International Journal of Communication 11(2017), Feature 1397–1413 1932–8036/2017FEA0002

A Coming Singularity in Media Regulation: The American Case

W. RUSSELL NEUMAN[1]
New York University, USA

The singularity identified in this article is the prospect that the cable-based Internet service provider could potentially become the sole vendor capable of providing truly high-speed residential broadband connectivity in the United States. The premise is that broadband Internet replaces virtually all of its legacy competitors such as analog telephony and terrestrial broadcasting. This prospectively unchallenged chokepoint for political communication, advertising, entertainment, and economic transactions could extract monopoly rents and distort otherwise open political processes. As minimally acceptable broadband data rates escalate, the physical limitations of copper-wire technologies increasingly limit the incumbent telephone carrier as a meaningful competitor. Satellite-based Internet service providers face equally if not even more daunting technical challenges in providing true broadband connectivity at scale. To avoid a return to the inflexibility of full tariff-based common carrier regulation of an inadvertent, but potentially de facto monopolist, there remains one potential for meaningful competitive technology for provision of broadband Internet—fixed terrestrial wireless Internet based on fifth-generation and successor cellular technologies with competitive monthly fees for unlimited data.

Keywords: Internet, broadband, telecommunications, regulation, competition, Internet service providers, cable

The fact that the once separate industries of publishing, broadcasting, and telecommunications have converged into what is largely a singular means of digital provision via the Internet is widely acknowledged and no longer even controversial (Doyle, 2002; Jensen, 2010; Wu, 2010). However, because there are seemingly unlimited voices competing for attention on the Web and because there are at present multiple firms offering Internet connectivity, the case for regulatory intervention to protect diversity of access remains highly controversial. Most of this debate pivots on the concept of network neutrality and a concern that a particular network service provider such as Comcast, Verizon, or AT&T might be incented to provide faster or more reliable service to one particular content-based service such as Netflix or Amazon for financial gain (FCC, 2015; Wu, 2003). This article focuses on a related and potentially even more troubling challenge to the openness of a digital marketplace of ideas—the evolution of a singular and monopolistic provider of Internet service.

[1] I am thankful for the advice and counsel of Eli Noam, David Burstein, and Richard Clarke.

As demand for megabit and gigabit broadband transmission become the norm, the physical limitations of twisted-pair or copper-based digital subscriber loop technologies increasingly limit the incumbent landline telephone carrier as a meaningful competitor. Satellite-based Internet services have traditionally been weak competitors because of limited available satellite spectrum, intermittent atmospheric interference, and transmission delays (latencies) over the long distances necessary for geostationary satellites. That puts the incumbent cable-based provider of Internet service in a dominant position technically. The driving force behind this singularity is the apparently boundless demand for broadband data rates.

The Broadband Issue

Meaningful competition among Internet service providers (ISPs) is inevitably tied to the bandwidth of the service under consideration—the higher the bandwidth, the fewer the providers. This has come to the fore in the recent American debates about universal broadband provision (FCC, 2010). Figure 1, for example, demonstrates that at the Federal Communications Commission's (FCC's) minimal definition of broadband at 25 megabits per second (Mbps), less than half of American households have any choice of service provider at all and 14% have no service available at that level. Only 9% have options beyond the cable–telco duopoly. The main point of the figure is to illustrate the dramatically strong inverse relationship between broadband speeds and level of service competition. As the Internet becomes the standard source for over-the-top streaming digital video (Malone, Nevo, & Williams, 2015), it may be a monopolist providing the video.

Skeptics of such concerns might assert that high-resolution video might be characterized as a luxury and that essential services such as e-mail, telecommunication, and transaction require less demanding bandwidths. Although it is not possible to precisely estimate the evolution of demand for higher bandwidths, many of the newer services are heavily bandwidth dependent. Prominent among them are video conferencing, social hangouts, and webinars. In addition, e-mail and social media increasingly include high resolution images and video an addition to text.

Duopoly Competition

If we proceed on the premise that Internet service demand will largely require broadband access, we can explore the prospect that the currently dominant telco-cable duopoly will provide sufficient incentives for technical innovation and put downward pressure on pricing. If recent economic history is a guide, the answer appears to be that duopolies behave much more like monopolies than competitive markets. In the early days of cellular telephony, for example, the FCC promulgated a duopoly system of the incumbent telco and one competitor for most markets in the United States. The result by all accounts was relatively limited service provision and noncompetitive pricing until additional competitors entered the marketplace (Gruber, 2005).

