

Telecommunications competition: the infrastructure-investment race¹

Anna-Maria Kovacs, Ph.D., CFA²

October 8, 2013

Key findings:

- U.S. communications traffic has almost completed the transition to Internet Protocol (IP). Legacy switched traffic amounts to less than 1% of IP traffic today and is likely to decrease to a small fraction of 1% by 2017. The regulatory framework, however, has not caught up to the marketplace reality.
- The development of multiple platforms which provide transport for IP has helped create a highly competitive communications ecosystem, which provides consumers with a plethora of choices.
- As a result, consumers no longer have to fit into a “one-size-fits-all” mold. Each consumer can pick and choose among different bundles of networks/devices/content-applications-services to find the best fit for that individual.
- Those choices are provided over various platforms that compete with each other on the basis of different technology capabilities and different economics. That makes the competition sustainable. It also makes the variety of choices possible.
- The greatest benefits of the *Telecommunications Act of 1996* have resulted from inter-platform competition, while attempts at artificially induced intra-platform competition have failed.
- The least-regulated platforms—Internet, cable, and wireless—are the most successful, because they have been free to innovate and to invest their capital efficiently. The most regulated—the incumbent telephone companies (ILECs)—have been forced to waste both capital and operating funds on obsolete networks, thus limiting their ability to upgrade their infrastructure.
- A team led by Robert C. Atkinson of CITI estimated that from 2006 through 2011, 53% of the capital investment made by the three largest ILECs was allocated to their legacy networks, while just 47% was spent on broadband infrastructure. Assuming that ratio is typical of the industry during those six years, and given that the ILEC industry spent \$154 billion in capex during those

¹ This study was commissioned by the Internet Innovation Alliance. The views and opinions expressed in this study are solely those of the author.

² © Anna-Maria Kovacs 2013. All rights reserved.

Anna-Maria Kovacs is a Visiting Senior Policy Scholar at Georgetown University’s Center for Business and Public Policy. She has covered the communications industry for more than three decades as a financial analyst and consultant.

years, the ILECs spent \$81 billion on legacy networks, while just \$73 billion was spent on modern broadband infrastructure.

- The ILECs are losing circuit-switched voice and low-speed DSL subscribers. On the other hand, where they have deployed IP over fiber-based infrastructure, they are gaining Internet-access and video subscribers.
- To enhance competition and achieve the world-leading role in broadband-access that Congress and the Administration desire, the U.S. IP transition must be completed and the ILECs must be allowed to repurpose the capital that is currently deployed to support their obsolete circuit-switched networks into fiber-based broadband IP networks.

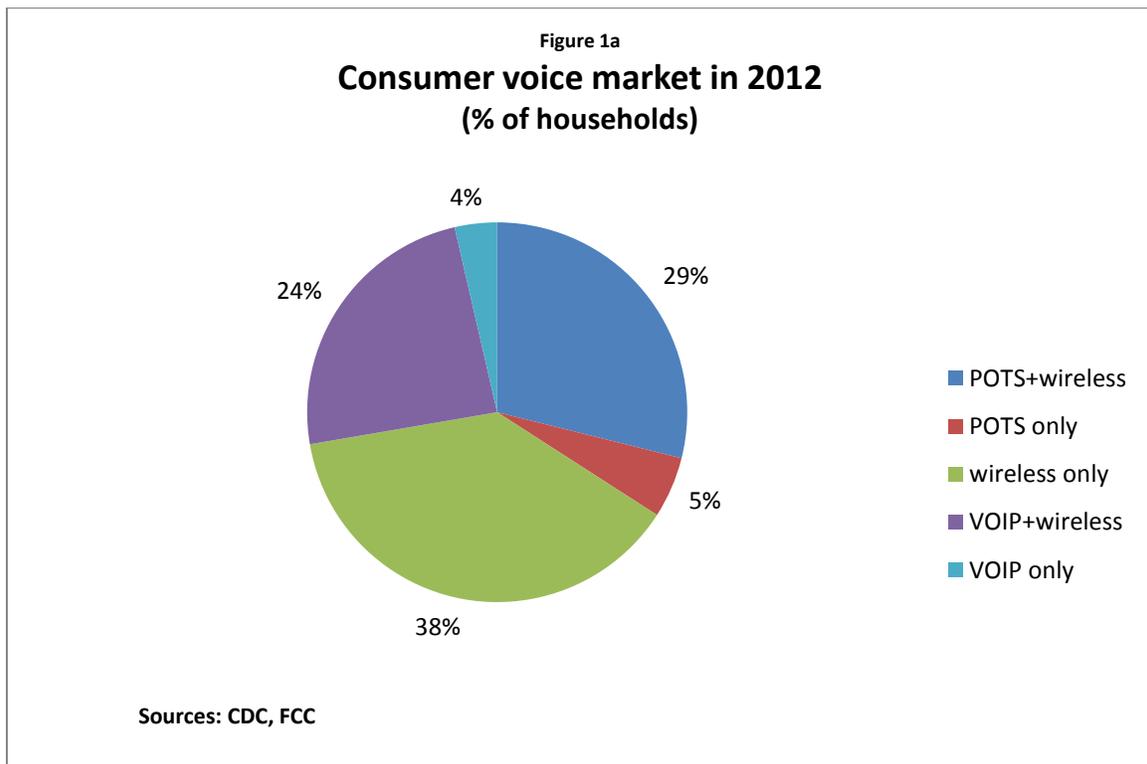
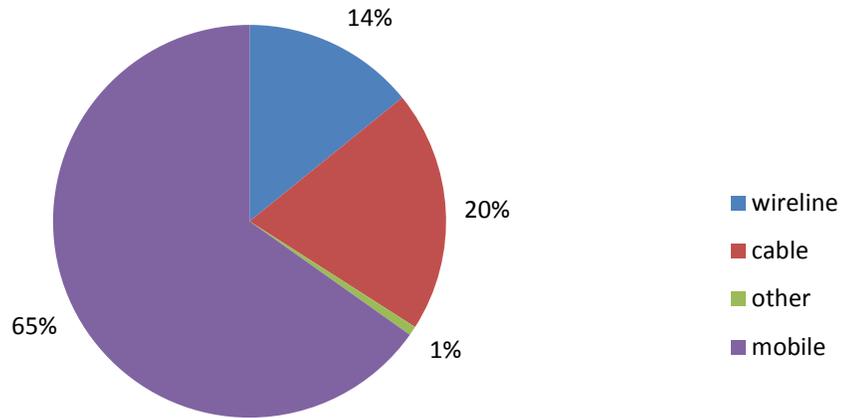
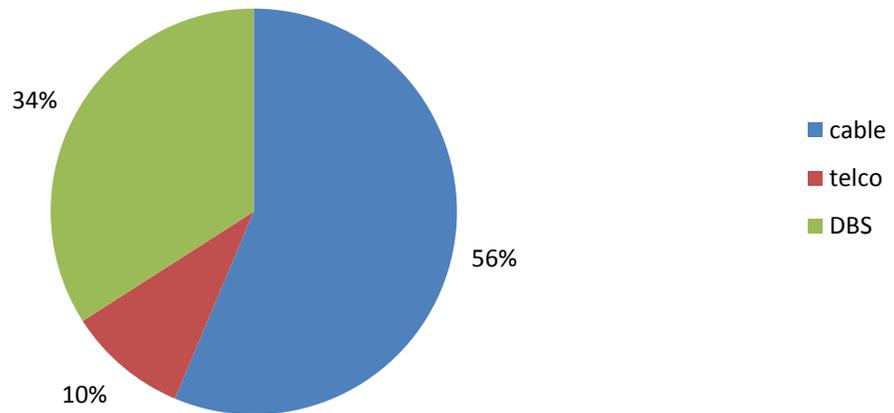


Figure 1b
Internet-access market in 2012
(% of connections)



Source: FCC

Figure 1c
MVPD market in 2012
(% of subscribers)



Sources: FCC, NCTA, J.P. Morgan

Contents

Key Findings	1
Executive Summary	5
Discussion:	
• Consumers today have a plethora of choices	6
• Consumers' choices rely on infrastructure investment	7
• Today's network-traffic is almost all IP	7
• Circuit-switched networks divert capital from IP-based broadband	9
• What do consumers really want?	11
• Regulatory requirements lag consumer choices	12
• Are consumer choices endangered?	14
• The Google-Fiber model v. the ILEC model	21
• The <i>Telecom Act of 1996</i>, platform competition, and consumer choice	24
• The failure of mandated network-sharing	27
• Inter-platform competition succeeded	30
Summary	44

Executive summary

Traditional switched traffic today amounts to less than 1% of the amount of traffic that is transmitted over IP. The transition for data is essentially complete, and the transition for voice is well underway, as consumers abandon the POTS (plain-old-telephone-system) legacy network. They are migrating to VOIP (voice over Internet Protocol) and to wireless, which will become an all-IP infrastructure over the next few years. In other words, the networks' transition from circuit-switched to IP traffic is nearly complete.

