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10 *Broadband Deployment: Is Policy in the Way?*

After years of connecting to the Internet via narrowband telephone lines, customers will finally have the opportunity to connect from home at speeds close to those that they experience at work, thanks to the broadband revolution. But many claim that the broadband revolution is the newest version of the World Wide Wait: It just is not happening fast enough. What is the problem? Is it a lack of demand? Is it the inability of providers to deliver broadband to customers? Or is it, as some claim, a policy failure? In particular, have policies of the Federal Communications Commission (FCC) hindered the deployment of broadband to the home? The regional Bell operating companies have taken the position that FCC regulations requiring resale of digital subscriber lines (DSL) over loops inhibit broadband deployment, and they have sponsored a television advertising campaign and lobbied Congress for legislation to grant them relief from such regulations.

This chapter addresses the following questions:

—Has the rollout of broadband to the home been too slow? What is an appropriate standard of comparison? Is there in fact a problem?

—What has experience taught us about the incentives and the abilities of the telephone and cable industries to deploy broadband? What have been the drivers, and what have been the roadblocks? What does this experience portend for the future of broadband deployment?

—What has been the policy posture of the FCC regarding broadband for both cable and telephone providers? What is the likelihood that specific regulations (for example, mandated resale of the digital subscriber line portion of the local loop) have inhibited the deployment of broadband or may inhibit it in the future?

—Are there public policies available that will truly enhance the deployment of broadband and help ensure its aggressive development?

To preview the results, the findings of this chapter are as follows:

—Broadband deployment appears to be tracking the same growth path of other consumer communications goods, such as cellular service. In the medium term, broadband is doing just fine.

—In the short-to-medium term, impediments to deployment have been on the supply side: the ability of cable and telephone companies to get the product into the hands of customers. The regional Bell operating companies in particular have had problems executing installations and delivering reliable service with good customer support. Over the longer term, both the cable industry and the Bells have been sluggish in recognizing the strategic opportunity of broadband, and both entered rather late, dragged into it by competitive necessity. We cannot expect these firms to have the strategic vision to aggressively take the next steps in broadband, but platform competition may push them forward.

—The FCC has adopted and maintained a generally promarket approach to broadband. It has been cautious regarding regulation of cable broadband, far more so than the Federal Trade Commission in its findings in the America Online–Time Warner merger. It has been somewhat more aggressive in requiring the regional Bells to unbundle the digital portion of the local loop, presumably as part of its regulation of this legacy bottleneck facility. It is possible that the FCC's loop-unbundling requirement has had some effect on investment incentives to deploy digital broadband. However, the effect is most likely small compared to the supply, provisioning, and service problems the Bells have had in the digital subscriber line rollout. Additionally, the unbundling requirement has been largely vitiated by a combination of the Bells' aggressive pricing strategy and the data local-exchange companies' poorly conceived and executed business plans.

—Public policy should be focused on encouraging platform competition in broadband distribution to the home: cable, cable overbuilders, telephone, fiber to the home, satellite, and wireless. Competing platforms exhibit scope economies across various applications, such as video programming, broadband Internet, and telephony. Policies should thus

favor removing restrictions on new platform deployment and facilitating access to content required to support competitive platforms. In particular,

—Local municipalities should be prohibited from imposing conditions on infrastructure providers, including fees in excess of costs, that discourage entry.

—Federal authorities should be receptive to the development of spectrum uses by direct broadcast satellite providers for two-way broadband.

—The FCC should continue its program access rules for video programming distributors to ensure that the content owned by the incumbent cable firms is available to new platform entrants.

Broadband Rollout: What Are the Facts?

In 2000 I published a paper (with Christiaan Hogendorn) with a model of broadband deployment.[1] When we first presented this paper in 1997 to general academic audiences, the most difficult questions we confronted were explaining what broadband access is and why anyone would want it. In the following two years broadband has become a generally understood term for at least some of the public. The fact that broadband is now being deployed at all is a mark of how rapidly the economy changes. But somewhat more surprising is the current view of many that the speed of deployment is less than expectations.[2] In 2000 most Americans did not know what broadband was; those who did seemed uninterested. Now many seem to expect that everyone should have broadband and are disappointed that this is not the case.

It is tempting to view these assertions as yet another demand for instant gratification, without regard to the cost and difficulty of rolling out a nationwide broadband infrastructure. Building infrastructure is generally much more capital-intensive and takes much longer than, say, introducing a new hand-held computer. Digging up the streets and laying fiber does

1. Faulhaber and Hogendorn (2000).

2. See for example Richard Martin, "What Broadband Revolution?" *Industry Standard,* December 11, 2000 (www.thestandard.com/article/0,1902,20440,00.html [April 15, 2002]); Matt Kranz, "Broadband's Slow Start Strangles Shares," *USA Today,* October 19, 2000 (www.usatoday.com/life/cyber/invest/ina246.htm [April 15, 2002]); Steven Rosenbush, "Broadband: What Happened?" *Business Week Online,* June 11, 2001 (www.businessweek.com/magazine/content/01_24/b3736066.htm [April 15, 2002]).

not get done on "Internet time." In this view, expectations that broadband would be available to all immediately if not sooner were simply naïve.

In 2001 two researchers estimated that broadband deployment to 94 percent of U.S. homes would provide a huge boost to economic welfare, in the neighborhood of $300 billion a year.[3] If this result is to be believed, then encouraging, even subsidizing, extensive broadband deployment may be a suitable public policy goal and is certainly a reason to be concerned about any slowdown of broadband deployment.[4] Of course, if such gains do exist, then one would expect the market to respond enthusiastically, and potential providers would be rushing to build infrastructure to the home, provided they could find a way to capture at least some of the surplus they would thus generate. The alleged slowdown, if real, casts doubt on this hypothesis of the pot of gold at the end of the broadband rainbow. Nevertheless, these results suggest that the issue of the speed of broadband deployment is worth addressing.

