CONNECTIONS: BEYOND UNIVERSAL SERVICE IN THE DIGITAL AGE

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INTRODUCTION

Broadband connectivity is the fundamental public utility of the digital age. Like roads, libraries, electric grids, schools, and telephone networks before it, broadband will be a basis through which citizens are empowered to realize their potential, economic productivity is fostered, and major social goals are achieved. It is already a yardstick for competitiveness among nations. Given broadband's importance, there are few areas where government engagement is more necessary or, potentially, more productive. Yet America, almost uniquely among major industrialized countries, lacks a national broadband strategy. Worse still, discussions about broadband policy in the U.S. are deeply marred by

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legacy approaches and outmoded analogies to telephone service. A true broadband strategy must acknowledge the new realities of the 21st century environment of networked digital convergence.

The core of that shift must be to re-imagine, rather than simply extend, the nearly century-old concept of universal service. Universal service in U.S. telecommunications policy has always had two key—if not always well-articulated—attributes. It means *ubiquitous service*, or affordable access for everyone. And it means *unitary service*, or an interconnected grid that connects all to all. That distinction provides the basis for a new broadband-centered universal service policy. Subsidy mechanisms to enhance ubiquity should be linked to obligations to preserve the unitary nature of the Internet. Similarly, growing government engagement in promoting universal broadband connectivity should facilitate a transition away from legacy universal service programs that no longer serve public interest goals.

Both ubiquity and unitary systems are important for an effective national broadband strategy. Achieving ubiquitous broadband connectivity will require an effort that is significantly more focused, and accepts substantially more variability of solutions, than current universal service funding mechanisms. At the same time, to maintain a unitary broadband environment, the federal government should promote open interconnection among networks, not only at the baseline physical layer, but for addressing and potentially higher-level applications as well. Narrowing the scope of universality when it comes to baseline connectivity, while simultaneously broadening it for information flows, will make universal broadband policies both more efficient and more effective than their legacy antecedents in the telephone world.

This paper sets forth an outline for a national broadband strategy that goes beyond existing communications policy debates. It is based on the recognition that the simple concept of universal service as widespread uniform deployment, while important in the development of telephony, is inapposite to broadband. A broadband network is a multi-faceted and multi-layered platform, rather than a single service. The "floor" broadband capacity to realize the full benefits of digital-age citizenship is important, but so is the "ceiling" of widely available commercial broadband capabilities, even if not available everywhere.[1] Moreover, a broadband environment that sacrifices interconnectivity in the name of ubiquity will destroy many of the beneficial network effects that make broadband so valuable.

1. I am indebted to Kevin Kahn of Intel Corp. for introducing this distinction at the Aspen conference.

I. BROADBAND IN AMERICA

The United States led the world in commercial Internet deployment, and is still home to many of the leading Internet companies. However, broadband Internet access is fundamentally different from the dial-up service of the first-generation commercial Internet. Broadband offers substantially higher connection speeds and "always-on" capability, which are necessary for many applications such as video and interactive messaging. And it cannot simply run on top of the circuit-switched telephone network; new infrastructure is required.

There is widespread concern that the U.S. is behind most industrialized nations in broadband.[2] According to Organization for Economic Cooperation and Development (OECD) rankings, the United States has fallen from 4th to 15th in the world in per-capita broadband adoption.[3] In countries such as Japan and South Korea, fiber-based residential broadband service is widely available, offering speeds several times greater than most Americans enjoy.[4] In much of Europe, there are several competing broadband players, typically delivering DSL-based services through the incumbent's phone network, at prices well below the U.S. norm.[5]

In the U.S., over ninety percent of customers have no more than two broadband choices (DSL and cable modem).[6] Twenty percent have only one.[7] And while broadband service is available to a high percentage of the U.S. population, there remain gaps in deployment.[8] Even these

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2. *See* Robert D. Atkinson, *Framing a National Broadband Policy,* 16 COMMLAW CONSPECTUS 145, 145 (2007) ("It is difficult to pick up a business or technology magazine without reading that the United States is falling behind other nations in broadband telecommunications."); Richard Hoffman, *When It Comes to Broadband, U.S. Plays Follow the Leader,* INFORMATIONWEEK, Feb. 15, 2007, http://www.informationweek.com/story/showArticle.jhtml?articleID=197006038.

3. OECD Broadband Portal, http://www.oecd.org/sti/ict/broadband.

4. *See* DANIEL K. CORREA, ASSESSING BROADBAND IN AMERICA: OECD AND ITIF BROADBAND RANKINGS (2007), http://www.itif.org/files/BroadbandRankings.pdf; Takanori Ida, *Broadband, Information Society, and the National System in Japan*, and Inho Chung, *Broadband, Information Society, and the National Systems: The Korean Case, in* GLOBAL BROADBAND BATTLES: WHY THE U.S. AND EUROPE LAG WHILE ASIA LEADS 65-108 (Martin Fransman ed., 2006); Delphine Strauss and Frances Williams, *S. Korea Leads Digital World*, FINANCIAL TIMES, July 6, 2006.

5. *See* OECD Broadband Portal, *supra* note 3.

6. INDUS. ANALYSIS & TECH. DIV., FCC, HIGH-SPEED SERVICES FOR INTERNET ACCESS: STATUS AS OF JUNE 30, 2007 (2008), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-280906A1.pdf [*hereinafter* INTERNET ACCESS REPORT].

7. *See id*.

8. U.S. GOV'T ACCOUNTABILITY OFFICE, TELECOMMS.: BROADBAND DEPLOYMENT IS EXTENSIVE THROUGHOUT THE U.S., BUT IT IS DIFFICULT TO ASSESS THE EXTENT OF DEPLOYMENT GAPS IN RURAL AREAS 10 (2006), http://www.gao.gov/new.items/d06426.pdf [*hereinafter* BROADBAND DEPLOYMENT

numbers may paint an overly rosy picture. The U.S. government has been accused of sugar-coating the level of broadband penetration that exists.[9] The Federal Communications Commission ("FCC" or "the Commission") in its data-collection defines broadband as speeds of at least 200 kilobits-per-second (kbps) in both directions, which is far lower than most experts consider true broadband.[10] A final concern about the U.S. broadband environment is network neutrality: the fear that broadband access providers will disadvantage unaffiliated content and application providers, thereby slowing innovation and investment in these areas.[11]

The FCC under the Bush Administration, and its defenders such as the incumbent phone and cable companies, take issue with assertions of U.S. broadband inferiority.[12] They point out that the size and relative lack of population density across the U.S. makes comparisons to primarily urban nations such as South Korea inappropriate.[13] They also question, with some support, the accuracy of the OECD figures, and their focus on per-capita adoption.[14] Moreover, the fact that so many Americans have dial-up Internet access, and thus must be convinced of the benefits of upgrading to a (more-expensive) broadband alternative, rather than seeing broadband as their initial form of Internet connectivity, doubtless skews the comparisons somewhat.

It is true that broadband penetration in the U.S. has increased

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9. S. DEREK TURNER, BROADBAND REALITY CHECK II: THE TRUTH BEHIND AMERICA'S DIGITAL DECLINE 31 (2006), http://www.freepress.net/docs/bbrc2-final.pdf.

10. *See* Press Release, FCC, FCC Adopts Data Collection Program to Assess Local Telecommunications Competition and Broadband Deployment, (Mar. 24, 2000), http://www.fcc.gov/Bureaus/Common_Carrier/News_Releases/2000/nrcc0020.html; *see also* Dev. of Nationwide Broadband Data to Evaluate Reasonable & Timely Deployment of Advanced Servs. to All Amns., Improvement of Wireless Broadband Subscribership Data, & Dev. of Data on Interconnected Voice over Internet Protocol (VoIP) Subscribership, *Report & Order & Further Notice of Proposed Rulemaking*, 2008 WL 2404500, ¶ 20 (2008) (In June 2008, the FCC modified the reporting requirements to include eight different speed tiers between 200 kbps and 100 Mbps.).