However, the regulatory framework lags the marketplace reality. Subject to regulation at both the state and federal levels, even ILECs who receive relief from a regulation at one level may find that they cannot enjoy it because it is still backstopped at the other level. As a result, the ILECs (incumbent phone companies) remain subject to regulations that were formulated when they were monopolies with 100% market share and when their legacy POTS networks were the state of the art.

For example, ILECs have to operate according to standards that were relevant for POTS but may not be technically applicable to IP. They have to ask permission to discontinue the use of obsolete technologies, even when they have deployed new technologies with better capabilities. Although Congress, the Administration, the Federal Communications Commission (FCC), and most state regulators are eager to see the U.S. lead the world in broadband deployment, when ILECs attempt to replace legacy technologies with new they are often told that while they may deploy the new, they must also retain the old, whether it is actually in use or not. Capital is a scarce resource—what is expended on the old network can't be spent on the new.

The great lesson of the *Telecom Act of 1996* is that the most effective competition is between different technology platforms that bring different characteristics and economics to bear. The *Act* helped to promote competition by freeing the cable and telephone carriers to enter into each others' markets and by leaving satellite and wireless free to do so, as well. Its most successful progeny is the Internet, which it left completely unregulated.

Competition is, indeed, thriving among all of these infrastructures, and the result is the plethora of choices consumers enjoy. To ensure that ILECs can continue to provide innovative solutions for consumers and compete effectively against other platforms, they must be free to make the best use of their capital. That, in turn, means dedicating their capital to IP- and fiber-based broadband networks, rather than tying it up in obsolete copper-based circuit-switched networks.

At the end of 2012, the ILECs' share of the consumer voice, broadband-access, and video markets was 34%, 14%, and 10% respectively. It is time to stop treating the ILECs as monopolies that must be hobbled and start treating them as useful assets whose health is important to this nation's economy and global competitiveness.

Thus, if America's goal is to have a world-leading, competitive communications market that is responsive to consumers' needs and desires, the solution is not to hamstring those players that have been free to innovate, but to liberate those that have been hamstrung.

Telecommunications competition: the infrastructure-investment race

Discussion

Consumers today have a plethora of choices

When the *Telecommunications Act of 1996 (Act)* was enacted, consumers had few choices. Communication meant a letter or a phone call (with a careful eye on the clock, if this was long-distance), or a telegram in dire emergency. Wireless phones were becoming popular, but largely as car-phones and generally for business. Video entertainment at home came from TV--over-the-air or via cable--with a limited number of channels, or from videos. Satellite had been around for several years via large dishes, but the more appealing DBS (direct broadcast satellite) was just beginning to gain popularity. The Internet was still in its infancy, and access was via dial-up modem.

Today, consumers enjoy a dazzling array of communications choices and they are exercising them with abandon. A college student checking in with her Mom in 1996 would have written a letter or made a quick long-distance call. Today, those options are still available, but the call would now be part of an all-distance plan on a wireline, wireless, or VOIP network, and the device might be a landline phone, or one of many types of cell phones or smartphones. The "call" might avoid the phone network altogether, and be carried computer to computer. In that case, it would most likely be a video chat, rather than simply a conversation. Alternately, the connection might be an email (with or without a video-clip), a text, a tweet, or an update to a social network site. Indeed, by the time that student makes a single contact, she has instantly weighed hundreds of permutations, selected among hundreds of choices: which one of dozens of possible applications, over which of several devices, over which of several networks will she use?

Similarly, entertainment options still include over-the-air TV or cable networks, but there are now literally hundreds of channels, and equally rich satellite packages are available as an alternative. The content can still be viewed on that big TV at home, or ported to a laptop, tablet, or other device the consumer prefers. For those who want what they want, when and how they want it, there are a range of variations on video-on-demand, including video-streaming from a variety of different sites, sent over different platforms, available on a host of devices. Games, played with partners around the globe, provide yet another option for fun, similarly accessible over various networks and devices.

This plethora of consumer choice is the result of innovation in all of the layers of the communications ecosystem—networks, devices, and content, services and applications. Innovation in each layer stimulates innovation in the others. The iPhone, iPad, and other smartphones and tablets, for example, would not have been such a huge success without a robust wireless infrastructure that allowed for broadband access to the Internet. Nor would they have been desired by consumers without attractive applications that could be accessed over these devices. But the sharp increase in

traffic that followed the introduction of these devices then stimulated the next network upgrades, first to HSPA+ or CDMA EV-DO and now to LTE.

Consumers' choices rely on infrastructure investment

While innovation is needed at all levels of the ecosystem, the greatest financial investment is in the networks, the infrastructure on which all the rest relies. Traditional U.S. wireline, wireless, and cable network providers collectively invest upward of \$65 billion in capital expenditures every year to provide both the access networks and the backbones over which all those communications flow. The split has been roughly 40%/40%/20% between wireline, wireless, and cable. In the aggregate, these carriers have invested about \$1.2 trillion since 1996.

New networks have also sprung up to facilitate delivery of Internet traffic--content delivery networks (CDNs). Some, like Google's and Amazon's and Comcast's networks, are vertically integrated into companies that also operate at other levels of the ecosystem. Others, like Akamai's and Limelight's, are stand-alone publicly-held networks. CDNs' goal is to provide just that bit of competitive advantage a content or application provider seeks in delivery speed or assured quality by caching at multiple points close to edge access-networks. Cisco expects that CDNs will touch two-thirds of video traffic by 2017.³ Because the Internet has become so video-centric, that means that they will touch the majority of all communications traffic in 2017, which they will then deliver to various access networks.

Today's network-traffic is almost all IP

The overwhelming majority of communication now takes place in IP. Cisco VNI's study of U.S. IP traffic shows that consumer traffic constitutes most of IP traffic. In 2012, total U.S. IP traffic was 157 exabytes and that is expected to triple in the next five years, so that total U.S. IP traffic in 2017 will be 445 exabytes. Consumer U.S. IP traffic in 2012 was 136 exabytes and by 2017 is expected to increase to 387 exabytes, roughly 86% of total IP traffic in each year.⁴ Most of this traffic is IP video, either over the open Internet or managed.⁵ In 2012, IP video accounted for 120 exabytes of traffic and by 2017 it is expected to grow to 359 exabytes, i.e., to roughly 80% of all U.S. IP traffic.⁶

By contrast, we estimate that U.S. traditional switched traffic, which consists primarily of voice traffic, constituted less than 1 exabyte in 2012. We calculate the wireless voice traffic by converting the minutes reported by CTIA to bytes and make a similar calculation for wireline based on the 102 million

