Testimony of

Sascha D. Meinrath

Palmer Chair in Telecommunications

The Penn State University

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Introduction

Thank you, Chairwoman Muth, Senator Cappelletti, and Representative Fiedler, for this opportunity to discuss the importance of Network Neutrality, and its myriad intersections with the current state of broadband adoption, both across the Commonwealth of Pennsylvania, and the country as a whole.

My name is Sascha Meinrath, and, since 2015, I have been the Palmer Chair in Telecommunications at Penn State University. However, my work on Network Neutrality dates back to early 2004 -- very near the genesis point when Tim Wu coined the term[1]. In 2004, I was tasked to help develop the Internet advocacy portfolio of the then-fledgling journalism-reform group, Free Press, and I spent the next few years working on the strategic framing that has defined the debate over Network Neutrality ever since.

In 2006, I co-founded the Cooperative Measurement and Modeling of Open Networked Systems Initiative at the Center for Applied Internet Data Analysis, in San Diego. And, in 2008, I founded the Open Technology Institute, a DC-based policy think tank, that I grew to become one of the major public interest groups working on various facets of the Network Neutrality policy battles. Tim Wu was one of OTI's original steering committee members.

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[1] 'Network Neutrality, Broadband Discrimination', 2003, Tim Wu - Kernochan Center for Law, Media and the Arts: https://scholarship.law.columbia.edu/faculty_scholarship/1281/

In 2009, I co-founded Measurement Lab, which has grown to become the world's largest open broadband measurement data repository. And, more recently, in 2015, along with joining Penn State Faculty, I founded X-Lab, a tech policy institute devoted to exactly the type of vanguard research that brings me before you today.

Since 2018, I've led multiple broadband mapping efforts -- supported by the Center for Rural Pennsylvania -- that have provided unprecedented insights and resources to the members of the Pennsylvania legislature. In 2018, my team conducted an in-depth analysis of connectivity speeds; and our findings, delivered to the Pennsylvania legislature in June 2019's, "Broadband Availability and Access in Rural Pennsylvania" report were quite stark -- showing major discrepancies across the commonwealth between claimed availability of service and actual adoption of broadband services. In 2020, my team delivered a second major research report, "Broadband Demand: The Cost and Price Elasticity of Broadband Internet Service in Rural Pennsylvania," which documented major pricing differentials between rural and urban constituencies. Both data collection efforts underscored the dire state of broadband connectivity across Pennsylvania -- a fact that is now well-known, yet remains under-addressed.

As I've testified previously before the Pennsylvania legislature, our research results:

> "systematically document that we face a dire crisis that is undermining our
> economy, our educational system, our health care, our access to media and

information, and availability of untold additional resources that broadband connectivity makes possible."

Given the current state of connectivity demonstrated in this post-COVID world, the importance of maintaining a neutral network for broadband service provision has never been greater.

Network Neutrality & Competition

Put simply, network neutrality is the idea that a telecommunications network should be a neutral medium of transport -- and that a failure to maintain a neutral network inevitably leads to discriminatory practices that invariably harm some users of that network. Without net neutrality regulations in place, Internet service providers as well as mobile network carries are free to - and have previously[2] - restrain or altogether deny access to websites, streaming services and other online resources.

In a meaningfully competitive market, the dangers brought on by a lack of network neutrality would be far less dire; in essence, a customer whose connection to the Internet is throttled, limited, or otherwise compromised by their ISP would simply switch over to another provider who did not engage in those detrimental business practices. However, the stark reality is that citizens in most states - including

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[2] See https://news.northeastern.edu/2018/09/10/new-research-shows-your-internet-provider-is-in-control/ for one such example.

Pennsylvania - have few or no alternatives to their existing company, when it comes to switching Internet providers.

Several carriers have already engaged in a host of different blocking, throttling, and prioritization regimes, including reducing performance to a competitor's video streaming platform or telephone services, or restricting viewing of news or legal proceedings against itself from within its own network. It's the same kind of censorship technology employed by ISPs in other countries with oppressive censorship regimes, such as in China or Iran.[3] The issue of Net Neutrality is, at its core, one of free speech and functioning markets. Broadband providers are the highways that we use to get online; they are not the Internet itself. As Free Press underscored, "To install broadband providers as gatekeepers of that open platform strips communities and individuals of their power and hands it to corporate behemoths like Verizon, AT&T and Comcast."[4] Giving any entity - corporate or governmental - unrestricted power to censor or hide any content they deem unfit, is something that all Americans can agree is inherently dangerous to our civil society, regardless of politics.

There are countless examples documenting the harms caused by violations of Network Neutrality: from the censoring of political speech telecom providers didn't like, to the blocking of specific services which compete with that provider's service offerings, to interfering with legal applications (and then lying about it). Most of the major telcos have engaged in fairly egregious Network Neutrality

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[3] See this 2019 FreedomHouse report: https://freedomhouse.org/country/united-arab-emirates/freedom-net/2019
[4] "Net Neutrality's Impact on Free Speech" June 23, 2014 freepress.net- Lauren Wilson, https://www.freepress.net/our-response/expert-analysis/insights-opinions/net-neutralitys-impact-free-speech

violations over the years. In fact, after Net Neutrality rules were repealed in 2017, most ISPs refused to comment on whether or not they would treat all Internet traffic equally, block or throttle traffic or offer higher-priced "fast lanes" for content they choose to prioritize.[5]

I've been writing peer-reviewed journal articles about Net Neutrality since 2008; in the Journal of Internet Law[6], I discussed the importance of maintaining an open Internet, and warned about the dangers of abandoning net neutrality and allowing ISPs to act as the gatekeepers of information, knowledge, and content:

> *Despite network operators assurances to the contrary,*
> *over the past several years there have been ominous*
> *glimpses of what a non-neutral network might look like.*
> *In 2004, North Carolina ISP Madison River blocked DSL*
> *customers from using its rival's (Vonage) VOIP telephony*
> *services. In 2005, the Canadian telecom corporation,*
> *Telus, blocked users from accessing a pro-union Web*
> *site during a labor dispute. In 2006, AOL Time Warner*
> *blocked a mass email campaign from its customers that*
> *opposed AOL's proposed tiered email system. In 2007,*
> *AT&T apparently censored a Webcast of the rock band*
> *Pearl Jam's anti-Bush political commentary. Also in 2007,*

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[5] ISPs won't promise to treat all traffic equally after net neutrality, Dec 15, 2017, The Verge - Jacob Kastrenakes: https://www.theverge.com/2017/12/15/16768088/internet-providers-plans-without-net-neutrality-comcast-att-verizon

[6] Transcending Net Neutrality: Ten Steps Toward an Open Internet, December 2008, Sascha Meinrath and Viktor Pickard, Journal of Internet Law: https://repository.upenn.edu/cgi/viewcontent.cgi?article=1425&context=asc_papers

Verizon was found blocking the pro-choice organization NARAL's text messages. In 2008, Bell Canada was caught throttling third-party DSL providers' P2P traffic. Perhaps best exemplifying the potential for abusing net neutrality has been Comcast, whose practices of blocking traffic associated with Bit Torrent, a peer-to-peer file-sharing system, were exposed in 2007. These are just a few of the more egregious infractions against net neutrality.

Post-COVID Reality

Pennsylvania's post-COVID broadband-reality is calamitous for both individuals and the communities in which they live. The Coronavirus pandemic focused our attention upon this longstanding service provisioning shortcoming because it has acted as a "force-multiplier" for the detrimental impacts of the digital divide and of the lack of meaningful net neutrality legislation:

1. Students learn less without broadband access -- and a generation of children are learning *far* less when distance learning is so prevalent and they don't have adequate broadband access.[7]

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[7] What We're Learning About Online Learning, June 13 2020, Benedict Carey - New York Times: https://www.nytimes.com/2020/06/13/health/school-learning-online-education.html

2. Entrepreneurs have difficulty thriving without broadband -- but today's local businesses face far greater disadvantages when they cannot pivot to online operations.

Because of the digital divide plaguing Pennsylvania during the coronavirus epidemic, administrators are compelled to send students to school, even when it's dangerous; local businesses stay open because they have no meaningful online capacity (and even if they did have connectivity, their customers too often do not); and these communities face greater risk that may be measured in increased sickness and mortality rates that are then further exasperated due to a lack of access to telehealth resources.

This state of affairs is particularly troubling for Pennsylvania residents, since, unlike other states, we've actually already paid for universal broadband service guarantees that were never actually delivered. When the state granted tax breaks and "rate flexibility" -- resulting in higher monthly bills for PA residents -- it was in return for an explicit commitment. To quote Verizon:

> "Bell commits to deploy the technologies necessary to provide universal broadband availability in 2015...capable of supporting services requiring bandwidth of ***at least 45 megabits per second***..."