11. *See generally* Tim Wu, *Network Neutrality, Broadband Discrimination*, 2 J. TELECOMM. & HIGH TECH. L. 141, 141-44 (2003). For further information, see generally Barbara van Schewick, *Toward an Economic Framework for Network Neutrality Regulation*, 5 J. TELECOMM. & HIGH TECH. L. 329 (2007); Tim Wu, *The Broadband Debate, A User's Guide*, 3 J. TELECOMM. & HIGH TECH. L. 69 (2004); Christopher S. Yoo, *Network Neutrality and the Economics of Congestion*, 94 GEO. L.J. 1847 (2006); Christopher S. Yoo, *Beyond Network Neutrality*, 19 HARV. J.L. & TECH. 1 (2005).

12. *See* U.S. INTERNET INDUS. ASS'N, DEPLOYMENT OF BROADBAND TO RURAL AMERICA 16 (2008), http://www.usiia.org/pubs/Rural.pdf; SCOTT WALLSTEN, EVERYTHING YOU HEAR ABOUT BROADBAND IN THE U.S. IS WRONG (2007), http://pff.org/issues-pubs/pops/pop14.13wallstenOECDbroadband.pdf.

13. *See* Wallsten, *supra* note 12.

14. *See* SCOTT WALLSTEN, TOWARDS EFFECTIVE U.S. BROADBAND POLICIES (2007), http://www.pff.org/issues-pubs/pops/pop14.7usbroadbandpolicy.pdf.

substantially in recent years. Moreover, the U.S. is relatively rare in having two competing physical broadband platforms with wide adoption – telephone and cable – although the lack of competition within each of those categories in most areas means there are typically fewer broadband Internet service provider choices for Americans than for residents of many countries in Europe and Asia.[15] The ultimate question, however, is not whether the U.S. is ahead of or behind other countries when it comes to broadband. It is whether the U.S. should be doing more, and differently, when it comes to broadband strategy. And there the answer is quite clear.

Put simply, the U.S. needs a broadband strategy. Most of America's global competitors have, in recent years, made broadband deployment a significant public policy priority.[16] In the U.S., President Bush, during the 2004 Presidential campaign, articulated a goal of universal broadband availability by 2007, but there have been virtually no policy initiatives supporting that goal.[17] Innovators and investors take their cues from the messages that governments articulate. If other countries clearly define how they plan to leverage the extraordinary power of broadband for their nations, and put into place concrete steps to do so, the U.S. faces a loss in global competitiveness to the extent it merely asserts that things are going well. Furthermore, a national broadband strategy is more than just a set of deployment and adoption goals, although defining such goals through the "bully pulpit" of national leadership can definitely have salutary effects. The real policy questions about broadband involve defining the value of broadband as a subject for government involvement, and the steps that government can take to achieve those values.

The other problem with U.S. broadband policy is the legacy of wasteful and often perverse telecommunications subsidy programs. "Universal service" has been an acknowledged goal of U.S. policy for decades, and an express statutory mandate since 1996.[18] Yet the mechanisms for achieving universal service were designed for basic telephone service and a monopoly carrier, AT&T. Broadband today is not considered a supported service under major U.S. universal service programs.[19] Moreover, the existing universal service programs largely involve hidden subsidies that distort investment incentives and waste resources.[20] Broadband provides an opportunity not simply to expand

15. *See* Correa, *supra* note 4; *see also* Turner, *supra* note 9, at 13.

16. *See id*.

17. President George W. Bush, Remarks by the President on Homeownership (Mar. 26, 2004), http://www.whitehouse.gov/news/releases/2004/03/20040326-9.html.

18. 47 U.S.C. § 254 (2006).

19. *See* 47 C.F.R. §§ 54.503, 54.621 (2001).

20. *See* Rob Frieden, *Killing With Kindness: Fatal Flaws In The $ 6.5 Billion Universal Service Funding Mission And What Should Be Done To Narrow The Digital Divide*, 24

universal service, but to reinvent it. What made sense in the 1920s should not necessarily be the template for the 2000s. Only a coherent national broadband strategy can avoid the trap of incremental changes to legacy universal service mechanisms.

II. UBIQUITOUS BROADBAND

Universal service developed at a time when there was one dominant service provider (AT&T), providing one service (basic telephony), and engaged in a decades-long process of network deployment across the U.S. By contrast, universal broadband today means supporting many different providers who offer service in particularly under-served areas, using a variety of different technologies, covering a wide range of potential capabilities, and with varying degrees of new investment required beyond the existing telephony infrastructure.[21] Current universal service mechanisms involve a variety of explicit and implicit subsidies, at both the state and federal levels.[22] By in large, these programs support basic telephone service, and exclude broadband data connectivity.[23]

The Federal-State Joint Board on Universal Service has proposed adding broadband to the list of services supported under current subsidy mechanisms.[24] However, this leaves open significant questions about the magnitude of support, and the specific capabilities to be supported. It would also place broadband squarely within a subsidy system that is widely acknowledged to be in jeopardy as revenues and subscribers shift away from conventional wireline services.[25] Broadband is not simply another way to deliver telephone service; it is an entirely new communications platform. That platform can itself deliver basic telephony through voice-over-Internet-protocol (VoIP) technology, as

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CARDOZO ARTS & ENT L.J. 447 (2006).

21. This actually resembles the early days of phone service, as Milton Mueller has documented. *See* Milton L. Mueller, Jr., *Universal Service: Competition, Interconnection, and Monopoly in the Making of the American Telephone System*, 50 FED. COMM. L.J. 275 (1997) (explaining that it was the competition, not the later monopoly, that produced universal service).

22. *See* Frieden, *supra* note 20.

23. *See id;* LENNARD G. KRUGER & ANGELE A. GILROY, CONGRESSIONAL RESEARCH SERVICE, BROADBAND INTERNET ACCESS AND THE DIGITAL DIVIDE 12 (2005), http://www.usembassy.it/pdf/other/RL30719.pdf (explaining that the FCC's School and Libraries ("E-Rate") Program funds data network connectivity, but this program does not apply to residential subscribers).

24. FCC, FED.-STATE JOINT BD. ON UNIVERSAL SERVICE STATEMENT ON LONG TERM, COMPREHENSIVE HIGH-COST UNIVERSAL SERVICE REFORM (2007), http://fjallfoss.fcc.gov/edocs_public/attachmatch/FCC-07J-3A1.doc.

25. *See* Frieden, *supra* note 20. If broadband were added as a supported service for universal service distributions, broadband revenues would likely be required to contribute to universal service support. While this might alleviate current structural problems in funding universal service subsidies, it would further entrench the distortions in the current system.

well as a multitude of informational, commercial, educational, social, political, and entertainment capabilities. At the same time, broadband is a form of Internet access. It substitutes for dial-up connectivity, which is delivered over the public switched telephone network (PSTN). And there are many types of broadband connections, with different costs and benefits.

The first question for universal broadband policy should therefore be what precisely "universal broadband" means. A better understanding of goals will lead to a better set of solutions.

A. The Floor and the Ceiling

Unlike basic telephone service, which is a specific, well-defined offering (generally, a voice-grade circuit allowing touchtone dialing with local and long-distance service), broadband is a class of digital connectivity platforms. There is no standard, agreed-upon definition of broadband, other than a digital connection that is always-on (i.e., not requiring a phone call to connect), and substantially faster than the dial-up Internet connections, which top out at approximately 56 kilobits-per-second downstream. The FCC defines broadband as more than 200 kilobits-per-second in both directions, but that is widely considered too low a baseline.[26]

Moreover, the capability of a broadband connection involves many factors. Some applications such as video conferencing and peer-to-peer file-sharing require significant upstream capacity. For others, such as streaming movies from a central website, the downstream speed is the limiting factor. For some applications, "burst" capabilities for extra-high speeds raise the effective performance to those levels. For others, the baseline guaranteed performance level is a more accurate measurement. Also, some applications may require reliability or low latency, which are distinct from raw transmission speeds.[27] Finally, the broadband pipe alone is not sufficient to unlock broadband capabilities for all users. End-user hardware, software, and applications, plus education and training for users, may be required for the broadband connection to have any real utility.