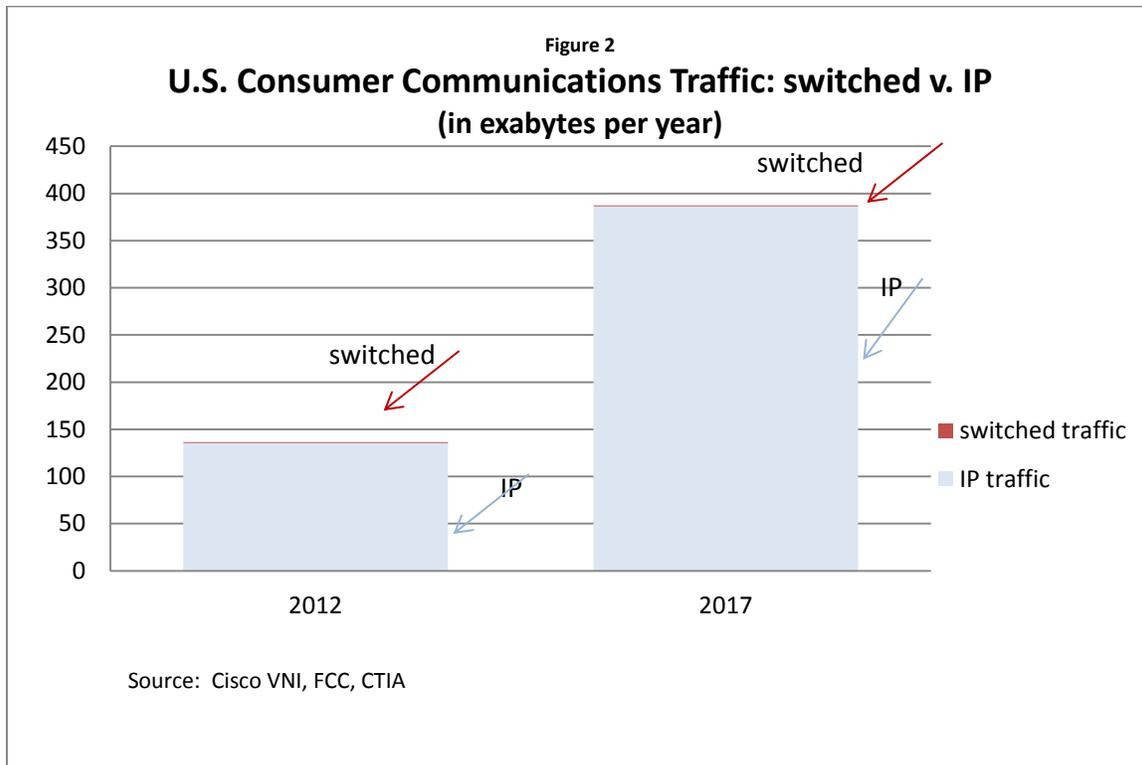
³ Cisco VNI, *The Zettabyte Era—Trends and Analysis*, May 29, 2013, p. 2. The traffic will also, of course, be carried on the access networks to reach the ultimate consumer. What the CDNs replace or complement are the long-haul networks. (Hereafter referred to as Cisco VNI, *Zettabyte Era*.)

⁴ Cisco VNI, U.S. Forecast Highlights and U.S. Consumer Highlights for 2012 and 2017.

⁵ Cisco VNI, U.S. Forecast Highlights for 2012 and 2017.

⁶ Cisco puts these figures into context by explaining that in 1992, global Internet traffic consumed 100 gigabytes per day. By 2012, it consumed 12,000 gigabytes per second. Cisco VNI, *Zettabyte Era*, table 1, p. 4. This does not include the portion of MVPD video that is run in broadcast rather than IP mode.

access lines reported by the FCC as of mid-2012.⁷ In other words, even in 2012, there was less than 1% as much traditional circuit-switched traffic as there was IP traffic on U.S. networks.⁸ By 2017, with continued growth in wired VOIP and most wireless voice transmitted in IP on voice-over-LTE networks (VOLTE), switched traffic will be a small fraction of 1%.



What has made the explosive growth of IP traffic possible is the fungibility of IP traffic—its ability to move seamlessly across various IP networks under an informal set of commercial agreements. Unlike the world of switched traffic, which is burdened with a complex set of regulated access charges within the U.S. and settlements outside the U.S., the IP world is unregulated. IP networks can spring up at will, they can reach commercial agreements about traffic exchange with each other without interference, and they allow the traffic to find the most efficient available route.

This unregulated system has worked extraordinarily efficiently and effectively across the U.S. and across the globe, with the supply of bandwidth meeting demand, however rapidly that demand has

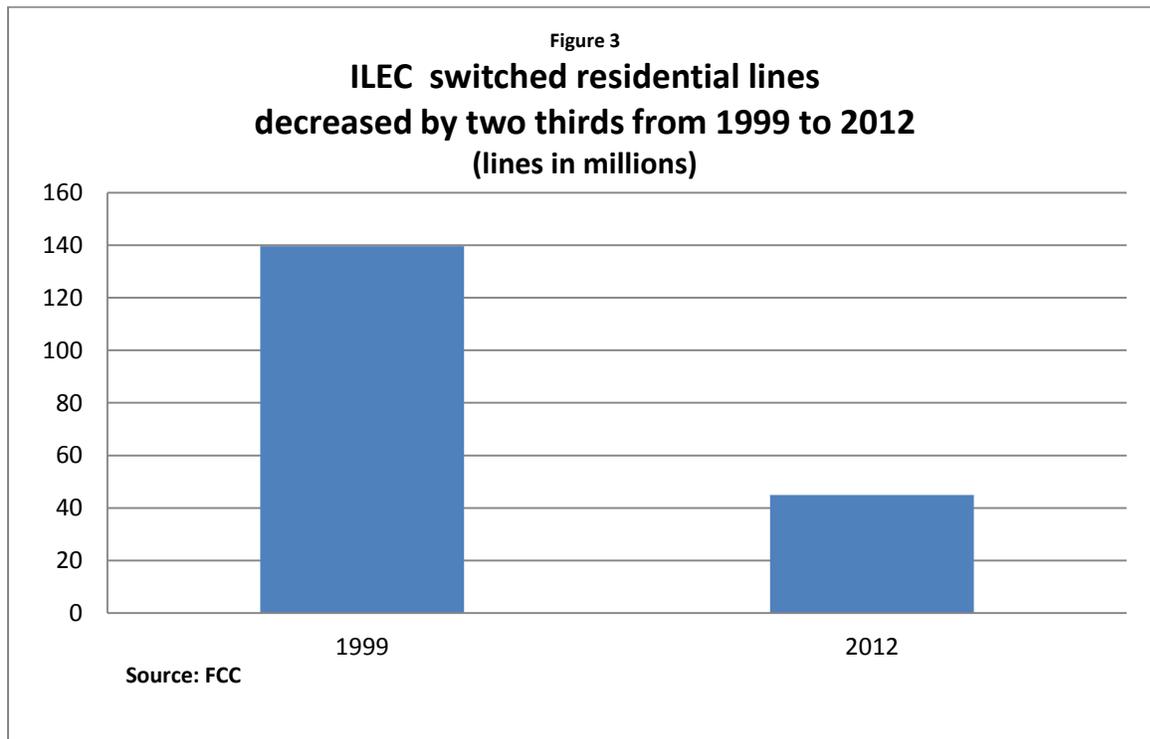
⁷ CTIA, *Semi-Annual Wireless Industry Survey for Year-end 2012*, p. 8, and Federal Communications Commission, *Local Telephone Competition: Status as of June 2012*, June 2013, table 9, p. 20. CTIA reported 2.3 trillion minutes, counting each end of a call on the wireless network as a minute. We adjusted that down to 1.3 trillion actual rather than access minutes. The 102 million end-user switched access lines include both business and residential, both ILEC and non-ILEC. We assume 30 minutes of use per line per day on the switched lines, recognizing that's on the high side. The switched traffic would use 64 kbps which translates to 8 bytes. The wireless traffic is more compressed and would use roughly a third of that. (Hereafter referred to as CTIA, *Wireless Survey* and hereafter referred to as FCC, *Local Telephone Competition* as of ...)

