

A National Plan for Broadband in the United States

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In early 2009, the US Congress directed the US Federal Communications Commission (FCC) to develop a plan to ensure that every American has “access to broadband capability.” That planning exercise resulted in *Connecting America: The National Broadband Plan* (NBP) issued in March 2010,¹ which we discuss in this chapter.²

For the purposes of the Plan, *broadband* means high-capacity Internet access and the associated networks, devices, content, and applications.³ The NBP describes broadband development as “the great infrastructure challenge of the early 21st century,”⁴ in part because of the Internet’s role as a general purpose technology—that is, a technology that has the potential to spread through the economy and bring about generalized productivity gains.⁵ From a public policy perspective, the NBP highlighted in particular the idea that broadband is not an *end*, but rather a *means* for furthering national purposes, such as improving education, health-care, energy efficiency, public safety, and the delivery of government services. As such, there are four main ways in which the government can influence the development of broadband: (1) ensuring robust competition; (2) efficiently allocating assets that the public sector controls or influences (such as spectrum and public infrastructure); (3) encouraging the deployment, adoption, and use of broadband in areas where the market alone is not enough (such as areas where the cost of deployment is too high to earn a return on private capital or where households cannot afford to connect); and (4) providing firms and consumers with incentives to extract value from the use of broadband, particularly in sectors that further national purposes, such as those mentioned above (education, healthcare, and so forth).

The National Broadband Plan: Main themes

Creating the NBP required the FCC to apply long-standing principles of economics and regulatory policy to an important and emerging sector of the communications industry to encourage the deployment, adoption, and usage of broadband. Below we provide an overview of some important themes in the NBP.

Ensuring robust competition

The modern trajectory of US federal communications policy has been directed toward creating and protecting competitive communications services markets. This goal can be in conflict with the fact that important sectors of the communications industry have long been thought to possess natural monopoly features, which is a familiar basis for regulation. Most importantly, economies of scale and density in the deployment of residential wireline

The views expressed here are those of the authors, not necessarily those of the FCC or any individual Commissioner. Nor are they necessarily those of the team that was responsible for the development of the National Broadband Plan.

infrastructure mean that both telephone voice service and cable video service have each traditionally been viewed as natural monopolies, at least over the “last mile” between the house and the first switch. For this reason, local residential telephone service has traditionally been subject to rate regulation, and basic cable prices may also be regulated. It can, however, be difficult to regulate natural monopolies in communications industries for a number of reasons. Some of these are discussed in the following sections.

Changing technology and demand

First, technological change—a notable feature of communications since at least the development of the telegraph and radio—may alter the scope of the natural monopoly. During the latter half of the 20th century, for example, the development of microwave technologies for transmitting telephone calls made competition possible in long-distance services, which (like local telephone service) had been regulated as a natural monopoly.

A similar phenomenon is occurring today with the convergence of the technologies for providing voice and video, as they both become merely data packets. With two wires to the typical US household (the cable television line and the telephone line), it is possible that the last mile could support two broadband providers at anticipated levels of future demand. And if users come to view wireless technologies—whether mobile or fixed—as wireline substitutes for data and video services (as they increasingly do for voice services), residential data transmission services could develop an even more competitive market structure.

But other, less competitive, scenarios are possible, and the NBP views future broadband market structures as highly uncertain.⁶ Because mobile wireless technologies appear more likely to be constrained in bandwidth than wireline technologies, the extent to which mobile wireless service will substitute for wireline service depends in part on how demand evolves. If demand shifts more to high-bandwidth, low-latency applications than to mobile applications, the two services may better be viewed as complements rather than substitutes. In addition, all wireless broadband technologies, whether fixed or mobile, may be more prone than wireline to the possibility that congestion would degrade quality or raise marginal cost.

Moreover, even if wireless technologies become important substitutes for wireline broadband, it is unclear how much competition that sector will provide. In the United States, most of the leading wireless service providers also offer wireline services,⁷ which may dampen their incentive to have wireless services compete aggressively and substitute for wireline services.