While it is difficult to determine just how much money Pennsylvania residents have already paid for universal broadband we have yet to receive, the consumer

watchdog group, Teletruth, conducted in-depth investigations looking at Verizon's SEC filings and tax documents, and estimated that:

> "...by the end of 2014, Verizon PA overcharged customers about $18 billion for a fiber optic future they never got."[8]

Today, Verizon continues to state that it has, "...met its Chapter 30 obligations to deliver broadband to 100% of its Pennsylvania service territory by the end of 2015."[9]

Key 2020 Findings: Broadband Pricing

Our most recent research initiative for the Center for Rural PA[10] collected survey/polling data from over 1400 PA residents regarding their broadband speeds, pricing, willingness-to-pay, and demographics. Key findings from this research include that:

1. Substantial service provision differentials exist between urban and rural communities;
2. Pricing data alone hides substantial differentials within speed tiers between urban and rural constituencies; within pricing tiers, rural areas are overrepresented with slower speeds, while urban areas are

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[8] Available from: https://www.verizon.com/about/sites/default/files/pa_hsi.pdf
[9] Ibid.
[10] Tentatively titled, "Broadband Demand: The Cost and Price Elasticity of Broadband Internet Service in Rural Pennsylvania," which will be available via the Center for Rural PA website.

more likely to have faster speeds; thus, dollar for dollar, rural areas receive slower speeds than urban areas;

3. Survey responses document a "sweet spot" in terms of a willingness to adopt broadband (of under $61/month), as well as relatively static "unwillingness-to-pay" for services above $80/month; rural constituencies have consistently *higher* willingness-to-pay than urban respondents, regardless of price point;

4. Pennsylvania's current definition of "broadband" is shockingly antiquated and should be harmonized to meet or exceed long-established federal standards. Currently, the Commonwealth's definition is more than an order-of-magnitude slower than the current FCC definition of "broadband" connectivity; and,

5. The state should mandate standardized public disclosure of broadband service characteristics including price, speed, service limitations (e.g., data caps, throttling), and guaranteed minimum service levels, so that consumers can comparison shop and make informed decisions about which service to purchase.

And, of course, Pennsylvania would be far better positioned to leverage federal broadband support mechanisms if the State developed a comprehensive broadband mapping initiative using best-practices from the scientific and research community. [11] The State's failure to do so will likely be measurable in the tens, if not hundreds of millions of dollars in funding that will either be forgone or ill-applied.

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[11] Funding sources include the $16 billion Rural Digital Opportunities Fund administered by the Federal Communications Commission, and potentially tens of billions of dollars in broadband support proposed by Congress through programs like the HEROES Act and the Moving Forward Act.

Economic Take-Home Message

In 2015, the US Census Bureau reported that Pennsylvania had 1.35 million rural households. Based on the FCC's *optimistic* estimates, about 40% of rural households (540,000 households) do not have broadband connectivity. Taking into the $2000/year opportunity cost[12], **the current lack of broadband connectivity costs rural Pennsylvania residents over $1 billion a year in lost economic opportunity.**

Together with the $18 billion in overcharges and tax subsidies already paid to Verizon and other ISPs since the mid-1990s, **Pennsylvania's lack of universal broadband connectivity has likely already cost the state well over $25 billion**.

Conclusions

Pennsylvania's rural residents face a trifecta of digital disadvantage:

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[12] The opportunity costs of continuing inaction are enormous. The National Bureau of Economic Research estimated that broadband connectivity supplies roughly $2,000 a year *per household* in economic value (see: http://www.nber.org/papers/w21321.pdf). This cost isn't just due to increased job prospects, but also cheaper flights, less expensive diapers, better medical advice, access to online resources, and e-commerce cost-savings. And that opportunity costs is without taking into account the bolstering of home property values associated with broadband connectivity. Researchers Steven Deller and Brian Whitacre released a 2019 study looking at 887 rural communities looking at the effect of broadband connectivity on home value. Among their many interesting findings, one, in particular, stood out: "...higher access to broadband, regardless of the specific estimator used, has a positive impact on remote rural housing values." (Pg. 15). According to Deller and Whitacre, these results translated to fairly extensive benefits that a "10% increase in coverage of at least 0.2Mbps results in the median house value increasing by $661." Thus, for an unserved community, increasing even baseline connectivity by even a modest amount may have an impact of thousands of dollars *per house* within that local community. [From: https://blogs.extension.wisc.edu/cced/files/2019/07/Deller-Whitacre-2019.pdf]. Likewise, the National Federation of Independent Business (NFIB) found that lack of broadband access, especially in rural areas, hurts start-ups and small business prospects. According to the NFIB, "...for business owners in rural communities, [broadband] has become an issue they can't ignore. As more industries and day-to-day operations rely on fast and reliable connectivity, areas that lack the essential tool are increasingly left in the dust." [See: https://bit.ly/2F8LeFW].

1. Official measures overstate broadband availability;
2. The magnitude of the discrepancy is greater for rural areas than urban locales, thus hiding the extent of the divide; and,
3. Even when connectivity is available, dollar for dollar, rural residents appear to receive worse service than urban constituents.

As a first step to solving these problems, Pennsylvania should invest in the independent, longitudinal documentation of the state of broadband connectivity across the Commonwealth. Not only will a comprehensive documentation effort increase access to broadband buildout funding (likely more than paying for itself), it would also enable more effective implementation of broadband interventions by more accurately identifying underserved areas.

Furthermore, longitudinal speed and pricing data will empower the State of Pennsylvania to objectively measure which strategies and ISPs have been most effective at bridging the digital divide and improving broadband affordability over time. And in the immediacy, the State should substantially increase investment in immediate buildout efforts to slow the hemorrhaging of economic wealth, well-being, and vitality from communities across Pennsylvania.

A New Network Neutrality

Rather than wait for the Federal Communications Commission and Federal Trade Commissions to address the harms being perpetuated against Pennsylvanians, Pennsylvania's State Legislature has an opportunity to enact a state-wide,

comprehensive framework to protect local residents -- particularly rural residents and others who do not have a meaningful number of broadband service providers to choose from. The detrimental effects of zero-rating, data caps, prioritization, content blocking, and Internet speed throttling are all well documented; and other states such as California have rightly already begun addressing these harms and protecting local residents by enacting their own state net neutrality laws.[13] We can start by revisiting how to operationalize the facets of a new network neutrality framework in my 2008 co-authorized article, "Transcending Net Neutrality: Ten Steps Toward an Open Internet":

1. Common carriage
2. Open architecture and open source driver development
3. Open protocols and open standards
4. An end-to-end architecture (i.e., is based upon a "dumb network")
5. Safeguards privacy (e.g ., no back doors, deep packet inspection, etc.)
6. Fosters application-neutrality
7. Mandates low-latency and first-in/first-out (i.e ., adequate capacity)
8. Interoperability
9. Business-model neutrality
10. Is governed by its users

Thank you for this opportunity to discuss net neutrality, our research, and the importance in forthrightly addressing these issues for all Pennsylvanians. I look forward to answering any follow-up questions you may have.

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[13]'California can enforce its tough net neutrality law, federal judge says', February 24 2021, Brian Fung, CNN, https://www.cnn.com/2021/02/24/tech/california-net-neutrality/index.html

Editor: Stephen Ruth • *ruth@gmu.edu*

A Growing Digital Divide

Internet Freedom and the Negative Impact of Command-and-Control Networking

Sascha D. Meinrath, James Losey, and Benjamin Lennett •
New America Foundation

There is a growing consensus that communications is a fundamental right. However, achieving digital equality in the broadband age has become considerably more complex than just universal access. This article offers a more nuanced perspective on the widening digital divide that's centered on a user's utility of a broadband connection and outlines networking technologies that place control in users' hands.

A growing international consensus holds that communication is a fundamental human right (www.un.org/en/documents/udhr/index.shtml). In 2010, United Nations Secretary-General Ban Ki-moon stressed the importance of access to the Internet and information in his remarks to the assembly (see www.un.org/News/Press/docs/2010/obv875.doc.htm), and last September, ITU Secretary-General Hamadoun I. Touré said, "Broadband is the next tipping point, the next truly transformational technology. It can generate jobs, drive growth and productivity, and underpin long-term economic competitiveness."[1] Additionally, Spain and Finland have elevated broadband access to a legal right (see www.bbc.co.uk/news/10461048 and http://tinyurl.com/3qp54de), and 20 EU nations along with the US have set goals for universal broadband access (http://ec.europa.eu/information_society/activities/broadband/docs/annex_2.pdf).

While most commentators and policy makers have focused on the benefits of broadband and Internet connectivity, two significant dilemmas receive less attention. First, the challenges the unconnected face — the "dark side of Metcalfe's law" — have remained less explored. Telecommunications experts Rahul Tongia and Ernest Wilson propose that "the more people included within and enjoying the benefits of a network, the more the costs of exclusion grow exponentially to the excluded."[2]

The second key overlooked facet is that not all connectivity is created equal. Where, how, and what technologies and devices you use to connect to the Internet or broadband will increasingly determine your experience and access to digital opportunities. These two concerns are creating a more nuanced digital divide that manifests itself in terms not only of who has access to broadband and who doesn't but also of what users can actually do with their connectivity. How government policies address these new divides could determine whether the promise of the Internet as a universal communications medium is fulfilled or serves to reenforce existing societal inequities.

Emerging Digital Inequalities

As each new communications revolution opens the door for greater equality — making information and knowledge more available to many — history documents that availability is insufficient unto itself. Confronting inequalities created by a divide between those who can take advantage of the Internet and those facing barriers is becoming increasingly complex. Whereas two telephone services, for example, could expect to have relatively equal experiences and opportunities, this isn't necessarily the case for broadband access. Rather, depending on the network provider, the broadband connection capabilities, or

the access device, one user might have considerably less freedom and opportunity than the other. These stark differences can create increased disparities in broadband's ability to benefit certain communities and users.