⁸ See also Michael Kende, *Voice Traffic Exchange in an IP World*, Analysis Mason, April 12, 2013, p. 24, for an estimate of U.S. voice traffic v. data traffic.

grown.⁹ Indeed, Congress recognized the desirability of an unregulated Internet infrastructure with its resolution supporting the continuation of the current system of Internet governance and the Administration has fought for that principle in international negotiations.¹⁰

Circuit-switched networks divert capital from IP-based broadband

IP is now overwhelmingly the communication protocol of the U.S. and of the world and it is transported on networks that are optimized for it. In contrast, switched traffic is a tiny and declining portion of U.S. traffic that requires, nevertheless, its own separate parallel networks. Because the switched-networks were optimized for a much higher volume of traffic than they now carry, they are increasingly inefficient and wasteful of both capital and operating funds.



As Figure 3 shows,¹¹ ILEC consumer switched access lines have decreased by two-thirds since 1999, the earliest period for which the FCC reports these numbers.¹² Since these networks have a high component of fixed cost, the cost per subscriber rises sharply as the number of subscribers falls.

⁹ See Anna-Maria Kovacs, *Internet Peering and Transit*, April 4, 2012, posted by Broadband For America, for a discussion of the movement of unregulated Internet traffic.

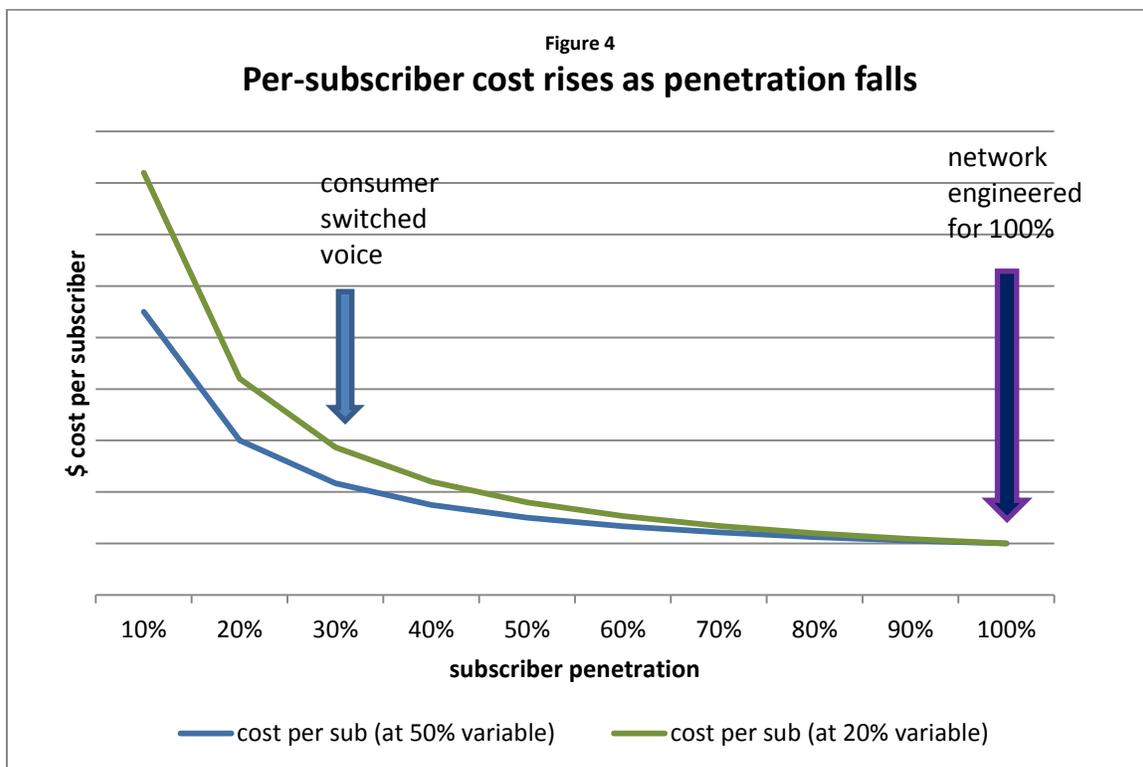
¹⁰ S. Con. Res. 50, One Hundred Twelfth Congress of the United States of America at the second session, agreed to December 5, 2012.

¹¹ FCC, *Local Telephone Competition: Status as of June 2012*, figure 4, p. 5. *Local Telephone Competition Report: Status as of December 2008*, table 2, p. 13. (Hereafter referred to as FCC, *Local Competition* as of ...)

¹² Please note that before 2008, the FCC's reports did not split out VOIP lines from switched lines. For 1999, of course, that was not an issue.

As Figure 4 indicates, at penetration levels below 30%—the likely level of consumer lines by the end of 2013—the cost per remaining subscriber increases more and more sharply. Even if network operators are efficient and manage to make 50% of their cost variable, cost per subscriber at 30% penetration is more than twice what it was at 100% penetration. If only 20% of the cost is variable, then cost per subscriber is nearly tripled at 30% penetration. At 15% penetration, the level AT&T is approaching in some of its states, cost per subscriber quintuples for a network that has 20% variable cost and quadruples even for a network that has 50% variable cost.

Both capital investment and operating expense follow this curve, for the same reason. To serve any customer in a neighborhood, the basic network infrastructure must be built out to the entire neighborhood and it must all be maintained. It is only the drop—the line from the trunk running down the street into the customer’s premise—that can be avoided (or not maintained) for a non-subscriber. Similarly, in the context of circuit switching, the central office and the switches in it must be bought and maintained. As subscribers are lost, individual line cards or units may be removed, and ultimately some switches decommissioned, but much of the cost of the central offices remains.



A network engineered to serve 100% of a neighborhood will have terrible economics at 30% penetration, unless it can increase its revenue commensurately by either raising price or adding other services that require minimal variable cost but bring in high variable revenue. Caller-ID and similar

software based services, for example, served such a function in the circuit-switched world. In the IP world, adding IP-data or IP-voice to an IP-based video network can serve the function of adding revenues at minimal incremental cost, because the network is engineered for the highest volume service.

We have focused on 30% penetration, because the ILECs' consumer penetration is rapidly approaching that level for their legacy circuit-switched (POTS) service. However, consumer telephony prices are either regulated or derived from prices that were regulated assuming cost at 100% penetration. In many cases, they are disciplined by even lower prices based on the economics of other platforms. But the ILECs' profitability is only one issue. There is also an opportunity cost—legacy networks are eating up capital and operating funds that could be used to expand the ILECs' IP-broadband footprint.

What do consumers really want?

While consumers have abandoned ILEC circuit-switched lines, they have adopted VOIP lines, primarily bundled with video and/or broadband over cable networks. CLEC switched lines have also declined and now serve fewer than 3% of households.¹³ Of course, the major competitive force in the consumer voice market is wireless. By the end of 2012, 38.3% of households were wireless-only, up from 35.8% in mid-2012.¹⁴ Unlike wireless Internet-access which has been transmitted in IP all along, wireless voice is just about to begin the move to IP with VOLTE. With the continued decline of circuit-switched consumer fixed-access lines and the conversion of wireless to IP, it is likely that by 2017 circuit-switched traffic will comprise far less than even the 1% of traffic it constitutes today.

As Figure 5 shows,¹⁵ by the end of 2012 only 34% of households purchased traditional switched telephony service (POTS),¹⁶ and only 5% of households relied on it exclusively. The other 29% combined it with wireless. 28% of households used VOIP service, and only 4% relied on it exclusively. Over 90% of households took wireless service, and 38% cut the cord altogether. Another 15.9% of households used wireless mostly.¹⁷ By year-end 2013, it is likely that more than 60% of households will be wireless-only or wireless-mostly. More to the point in terms of cost, by the end of 2013, POTS' penetration is likely to be at or below 30% and still falling.

¹³ FCC, *Local Competition* as of June 2012, figure 4, p. 5.