The first statistics on broadband deployment became available in 1998. The FCC reported that by year-end 1998, 375,000 U.S. households subscribed to high-speed Internet access. By the end of 2000 over 7.1 million U.S. households had high-speed access. On September 30, 2001, the number of U.S. households with broadband was over 8.4 million (see table 10-1), a penetration of 8.1 percent. These growth rates outstripped one estimate of 5.9 million subscribers by end-of-year 2000.[5] By way of comparison, cellular telephones were commercially introduced in the United States in 1985; it was not until the end of 1991, seven years later, that cell phone subscribership reached 7.5 million (see figure 10-1).

Broadband appears to be deploying about twice as quickly as cellular did in the mid-1980s to early 1990s. Of course, analog cellular, before the introduction of digital wireless, was rather expensive. A more compelling comparison is with the rollout of the videocassette recorder (VCR), a popular consumer electronics product introduced in 1982 at a relatively low price. Broadband is apparently growing at least as fast as the VCR did in the 1980s. While 8.1 percent of U.S. households clearly is not the entire population, broadband appears to be on a high-growth trajectory, similar

3. Crandall and Jackson (2001).

4. If broadband deployment is really this important, then perhaps the federal government should make low-interest loans available to municipalities to build broadband infrastructure, just as it helps build local sewer systems (Federal Clean Water Act of 1977).

5. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

Table 10-1. *U.S. Households with High-Speed Lines, 1998–2001*[a]

Technology	*December 1998*	*December 1999*	*June 2000*	*December 2000*	*September 2001*[b]
Asymmetric digital subscriber line		369,792	951,583	1,977,377	3,947,808
Other wire line		609,909	764,099	1,063,563	1,078,597
Coaxial cable		1,414,183	2,284,491	3,576,378	7,059,598
Fiber		312,204	307,151	376,506	494,199
Satellite and fixed wireless		50,404	65,615	112,405	212,610
Total	375,000	2,756,492	4,372,939	7,106,229	12,792,912

Source: FCC (1999, 2002).

a. High-speed lines are those able to send more than 200 kilobits a second.

b. Estimated.

to or faster than the adoption trajectories of other popular technologies such as cell phones, VCRs, and television.[6]

In sum, broadband deployment is moving along quite briskly, certainly in comparison with other recently introduced popular products. It is unclear what the expectations are of those who assert that the broadband deployment is disappointing, but these expectations do not appear to be well calibrated to similar historical growth patterns.

Are There Problems?

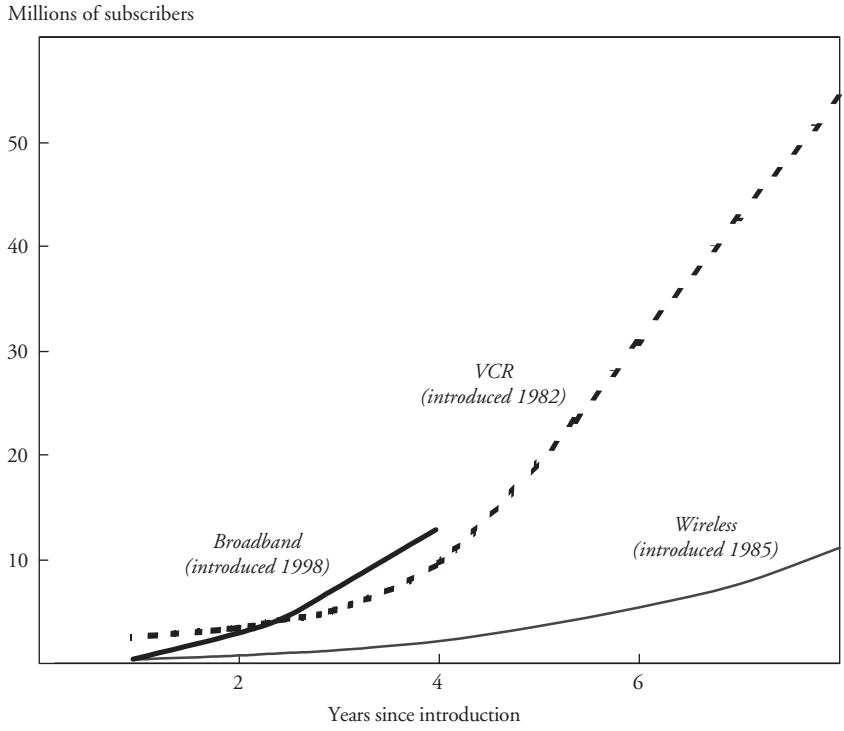
What are the current bottlenecks to broadband deployment? Are they on the demand side (customers do not really want it) or the supply side (firms cannot produce it quickly enough or with sufficient quality)?

Demand

There has been some discussion of whether or not customers are really interested in broadband; perhaps it is a market limited to online junkies and technology aficionados. Research done in 2000 suggests this is not true

6. It is unlikely, however, that broadband will deploy more quickly than the all-time champion, black-and-white television. Between 1947 and 1952, penetration of black-and-white television grew from essentially zero to 20 percent of U.S. households. See FCC (1999).

