular is because they allow people to use their own infrastructure for file sharing. With the emergence of inexpensive cloud computing and other leased computing services, there has been a surge in the amount of Internet traffic for "hosted file services" at the expense of P2P services,[94] making it easier for file sharing to use those high-performance systems rather than rely on the low-bandwidth uplinks common to the asymmetric network architectures used for access.

The rapid change in infrastructure that drives much of the Internet ecosystem illustrates the challenge to monitoring unlawful content. In two short years, "bandwidth intensive" applications such as video and file sharing have moved to systems using the same protocols and service

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90. AT&T has stated that it will filter Internet content for such purposes. *See* Tim Wu, *Has AT&T Lost Its Mind? A Baffling Proposal to Filter the Internet*, SLATE (Jan. 16, 2008, 10:15 AM), http://www.slate.com/id/2182152. Similar statements have recently been made by Comcast CEO Brian Roberts. *See* Kenneth Corbin, *Comcast Set to Enter Copyright Wars*, DATAMATION (Jan. 27, 2010), http://itmanagement.earthweb.com/cnews/article.php/3861096/Comcast-Set-to-Enter-Copyright-Wars.htm.

91. *See* Michael Piatek et al., *Challenges and Directions for Monitoring P2P File Sharing Networks – or – Why My Printer Received a DMCA Takedown Notice*, HOTSEC'08, PROCEEDINGS OF THE 3RD CONFERENCE ON HOT TOPICS IN SECURITY (2008) (showing that the method used in identifying file sharing is susceptible to false accusations).

92. Several such systems exist, the most common of which is the "Tor Network." *See* Damon McCoy et al., *Shining Light in Dark Places: Understanding the Tor Network*, PROCEEDINGS OF THE 8TH INTERNATIONAL SYMPOSIUM ON PRIVACY ENHANCING TECHNOLOGIES 63 (2008).

93. Again, several such systems exist. The system designed by our research group is very efficient and uses existing BitTorrent protocols. Kevin Bauer et al., *BitBlender: Light-Weight Anonymity for BitTorrent*, PROCEEDINGS OF THE WORKSHOP ON APPLICATIONS OF PRIVATE AND ANONYMOUS COMMUNICATIONS (2008).

94. This trend has been reported in numerous venues. One of the more detailed studies was *ATLAS Internet Observatory 2009 Annual Report*, which was presented to the 2009 NANOG network operators meeting. LABOVITZ ET AL., *supra* note 77. The report showed a dramatic increase in "hosted HTTP" services rather than the expected increase in P2P services. *Id.*

providers as "legitimate" services. Because those systems use encryption, any mandated monitoring of such traffic will be both expensive and error prone. Stopping illegal content by monitoring traffic requires that *all* traffic be monitored and the costs to implement this will be borne by all users of the Internet. Pushing this requirement on all network providers imposes a significant cost to benefit a different industry.

D. Curtailing Innovation in Network Management

The proposed neutrality rules distinguish between "managed" and "public" services, but the discussion about what constitutes managed services is relatively ad hoc and clearly captures the status quo rather than what is possible. An existing example would be having a distinct network service for latency-sensitive traffic, such as voice. Some existing "competition-friendly" networks use a managed network exclusively for one of many possible voice services and relegate "best effort" and streaming video services to other networks all carried on the same fiber.[95] Similar capabilities are present to varying degrees in almost all other access networks. Commercial Ethernet uses 802.1Q (Virtual LAN) and 802.1P (Class of Service) to provide such managed networks.[96] New home network technologies such as Multimedia over Coax Alliance (MoCA) and HomePlug are rapidly being developed and will allow different managed streams to be carried over the same physical cable.[97]

What have been missing are standards to link the differing streams in access network media to similar capabilities in home networks. A generalized capability to have multiple streams of data for multiple classes of service simplifies the distinction between "managed" and the "public" Internet and would allow additional managed services (for example, video-conferencing could extend current "triple play" networks) or service offerings that let consumers choose between multiple service qualities. Some of these mechanisms are being developed,[98] but such innovation will

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95. Several Internet technologies promote "line sharing." The Ethernet-based architecture of the UTOPIA network is one of the most versatile designs. *See* Ken Moerman et al., *Utah's UTOPIA: An Ethernet-Based MPLS/VPLS Triple Play Deployment*, IEEE COMM. MAG., Nov. 2005, at 142.