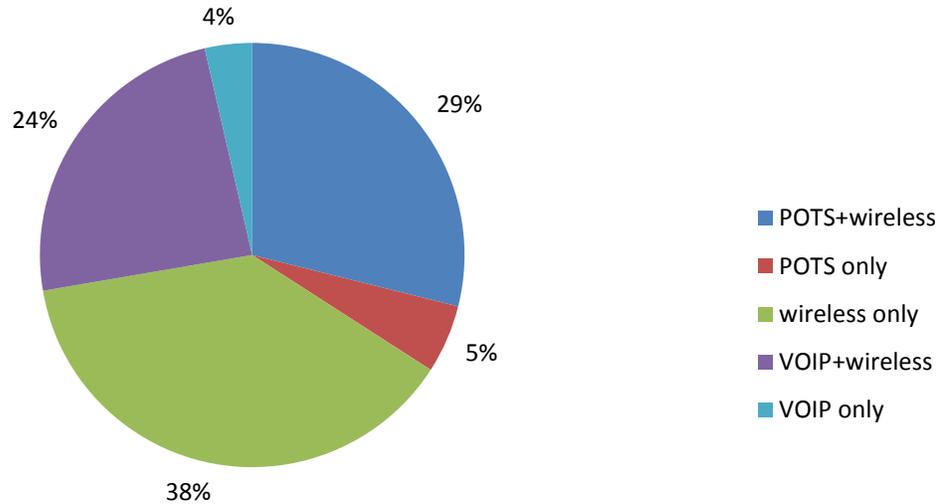
¹⁴ S. J. Blumberg and J.V. Luke, Center for Disease Control and Prevention, *Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2012*, National Center for Health Statistics, released 6/2013, table 1. (Hereafter referred to as CDC, *Wireless Substitution*, released...)

¹⁵ CDC, *Wireless Substitution*, released 6/2013, table 1, and FCC, *Local Competition* as of June 2012, figure 4, page 5, and linear projection from the FCC data.

¹⁶ The POTS figure includes switched lines from both ILECs and CLECs.

¹⁷ CDC, *Wireless Substitution*, released 6/2013, p. 4.

Figure 5
U.S. consumer voice market in 2012
(% of households)



Sources: CDC, FCC

Regulatory requirements lag consumer choices

Unlike the cable, wireless, competitive carrier, or CDN industries, the ILECs' operational and technology choices are restricted via state and federal regulations that were developed for legacy networks operating as monopolies.¹⁸

Although 95% of consumers no longer rely on their ILEC as their sole carrier, and we estimate that as of mid-2013 fewer than one third of households take traditional ILEC service at all, carrier-of-last-resort (COLR) rules require ILECs (and only ILECs) to keep their networks ready to serve all would-be-customers. Those rules, which still apply in most states and are backstopped at the federal level, assume that ILECs have deployed and are maintaining their networks as though they still provided service to almost 100% of households.¹⁹

There are also more specific restrictions. For example, ILECs have to ask permission to drop services that they offer, and that permission is not automatic, even when the service is obsolete and incompatible with the latest network technology. ILECs are also subject to various requirements and metrics that govern anything from service quality to copper-loop retirement. The regulations, which

¹⁸ The FCC's *National Broadband Plan* issued in 2010 noted on p. 59: "Regulations require certain carriers to maintain POTS—a requirement that is not sustainable—and lead to investments in assets that could be stranded."

¹⁹ Even when ILECs had a monopoly, they did not serve 100% of households, since about 2% tended not to take service.

are often very specific, were designed for a copper-based circuit-switched network rather than a fiber-fed IP-based network. Many are technologically inapplicable to broadband IP networks.

The combination of such service-discontinuation and service-quality regulations with COLR obligations has forced the ILECs to continue to spend capital and operating funds on the obsolete copper-based, circuit-switched legacy network that most consumers no longer desire. That leaves less capital available for the fiber-based IP network consumers do need and want. As Figure 4 above shows, maintaining a barely-used parallel network is very costly.

Some of the goals behind the ILEC regulations remain relevant: ensuring that communications-access is available to all, that traffic will flow smoothly, that anyone on the network can reach anyone else, that public safety is well served—these goals still have to be satisfied. However, their implementation has to be different for IP broadband networks which face competition, whose architecture is different from that of circuit-switched narrowband networks, and whose physical media have different characteristics and capabilities.

For example, ensuring ongoing access to communications, especially in emergency situations, is just as important today as it was in the past. But the old solution of relying on reverse-powering from the central office to deal with power outages is no longer useful in most cases. That solution does not work over the “lines” that consumers most desire. Fiber-to-the-premise, hybrid fiber-coax, and wireless connections are unable to provide reverse-powering. Yet, these are the links more than 60% of consumers have chosen as their primary means of communication. It is clear that regulators cannot—and should not—force consumers to reverse course. Instead, regulation must catch up to the technology choices consumers have made. Regulation must also acknowledge the reality that most consumers today rely on multiple infrastructures and thus, to a large extent, provide their own backup sources.²⁰

This is not only important to the companies, it is vital to consumers. Regulators and consumer advocates who still cling to copper as the solution for power outages do nothing for the 60+% of consumers who have chosen to not have a POTS line in their home. And, of course, copper cannot provide service when the central office itself is put out of commission by flooding, or when the lines are cut by a storm.

Similarly, insisting on circuit-switching as a more secure form of communication than IP does nothing to protect the 99%-plus of communication traffic that is already being transmitted in IP. Cyber-security is vital, but it must be solved within the context of the IP ecosystem.

Consumers will be best protected if all resources are devoted to the networks that they have chosen to use, rather than being wasted on the networks most have abandoned and the rest are likely to abandon within a few years. Thus, ILECs need the same engineering freedom to evolve their networks as do their cable, wireless, and CDN siblings. They also need the same financial freedom to invest all

²⁰ Of course, powering over copper lines also fails sometimes—the lines themselves can break or the central office can fail to generate power, e.g. during flooding.

of their capital in the network of the present and future, rather than being forced to devote much of it to the network of the past.

Are consumer choices endangered?

It has been argued that the communications industry is becoming less competitive, and that cable is about to become a broadband monopoly.²¹ That view assumes that the ILECs have lost so much wired-broadband share that they are on the path to extinction. It also assumes that wireless broadband cannot compete on speed and capacity with wired broadband. Those who hold this view argue that rather than liberating the ILECs from obsolete regulations that waste capital, regulators should impose similar regulations on the cable industry which has been largely unregulated.²²

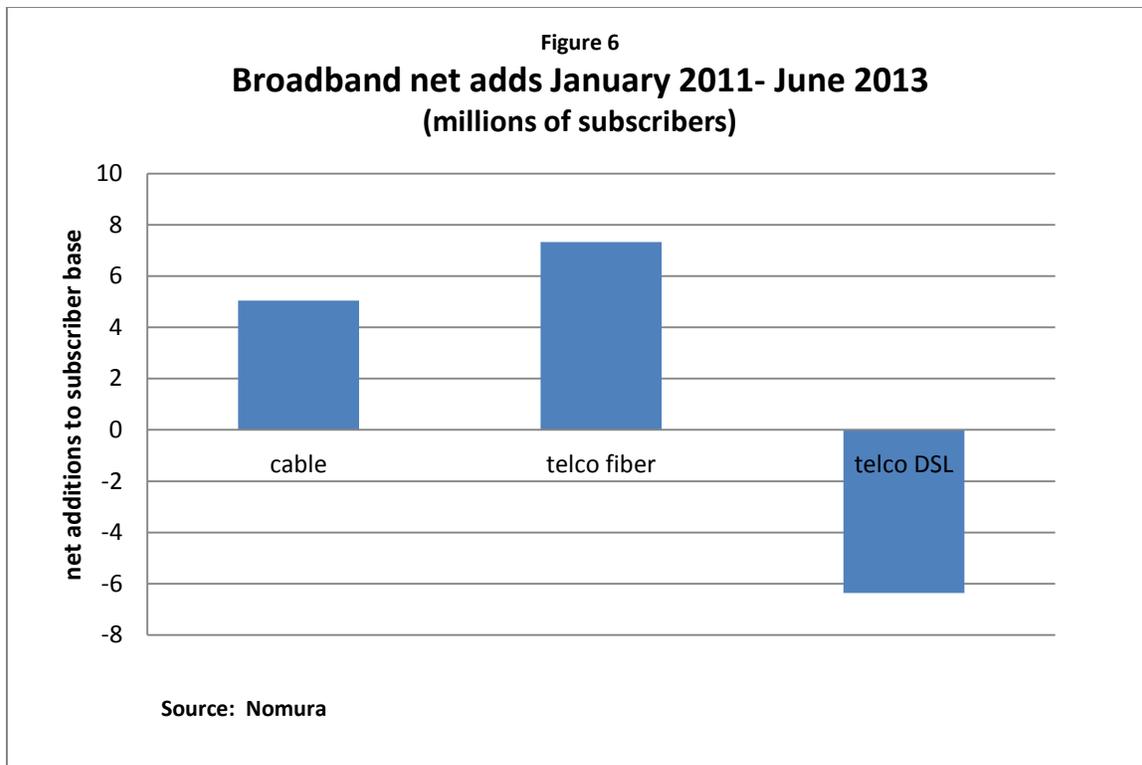
There are several problems with this approach. First, it is over-simplistic in its interpretation of the facts. While the ILECs are losing share in low-speed DSL, they are gaining where they have upgraded to high-speed broadband, in video as well as in Internet-access. Thus, the most effective way to constrain cable gains in the fixed-broadband market is to encourage ILEC upgrades. Unshackling the ILECs is more likely to benefit consumers than shackling the cable providers. Second, wireless broadband has become a powerful competitor in the broadband Internet-access market and it constrains both ILEC and cable providers.