Broadband policy evaluations generally pick a baseline broadband speed, and then simply count up what percentage of households have

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26. *See* Turner, *supra* note 9.

27. Latency is essentially the delay before a packet is sent. Interactive applications such as voice communications require low latency for parties to communicate effectively. One-way applications such as streaming video of commercial programming, although benefiting from higher throughput, may not require low latency, because a short delay before starting does not degrade the user experience.

access to, or subscribe to, that level of service, and at what price.[28] This is a fundamentally misleading approach. As already noted, speed alone, especially just downstream speed, is a limited representation of broadband capabilities. Moreover, broadband is not a single application like telephone service. It enables many kinds of applications and services with different requirements. The question policy-makers should focus on is whether broadband is being provided and adopted in ways that allow for certain *uses*. For many applications, such as browsing many government informational websites, a dial-up connection is virtually as good as what the FCC would consider a broadband connection. These applications do not require always-on access or download speeds over 56 kilobits-per-second in order to provide civic benefits. On the other end of the spectrum, some applications, such as video-based telemedicine, are not possible even with the highest-speed broadband services commercially available in major cities in the U.S. today.[29]

No policy approach can address both needs simultaneously. The networks needed for telemedicine are vastly more expensive than those needed for browsing government websites, to the point that a universal service plan pegged to the former would be prohibitively expensive. Further complicating the picture, capabilities and costs are dynamic. As technology advances, fixed costs of network construction are incurred, and manufacturers increase equipment volumes, the cost to provide a given level of connectivity falls. At the same time, the zone of coverage (both applications and households) that market forces serve will grow. Hence "universal broadband" as a policy objective should be divided into two components: a floor and a ceiling. Both levels are dynamic, based on technology and adoption patterns, so they must be adjusted periodically.

The floor is the minimal level of broadband capability needed to participate fully as a connected citizen. That means utilizing public services and accessing governmental information that are made available online, taking advantage of mainstream private services for basic needs, such as employment and health care, and accessing news of local, national, and world events. This should be the central concern of policies designed to promote a broadband analogue to universal service. It is through these mechanisms that broadband can facilitate education, health care, economic opportunity, and participation in the democratic process. Since virtually every commercial broadband deployment provides such baseline capabilities, the universal service question for the broadband "floor" is therefore how to ensure that networks are built and operated so as to reach every citizen with affordable service.

28. *See, e.g.,* INTERNET ACCESS REPORT, *supra* note 6.

29. Some telemedicine applications, involving sensor data for example, do not require as much bandwidth.

The broadband ceiling represents the level of capability available to the top end of the mass market. It is the highest level of broadband that major providers in the U.S. deem commercially viable. This will almost certainly be less than the maximum theoretical capacity of current broadband networks. For example, fiber-optic systems that telephone companies are deploying could conceivably offer one gigabit-per-second or more of capacity, but Verizon's current Fiber Optic Service (FiOS) offerings top out at 30 megabits-per-second, and AT&T's U-verse at less than that.[30] Even these fiber systems might not be counted today in the broadband ceiling available to Americans, because Verizon and AT&T are still building them out.

The importance of the broadband ceiling is that it defines the applications, services, and content that can use the broadband platform. In countries such as Japan, where most citizens have access to fiber-based broadband services that deliver 100 megabits-per-second at under $30/month,[31] applications such as television on mobile phones and interactive online gaming are taking off at rates far greater than in the U.S.[32] A comprehensive broadband strategy should recognize that the broadband ceiling impacts the level of competition, innovation, investment, and job creation in complementary broadband application, service, and content markets. Moreover, new services further stimulate broadband demand.

The policies necessary to bring up adoption levels at the broadband floor are not the same as those needed to increase the broadband ceiling. By definition, broadband access at the ceiling level is commercially viable, while the broadband floor includes many users who would not be reached by market forces alone. Thus, less direct government intervention will be required, and perhaps none at all at certain times. The benefits of bringing up the floor relate to citizen participation, opportunity, empowerment, and equity, while the benefits of bringing up the ceiling go more toward economic benefits and national competitiveness. Because the available services depend on the level of capacity as well as the imagination and investment of content and application providers, the appropriate target for the broadband ceiling at any time is more difficult to peg than the broadband floor. It is uncertain whether some level of capacity – perhaps 50 megabits-per-second – is sufficient for all foreseeable applications in the near future, or whether

30. *See* Leslie Cauley, *Verizon's Army Toils at Daunting Upgrade; Company's Future Rests on $23B Herculean Task,* USA TODAY, Mar. 1, 2007, at 1B.

31. *See* TAKA EBIHARA, UNDERSTANDING THE JAPANESE BROADBAND MIRACLE, INFORMATION TECHNOLOGY AND INNOVATION FOUNDATION (2007), http://www.itif.org/files/Ebihara_Japanese_Broadband.pdf.

32. *See id.*; *see also* Ida *supra* note 4, at 83.

any increment in the broadband ceiling will stimulate new applications that use up the new capacity.

Dividing the broadband floor and ceiling acknowledges that every American will not have exactly the same broadband capabilities. With telephony, the networks offering the "floor" capabilities for civic engagement and economic participation were the same ones that might offer additional features in more densely populated or otherwise attractive locations. Even with Internet, there was a standard set of capabilities that had to be added to the network to enable the "advanced services" of data connectivity, which the FCC was required to monitor under Section 706 of the 1996 Telecommunications Act.[33] A 56 kbps modem connection might offer a better experience than a 14.4 kbps one, but both provided access to the kinds of services that predominated on the Internet of the late 1990s. Even the best available dial-up connection was only moderately better than the worst.

With broadband, however, the experience that a 100 megabit-per-second symmetrical connection offers is very different from that of an asymmetric DSL connection offering a 384 kilobit-per-second downstream channel. The lower-speed service will have difficulty supporting video, telepresence, telemedicine, advanced gaming, and other applications. While it would be equitable to ensure all Americans access to those higher-end services as part of a broadband universal service plan, such an approach would be infeasible given the costs involved. Having such capabilities widely available is within the score of universal service policy; having them available to everyone is not. Dividing between a broadband floor and ceiling makes clear the kinds of capabilities that should be supported for virtually every American from those whose deployment patterns should be primarily left to market forces.

B.A Three-Ring Approach[34]

Ensuring that all Americans have access to the "floor" level of broadband should be the initial universal service objective for the broadband era. An important question concerns the level of that floor. Too high a floor will require excessively large subsidies, which will also create perverse investment incentives. Too low a floor will mean the civic benefits of universal broadband are not realized. The challenge is that the costs of delivering broadband connectivity outside of major metropolitan areas are highly dependent on density and topography. The more rural

33. 47 U.S.C. § 706 (2006).

34. The basic framework of the three rings originated at the Aspen conference. The specific recommendations are my own.

and the more mountainous or otherwise inaccessible the location, generally speaking, the more it will cost to deliver a given level of broadband service. Moreover, different broadband technologies are more efficient for certain locations. Wireless and satellite service, for example, have very different economics than wired broadband, because they do not require construction of physical wires directly to each customer premises.

Given all these variables, it makes sense to further subdivide the broadband floor into three categories. These roughly correspond to three rings of population density, since density is usually a reasonable proxy for the cost variables described above. The three rings are: metropolitan and suburban areas; less-densely-populated "exurban" regions or small towns; and very low-density rural areas. The dividing lines between these regions may be subject to debate, but the three categories represent significantly different environments for broadband deployment. Additional funds will be necessary to ensure that all Americans have access to a baseline level of broadband. However, direct subsidies are likely needed only for the outermost ring. A framework recognizing that broadband is not an all-or-nothing proposition will avoid subsidizing those areas where market forces might suffice.

