

Broadband Deployment: Is Policy in the Way?

Gerald R. Faulhaber

Abstract

After years of delay, broadband services that connect homes to the Internet are finally rolling out. However, some has called the pace of this rollout “disappointing”. The Regional Bell Operating Companies (RBOCs), who are deploying DSL, a broadband technology, have claimed that FCC regulations are a cause of this slow deployment, arguing that these regulations reduce their broadband investments incentive. In this paper, I examine the pace of the broadband rollout relative to the historical deployment pace of other popular electronic products and services; I find that broadband is being deployed at least as fast as recently introduced products and services. I also examine the hypothesis that government regulation has impeded broadband deployment. I find there is no empirical evidence to support this hypothesis and a number of factors that suggest otherwise. Finally, I make recommendations of actions regulators and legislators could take that are likely to have a significant impact on the pace of broadband deployment.

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1. Introduction

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 that which 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 isn't 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 FCC hindered the deployment of broadband to the home? The regional Bell operating companies (RBOCs) have taken the position that FCC regulations requiring resale of DSL over loops inhibits broadband deployment, sponsoring a TV ad campaign and lobbying strongly for legislation in Congress to grant them relief from such regulations.

In this paper, I examine 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 (e.g., mandated resale of the DSL portion of the local loop) have inhibited the deployment of broadband, or may inhibit it in the future?
- Are there public policy actions we can take that will truly enhance the deployment of broadband and help ensure its aggressive development?

To preview the results, I find that

- 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.

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- 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 RBOCs in particular have had problems executing installs and delivering reliable service with good customer support. In the longer term, both the cable industry and the RBOCs were sluggish in recognizing the strategic opportunity of broadband, and both entered rather late, dragged into it by competitive necessity. We cannot expect these industries to have the strategic vision to take aggressively the next steps in broadband; platform competition may push them forward.
- The FCC has adopted and maintained a generally pro-market approach to broadband. It has been quite cautious regarding regulation of cable broadband, far more so than the Federal Trade Commission in its recent findings in the AOL-Time Warner merger. It has been somewhat more aggressive in requiring the RBOCs to unbundle the DSL 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 DSL broadband. However, the effect is most likely infinitesimally small compared to the supply, provisioning and service problems the RBOCs have had in the DSL rollout. Additionally, the unbundling requirement has been largely mitigated by a combination of RBOC aggressive pricing strategy and DLEC's (Data Local Exchange Company) poor conception and execution of their business plans.
- Public policy should be focused on encouraging platform competition in broadband distribution to the home. In particular, (i) prohibit local municipalities from imposing conditions on infrastructure providers, including fees in excess of costs, that discourage entry; (ii) be receptive to development of spectrum uses by DBS providers for 2-way broadband; (iii) ensure continuation of the FCC's program access rules for video distributors (as video and broadband are likely to be bundled services).

2. Broadband Rollout: What Are the Facts?

I recently published a paper (with Christiaan Hogendorn) with a model of broadband deployment (Faulhaber and Hogendorn, 2000). 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. It is only in the past two years that 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 our economy changes. But somewhat more surprising is the current view of many that the speed of deployment is less than our expectations.¹ Two years ago, most Americans didn't know what broadband was, and when they found out were not interested in it. Now many seem to expect that everyone should have broadband, and are disappointed that this is not the case. A typical response: "I think the pace of broadband deployment on the national level, beyond a few select markets, is very disappointing," says Christine Heckart, president of TeleChoice Inc., a network consulting company," quoted in Rosenbush (2001).

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

Recently, Crandall and Jackson (2001) have alleged that broadband deployment to most homes in the US would provide a huge boost to economic welfare, in the neighborhood of \$500 billion. If this result is to be believed, then encouraging, even subsidizing, extensive broadband deployment may be a suitable public policy goal,² and is certainly a reason to be concerned about any slowdown of broadband deployment. 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 slowdown itself, if real, cast 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.

Statistics of broadband deployment first became available in 1998; the FCC reported that by year-end 1998, 375,000 US households subscribed to high-speed Internet access. By the end of 2000, over 7.1 million US households had high-speed access; press surveys count the number of US households with broadband at over 8.4 million as of September 30, 2001.