A Nomura report issued in July shows that where ILECs have upgraded their networks with fiber to the home or to nodes close to the home, the ILECs gained broadband-access share over cable broadband.²³ From January 2011 to June 2013, ILEC fiber (primarily FIOS and U-verse) gained 7.3 million subscribers, while cable broadband gained only 5 million. It is only where ILECs rely on low-speed DSL that they lose share against cable in the broadband market.

²¹ Susan P. Crawford, "The Looming Cable Monopoly," *Yale Law & Policy Review Inter Alia*, 29:34-29:40, 2010. That is also the premise of her recent book, *Captive Audience*, Yale University Press, 2013, although the book is devoted more specifically to the Comcast-NBCU merger.

²² Cable is regulated to some extent on the video side, e.g. via must-carry and retransmission consent rules as well as local requirements for provision of PEG channels. There are also some local franchising regulations, e.g. build-out requirements.

²³ Mike McCormack CFA, "Watching Video Subscriber Trends in 2Q13," Nomura Equity Research: U.S. Cable and Satellite, July 16, 2013, figure 2, p. 2. (Hereafter referred to as McCormack, "2Q13," Nomura.)



But, as Figure 7 shows, even with the ILECs' loss of DSL subscribers, the cable industry's share of the residential wired-broadband market has remained remarkably stable, at roughly 57% to 59%.²⁴ It has been in that range for nearly six years now, since 2007, down from a peak of 66% in 2002.²⁵

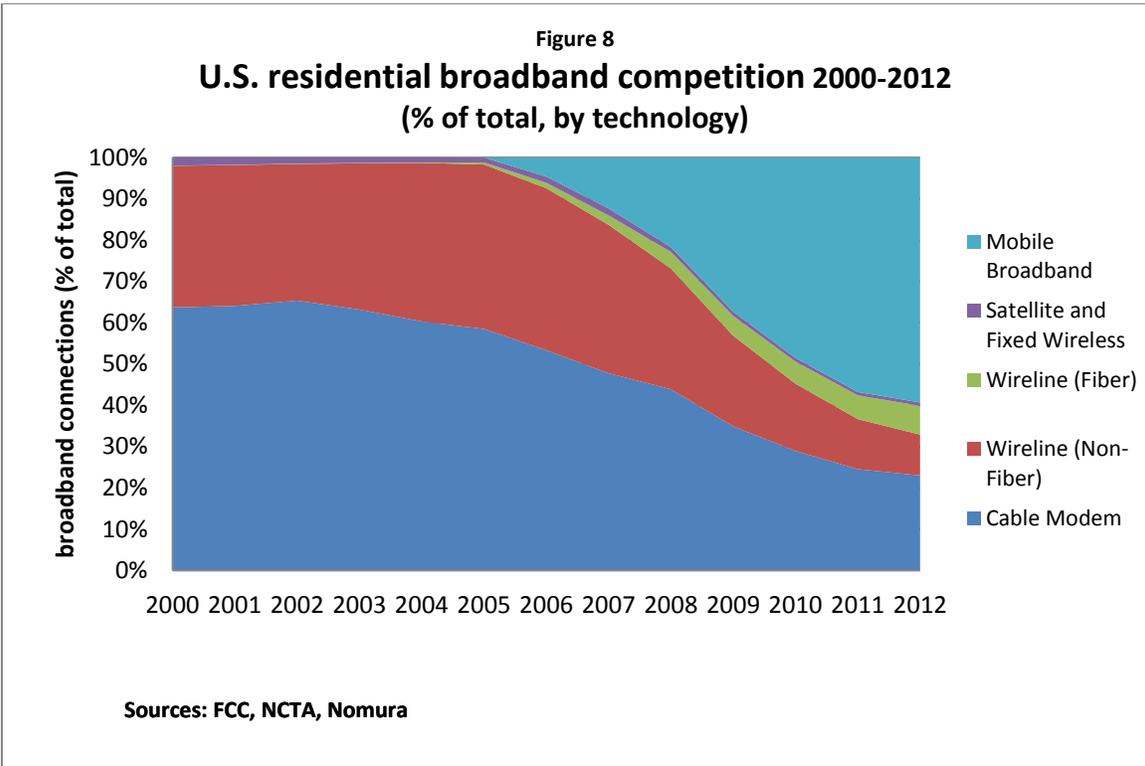
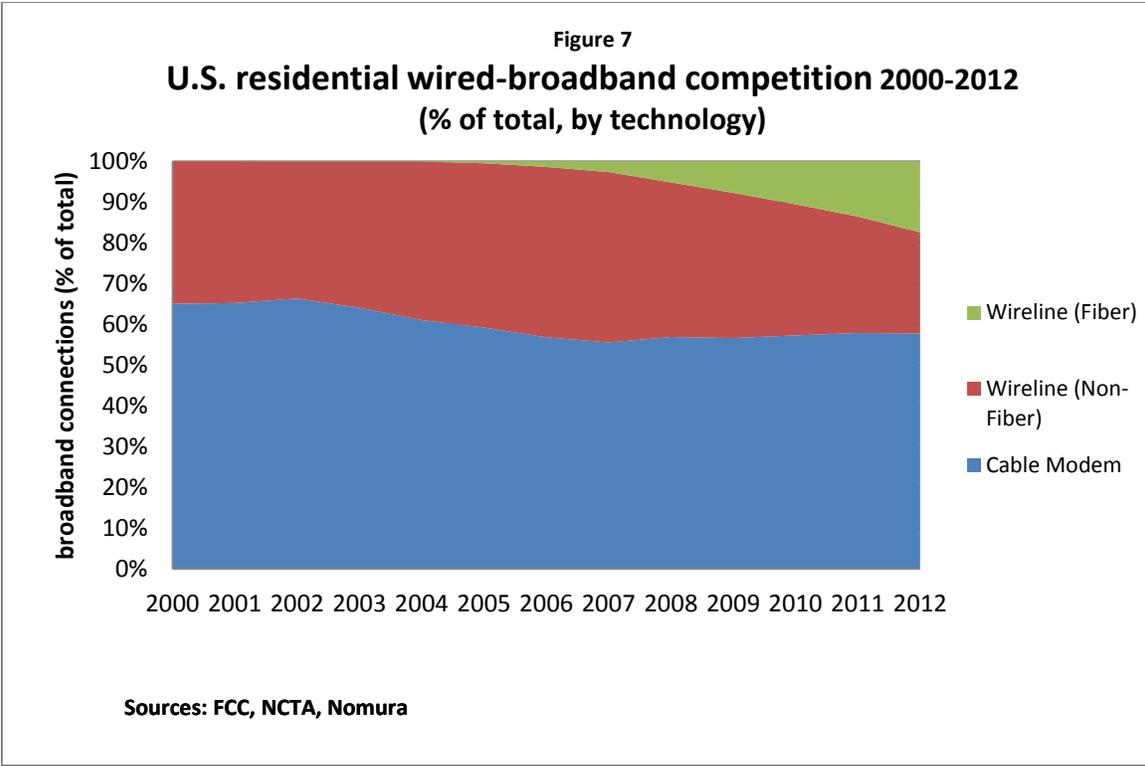
Of course, as Figure 8 shows, the greatest number of new broadband subscribers since 2005, and especially since the introduction of the iPhone in 2007, has been in mobile wireless. At the end of 2012, mobile broadband accounted for roughly 60% of U.S. residential broadband connections,²⁶ making cable's share of the U.S. residential broadband market only 23%, and falling. With LTE speeds now much higher than the fixed speeds consumers actually use, mobile wireless is both growing the broadband-access market and providing a competitive alternative for some consumers.²⁷