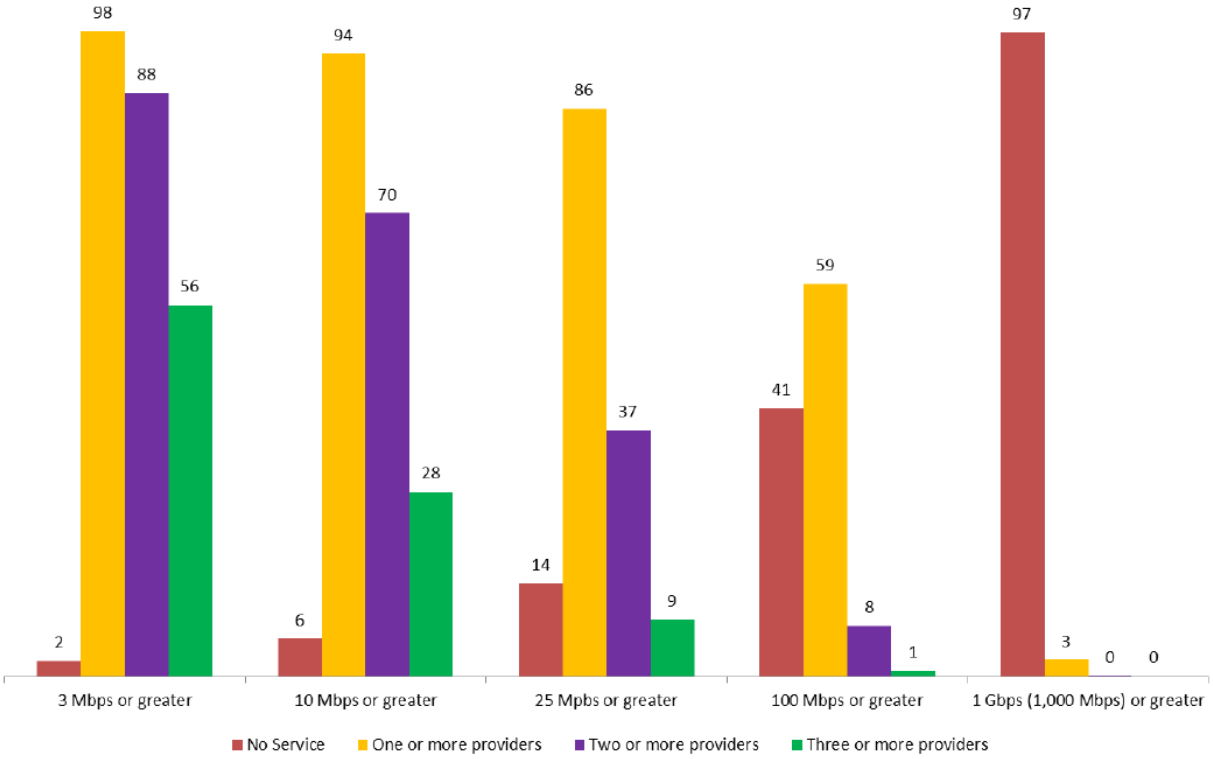

Figure 1. 2013 Population share by number of available fixed broadband providers by maximum available advertised download speeds in megabits per second (percentages). Source: 2013 NTIA State Broadband Initiative Dataset, U.S. Department of Commerce.

Furthermore, the technical character of ISP competition is not true competition in the currently dominant two-provider arrangement because the telco digital subscriber loop (DSL) technology that pushes the limits of the traditional copper twisted-pair network at speeds of 3–5 Mbps cannot match cable coaxial or optical systems with much higher capacities (Crawford, 2011). In one closely watched case in 2005, one telecommunications incumbent, Verizon, recognizing this technical limitation, decided to attempt a leapfrog of cable's coaxial cable advantage by investing in a massive upgrade in optical fiber to the home under the brand name FiOS. It is described by some as a most interesting $25 billion gamble on the American market for broadband connectivity. Although the full story is yet to be played out, recent reports indicate that Verizon has scaled back its ambitions and is slowing deployment and not planning any further expansion of its fiber network (Horrigan, 2016). Also noteworthy is that no other telecommunications incumbent followed suit (Crawford, 2012; Hansell, 2008).

A difficult question in the evaluation of duopolies of various sorts is the extent to which they might even keep prices down and quality up in an effort to disincent market entry by new competitors. The key analytic in this case is the question of how realistic market entry actually is. Given the extraordinarily high costs of wireline-type infrastructure deployment at a meaningfully large scale (noting the Verizon FiOS case again as an example), significant competition from market entry does not appear to be a realistic threat to incumbent duopolists. Smaller scale field experiments by municipal service providers and the limited Google fiber experiment are more realistic. Because neither the Google nor most municipal experiments require timely repayment of the costs of infrastructure deployment, the prospect of their expansion beyond the demonstration or experimental stage remains questionable. Confronting the costs and local regulatory complexities of getting fiber cables on poles and in the ground, Google, like Verizon, has recently scaled back its fiber-to-the-home ambitions (Bailey, 2016).

We have proceeded thus far under the working premise that newly built wireline-type physical broadband infrastructure to the home in large scale is not likely. Furthermore, although there are numerous technical breakthroughs in, for example, the throughput capacity of optical fiber (Keiser, 2003) and lowered costs of fiber over long distances (Markoff, 2015), the physical business of underground and above-ground cables and home connections is characteristically resistant to dramatic cost reductions based on technical breakthroughs (McGarty, 2006). So if a truly competitive multiprovider wireline-based competitive environment is apparently not realistic under current conditions, a spectrum-based alternative would be of critical importance.

Network Neutrality

Of course, meaningful competition in Internet service provision is desirable to keep prices down and quality of service up and represents an unambiguous policy goal in its own right. The numerous economic benefits of ubiquitous and affordable broadband are widely cited (FCC, 2010), as is the unfortunate gap in service between the United States and peer countries—as Burstein (2014) notes, "Over the last 7 years, U.S. prices for high-speed broadband have risen to typically 30%-70% higher than Germany, France & England" (Comment 3). But there is an equally compelling policy imperative that arises out of the turbulent network neutrality debate. Even strong advocates of network neutrality acknowledge that policing the ISPs to prevent various flavors of preferential throughput in zettabyte networks is a daunting challenge (Herman, 2006). True competition in access provision provides a market solution to such problems, as consumers unhappy with throttled access can seek out a provider that makes neutrality a competitive selling point. One could even imagine a scenario when the marketplace could provide somewhat discounted access with corresponding traffic shaping for consumers unconcerned about latencies and slow lanes and full service for those for whom it is a relevant concern.

