Executive Summary: A Roundtable on the End of Scarcity, Open Architecture, and the Future of Broadband Competition Policy

BY ROBERT D. ATKINSON AND PHIL WEISER | JUNE 2009

The discussion about the state of the Internet and the future of Internet policy highlighted a number of key challenges for policymakers, underscored some important areas of consensus, and pointed to at least three questions for further analysis.

On May 5, 2009, the Silicon Flatirons Center and the Information Technology & Innovation Foundation (ITIF) brought together leading individuals from the telecommunications industry, academia, and public interest community to discuss the state of broadband competition policy. This discussion, which included Dick Lynch, Chief Technology Officer of Verizon, was held at ITIF and was moderated by Phil Weiser and Rob Atkinson. Overall, the discussion touched on a number of topics, which fell under the broad questions of what policy goals should guide broadband policy and what institutional strategies are best positioned to advance them.

The discussion converged on some important points about the future of broadband policy. First, there was considerable agreement that targeted subsidies could be used effectively to ensure access to broadband for all and that the American Recovery and Reinvestment Act (ARRA) was an important step in that direction. Second, the participants largely recognized that the "middle mile" of broadband networks is sometimes the constraint to providing robust levels of broadband connectivity and that the integrated nature of Internet traffic makes it difficult to guarantee service levels across different networks, particularly given the current set of commercial relationships. Finally, as both authors have underscored previously, a focus on peak broadband speeds is misleading in that it does not represent what consumers are likely to receive most of the time and thus constitutes an area that deserved increased scrutiny in the years ahead.

The roundtable left three questions on the table for further discussion. First, as to the nature of broadband competition, the level of competition and the role of next generation wireless networks were questions about which the participants either remained uncertain or had different opinions. Second, the roundtable participants did not achieve consensus on the optimal nature of network man-

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agement. While all participants agreed that network management could improve the broadband user's experience, there was less consensus on where that network management control should (or could) lie: with the consumer or with the network provider. Finally, there was no consensus on what strategy should be used to guarantee that broadband providers continue to provide robust and growing levels of basic best efforts access to the public Internet. Some agreed with Dick Lynch that competition will keep firms honest in this regard. But others suggested that it was possible that insufficient levels of competition could fail to constrain firms from encouraging a reliance on proprietary networks (as opposed to using the best efforts nature of the public Internet) and thus some form of regulatory oversight could ultimately be necessary.

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The Internet's engine of innovation continues to evolve. So too do the policy questions around Internet regulation. In particular, a set of key debates has raged over the last several years related to the issue of "network neutrality."[1] In the spring of 2006, we suggested "A Third Way for Network Neutrality," emphasizing the importance of an evolving level of open—or "best efforts"—basic broadband connectivity and "fat pipes."[2] With those ingredients in place, we were less concerned than others that some applications and content providers might gain access to quality of service assurances that other applications and content providers could not afford. Finally, we suggested that the optimal strategy for addressing concerns about broadband discrimination—including as to the provision of quality of service assurances—was to handle them on a case-by-case basis, anticipating the FCC's approach in (but without some of the procedural concerns inherent in) the *Comcast* decision.[3]

To revisit the set of issues addressed in the "Third Way" paper, the Silicon Flatirons Center and the Information Technology and Innovation Foundation (ITIF) held a roundtable discussion on *The End of Scarcity, Open Architecture, and The Future of Broadband Competition Policy*. This roundtable, held on May 5, 2009, brought together leading individuals from the telecommunications industry, academia, and public interest community. This discussion, which included Dick Lynch, Chief Technology Officer of Verizon, was held at ITIF and was moderated by Phil Weiser and Rob Atkinson. (A full list of roundtable attendees is set forth in Appendix A.)

The issues discussed at the roundtable fell within two overarching questions that policymakers will address as they consider the future of broadband Internet policy. First, what goals should policymakers have for the development

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of the broadband market? This question focuses on the evolving demands of users, the adequacy of "last mile" and "middle mile" facilities, the appropriate role of network management and the extent to which wireless and other technologies provide meaningful competition against higher bandwidth technologies like optical fiber. Second, which institutional strategies are best suited to advance our nation's goals for broadband Internet policy? For example, to what extent is the government willing and able to subsidize the capital investments and recurring costs to produce the desired outcome (as opposed to merely relying on private sector investment)? And, to the extent both public and private involvement is needed, how might the public sector encourage (or discourage) the private sector with respect to achieving policymakers' vision for broadband?