Figure 10-1. *Early Subscriber Growth, Broadband, Wireless, and VCR*



and that there is a substantial demand for broadband and a deep interest in it.[7] This research found that about a third of online users were interested in high-speed service and that, among those who had actually used it (at work, for example), about three-quarters were interested. The report anticipated four distinct waves of broadband purchasers, each with different demand drivers.

Some have mentioned that the deployment of broadband will not proceed quickly until there is a compelling application for broadband.[8] While such an application would be valuable, there is no evidence that broadband is not attractive to many customers without it. Most broadband customers

7. McKinsey and Company and Sanford Bernstein and Company, "Broadband!" Internal Report, January 2000 (broadband2@mckinsey.com).

8. According to AT&T president David Dorman, "except for high-speed Internet access, there are no 'killer' applications driving demand for broadband today. That may be why, today, so few families subscribe to broadband services where they are available." *Information Week* (2001).

value the significantly improved response speed and the always-on feature and find that this justifies the extra cost of broadband.[9]

Supply

The most significant impediments have been on the supply side. The problems can be classified into four categories: addressability, provisioning, customer self-installation, and customer service.

ADDRESSABILITY. Digital subscriber line service can be provided only over certain telephone lines, generally limited in length from the subscriber's home to the telephone company's central office. In addition, the availability may depend on whether the subscriber is behind a digital-loop concentrator. In 1999 only 44 percent of telephone subscribers were addressable by digital subscriber lines; by 2000 this had increased to 64 percent, as a result of the efforts by regional Bell operating companies' efforts to improve addressability.[10] For cable, high-speed service can be provided only to customers passed by two-way enabled digital cable. In 2000, 74 percent of cable households were two-way enabled and thus addressable for cable modem service. It is expected that cable will maintain its lead in addressable households in the foreseeable future.[11]

PROVISIONING. The seemingly simple act of actually turning the service on in a timely way appears to have stumped the regional Bells, at least into 2000. Bringing customers online lagged far behind demand during 1999–2000, with both digital subscriber lines and cable modems. In 1999 the regional Bells (serving about 25,000 customers a week) and cable (serving about 30,000 customers a week) both operated significantly below requests for service, which were around 39,000 and 47,000, respectively. In 2000 these provisioning rates increased dramatically, to about 40,000 and 68,000, respectively, as providers solved their back-office problems.[12]

9. By way of analogy, an automobile that is capable of a speed of eighty miles an hour does not do anything fundamentally different from an automobile that is capable of a speed of only twenty miles an hour. Both can still get the driver from point A to point B; the only difference is speed, and for some applications (such as city driving) this is equivalent. Yet virtually everyone would prefer the faster car.

10. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

11. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com); Morgan Stanley Dean Witter, "The Sequel: Open Access Is Better," June 29, 2001 (available from author).

12. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

CUSTOMER SELF-INSTALLATION. Early installations of broadband took at least one visit from an installer ("truck roll") and often more, creating both a customer problem (who had to stay at home until the installer showed up) and a cost problem (in that each truck roll costs the provider several hundred dollars). In 2000 the regional Bells moved more swiftly than cable firms to subscriber self-installation and may thus have a long-term advantage over cable in this regard.

CUSTOMER SERVICE. Constant service outages, some of which lasted for months without repair, and incompetent technical support personnel were part of the digital horror stories making the rounds in 1999–2000.[13] Cable outages were more rare.[14] The problems with digital subscriber lines were exacerbated when more than one company was involved; customers who purchased digital subscriber lines from competitive local exchange carriers that offered service over incumbent local exchange carrier lines were caught in the middle, while each company pointed its finger at the other.[15] Recent reports suggest that the worst of the bad customer service is over and that the regional Bells are getting a grip on their customer service problems.

The evidence strongly suggests that market impediments to deployment are on the supply side, and they have been substantial.[16] However, these problems are being solved, and broadband is rolling out at an impressive speed. While addressability and customer service remain problems, especially for digital subscriber lines, the expectation is that in the medium term the providers will deal with them effectively.

Are There Problems? A Broader View

The focus of the previous section is the speed of broadband deployment starting in 1998, when it was introduced, through today. There are two broader questions: Why did it take until 1998 to get started? And what is the future of broadband?

13. Sean Silverthorne, "Broadband—Fast Access, Slow Install," *ZDNet News,* June 13, 2000 (www.zdnet.com/zdnn/stories/news/0,4586,2581476,00.html [April 16, 2002]).

14. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

15. Steven Rosenbush, "Broadband: What Happened?" *Business Week Online,* June 11, 2001 (www.businessweek.com/magazine/content/01_24/b3736066.htm [April 15, 2002]).

16. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

A Sluggish Start

In the early to mid-1990s, many U.S. businesses invested in extensive Ethernet networks, which were connected to the Internet for use by its employees. Only the smallest firms connected over the telephone to the Internet, perhaps because of the high cost of high-speed T1 connections from their local Bell company. In this market, there was never a question about the appropriate connection speed to the Internet: fast.

Of course, firms and universities had sufficient Internet traffic to justify the expense of high-speed connections. Small firms and individuals did not have this luxury. As Internet use became popular in 1995 and later, owners of newly acquired home personal computers used their telephone line to connect to the Internet via an Internet service provider. During this period, the Internet service provider industry was built almost overnight; barriers to entry were low, required technical skills were negligible, and costs of entry were small.[17] During 1996–97 the volume of Internet-bound telephone traffic grew at astounding rates, perhaps tripling each year, as the U.S. public flocked to the Internet. No firms were better positioned to observe this growth than the regional Bells; they actually carried all this Internet-bound traffic on their networks.