These differences are largely being driven by a worsening trend among communication providers and others to lock down networks, devices, and users. Consequently, we're in danger of losing our access to the technologies underlying today's communications renaissance. The Internet, though predicated on an open, decentralized architecture, is at risk of becoming subject to companies' and governments' command-and-control strategies. IP-based networks once optimized to facilitate open, end-to-end communications are increasingly designed with barriers that limit our right to communicate. In doing so, some network operators, business models, and government policies are fundamentally undermining the very freedom and openness of the Internet that helped create and shape 21st century communications.

Here, we look at some of the less-explored factors of rapidly developing digital divides — ones based not only on access to the Internet but also on how individuals can actually utilize that access. By highlighting the nuanced nature of today's digital exclusion, we hope to draw attention to new forms of discrimination and disempowerment that are becoming hallmarks of the next generation of broadband networking. We suggest real-world alternatives based on fundamentally different networking methodologies — ones that are user-defined and predicated on spreading equal opportunity to learn, innovate, and adapt new communication technologies.

Defining the Digital Divide

The digital divide has traditionally been defined as a "gap between people with and without Internet access."[3] Although universal access is an important measure and a goal of many nations,[4,5] Paul DiMaggio and his colleagues suggest that "understanding of digital inequality requires placing Internet access in a broader theoretical context."[3] A focus on access alone fails to determine whether all members of a society actually benefit from broadband connectivity. In much the same way that we could argue that 100 percent of US citizens have access to healthcare or education, we know that what really matters are outcomes: many people suffer from poor health because they can't afford appropriate healthcare or fail to graduate as a result of ineffective schools and teachers.

Likewise, the US government claims that "290 million Americans — 95 percent of the US population — live in housing units with access to terrestrial, fixed broadband infrastructure capable of supporting actual download speeds of at least 4 Mbps" (http://tinyurl.com/3sftqpo). Yet only 68 percent of all Americans and less than 50 percent of African-Americans and Hispanics actually use broadband at home (http://tinyurl.com/3p7a6bo). The rural/urban divide is also quite pronounced, with home broadband use at 60 percent in rural communities compared to 70 percent among urban constituencies.

Broadband adoption differentials around the globe also document this form of digital divide. The Organization for Economic Cooperation and Development (OECD) reports that Denmark leads OECD nations in broadband penetration — that is, subscribers per 100 inhabitants — with a rate of 38. Denmark is followed closely by the Netherlands, Switzerland, and Norway. The US has a penetration rate of 27 and is ranked 14th (before Finland but lagging behind Germany, the UK, Canada, Sweden, France, and Korea among others). Broadband penetration is lower still

in other OECD countries such as Mexico, Chile, and Turkey, where only 10 inhabitants per 100 have broadband subscriptions (see www.oecd.org/dataoecd/21/35/39574709.xls). In 2009, the ITU estimated that the average fixed broadband penetration percentage in the developed world is 23 percent. Comparatively, the average penetration in developing countries is only 4 percent. As a whole, home broadband penetration rates worldwide are only 7 percent, although nearly a quarter of the world's citizens are Internet users.[6]

This discrepancy between access and adoption is only part of a considerably more nuanced digital divide. The Investigative Reporting Workshop at American University found that the best values for broadband were in the wealthy areas; poorer areas might pay slightly less but are getting significantly slower broadband speeds.[7] As the Internet has transitioned from dial-up, the minimum capacity requirements of connections necessary to access the full Internet ecosystem has likewise increased substantially. A recent ITU report estimates that a relatively simple webpage today can take 23 seconds to load on a dial-up connection versus half a second on broadband.[8] The divide can be even more pronounced when we factor in the significant discrepancies in advertised versus actual broadband speeds, a differential that can vary dramatically from network to network. For example, regulators in both the US and UK have found that actual speeds are regularly half of what's advertised (see http://tinyurl.com/3bkbw63 and http://tinyurl.com/3rhl9dw).

Even this divide, however, is relatively straightforward compared with the myriad different traffic-management practices that detrimentally affect network users. Several wireline networks in Europe limit different types of traffic over networks, whereas

others have announced plans to charge per connected application. For example, O2 in the UK deprioritizes video and peer-to-peer (P2P) protocols,[9] a limiting network management practice that Free in France has reportedly employed in some areas as well.[10] BT in the UK blocked access to the website thepiratebay.com before relenting under regulator pressure.[11] PlusNet in the UK sets different levels of speeds to different categories of Internet traffic (see http://tinyurl.com/3d7drk3). And KPN, a Dutch service provider, is taking these practices to a new level, announcing plans for differentiated pricing in which "services such as browsing, using mobile VoIP [voice over IP], instant messaging, and watching videos will get their own price tag" (http://tinyurl.com/3efy9hf).

These differentiated pricing models are prevalent on most mobile phone networks. Although many users already pay three times for data traffic (for voice, SMS, and a data plan), additional types of data use are beginning to carry their own fees. For example, Orange in France charges 15€ per month for VoIP,[12] and Vodafone and Deutsche Telekom respectively charge 10€ and 9,95€ per month for the service.[13] Telia Sonera in Sweden allows VoIP but only on its most expensive data plans (www.telia.se/privat/produkter_tjanster/mobilt/surfaimobilen/), while SFR in France has blocked VoIP altogether on the iPad (http://img.telecomix.org/EU/src/127728743242.png). Additional carriers such as Vodafone in Italy block or degrade P2P traffic (http://tinyurl.com/oj5a7e).

Because lower-income subscribers rely more on mobile connectivity than affluent constituencies, these restrictions affect such subscribers most — populations where Internet access is most critical for opening doors to economic, educational, and other opportunities

and where mobile access might be the only connection to the Internet. In the US, for example, Metro PCS offers unlimited "MetroWeb" 4G service coupled with unlimited YouTube, yet blocks other streaming video services and applications such as Skype. Addressing the carrier's severe limitations, civil rights advocate Malkia Cyril wrote that Metro PCS has been "termed 'Ghettro PCS' by many low-income black and Latino subscribers."[14]

The Impact of Command-and-Control Networks

Key technological advances are enabling this trend of restricting user freedom on Internet access networks. For example, the IP Multimedia Subsystem (IMS) is a still-evolving feature set being deployed on wireless networks that can designate an earmarked end-to-end channel to different dataflows.[15] Whereas the Internet once permitted users to access any number of applications and services that ran on top of the network, IMS lets a carrier break the Internet into differentiated services such as email or voice traffic and then charge the user for them on an individual basis. Likewise, Deep Packet Inspection (DPI) technologies let a network operator identify and monitor specific kinds of traffic — and both Plusnet and KPN (whose differentiated pricing depends on it) are avid DPI users. Meanwhile, authoritative regimes are using this same DPI technology to monitor and censor Internet communications, as documented by case studies conducted by the OpenNet Initiative (http://opennet.net).

In addition, the worldwide popularity of iPhones has further allowed Apple to export its iOS operating system. Because only Apple-approved applications can be officially installed through the iTunes App Store, Apple has significant control over its mobile devices.

Harvard Law professor Jonathan Zittrain warns that iPhones and similar technologies are examples of computing devices devolving into "dumb terminals" — no longer programmable computers but rather appliances with a predefined set of functions.[16] Some devices, such as the HTC G2 phone with Google, resist user modification by storing core software in read-only memory, while the Motorola Droid X contains a chip that can render the device inoperable if the phone detects unauthorized, though legal, software.[16,17]

Stanford Law professor Barbara van Schewick explains that a significant gap exists "between network providers' private interests and the public interests."[18] This gap has continued to manifest itself throughout history. As legal scholar Tim Wu writes in his review of information technologies of the past 100 years, "History shows a typical progression of information technologies … from a freely accessible channel to one strictly controlled by a single corporation or cartel — from open to closed system."[19] This shift to a more closed system on mobile networks poses significant dilemmas for closing the digital divide because it creates an unequal hierarchy of digital opportunities depending on how an individual accesses the Internet and could lead to fundamentally different Internets for different users.

If carriers and device manufacturers are in a position to determine the functionality of an Internet connection or an Internet-enabled device, efforts to close the digital divide will be negatively affected. As DiMaggio and his colleagues stress, understanding the digital divide requires that we comprehend what benefits users can achieve through their Internet connection.[3] Given current trends, those who can afford to access the Internet through a traditional wireline connection will have a considerable advantage over those who can

afford only a mobile connection. This divide won't be due to speed or price, but rather functionality. As providers add further limitations, such as bandwidth caps, or let users access certain applications only after purchasing higher-cost plans, the promise of the Internet and broadband as a great resource for society's least advantaged will go unfulfilled.

Moreover, the Internet's success as a transformative medium for communications rests on its users' ability to be active participants in its ongoing development. New York University professor Richard Sennett posits that craftsmanship, whether of a new cabinet or a new media, is a "basic human impulse, the desire to do a job well for its own sake."[20] In essence, the ability to localize, improve, question, and explore the tools we use is an important facet of being human. Early Internet adopters, in addition to possessing certain technical skills, were empowered to fundamentally shape the medium. The Internet in many respects reflects their ideas and innovations. These early users, or "Internet craftsmen," were fully empowered to build, improve, and innovate the technology. Yet over the past several years, that level of freedom and opportunity has been systematically erased. Today's networking technologies are continually shifting away from this open and participatory architecture. ISPs are creating ever-increasing barriers to innovation and are more resistant to end-user modifications. Today, ISPs are focusing substantial time and energy to locking down every facet of their networks, designing their systems to prioritize content consumption, and creating barriers to user-driven communications, adaptations, and innovations.