This report summarizes the discussion at the roundtable and proceeds in four parts. Part I outlines the evolving nature of the Internet. Part II examines the question of network management, discussing how policymakers should view the issue. Part III examines the future of Internet policy, evaluating alternative strategies for supporting broadband deployment. Part IV offers a short conclusion.

I. THE INTERNET'S EVOLVING ARCHITECTURE

Rob Atkinson began the event by suggesting that the "Third Way" report may have overstated the point that sufficient bandwidth obviates the need for network management. Along those lines, ITIF issued a report in November 2008, discussing the role network management plays in broadband networks. Notably, that report suggested that, even with bandwidth levels of 100 megabits per second, there will still be a role for network management—particularly for latency-sensitive applications, such as Voice over Internet Protocol (VoIP) or interactive gaming.[4]

As Verizon rolls out fiber optic connections to residential households and as Comcast—along with other cable companies—upgrades to DOCSIS 3.0 and provides speeds of up to 60 megabits per second, the question of what a world of "fat pipes" looks like is no longer a hypothetical one. Opening that conversation, Dick Lynch emphasized that, as the end links provide greater speeds, it becomes important to appreciate that the constraint on bandwidth levels is not necessarily always the "last mile."

To underscore how Internet traffic can be delayed, Verizon's Stu Elby presented a slide that followed a single web transaction—as indicated by a "trace route"—and highlighted that it went through 5 domains and 19 router hops en route from a Verizon customer on the east coast to a web server in Berkeley, California. In particular, he commented that the entire transaction (i.e., the "round trip") took 165 milliseconds—three times as long as one on a single network. By Elby's account, this data rate is unlikely to be relevant for customers using today's real-time applications, which function well with a delay of a few hundred milliseconds. In the cell phone environment, as Lynch pointed out, delays can sometimes exceed a couple hundred milliseconds and customers are likely to notice—and complain—about the delay (or latency, as it is called in technical terminology).

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The overall path that Internet traffic travels underscores the interconnected nature of Internet networks. It also, as Lynch emphasized, explains the need to constantly upgrade investments in all parts of the network. Contrary to the impressions of many, including Union Square Ventures' Brad Burnham, Lynch challenged the assumption that the last mile broadband connections are where added investment is most needed. In particular, Lynch noted that the "middle mile"—i.e., backhaul connections provided to and from aggregation points—is often the constraint on bandwidth, particularly on networks like Verizon's where last mile speeds are quite robust. He also noted that the delivery of reliable service also depends on investment in the core of the network—i.e., the Internet backbone.

The actual—as opposed to promised—capabilities of broadband networks are starting to receive increased attention. Indeed, both of us have called for greater vigilance as to whether consumers receive in practice the levels of bandwidth promised by broadband providers.[5] In the United Kingdom, for example, the telecommunications regulator (Ofcom) has "ruled that broadband providers could use the words 'up to' 8 [megabits per second] when describing services as long

as customers were likely to get close to those speeds."[6] As for the advertising practices of U.K. firms, Ofcom concluded that, for those firms promising speeds of up to 8 megabits per second, the average speed "was 2.7 [megabits per second], with the lowest coming in at under 0.09 [megabits per second], barely at dial-up rates, and the maximum only reaching 6.7 [megabits per second]."[7] To be fair to the broadband providers, the nature of best efforts networks means that, by definition, network speeds will vary by traffic level and it is difficult to provide guaranteed levels of bandwidth on a consistent basis. Moreover, speeds are not the only metric that will affect a customer's experience; high latency (or delay) will also undermine service quality, particularly—as discussed above—when a service is a real-time one such as voice conversations or interactive gaming.

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Verizon's Lynch emphasized that he believed that the focus to date on "peak speeds" was not productive and he related that Verizon (at least in the wireless context) had moved away from focusing on the "up to" number and is moving toward a focus on "average speeds." As he put it, "the average speed tells the customer what they need and tells application writers what can be executed in that average."