Technology	12/98*	12/99**	6/00**	12/00**	9/01 (est)***
ADSL		369,792	951,583	1,977,377	2,484,789
Other Wireline		609,909	764,099	1,063,563	
Coaxial Cable		1,414,183	2,284,491	3,576,378	5,955,876
Fiber		312,204	307,151	376,506	
Satellite & Fixed Wireless		50,404	65,615	112,405	
Total Lines	375,000	2,756,492	4,372,939	7,106,229	8,440,665

Table 1—US Households with High Speed Lines (> 200 Kbps in one direction)

Sources: * FCC (1999); ** FCC (2001); *** Kinetic Strategies, Inc. (2001).

In 3½ years, broadband grew from zero to over 8.4 million households, a penetration of 8.1%. These growth rates outstripped the forecast of McKinsey *et al.* (2001), who forecast 5.9 million subscribers by EOY 2000.

By way of comparison, cellular telephones were commercially introduced in the US in 1985; it was not until the end of 1991, seven years later, that cell phone subscribership reached 7.5 million. Figure 1 compares the early growth path of wireless with the recent growth path of broadband.

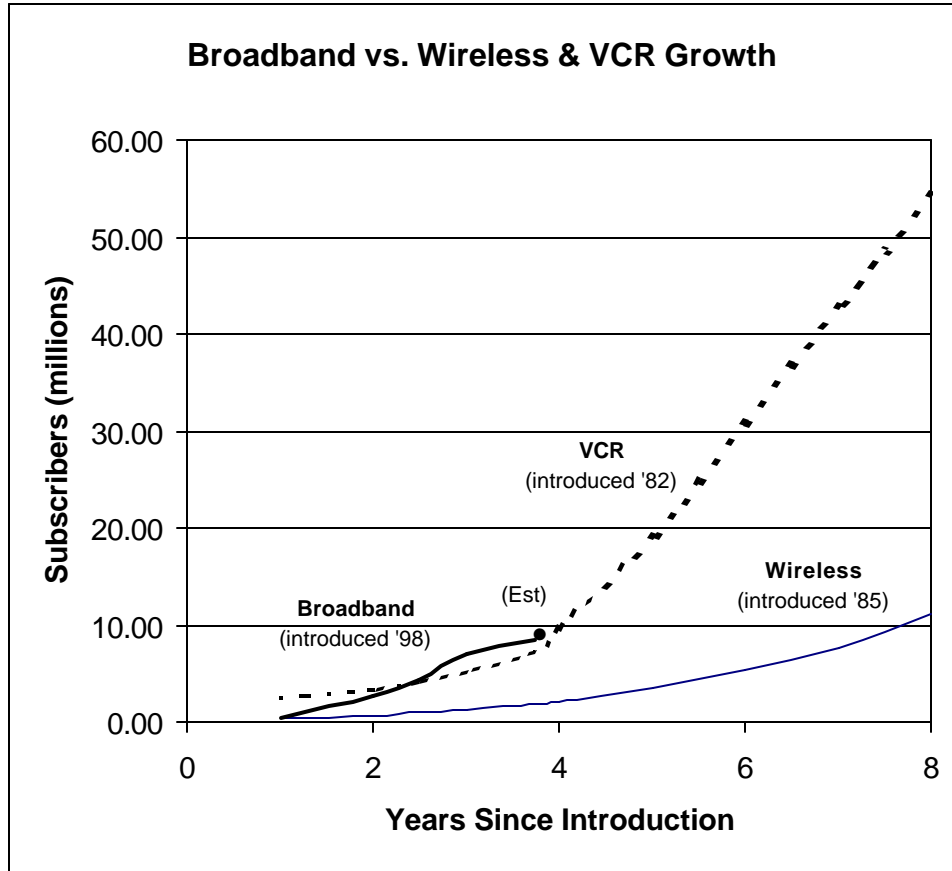


Figure 1 Early Subscriber Growth – Broadband vs. Wireless vs. VCR
 Source for Wireless: Cellular Telecommunications and Internet Association, 2001
 Source for VCR: TV Dimensions 2001

Broadband appears to be deploying about twice as quickly as did cellular in the mid-1980s to early-1990s. Of course, analog cellular prior to the introduction of digital wireless was rather expensive. A more compelling comparison is with the rollout of the VCR, a popular consumer electronics product introduced in 1982 at a relatively low price. Broadband is apparently growing at least as fast as did the VCR. While 8.1% of US households clearly isn't the entire population, broadband appears to be on a high-growth trajectory, similar to or faster than the adoption trajectories of other popular technologies such as cell phones, VCRs, and television.³

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.