One might expect that smart businesspersons in the Bells would have noticed this tremendous growth and assessed the business opportunity it presented. The experience of U.S. business connecting to the Internet strongly suggested that narrowband telephone lines are a poor way to connect; high speed is what the market demands. Furthermore, the telephone industry had a proven technology on the shelf for rejuvenating its narrowband loops to high-speed lines: digital subscriber lines.[18]

The regional Bells' unique knowledge of growth in Internet demand coupled with market and technological facts should have led them to roll out digital lines in 1997 and be ahead of the market. But this did not occur. In fact these companies were well aware of the growth of demand for Internet access and were also aware that this traffic had long connect times. Since rates for local service do not depend upon connect times, such traffic imposed unexpected costs on the Bells. Rather than view this as an

17. During this period, several undergraduates in my classes at Wharton owned and operated local Internet service providers in their spare time.

18. Charles Jackson (this volume) notes that certain essential electronic components required for a digital subscriber line were quite expensive before about 1998. Of course, it is possible that the cost of such components could have come down substantially had the regional Bells rolled out digital service earlier. In high-technology markets, costs are often endogenous.

extraordinary business opportunity, they chose to view it as an "abuse" of their network and petitioned the FCC and state regulators to force Internet service providers to pay them higher, usage-sensitive, rates, perhaps modeled on carrier access charges paid by interexchange carriers.[19] In short, when confronted with an unprecedented market opportunity of which they had unique knowledge, the regional Bells took the traditional public utility "cost recovery" view and sought regulatory relief.[20] In my view, this incident reveals more about the effects of a century of regulation than any academic treatise could ever do.

The fact that DSL deployment lags cable modem deployment suggests that it was competition, not their market foresight, which drove the regional Bells to deploy digital subscriber lines. In 1999 AT&T in particular announced a broadband strategy in which cable telephony in competition with the regional Bells would play a significant role. In addition, the FCC ordered "line sharing" of local loops, in effect mandating that the Bell companies provide the digital portion of any customer's local loop to any carrier that requested it, as an "unbundled network element" as authorized by the Telecommunications Act of 1996. Soon a small industry of data local-exchange carriers sprang up, such as Covad and Northpoint, showing up at Bell central offices with their own equipment, demanding access to "their" customers' local loops. The Bell digital subscriber line deployment certainly followed that of the cable industry and was certainly no faster than the early deployment of the data carriers. This is consistent with the hypothesis that it was competition, both intramodal and intermodal, that drove digital subscriber line deployment by the regional Bells.

Meanwhile, cable firms began broadband deployment experimentally around 1996 and expanded into a commercial offering in 1998. Cable suffered from an addressability problem, in that significant upgrades of old analog cable systems to new digital systems with two-way capability were required. The impetus for the costly upgrade to digital systems was not broadband; it was competitive pressure from a new high-powered, direct broadcast satellite, an alternative video delivery system that promised far higher quality and far more channels than the old analog cable systems

19. For comments filed by Bell Atlantic and NYNEX, see FCC (1997) (www.fcc.gov/bureaus/common_carrier/comments/access_reform/noicoms.html [April 16, 2002]).

20. The prices of digital-line modems were high in early years, although by 1997 cable modem prices had dropped considerably (see Jackson, this volume). It is alleged that the regional Bells were reluctant to introduce digital lines into the market for fear of cannibalizing their lucrative T1 service.

could deliver.[21] To meet this competitive threat, cable systems were pressed to invest heavily in upgrades of their systems to digital. Fortunately for broadband customers, this digital upgrade, required for cable to compete in the video marketplace, made the provision of high-speed access to the Internet an inexpensive add-on to the new systems.[22]

In short, customers desiring broadband Internet connections were greatly advantaged by the desire of Americans to watch high-quality television shows and by the competition for that market initiated by the introduction of high-powered satellites. This provided the impetus for cable firms to deploy broadband access in their search for a low incremental investment revenue stream. In turn, cable deployment provided the impetus for the regional Bells to deploy digital subscriber lines for fear of being attacked in their core business by the cable firms.

One should indeed be grateful for this happy if somewhat random sequence of events, which has provided many Americans with fast Internet access. But this outcome is not the result of great vision and superb strategic planning on the part of either the cable industry or the regional Bells. It would be accurate if ungracious to suggest that broadband deployment occurred in spite of, rather than because of, these two legacy industries.

An Uncertain Future

The high demand for broadband by U.S. residential customers suggests that this service is creating substantial value for them and the economy.[23] One may have faith in the ability of business to capture a substantial portion of this value; already, the 6 megahertz Internet Protocol channel on digital cable systems is producing as much base revenue as the remaining 700-plus megahertz video channels for cable firms.[24] As new

21. George Bittlingmayer and Thomas W. Hazlett, "The Political Economy of Cable 'Open Access,'" *Stanford Technology Law Review* (stlr.stanford.edu/core_page/index.htm): "One interesting development is that cable TV systems are aggressively upgrading from analog to digital transmission. Driven by competition from satellite TV providers, digital cable delivers far larger packages of video channels."

22. Although cable system costs were low (given the digital upgrade), the costs to add a customer were not; this includes the modem (which customers pay for directly) and the "truck roll" for a cable installer to get the customer online.

23. Crandall and Jackson (2001).

24. A typical price for cable modem service (excluding the modem) is about $40 a month, and a typical price for basic digital cable for video only is also about $40 a month. Of course, video also generates pay-per-view revenues and premium-channel revenues.

services become available to take advantage of this bandwidth, it is likely that the existing systems will become capacity-constrained. A similar phenomenon occurred with personal computers, as new software placed demands on existing hardware, leading to a constant spiral of upgrades of processors, hard drives, random-access memory, and so forth. It is likely that today's broadband systems are merely introductory; my expectation is that, as applications develop, substantially greater bandwidth—coupled with ease of use—will be available to the home.