After noting the Obama Administration commitment to promoting ubiquitous broadband availability, the participants agreed that bringing broadband to areas that currently have no broadband access should be a top priority for stimulus funding. The roundtable then discussed what might be an appropriate benchmark for what constitutes "broadband." On that point, Lynch observed that, "although it will move over time with added applications, the typical speed used by most consumers today is 3 megabits per second." Mark Cooper, Research Director of the Consumer Federation of America, seconded that conclusion, adding that he was advocating for "basic connectivity in the stimulus because I ask what can people do with 50 megabits per second? You can do a lot with basic connectivity." Finally, Comcast's Joe Waz added that a recent survey echoes that assessment, relating that 3.75 megabits per second downstream is adequate for most everything in the market at this point.[8]

Debbie Goldman, of the Communications Workers of America, asked what upstream speeds were necessary for typical uses. Verizon's Elby suggested that "it's very low because web surfing is the predominant use and uses minimal bandwidth upstream, but video conferences and social networking are changing that." Today, he reported, "average demand is asymmetrical, but we anticipate it is becoming more symmetrical."

After outlining the broadband speeds expected by and used by most consumers, the discussion turned to the question of how networks can be built to meet those expectations. As Stu Elby explained, network investment in total capacity enables greater shared access capacity. To make the point, he used the example of how cellular networks use shared capacity rather than rely on multiple, smaller pipes that are likely to involve a more expensive overinvestment in the network. In determining the right balance between shared fatter pipes and smaller pipes dedicated to a smaller number of uses, providers use statistical multiplexing to invest in less capacity than the summation of every user's access bandwidth for a shared network without sacrificing the ability to offer expected bandwidth levels. In particular, this technique takes advantage of the fact that if a lot of users access the Internet but not at the same time, the broadband provider need not provide the level of capacity necessary to enable all users to communicate at the same time. Notably, with respect to data traffic, consumer uses of bandwidth vary considerably—i.e., there is a staged process of requesting and receiving information—that contrasts with traditional voice communications. This dynamic means, as Georgetown Economics professor Marius Schwartz put it, that statistical multiplexing provides real economies by avoiding the need for broadband providers to overinvest in bandwidth and therefore can charge lower prices.

As Dale Hatfield, the incoming Executive Director of Silicon Flatirons, often emphasizes, wireless networks present some different dynamics than wireline networks. These differences are thus ones that policymakers must evaluate in determining whether wireless

broadband networks are relevant competitors to their wireline counterparts. Notably, some suggest that next generation (e.g., LTE and WiMAX) wireless broadband might well provide a "good enough" broadband connection for some consumers.[9] Indeed, as Dick Lynch reported, wireless links continue to improve, as technologists find more efficient ways to use spectrum. To be sure, Lynch acknowledged, wireless will never be able to match the bandwidth levels of fiber because there are physical limits. Nonetheless, Lynch believes, the 4G standard of LTE is likely to provide a reasonable level of service for consumers who expect around a 3 megabits per second level of bandwidth and compete with wired counterparts providing similar levels of bandwidth. Others have suggested that the same is also likely to be the case for the rival WiMAX standard.[10]

Mark Cooper suggested that the effort to evaluate the substitutability of wireless versus wireline misses a fundamental point—that they provide for a different customer experience. For areas—particularly rural ones—without robust wireline broadband, Cooper noted that a 4 megabit per second connection is a substitute for anything they have. Moreover, Gigi Sohn of Public Knowledge added, wireless connections will be in demand because people value mobility even more than (fixed) broadband data networks.

As to the capabilities of wireless networks, Jonathan Sallet, a Silicon Flatirons Adjunct Fellow, underscored that ongoing technological change—such as that involved in improving compression technology—can improve the functionality of networks that provide lower levels of bandwidth. Such improvements, which take place at the applications level, can enable services like high definition (HD) programming to function effectively while using less bandwidth. As Elby added, the changing codec standards will enable HD programming that currently use 20 megabits per second to be delivered using 10 megabits per second—and possibly even less in the future. Consequently, Elby concluded, the claim that "we won't have HD for a mobile device is clearly directed at a moving target and that's something we need to think about."

Dorothy Attwood, Senior VP at AT&T, picked up the innovation theme in wireless broadband and invoked AT&T's experience with the iPhone. This application, she related, both relied on and spurred continuing innovation at the network level. In so doing, it reflects the concept that "by developing a mobile broadband network, we have changed what consumers expect and demand of the network."