3. Are There Problems?

What are the current bottlenecks to broadband deployment? Are they on the *demand* side (customers don't really want it) or the *supply* side (firms can't produce it quickly enough or with sufficient quality)? I examine each in turn.

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 by McKinsey suggests this is not true. They find very substantial demand for broadband and a deep interest in it. In McKinsey *et al* (2000) they find a strong learning effect; about one-third of online users are interested in high-speed service, but among those who have actually used it (at work, for example), about three-quarters of users expressed interest. In McKinsey *et al* (2001) their work in micro-markets found intense interest in broadband, anticipating four distinct “waves” of broadband purchasers, each with different demand drivers. Overall, their reports are very optimistic about the demand for broadband.

Some have mentioned that the deployment of broadband won't proceed quickly until there is a “killer app” for broadband; a service or feature that depends upon a high-speed connection that is very compelling for the average customer.⁴ While such an application would be valuable, there is no evidence that broadband is not attractive to many customers without it. Most broadband customers value the significantly improved response speed and the “always on” feature, and find this is quite enough to justify the extra cost of broadband.⁵

Supply The most significant impediments have been on the supply side. The problems can be classified into four categories: (i) addressability; (ii) provisioning; (iii) customer self-installation; and (iv) customer service issues.

Addressability DSL service can only be provided over certain telephone lines, generally limited in length from the subscriber's home to the telephone company's central office, as well as whether or not the subscriber is behind a digital line concentrator (DLC). In 1999, only 44% of telephone subscribers were addressable by DSL; by 2000, this had increased to 64%, as a result of RBOC efforts to improve addressability (McKinsey *et al.* (2001)). For cable, high-speed service can only be provided to customers passed by 2-way enabled digital cable. In 2000, 74% of cable households were 2-way enabled, and thus addressable for cable modem. It is expected that cable will maintain its lead in addressable households in the foreseeable future (McKinsey *et al.* (2001), Morgan Stanley Dean Witter (2001)).

Provisioning The seemingly simple act of actually turning the service on in a timely way appears to have stumped the RBOCs, at least into 2000. Bringing customers online lagged far behind demand during 1999-2000, with both DSL and cable. In 1999, RBOCs were provisioning at about 25,000 customers per week; cable was provisioning at about 30,000 customers per week, both significantly below requests for service, which were running 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 (McKinsey *et al.* (2001)).

Customer Self-Installation Early installations of broadband took at least one visit from an installer (“truck roll”) and often more. This creates both a customer problem (who must now stay at home until the installer shows up...or not) and a cost problem (in that each truck roll costs the provider several hundred dollars). The RBOCs have moved more swiftly to self-install in 2000 than the cable firms, and may have a long-term advantage over cable in this regard.

Customer Service Constant service outages, some DSL customers down for months without repair, clueless technical support personnel, all were part of the broadband horror stories making the rounds in 1999-2000 (Silverthorne, 2000). Cable fared somewhat

better than DSL, in that cable service outages were more rare than DSL outages (McKinsey *et al.* (2001)). The problems with DSL were exacerbated when more than one company was involved; customers that purchased DSL from firms that offered service over telephone company lines were caught in the middle while each company pointed their finger at the other and the problem didn't get solved (Rosenbush (2001)). Recent reports suggest the worst of the bad customer service is over, and the RBOCs 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 (McKinsey *et al.* (2001)). However, these problems are being solved and broadband is rolling out at an impressive speed. While addressability and customer service remain problems, especially for DSL, I expect in the medium term the providers will deal with them effectively.