²⁴ FCC, *Internet Access Services: Status as of December 2007*, table 3, and *Internet Access Services: Status as of June 2012*, table 6, (these reports are hereafter referred to as *Internet Access as of ...*), NCTA for December 2012 cable modem data, and linear projection for other year-end 2012 data. U-verse is included in fiber rather than in DSL.

²⁵ *Ibid.*

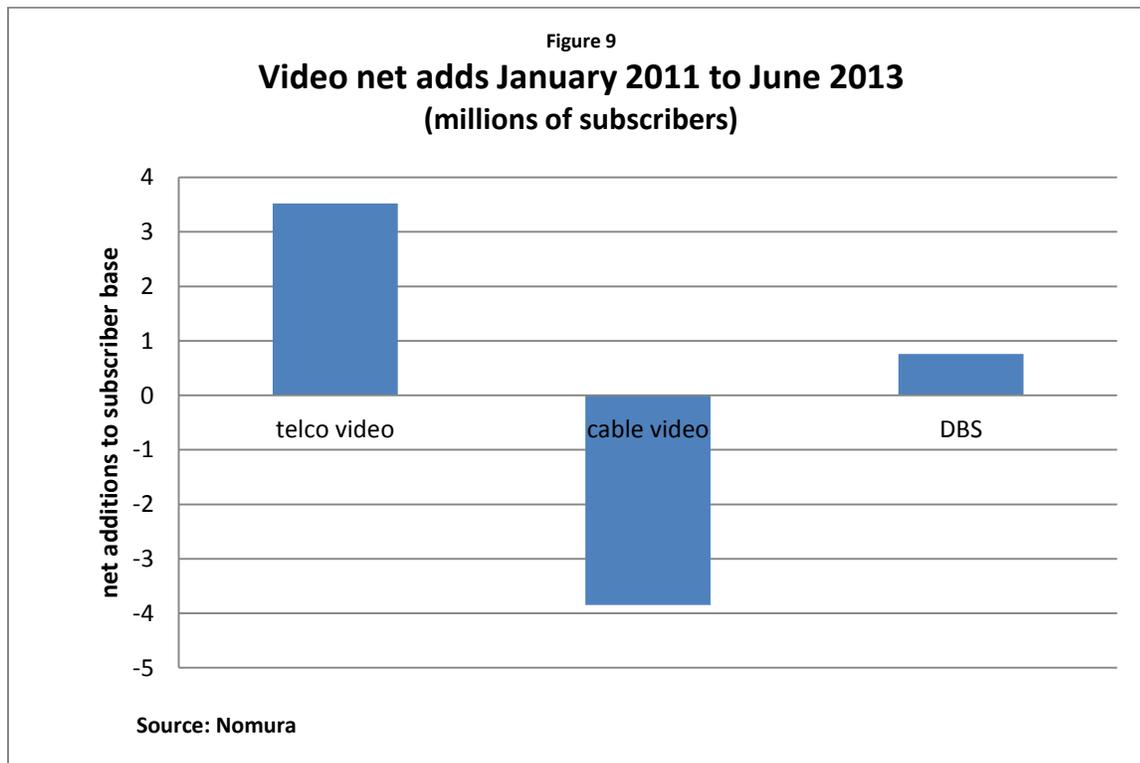
²⁶ *Ibid.*

²⁷ We discuss the impact of wireless broadband in detail on pages 37-41.



Cable is also constrained to some extent by ILECs' share gains in video. Nomura statistics show that since January 2011, cable has lost 3.8 million video subscribers, while the ILECs have gained 3.5 million

video subscribers, and DBS has gained 0.8 million.²⁸ Of the ILEC video gains, AT&T's U-verse had the majority at nearly 2 million, and FIOS captured 1.5 million. Indeed, an August 2013 report by Moffett Research expresses concern about the welfare of Cablevision, which is the cable incumbent that has the greatest overlap with FIOS.²⁹ There is also finally a perception that over-the-top (online) video will begin to impact MVPDs (multichannel video programming distributors). An Oppenheimer report in July predicted that consumers will start dropping pay-tv at the rate of 1% of households per year, and then ramping up gradually.³⁰



That is not to say that the ILECs' prospects are entirely rosy. They are losing subscribers massively in the voice market³¹ where they are providing a service most consumers no longer desire but which regulators force them to offer. As we discussed earlier, running a circuit-switched network at 30% penetration is very costly. That capital could be redeployed if the ILECs were allowed to switch over completely to an IP-based infrastructure on which voice, data, and video revenues could cover the shared cost of the IP infrastructure that supports all three services.

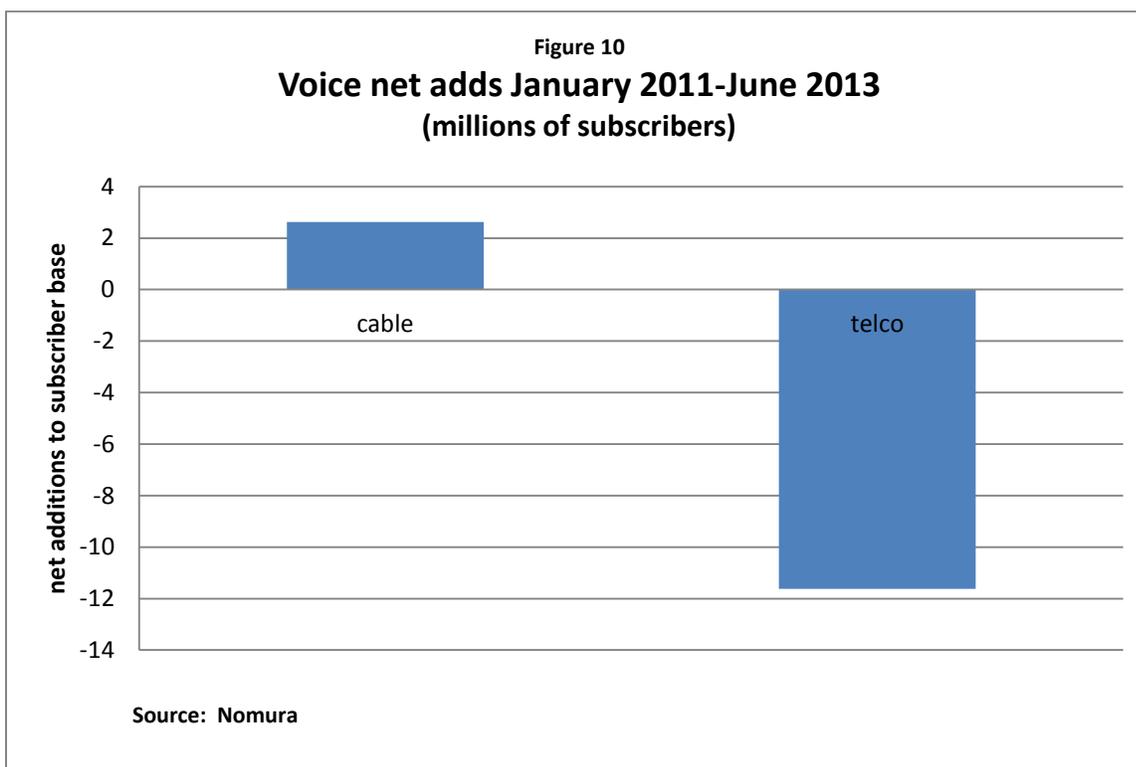
But even here, the ILECs' loss is only partly the cable industry's gain. Of the 11.6 million lines lost by the ILECs, only 2.6 million were picked up by cable VOIP. The rest went to wireless.