96. Dirceu Cavendish, *Operation, Administration, and Maintenance of Ethernet Services in Wide Area Networks*, IEEE COMM. MAG., Mar. 2004, at 72–79.

97. HOMEPLUG: POWERLINE ALLIANCE, http://www.homeplug.org/home (last visited Feb. 21, 2011); MOCA, http://www.mocalliance.org/ (last visited Feb. 21, 2011).

98. The problem arises because attempts at standardizing "resource reservation" for the Internet have not been successful for a variety of business and technical reasons. However, most networks that makes up the Internet have mechanisms to reserve resources for specific tasks. For example, cable modems use the PacketCable standard, which uses a technique called "Reserved Services Domain" to handle managed services. The step that is lacking is connecting services in one network (e.g., PacketCable) to another (e.g., MoCA).

likely be halted if ambiguous regulation is in place.

Similarly, many existing access network technologies have impediments that limit performance; even seemingly high-performance networks such as DOCSIS cable modems benefit from "management" mechanisms to overcome such impediments.[99] Even long-studied systems in the Internet benefit from continued improvement. Congestion control algorithms are used to balance the performance of one "flow" of information versus another at all scales of the Internet. Recently, the design and "fairness" of these algorithms is being reexamined by the technical community. Steven Bauer, David Clark, and William Lehr published a very readable history of congestion control.[100] Internet connections "self-regulate" the bandwidth they use—without such self-regulation, TCP connections would only be limited by the ability of the sender to transmit data. Those algorithms seek to balance congestion in the network with the ability of the receiver to accept packets. The original algorithms sought to allocate each "flow" a fair share of bandwidth.[101] That design decision was reflective of the Internet at the time. Per-flow fairness is one reason why P2P applications exert more pressure on networks than, for example, simple host-based streaming—P2P applications use many connections to download content, and each is striving for a "fair share" of the access network. There are ongoing efforts to evolve network congestion control algorithms to include information from the network in order to build a more responsive and efficient network; network neutrality legislation seemingly precludes such efforts. These efforts include both the access network and congestion control at routers in the "core" of the Internet.[102]

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99. DOCSIS cable modem networks tend to have "bursty" uplink connections, and this causes TCP/IP throughput to be lower than what the downlink can support. *See* Jim Martin, *The Impact of the DOCSIS 1.1/2.0 MAC Protocol on TCP*, CONSUMER COMMUNICATIONS AND NETWORKING CONFERENCE 302 (2005). This particular study examines the effectiveness of "TCP ACK compression" to see if it overcomes the problems in the physical access network. *See id.* This mechanism monitors TCP/IP connection characteristics and delays specific uplink traffic at the cable modem to eliminate redundant acknowledgement messages. As described in the study, this basic mechanism has been studied in other domains, but is rarely applied. *Id.*

100. Steven Bauer, David Clark & William Lehr, The Evolution of Internet Congestion (2009) (unpublished paper) (on file with the Massachusetts Institute of Technology) (prepared for the 37th Research Conference on Communication, Information and Internet), http://www.tprcweb.com/images/stories/papers/Bauer_Clark_Lehr_2009.pdf.