The discussion about the relative effectiveness of wireless as well as the adequacy of 3 megabits per second connections for most consumers begged the question of why Verizon was investing so heavily in fiber. To that, Lynch replied that fiber serves not only Verizon's data customers, but also its video subscribers. Brad Burnham, of Union Square Ventures, questioned the wisdom of that strategy, asking whether it made sense to continue offering broadcast TV offerings and send hundreds of channels to someone who can only watch one at a time. In response, Lynch acknowledged that while the evolution away from the broadcast model was inevitable, he believed that the broadcast model will be around for a long time—a prediction with which Mark Cooper concurred.

II. NETWORK MANAGEMENT

The second part of the discussion turned to the point that Rob Atkinson opened with—is network management here to stay? On that question, Lynch concluded that the role of network management is to ensure that customers receive the service they expect, particularly as to time-sensitive applications. These applications can include VoIP, video conferencing, tele-medicine and interactive gaming. But, Lynch added, firms need to make the appropriate investment in bandwidth and "shouldn't depend on network management to take the place of network infrastructure that you've promised your customers." Verizon, he noted, has internal auditing to ensure that it makes available sufficient capacity to provide customers with the level of bandwidth it promises to make available.

In terms of what applications are treated as time sensitive and in need of network management, Gigi Sohn asked whether the technology existed to enable consumers to make that choice. In particular, she invoked the fact that Cox and other providers are now making that decision. Rob Atkinson phrased the question slightly differently, asking "if a network is already offering network management, is prioritizing some kinds of applications (like VoIP), and if the customers want something else to be given priority, why can't they choose?" The problem, Lynch suggested, "is not at the customer's end link, but further up the chain,

where, at the first aggregation point, the network is combining that customer's traffic with everyone else's. In particular, if one customer wants to pay for guaranteed levels of assurance for peer-to-peer traffic and six others want to pay for something else, the challenge is how you manage quality assurance at the aggregation points in the network?" In other words, which application gets priority in this situation? In short, Lynch concluded, "customers can't assume that because they are given a choice about how to prioritize traffic at their endpoint that they get to prioritize the common aggregation point."

As a practical matter, the best option may well be to allow consumers choice as to "how fat a pipe" they want while giving providers some flexibility (as a proxy for their customers) on quality of service for different classes of applications depending on how they use the network.

Jon Nuechterlein, a partner at WilmerHale, followed up on Sohn's question. He asked Lynch to elaborate on why it is easier to provide quality of service assurances based on the preferences of applications developers as opposed to end users. In theory, Nuechterlein suggested, providers could offer either applications providers or customers the option of paying for different types of quality of service, although the feasibility and transaction costs of the two options might diverge substantially. Lynch responded that "the idea of each consumer defining their use by packet across the network, I think it's untenable in the existing architecture, which is based on all carriers agreeing on prioritization." Notably, the limitation here is not technical—insofar as networks can and do provide prioritization and commitments to provide a level of service—but that such commitments are not able to be honored across different networks, as they do not coordinate with one another in assuring such reliability across their networks.

Addressing the basic question at a higher level of generality, Rob Atkinson suggested that this debate reflected two different overarching views. The first view can be thought of as individualism—committing to give each individual as much choice as possible, regardless of the impact of those choices on the overall network or other users. The second view can be thought of as communitarianism—the shared nature of the network can involve shared commitments that require some sacrifice by individuals of their ideal preferences so that the overall experience of everyone is better off. Significantly, different choices about network architecture can cater more closely to one perspective or the other, within the constraints of what the relevant technology can feasibly allow and what market arrangements are in place (insofar as cooperation among different providers is required).

Howard Shelanski, a law professor at University of California-Berkeley, explained the relevant tradeoffs and that the nature of choices offered to different market participants would lead to very different results. Picking up on Atkinson's suggestion of a collective choice problem, Shelanski argued that "if one person wants one service and the provider prioritizes that service, it also necessarily affects others' service." This problem, moreover, is not solved by giving providers (or customers) the opportunity to pay for quality of service because charging upstream applications developers for faster peer-to-peer connections, for example, leaves others with different preferences (and without the ability to receive prioritization for their preferred services) unhappy. As a practical matter, Shelanski concluded, the best option may well be to allow consumers choice as to "how fat a pipe" they want and to give providers some flexibility (as a proxy for their customers) on quality of service for different classes of applications depending on how they use the network. Dorothy Attwood of AT&T concurred with Shelanski's basic analysis, noting that enterprise business customers are big enough to be treated like applications developers and thus can be given an opportunity to purchase quality of service assurances. But for ordinary residential customers, Attwood added, "you can't coordinate across the Internet" because there are too many different sets of preferences.