In metropolitan areas, even smaller cities, there is likely to be an operator capable of building a commercial wired broadband network, and a base of customers for that network. According to FCC data, 99% of U.S. zip codes have at least one broadband provider.[35] Cable operators claim to offer broadband service today to 94.4% of U.S. households.[36] While, as noted above, the accuracy and baseline requirements of the FCC numbers are questionable, they do suggest that some form of broadband is available in virtually every metropolitan area.[37] Because broadband service can "piggy-back" on existing telephone and cable networks at minimal additional cost, obstacles such as mountainous terrain that made deployment of telephone service difficult in some cities will be less of an issue for broadband. In most cases, therefore, direct government intervention will not be needed for the densest population ring. Policies to encourage competition in telecommunications and video services, and to create incentives for technological and infrastructure investments, will be the primary stimulus in these regions.

When broadband is not commercially available in the metropolitan ring, it is likely to be in localized coverage "holes." These may not be

35. *See* INTERNET ACCESS REPORT, *supra* note 6, at 1.

36. *See* PHILIP J. WEISER, A FRAMEWORK FOR A NATIONAL BROADBAND POLICY 11 (2008) (quoting Joseph Waz of Comcast), *available at* http://lawweb.colorado.edu/profiles (follow "Philip J. Weiser" hyperlink; then follow "A Framework for National Broadband Policy" hyperlink).

37. *See* BROADBAND DEPLOYMENT REPORT, *supra* note 8, at 15.

served due to simple oversight on the part of service providers, or perhaps topographical obstacles, or a lack of incentive to serve a very economically disadvantaged area. In such situations, a program to bring together existing service providers to identify, map, and address broadband connectivity holes can be highly effective. Subsidy and grant programs not specific to broadband can also be brought to bear as part of a concerted effort to overcome localized connectivity barriers. Connect Kentucky, a model of this approach, raised coverage to 98%.[38] Awareness and broadband literacy programs, discussed below, can also help address connectivity holes from the demand side.

For those in metropolitan areas, the key question is where to set the baseline level of connectivity that is considered broadband. The FCC's 200 kilobit number is clearly too low, especially as a going-forward target. Both telephone and cable-based providers are now deploying technologies – fiber-optic transmission and DOCSIS 3.0 respectively— capable of delivering broadband speeds in excess of 100 megabits-per-second.[39] An appropriate broadband policy should set goals that are reasonably achievable, but should recognize that today's median U.S. speeds are well behind those of other industrialized nations.[40]

Since there is no fundamental barrier to such deployment in virtually all metropolitan areas, a reasonable five-year target for broadband service in the innermost ring would be 50 megabits-per-second downstream, with at least 10 megabits-per-second (and ideally the full 50) available in an upstream channel. As discussed above, speed alone is an insufficient metric. The applicable targets could incorporate other elements, such as an upstream channel that is not disproportionately slow. Or they could be denominated by applications rather than bandwidth. One tier of broadband might support voice and Web capabilities, a second might support high-quality video, and a third might support emerging services such as telepresence and telemedicine. A national broadband strategy should articulate those goals, and then put into place an annual and five-year reporting process to assess progress toward them. If deployment and adoption fall short after five years, additional policies should be considered.

The second ring of users live in less-dense suburbs and exurbs. Even in such non-metropolitan areas, market forces are generally sufficient to support a broadband provider, although there may not yet be one

38. *Wiring Rural America: A Public-Private Partnership Success*, THE ECONOMIST, Sept. 13, 2007, http://www.economist.com/displaystory.cfm?story_id=9803963.

39. *See* Todd Spangler, *Comcast Opens Up Wideband; Rollout Is U.S. Debut Of DOCSIS 3.0*, MULTICHANNEL NEWS, Apr. 7, 2008, http://www.multichannel.com/article/CA6548163.html.

40. *See* Correa, *supra* note 4, at 4.

operating in a local area. The question is how to address those areas that could in theory support a commercial broadband offering, but do not yet have one, or have one that offers inferior service.[41] As with metropolitan areas, policies to encourage competition and investment, and to identify both unconnected regions and sources of capital, are likely to stimulate broadband deployment in lower-density areas.

The most significant difference from the metropolitan ring is that the second density tier may not be able to support the latest high-capacity broadband networks, at least in the five-year time horizon. A realistic initial goal would therefore be one level below that of the inner ring, or roughly the five to ten megabit-per-second service achievable with current mainstream cable and telephone-based broadband. Within ten years, however, even these areas should be able to enjoy next-generation infrastructure, providing broadband speeds of roughly twenty megabits-per-second.

The least-dense regions, where many citizens currently lack any broadband connection, are where subsidy mechanisms should be concentrated. At a minimum, all citizens should have access to some baseline broadband service. Satellite services such as WildBlue arguably provide that already, but they involve significant latency and backhaul constraints that make them inferior to terrestrial networks with comparable speeds.[42] Moreover, the acceptable level of even the most basic broadband connection will increase over time. Terrestrial wireless networks, which do not require expensive wireline infrastructure out to each subscriber, are likely to be the dominant means of reaching the most remote users, but DSL will also play a role where telephone service is available.

For this outmost connectivity ring, market forces alone are unlikely to ensure broadband deployment. The density levels are simply too low for commercial ventures to obtain a sufficient return in most cases.[43] Subsidies can provide the necessary push to make deployment happen, or for existing service providers to extend coverage to more isolated subscribers. Those subsidy programs, however, should be separate from

41. *See* Robert Mitchell, *ISPs To Rural America: Live With Dial-up*, COMPUTERWORLD Aug. 27, 2007, http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=299844 ("21% of Americans—the nearly 60 million people who live in rural areas—are often underserved.").

42. Moreover, in some areas, dense tree cover or other topographical obstacles may make satellite service infeasible.

43. There are some efforts to provide service in very rural areas, including Denver-based Open Range Communications. *See* Kimberly S. Johnson, *Firm Eyes Rural Net*, DENVER POST, May 18, 2008, at K1. Prospects for such services remain uncertain. Moreover, even for rural service providers, there is some level of population density or geographical hurdles beyond which commercial service is not feasible.

the existing universal service structure. Simply tacking on broadband to the current subsidy regime would create a competition for resources. Incumbent rural local exchange carriers would oppose any change that transferred money from high-cost telephone service subsidies to fund broadband. In addition, broadband should be seen as a new capability that primarily requires a one-time investment to deploy necessary infrastructure. A reverse auction mechanism, which creates incentives to provide the subsidized service efficiently, would be an effective way to distribute broadband funds.[44] The auction would allow new entrants, including wireless providers, to competitively deliver service in areas that already have basic telephone service but lack broadband. While competition may not be feasible in some rural and other underserved areas, it can be a valuable catalyst for efficiency and investment in others.

As this discussion shows, ubiquitous broadband is a serious challenge, but not an insurmountable one. Especially when the focus is limited to the broadband floor, where traditional universal service principles are most relevant, making broadband available to all but a few percent of Americans looks to be a question of when, not if. The timing matters, of course. Coherent policies will make a difference, and even a rhetorical commitment from the federal government would accelerate the deployment of broadband to under-served areas. The point is that most of the necessary answers are already floating around in policy discussions, awaiting sufficient political will to implement them. The story for the other aspect of universal broadband, unitary service, is quite different.