The recent FCC classification of Internet service as a utility under selected portions of the Commission's Part II authority (Ruiz & Lohr, 2015) was hailed by supporters as a step forward for network neutrality and preventing the creation of a slow lane on the Web. It is, however, widely understood within the policy community to be just a single step in what is likely to be another drawn out, multistage judicial review complicated in recent months by President Trump's new leadership at the commission. The backbone technologies are evolving at Internet speeds, whereas policy and bureaucratic enforcement will inevitably

lag far behind. A successful policy initiative in facilities-based competitive provision offers the potential to make the whole neutrality brouhaha a moot question, regardless of who is heading up the FCC.

New Technologies

Many continue to think of broadband access in terms of television sets and laptop or desktop computers, but the dramatic growth of tablets and smartphones has already tipped the balance in user behavior to mobile technology for many applications (Dunaway, 2016). The proliferation of devices simply reinforces the growth of demand for bandwidth and the centrality of Internet connectivity in our daily lives. The Internet of things and the growth of ubiquitous computing reinforce both demand and dependence but also raise additional questions about individual privacy and security from various forms of hacking and malicious software. A singular provider of Internet service provides both a prime target for malicious attacks and, without competition, a vendor potentially reluctant to protect its customers from the resale of their personal data to commercial and other clients.

Rural Broadband Access Inequities

One enduring digital divide that draws the focused attention of policy makers and national broadband planners is the dramatically higher costs of access provision in areas with the lowest population densities. Historically, when the market-based vendors hesitate, the state is likely to intervene in various ways, a narrative stretching back to rural electrification in the early twentieth century to cross-subsidization norms for telecommunication tariffs and rural subsidies for broadband under the Universal Service Fund. The singularity argument put forward here focuses primarily on the core market, the 97% of the population typically served by cable, wireline telephony, and cellular service rather than the highly remote rural special case. Although 18% of the American population is classified as rural, the great majority of those citizens have wireline and wireless access roughly equivalent to their urban and suburban fellow citizens. Importantly, it should be noted that wireless service provision is less sensitive to low-density cost issues than wireline provision, as reflected by the fact that the current wireless Internet service provider industry is almost entirely small-scale entities in rural communities providing service where it would otherwise not be available (Interisle Consulting Group, 2015). So for fundamental technical reasons, an emphasis on wireless provision is good news for rural communities.

Open Access Policy

One potential solution to monopoly provision of broadband Internet is a legally enforced separation between the management of the technical delivery system and the content that flows over it (Forzati, Larsen, & Mattsson, 2010; OECD, 2013). Open access networks have been experimented with in Sweden, Australia, New Zealand, and elsewhere with varying success. Some have suggested regulatory separation as a solution to the singularity issue in the United States (Cohill, 2013). The difficulty here is that the American telecommunications infrastructure has been built with private capital, and the international experiments are virtually all products of local or national government investment in

infrastructure development. The trend in the United States is, if anything, in the opposite direction with Comcast's investment in NBCUniversal and AT&T's proposed merger with Time Warner signaling an industrial shift toward vertical integration of content creation and delivery, regulators permitting. The historical model of American reliance on private enterprise rather than public-sector management makes the United States an unpromising environment for open-access initiatives. Municipal provision of broadband infrastructure in the United States has a checkered history and at present reflects a tiny footprint of a few dozen systems with subscribership in the thousands (Institute for Local Self-Reliance, 2016; Lehr, Sirbu, & Gillett, 2004). Open-access-network initiatives should remain on the table in policy debates and local experimentation, but must be recognized as an unrealistic option for full-scale deployment in the American case, at least in the near term.

The Key to the Puzzle: Wireless Broadband Internet Service Provision

Current norms in the domain of wireless are marked by a clear distinction between the fixed and mobile categories. Fixed wireless functions much like a wireline provider, typically with monthly charges for unlimited access. The industry, however, is characterized by small-scale providers in unserved and remote areas rather than competitors to the duopolists in urban and suburban areas. There is no technical or essential economic reason that the line-of-sight and non-line-of-sight technologies the industry uses could not be meaningful competitors in more densely populated areas currently served by a monopoly or duopoly wireline system. The mobile wireless data field, of course, is dominated by the economically and physically massive and highly profitable cellular telephony industry. Figure 2 outlines the current state of competition in the recently merged cellular industry, and Figure 3 outlines the current and evolving data speeds of current cellular data standards. Mobile is a fast growing aspect of Internet service provision currently, for example, for more than half the routine access of popular social networks such as Twitter and Facebook (Lenhart, 2015). But mobile is typically billed by the bit rather than by the month and as a result is not an obvious potential competitor for wireline service, although, like fixed wireless, there is no fundamental technical or economic reason it could not be.

Figure 2 reports that 91% of American households have at least four cellular competitors. Figure 3 reports that cellular service as of mid-2014 provides download speeds between 6 and 10 Mbps. But fourth-generation (4G) data standards such as LTE are being implemented actively at scale and should bring maximum download speeds to 100 Mbps. Moreover, 5G with gigabit speeds is currently moving from the lab to pilot markets, raising new possibilities for broadband competition.