Bridging the New Digital Divides

While world leaders are recognizing the Internet's importance, current trends toward command-and-control networks pose a significant challenge for closing the digital divide and empowering all users. Solutions that help solve these problems embrace craftsmanship and participant control over networking technologies. Recent technological advances are already facilitating the development of hybrid networks that can utilize ISP networks when needed but create locally controlled networks that prioritize user-generated communication, applications, and services.

Metcalfe's law assumes that a new network participant gains the benefits gleaned from other members. As we're seeing today, however, command-and-control networks sustained by business models based on an all-powerful network operator are bleeding off these networks' exponential benefits. Whereas such companies stand to gain enormous profits by commoditizing every form of communication possible, the inefficiencies these practices cause (in terms of lowered information flow, network congestion over centralized relay points, greatly lessened innovation at network edges, and so on) are coming at edge-users' expense. Better technologies exist that would dramatically lower communication costs, increase adoption rates, and fuel new service and application development, and that are synergistic with pre-existing infrastructure.

For example, using off-the-shelf Wi-Fi routers with upgraded software, mesh networks can facilitate local-to-local communications, letting individuals stream video, share local media, and use VoIP applications (such as Skype) for free phone calls.[21] Current implementations range from covering a few blocks in Detroit, Michigan (www.newamerica.net/node/34925), to covering hundreds of square kilometers in and around Vienna.[22] One recent report describes how in Berlin, "a city that has struggled with depopulation, high unemployment, and budget deficits since the fall of the Berlin Wall, the community wireless network Freifunk has provided free Internet access to residents who cannot afford commercial services since 2002."[22] P2P networking on mobile handsets creates additional opportunities for edge-user empowerment. In Australia, the Serval Project (www.servalproject.org) has developed mesh networking for cell phones running Android. Its system lets users make free voice calls through a local network or — by adding Asterisk (www.asterisk.org) or another VoIP gateway — to almost anywhere in the world (http://tinyurl.com/4g5cjnp).

Gnu Radio and the OpenBTS projects are examples of what an empowering alternative to mobile network lockdown might look like. OpenBTS is developing an open source GSM air interface, potentially enabling users everywhere to build their own cell phone networks and provide low-cost or free services.[23] Gnu Radio, a software development toolkit that performs signal processing and lets users develop software radios using cheap hardware, could put adaptive networking technologies into the hands of the masses (see http://gnuradio.org/redmine/wiki/gnuradio).

Yet the direction of regulation has been to prevent the rollout of these innovations. Spectrum reforms to allow widespread use of cognitive radio technologies (especially shared and opportunistic spectrum access) have been met with hostility by current and previous US Federal Communications Commissions. Instead, the overarching focus has been on maintaining artificial scarcity through limited spectrum access. As these technologies mature, the gap between technological capabilities and permissible use will increase. Users will have far too limited legal space for communications due to this regulatory stagnation — a process that will

eventually lead to the rise of a generation of electromagnetic jaywalkers.

The changes needed aren't solely in the regulatory space, however. Bridging today's digital divides means understanding that Internet craftsmen are digital literacy crusaders and mentors and that new thinking and innovative technologies are direly needed. Closing the divide means getting rid of antiquated barriers that prevent Internet craftsmen from pursuing outside-the-box thinking, but it also means making it illegal to develop new barriers to tinkering with and extending functionality. Supporting the Internet craftsman doesn't mean every Internet user will become an expert — it means providing the resources and opportunity necessary for anyone to develop innovative infrastructure, new services, and applications, and improve communications to better meet their own needs and that of their community.

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Sascha D. Meinrath is the director of the New America Foundation's Open Technology Initiative. Contact him at meinrath@newamerica.net.

James Losey is a policy analyst with the New America Foundation's Open Technology Initiative. Contact him at losey@newamerica.net.

Benjamin Lennett is a senior policy analyst at the New America Foundation's Open Technology Initiative. Contact him at lennett@newamerica.net.

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Transcending Net Neutrality: Ten Steps Toward an Open Internet

Sascha Meinrath

Victor Pickard
University of Pennsylvania

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Abstract

The past few years have witnessed a once-obscure issue known as "net neutrality" blow up into arguably the most publicized policy debate in US telecommunications history. An untold story is how this relatively technical debate spilled outside the rarefied airs of Congressional Committees and the Federal Communications Commission's (FCC's) eighth floor to rage across the blogosphere, major newspapers, YouTube clips, and episodes of The Daily Show to become, if not a household phrase, a topic of popular debate involving millions of Americans. One explanation is that, at its root, the net neutrality debate is far more significant than a squabble among technocrats. Rather, it is first and foremost a normative debate, one that will determine the role of the Internet in a democratic society, with profound implications for the daily welfare of millions of citizens who rely on the Internet as a critical resource. Unfortunately, it is such normative concerns, along with related political and historical contexts, that have been least explored in much of the net neutrality scholarship to date. This article aims to address these gaps while expanding the parameters of the existing debate.

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Transcending Net Neutrality: Ten Steps Toward an Open Internet

Sascha D. Meinrath and Victor W. Pickard

The past few years have witnessed a once-obscure issue known as "net neutrality" blow up into arguably the most publicized policy debate in US telecommunications history. An untold story is how this relatively technical debate spilled outside the rarefied airs of Congressional Committees and the Federal Communications Commission's (FCC's) eighth floor to rage across the blogosphere, major newspapers, YouTube clips, and episodes of *The Daily Show* to become, if not a household phrase, a topic of popular debate involving millions of Americans. One explanation is that, at its root, the net neutrality debate is far more significant than a squabble among technocrats. Rather, it is first and foremost a normative debate, one that will determine the role of the Internet in a democratic society, with profound implications for the daily welfare of millions of citizens who rely on the Internet as a critical resource. Unfortunately, it is such normative concerns, along with related political and historical contexts, that have been least explored in much of the net neutrality scholarship to date. This article aims to address these gaps while expanding the parameters of the existing debate.

"Network neutrality," defined broadly, is non-discriminatory interconnectedness among data communication networks that allows users to access the content and to run the services, applications, and devices of their choice. In essence, network neutrality forbids preferential treatment of specific content, services, applications, and devices that can be integrated into the network infrastructure. This principle has been the foundation for rapid innovation and the Internet's relative openness. As Congress debates whether network neutrality protections should be written into current legislation, the battle lines have been drawn between large telecommunications companies that own the pipes, on one side, and Internet content companies and public interest groups on the other. Although scholarship has begun to catch up with the net neutrality debate, the majority of this work has failed to connect this issue with larger

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Sascha D. Meinrath is the Research Director for the New America Foundation's Wireless Future Program. Additionally, he coordinates the Open Source Wireless Coalition, a global partnership of open source wireless integrators, researchers, implementers, and companies dedicated to the development of open source, interoperable, low-cost wireless technologies. He can be reached at sascha@saschameinrath.com and (202) 986-2700 x226. Victor W. Pickard recently finished his PhD at the Institute of Communications Research at the University of Illinois, Urbana-Champaign. Currently, he works on telecommunications policy as a Research Fellow for the New America Foundation.

ramifications that arise while striving toward a democratic Internet.

In this article, we attempt to broaden the net neutrality debate while briefly taking stock of recent scholarship. In doing so, we critically evaluate the current network neutrality debate and offer a set of technical and policy guidelines for a new, more broadly defined open Internet.[1] Specifically, we submit that beyond redefining network neutrality, we must connect issues usually dealt with separately—issues that are actually a subset of one overarching concern: the struggle for a democratic Internet. We conclude with an exploration of the social and political impacts of this broader conception of network neutrality. These recommendations, we argue, provide a proactive foundation for creating a more open and participatory Internet. This project builds upon an earlier formulation that we referred to as the "New Network Neutrality."

WHY NET NEUTRALITY MATTERS

Network neutrality helps ensure that telecommunication infrastructures remain "dumb," delivering content and services equally in a best-effort manner that treats data/content delivery equitably. This best effort entails packets being delivered in a first-in first-out method at the maximum speed possible given network constraints. Under a framework of network neutrality, network operators do not decide what content users can access and cannot impede the flow of or give preferential treatment to particular kinds of content. The loss of network neutrality provisions, in effect, removes a crucial safeguard and increases the likelihood of a discriminatory telecommunications system.

A largely straightforward question of how the network will be operated has been rendered unnecessarily opaque by some of the actors in these debates. In particular, public relations representatives of the phone and cable companies who stand to gain the most from an Internet stripped of net neutrality protections devoted considerable resources toward averting consensus while maintaining a façade of a debate over democratic requirements for an open Internet. Some industry-funded "astro turf" groups have recast the debate as one over government regulation. Christopher Wolf, Co-Chair of HandsOff.org, claimed that "There is no established definition for the concept of 'net neutrality'" and that "Such government control over the evolution of the Internet is unprecedented."[2] Similarly, former Congressman Dick Armey's organization FreedomWorks advocates for such a *laissez faire* regulatory approach.[3] Many of these claims against regulation ignore the fact that the federal government developed, funded, and directly managed the Internet for more than a quarter of a century (until US officials handed over network control to the private sector in the mid-1990s), and continues to actively regulate and subsidize the Internet. Moreover, many of these self-defined anti-regulation organizations appear oddly complacent toward heavy-handed private control over the Internet.