101. A "flow" represents a data connection between end points on a source and a destination in the Internet. Originally, each "application" (such as a web browser or file transfer program) would use a single flow at a time and "per flow" fairness results in "per user" fairness; over time, applications began to use more flows for performance and flexibility. The Evolution of Internet Congestion describes the history of these developments. *Id.*

102. The Evolution of Internet Congestion above describes some research studies on this topic. *Id.* One of the more readable descriptions is Matthew Mathis, *Reflections on the TCP*

E. Technology on Internet Time

The FCC orders affecting the AOL Instant Messaging system during the Time Warner and AOL merger provide a historical lesson about the risks and challenges of predicting the path of technology and the impact that regulation has on that path.[103] Instant messaging (IM) emerged in the mid-1990s as a popular communication system based on a long history of "computer chat" systems in place since the early 1970s. Messaging or "talk" applications were initially used on local area networks where the communication latency was sufficiently low. Because "chat" programs allowed users to communicate over long distances in near-real-time, they became increasingly popular on systems run by companies such as CompuServe, Prodigy, AOL, and others. As with much of the online content of those systems, chat systems were initially "walled gardens" that served only the members of those services.[104] As the commercial Internet evolved and became popular in the mid- to late- 1990s, there was greater interest in having IM systems operate across multiple services.

Instant messaging is notable because it is one of the few Internet technologies to have been affected by FCC and FTC orders. This occurred during the merger between AOL and Time Warner; Gerald Faulhaber wrote an excellent analysis and history of the reasoning behind orders affecting AOL Instant Messaging (AIM).[105] Lehman Brothers valued AIM as $5.8 billion during the merger in 2000.[106] AIM had 130 million members or users and appeared to have considerable market dominance over nascent IM alternatives such as Microsoft MSN Messenger.[107]

Prior to the merger, AOL and Microsoft had engaged in the "IM wars" wherein AOL exploited a security flaw in the AIM software to block interoperation with competing services, such as Microsoft Messenger.[108] Microsoft and other IM companies lobbied for open access to the AIM service as a condition of merger. Faulhaber argues that this was one of the first times that network effects were used as an argument in regulatory oversight in the absence of specific harm.[109] It was thought that if Time

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Macroscopic Model, ACM SIGCOMM COMPUTER COMM. REV., Dec. 2008, at 47–49.

103. Comments in FCC Cable Services Bureau CS Docket 00-30, Time Warner Inc./AOL Time Warner Inc. Transfer of Control Applications; FTC Docket No. C-3989, America Online, Inc., and Time Warner Inc.

104. *See* Gerald Faulhaber, *Network Effects and Merger Analysis: Instant Messaging and the AOL-Time Warner Case*, 25 TELECOMM. POL'Y 311 (2002).

105. *See id.*

106. Comments of Covington & Burling at 1, Applications of America Online, Inc., and Time Warner Inc. for Transfers of Control, CS Docket No. 00-30 (rel. Sept. 27, 2000).

107. Louise Rosen notes this in *Why IM Matters So Much*, UPSIDE TODAY, Sept. 19, 2000, which appears in Comments of Covington & Burling, *supra* note 106, at 3.

108. *See* Faulhaber, *supra* note 104, at 314–17.

109. *See generally id.*

Warner were able to block other IM systems from access to their cable modem networks, AIM would have significant advantage. This was thought important because it was clear that as network speeds increased, IM systems would evolve into a series of services (such as video chat or file transfer) that would expand on the value of the existing systems.[110] The "names and presence directory" (NPD) was seen as being a critical infrastructure for IM services that precluded interoperability with other services.[111] AOL resisted efforts to publish clear protocol standards or allow interoperation between its NPD and other software, asserting concerns of "security" and "privacy" for its users.[112]

The FCC conditions for the AOL and Time Warner merger prohibited the use of new "advanced" videoconference extensions unless standardized server-to-server interoperability mechanisms were implemented.[113] Today, AIM is one of many protocols. Although AOL still has the largest number of users, IM has diminished in importance and multiple competing protocols and systems have emerged. Today, it would be fanciful to imagine that AIM adds $5.8 billion of value for AOL. What happened?