III. UNITARY BROADBAND

Historically, the discussion about universal service focused on network endpoints. It emphasized ubiquity, which meant growing the geographic footprint of customers connected to the network, and ensuring those customers had access to a baseline level of service (such as touchtone). This was done with the backdrop of a monopoly network operator, or later a dominant regulated incumbent in virtually every area. If there is effectively only one network provider, and one service, the internal structure of the network is less important than the reach of its edges. Joining the network delivers the full benefits of connectivity to all users.[45]

44. In a reverse auction, bidders compete to deliver the service for the lowest price.

45. There are a few caveats to this point. Some important aspects of basic telephone service, such as touchtone and 911 support, were written into the definition of universal service as they become mainstream requirements, or they may not have been provided everywhere. When the telephone network is used for dial-up Internet access, users in under-served areas may not have local service-provider points of presence to reach without a long-distance call, or may have limitations on their telephone company's access equipment (such as remote terminals

In a broadband world, however, the endpoints are not the whole story. The Internet is a network of networks. Its constituent service providers must voluntarily decide to interconnect with one another, and the terms of that interconnection.[46] For the most part, this voluntary federation has worked extremely well, even without the level of regulation that predominates on the telephone network.[47] However, the unitary Internet of today is under stress. Broadband access providers, as the crucial "last mile" for user connectivity to the Internet, will have significant influence over whether the Internet remains primarily a federated system, or becomes more like the independent walled gardens of pre-Internet online services. A 21st century conception of universal service must recognize that a ubiquitous connection only to some of the Internet is not truly universal broadband. It is therefore incumbent on policy makers to incorporate principles of unitary service into a national broadband strategy.

A. Unitary Service

1. From past to present

"Universal service" has come to stand for ubiquitous telephone service for all Americans. However, the original meaning of the term was somewhat different. Universal service was initially a marketing slogan of AT&T under Theodore Vail, the CEO who brought AT&T to its position of dominance early in the 20th century.[48] The idea was that only AT&T – which had a near-monopoly on long-distance connections and the largest local footprint – could provide "universal" service across the entire country.[49] It was only later when the federal government effectively ratified AT&T's exclusionary policies to prevent competitive entry that universal service evolved into a public policy mandate for increasing telephone subscribership. Because AT&T was a regulated monopoly, it could offer some services, such as business lines and long-distance, at above-market prices, and use the revenues to cross-subsidize below-market prices for local telephone service, especially in high-cost areas.[50]

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or load coils) that limits the speed of connections.

46. *See* Kevin Werbach, *The Centripetal Network: How the Internet Holds Itself Together, and the Forces Tearing it Apart*, 42 UC DAVIS L.REV. 343 (2008).

47. *See id.*

48. *See* Mueller, *supra* note 21, at 4.

49. *See* ROBERT W. CRANDALL & LEONARD WAVERMAN, WHO PAYS FOR UNIVERSAL SERVICE?: WHEN TELEPHONE SUBSIDIES BECOME TRANSPARENT 6 (2000); *see also* Patricia M. Worthy, *Racial Minorities and the Quest to Narrow the Digital Divide: Redefining the Concept of "Universal Service"*, 26 HASTINGS COMM. & ENT. L.J. 1, 7-8 (2003); Mueller, *supra* note 21, at 4-8.

50. With competitive entry, competitors would have "cherry-picked" the customers

The ability to fund ubiquitous access was perceived as a benefit in return for the absence of open competition.

AT&T thus used ubiquitous service as an argument for its particular vision of unitary service. To serve everyone, it claimed, there had to be one network. AT&T may or may not have been correct. What matters is that the U.S. government acted as though it was, and endorsed a system where one operator provided end-to-end service to most Americans. Awareness of the significance of unitary service faded during the years of the AT&T monopoly, since there was no possibility of interconnection outside of a small group of independent companies. Until the FCC's 1968 *Carterphone* decision, customers could not even attach their own telephones or other devices to the network.[51]

As competition took root in the telephone industry, the accepted understanding didn't change, even though the link between monopoly and universal service was broken. The break-up of AT&T in the 1980s and the expansion of local competition under the 1996 Telecommunications Act replaced the power of one monopolist with technical standards and government mandates to ensure the network provided unitary service.[52] Because the network only delivered one service, however, and supplemental functions such as directory assistance and number portability were centralized and regulated, there were few opportunities for providers to deliver something different from other providers. New entrants could compete in price, customer service, and additional services delivered at the edge of the network, but they all still offered access to the same unitary telephone network.

During the past several years, however, two significant developments have undermined the foundations of the unitary network. First, the growth of broadband and wireless services altered the center of gravity for communications policy. The long-term effort to make telephone service available to all Americans has largely succeeded, with telephone subscribership leveling off at approximately 95%.[53] U.S. broadband subscribership levels, by contrast, are still only 22%, according to OECD statistics.[54] On a broadband network, voice communication is simply one application, which uses a relatively tiny amount of capacity. The key future questions regarding the unitary network therefore

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paying the extra-high rates, unbalancing and undermining the system.

51. *See* Kevin Werbach, *The Federal Computer Commission*, 84 N.C. L. REV 1, 21 (2005); Use of the Carterphone Device in Message Toll Telephone Service, *Decision*, 13 FCC 2d 420, 423-424. (1968), *recon. denied*, 14 FCC 2d 571 (1968).

52. *See* 47 U.S.C. § 251 (2006).

53. *See* Press Release, FCC, FCC Releases New Telephone Subscribership Report (Mar. 21, 2008), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-280979A1.pdf; *see also* Crandall & Waverman, *supra* note 49.

54. *See* OECD Broadband Portal, *supra* note 3.

concern the broadband infrastructure of Internet access, rather than the legacy PSTN.

The second important shift occurred when the FCC abandoned its efforts to encourage local competition through mandatory sharing of incumbent networks, including broadband access networks.[55] In a series of decisions, ratified by the Supreme Court in the *Brand X* decision, the FCC reclassified broadband access as an information service.[56] The implication of that shift is that the Title II rules governing telecommunications service providers, including the baseline interconnection requirement under Section 251 of the 1996 Act, do not apply.[57] The FCC left open the possibility of imposing some requirements under its backstop Title I authority, but so far it has not articulated what those might be.[58]

These two developments mean that the terms of network-to-network interconnection, as well as the basic service definition for the communications platform, are no longer subject to the business, technical, or regulatory regimes that produced the unitary telephone network. Network operators have significant freedom to define their offerings in distinctive ways. Furthermore, because the Internet is a platform for applications and content, certain service providers and others operating on top of the network also have the power to shape the user experience in fragmented ways.

2.The Value of Federation

Systems such as the telephone network are subject to network effects: additional users and usage of the network benefits other users.[59] In simple economic terms, there is a positive externality to each new subscriber. That subscriber benefits, but so do existing users whose calling circle expands. Network effects have long been understood as an important factor in telecommunications policy.[60] In a broadband environment, however, their implications shift in important ways.

Historically, network effects were a driver for treating the telephone

55. *See* Kevin Werbach, *Only Connect*, 22 BERKELEY TECH. L.J. 1233, 1268-69; Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, *Policy Statement*, 20 FCC Rcd. 14,986, 14,987-88 (2005).

56. *See* Nat'l Cable & Telecomm. Ass'n v. Brand X Internet Servs., 545 U.S. 967, 977-78 (2005).

57. *See id.*

58. *See id.* at 1002-1003; *see also* James B. Speta, *FCC Authority To Regulate the Internet: Creating It and Limiting It,* 35 LOY. U. CHI. L.J. 15, 16 (2003).

59. Mark Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 CAL. L. REV. 479, 481 (1998); Michael L. Katz & Carl Shapiro, *Network Externalities, Competition, and Compatibility*, 75 AM. ECON. REV. 424, 424 (1985).

60. *See* Werbach, *supra* note 46.

network as a regulated monopoly. Because the largest network experienced the greatest positive externalities, it had a massive advantage over smaller networks. A new user gained less from joining a smaller network, even at the same price and service level, because he or she gained fewer calling partners. Moreover, when it came to interconnection between networks, the larger network could insist on advantageous terms. The smaller network would gain more from the linkage of the two networks, because its subscribers would see their calling options expanded more. A skillful company such as AT&T was able to exploit this imbalance to entrench its dominant position in the marketplace. From a public policy perspective, moreover, the most beneficial network was the one that included everyone. That network, the monopoly network, would generate the greatest positive externalities for its users.