The next generation of systems may well be introduced by new competitors using new platforms—those not yet on the scene: cable overbuilders, fiber to the home (or curb), satellite with two-way capability, to mention a few. Each new platform exhibits strong economies of scope among communications services: one-way video, broadband Internet access, even telephony. Some of these new platforms require new physical infrastructure; some require spectrum bandwidth. As broadband proves its economic value in conjunction with one-way video entertainment, it is likely that new infrastructure players may attempt entry into cities and neighborhoods with profitable customers, a strategy currently pursued by RCN, for example. Currently, a few of these overbuilders are pursuing a technology strategy similar to that of traditional cable firms; fiber is taken from the cable company's head end to a node serving anywhere from 100 to 500 customers, and then coaxial cable is taken from the node to the customer's residence. The system is called hybrid fiber-coaxial cable.[25] However, a few firms are actually taking fiber all the way to the home, and this may well be the driver for future systems.[26]

Other distribution systems for broadband have yet to demonstrate viable business models. A multipoint, multichannel distribution system, for example, is available today but is not a factor in the market.[27] Direct broadcast satellite suffers from the lack of an integrated path; DirectPC, for example, requires a telephone uplink. The success of direct broadcast satellite in the video marketplace has led to extensive development work to provide an integrated return path in the near future. The FCC has allocated spectrum in the Ka band specifically for a spot-beam satellite return path. Whether these efforts come to fruition remains to be seen.

25. RCN in particular has deployed such systems.

26. See KMI Corp., "Residential Access to the Home: Fiber-to-the-Curb and Fiber-to-the-Home" (www.kmicorp.com/press/011015.htm).

27. McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

A number of municipalities (or more accurately, their municipal water and sewer authorities) have taken it upon themselves to construct broadband infrastructure to every home, presumably on the theory that electronic infrastructure is no different from physical infrastructure such as streets, water lines, and sewer lines, for which they assume ownership and responsibility.[28] This movement is likely to continue; for some municipalities with technology-oriented citizens, constituents may be unwilling to wait for telephone companies and cable firms to put in infrastructure and may demand that their local governments get the job done. For other municipalities anxious to attract high-technology industry to their area, their electronic infrastructure could well be an attraction for businesses looking to relocate. It can also be expected that both telephone and cable firms will strongly object to this and attempt to block it in state legislatures.

Clearly, not all potential platforms can succeed in the market. However, several regulatory impediments make it more difficult than necessary for competitive entry using new platforms:

—In spite of the provisions of the Telecommunications Act of 1996 that prohibit state and local authorities from preventing competition, many local municipalities still impose stiff conditions on new entrants, often at the behest of incumbent cable companies.[29]

—The FCC recently renewed its program access rule, which was due to sunset on October 13, 2002. In brief, this rule prohibits cable owners of networks (for example, Time Warner's ownership of Home Box Office) from refusing to sell carriage of such networks to competing distribution channels (for example, direct broadcast satellite). Many view the viability and rapid growth of direct broadcast satellite video distribution as a direct result of the program access rule.[30] It appears likely that similar access to video content is necessary for future alternative platforms to be competitively viable.[31]

28. Ca-botics, Inc., a firm in Dublin, Ohio, offers a technology that lays fiber to homes using sewer lines, an existing infrastructure with almost universal deployment (www.ca-botics.com/ [April 16, 2002]).

29. See, for example, The Insider, "Saidel Slams shunning of RCN by Philadelphia," *Philadelphia Business Journal,* February 16, 2001 (philadelphiabizjournals.com/philadelphia/stories/2001/02/19/tidbits.html), describing the two-year delays by the Philadelphia city council to approve RCN's application for a license to build a fiber-optic network; the delay is alleged to be motivated by the council's desire to protect Comcast, the local cable television provider.

30. See FCC (2001) (www.fcc.gov/Bureaus/Cable/Reports/fcc01001.pdf [April 16, 2002]).

31. It is claimed that one factor leading to RCN's lack of success in Philadelphia was the unwillingness of Comcast, the dominant cable firm in Philadelphia and owner of the city's major sports franchises, to sell RCN its sports programming. It was able to deny access under the program access rules

—The FCC must continue to be receptive to bandwidth needs for two-way satellite systems. Currently, spectrum in the Ka band is reserved for a two-way, spot-beam satellite, which will enable direct broadcast satellite providers to compete in the broadband Internet access market and to ensure that direct broadcast satellite can provide the full range of broadband services.

The existing distribution systems will no doubt respond to such competitive threats should they materialize. However, both cable and telephone have demonstrated a remarkable lack of strategic vision in this area, preferring to wait until a challenge appears rather than moving aggressively and preemptively.

For cable, the technological and operational response is fairly clear:

—Cable systems can increase the bandwidth committed to the Internet Protocol channel from six megahertz to twelve megahertz or more, perhaps taking the Monster Truck Channel out of the lineup.

—Cable systems can reduce the node size below 500 homes, perhaps to 60 homes. This is likely to be an expensive option, requiring further extension of fiber closer to the home. This strategy could eventually lead to fiber all the way to the home (node size = 1). It will be difficult for cable systems to change the shared nature of the cable modem connection; even with full fiber to the home, the cable infrastructure leads to customers sharing bandwidth. How well this model scales remains to be seen.