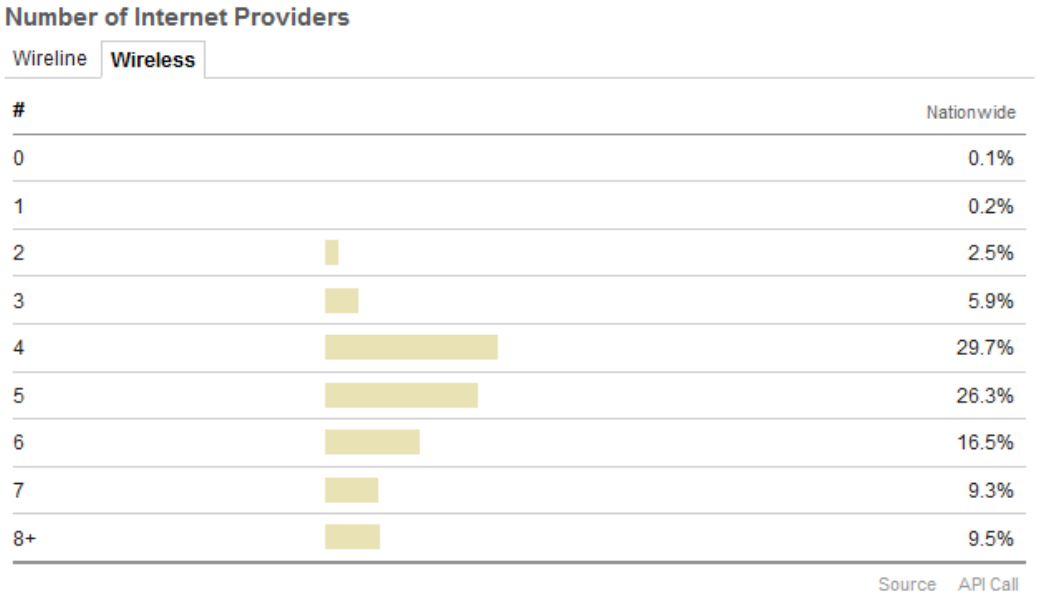

Figure 2. Wireless ISP competition.

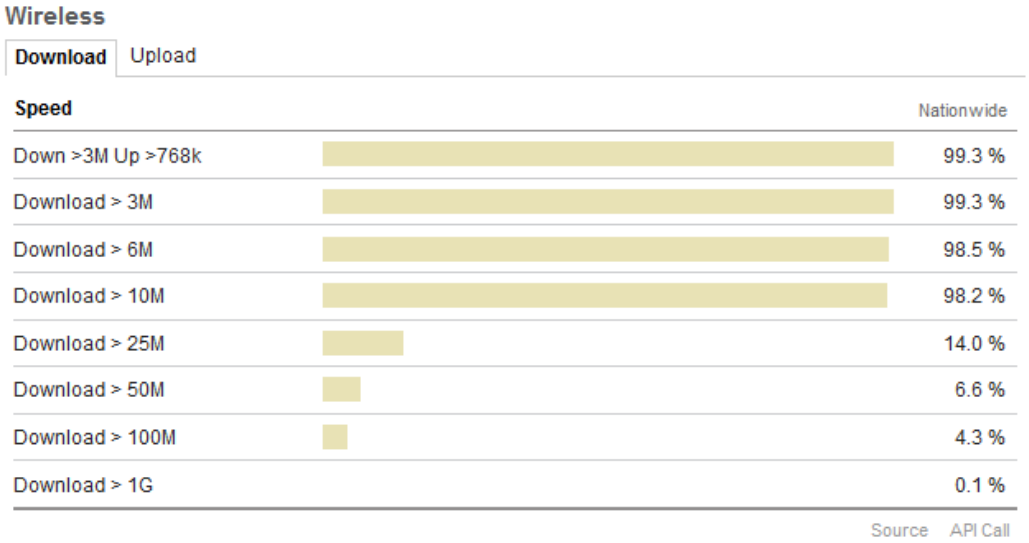

Figure 3. Wireless ISP data speeds.

So we have a potential response to the limited competition of ISPs based on physical wireline infrastructure—wireless provision built out from the current cellular infrastructure. Two questions remain: First, does it scale? Is there sufficient spectrum available to serve a larger always-on demand at these much higher data speeds? And second, are there sufficient economic incentives to move these cellular providers from a more specialized traffic-sensitive billing structure to a meaningfully competitive, reliable, monthly-billed, truly broadband service?

The answer to the first question, concerning scale, is that there could be enough spectrum. It depends on how the process of spectrum auctions and federal spectrum policy evolve. A large swath of very valuable low-frequency spectrum currently occupied by broadcasters is potentially available for reallocation and auction. Television broadcasters, by the way, are currently transmitting to a shrinking 8% of the population who rely primarily on these over-the-air transmissions. Clarke (2014) reports that from a combination of increased spectral efficiency and additional allocated spectrum, the increased throughput from 1985 to 2012 approaches a factor of 100,000. It would appear to be a sort of Moore's law of spectral data growth (Ford, 2015; see also Rappaport et al., 2013). So, the answer to the first question is a tentative *yes*, depending in part on spectrum policy and the strategic behavior of those firms that respond to the auctions. Several observers, including Crawford (2011), Noam (2011), and Napoli and Obar (2014), remain skeptical on this point. Noam, in particular, posits that as broadband demand increases, the costs per bit will increase for wireless provision, but decrease for wireline provision, which, if true, would be particularly troubling. But the proposition awaits an empirical test.