In large part, the efforts of AOL to block use of its services spurred development of competing services—this was apparent even at the time the merger conditions were being debated.[114] In addition to the MSN Messenger system, several "open source" efforts were developed to produce scalable messaging platforms with the most successful being Jabber, which produced the XMPP protocol.[115] These multiple implementations allowed companies to launch their own private and customized IM services because the cost of deploying the technology had been greatly reduced. People learned that adopting a new IM system was not hard. In part, the plurality of systems and the willingness to adopt new IM systems accelerated the use of IM and messaging systems for business applications. One of the complications of using AIM for business purposes was that AIM was often blamed for security lapses, and businesses had

110. *Id.* at 317–19.

111. *Id.*

112. AOL's concern about security and privacy was disingenuous given AOL's reliance on a "buffer overflow" attack to block competing services; that same attack could be used to compromise the customer's computer.

113. *See* Applications for Consent to the Transfer of Control of Licenses and Section 214 Authorizations by Time Warner Inc. and America Online, Inc., Transferors, to AOL Time Warner Inc., Transferee, *Memorandum Opinion and Order*, 16 F.C.C.R. 6547, para. 167 (2001) [hereinafter Time Warner & AOL Transfers].

114. *See* Jim Hu, *AOL's Lead in Instant Messaging Arena Dwindles*, CNETNEWS.COM (Nov. 16, 2000), http://news.cnet.com/AOLs-lead-in-instant-messaging-arena-dwindles/2100-1023_3-248700.html?tag=mncol;1n.

115. XMPP stands for Extensible Messaging and Presence Protocol. *About*, XMPP STANDARDS FOUND., http://xmpp.org/about-xmpp/ (last visited Feb. 21, 2010).

poor controls over the identity, security, privacy, and logging needed when applying AIM to business applications.[116] In particular, the Sarbanes-Oxley Act of 2002 and other reporting and disclosure rules, precipitated by various financial scandals, make it more important to keep accurate records and logs of communication between investors and financial advisors, as well as between people in the investment community. This led several companies to stop using public IM networks in favor of in-house networks.[117] Eventually, those IM systems used web browsers rather than requiring extra clients to be downloaded. The development of "Web 2.0" technologies such as Ajax changed the IM experience afforded by a browser interface so that it was equal to that of dedicated software. This allowed businesses to maintain control over "customer chat" and integrate those chat records with other "customer relationship management" (CRM) software that records customer names, account numbers, service and sales calls and all customer interactions.

The pace of technology adoption and the peculiar needs of companies seeking to employ IM systems means that although AOL's system is still the largest IM system, there has been no stranglehold on innovation or capabilities. The pace of this innovation was addressed in the FCC merger memorandum:

> Finally, it might be thought that in the rapidly changing technology of the Internet, even network effects and AOL's present position in the market would not prevent successful entry by IM providers other than AOL, that a new breakthrough technology might become available and would be superior enough to AOL's service to overcome the network effects flowing from its NPD, and cause users to shift *en masse* away from AOL. . . . We see no evidence at this time, however, of such a new breakthrough technology strong enough to overtake AOL's NPD.[118]

With the benefit of hindsight, we see that within two to four years after the merger orders were written, rich IM competition developed. Customers did not shift *en masse* away from AOL because they did not need to—they

116. The AIM instant message system had numerous security flaws that were used to block interoperability but could also be used by attackers against computer security. AIM also functioned by sending all data to AOL and, in later versions, that communication was encrypted, making it impossible to record the "plain text" version of the conversation. The Instant Messaging market split into "Enterprise" and "Consumer" instant messaging in 1998 with companies such as Lotus, Microsoft, and others providing solutions with features specifically for business uses. Wikipedia has a history and supplementary references on those developments. *Instant Messaging*, WIKIPEDIA, http://en.wikipedia.org/wiki/Instant_messaging (last visited Feb. 21, 2011).

117. *See, e.g.*, Thomas Hoffman, *Sarbanes-Oxley Trumps IM at Some Firms: Concerns About Security, Archiving Prompt Companies to Unplug Instant Messaging Systems*, COMPUTERWORLD (Aug. 8, 2005), http://www.computerworld.com/s/article/103752/Sarbanes_Oxley_trumps_IM_at_some_firms.