While groups like HandsOff seem driven by a categorical opposition against all governmental interventions, public interest advocates, on the other hand, tend to stress openness as their main concerns. Many groups and individuals within the "Internet freedom" coalition have sought net neutrality as an end in itself, while others have cautioned that net neutrality does not fully restore common carriage and should not be seen as a silver bullet. Josh Breitbart makes the important point that net neutrality is actually a retreat from earlier ideas such as open access and common carriage, which were US law prior to *Brand X*:

> Net neutrality is actually a retreat from "open access," which is what we had before the Supreme Court's Brand X decision. Open access applied to the Internet when we were using dial-up and it was classified as a "telecommunications service" like the telephone. With the telephone, that means owners of the lines can't prioritize their customers' calls over those of their competitors' (net neutrality or, as it's known in the phone world, "common carrier"), but it also means they have to lease their lines to other phone service providers (open access). Open access is how you can have real competition without having a dozen different wires running under your street, through your backyard, and into your house.[4]

As Breitbart suggests, network neutrality is inextricably linked to principles of "common carriage," a bedrock principle of telecommunications policy for nearly 100 years that mandated non-discriminatory service.[5]

Making sense of what is at stake in current net neutrality debates requires examining key antecedents in telecommunications history. In the following section, we examine the historical context and the current parameters of the debate. This historical context, we argue, is necessary to begin imagining alternative trajectories for internet policy.

HISTORICAL OVERVIEW

Prior to common carriage laws, telecommunication operators were able to abuse their market position. During the Civil War, Western Union controlled telegraph trunk

lines across the country and gradually achieved near monopolistic dominance by buying up competing companies and actively undercutting congressional and popular support for constructing a rival postal telegraph system. As its network expanded in the 20th century, Western Union focused on serving business clients while pricing potential competitors out of specific geographic markets and ignoring social obligations, such as universal service. Based on Western Union's business model and the larger political and regulatory environment, there was little incentive to create innovations that could have made access affordable for average citizens. With the rise of telephony and early build out of telephone networks during the early 20th century, public service protections were introduced into the telecommunications regulatory structure, including common carriage.

For decades, telephone network operators were considered "natural monopolies." The biggest monopoly (and largest corporation in the world) was the American Telegraph and Telephone Company, which, until its forced 1984 breakup into the "baby bells," dominated the telecommunications industry. Given its monopoly privileges, it was mandated as a basic public service that AT&T could not discriminate against other carriers using its lines. Leading up to the Modified Final Judgment that broke up the Bell system, Judge Harold Green in 1982 maintained that phone companies should not sell information. At the time, former FCC commissioner Nicholas Johnson argued that allowing phone companies to provide both conduit and content would hurt both businesses and consumers instead of providing the "channels of communication for a democratic society." Johnson argued that the phone companies' drive to get into the information selling business was the "No. 1 public policy issue confronting our nation." Arguing that they already profit from both ends of the process, he worried that telecom providers "charge us for getting information out of the system and they charge the supplier for putting it in."[6] Commissioner Johnson's fears became even more warranted after the 1984 Cable Act and the 1996 Telecommunications Act, which, respectively, allowed cable to remain a closed system and to become an Internet service provider.

The Telecommunications Act of 1996 was the first major overhaul of the landmark 1934 Communications Act and the first comprehensive attempt to reform US media policy for the digital era. This complex and far-reaching legislation replaced structural regulation with market incentives for telephony, radio, broadcast television, cable television, and satellite communications. Hailed as an effort to unshackle market forces and sold with the promise that deregulation leads to enhanced competition, the bill has instead led to unprecedented

telecommunications conglomeration, lessened consumer protections, and decreased ownership diversity. However, taking for granted the historical importance of common carriage in curbing market excesses, even the deregulatory thrust of the 1996 Telecom Act left the principles of non-discrimination intact.

This changed with the June 27, 2005, Supreme Court *Brand X* decision and subsequent August 5, 2005, FCC decision to "deregulate" carriage. Culminating after a long legal fight between cable companies (like Comcast and Time Warner) and independent ISPs (like Earthlink and Brand X) over whether cable operators should be required to sell access to their networks to potential broadband service provision competitors, the *Brand X* decision was significant for essentially deregulating broadband. The Supreme Court's 6-3 decision favored the National Cable and Telecommunications Association (NCTA), the principal trade association of the cable television industry, by overturning an earlier appellate court decision and affirming the FCC classification that cable broadband was an "information service" instead of a "telecommunications service," thus exempting cable companies from common carriage laws.

This seemingly minor turn of phrase meant that cable providers did not have to share their infrastructure with competitors. Together with the subsequent FCC decision to extend this exemption to phone companies (ostensibly to provide a level playing field among market players), this court decision removed safeguards and created the potential for access restrictions to non-preferred content. Many public interest advocates pointed out how this decision countered 100 years of telecom policy and risked changing the open and non-discriminatory nature of the Internet while creating a new class of potential gatekeepers.

MONOPOLY POWER AND CONTENT DISCRIMINATION

The history of content control goes back centuries and bears mentioning given parallels to the outcomes that network neutrality advocates fear today, particularly when looking at the history of the US postal system. For example, analogies can be seen with the abortive attempt in the early 1790s to admit only certain newspapers into the mail. Congress rejected this policy when it enacted the Post Office Act of 1792, which put into law principles of non-discrimination. However, content restrictions persisted, such as postal administrators blocking the dissemination of books via mail, which they argued were too bulky, and southerners after 1835 blocking the circulation of information on slavery.[7] Although varying degrees of content discrimination have persisted, in general the opportunity

for anyone to send anything anywhere without constraint or discrimination was a fundamental assumption of this early US communications system. Alexis de Tocqueville, who credited newspapers and other information delivered via the post as greatly responsible for America's thriving democratic culture, praised the US system.[8]

This openness was periodically challenged, particularly by the monopolistic telegraph industry, which abused its market power. Paul Starr notes historical parallels with contemporary telecommunications marketplaces in which incumbents dominate networks to exploit their existing position rather than innovate and spend little money on research and development, often investing more in politics than in technology. Similar market conditions exist today. Once again, first-mile telecommunications are heading toward near-monopoly status. This time, however, a crucial safeguard is missing; the Internet is no longer classified as a telecom service and is at risk in being transformed into a cable television business model.[9]

Despite network operators assurances to the contrary, over the past several years there have been ominous glimpses of what a non-neutral network might look like. In 2004, North Carolina ISP Madison River blocked DSL customers from using its rival's (Vonage) VOIP telephony services. In 2005, the Canadian telecom corporation, Telus, blocked users from accessing a pro-union Web site during a labor dispute. In 2006, AOL Time Warner blocked a mass email campaign from its customers that opposed AOL's proposed tiered email system. In 2007, AT&T apparently censored a Webcast of the rock band Pearl Jam's anti-Bush political commentary. Also in 2007, Verizon was found blocking the pro-choice organization NARAL's text messages. In 2008, Bell Canada was caught throttling third-party DSL providers' P2P traffic. Perhaps best exemplifying the potential for abusing net neutrality has been Comcast, whose practices of blocking traffic associated with Bit Torrent, a peer-to-peer file-sharing system, were exposed in 2007. These are just a few of the more egregious infractions against net neutrality.

PREVIOUS LITERATURE

Three waves of scholarship addressing the net neutrality debate can be discerned thus far. Although anticipated by earlier debates, the first phase was marked by Timothy Wu's initial formulation of "network neutrality" in his seminal 2003 work, *Network Neutrality, Broadband Discrimination*, where he forwarded the idea that network architectures should be neutral purveyors of data.[10] The debate simmered among a relatively small group of commentators until the Supreme Court's pivotal *Brand X* decision, which catapulted net neutrality to a new level of

urgency as the prospects of tiered Internet services paralleling a cable television business model became a distinct reality.[11]

The *Brand X* decision ushered in a second wave of scholarship that was remarkably cautious given the stakes involved. For example, Eli Noam has suggested a "Third Way" for net neutrality limited to "Last Mile" concerns.[12] Christian Sandvig was quick to discount some arguments posed by network neutrality advocates, suggesting that many aspects of net neutrality smacks of an old debate, evidenced by principles laid out by Ithiel de Sola Pool decades earlier. Noting that network neutrality has never been the norm given that all Internet providers have discriminated against certain types of content to some extent, Sandvig called for establishing a set of normative guidelines to distinguish acceptable types of traffic shaping.[13] Less common in this second wave were articles that staked out a position boldly calling for mandated net neutrality.[14]