4. Are There Problems? A Broader View

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

A Sluggish Start In the early to mid-1990s, most US businesses had invested in extensive Ethernet networks that 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 RBOC. In this market, there was never a question about the appropriate connect 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, proud owners of newly acquired home PCs used their telephone line to connect to the Internet via an ISP. During this period, the ISP industry was built almost overnight; barriers to entry are very low, required technical skills negligible, and costs of entry small.⁶

During 1996-1997, the volume of ISP-bound telephone traffic grew at astounding rates, perhaps tripling every year, as the American public flocked to the Internet. No firms were better positioned to observe this growth phenomenon than the RBOCs; they actually carried all this ISP-bound traffic on their networks.

One might expect that smart businesspersons in the RBOCs would have noticed this tremendous growth and assessed the business opportunity it presented. The experience of US 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: DSL.⁷

One might expect that the RBOCs unique knowledge of growth in Internet demand coupled with market and technological facts would have led the RBOCs to roll out DSL in 1997 and be ahead of the market. But one would be wrong. In fact, the RBOCs were well aware of the growth of demand for ISP access, and were also aware that this traffic had very long connect times. Since rates for local service do not depend upon connect times, such traffic imposed unexpected costs on the RBOCs. Rather than view this as an extraordinary business opportunity, the RBOCs chose

to view it as an “abuse” of their network and petitioned the FCC and state regulators to force ISPs to pay higher, usage-sensitive rates to the RBOCs, perhaps modeled on carrier access charges paid by interexchange carriers (see FCC (1997) for example comments filed by Bell Atlantic and NYNEX). In short, when confronted with an unprecedented market opportunity of which they had unique knowledge, the RBOCs took the traditional public utility “cost recovery” view and sought regulatory relief from the FCC.⁸ 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 (see **Error! Reference source not found.**) suggests that it was competition, not their market foresight, that has driven the RBOCs to deploy DSL. In 1999, AT&T in particular announced a broadband strategy in which cable telephony in competition with the RBOCs played a significant role. In addition, the FCC ordered “line sharing” of local loops, in effect mandating that the RBOCs were required to provide the DSL 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 (DLECs) sprang up, such as Covad and Northpoint, showing up at RBOC central offices with their own equipment, demanding access to “their” customers’ local loops. The RBOCs’ DSL deployment certainly followed that of the cable industry, and was certainly no faster than the early deployment of the DLECs. This is consistent with the hypothesis that it was intra- and inter-modal competition alone that drove DSL deployment by the RBOCs.

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 2-way capability were required. The impetus for the costly upgrade to digital systems was not broadband; it was competitive pressure from DBS satellite, an alternative video delivery system that promised far higher quality and far more channels than the old analog cable systems could deliver (see Hazlett and Bittlingmayer (2001)⁹). To meet this competitive threat, cable systems were pressed to invest heavily in system 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 a very inexpensive add-on to the new systems.¹⁰

In short, customers desiring broadband Internet connections were greatly advantaged by the desire of Americans to watch high quality television, and 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 RBOCs to deploy DSL for fear of being attacked in their core business by the cable firms.

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

Uncertain Future The high demand for broadband by US residential customers suggests this is creating substantial value for them and the economy (Crandall and Jackson (2001)). We may all have faith in the ability of business to capture a substantial portion of this value; already, the 6 Mhz IP channel on digital cable systems is producing as much base revenue¹¹ as the remaining 700+ Mhz video channels for cable firms. As new 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, RAM, 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 competitors not yet on the scene. 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, such "overbuilders" are pursuing a similar technology strategy as traditional cable firms, namely hybrid fiber-coax systems, in which 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. However, a few firms are actually taking fiber all the way to the home, and this may well be the driver for future systems.

There are two impediments to wireline competition: (i) in spite of the provisions of the Telecommunications Act of 1996 prohibiting 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.¹² (ii) Possible discontinuance of the FCC's program access rule, which comes up for review in 2002. In brief, this rule prohibits cable owners of networks (for example, Time Warner's ownership of HBO) from refusing to sell carriage of such networks to competing distribution channels (for example, DBS satellite). Many view the viability and rapid growth of DBS video distribution as a direct result of the program access rule, which rule sunsets in 2002 unless renewed by the FCC (see FCC (2001a)).