Given the expense of providing individual levels of quality of service to ordinary consumers, the best-efforts public Internet provides them with a basic level of service that they can expect—without the ability for them to prioritize one service over others. The network, as Jonathan Sallet put it, "creates a rule which people organize their behavior around." This public network, however, is different from private networks that are controlled and managed by either enterprise

businesses or providers that offer services on proprietary networks (including video and voice services). As Brad Burnham noted, the "managed services provided to businesses via private networks are expensive and have lots of other costs within them. But we don't want to burden the entire [public] Internet with these similar cost structures." As for the management of basic connectivity delivered via the public Internet, Kathy Brown of Verizon added, the FCC has made clear that it must be justified as "reasonable."

Having outlined the distinction between best efforts access to the public Internet and managed proprietary networks, Brad Burnham asked whether "there is a conflict between the provider of best efforts access to the public Internet and the provider of guaranteed quality-of-service provided by private networks being the same company." In particular, he inquired "how can you be certain that one isn't driving profits for the other?" To that, Weiser referred back to the original "Third Way" paper, which called for an evolving level of best efforts access to the public Internet—a requirement that does not exist, but could address the temptation to engage in the type of conduct feared by Burnham. Lynch countered that competition in the market can play the role of disciplining any conduct along these lines. As he put it, "My best efforts access to the public Internet has to be better or I lose customers and I need to do the same for managed [proprietary] services too." Mark Cooper expressed some skepticism on this point, noting the limited degree of competition in the broadband market and underscoring that network management should not impede applications from services that compete against those provided by the platform owner (e.g., voice and video services).

III. THE FUTURE OF INTERNET POLICY

The final part of the discussion focused on the role that the federal government should play in spurring the evolution of the Internet. Rob Atkinson noted that Susan Crawford, now serving as Special Assistant to the President for Science, Technology, and Innovation Policy, recently suggested that the model used to promote broadband deployment in Australia is an intriguing strategy.[11] That model entails a substantial commitment by the Australian government to deliver broadband to all consumers—at a cost of over $30 billion. This model reflects "an engineer's view" of the optimal regulatory policy—i.e., one focused on supporting a single "future proof" fiber optic network.[12] The alternative view is the "economists' view," which emphasizes the difficulty in making technological predictions, the importance of allowing experimentation among alternative strategies, and competition among different networks.[13]

In many broadband policy debates, the lack of clarity between the basic paradigms—the engineers' view or the economists' view—leads to different understandings of basic concepts like "underserved areas." On the engineer's view, "underserved" means that some areas lack sufficient levels of bandwidth. On the economists' view, "underserved" refers to a lack of alternative networks in particular areas.

In many broadband policy debates, the lack of clarity between the basic paradigms—the engineers' view or the economists' view—leads to different understandings of basic concepts like "underserved areas."

Depending on what view one assumes as a basic paradigm, there are different policy consequences. On the engineers' view, the best investment would be to spur greater levels of bandwidth, even if it means focusing on a single network. On the economists' view, the best policy strategy is to ensure a minimum level of service and encourage competitive provisioning of broadband. In Australia, where some claim that there are few competitive networks and the existing infrastructure is of limited bandwidth, the policy of supporting broadband development through a single "fat pipe" might be a reasonable strategy; in the U.S., by contrast, the existence of already built-out and evolving, competitive infrastructure in most places makes such a strategy more questionable. To that end, Cathy Sloan suggested that an important focus of government policy is to evaluate, through mapping, where facilities-based competition is still lacking and what policies—including facilitating access to spectrum and rights of way—can spur competition. She noted, moreover, that if competition is key to ensuring the quality of best efforts connections for consumers, then regulatory oversight may be required in places where competition is in fact absent.

Highlighting the connection between competition and innovation, Brad Burnham explained that *a*—if not *the*—principal advantage of the competitive model is that it spurs innovation in new physical networks and types of offerings. By contrast, he explained, the model being pursued in Australia risks preventing or deterring investment in new network technology as well as losing innovation in alternative business models that could be spurred by competition between different networks. He suggested, for example, that a firm might want to be the "Dell of the Internet, focusing on offering no frills, best efforts access to the public Internet at the best price." Such a development, he explained, would not happen in a world with one provider. He added that he is hopeful that wireless offerings will create competition at the edge. This hope, Mark Cooper added, will only be borne out in reality if a third competitor can exist at a minimum efficient scale.