118. Time Warner & AOL Transfers, *supra* note 113, at para. 167.

simply used other technologies in concert with AIM.

Hindsight certainly helps in seeing trends, but some trends are apparent only when other technologies arise. One of the FCC's concerns with the AOL and Time Warner merger was that it might lead to a new dominant signaling and communication system by the introduction of new services over AIM.[119] This did not come to pass because alternate services became available (and were easy to adopt), mechanisms existed to work around restrictions, and open standards reduced the barrier for entry. The rapid evolution of technology was in contrast to most of the history of telecommunications, and this rapid evolution made it difficult to estimate the impact of regulation.

IV. MAINTAINING A VIBRANT INTERNET ECOSYSTEM

Technology on the Internet moves both more slowly and more quickly than most technology overseen by traditional regulation. VoIP technologies were in place almost a decade before they became widely adopted. Promising technologies such as AIM arose, peaked, and then diminished in value dramatically within that same period of time. The technology for one application was largely a substitute for the other,[120] but that was not clear at the time.

Regulation may not always be the best way to maintain a vibrant Internet. Standard methods for measuring what is actually happening in the Internet can help identify the root cause of complex service problems. Standard methods for reporting or disseminating policy to consumers in understandable terms can reduce confusion about services and performance guarantees. Existing agencies and policies can be used to maintain competition. Increased innovation and competition for access networks can provide consumers access to the competitive services in the Internet ecosystem. Lastly, developing "best practices" that can be clearly understood by network operators, regulators, and consumers will set "networking norms" that highlight the violation of those norms.

A. Measure and Report

Clearly identifying problems in the Internet and apportioning blame is very difficult. Consumers on access networks typically want answers to three questions: Can I access a specific service? Is the latency or quality of

119. *Id.* at para. 2.

120. The XMPP protocol used by Jabber and Google Talk has been extended as "Jingle" by Google to enable voice calls. *What Is Google Talk?*, GOOGLE CODE LABS, http://code.google.com/apis/talk/ (last visited Feb. 21, 2011). Similarly, voice systems such as Skype added support for basic and "enhanced" IM services. *Instant Messaging*, SKYPE, http://www.skype.com/intl/en/features/allfeatures/instant-messaging/ (last visited Feb. 21, 2011).

that service acceptable? Is there a bandwidth problem for a specific service?

Consumers often jump to conclusions when a service or site is blocked or unavailable. Services may be blocked by an ISP—or, the service may actually be down. Alternatively, parts of the Internet protocols not under control of the ISP (such as DNS) may misdirect traffic. In extreme cases, events halfway around the world may block services.[121]

The debate concerning network neutrality has prompted the development of several measurement tools to determine if application blocking or data modification is occurring. Examples include the "Switzerland" tool, developed by the Electronic Frontier Foundation;[122] the "Glasnost" tool, developed by The Max Planck Institute;[123] and the "Measurement Lab" consortium that supports both education and analysis tools.[124] These tools either detect specific problems (e.g. BitTorrent blocking) or identify factors that may delay communication. They are first steps in helping consumers identify what may be wrong and assisting in network monitoring. However, they are still primitive and require considerable sophistication to deploy and interpret.

It would be better for ISPs to be transparent about their network management policies and network conditions. Many ISPs block services that appear to arise from "malware"; sometimes those services are actual but uncommon services. For example, Scherlis notes that game developers often need to contact ISPs to remove blocked services that are mis-identified as malware.[125] At the same time, consumers are typically unaware when one of their home computers or devices is launching network attacks on others.