The second question, about whether the cellular providers can be incented to function as a serious competitor to cable-based fixed broadband, is more challenging. Verizon and AT&T are both major cellular and wireline ISP players. They both developed strategies to compete with the superior bandwidth capacities of the cable competitors, Verizon with FiOS fiber to the home (for part of its service area) and AT&T with a hybrid fiber-DSL system under the U-verse brand. Both have been hesitant about standing up a mobile- or fixed-spectrum-based ISP service based on their existing extensive cellular tower networks. It would appear that if the economic incentives made sense, they would have already jumped into those markets. The other two major cellular carriers in the American market, Sprint and T-Mobile, are struggling in this particularly competitive marketplace and apparently unlikely to initiate new investments in marketing and infrastructure rollout under current conditions, answering a tentative *no* to the second question. But conditions could change.[2]

Wireless Data Caps

The major mobile wireless carriers are actually already in the business of offering a potentially competitive 4G-based Internet access service at speeds up to 100 Mbps. They are relatively quiet about it and limit their offerings to specific geographic areas. AT&T and Verizon offer USB dongle access devices and home Internet routers for less than $200. Like some cell phones, the devices are offered for free or

[2] As this article goes to press, it appears that they have. Suddenly, after a five-year hiatus, virtually all of the American cellular providers began offering unlimited data plans as competition mounted. This is promising.

nearly free when tied to multiyear cellular subscription plans. The key issue, of course, if such offerings were to be meaningfully competitive, revolves around data caps and consumer sensitivity to increased costs for heavy Internet usage. One recent estimate of monthly household Internet usage (based on wireline provision) in the United Kingdom calculated the average at 17 gigabytes (GB; Ofcom, 2011). At such usage, U.S. carriers would charge about $150 a month for bulk data plans, roughly twice typical wireline-based access charges. Charging by the bit is deep in the DNA of the wireless carriers, just as charging by the minute was deeply ingrained for their wireline predecessors. "Unlimited" data plans have floated in and out of the marketing offerings of the wireless carriers (Segan, 2014) mostly based on data usage estimates for a single smartphone rather than a household full of digital devices including high resolution digital displays. So the prospect of truly price-competitive wireless data access plans at scale that are either unlimited or with data caps well above typical usage in Internet-active households might be described as just over the horizon and not yet in view of the cellular marketing executives (see footnote 2). Its practical application, of course, depends on technological progress in wireless data standards and spectrum availability. Large-scale spectrum auctions, as noted, are currently underway, and Verizon, among other companies, is pilot testing 5G mobile connectivity at gigabit speeds in 2017, with full commercialization expected two to three years down the line. We may yet see a wholesale transition to unlimited data plans for the cellular market. Note that America Online, then the dominant provider of connectivity, switched from billing by the minute to providing unlimited monthly access for $19.95 in 1996 in an effort to solidify its market dominance. This could happen in wireless. In the American case, the fact that both Verizon and AT&T are both in the wireline and wireless access business, as noted above, may temper the libido of those who would otherwise express interest in exploring new market opportunities for their wireless service.

National Broadband Plans

The national economic benefits of widely available and reasonably priced broadband are evident, so the United States, like most of its industrial and industrializing peers, has developed a national broadband plan to encourage growth and confront potential impediments. In 2010 the FCC published its call for at least 100 million U.S. homes to have affordable access to actual download speeds of at least 100 Mbps and actual upload speeds of at least 50 Mbps by the year 2020 (FCC, 2010). The plan did call for massive spectrum reallocation, but, curiously, only obliquely addressed the underlying question of monopoly or quasiduopoly wireline provision. The plan even included some rhetorical gymnastics to assert that under some conditions, duopolies might even be relatively competitive (FCC, 2010). As a result, although the plan celebrates the notions of competition, affordability, and universal availability of broadband, it is frustratingly vague on how meaningfully competitive facilities-based broadband provision might be achieved.

A Market Response to the Singularity

There is meaningful competition in the American cellular marketplace (although the incumbents frequently propose mergers that would reduce that competition). Advanced cellular data technologies such as LTE permit broadband speeds of 100 Mbps, which would provide serious competition for mobile and fixed wireless Internet service provision. The problem is that the two cellular providers that dominate the

industry, AT&T and Verizon, are also very active wireline ISPs and would seem to have every incentive to maintain the artificial distinction between wireline and wireless service, as each market is profitable and each has limited competition.

Most agree that the extant infrastructure of cable or telephonic provision would be prohibitively expensive to reproduce by a new market entrant. But such infrastructure already exists, as the extensive fiber-based cellular tower network of the cellular providers. What is missing is the much touted last mile, which, of course, could be amply served by wireless technologies using the increasingly efficient data standards and hopefully significant new allocations of usable spectrum. Cellular providers, unsurprisingly, opt to sell data by the megabit rather than offer unlimited monthly access (although the smaller cellular players sometimes explore various versions of "unlimited" data as marketing gambits). Data demand by multiple digital devices in the home served by local Wi-Fi already blurs the wireless-wireline distinction. The bottleneck, the noncompetitive singularity, is getting broadband connectivity to the home Wi-Fi router.

Lessons from the International ISP Marketplace

There are a few lessons to be drawn from a brief overview of the global scene. First, wireless provision of Internet service is dominant. Typically, this results from reliance on mobile devices, as individuals are much more likely to own smartphones than laptops. In China, for example, the projected ratio of wireless to wireline Internet provision is 3.4 to 1. In India it is a remarkable 24 to 1 (Ault, 2016). But interestingly, the issue is still defined as "mobile versus broadband"—somehow entirely incommensurate marketplaces rather than simply wireless versus wireline provision of uncapped broadband connectivity. Furthermore, the dramatic growth of public Wi-Fi hot spots (with and without access fees) further complicates the marketplace and consumer perceptions of the cost and character of access. Second, the structure of ISP provision and competition and cellular provision varies dramatically from country to country for a variety of historical regulatory conditions. It appears that, setting aside bandwidth for the moment, ISP provision in the United States is actually among the most competitive to date and becoming more so, whereas international trends, unfortunately, are in the opposite direction, as illustrated by Figure 4 (Noam, 2016).