The $7.2 billion devoted to supporting broadband in the ARRA is unlikely to be enough to address even the basic challenges of spurring widespread broadband deployment.

The final premise of both the engineers' and economists' model is that all citizens should have a basic level of access. In that vein, Mark Cooper suggested that the best metaphor for broadband policy is the New York City subway—it should afford everyone a basic level of access that gets them where they need to go at a reasonable price. For those who want higher quality services, he suggests, people can pay more for them. He noted, moreover, that even under the Australia plan, 10% of the population won't get fiber, which is the same percent of the U.S. population that currently has no access to any form of broadband. If the U.S. takes this part of the population as the core policy concern, he explained, the $7.2 billion provided by the American Recovery and Reinvestment Act (ARRA) could be put to its best use.

Continuing the discussion as to how to spend the money provided in the ARRA, a number of individuals asked what level of government support is reasonable. As Gigi Sohn highlighted, the $7.2 billion devoted to supporting broadband in the ARRA is unlikely to be enough to address even the basic challenges of spurring widespread broadband deployment. Indeed, Sohn suggested that, even where the available funds spur the deployment of broadband, providing only for capital expenses (and no funds for ongoing operating expenses) may leave providers in a position where they are unable to sustain the ongoing provision of service in higher cost areas.

The final question the roundtable focused on was whether the prices charged by broadband providers in underserved areas (areas with only one provider, not including satellite) would be reasonable. Rob Atkinson suggested that one important constraint might be that broadband providers will not engage in price discrimination and instead charge the same prices in areas where there is competition as in areas where there is not competition; if this happens, Atkinson explained, it would not be necessary to have actual physical competition everywhere in order to secure the benefits of competition everywhere. On that point, Howard Shelanski countered that prices would be even lower in rural areas if another competitor were in the market. Dorothy Attwood added that, to the extent that no providers exist in a particular area, the government might need to provide subsidies, for at least one provider, along with a concomitant requirement to charge comparable rates to those offered in areas that benefit from competition, to ensure a reasonable level of service for all consumers. She explained that this was the basic theory for universal service in the 1996 Telecommunications Act, but it has not worked as well as expected in that the subsidies are not being targeted effectively.

IV. CONCLUSION

The discussion about the state of the Internet and the future of Internet policy highlighted a number of key challenges for policymakers, underscored some important areas of consensus, and pointed to at least three questions for further analysis. First, regardless of the metaphor used, there was considerable agreement that a targeted use of subsidies was an important policy goal for the United States to use for ensuring access to broadband for all. Second, the participants largely recognized that the "middle mile" of broadband networks is sometimes the constraint to providing robust levels of broadband connectivity and that the integrated nature of Internet traffic makes it difficult to guarantee service levels across different networks. Third,

as Dick Lynch underscored, the focus on peak broadband speeds alone is misleading in that it does not represent what consumers are likely to receive most of the time.

Finally, the roundtable left three questions on the table for further discussion. First, as to the nature of broadband competition, the participants either remained uncertain or had different opinions on the level of competition and the competitive significance of next generation wireless networks. A second question on which the roundtable did not achieve consensus on was the optimal nature of network management. While all participants agreed that network management could improve the broadband user's experience, there was less consensus on where that network management control should (or could) lie: with the consumer or with the network provider. Finally, there was no consensus on what strategy should be used to guarantee that broadband providers continue to provide robust and growing levels of basic best efforts access to the public Internet. Some agreed with Dick Lynch, that competition will keep firms honest in this regard. But others suggested that it was possible that insufficient levels of competition could fail to constrain firms from encouraging a reliance on proprietary networks (as opposed to using the best efforts nature of the public Internet) and thus some form of regulatory oversight could ultimately be necessary.

APPENDIX A: LIST OF ROUNDTABLE PARTICIPANTS

James Assey, National Cable and Telecommunications Association (NCTA)

Rob Atkinson, Information Technology and Innovation Foundation (ITIF)

Dorothy Attwood, AT&T

Jon Baker, American University College of Law

Kathy Brown, Verizon

Brad Burnham, Union Square Ventures

Mark Cooper, Consumer Federation of America

Kyle Dixon, Kamlet & Reichert

Stu Elby, Verizon

Debbie Goldman, Communications Workers of America (CWA)