Currently, we have reached a new phase of the debate, one that places net neutrality provisions in a state of uncertainty. Although prospects seem less dire than when we began working on this issue in 2005-2006, net neutrality protections are still not codified into law. However, even as scholarship has become less complacent toward the loss of net neutrality, we submit that now is precisely the moment that we should be aiming beyond mandated net neutrality for more encompassing safeguards to ensure an open Internet. Much of the existing scholarship and commentary fails to sufficiently emphasize the import of normative principles—principles regarding the role of the Internet in a democratic society and the debt that Internet providers owe to the public. When considering the fact that the four Bell companies earn roughly $14 billion every year from access to Internet content and applications in addition to $20 billion a year in direct access fees from broadband Internet subscribers and when taken in the context of the enormous tax subsidies and other benefits that telecom corporations receive from public entities, this debate should focus more on the social contract between telecom network operators and the public. These kinds of social contract debates often present themselves during critical junctures and periods of media crisis.[15] The fact that network neutrality *is* a normative principle is far too often overlooked. Industry attempts to reframe the debate, growing technological complexity, and shifting allegiances among competing actors artificially sunder democratic Internet principles that should be considered together.[16]

Contrary to these general trends lies a neglected tradition located in scholarship that addresses more normative concerns like open architecture, open access, and online

ethics.[17] Wu offers a short list of network neutrality rules that would prohibit carriers from discriminating content. Similarly, Benkler's *Wealth of Networks* advocates for a commons-based policy orientation. Along with Lessig and others, this approach is aligned with the notion of Cooper's "open architecture."[18] Drawing from the research of Yochai Benkler, Mark Cooper, Lawrence Lessig, Tim Wu, and others, we envision a more open and participatory Internet. Frequently referred to as a commons-based approach to the management of communications systems, this model emphasizes cooperation and innovation as opposed to privatization and enclosure. Given that all technology is inscribed with social values that foreclose certain possibilities while encouraging others, emphasizing these linkages illuminates what is at stake with network neutrality and situates this debate within a larger vision of Internet openness. We sit at a critical juncture for Internet policy; opportunities now abound that soon will disappear.

CURRENT STATE OF AFFAIRS

While net neutrality helps prevent many of the worst market excesses, it does little to ameliorate some of the systemic problems that necessitate it. Media conglomeration and the attendant lack of diversity of ownership and perspectives provide one focal point for discussing network neutrality.[19] From the reemergence of telecommunications giant AT&T to current efforts by FCC Chairman Kevin Martin to relax media ownership restrictions, fewer players are gaining massive market share, creating increasingly vertically and horizontally integrated corporations with the potential to dominate entire market sectors.[20] By many measures, the current FCC regulatory environment fails to spur technological innovation and has retarded expansion of digital inclusion efforts.[21] Instead, the FCC has fostered a decades-long market environment fraught with pricing and geographical discrimination as well as overpriced, substandard telecommunications services.[22]

Exacerbating difficulties in these crucial media policy areas are state and national telecommunications laws that slow innovation and competition in broadband services, thus creating an environment of digital exclusion. To date, more than a dozen states have passed laws that in some way limit competition and prevent innovation in business models, public investment, and public-private partnerships.[23] At the national level, everything from local control over local rights-of-way to consumer protections would be undermined by pending legislation.

While yesteryear's newspapers and today's Internet are quite different media, their social functionality within civil society is remarkably similar. Whereas the unrestricted transport of newspapers via the postal service has long been protected and subsidized, today ISPs are proposing to have discriminatory power over social networking applications that use their networks. Using the postal service, anyone can send packets first-class, second-class, third-class, parcel post, overnight, etc. However, when one sends a packet, it will be handled in a first-in-first-out manner within the chosen service without regard to the type of packet being sent. Likewise, network neutrality incorporates strong civil rights protections simply by mandating a neutral and non-reactive transport medium.

A related issue underlies concerns over surveillance. Recent endeavors to surveil network traffic encroach upon users' rights to privacy, creating a panoptic environment that undermines civil society, creativity, and public dialogue. Current law enforcement efforts should err on the side of maintaining network neutrality, yet often mandate data collection of user information that demonstrates both a lack of understanding of the current state of technology and, in actuality, undermines long-term law-enforcement goals (as discussed later in this article). The Communications Aid to Law Enforcement Act (CALEA) is just one example of significant risks posed to Internet freedom and, ironically, long-term law enforcement.

ABUSE OF MONOPOLY MARKET POWER

The rise of telephony over the past century suggests that our current path has been tried before. As Paul Starr writes in *The Creation of the Media*, "From 1894 until 1907. . . the market broke open with a surge of independent commercial and nonprofit cooperative telephone enterprises."[24] AT&T and the Bell system, however, as the primary owner of telephone long-distance service, often refused to interconnect these "independent commercial and nonprofit cooperative enterprises" wherever they were in competition for local phone customers. Instead, AT&T used its long-distance monopoly to open 3,500 new exchanges in smaller communities of less than 10,000 people between 1894 and 1907. As Starr sums up:

> The Bell-independent rivalry at the turn of the century led to the same breakneck extension of networks that had characterized the early telegraph industry around 1850. . . prices for telephone service fell sharply. Independent phone companies generally offered lower rates than Bell, and though Bell cut its rates everywhere, they were lower where it faced a rival.[25]

At least until the 1913 Kingsbury Agreement, AT&T interconnected with "Independents" when it suited its needs; however, it preferred to buy out or quash these competitors. Today, in the wake of *Brand X*, a market and regulatory environment has been recreated that eliminates independent companies and allows backhaul owners to engage in similar anti-competitive practices.

In 1907, AT&T's new president, Theodore Vail, publicly declared that telephone service should be, in essence, a unified, interoperable, neutral network. AT&T, through the judicious use of governmental regulation—for which AT&T often directly lobbied—was able to create a national interconnected telephone network and grow its market share dramatically during the first three decades of the 20th century (to 66 percent in 1920 and 81 percent in 1932), crushing the "home rule" telephone movement, thus ensuring decades of market dominance until the 1984 divestiture. The public statements of today's telecommunications leaders are explicitly interested in devising ways to close off their networks, maximize their billable minutes, and create new avenues for extracting additional fees for service quality, non-interference, and non-discrimination. This sensibility is best exemplified by AT&T and statements made by its CEO, Ed Whitacre:

> I think the content providers should be paying for the use of the network—obviously not the piece from the customer to the network, which has already been paid for by the customer in Internet access fees—but for accessing the so-called Internet cloud . . . If someone wants to transmit a high quality service with no interruptions and 'guaranteed this, guaranteed that', they should be willing to pay for that . . . They shouldn't get on and expect a free ride.[26]

An important lesson is that AT&T gained its prominence not by any superior business model alone, but through governmental regulation, predatory pricing, buying up competition, centralizing network control, and a dedication to creating *and controlling* a nationally interconnected network. Today, in much the same way it undermined the "home rule" telephone movement 100 years ago, AT&T is again attempting to leverage its network ownership—this time targeting not only telephone services but also all Internet-mediated communications, including data services, streaming audio and video, and television.

FCC REGULATORY ENVIRONMENT

Network neutrality protections treat the question of access as a critical element in determining whether a network is being operated in an open manner. Bottlenecks to network access undermine the types of services offered, create artificial scarcity, and lead to increased pricing and lowered quality of service. This is exemplified by current national policy surrounding the licensure of the public airwaves.[27] Well more than 99 percent of the public airwaves are either reserved for governmental use or licensed to private companies.[28] Even though the tiny sliver of so-called unlicensed frequencies has generated enormous economic activity and innovation, everything from WiFi devices to baby monitors, radio phones, garage-door openers, and microwave ovens coexist within these rare frequencies.[29]

The FCC has continued to privilege a model for licensure that allows only a single entity to broadcast on a given swath of spectrum, often at a specific power level and geographic location. While digital technologies have radically transformed almost every aspect of current society, our licensure regime is predicated on use of the public airwaves as if we were still using 1920s and '30s technologies. Whether one looks at the debate over low-power FM radio licensure, interference temperature, or unlicensed devices in unused television broadcast bands, the story is invariably the same: Incumbent interests already invested in licensed frequencies seek to prevent competition by maintaining the licensure status quo and thereby dramatically slowing down change or stopping it altogether.

Given the accumulating evidence for broadband connectivity's importance for economic development, purposefully limiting access to the necessary tools to build data communications networks is a disservice to the general populace.[30] Today, most wireless broadband providers are forced to use only a handful of unlicensed frequencies, creating a scarcity of capacity in dense urban areas. Meanwhile, rural areas are often completely neglected by broadband providers. Opening up large swaths of unlicensed frequencies would not only help meet current demand but also provide ample spectrum for future technologies such as cognitive and software defined radios. Yet proceedings to open up additional bands such as 3650-3700MHz or to open up bands to more users and unlicensed devices in unused 700MHz television broadcast frequencies continue to stagnate.

These same problems exist with other telecommunications media. Classical economics dictate that a glut of supply should lower pricing. However, US broadband pricing remains exceptionally high despite the open secret that a majority of fiber infrastructure in the United States is "dark" and remains underused. Information on where this dark fiber exists and how much is available is considered a "trade secret." In his book *Broadbandits: Inside*

the $750 Billion Telecom Heist, Om Malik discusses the enormous infrastructure overbuild of the late 1990s.[31] The reverberating effects from this $750 billion market failure are still hindering US broadband development today. Meanwhile, the FCC has in many cases systematically removed the few remaining checks and balances protecting US residents from corporate malfeasance and market excesses.