There is, however, another means to achieve the beneficial network effects of ubiquitous connectivity. If networks can interconnect and federate using common standards, they become virtual super-networks. Their users gain the same benefits as users of one monopoly network, without the well-known economic and social policy limitations of monopolies. On the PSTN, with its flat connectivity for a single service, federation means simple interconnection. On the Internet, the picture is more complicated. As already mentioned, the Internet is a layered environment. Physical connectivity is separable from logical, application, and content elements. Furthermore, the Internet is a packet-switched network.[61] Traffic does not flow across pre-defined, exclusive paths, but is split up and routed in real-time. More links across the network increase the capacity of the Internet to sustain more and more sophisticated connections. Specialized providers, with different levels of infrastructure, can provide various services to enhance the network. For example, content delivery networks (CDNs) provide overlays that improve Internet performance, benefiting both users and network operators.[62] This rich environment depends critically on interconnection through open standards.

The major innovators and business success of today's broadband Internet are a testimony to the value of federation. For example, Google can pull in content from across the entire Web to generate its search engine indices, and can deliver its services across a globally distributed network of data centers. And Facebook can rapidly build a social network encompassing tens of millions of users, because those users already share

61. For an example of a packet-switched network, see Kevin Werbach, *Digital Tornado: The Internet and Telecommunications Policy* 10 (FCC Office of Plans and Pol., Working Paper No. 29, 1997), http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp29pdf.html.

62. *See* John Dilley, Bruce Maggs, Jay Parikh, Harold Prokop, Ramesh Sitaraman & Bill Weihl, *Globally Distributed Content Delivery*, 6 IEEE INTERNET COMPUTING 50 (2002).

common platforms such as the Web and email. Facebook itself is now becoming a platform for thousands of applications and groups, by opening up its interfaces to third parties. All these users originate on different kinds of networks, in different geographical locations, owned by many different providers. Those factors become irrelevant once they reach the great global pool of connectivity that is the Internet.[63] Any user can potentially use any service, and on the other side, an application developer can potentially reach any user. The network effects build on each other, producing the vibrant ecosystem of today's Internet.

B. The Threat of Fragmentation

The rise of broadband may produce a new fragmentation of connectivity. At first, this may sound unlikely. Why would anyone seek to undermine the federated structure that has served the Internet so well? And even if some parties adopted proprietary strategies, how could they succeed against the overwhelming inertia of the current, federated model?

The answer to both questions lies in the basic dynamics of growing networks.[64] Network effects tend to produce powerful hubs, because new nodes express "preferential attachment" to the most-connected nodes in the existing network.[65] The best-connected nodes become even more dominant as the network grows. Network scientists refer to this as the commonly-occurring "scale-free" or "power law" distribution of many network attributes.[66] To a point, everyone benefits from standards, even if they are de facto standards defined by private parties such as Microsoft or Google. Eventually, though, the pendulum swings the other way. The dominant hubs become tempted to exploit their control for private gain, and those at the periphery chafe at the power the hubs enjoy.[67] Both pressures produce proprietary alternatives to the common standards. As network links are broken or weakened, the topology of the network can quickly shift from one that is largely unified to a collection of loosely-

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63. Of course, some differences such as connection speed matter to the user experience, especially with services such as video. These are issues of network capability, not network differentiation.

64. *See* ALBERT-LÁSZLÓ BARABÁSI, ET AL, EDS., THE STRUCTURE AND DYNAMICS OF NETWORKS (2006); MARK BUCHANAN, NEXUS: SMALL WORLDS AND THE GROUNDBREAKING SCIENCE OF NETWORKS (2002); Matthew O. Jackson, *The Stability and Efficiency of Economic and Social Networks*, *in* ADVANCES IN ECONOMIC DESIGN (S. Koray & M. Sertel, eds., 2003); DUNCAN J. WATTS, SIX DEGREES: THE SCIENCE OF A CONNECTED AGE (2003); Werbach, *supra* note 46.

65. *See* Albert-László Barabási & Réka Albert, *Emergence of Scaling in Random Networks*, SCIENCE, Oct. 15, 1999, at 509-10.

66. *See* ALBERT-LÁSZLÓ BARABÁSI, LINKED: HOW EVERYTHING IS CONNECTED TO EVERYTHING ELSE (2002); *id.* at 509.

67. *See* Werbach, *supra* note 46.

connected islands.[68]

The fragmentation of the broadband Internet is most visible in three areas: application exclusivity and service tiering; non-universal addressing; and interconnection patents.

1.Application discrimination

A core design feature of the Internet is that it is not limited to providing a particular application or class of application. It is, in the words of renowned Internet engineer David Clark, "oblivious" to the uses of the network.[69] Any service that can be encapsulated into the TCP/IP protocol stack can be delivered over the network. As has already been discussed, this makes the Internet very different from platforms such as the public switched telephone network, which are highly optimized for one kind of service.[70] The telephone network does an excellent job of delivering reliable, good-quality voice phone calls, but its suitability for other applications is limited. The Internet promotes innovation because the network itself is not optimized for one service and is flexible enough to support unanticipated applications.[71]

The application indifference of the Internet is in danger of giving way to a collection of "fenced gardens": application environments that are tied to the user's access provider.[72] Retail broadband access in the U.S. is largely a duopoly, with major cable and telephone companies dominating the market.[73] Two companies—AT&T and Verizon—control the lion's share of the DSL access market nationwide, and a small number of cable operators, led by Comcast and Time Warner, are their primary competitors.[74] The raging debate over network neutrality revolves around the concern that those providers will use their power to discriminate

68. *See id*.

69. *See* BERNARD ABOBA & ELWYN DAVIES, REFLECTIONS ON INTERNET TRANSPARENCY 1 (2007), http://tools.ietf.org/rfc/rfc4924.txt; DAVID CLARK, ET AL., NEW ARCH: FUTURE GENERATION INTERNET ARCHITECTURE (2003), http://www.isi.edu/newarch/iDOCS/final.finalreport.pdf.

70. There are some optimizations (e.g. more file transfer than real-time services) implicit in the protocol design, based on the assumption of the engineers at the time. However, such tradeoffs are necessary in any engineered system. The Internet protocols may express an implicit bias for certain applications, but they in no way preclude other applications, nor do they prevent network operators, service providers, and equipment vendors from devising clever techniques to circumvent the limitations in the protocol.

71. KEMPF, ET AL., THE RISE OF THE MIDDLE AND THE FUTURE OF END-TO-END: REFLECTIONS ON THE EVOLUTION OF THE INTERNET ARCHITECTURE 7-8 (2004), http://tools.ietf.org/html/rfc3724.

72. Some are even more tightly-controlled "walled gardens", offering little access beyond the approved applications and content.

73. *See* Turner, *supra* note 9, at 24.

74. A few independent providers such as Earthlink remain active, but their share of the market is small, and they depend on reselling incumbent services.

against unaffiliated application and content providers.[75] Such exclusive or exclusionary practices would have the effect of fragmenting the Internet into distinct zones.[76] If Verizon users could access peer-to-peer video content but Comcast users could not, or if customers of only some access providers could use voice over IP services, the Internet would no longer be a unitary application environment.

While most of the debate over network neutrality involves the largest network operators, small rural operators may be more likely to impose discriminatory restrictions on applications or content. Rural local exchange carriers often depend on inflated interstate access charges for a substantial portion of their revenues, which creates a strong incentive to block or degrade VoIP services that circumvent those charges.[77] This was apparently the case for the clearest violation of network neutrality to date, when Madison River, a rural phone company, blocked Vonage from its broadband network.[78] Moreover, rural broadband providers are likely to face less competitive pressures, and more bandwidth constraints for backhaul connections from their networks, both of which create incentives for discriminatory treatment of certain traffic. And while the major national providers are now subject to significant public scrutiny because of the political significance of the network neutrality debate, smaller providers in under-served areas may have an easier time engaging in practices that constrain uses of their broadband networks.