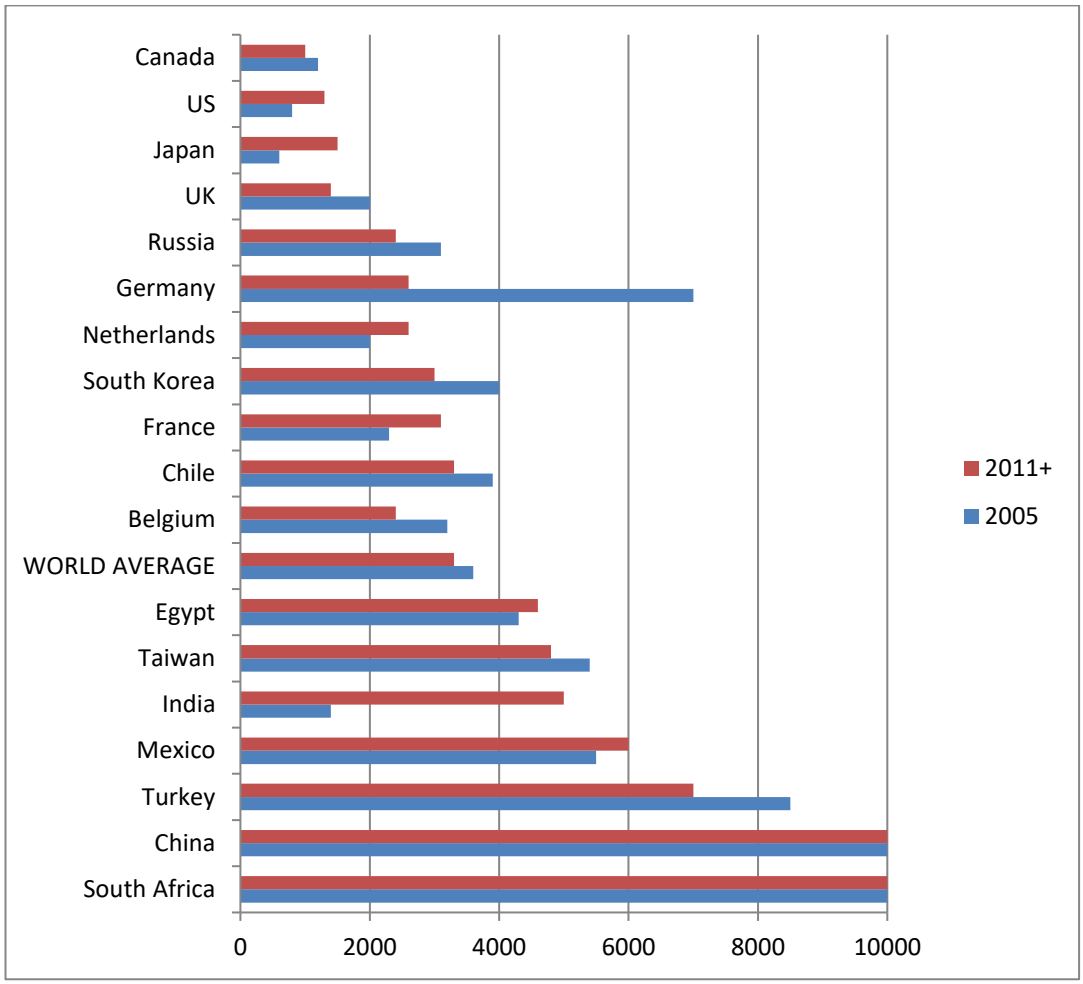

Figure 4. Global comparison of ISP concentration, Herfindahl-Hirschman index. Source: Noam, 2016.

ITU statistics on international provision of cellular data make a distinction between traditional voice service with add-on data for smartphone-type applications and what the organization calls dedicated mobile data subscriptions, which might be characterized as wireless Internet access in the spirit of what is being proposed here. In June of 2015, only 13.9% of service contracts were characterized as dedicated mobile (OECD, 2015). But interestingly, the patterns vary dramatically by country, with Scandinavians most likely to experiment with this form of provision. To date, unfortunately, this comparative data is not broken down by access speeds (see Figure 5).

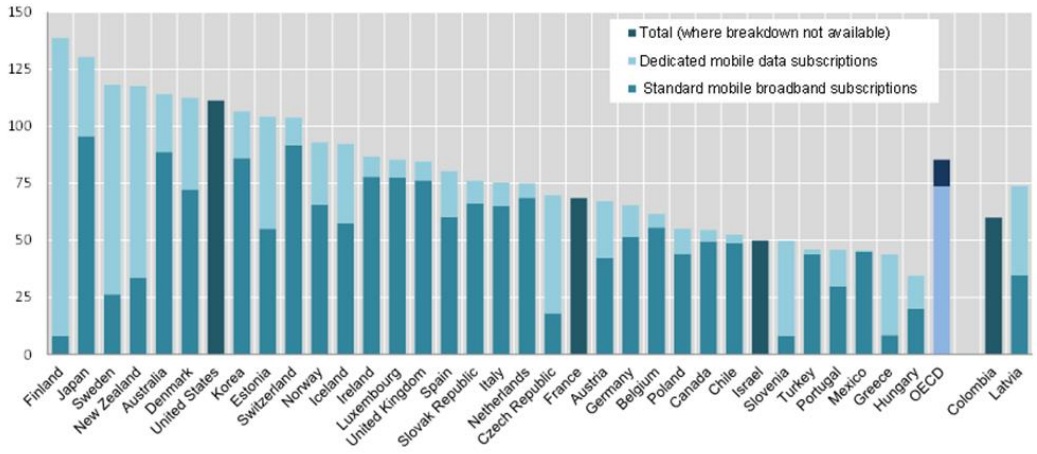

Figure 5. Global patterns of wireless Internet access subscriptions per 100 inhabitants, June 2015. Source: OECD Broadband Portal.