The NBP also points to a substantial uncertainty about the extent of future competition among wireline broadband providers. By one forecast, 11 percent of households in 2012 will have only one broadband wire

to the home, another 45 percent of households will choose between a cable provider that offers high-speed service and a telephone provider that has not upgraded beyond DSL service to offer broadband on high-capacity fiber, and 30 percent more will choose between a cable provider with high-speed service and a telephone provider that has upgraded only to fiber-to-the-node (essentially the neighborhood) and not to fiber-to-the-home.⁸ If this forecast proves correct, 86 percent of households may have limited wireline competition for high-bandwidth broadband services.⁹

Uncertainty about regulatory outcomes

Uncertainty about the scope of a natural monopoly creates a number of problems for a regulatory agency. The most obvious problems involve the difficulties of conducting a cost-benefit assessment of potential policy actions when the probabilities and social benefits or costs of a range of possible outcomes are hard to assess. In modern times, the FCC, spurred by Congress, has generally tried to err in favor of choosing policies that aim to encourage competition.¹⁰

In addition to evaluating uncertainty about the likely costs and benefits of alternative regulatory decisions, the regulator must consider the costs and benefits of delay. A regulator, like a firm that makes an investment decision under uncertainty, obtains an option value from delaying its decision. Waiting until uncertainty about the world is clarified avoids the possibility of locking in what could turn out to be a suboptimal regulatory strategy, and thus avoids inducing firms to make sunk investments conditional on that strategy.

But regulatory delay also creates costs. When a firm’s investment decisions would vary with the regulator’s choice of strategy and involve substantial sunk costs, uncertainty as to regulation can lead firms to defer investments—in this case potentially slowing the deployment of broadband technology. With respect to residential broadband competition, the NBP seeks to resolve this trade-off by boosting the prospects for wireless competition (through spectrum and other policies discussed below) while simultaneously delaying regulatory action in favor of collecting better data to monitor trends.¹¹ This approach permits the FCC to act later to foster competition if it seems viable or to regulate as necessary if the last mile of the emerging broadband industry turns out to have natural monopoly characteristics or competition is otherwise limited.

Efficient allocation of assets that the public sector controls or influences

The public sector establishes rules for the allocation and use of spectrum and oversees access to infrastructure—such as poles, conduits, rooftops, and right-of-way—that is used by the private sector in the deployment of broadband networks. Ensuring these assets are allocated and managed efficiently can lower barriers to providing

broadband service, and the NBP contains an extensive discussion of each.

Use of spectrum

Spectrum is an essential input into wireless communication. It is scarce in the sense that there is a fixed range of useable frequencies, although technological developments such as cell splitting have made it possible over time to use the spectrum that has been set aside for communications more intensively and to use a wider range of spectrum for that task. Still, given today's technology, the existing allocations of spectrum, and the ongoing rapid growth rate of wireless services, the NBP takes the view that it is essential to make additional spectrum available for wireless broadband.

New technologies and changing FCC priorities have led in the past to alterations in the way spectrum is used—for example, to facilitate the introduction of mobile phones or digital television. The best use of spectrum may change from one decade to the next, which raises the importance of developing mechanisms to identify higher-valued uses and to reallocate spectrum to those uses.

Input scarcity and changing valuations are not by themselves necessarily reasons for regulation; the allocation and reallocation of scarce resources may be what markets do best. But spectrum usage raises unusually complex coordination problems that may justify regulatory intervention to support the market. In particular, spectrum must be allocated in a way that avoids interference across frequency bands and across geographic boundaries. Moreover, it may be necessary technologically, or at least confer substantial cost savings, to permit spectrum users to employ contiguous blocks of frequencies (across both frequencies and geographic regions). Markets may not successfully move underutilized spectrum to higher-value uses even if incumbents are permitted greater flexibility in spectrum use because of the need to assemble large contiguous blocks for new uses and the incentives of incumbents to hold out for a significant share of the gain.