2.Addressing

Addressing is an overlooked element of a unitary communications network. If a user cannot reach another user, or some other resource, it is as though they are not on the same network. Globally routable addresses can require many levels of standardization and agreement. The PSTN, for example, uses universal e.164 telephone numbers, and area codes managed through inter-governmental frameworks such as the North American Numbering Plan.[79] This system allows each of the more than three billion telephone users worldwide to potentially call any other.

The broadband transition poses two major threats to unitary addressing. First, VoIP and other Internet-based real-time communications services do not necessarily use existing telephone numbers. Skype, for example, uses its own proprietary usernames, which

75. *See* Yoo, *Beyond Network Neutrality, supra* note 11.

76. *See id.*

77. Schewick, *supra* note 11 at 347.

78. Madison River Commc'ns, LLC & Affiliated Companies, *Order*, 20 FCC Rcd. 4295, 4297 (2005) [*hereinafter* Madison River Order].

79. Administration of the North American Numbering Plan, *Notice of Inquiry*, 7 FCC Rcd. 6837 (1992).

are only useful within Skype.[80] The value of such private namespaces depends on the size of the user base. Skype has over 300 million users, so there are powerful incentives to adopt its platform rather than another service that offers less widespread calling partners.[81] The potentially anti-competitive effects of addressing were considered in the AOL-Time Warner merger, when control over instant messaging was considered significant, and may be raised again if Microsoft successfully acquires Yahoo!.[82] With regard to broadband and telephone networks in under-served areas, however, this concern is not substantial today, since a PSTN connection and telephone number will always be a part of the service bundle.

A greater concern involves the addressing mechanisms behind the scenes. Information is routed between devices on the Internet using what are called Internet Protocol (IP) numbers. The current version of the protocol, IPv4, was developed before the Internet became a global commercial phenomenon.[83] It supports about four billion unique network addresses.[84] Between inefficiencies in address allocation and the massive growth of the network, those addresses are rapidly being exhausted. It is now estimated that all available IPv4 addresses will be give out by 2011.[85] A new version of the protocol, IPv6, offers a vastly larger address space.[86]

However, although IPv6 was adopted as a technical standard more than ten years ago, adoption has been slow. Networks see little reason to spend the money involved in upgrading until there is a crisis. One result is that many networks use techniques such as Network Address Translation (NAT) to conserve IP addresses.[87]NAT, however, means there is no end-to-end visibility across the network, which can impair some services. A second consequence of IP address exhaustion is that the

80. Skype does allow users to dial in or out through the PSTN using traditional telephone numbers.

81. *See* Press Release, Skype, Skype Announces Unlimited Long-Distance Calls to Over a Third of the World's Population (Apr. 21, 2008), http://about.skype.com/2008/04/skype_announces_unlimited_long.html.

82. *See* Philip J. Weiser, *Internet Governance, Standard Setting and Self-Regulation,* 28 N. KY. L. REV. 822-42 (2001) (concerning AOL-Time Warner); *Microsoft v Google: When Clouds Collide,* THE ECONOMIST, Feb. 9, 2008, http://www.economist.com/business/displaystory.cfm?story_id=10650607.

83. *See* INFORMATION SCIENCES INSTITUTE, INTERNET PROTOCOL (1979), http://www.networksorcery.com/enp/ien/ien111.txt.

84. *See Upgrading the Internet*, THE ECONOMIST, Mar. 24, 2001, at 32.

85. *See* Neil Weinberg, *D-Day is Coming Up Fast*, NETWORK WORLD, June 28, 2007, http://www.networkworld.com/news/2007/062807-ipv6-deadline.html (stating ARIN head John Curran's estimate of a 2011 exhaustion date).

86. Internet Engineering Task Force Request for Comment, RFC 2460, Internet Protocol Version 6 (IPv6) Specification (1998), http://www.ietf.org/rfc/rfc2460.txt; IPv6: The Next Generation Internet!, http://www.ipv6.org/.

87. COMMITTEE ON THE INTERNET IN THE EVOLVING INFORMATION INDUSTRIES, THE INTERNET'S COMING OF AGE 7 (2001).

IPv6 transition will have significant impacts on Internet connectivity. If many networks continue to lag in adoption of IPv6, unitary connectivity could be threatened as IPv4 addresses are exhausted. Users of one Internet service provider or backbone might have difficulty reaching users of others, moreover, China has determined that IPv6 represents an opportunity to define the next generation of the Internet. It is investing significant resources to make its implementations of IPv6 into *de facto* standards.[88]

Broadband networks being deployed in rural and other under-served areas will have choices to make about the addressing mechanisms they adopt. If they fail to build in IPv6 support from the start, they may not have the resources to upgrade in the next few years, when IPv4 address exhaustion becomes acute. That will lead to a variety of responses that make those networks less effectively connected to the rest of the Internet.

3.Interconnection patents

A final area of concern is that patent holders will use their exclusive rights over key interconnection technologies to prevent smooth federation of broadband networks, especially for VoIP. Several companies, beginning with Verizon, successfully sued the VoIP startup Vonage for infringing their patents, nearly forcing Vonage out of business.[89] The most disconcerting aspects of the litigation are what many of the patents, including Verizon's cover: interconnection of VoIP services with the PSTN.[90] Vonage operates as a direct competitor to traditional phone services, offering customers the ability to use ordinary telephones and phone numbers. It therefore must translate between VoIP and calls originated and terminated on the PSTN. The basic technical standards and addressing systems involved are industry standards and non-proprietary, but the implementation methodologies for implementing a service like Vonage's are patentable.[91]

Interconnection patents strike at the heart of the unitary network. They take the common resource of interconnection and turn it into a proprietary property right. Moreover, because most of the major incumbent operators and equipment vendors hold some patents on VoIP technologies, there is great potential for patents to be used oligopolistically as a barrier to competitive entry. Vonage had business problems unrelated to the patent litigation, but the fact that it was the

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88. *See* Ben Worthen, *China Builds a Better Internet*, CIO MAG., July 15, 2006, http://www.cio.com/article/22985/Internet_Strategy_China_s_Next_Generation_Internet.

89. *See* Laura Holson, *A Settlement By Vonage Over Patents*, N.Y. TIMES, Oct. 9, 2007, at C1; Kevin Murphy, *Legal Costs Hit Vonage Hard*, COMPUTERWIRE, Nov. 9, 2007.

90. *See* Holson, *supra* note 89; Murphy, *supra* note 89.

91. *See* Holson, *supra* note 89; Murphy, *supra* note 89.

company targeted by patent-holders raises the possibility that the patents are being used anti-competitively. In the early days of telephony, AT&T used its patents over key technologies for long-distance transmission to maintain its dominance over independent carriers.[92] The current VoIP situation bears some similarities to that behavior.

As convergence proceeds, a greater array of voice, video, and data services will have to be delivered across diverse legacy and new networks. It is hard to imagine that there are not many other issued patents similar to those asserted against Vonage, which could be deployed against providers of converged broadband services. Rural broadband providers are unlikely to be the holders of these patent portfolios. However, the kinds of services delivered over their networks will depend on how interconnection patents are enforced. If the Vonage experience is a harbinger of things to come, technologies such as VOIP, which have the potential to greatly reduce costs and increase functionality of telephony in rural as well urban environments, will be significantly limited.