For systems using a digital subscriber line, the expansion route is less clear. Digital subscriber line service is essentially a stopgap measure designed to squeeze yet more life out of the copper twisted pair that has served the Bells so well. Even today it is electronics intensive and quite limited by constraints of the copper path. More can be squeezed out, using even fancier electronics, but eventually this technology must be abandoned should the demand for bandwidth accelerate. The cost of the electronics required to reach speeds of ten megabits a second or more over copper at arbitrary distances from the central office becomes prohibitive.

The most likely expansion path to fiber closer to the home is illustrated by SBC's Project Pronto, in which fiber is taken to a remote terminal, much closer to the customer than today's central Bell office.[32] The copper

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because it did not distribute this material via satellite and was thus beyond the reach of the FCC's program access rule.

32. Recently, SBC has slowed deployment of Pronto in Illinois, citing regulatory issues. However, it is still rolling Pronto out in other areas, possibly at a slower pace. See, for example, Kirk Landendorf, "SBC's Daley Joins Battle to Control Internet's Future," *Austin American Statesman*, January 7, 2002,

twisted pair (or its equivalent) is taken from the remote terminal to the customer's home. In this model, the remote terminal serves a purpose similar to the node in the hybrid fiber-coaxial model of the cable systems and could eventually be the springboard to build fiber to the home (remote terminal size = 1). The two systems differ in that the telephone model has a dedicated line for each customer, and no sharing occurs in the distribution plant; this is likely to be a long-term advantage to the regional Bells. This may well be counterbalanced by the strategic disadvantage of being saddled with digital subscriber lines, a technology whose days are likely numbered.

Should broadband fulfill its promise to be a valued and profitable distribution channel, its future bandwidth expansion still appears problematic. The track record of the existing channel providers (cable and telephone) suggests that we cannot expect strategic leadership from them. Indeed, we may expect them to attempt to obstruct new entrants and new technologies to protect their existing product base. New entrants may face substantial regulatory and legal obstacles.

Is Regulatory Policy a Problem?

It is certainly natural, even fashionable, for economists to believe that regulatory policy is always a problem. Much of this is deserved, but much is not; certainly the Bells have argued that the "slow" rollout of broadband is due to bad regulations—regulations they are working hard to change. A close look at the facts is needed before we can render judgment on this hypothesis.

How have regulators handled broadband infrastructure? As public recognition of broadband has increased, regulators have kept a wary eye on the service, contemplating intervention—and sometimes attempting to intervene—to ensure "fairness" in the marketplace. On balance, regulation of broadband has been minimal—not zero, but certainly minimal.

Cable

The major focus of regulators in the high-speed cable modem market has been the open-access issue. In 1999 groups protesting the AT&T-TCI

p. D1 (//archives.statesman.com/cgi-bin/display.cgi?id=3c3dd43733e70mpqaweb1p11011&doc=results.html).

merger demanded that the merging firms be required to accommodate any Internet service provider that wished to offer high-speed service over their cable facilities, on identical terms and conditions as the cable firm's contract provider (@Home, in the case of AT&T-TCI). The issue was renewed at the time of the AT&T-MediaOne merger and later during the AOL Time Warner merger.[33] In the first two mergers, the FCC and the Department of Justice declined to require open access. Several local municipalities attempted to impose open access as a condition on the transfer of cable licenses to AT&T; all were overturned on appeal, stating that the FCC, not local governments, had authority to make this determination. In the AOL Time Warner merger, open access became the lead issue for the Federal Trade Commission (FTC). Eventually, the parties agreed that AOL Time Warner would offer access to their high-speed Internet channel to three Internet service providers other than AOL, one before merger approval and two within ninety days of AOL offering Internet service over Time Warner facilities.[34] The FCC opened a Notice of Inquiry, indicating its intent to examine the question of open access in a formal proceeding. However, the commission is not addressing this issue with much urgency, and it is likely that the FTC's actions in the merger will be the high-water mark of the open-access movement.

Much more important, however, is the fact that the cable industry appears to be moving toward a wholesale model, in which the cable firm opens its high-speed service to Internet service providers of its choosing. This model represents a departure from cable's previous practice of sole sourcing its Internet service function. Recent reports suggest that this wholesale model is likely more profitable than the sole-source model, and several large cable companies are experimenting with it.[35] Adopting a wholesale model for cable is not without problems; it generally requires some co-location of equipment at the cable head end (similar to co-location in a telephone company central office), and it involves establishing acceptable rules for sharing a common resource: the high-speed Internet channel. But the economics of wholesale appear to be compelling enough that cable operators are seeking to overcome these problems.

33. For a history of open-access groups, court rulings, and regulatory actions, see CATV/CyberLab, "Broadband Report—Open Access" (2001) (www.catv.org/modemtech/opencable [April 16, 2002]).

34. The FCC imposed some additional conditions, which are of minor interest here.

35. Morgan Stanley Dean Witter, "The Sequel: Open Access Is Better," June 29, 2001, available from author.

Digital Subscriber Lines

Digital service is provided over the telephone companies' local loop, the pair of wires (or electrical path) between the customer's place of business or residence and the telephone companies' central office. The local loop has always been viewed as an essential facility; indeed, the AT&T antitrust case that led to the 1984 breakup of the Bell system was predicated on the local loop as an essential facility. The FCC ordered regional Bells to provide the high-frequency portion of the local loop, over which digital service is provided, to any carrier that requests access, so that the carrier can offer digital service over the regional Bell loop.[36] This "line sharing" decision designated this digital portion of the loop as an unbundled network element and thus subject to resale under state and federal rules implementing the Telecommunications Act of 1996. In essence, the FCC mandated the equivalent of open access for the Bells' local loops.