The coordination difficulties that arise from interference may be exacerbated by the path dependence that arises from past investments. For example, had satellite radio broadcasters chosen to deploy more expensive receivers that are more resistant to interference, it might now be possible to allow higher limits on the power that is employed by users of adjoining spectrum blocks, increasing the value of that adjoining spectrum.

The NBP's spectrum discussion is premised on a view that recent technological change has likely made wireless services a higher-valued use for some spectrum, at appropriate frequencies, than its current use. The NBP notes a range of reallocation possibilities, including changes in the use of some spectrum that is now allocated to satellite, broadcast television, and federal uses. To determine whether this is so, and to reallocate

spectrum if it is, the NBP encourages the use of market mechanisms.¹²

One NBP proposal is already moving forward: the FCC has proposed changing the rules regarding spectrum that is allocated to mobile satellite uses in order to facilitate the deployment of complementary terrestrial networks that share the frequency, thereby enhancing spectral efficiency and coverage in urban areas or inside buildings, where the satellite signal is attenuated or unavailable.¹³ This particular spectrum is tied to mobile satellite services because its allocation is coordinated internationally, and thus generally lies beyond the ability of the FCC to alter on its own.

Another spectrum reallocation problem that is highlighted in the NBP involves broadcast television spectrum. If some other use, such as wireless broadband, now has a higher value than does broadcast television for some of that spectrum, and if today's broadcasters are not the best parties to provide the alternative service, the spectrum could be put to better use by encouraging the movement of spectrum from the broadcasters to other firms. To find out whether this switch makes sense and, if it does, to facilitate it, the NBP proposes developing a market mechanism that would permit incumbent broadcasters to receive compensation if they voluntarily release spectrum by discontinuing over-the-air broadcasting or if they "channel share" (multicast on the same channel) with other broadcasters.¹⁴ If any spectrum is voluntarily given up by broadcasters, moreover, that spectrum must then be repacked into contiguous geographic and frequency blocks to make it more valuable for alternative uses.¹⁵ Finally, the repackaged spectrum must be auctioned to new providers.

The NBP contemplates developing an "incentive auction" mechanism to accomplish these tasks.¹⁶ As a design problem, it poses several challenges. It is necessary to develop a procedure for constructing both a supply curve (from the broadcasters) and a demand curve (by bidders such as broadband providers) in order to clear the market, while simultaneously defining the scope of the repackaged product. This might be accomplished simultaneously in a single exchange. Alternatively, it might be accomplished sequentially, by first conducting a reverse auction to determine the cost of clearing spectrum and then conducting a forward auction for cleared spectrum. By combining information from both auctions, spectrum would be cleared up to the point where the value of a spectrum unit in the new use in a particular market equals the cost of clearing that unit, subject to the requirement of maintaining an acceptable amount of over-the-air broadcasting.

Finally, the NBP proposes reallocating some spectrum that is now devoted to federal uses. That spectrum might include a block that could be combined with other spectrum that is now available in order to make a more valuable package for auction.¹⁷ On a related note, the NBP proposes encouraging the reallocation of

spectrum that is not licensed for flexible use—whether used by governmental entities or private firms—by seeking the authority to impose fees on that spectrum that reflects its opportunity cost.¹⁸ Such fees promise to induce licensees to use spectrum more efficiently and perhaps, in consequence, reduce their holdings, making more spectrum available for other uses.