IV. MAKING THE CONNECTION BETWEEN SUBSIDIES AND FEDERATION

The potential balkanization of broadband is not just an Internet concern. Data communications networks are converging with voice and video networks. Cable operators already primarily use VOIP to deliver telephony, and telephone companies such as Verizon are employing packet-based technologies to deliver video. As communications networks evolve, they will move increasingly from the legacy technologies of the PSTN to architectures based on Internet technologies. This transition may be slower for small rural incumbents, who have limited capital budgets and no competitive pressures to upgrade. However, in under-served areas where broadband deployment catalyzes new network investment, the changeover may come more quickly. All this means that the ubiquity and unitary structure of broadband will increasingly reflect the character of telecommunications as a whole.

While diversity of platforms and service offerings can be positive developments, excessive broadband balkanization represents a dangerous possibility, particularly for users in under-served areas and communities. By definition, these are the users who are perceived as being more expensive to serve, or less desirable as customers for existing providers. If broadband access becomes a collection of different packages based on the decisions of the access providers or other intermediaries, those in need of

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92. *See* AMY FRIEDLANDER, NATURAL MONOPOLY AND UNIVERSAL SERVICE: TELEPHONES AND TELEGRAPHS IN THE U.S. COMMUNICATIONS INFRASTRUCTURE, 1837-1940, 42-53 (Corporation for National Research Initiatives 1995).

universal service mechanisms are likely to receive the most restricted offerings. Some variability between different areas, such as higher-speed broadband plans in cities compared to rural areas, makes good economic sense and still provides the underserved communities with the floor connectivity levels which public policy is most concerned about. With no limits on the balkanization of the network, however, under-served users may not enjoy the true connectivity benefits the national broadband strategy is designed to deliver. They may be structurally locked out of the capabilities that mainstream users enjoy, a gap that will only grow larger as the network and its services evolve.

The potential fragmentation of the Internet is therefore a threat to universal broadband. However, it is a different threat than the absence of broadband access networks in particular locations. Addressing either ubiquity or unitary service individually would do little to promote the other goal. The subsidy mechanisms that support widespread broadband deployment in under-served areas will not, by themselves, reduce the likelihood of Internet fragmentation. By the same token, FCC policies to promote open interfaces and interconnection across the federated Internet will not directly increase broadband availability in rural areas. If, however, the government adopts a ubiquitous broadband framework along the lines set forth in Part II, it would offer a unique opportunity to address unitary service at the same time.

Both ubiquity and unitary service are facets of universal broadband, and it makes sense to link them together. A new broadband policy for the U.S. should condition the benefits it offers on adherence to open interconnection requirements. This condition could apply to the new reverse auction mechanism proposed here, or to broadband subsidies from existing universal service funding mechanisms.

Specifically, the interconnection obligation could include the following:

- A commitment to adhere to the FCC's Internet Policy Statement[93] (assuming such obligations do not otherwise become mandatory under further FCC action or federal network neutrality legislation).
- Support for IPv6 addressing across their networks.
- Not assert any patent against a provider seeking to interconnect with its network for the purpose of providing telecommunications or Internet services.

93. *See* Appropriate Framework for Broadband Access to the Internet over Wireline Facilities, *Internet Policy Statement*, 20 FCC Rcd. 14,986, 14,987-88 (2005).

These basic commitments cover the main areas where Internet fragmentation seems likely. These requirements would not address every possible scenario of Internet balkanization, but they would ensure that baseline end-to-end connectivity is available along the most significant dimensions.

The first condition addresses network neutrality. The FCC's Policy Statement asserts that consumers are entitled to access the lawful Internet content of their choice, run applications and use services of their choice, connect their choice of legal devices, and to competition among network providers, application and service providers, and content providers.[94] Though it does not go as far as many network neutrality proposals, it provides a minimal set of guarantees against the kinds of anti-competitive practices that were at issue in the *Madison River* case.[95] The Policy Statement is, however, not an enforceable FCC order. Requiring recipients of broadband subsidies to adhere to it would ensure that one segment of the industry, perhaps the one most likely to engage in anti-competitive limitations on Internet innovation, will face network neutrality requirements. The Commission has already adopted such a piecemeal approach, when it agreed to temporary network neutrality conditions on AT&T as part of its merger with BellSouth.[96] And in this case, the Commission would be putting conditions on a grant of funding, much as Congress often imposes conditions on funds it provides to state governments. The case for network neutrality requirements is stronger when they are in return for a benefit, rather than an over-arching industry mandate.

The second condition would alleviate the potential balkanization of address space. Network operators in under-served areas will likely be purchasing new equipment to deploy and improve their broadband capabilities. The cost of IPv6 compliance may therefore be small or non-existent. However, given the slow pace of the IPv6 transition, such providers may need an incentive to prioritize IPv6 compliance in their network deployment plans.[97] Moreover, by requiring providers that accept new broadband subsidies to adopt IPv6, the requirement would have a side benefit. It would increase demand for compliant equipment

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94. *See* Telecommunications Act of 1996, Preamble, Pub. L. 104-104, 110 Stat. 56 (1996) (enacting 1996 Act "to promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers and encourage the rapid deployment of new telecommunications technologies.").

95. Skype allows users to dial in or out through the PSTN, using traditional telephone numbers. *See* Madison River Order, *supra* note 78.

96. Letter from Robert W. Quinn, Jr., Senior Vice President, AT&T Servs. Inc., to Marlene H. Dortch, Sec'y, Fed. Commc'ns. Comm'n, (Dec. 28, 2006), http://www.fcc.gov/ATT FINALMergerCommitments12-28.pdf.

97. There are mechanisms to provide backward compatibility with IPv4 networks elsewhere.

among vendors, and would increase the number of networks and backbones with IPv6 support. Even though many of the networks involved will be small, this change may help produce a critical mass of IPv6-compliant networks, which will encourage others to make the investment. While there are many other aspects of addressing that are subject to fragmentation, the government should be careful about intervening too much into the technical decisions of network operators. IPv6 is the one area where the industry standard is crystal clear.

Finally, the patent condition will prevent a Vonage-type situation from emerging among the networks receiving broadband subsidies. The small rural providers who receive broadband subsidies are not likely to be significant patent holders. So the direct effects of such a condition may be largely symbolic. Even so, by establishing that interconnection patents are potentially as significant a barrier to competition and innovation as content or application discrimination, this condition will raise awareness about the threat. The FCC does not assess liability for patent infringement, so its ability to address the fragmentation threat from interconnection patents is limited. Reform of the patent process itself, or Congressional action to immunize providers who might run afoul of over-broad interconnection patents, may be needed to fully address this challenge. Incorporating patent limitations into the broadband subsidy framework will establish a precedent for future action.

All in all, tying these open interconnection obligations to universal broadband funding would have a significant impact. Even though only providers reaching rural and other under-served areas would be directly affected, the regime would create a template for open connectivity that could be more broadly adopted. The creeping fragmentation of the Internet reflects a weakening of norms that encouraged open connectivity. If universal broadband programs create a new cadre of service providers who are used to following such approaches, it may help turn the tide back toward those norms. The importance of unitary service, alongside ubiquity, to a full conception of universal service, would once again be recognized.

CONCLUSION

The plan laid out here is designed to address the greatest challenges associated with truly ubiquitous broadband in the U.S. The federal government, as well as states and localities, could certainly choose to do more. Studies have documented the massive economic stimulus that broadband deployment can produce.[98] However, given fiscal constraints,

98. *E.g.* ROBERT W. CRANDALL & CHARLES L. JACKSON, THE $500 BILLION OPPORTUNITY, http://www.att.com/public_affairs/broadband_policy/BrookingsStudy.pdf.

and the possibility that market forces will achieve much of what the government seeks, it makes sense to begin with a limited program that focuses on the areas of most significant need.

The most important element of any national broadband strategy is that it *be* a national broadband strategy. Raising the policy status of broadband, and especially of universal broadband, will catalyze other activities that promote investment and innovation. The time to think of broadband policy as a luxury has passed. So has the time to view it as a linear extension of policies designed for telephone service. Broadband is the future. It demands policies that reflect both its unique potential, and the novel challenges it raises.