The Bells claim that this puts them at a disadvantage vis-à-vis cable companies, which are not required to provide access to nonaffiliated Internet service providers. Further, they claim that line sharing increases their cost of broadband deployment and therefore reduces the speed of deployment. The regional Bells lobbied Congress to pass the Tauzin-Dingell bill, which seeks to reclassify digital subscriber line service as an "advanced" service (and therefor not subject to mandatory line sharing).[37] The Bells reject the "essential facility" rationale for digital subscriber line sharing, arguing that broadband to the home is (at least potentially) competitive, even if for voice telephony the local loop is an essential facility.

Line sharing involves co-location of digital subscriber line providers' equipment in the central offices of the regional Bells, just as the wholesale cable model involves co-location at the head end. The digital channel is specific to each customer's loop, so no sharing of a common Internet channel is required, as it is in cable. However, customer specificity of the data channel suggests that co-location of equipment may be more extensive and more intrusive in the Bell's central office than in the cable firm's head end.

In fact, line sharing is a form of wholesaling, albeit one that is mandated by regulation. It appears that the cable industry is moving toward a wholesale model for broadband at exactly the point that the regional Bells

36. FCC (1999) (www.fcc.gov/bureaus/comon_carrier/orders/1999/fcc99355.txt [April 15, 2002]).

37. See David McGuire, "Bells, Rivals Gear up for Battle," *WashingtonPost.com,* February 28, 2001 (www.washtech.com/news/telecom/7915-1.html [April 16, 2002]).

are trying to escape a regulated version of broadband wholesaling.[38] If wholesaling is profitable for cable firms, why is it not profitable for the telephone companies' digital service (or at least not costly)? Granted, cable broadband and digital broadband have different technical characteristics, but there is no evidence that the differences are large enough to support totally different business models.

The question is, Does mandated line sharing constitute a significant barrier to investment in expanding digital service, in light of cable's move toward a wholesale model? One likely barrier is pricing; for example, the claim by the Bells that the wholesale rate they are permitted to charge data local-exchange carriers does not permit them to earn a profit on their wholesale service, although this claim is hotly disputed.[39]

Has the FCC's imposition of line sharing on legacy local loops actually imposed sufficient costs on the regional Bells to reduce investment? Most likely not, for the following reasons:

—The Bells are currently rolling out digital subscriber lines as fast as they can; as documented above, they are limited by their operational capabilities, not investment profitability.[40] This may be as much a defensive move as an offensive move.[41] Changing the rules may increase the profitability of these companies but is not likely to increase their speed of rollout.

—The data local-exchange carriers are in steep decline. Whether or not the Bells bear any responsibility for this, the decline has surely eased their pain sufficiently that several have increased their retail digital sub-

38. The exception here is Qwest, which is apparently exiting the Internet service provider business and moving its customers to Microsoft Network (www.qwest.net/nav4/msn/faq.html [April 17, 2002]).

39. It is claimed that the rate for a retail digital subscriber line from some Bell companies is less than their wholesale rate to data local-exchange carriers. See Luc Hatlestad, "The DSL Debacle," *Red Herring,* July 24, 2001 (www.redherring.com/index.asp?layout=story_imu&doc_id=170019817&channel=10000001 [April 17, 2002]).

40. In recent months, investment in digital broadband has slowed somewhat, at least at SBC. See Kirk Landendorf, "SBC's Daley Joins Battle to Control Internet's Future," *Austin American Statesman,* January 7, 2002, p. D1 (//archives.statesman.com/cgi-bin/display.cgi?id=3c3dd43733e70mpqaweb1p11011&doc=results.html). However, BellSouth appears to exhibit strong growth and the intent to continue that growth; BellSouth chair Duane Ackerman told a Salomon Smith Barney conference in Scottsdale, Arizona, on January 9, 2002, that the company beat its 2001 goal of 600,000 digital customers by 20,000, with a target of 1.1 million by year's end.

41. McKinsey and Company and Sanford Bernstein and Company, "Broadband!" Internal Report, January 2000 (broadband2@mckinsey.com), notes the competitive challenge of cable and has pressed the Bells to respond.

scriber line price.[42] The market results have delivered what the Bells have been seeking in the political arena: no competitors.

—The total cost, both pecuniary and reputational, of the regional Bells' initial deployment problems almost surely dwarfs whatever costs are mandated by the line-sharing rule and concomitant pricing rules.

—In fact the costs of line sharing are likely to be similar under a regulatory mandate for wholesaling as under voluntary wholesaling. Cable firms appear to find it profitable to undertake voluntary wholesaling, so it is unlikely that this cost is substantial.[43]

—In their extensive analyses of the broadband market, some researchers make no mention of FCC-mandated line sharing as having any effect on the market for broadband or the speed of deployment.[44]

In sum, the regional Bells are deploying broadband as fast as they can as a competitive necessity, and they have been willing to suffer substantial internal inefficiencies to do so. It is likely that the cost increase due to the line-sharing mandate is small compared to these other costs and will have no effect on the deployment speed of digital subscriber lines. Ultimately, this is an empirical issue, and the hard evidence of what these costs are and how they compare to the relevant market incentives is not yet available. This brief analysis can only sketch what data are needed to make the case. But the data are suggestive enough that, before Congress and the regulators give up on line sharing, a much stronger empirical case needs to be made by the Bell companies.

In conclusion, it is difficult to sustain the argument that regulatory policy regarding open access for cable or line sharing for digital service has in any way been an impediment to broadband deployment. If there have been impediments to deployment, they have been overwhelmingly on the supply side.