Access to infrastructure

Just as wireless networks use publicly owned spectrum, wireless and wireline networks alike rely on cables and conduits attached to public roads, bridges, poles, and tunnels. Securing rights to this infrastructure is often a costly and time-consuming process—notably because of the need to navigate permitting and zoning rules. Indeed, the NBP estimated that, in the United States, the expense of obtaining permits and leasing pole attachments and rights-of-way can amount to 20 percent of the cost of fiber optic deployment. To improve access to infrastructure and thereby improve the business case for deploying and upgrading broadband networks, the NBP recommended that federal, state, and local governments focus on two areas: first, improving the utilization of existing infrastructure to ensure that network providers have easier access to poles, conduits, ducts, and rights of way. Second, facilitating the placement of broadband infrastructure on property managed by the government, which could have an enormous impact on broadband deployment given that the federal government alone owns nearly one-third of the land area of the United States and owns or leases space in 8,600 buildings nationwide.

Having already taken action in some areas, such as the siting of wireless towers, the FCC recently launched a “Broadband Acceleration Initiative” to complete the implementation of these recommendations.¹⁹

Encouraging broadband deployment, adoption, and use

Another feature of communications markets also provides an additional basis for some regulatory initiatives contained in the NBP, namely the large external benefits that are generated by the provision of communications services. These benefits go beyond network effects (demand-scale economies arising from each consumer’s increased opportunities to interact with others),²⁰ and include innovation and economic growth, recognizing the Internet’s role as a general purpose technology.²¹ They also include non-market values such as enhancing free speech and fostering civic engagement.

All of these external benefits will likely grow as technology increasingly permits rapid transmission of data, and not simply voice and video communications services. These external benefits, along with distributional considerations, historically led regulators to subsidize voice telephony services for lower-income users and those for whom the cost of supplying service is high (such as rural users) to maximize the number of users

on the network. Decades ago, US regulators sought to encourage increased telephone subscribership through a system of implicit subsidies. The regulated monopolist, which offered a full range of telephone services, set low rates for local telephone service, particularly for residential customers in high-cost and rural areas (as through geographic rate averaging). Under this scheme, the higher rates for long-distance service and for business customers covered a relatively large share of the fixed, joint, and common costs of telephone system operation. Moreover, telephone providers were subjected to universal service or carrier-of-last-resort obligations, and compensated for providing this service by setting higher prices to their customers (particularly, again, business and long-distance customers).

The shrinking natural monopoly led Congress in 1996 to introduce competition into local telephone service, putting pressure on this informal regulatory compact. The cross-subsidies were not sustainable against partial line entry by firms that were cherry-picking to undercut prices on high-margin services. In consequence, regulators have been led to unwind the old cross-subsidies and to replace them with direct transfers to subsidized customers or the carriers that serve them, paid for by service charges on all customers. The NBP recommends that the FCC examine the possibility of using market-based mechanisms, perhaps including reverse auctions, to minimize the costs of providing subsidized service.²²

Voice traffic is increasingly provided in the same way as other data, and data providers now include cable, wireless, and satellite companies as well as traditional telephone firms. Accordingly, the NBP proposes extending the modern approach to providing universal service from telephony to broadband by introducing a new program that focuses on subsidizing broadband infrastructure buildout in high-cost areas that are unlikely to be served by the private sector.²³ To fund these programs, the NBP proposes broadening the requirement for contribution to the universal service fund beyond the current base.²⁴

With respect to adoption and usage, the NBP notes that roughly 35 percent of Americans (roughly 80 million adults) do not use broadband at home, and these non-users are generally older, poorer, less educated, and more likely to be part of a minority group than those with a home connection. As part of the NBP’s fact base, the FCC commissioned the largest ever survey of non-adopters, which found three major barriers to adoption: (1) cost of service and/or devices; (2) digital literacy—that is, discomfort with the use of computers or the Internet; and (3) perceived relevance of the content that is available online. Accordingly, the NBP proposed a series of initiatives to address each of these barriers, many of which have been adopted since its release. They range from explicit subsidies to make broadband more affordable for low-income households

to the creation of a “Digital Literacy Corps” to promote community awareness and usage of broadband and the promotion of online content targeted toward groups such as older Americans.