Other distribution systems for broadband have yet to demonstrate viable business models. MMDS, for example, is available today but not a factor in the market (McKinsey *et al* (2001)). DBS suffers from the lack of an integrated return path; DirectPC, for example, requires a telephone uplink. The success of DBS 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.

I also note that a number of municipalities have taken it upon themselves (or more accurately, their municipal water and/or sewer authorities) to construct broadband infrastructure to every home, presumably on the theory that this electronic infrastructure is no different than the physical infrastructure such as streets, water and sewer for which they assume ownership and responsibility.¹³ I expect this movement to continue; for some municipalities with technology-oriented citizens, constituents may be unwilling to wait for telcos and cable firms to put in infrastructure, and 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. I also expect that both telephone and cable firms will strongly object to this, and attempt to block it in state legislatures.

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: (i) cable systems can increase the bandwidth committed to the IP channel from 6 Mhz to 12Mhz, perhaps taking the Monster Truck Channel out of the lineup. (ii) 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). What will be difficult for cable systems to change is the shared nature of the cable modem connection; even with full fiber to the home, at some point the cable infrastructure leads to customers sharing bandwidth at some point. How well this model scales remains to be seen.

For telephone/DSL systems, the expansion route is less clear. DSL is essentially a stopgap measure designed to squeeze yet more life out of the copper twisted pair which has served the RBOCs 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 most likely expansion path to fiber 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 office. The copper twisted pair (or its equivalent) is taken from the remote terminal to the customer's home. In this model, the remote terminal serves a similar purpose to the node in the hybrid fiber-coax 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 RBOCs. This may well be counterbalanced by the strategic disadvantage of being saddled with DSL, 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, particularly if the FCC permits the program access rules to sunset.

5. 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 RBOCs 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 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 merger demanded that the merging firms be required to accommodate any ISP that wished to offer high-speed service over their cable facilities, on identical terms and conditions as the cable firm's contract ISP (@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.¹⁴ 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 had authority to make this determination, not local governments. In the AOL-Time Warner merger, open access became the lead issue for the FTC. Eventually, the parties agreed that AOL-Time Warner would offer access to their high-speed Internet channel to three ISPs (other than AOL itself); one prior to merger approval and two within 90 days of AOL itself offering ISP service over Time Warner facilities.¹⁵ 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 other ISPs of its choosing. This model represents a departure from cable's previous practice of sole sourcing its ISP 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 (Morgan Stanley Dean Witter (2001)). 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 so that cable operators are seeking to overcome these problems.

DSL DSL 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 RBOCs to provide the high-frequency portion of the local loop, over which DSL is provided, to any carrier that requests access, so that the carrier can offer DSL service over the RBOC loop (FCC (1999a)). This "line sharing" decision designated this DSL 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 RBOC's local loops.

The RBOCs claim that this puts them at a disadvantage vis-à-vis the cable companies, who are not required to provide access to non-affiliated ISPs. Further, they claim that line sharing increases their cost of broadband deployment and therefore is reducing the speed of deployment. The RBOCs are lobbying Congress to pass the Tauzin-Dingell bill that seeks to reclassify DSL as an "advanced" service, and therefore should not be subject to mandatory line sharing (see McGuire (2001)). The RBOCs reject the "essential facility" rationale for DSL 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 DSL providers' equipment in RBOC central offices, just as the wholesale cable model involves co-location at the head end. The DSL 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 RBOC'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 RBOCs are trying to escape a regulated version of broadband wholesaling.¹⁶ If wholesaling is profitable for cable firms, why isn't it profitable for the RBOC's DSL service (or

at least not very costly)? Granted, cable broadband and DSL 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 DSL service, in light of cable's move toward a wholesale model? One likely barrier is pricing; the RBOCs claim that the wholesale rate they are permitted to charge DLECs doesn't permit them to earn a profit on their wholesale service, although this claim is hotly disputed.¹⁷

Has the imposition of line sharing by the FCC actually imposed sufficient costs on the RBOCs to reduce investment? I believe not, for the following reasons:

- The RBOCs are currently rolling out DSL as fast as they can; as documented above, they are limited by their operational capabilities, not investment profitability. This may be as much a defensive move as an offensive move; McKinsey *et al* (2000) notes the competitive challenge of cable has pressed the RBOCs to respond. Changing the rules may increase RBOC profitability but is not likely to increase their speed of rollout.
- The DLECs are all fading fast as the dot com and telecoms bubble bursts. Whether or not the RBOCs bear any responsibility for this, it has surely eased their pain sufficiently that several have recently increased their retail DSL price (see Morgan Stanley Dean Witter (2001). The market results have delivered what the RBOCs have been seeking in the political arena: no competitors.
- The total cost, both pecuniary and reputational, of the RBOCs' initial deployment problems almost surely dwarfs whatever costs are mandated by the line sharing rule, in my view based on the analysis above.
- 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,¹⁸ so it is unlikely that this cost is very substantial.
- In their extensive analyses of the broadband market, McKinsey *et al* (2000) and McKinsey *et al* (2001), no mention is made of FCC-mandated line sharing as having any effect whatsoever on the market for broadband or the speed of deployment.

In sum, the RBOCs 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 speed of DSL deployment.

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 on the table. This brief analysis can only sketch what data is needed to make the case. But it is suggestive enough that before Congress and the regulators give up on line sharing, a much stronger empirical case needs to be made by the RBOCs.

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

6. Is Regulatory Policy a Problem (Part Deux)?

While I view the argument that line sharing rules have significantly impeded broadband deployment as unsupported, there are regulatory policies that 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.

1. The evidence strongly suggests that the incumbents will only respond to competitive threats, and yet many local municipalities impose conditions and fees that create a huge barrier to entry (see, Philadelphia Business Journal (2001)) in spite of the pro-competitive provisions of the Telecommunications Act of 1996 that supposedly limited this behavior.¹⁹ The statute gives the FCC authority to preempt contrary actions on the part of states or local authorities,²⁰ although it does not appear to have used this authority. Some states have stepped in to control such actions by local municipalities; for example, Michigan's Telecommunications Act has given strong authority to their Public Service Commission to fine municipalities that delay issuing permits in violation of their law and the Commission has not been afraid to use it (Michigan PSC (2001)).
2. Cable firms are concerned that expansion into broadband (from their entertainment base) may expose them to more state or Federal regulation (National Cable Television Association (2001)). Their broadband strategies have been correspondingly cautious (Hazlett and Bittlingmayer (2001)). Clear, credible policy statements from regulators regarding their commitment to market solutions could substantially reduce uncertainty and encourage cable investment in broadband.
3. DBS distribution systems have been a formidable video competitor to cable, and continue to grow rapidly (FCC (2001a)). Unfortunately, Internet access via satellite typically uses a telephone uplink, not an integrated broadband uplink. New systems now coming online may require innovative use of the spectrum (see Derfler (2001)); 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 DBS providers into integrated broadband.
4. Video and broadband are likely to be bundled products for the foreseeable future. Anything that helps new video infrastructure platforms to compete with cable will likely help broadband as well. The success of DBS against cable has been attributed by some (see FCC (2001a)) to the FCC's program access rules, due to sunset in 2002. Continuing these rules so that new competitors have reasonable access to "must have" programming reduces the entry barriers into the video and broadband infrastructure market.
5. As the RBOCs seek to deliver broadband to the home using technologies other than the legacy local loop, regulators need to back off requiring line sharing.²¹ The rationale for the imposition of line sharing on the RBOCs has always been that the local loop is a bottleneck facility. If RBOCs extend fiber closer to the home, thereby bypassing the legacy local loop, the policy rationale for line sharing simply doesn't 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." (Computer Science and Telecommunications Board of the National Academy of Science (2001), p. S-15).

The FCC's line sharing rule has received much criticism from the RBOC (but 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. In my view, line sharing will probably have no future effect on broadband deployment, either positive or negative. Telecommunications policy needs to focus more on removing roadblocks that encourage new infrastructure platforms to compete with incumbents, rather than spend more effort on getting line sharing "right."