42. See Morgan Stanley Dean Witter, "The Sequel: Open Access Is Better," June 29, 2001 (available from author).

43. Since the cable model involves sharing a common Internet Protocol channel among all customers and, of course, their Internet service providers, the problem of multiple providers is technically more difficult for cable than it appears to be for telephone companies, where the model is a dedicated line for each customer.

44. McKinsey and Company and Sanford Bernstein and Company, "Broadband!" Internal Report, January 2000 (broadband2@Mckinsey.com); McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

Is Regulatory Policy a Problem (Part Deux)?

The argument that line-sharing rules have significantly impeded broadband deployment is unsupported. However, regulatory policies could well stand in the way of broadband deployment, either now or in the future. It is important that regulators and legislators realize where these policies may impede deployment, as they are not on the face of it obvious problems.

—The evidence strongly suggests that the incumbents respond only to competitive threats, and yet many local municipalities impose conditions and fees that create a huge barrier to entry in spite of the procompetitive provisions of the Telecommunications Act of 1996.[45] The statute gives the FCC authority to preempt contrary actions on the part of states or local authorities, although it does not appear to have used this authority.[46] Some states have stepped in to control such actions by local municipalities; for example, Michigan's Telecommunications Act gives strong authority to the state's Public Service Commission to fine municipalities that delay issuing permits in violation of their law.[47]

—Cable firms are concerned that expansion into broadband (from their entertainment base) may expose them to more state or federal regulation.[48] Their broadband strategies have been correspondingly cautious.[49] Clear, credible policy statements from regulators regarding their commitment to market solutions could substantially reduce uncertainty and encourage cable investment in broadband.

—Direct broadcast satellite distribution systems have been a formidable competitor to cable and continue to grow rapidly.[50] Unfortunately, Internet access via satellite typically uses a telephone uplink, not an integrated broadband uplink. New systems now coming on line may require

45. The Insider, "Saidel Slams Shunning of RCN by Philadelphia," *Philadelphia Business Journal,* February 16, 2001 (philadelphiabizjournals.com/philadelphia/stories/2001/02/19/tidbits/html [April 16, 2002]); see also 47 USC, sec. 253(a): "No State or local statute or regulation, or other State or local legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide interstate or intrastate telecommunications service."

46. 47 USC, sec. 253(d).

47. "MPSC Fines the City of Dearborn for Violations of the MTA," August 16, 2001 (//cis.state.mi.us/mpsc/orders/press/2001/12797.txt.htm).

48. National Cable Television Association, "The Pitfalls of Forced Access," 2001 (www.ncta.com/legislative/legaffairs.cfm?legregid=14 [April 17, 2002]).

49. George Bittlingmayer and Thomas W. Hazlett, "The Political Economy of Cable 'Open Access,'" *Stanford Technology Law Review* (stlr.stanford.edu/core_page/index.htm).

50. FCC (2001) (www.fcc.gov/Bureaus/Cable/Reports/fcc01001.pdf [April 16, 2002]).

innovative use of the spectrum.[51] The FCC, as the nation's spectrum manager, has wisely set aside spectrum in the Ka band for use by spot-beam satellites for a return data path. The FCC must continue to be receptive and accepting of this use of satellite spectrum in order to facilitate entry by direct broadcast satellite providers into integrated broadband.

—Future platform competition is likely to depend upon new entrants having access to all necessary content, both video and Internet, to realize scope economies. The success of the direct broadcast satellite platform as opposed to the cable platform has been attributed by some to the FCC's program access rules, due to a 2002 sunset rule.[52] Continuing these rules so that new platform competitors have reasonable access to "must have" programming reduces the entry barriers into the platform infrastructure market.

—As the regional Bells seek to deliver broadband to the home using technologies other than the legacy local loop, regulators need to back off requiring line sharing.[53] The rationale for the imposition of line sharing on these companies has always been that the local loop is a bottleneck. If the Bells extend fiber closer to the home, bypassing the legacy local loop, the policy rationale for line sharing simply does not apply. This is likely to be a complicated bit of regulatory rulemaking, but applying legacy regulation to new technologies is almost surely inappropriate. In its recent report on broadband, the National Academy of Science reaches a similar conclusion: "It is reasonable to maintain unbundling rules for the present copper plant. . . . existing bundling rules should be relaxed only where the incumbent makes significant investment . . . to facilities constructed to enable new capabilities."[54]

The FCC's line-sharing rule has received much criticism from the regional Bell operating companies (but from almost no one else) as an impediment to broadband rollout. On the other hand, the FCC's point in adopting the rule was to increase the speed of broadband rollout by encouraging competition. On balance, line sharing will probably have no

51. See Frank Derfler, "Satellite: The Only Choice for Remote Locales?" *ZDNet Reviews* (www.zdnet.com/products/stories/reviews/0,4161,267113400.html [April 17, 2002]).

52. See FCC (2001) (www.fcc.gov/Bureaus/Cable/Reports/fcc01001.pdf [April 16, 2002]).

53. One report finds one regulatory threat to broadband deployment: the imposition of line sharing at the remote terminal by the Illinois Public Service Commission for SBC's Pronto system. See McKinsey and Company and JPMorgan, "Broadband 2001," Internal Report, April 2, 2001 (broadband2@mckinsey.com).

54. Computer Science and Telecommunications Board, National Academy of Science, 2001 (www4.nationalacademies.org/cpsma/cstb.nsf/web/pub_broadband?opendocument [April 17, 2002]).

future effect on broadband deployment, either positive or negative; telecommunications policy needs to focus on removing roadblocks that discourage new infrastructure platforms to compete with incumbents.

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