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121. One example occurred in February 2008, when the government of Pakistan ordered access to YouTube to be blocked within Pakistan. *See* Danny McPherson, *Internet Routing Insecurity: Pakistan Nukes YouTube?*, ARBOR NETWORKS (Feb. 25, 2008), http://asert.arbornetworks.com/2008/02/internet-routing-insecuritypakistan-nukes-youtube/. The network operators for Pakistan Telecom implemented that order by issuing a "black hole route." *See id.* This is a method whereby a network router advertizes that it has an efficient route to the designated host but then actually discards that traffic. That "black hole route" was then published to other ISPs, causing a large part of the world to think that Pakistan had a very good connection to YouTube; this caused broad outages for YouTube. *See id.*

122. *See, e.g.*, *Switzerland Network Testing Tool*, ELECTRONIC FRONTIER FOUND., http://www.eff.org/testyourisp/switzerland (last visited Feb. 21, 2011).

123. Marcel Dischinger et al., *Glasnost: Enabling End Users to Detect Traffic Differentiation*, PROCEEDINGS OF NSDI '10: 7TH USENIX SYMPOSIUM ON NETWORKED SYSTEMS DESIGN AND IMPLEMENTATION 405 (2010).

124. Measurement labs arose from an effort by a number of companies, university faculty, and Internet researchers to determine technical approaches to measuring the network access characteristics. *About Measurement Lab*, M-LAB, http://www.measurementlab.net/content/about-measurement-lab (last visited Feb. 21, 2011).

125. Comments of Scherlis, *supra* note 71.

What is missing is a mechanism or protocol for communicating current management and policy information to consumers. Developing standards or protocols for informing customers about "suspicious" traffic would remove much of the confusion when an application stops working. There are existing protocols, such as Simple Network Management Protocol (SNMP) and Remote Network Monitoring (RMON), designed to communicate network performance, but these protocols are designed for network management rather than consumer enlightenment—they provide too much detail for consumers and provide no insight into what steps can be taken to correct problems. Through efforts such as the P4P consortium,[126] ISPs have found that it is possible to work with applications to reduce bandwidth demands and costs. Similar tools for communicating with consumers would likely improve customer service and help reduce network security problems. Efforts to inform consumers about broadband capabilities would allow broadband providers to compete based on those different services without consumers complaining about hidden differences. The British regulator, Ofcom, has established a voluntary "Code of Practice" for ISPs that communicates much of this information to consumers prior to sale and during service.[127]

B. Maintain Competitive Applications, Content, and Services

Content distribution and cloud computing services dramatically reduce the infrastructure cost for computing and web applications, allowing noncommercial groups to rapidly scale their efforts. Software innovations and business models that can exploit these new platforms are enabling even more rapid innovation. Vertical integration in these markets may or may not lead to anticompetitive behavior; however, these technologies are so new that it is not clear whether they will remain in their current form or if concerns about fair competition will last longer than the technology itself. The possibility of antitrust enforcement from the FTC and the Justice Department will foster more innovation than enacting preemptive and broad rules to regulate these hybrid "private/public" networks.

Predicting the future of technology is difficult, as evidenced by the analyses of the predicted outcome of the competition surrounding AOL Instant Messaging. That regulation was eclipsed by the reality of rapid technology development, external technology, and changes in business practice and usage patterns. Although there is certain to be consolidation in

126. P4P is a reporting method that allows P2P software to learn the "topology" of ISPs, allowing the P2P software to avoid expensive or congested links. *The P4P Working Group*, PANDO NETWORKS, http://www.pandonetworks.com/p4p (last visited Feb. 21, 2011).

127. *Voluntary Code of Practice: Broadband Speeds*, OFCOM, http://www.ofcom.org.uk/telecoms/ioi/copbb/copbb/ (last visited Feb. 21, 2011).

the "cloud computing" ecosystem, it remains to be seen whether the consolidation will foster anticompetitive behaviors.

C. Maintain Competitive Networks with Transparency and Clarity

Business networks (primarily Ethernet) have many mechanisms to improve flexibility, control performance, and diagnose problems. Consumer access network technology is only beginning to see similar development, and there is a real risk that regulation will curtail investment in or development of those technologies. At the same time, certain services benefit from separation from general best-effort traffic—this is why many businesses use different "virtual private networks" to separate different kinds of traffic. As home users expand the range of services they use, consumers may be better served by technologies that enable multiple network services, each with different qualities.