US BROADBAND PENETRATION RATES

Numerous states have passed laws restricting municipal entry into broadband service provision. Prior to 2005, 14 states created barriers to municipal broadband service provision, which ranged from outright bans on public utility districts providing retail telecommunications services to taxes on telecommunications services provided by public entities (but not private providers) to increase their prices.[32] In response to direct lobbying by telecommunications incumbents, more than a dozen states have passed regulations restricting competition in this market sector.[33] As the city of New Orleans discovered during Hurricane Katrina, these state laws often force municipal entities to spend crucial resources on making their networks worse.

Stagnation of US broadband penetration rates relative to a growing number of industrialized nations is due to the combination of the aforementioned factors. While the nation continues to lag further behind, this suboptimal state of affairs is continually worsened by official comments, reports, and protocols that purposefully confuse the issue and hide the extent of the problem.[34] For example, on July 26, 2006, the FCC released its most recent figures on "high-speed services for Internet access." In previous years, the FCC had been lambasted for stating that 99 percent of the population had access to broadband services. Numerous experts provided feedback on how the data collected by the FCC could be improved so that its report would provide more useful information, such as collect information based on census track, disaggregate satellite and other services, and make explicit the speeds of the services provided.[35] Yet, the 2006 report does almost nothing to address the fundamental concerns raised. Instead, the FCC chose to wordsmith a "solution" that ignored the requested feedback, leaving many issues without redress: the inadequacy of the official definition for "broadband" as 200kbps in a single direction; the severe limitations of satellite as a medium for broadband service provision (in particular, speed limitations and latency, which severely limit its utility for streaming, VoIP, and other live services); and the lack of usefully disaggregated data. By systematically suppressing competition and erecting numerous barriers to entry, the FCC and telecom incumbents have created an environment whereby substandard and exorbitantly priced broadband service provision has become the norm.

TOWARD AN OPEN INTERNET

We synthesize existing commons-based models to create a more expansive standard of network neutrality conducive to Internet openness—a model that runs counter to US phone and cable companies' plans and challenges the overly narrow parameters of current public interest arguments. Discussion among pro-and anti-network neutrality camps often centers on the debate over quality of services, bundling of services, and interconnection of networks. At its core, the question is whether the Internet should use an end-to-end infrastructure consisting of a dumb network or whether a centralized infrastructure should be used to inspect and shape network traffic based upon its content, origin, and/or destination; thus, supporters of smart networks are often aligned with the anti-network neutrality camp.[36]

Fundamental to smart networks is the idea that higher latency is not conducive to some services and applications. Thus, for example, VoIP (Voice over Internet Protocol is packet-based telephony, a replacement phone service) or streaming HDTV (High Definition TV) both require low-latency and low-jitter throughput to be useful, whereas file transfers like Web surfing and email tend to be relatively latency-agnostic and jitter-insensitive. An ideal smart network would be able to distinguish services and applications requiring low-latency and prioritize these network uses. The flip side is that low-priority network uses would find their latency increasing once low-latency prioritization took place. A corollary of this phenomenon is that latency is mainly an issue of network capacity; with adequate capacity, packet prioritization becomes a moot point. Thus, smart networks have the potential to create a *disincentive* for system-wide capacity upgrades.

For example, within Ethernet systems, network neutrality might be circumvented through the use of the 3-bit-wide "Precedence" section of the 8-bit "Type of Service" field along with the existing 3-bit delay, throughput, and reliability quality of service parameters. Precedence is, for the most part, rarely used across most public network infrastructure (though it is more prevalent within private networks). While originally conceptualized as a mechanism for determining the prioritization of traffic based on its import to network control (*e.g.*, routine, priority, immediate, flash, flash override, CRITIC/ECP, Internetwork control, network control), it could also be

used to discriminate content based upon purchase of premium, high-speed, or tiered services.

Additional complexity arises in the administration of a packet-prioritizing network since this would necessarily involve some form of packet inspection (*i.e.*, to identify what type of packet is being sent and its prioritization level). Once system-wide prioritization levels are in place, an incentive exists to create software to "disguise" data as a higher priority form in order to speed its delivery. Thus, a user might "hide" instant messaging data by using a program that makes it appear to the network routers that these data are VoIP packets; someone downloading MP3 files might use an application that makes these data appear to be a streaming audio file. Network providers, knowing that this outcome is inevitable, would, in turn, need to do a deeper packet inspection, further slowing network capacity as router CPU time is used to ensure that each packet is correctly identified. A non-neutral network would create incentives for non-high-speed content providers to use high-speed content provision proxies to deliver content, creating an entire market dedicated to concealment of data-location and counter-measures to prevent these initiatives by network owners and those paying premium rates to avoid content discrimination. Thus, without network neutrality, a data-obfuscation arms race would certainly develop spanning all aspects of the network's infrastructure.

EXPANDING THE DEBATE

In our view, the ways in which network neutrality has been defined, with an emphasis on non-discriminating wires and common carriage, are too limited in their scope. Network neutrality advocates have been reacting to the actions of incumbents and their lobbyists instead of formulating more proactive next steps. Using the current national conversation as a springboard, we propose a far more encompassing perspective to help ensure network neutrality, one that we believe will better enable the Internet to reach its democratic and participatory potentials. Our recommendations go beyond questions of open access to consider the broader contours of Internet architecture, including software, hardware, wireless/broadband infrastructure, ownership, economics, and open protocols and standards.

Our model for an open Internet contains 10 facets that are necessary to ensure an interoperable, interconnected, non-discriminatory, global Internet. We assume that competition is vital at all layers of Internet operations. Without this competition, market capture through path dependency—a situation inherently detrimental to innovation and the best interests of network participants—tends to arise. While aspects of this analysis map onto the Open Systems Interconnection (OSI) Reference Model, we also incorporate factors that help ensure a politically neutral transport medium as well. In other words, "neutrality" is not just a technical specification; it also facilitates a social contract that supports equity and justice through data communications. Given the shortcomings of traditional neutral networking conceptualizations, this approach envisions a more democratic network infrastructure that:

1. Requires common carriage
2. Supports open architecture and open source driver development
3. Maintains open protocols and open standards
4. Facilitates an end-to-end architecture (*i.e.*, is based upon a "dumb network")
5. Safeguards privacy (*e.g.*, no back doors, deep packet inspection, etc.)
6. Fosters application-neutrality
7. Mandates low-latency and first-in/first-out (*i.e.*, requires adequate capacity)
8. Ensures interoperability
9. Remains business-model neutral.
10. Is governed by its users (*i.e.*, is internationally representative and non-Amerocentric)

The following provides an initial skeleton for what these 10 facets would entail; however, this is only a first step toward achieving full implementation. Substantial work is still required to flesh out these ideas.

RECOMMENDATION 1: REQUIRES COMMON CARRIAGE

Common carriage ensures that network operators lease their lines to all potential market players, including municipalities, at market (wholesale) rates. Ideally, this would include universal service provisions and service level agreements. As has been seen repeatedly throughout the history of transportation and telecommunications, common carriage protects the general public against price and geographic discrimination and other anti-competitive business practices. Since 2000, the number of Internet service providers has nearly halved (from 8,450 in 2001 to 4,417 in 2005). With the demise of common carriage provisions resulting from the *Brand X* Supreme Court decision, this number will continue to decrease.

RECOMMENDATION 2: SUPPORTS OPEN ARCHITECTURE AND OPEN SOURCE DRIVER DEVELOPMENT

Open architecture and open source driver development encourage a digital commons by keeping both the

hardware itself and any hardware access layer(s) open. As the open source movement gains ground (especially internationally) and hardware prices have plummeted, new business models have arisen to promulgate market capture and path dependence, creating potentials for secondary network closure.[37] Open architectures and access layers help promote competition by creating opportunities for new market entrants and rapid innovation of features and functionality.

RECOMMENDATION 3: MAINTAINS OPEN PROTOCOLS AND OPEN STANDARDS

Maintaining open protocols and standards helps ensure free-flowing, non-enclosed Internet services. This, in turn, facilitates innovation and widespread adoption of technologies. With the growing pull toward proprietary networking (especially within the wireless medium), it is vitally important to prevent the so-called Balkanization of the Internet. Protocols and standards are the building blocks for everything from interoperability to end-to-end connectivity.

RECOMMENDATION 4: SUPPORTS AN END-TO-END ARCHITECTURE

End-to-end architectures (E2E) help remove vulnerabilities to bottlenecks, gate-keeping, illegal surveillance by telcos, etc. E2E helps speed network throughput and increases network capacity while lowering network equipment costs and supporting peer-to-peer communications. An end-to-end architecture helps prevent both governmental and corporate interference in network traffic, an outcome that is especially important at a time when surveillance and digital rights management concerns are increasingly prevalent.

RECOMMENDATION 5: SAFEGUARDS PRIVACY

Private networks do not privilege state security imperatives that compromise individual privacy rights and help ensure a non-discriminatory environment for content access and information dissemination. Private networking is essential since back doors and other devices introduce both enormous security holes as well as increased impetus for development and widespread adoption of privacy software that hampers, over the long-term, legitimate law enforcement efforts. Privacy is also essential for ensuring the continued expansion of online business.[38]

RECOMMENDATION 6: FOSTERS APPLICATION-NEUTRALITY

With application neutrality, Internet television, VoIP, and diverse operating systems and services run unimpeded. Expected convergences in digital communications make this principle increasingly crucial to the long-term growth and health of the Internet. Digital Rights Management (DRM) considerations such as copyright also make this a critical facet for a more open Internet. In much the same way that telephone systems are neutral transport mediums for voice communications, the Internet must remain free from discriminatory practices that privilege some applications, services, or features over others.