Finally, consumer protection is another aspect of regulation that can affect broadband adoption and usage.²⁵ If the market does not provide consumers with inexpensive, clear, and reliable information, and the government can do so without bearing or imposing substantial costs—for example, by requiring disclosure—consumers may be able to match purchases better with their preferences.²⁶ If, in addition, buyers are able to search more effectively among sellers, firms may experience more elastic demand for their products, leading to lower consumer prices. These are not the only possible consequences of improving the information that is available to buyers—the increased information exchange could instead reduce seller discounting, for example²⁷—but it is likely, in general, that improved seller disclosure will benefit buyers.²⁸ Consumer protection also involves policing deceptive seller marketing practices, discouraging seller fraud, and protecting consumer privacy when market forces such as seller reputations are inadequate to do the job on their own.

The NBP highlights several areas in which consumer information appears less than ideal, given the ease in which it could be provided. It emphasizes that actual broadband speeds are less than half the advertised speed.²⁹ To address this problem, it calls on the FCC to establish technical standards for key attributes of broadband performance, measure how broadband providers stack up against the standards, and publish the results.³⁰ The FCC has already begun to do so.³¹

Using broadband to further national purposes

In requesting the NBP, Congress recognized that broadband service is not an end in itself, but rather that explicit actions may need to be taken to ensure that its full value is realized by incorporating the benefits it brings into other social and economic activities. Congress directed that the NBP include a “plan for use of broadband infrastructure and services in advancing consumer welfare, civic participation, public safety and homeland security, community development, healthcare delivery, energy independence and efficiency, education, worker training, private sector investment, entrepreneurial activity, job creation and economic growth, and other national purposes.”³²

Over one-third of the plan is devoted to describing how broadband can improve the performance of each of these sectors and recommending actions to increase use, private sector investment, and innovation. The main areas of focus are summarized below, and we refer the reader to the NBP itself for more details:

Healthcare: Ensure that healthcare providers have access to broadband, that regulatory barriers to innovation in areas such as wireless medical devices and electronic record keeping are removed, and that data and analytics that could improve patient care are enabled by broadband connectivity.

Education: Improve connectivity to schools and libraries, and accelerate online learning by enabling the creation of digital content, increased digital literacy, and the adoption of broadband-enabled devices and services.

Energy: Focus on broadband enabling the nation’s energy infrastructure, including broadband enabling the electricity grid (“smart grid”) and unleashing innovation in homes and buildings—for example, by making energy consumption and efficiency data readily available.

Public safety: Deploy a robust nationwide mobile broadband network for public safety use, and develop and deploy next-generation emergency alert systems.

Economic opportunity: Encourage broadband-enabled access to job training and placement programs and ensure that small businesses and entrepreneurs have adequate access and applications to realize potential productivity gains.

Government and civic engagement: Make government more open and transparent online, and improve government performance and operations through cloud computing, cyber security, and online service delivery.

Conclusion

The FCC’s National Broadband Plan contains much more than has been discussed here, although the core of the plan involves the traditional concerns of economic regulation: targeting limited government intervention to address market failures in order to create and support a robust competitive marketplace for communications services. One year after its release, most of the Plan’s recommendations are in the process of being implemented, although as its authors note:

*“The Plan is in beta and always will be. Like the internet itself, the plan will always be changing—adjusting to new developments in technologies and markets, reflecting new realities, and evolving to realize the unforeseen opportunities of a particular time. As such, implementation requires a long-term commitment to measuring progress and adjusting programs and policies to improve performance.”*³³