There are a few intriguing case studies of fixed wireless competition so far. One is Spark (formerly Telecom New Zealand), which has launched a new wireless broadband service for urban areas of the country, aimed, it says, at users with poor-quality fixed DSL Internet services. The telco is using its 4G wireless network to target low- to moderate-usage households that currently have slow broadband connections because of the distance from their nearest DSL-enabled exchange. The current version of the service includes an 80-GB monthly cap.

The Australian National Broadband Network (Ovum, 2015) commissioned a study of 21 international wireless broadband providers and found that although some providers (e.g., Bolt in Indonesia and Telekom in South Africa) advertise their data allowance as unlimited, both impose "fair use" limits at 30 GB. Only 15 of the providers studied identified unambiguous data caps, in this case averaging 33 GB per month. Pricing varied widely, averaging U.S.$2.24 per gigabyte. The Australians themselves, however, may be exploring new territory currently with monthly caps of 250 and 500 GB and at dramatically lower costs per gigabyte, which may well be interpreted by the marketplace as serious competition to wireline provision.

A Policy Response to the Prospect of Singularity

The FCC's policy on phone number portability has proven to be a striking success—a modest policy requirement has had a dramatic effect on meaningful competition among providers of cellular telephony (Dong Hee, 2007). The proposed FCC policy on interoperable set-top boxes in cable is similar in spirit (Salkowitz, 2016). The idea is to encourage competition by simply making it easier to switch providers. If a networked household had multiple 4G or 5G fixed wireless Internet providers available, one could imagine effective competition keeping service quality up and prices down. One could even imagine a household Wi-Fi router (the Internet equivalent to the cable set-top box or cable modem) electronically negotiating with wireless service providers in real time for the best service for the lowest price. Is such a prospect a pipe dream? It is certainly technically possible even if politically challenging.

The American National Broadband Plan's key objective has been characterized by its principal author, Blair Levin (2014), as "driving fiber deeper into the system" (para. 4). But the fiber is largely already there both in the cable systems' backhaul and the cell tower distribution system. The cellular infrastructure is anachronistically defined as a separate system for mobile data provision rather than as a candidate infrastructure for fixed broadband. Authors of federally mandated plans and reports are acutely aware of what is and what is not politically realistic. Perhaps when the original plan was drafted in 2009 and 2010, meaningful cellular competition with wireline-based Internet provision was viewed to be neither technically practical nor politically viable. But the nature of demand and of technology have been evolving quickly in this space.

We have witnessed two dramatic policy interventions in telecommunications provision in the United States in recent decades—the 1982–1984 AT&T divestiture and breakup and the 1996 Telecommunications Act's attempt at restructuring local exchange carrier service. Policy intervention is not unprecedented. The wireline and wireless divisions are separate organizational components of AT&T and Verizon, and meaningful competition may be possible, although a policy-mandated breakup and separate corporate ownership would be much more promising.

Many have speculated on the future of ubiquitous wireless digital networks—extensions of Wi-Fi, WiMax, and digital local and wide-area networks of various flavors. What have been missing thus far from the rhetoric and policy debate, however, are (a) full recognition of the central importance of the bottleneck singularity of the telco–cable noncompetitive duopoly, and (b) a viable policy pathway to achieving facilities-based competition in Internet service provision.

Tom Wheeler, the recent chair of the FCC, frequently noted that his policy guidance in the space was "competition, competition, competition." But he appeared hesitant to follow his own guidance by prejudging the capacity of mobile data to provide meaningful competition. Speaking in 2014, he noted:

We have great hopes for wireless as a potential substitute for fixed broadband connections. But today it seems clear that mobile broadband is just not a full substitute for fixed broadband, especially given mobile pricing levels and limited data allowances. We welcome, and we must encourage, the development of new technologies that can bring greater competition and more choices to consumers. In the end, at this moment, only fiber gives the local cable company a competitive run for its money. Once fiber is in place, its beauty is that throughput increases are largely a matter of upgrading the electronics at both ends, something that costs much less than laying new connections. While LTE and LTE-A offer new potential, consumers have yet to see how these technologies will be used to offer fixed wireless service (Wheeler, 2014, p. 5).

Yes, we have yet to see. Policy could be more proactive in this regard. My argument is that a fresh rethinking of broadband policy has singular promise.

References

Ault, S. (2016, March 2). Mobile vs. broadband. *Variety*, p. 45.

Bailey, B. (2016, October 26). Google is scaling back its planned expansion of fiber. *Salon*. Retrieved from http://www.salon.com/2016/10/26/google-fiber-halts-expansion-plans-as-chief-steps-down/

Burstein, D. (2014, September 5). Re: A brief history of competition policies and networks [blog comment]. *FCC Blog*. Retrieved from https://www.fcc.gov/news-events/blog/2014/09/05/brief-history-competition-policies-and-networks

Clarke, R. N. (2014). Expanding mobile wireless capacity: The challenges presented by technology and economics. *Telecommunications Policy, 38*(8–9), 693–708. doi:10.1016/j.telpol.2013.11.006

Cohill, A. M. (2013). *Broadband for America: The third way*. Retrieved from http://www.designnine.com/broadband-the-third-way.html

Crawford, S. P. (2011). The communications crisis in America. *Harvard Law & Policy Review, 5*, 245–263.

Crawford, S. P. (2012). *Captive audience: The telecom industry and monopoly power in the new gilded age*. New Haven, CT: Yale University Press.

Dong Hee, S. (2007). A study of mobile number portability effects in the United States. *Telematics and Informatics, 24*(1), 1–14. doi:10.1016/j.tele.2005.11.002

Doyle, G. (2002). *Media ownership: Concentration, convergence and public policy*. Thousand Oaks, CA: SAGE Publications.