Likewise, innovations in congestion control will continue and can be implemented in many parts of the networks. Researchers are exploring the tension between enforcing congestion control at the end-points (such as a laptop or cell phone, where it may take years to upgrade or replace all the software) versus upgrading specific routers or other parts of the network. Precluding implementation at the access network will simply increase the costs of network management. Rather than exclude specific mechanisms such as congestion control, regulation should be used to foster goals such as competition.

D. Keep Ahead of the Technology

The Internet is complex, encompassing both traditional communication services as well as computer systems, novel services, and rapidly evolving technology. Developing an ongoing process for discussing and analyzing the interplay between the different technologies is critical. There are specific actions that can foster more thoughtful review, such as creating an organization to provide independent and informed counsel to policy makers about the Internet ecosystem as a whole. This is a difficult charge because some emerging trends are not apparent until they are established practices. The other action is to counter specific concerns that have been indicated by prior regulators and develop standards or tools to mitigate those concerns.

There are many bodies that examine and discuss how Internet technology should be developed; other groups discuss business practices, and yet others research new techniques or services. It is equally important to have a continued and informed discussion about how technology, business, and new services affect future policy so that policy makers can stay ahead of the technology. It is useful to guide technology before it is

widely deployed because that lessens the cost of regulation.

Two such examples are the "network effects" of systems such as instant messaging, and the "stickiness" of specific e-mail addresses. As an example, although there have been calls for "e-mail portability," there has been little serious study of the concept. However, "identity" on the Internet is one of the key features that makes network effects important. Although AIM was not the only messaging tool available, moving to another system entailed rediscovering the online identity of your friends. Now, when instant messaging has been replaced with social networking, the same issues that were raised about AIM "stickiness" may be raised about Facebook or MySpace. Here, the technical community is moving faster than the regulatory world—there have long been Internet standards, such as DNS, for "machine portability," and now there are developing standards, such as OpenID,[128] for "people portability." Such identity systems could have significant impact when widely adopted, but it is also important to understand and clarify how such systems will interact with regulation.

V. REGULATION SHOULD BE A PROCESS, NOT A PRODUCT

This Article has argued that regulation or legislation that simply affects control of the access work policies while ignoring the impact of the rest of the Internet ecosystem is a disservice to consumers. At the same time, regulation or legislation that affects the *entire* Internet is overreaching and also not needed.

To date, most of the network neutrality discussion has been heavily influenced by existing telecommunications regulation—this is natural since most regulation seeks to model new systems after old. This has led regulators to focus on "bits in flight"—for example, the regulation of access networks—while largely ignoring the "bits at rest"—content distribution networks—that make up much of the Internet. That distinction between basic and information services is rapidly being challenged by the development of an integrated Internet ecosystem. Focusing on "bits in flight" also impacts the ability of regulators (or even technology pundits) to predict the evolution of services. This Article highlighted the example of AOL Instant Messenger, arguing that the comparison between AIM and the existing communications systems missed the rapidity with which new and competing systems could be *deployed* using the existing infrastructure. Standardization and open software and protocols also meant that the cost of *developing* a new system was radically reduced compared to existing telecommunications systems. The rapid evolution of the Internet makes it difficult to ensure that regulation is still meaningful by the time it is

128. *What Is OpenID?*, OPENID, http://openid.net/get-an-openid/what-is-openid/ (last visited Feb. 21, 2011).

developed.

True network neutrality is about competition and innovation, and any such discussion must involve the full Internet ecosystem. It is clear that narrowly defined rules affecting one part of that ecosystem are not the best solution to maintaining a competitive and responsive Internet. Existing legislation—primarily antitrust laws in the case of browsers and the threat of similar laws in advertising-based search—are being applied and should be able to address future anticompetitive actions. At the same time, consumers would benefit from competition, innovation, and better information about the services available to them.