-- References --

- CATV/CyberLab (2001), "Broadband Report – Open Access," at <http://www.catv.org/modemtech/opencable/>
- Computer Science and Telecommunications Board of the National Academy of Science (2001), *Broadband: Bringing Home the Bits*, National Academy Press, at http://www4.nationalacademies.org/cpsma/cstb.nsf/web/pub_broadband?OpenDocument
- Cellular Telecommunications and Internet Association (2001), *Semi-Annual Wireless Survey*, at <http://www.wow-com.com./industry/stats/surveys/>
- Crandall, Robert and Charles Jackson (1998) "Eliminating Barriers to DSL Service," July, study prepared for "Keep America Connected!" Main concerns from regulation are retail rate regulation, unbundling and resale, and universal service.
- _____ and _____ (2001) "The \$500 billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access," July 16, Criterion Economics report.
- Derfler, Frank (2001), "Satellite: the Only Choice for Remote Locales?" *ZDNet Reviews* January 22, at <http://www.zdnet.com/products/stories/reviews/0,4161,2671134,00.html>
- Faulhaber, Gerald and Christiaan Hogendorn (2000) "The Market Structure of Broadband Telecommunications," *Journal of Industrial Economics*, XLVIII(3), 305-329.
- FCC (1996) "Telecommunications Act of 1996," at <http://www.fcc.gov/telecom.html>
- FCC (1997), "Joint Comments by Bell Atlantic and NYNEX on Notice of Inquiry," *Usage of the Public Switched Network by Information Service and Internet Access Providers* March 24 at http://www.fcc.gov/Bureaus/Common_Carrier/Comments/access_reform/noicoms.html
- FCC (1997a), "Joint Comments of Bell Atlantic and NYNEX," *Access Charge Reform*, Jan 29, affidavit of Robert W. Crandall at http://www.fcc.gov/Bureaus/Common_Carrier/Comments/access_reform/
- FCC (1999), *Report*, FCC 99-5 ("First 706 Report") at <http://www.fcc.gov/Bureaus/CommonCarrier/Orders/1999/fcc99005.wp>
- FCC (1999a) *Third Report and Order*, "Deployment of Wireline Services Offering Advanced Telecommunications Capability," December 9, at http://www.fcc.gov/Bureaus/Common_Carrier/Orders/1999/fcc99355.txt
- FCC (2001), *High-Speed Services for Internet Access: Subscribership as of December 31, 2000*, August 9, Industry Analysis Division, at http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/hspd0801.pdf
- FCC (2001a), *Seventh Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, January 8, Cable Services Bureau, at <http://www.fcc.gov/Bureaus/Cable/Reports/fcc01001.txt>

Federal Clean Water Act (1977), 33 U.S.C., §1281(g), at <http://www4.law.cornell.edu/uscode/33/1281.html>

Hatlestad, Luc (2001) "The DSL Debacle," *Red Herring*, July 24, at http://www.redherring.com/index.asp?layout=story_imu&doc_id=170019817&channel=1000000
1

Hazlett, Thomas and George Bittlingmayer, "The Political Economy of 'Open Access'," AEI-Brookings Joint Center for Regulatory Studies Working Paper 01-06, May 2001. Forthcoming in the *Stanford Technology Law Review*, Fall 2001, at http://www.aei.brookings.org/publications/working/working_01_06.pdf

Kinetic Strategies, Inc. (2000) at <http://www.cabledatcomnews.com/sep01/sep01-1.html>.

Kranz, Matt (2000) "Broadband's Slow Start Strangles Shares" *USA Today*, October 19 at <http://www.usatoday.com/life/cyber/invest/ina246.htm> .

Martin, Richard (2000) "What Broadband Revolution?" *The Industry Standard*, December 11 at <http://www.thestandard.com/article/0,1902,20440,00.html>.

McGuire, David (2001) "Bells, Rivals Gear Up for Battle" *WashingtonPost.com*, February 28, at <http://www.washtech.com/news/telecom/7915-1.html> .