RECOMMENDATION 7: MANDATES LOW-LATENCY AND FIRST-IN/FIRST-OUT

Low-latency and first-in/first-out helps remove the impetus for data packet and application discrimination by requiring that a service provider's profit margins adhere to the fundamental basic corporate responsibility to provide adequate services to its customers. These mandates help lower over-subscription rates, artificial scarcity, and the hoarding of dark fiber assets by mandating adequate capacity and providing incentive for network and capacity upgrades.

RECOMMENDATION 8: ENSURES INTEROPERABILITY

Interoperability harmonizes different systems and integrates foreign attachments. This is especially important to the continued global expansion of broadband service provision. As Cooper points out, interoperability lowers costs while increasing the collaborative potential of the Internet. Interoperability is critical to ensuring that the 80 percent of humanity who are not currently online will be able to interconnect with next generation telecommunications infrastructures.

RECOMMENDATION 9: REMAINS BUSINESS-MODEL NEUTRAL

A business-model-neutral infrastructure allows for public players such as municipalities and non-profits, as well as public-private partnerships and private corporations, to provide Internet services. Too often, competition is lessened, and the options for consumers to receive broadband services artificially limited, by shortsighted rules, regulations, and laws. A neutral

network cannot exist when limited to specific business models.

RECOMMENDATION 10: IS GOVERNED BY ITS USERS

We recommend replacing and/or dramatically expanding control over important governance institutions like ICANN in a way that internationalizes control over such a vital global resource. The current US-controlled ICANN model is unsustainable over the long term.[39] Expanding governance would also help remove artificial scarcity and hoarding of IPv4 addresses. As Milton Mueller and others have documented, control over global communications networks and the Internet, in particular, has remained Amerocentric.[40] Moreover, purportedly representative bodies like ICANN and the Regional Internet Registries (RIRs) often appear to privilege industry interests.

CONCLUSION

We submit that the implementation of these 10 principles will create a more participatory Internet. On a fundamental level, an open system is key to network growth and innovation. We acknowledge that our model does not address all material inequities, such as digital divide and lack of universal service issues, which, to be sufficiently remedied, require a redistribution of critical resources. Nor do we tackle some issues related to copyright, surveillance, and other contemporary political battles. However, our recommendations, if enacted, could improve the global deficit in Internet connectivity and help propel the United States toward its goals of universal, affordable broadband. These principles could help establish normative parameters to guide policy makers, both national and global, in their quest to create a better Internet. Ideally, these principles will be presented as a broadband democracy manifesto to be endorsed by members of Congress, state legislatures, and political candidates. Although piecemeal efforts are better than no movement at all, only if approached in tandem will these steps constitute a model for the Internet that is simultaneously open, democratic, and efficient.

NOTES

1. This article builds on an earlier version written in fall 2008 published as Sascha D. Meinrath and Victor W. Pickard, "The New Network Neutrality: Criteria for Internet Freedom," *International Journal of Communication Law and Policy*, 12, 225-243 (2008).

2. *See* http://www.handsoff.org/blog/ "Hands Off the Internet" at one point was spending roughly $400,000 a day on TV and newspaper advertising to promote a position identical to corporate sponsors like AT&T.

3. *See* http://freedomworks.org/.

4. Josh Breitbart, "Where's My Open Access," Civil Defense blog (Aug. 7, 2006), *http://www.freepress.net/news/16943*.

5. Eli Noam, "Beyond Liberalization II: The Impending Doom of Common Carriage," *Telecommunications Policy*, Vol. 18, No. 6 pp.435-452 (1994).

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7. Richard John, Spreading the News: The American Postal System from Franklin to Morse (Cambridge: Harvard University Press 1998). We are also indebted to Richard John's personal communications regarding these points.

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9. Paul Starr, The Creation of the Media: Political Origins of Modern Communications (Basic Books: New York, NY, 2004).

10. Timothy Wu, "Network neutrality, Broadband Discrimination," *Journal of Telecommunications and High Technology Law* (2), 141-179 (2003).

11. For a description of this case, see *http://www.fcc.gov/ogc/documents/opinions/2005/04-277-062705.pdf*.

12. Eli Noam, "A Third Way for Net Neutrality," *Financial Times* (Aug. 29, 2006).

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14. One notable exception is Bill Herman, "Opening Bottlenecks: On Behalf of Mandated Network neutrality." *Federal Communications Law Journal*, 59, 1, 107-159 (2007). Herman provided a comprehensive overview and challenges Christopher Yoo's argument that net neutrality provisions are unnecessary. *See* Christopher Yoo, "Beyond Network neutrality," *Harvard Journal of Law and Technology*, Vol. 19 (2005).

15. For a similar argument, see Victor W. Pickard, "Media Democracy Deferred: The Postwar Settlement for U.S. Communications, 1945-1949" (PhD Dissertation, University of Illinois 2008).

16. Harold Feld, "Thinking a Bit More Clearly on Grokster and Brand X," WetMachine, Tales of the Sausage Factory, May 3, 2006, *http://www.wetmachine.com/totsf/item/500. See also* Yochai Benkler, "From Consumers to Users: Shifting the Deeper Structures of Regulation Toward Sustainable Commons and User Access," *Federal Communications Law Journal*, Vol. 52, pp.561-579 (2000).

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18. Yochai Benkler's (2006) The Wealth of Networks: How Social Production Transforms Markets and Freedom (Yale University Press: New Haven, CT, 2006; Lawrence Lessig, The Future of Ideas: The Fate of the Commons in a Connected World (Random House: New York, NY, 2001).

19. Ben Bagdikian, The Media Monopoly (Beacon Press: Boston, MA, 2000); Robert McChesney, Rich Media, Poor Democracy: Communications Politics in Dubious Times (The New Press: New York, NY, 1999).

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22. H. R Slotten, Radio and Television Regulation: Broadcast Technology in the United States, 1920-1960 (John Hopkins University Press: Baltimore, MD, 2000).

23. *See* APPA's "State Barriers to Community Broadband Services."

24. Paul Starr, *supra* n.9, at p.193.

25. *Id.* at 201-202.

26. Paul Taylor, "AT&T chief warns on internet costs," *http://www.ft.com/cms/s/2/3ced445e-91c5-11da-bab9-0000779e2340.html*.

27. *Supra* n.20.

28. Slotten, 2000.

29. New America Foundation, The Citizen's Guide to the Airwaves: A Graphic Depiction of the Uses—and Misuses—of the Radio Frequency Spectrum (Washington, DC, 2003).

30. W.H. Lehr, C.A. Osorio, S.E. Gillett, & M.A. Sirbu, "Measuring Broadband's Economic Impact," presented at the 33rd Research Conference on Communication, Information, and Internet Policy (TPRC). Arlington, VA, Sept. 23-25, 2005; S.E. Gillett, "Municipal Wireless Broadband: Hype or Harbinger?," presented at Symposium "Wireless Broadband: Is the U.S. Lagging?," Washington, DC, Oct. 26, 2005.

31. Om Malik, Broadbandits: Inside the $750 Billion Telecom Heist (John Wiley & Sons, Inc: Hoboken, NJ).

32. James Baller, *http://www.baller.com/pdfs/Baller_Proposed_State_Barriers.pdf* (accessed June 30, 2007).

33. Ironically, these are often the same companies, such as AT&T, which are lobbying against similar regulations at the national level.

34. The OECD puts the US in 12th place among its 31 members as of December 2005; the 2005 statistics from the ITU places the US in 16th place. In 2008, the OECD still ranked the 15th for overall nationwide broadband penetration. This report runs contrary to recent governmental assurances regarding the rosy outlook on the state of broadband in the United States. *See* National Telecommunications and Information Administration, "Networked Nation: Broadband in America," Jan. 30, 2008. This report concludes that "a reasonable assessment of the available data indicates" that President Bush's 2004 objective of affordable access to broadband for all by 2007 has been realized "to a very great degree."

35. Derek Turner, "Broadband Reality Check: The FCC Ignores America's Digital Divide," available at *http://www.freepress.net/docs/broadband_report.pdf*.

36. J.H. Saltzer, D.P. Reed, & D.D.Clark (1984), Transactions on Computer Systems 2, 4 (Nov. 1984), pp.277-288; David Isenberg, "The Rise of the Stupid Network," retrieved Dec. 1, 2006 from *http://www.rageboy.com/stupidnet.html*.

37. *See* Christian Sandvig, DavidYoung, & Sascha D. Meinrath, "Hidden Interfaces to 'Ownerless' Networks," presented to the 32nd Conference on Communication, Information, and Internet Policy (TPRC), Washington, DC, Sept. 2004.

38. Gerald Brock, The Second Information Revolution (Harvard University Press: Cambridge 2003); Ursula Huws. The Making of a Cybertariat: Virtual Work in a Real World (Monthly Review Press: New York, NY, 2003).

39. Victor W. Pickard, "Neoliberal Visions and Revisions in Global Communication Systems from NWICO to WSIS," *Journal of Communication Inquiry*, 31 (2), 118-139 (2007).

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