Notes

- 1 FCC 2010a.
- 2 This chapter was adapted, with permission, from an earlier work by the same authors published in the *Review of Industrial Organization*. See Baker and de Sa 2010.
- 3 Although the NBP does not explicitly define *broadband*, it sets a broadband availability target for universal access at 4 Mb/s actual download speed and 1 Mb/s actual upload speed. The median actual download speed today is 5–6 Mb/s for fiber and cable and 1.5 Mb/s for DSL. See FCC 2010a, Chapter 8.
- 4 FCC 2010a, pp. xi, 29.
- 5 See Bresnahan and Trajtenberg 1995.
- 6 FCC 2010a, Chapter 4.
- 7 Of the four national wireless providers, Verizon and AT&T also offer wireline telephone services, and Sprint's current 4G wireless partner, Clear, is co-owned by large cable television companies. Only T-Mobile does not have a US wireline affiliation.
- 8 FCC 2010a, p. 42, Exhibit 4-G.
- 9 More generally, the extent of growth in demand for high-speed applications will likely affect whether and how quickly different cable providers upgrade to higher speed technologies, telephone providers upgrade from DSL to fiber, and wireless providers build out 4G networks. Under some scenarios, these providers could differentiate—some offering higher-speed services with others unable to do so, which would limit competition for high-speed broadband.
- 10 This bias may in part reflect the traditional public choice concern that large regulated incumbent firms may have greater ability to influence political processes than do small rivals, entrants, and consumers, and consequently may capture regulatory agencies to act in their private interest.
- 11 The NBP recommends that the government make more spectrum available for wireless providers (FCC 2010a, Recommendation 4.1) and that it collect and analyze more information about broadband availability, penetration, prices, churn, and bundles offered by service providers (FCC 2010a, Recommendation 4.2). The FCC issues an annual report analyzing the competition in the mobile wireless industry; see, for example, FCC 2010c.
- 12 FCC 2010a, Chapter 5.
- 13 FCC 2010d, 2010a, Recommendation 5.8.4.
- 14 Although spectrum is a public asset, and the government has the legal right to reallocate it at will, incumbents are generally treated as though they have quasi-property rights in their spectrum license in order to provide appropriate incentives for licensees and their customers to make long-term investments. Reallocation under such circumstances requires that compensation is paid to the incumbent licensee. If compensation is set through negotiation, the process of spectrum reallocation could become mired in bargaining impasses; if it is set through regulatory determination, it will likely involve substantial administrative costs. A market mechanism employs a third approach: enlisting competition to determine the appropriate level of compensation. For more information on this proposal see FCC 2010a, Recommendation 5.8.5.
- 15 In principle one could imagine delegating the repacking to a market mechanism, but such a mechanism is difficult to devise, particularly when the optimal scope of spectrum packages (both in terms of geography and frequency) varies with the use to which the spectrum would be put.
- 16 FCC 2010a, Recommendation 5.4.
- 17 FCC 2010a, Recommendation 5.8.3; see Obama 2010.
- 18 FCC 2010a, Recommendation 5.6.
- 19 FCC 2011.
- 20 FCC 2010a, p. 29, Box I-1.
- 21 By one account, the Internet is in select company, joining technologies such as printing, the steam engine, the factory system, railways, electricity, and the computer as one of only twenty-four “transforming general purpose technologies” developed over the entire span of human history (Lipsey et al. 2005, p. 133).
- 22 FCC 2010a, p. 145 and n.79.
- 23 FCC 2010a, Recommendation 8.2.
- 24 FCC 2010a, Recommendation 8.10.
- 25 Armstrong 2008; Beales et al. 1981.
- 26 Bar-Gill and Stone (2009) argue that disclosures can discourage firms from taking advantage of systematic consumer misjudgments about their mobile phone usage.
- 27 Improved information to buyers could also undermine certain outcomes in which informed consumers benefit from the presence of uninformed buyers (Armstrong 2008, pp. 119–25).
- 28 Albæk et al. 1997; Baker 1996.
- 29 FCC 2010a, p. 21.
- 30 FCC 2010a, Recommendations 4.3 and 4.4.
- 31 For example, the FCC's Consumer Broadband Test application enables consumers to test the speed of their broadband connection and other quality attributes (FCC n.d., Consumer Broadband Test).
- 32 FCC 2010a, p. 193.
- 33 FCC 2010a, p. XV.

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