Scott Hemphill, Columbia University School of Law

Link Hoewing, Verizon

Fernando Laguarda, Time Warner Cable

Dick Lynch, Verizon

John Mayo, Georgetown University

Jon Nuechterlein, WilmerHale

Jonathan Sallet, Glover Park Group

Marius Schwartz, Georgetown University

Howard Shelanski, Georgetown University

Cathy Sloan, Computer and Communications Industry Association (CCIA)

Gigi Sohn, Public Knowledge

Joe Waz, Comcast

Phil Weiser, University of Colorado at Boulder

ENDNOTES

1. The discussion stemmed, in considerable part, from a series of papers presented and discussed at Silicon Flatirons conferences. See, e.g., Tim Wu, "Network Neutrality, Broadband Discrimination," *Journal on Telecommunications and High Technology Law* 2 (2003):141; Michael K. Powell, "Preserving Internet Freedom: Guiding Principles for the Industry," J*ournal on Telecommunications and High Technology Law* 3(5) (2004): 11-12.

2. Robert D. Atkinson and Philip J. Weiser, "A "Third Way" on Network Neutrality," Information Technology and Innovation Foundation, Washington, D.C., May 30, 2006 <www.itif.org/index.php?id=63>.

3. For a discussion of the FCC's decision in the Comcast case (Formal Complaint of Free Press and Public Knowledge Against Comcast Corporation for Secretly Degrading Peer-to-Peer Applications, "Memorandum Opinion & Order," 23 FCC Rcd. 13028 (2008)) and how the agency might approach related issues in a more effective fashion, see Philip J. Weiser, "The Future of Internet Regulation," *UC Davis Law Review* 43 (forthcoming 2009), available: <papers.ssrn.com/sol3/papers.cfm?abstract_id=1344757>.

4. George Ou, *Managing Broadband Networks: A Policymaker's Guide* (Washington, D.C.: Information Technology and Innovation Foundation, December 2008): 38-40 <www.itif.org/files/Network_Management.pdf>. Indeed, even in Japan where 100 megabits per second networks are deployed, at least some ISPs have concluded that network management—or packet shaping—techniques are necessary. *See* Japan Internet Providers Association et al., "Guideline for Packet Shaping" (May 2008): 1-2 <www.jaipa.or.jp/other/bandwidth/guidelines_e.pdf>.

5. For the discussion of that point, see Philip J. Weiser, "The Next Frontier for Network Neutrality," *Administrative Law Review* 60 (2008): 273 <papers.ssrn.com/sol3/papers.cfm?abstract_id=1080672>. *See also* Ou, Ibid., at 12-13.

6. "Britain 'Failing' Net Speed Tests," *BBC News*, August 2, 2007 <news.bbc.co.uk/2/hi/technology/6924866.stm>.

7. Ibid.

8. Oxford Said Business School and Universidad de Oviedo, Broadband Quality Score 5 (2008).

9. Philip J. Weiser, "A Framework for a National Broadband Policy," The Aspen Institute, Washington, D.C., 2008, 13-14 <www.aspeninstitute.org/sites/default/files/content/docs/pubs/A_Framework_for_a_National_Broadband_Policy_0.pdf>.

10. Glenn Fleishman, "Future of WiMAX is Clear as Sprint, Clearwire close deal," *ars technica*, December 1, 2008 <arstechnica.com/old/content/2008/12/future-of-wimax-is-clear-as-sprint-clearwire-close-deal.ars>.

11. David Hatch, "Obama Adviser Looks at U.S.-Built Broadband Network," *Congressdaily*, May 26, 2009 <www.nextgov.com/nextgov/ng_20090526_2886.php?oref=rss>.

12. This view is developed and explained in Robert D. Atkinson, "The Role of Competition in a National Broadband Policy," *Journal on Telecommunications and High Technology Law* 7(1)(2009): 6-7. For additional arguments in favor of government sponsorship of the broadband build-out, see Lawrence Lessig, *The Future of Ideas: The Fate of the Commons in a Connected World* (New York, NY: Random House, 2001) 244-46; Reed Hundt, "The Ineluctable Modality of Broadband," Y*ale Journal on Regulation* 21(2004): 239.

13. Atkinson also develops this view in Ibid, at 7-9. For a related argument, see Andrew Odlyzko, "The Many Paradoxes of Broadband," *First Monday* 8(9) (2003) ("Technological predictions have always been hard, of course, and much of what broadband proponents say has to be treated cautiously.").

ABOUT THE AUTHORS

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