Dunaway, J. (2016). *Mobile vs. computer: Implications for news audiences and outlets*. Shorenstein Center on Media, Politics and Public Policy Discussion Paper Series D–103.

FCC (Federal Communications Commission). (2010). *Connecting America: The national broadband plan*. Washington, DC: Author.

FCC (Federal Communications Commission). (2015). *Broadband progress report and notice of inquiry on immediate action to accelerate deployment*. Washington, DC: Author.

Ford, C. (2015). Cooper's law of spectral efficiency. *Mobility Tech Zone*. Retrieved from http://www.mobilitytechzone.com/topics/4g-wirelessevolution/articles/2015/03/18/399877-coopers-law-spectral-efficiency.htm

Forzati, M., Larsen, C. P., & Mattsson, C. (2010). *Open access networks, the Swedish experience*. Paper presented at the International Conference on Transparent Optical Networks (ICTON), Munich, Germany.

Gruber, H. (2005). *The economics of mobile telecommunications*. New York, NY: Cambridge University Press.

Hansell, S. (2008, August 18). Verizon's FiOS: A smart bet or a big mistake? *The New York Times*, p. C1.

Herman, B. D. (2006). Opening bottlenecks: On behalf of mandated network neutrality. *Federal Communication Law Journal, 103*, 103–156.

Horrigan, J. B. (2016). *Skirting bottlenecks: Policies to support network evolution, digital inclusion and data security*. Report of the 30th Annual Aspen Institute Conference on Communications Policy, Aspen, CO.

Institute for Local Self-Reliance. (2016). Open access. *Community networks*. Retrieved from https://muninetworks.org/content/open-access

Interisle Consulting Group. (2015). *The essential role of fixed wireless in universal broadband coverage.* Washington DC: Wireless Internet Service Providers Association.

Jensen, K. B. (2010). *Media convergence: The three degrees of network, mass, and interpersonal communication*. London, UK: Routledge.

Keiser, G. (2003). *Optical fiber communications*. New York, NY: Wiley.

Lehr, W., Sirbu, M., & Gillett, S. (2004, September 27–28). *Broadband open access: Lessons from municipal network case studies*. Paper presented at the Telecommunications Policy Research Conference, Arlington, VA.

Lenhart, A. (2015). *Mobile access shifts social media use and other online activities*. Washington, DC: Pew Research Center.

Levin, B. (2014). Surprises, lessons, and still in beta. *Information Technology and Innovation Foundation Forum*. Washington, DC: Benton Foundation.

Malone, J. B., Nevo, A., & Williams, J. W. (2015). *A snapshot of the current state of residential broadband networks* (NET Institute Working Paper No. 15–06). New York, NY: Networks, Electronic Commerce and Telecommunications Institute.

Markoff, J. (2015, June 25). An advance may double the capabilities of fiber optics. *The New York Times*, p. B1.

McGarty, T. P. (2006). *Fiber to the home: Capital costs and the viability of Verizon's FiOS*. Florham Park, NJ: Telmarc Group. Retrieved from http://www.telmarc.com/Documents/Papers/2006%2009%2001%20FTTH%20Capital%2001.pdf

Napoli, P. M., & Obar, J. A. (2014). The emerging mobile Internet underclass: A critique of mobile Internet access. *The Information Society, 30*(5), 323–334. doi:10.1080/01972243.2014.944726

Noam, E. (2011). Let them eat cellphones: Why mobile wireless is no solution for broadband. *Journal of Information Policy, 1*, 470–485. doi:10.5325/jinfopoli.1.2011.0470

Noam, E. (2016). *Who owns the world's media?* New York, NY: Oxford University Press.

OECD (Organisation for Economic Co-operation and Development). (2013). *Broadband networks and open access* (OECD Digital Economy Papers No. 218). Paris, France: Author.

OECD (Organisation for Economic Co-operation and Development). (2015). *OECD digital economy outlook 2015*. Paris, France: Author.

Ofcom. (2011). *Infrastructure report: The first communications infrastructure report*. London, UK: Author.

Ovum. (2015). *Fixed wireless broadband: A global comparison*. Retrieved from http://www.nbnco.com.au/content/dam/nbnco2/documents/ovum-fixed-wireless%20-broadband-a-global-comparison.PDF

Rappaport, T. S., Sun, S., Mayzus, R., Zhao, H., Azar, Y., Wang, K., . . . Gutierrez, F. (2013). Millimeter wave mobile communications for 5G cellular: It will work! *IEEE Access, 1*, 335–349. doi:10.1109/ACCESS.2013.2260813

Ruiz, R. R., & Lohr, S. (2015, February 26). F.C.C. Approves net neutrality rules, classifying broadband Internet service as a utility. *The New York Times,* p. B1.

Salkowitz, R. (2016, January). FCC's new plan for set top boxes could blow the cable market wide open. *Forbes*. Retrieved from https://www.forbes.com/sites/robsalkowitz/2016/01/28/fccs-new-plan-for-set-top-boxes-could-blow-the-cable-market-wide-open/#5fc31dc8101b

Segan, S. (2014, March 10). The death of unlimited mobile data. *PC*. Retrieved from http://www.pcmag.com/article2/0,2817,2454764,00.asp

Wheeler, T. (2014). *The facts and future of broadband competition*. Washington, DC: Federal Communications Commission. Retrieved from https://www.fcc.gov/document/chairman-remarks-facts-and-future-broadband-competition

Wu, T. (2003). Network neutrality, broadband discrimination. *Journal on Telecommunications and High Technology Law, 2*, 141–179.

Wu, T. (2010). *The master switch: The rise and fall of information empires*. New York, NY: Knopf.