McKinsey & Co and Sanford Bernstein & Co (2000) *Broadband!*, January, internal report, available at broadband2@mckinsey.com

McKinsey & Co. and JPMorgan, *Broadband 2001*, April 2, internal report, available at broadband2@mckinsey.com

Media Dynamics, Inc. (2001), *TV Dimensions 2001*, at <http://www.mediadynamicsinc.com/tvdoutline.htm>

Michigan PSC (2001), "MPSC fines the City of Dearborn for violations of the MTA," August 16, at <http://cis.state.mi.us/mpsc/orders/press/2001/12797.txt.htm>

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

National Cable Television Association (2001), "The Pitfalls of Forced Access," at <http://www.ncta.com/legislative/legAffairs.cfm?legRegID=14>

Philadelphia Business Journal (2001) "Saidel slams shunning of RCN by Philadelphia," February 16 at <http://philadelphia.bcentral.com/philadelphia/stories/2001/02/19/tidbits.html>

Rosenbush, Steven (2001) "Broadband: What Happened?," *Business Week Online*, June 11 at http://www.businessweek.com/magazine/content/01_24/b3736066.htm This article focuses on supply side problems in meeting customer demand.

Silverthorne, Sean (2000) "Broadband – Fast Access, Slow Install," ZDNet News, June 13, at <http://www.zdnet.com/zdnn/stories/news/0,4586,2581476,00.html>

Williamson, Richard and Rebecca Cantwell (2001) "Broadband Stalls With Net Economy," *Information Week*, August 27 at <http://www.interactiveweek.com/article/0,3658,s%253D1825%2526a%253D13414,00.asp>

¹ See for example, Martin (2000), Kranz (2000) and Rosenbush (2001) for references in the popular press regarding the broadband deployment “slowdown.”

² 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 makes aid available to build local sewer systems (Federal Clean Water Act (1977)).

³ Though it is unlikely that broadband will deploy more quickly than the all-time champion, black and white television. Between 1947 and 1952, black and white TV grew from essentially zero to 20% of US households.

⁴ An example press quote: "Except for high-speed Internet access, there are no 'killer' applications driving demand for broadband today," said AT&T President David Dorman. "That may be why, today, so few families subscribe to broadband services where they are available." *Information Week* (2001).

⁵ By way of analogy, an automobile that is capable of a speed of 80 mph does not do anything fundamentally different from an automobile that is only capable of a speed of 20 mph. 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) they are equivalent. Yet virtually everyone would prefer the faster car.

⁶ During this period, several undergraduates in my classes at Wharton owned and operated local ISPs in their spare time.

⁷ Jackson (2001) notes that certain essential electronic components required for DSL were quite expensive prior to about 1998. Of course, it is possible that the cost of such components could have come down substantially had the RBOCs rolled out DSL earlier. In high technology markets, costs are often endogenous.

⁸ It is alleged that the RBOCs were reluctant to introduce DSL into the market for fear of cannibalizing their lucrative T1 service.

⁹ p.17: "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"

¹⁰ While the 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.

¹¹ A typical price for cable modem service (excluding the modem) is about \$40/month, and a typical price for basic digital cable for video only is also about \$40/month. Of course, video also generates pay-per-view revenues and premium channel revenues.

¹² See, for example, Philadelphia Business Journal (2001) describing the two year delays of RCN's application for a license to build a fiber optic network at the hands of the Philadelphia City Council, alleged to be motivated by a desire to protect Comcast, the local cable provider.

¹³ Ca-botics, Inc., a firm located in Dayton, OH, offers a technology that lays fiber to homes using sewer lines, an existing infrastructure with almost universal deployment. See <http://www.ca-botics.com/>

¹⁴ For a history of open access groups, court rulings, and regulatory actions, see CATV/CyberLab (2001).

¹⁵ The FCC imposed some additional conditions which are of minor interest here.

¹⁶ The exception here is Qwest, which is apparently exiting the ISP business and moving its customers to MSN (see <http://www.qwest.net/nav4/msn/faq.html>).

¹⁷ It is claimed that the retail DSL rate for some RBOCs is less than their wholesale rate to DLECs; see Hatlestad (2001).

¹⁸ Since the cable model involves sharing a common IP channel among all customers and of course their ISPs, the problem of multiple ISPs is technically more difficult for cable than it appears for telephone companies, where the model is a dedicated line for each customer.

¹⁹ 47 U.S.C. §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."

²⁰ *op cit* §253(d).

²¹ McKinsey (2001) 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.