²⁸ McCormack, "2Q13," Nomura, figure 1, p. 2.

²⁹ Craig Moffett, "U.S. Telecom and U.S. Pay TV: The FIOS Effect," Moffett Research LLC, August 14, 2013, p. 1.

³⁰ Tim Horan, "2Q13 Preview," Oppenheimer Equity Research, July 16, 2013, p. 1.

³¹ McCormack, "2Q13," Nomura, figure 3, p. 3.



These data negate the allegation that cable is about to become a monopoly. Even if the ILECs vanished, cable would still face competition from wireless and/or satellite in all the services cable offers—video, data, and voice. That means that cable would not be in a position to enjoy the economics of 100% penetration, and would not be able to reduce prices to reflect such economics.

We highlight this point because it is important to understand that regulators can't simply create a lower-cost cable bundle by turning cable into a fixed-access monopoly and then attempting to price-regulate it. For one thing, cable has never had a COLR obligation. While various localities have demanded that cable networks cover their entire franchise areas, cable has been able to select the areas in which it sought franchises. While cable passes most U.S. homes, it does not pass all of them.

Nor does cable have anything close to 100% penetration of all U.S. housing units.³² Indeed, cable never was priced for 100% penetration, because it never reached anything close to that level. Cable video penetration of housing units peaked at about 68% in 1998 and was at about 42% in 2012. Cable-modem penetration of housing units in 2012 was about 38% and cable VOIP penetration was at about 20% of U.S. housing units.³³

³² Because of the way the FCC reports the data in its MVPD-competition reports, we use all U.S. housing units, rather than households, as “homes passed” to report penetration levels.

³³ FCC, *Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, Reports #7-#15 for housing units (these reports are hereafter referred to as FCC, *Video Competition* released ...), NCTA website for cable video subscribers, and FCC *Internet Access* as of June 2012 for cable-modem penetration.

Where cable does provide coverage, it faces competitive alternatives in addition to the ILECs. Satellite is cable's greatest video competitor. However, over-the-top-streaming, some of it over mobile wireless, is gaining a foothold. Some consumers rely entirely on mobile-wireless broadband and many use it along with fixed broadband.³⁴ Sandvine's latest *Global Internet Phenomena Report* shows that real-time entertainment accounts for about 47% of peak-time downstream traffic on North American mobile Internet-access networks.³⁵

That trend is likely to increase as consumers migrate to higher mobile speed via LTE. NTIA's *U.S. Broadband Availability: June 2010-June 2012* indicated that 79% of Americans had access to mobile broadband speeds of 10 Mbps (megabits per second) or higher in mid-2012.³⁶ Now that Verizon's LTE deployment covers about 300 million Americans, that number is closer to 95%. With AT&T's LTE deployment reaching 270 million Americans by year-end-2013 and 300 million Americans by mid-2014, that number will be even higher, assuming the two networks do not overlap completely. And, of course, that means that at least 95% of Americans will have access to at least two competing mobile wireless broadband networks within a year. Once T-Mobile and Sprint complete their LTE buildout to the roughly 225 and 200 million Americans that they have, respectively, committed to cover, about 60%-70% of Americans will have access to between three and four LTE networks.

These alternatives, which are based on a totally different set of economics, should provide pricing discipline to both cable and ILEC broadband. DBS can cover millions of subscribers with a single satellite, and is thus the ultimate in fixed-cost economics. Its advantage, however, is that it can serve widely dispersed subscribers and thus spread that fixed cost over an enormous geographic area. Mobile wireless, on the other hand, adds capacity incrementally, via technology upgrades, spectrum acquisitions, cell-splitting, and densification. Indeed, the primary constraint that keeps mobile wireless broadband from becoming a competitor to fixed-broadband—one that is able to serve all consumers fully and simultaneously—is lack of spectrum. It does, however, provide a solution to most consumers some of the time, and to some consumers all of the time.

Bottom line, satellite and wireless alternatives would, thus, make it impossible to price cable as if it had 100% penetration even in the absence of ILEC broadband access. Having said that, it clearly is desirable to have the ILECs continue to provide a fixed-broadband alternative to cable. Fortunately, it appears likely that they will do so.

As Figure 7 above shows, the telcos retain nearly 40% of the fixed-broadband market. While they lose share in low-speed DSL, they gain it in fiber-fed broadband, so that their overall share remains essentially stable. In particular, U-verse not only refuses to wither away, it is the fastest growing fixed-broadband technology. Of the 7.5 million telco-broadband net adds in 2011-2013, 5.8 million

³⁴ We have not dealt in this paper with over-the-top video as a competitor to MVPD options, because it is still sufficiently early in its development to be difficult to quantify.

³⁵ Sandvine, *Global Internet Phenomena*, 1H 2013, figure 3. On fixed networks it is 68%, per figure 1.

³⁶ National Telecommunications and Information Administration, *U.S. Broadband Availability: June 2010-June 2012*, May 2013, figure 4, p. 9.

were U-verse broadband net adds. That was 0.8 million more than cable gained—despite its larger footprint—and nearly four times as much as FIOS’ 1.5 million net adds.³⁷

In response to the success of U-verse, AT&T has increased its investment, announcing that it would spend an additional \$6 billion to bring U-Verse to 8.5 million more customer locations over three years.³⁸ In total, its goal is to cover 57 million customer locations with U-verse and U-verse IPDSLAM by the end of 2015. AT&T is also investing to increase U-verse transmission speed, to 45 Mbps initially, with a goal of 100 Mbps. AT&T also announced that it would take fiber to an incremental 1 million business locations. Verizon is also still expanding FIOS, not adding new markets, but extending the fiber into additional locations that its fiber now passes.

Indeed, the ILECs are moving their focus away from legacy investment to broadband. *Broadband in America – 2d Edition*, a report prepared by a team led by Bob Atkinson of CITI in 2011, estimated that 53% of the capital investment (capex) made by the three largest ILECs, the Regional Bells (RBOCs), from 2006 through 2011 was spent on their legacy networks and only 47% was spent on broadband.³⁹

The ILEC industry as a whole spent \$154 billion in capex during 2006 through 2011,⁴⁰ while the cable industry spent \$81 billion in capex over the same period.⁴¹ Assuming the RBOCs’ spending on legacy infrastructure is characteristic of the ILEC industry as a whole, we estimate that the ILECs spent \$81 billion on legacy infrastructure during those six years, i.e. 53% of \$154 billion. In other words, the ILECs spent nearly twice as much capital investment as the cable companies, and all of that extra capital—and then some—can be accounted for by their spending on their legacy networks.

Having said that, the ratio has improved over time. In 2006, 69% of the ILEC capital was spent on legacy infrastructure and only 31% on broadband. By 2011, 42% was spent on the legacy networks and 58% on broadband.⁴² That is, of course, still far too much capital devoted to plant that is already obsolete, but it is a significant improvement.

Capital expenditures represent only a small part of the picture. In 2012, the ILECs spent roughly \$21 billion in capex, and we estimate that about \$8 billion of that was spent on legacy infrastructure.⁴³ But the ILECs spent far more on operating their networks. In 2012, the ILECs spent roughly \$72 billion

³⁷ McCormack, “2Q13,” Nomura, figure 2, p. 2.

³⁸ AT&T Analyst Conference 2012, November 7, 2012, slide presentation, slide 112.

³⁹ Robert C. Atkinson, Ivy E. Schultz, Travis Korte, and Timothy Krompinger, *Broadband in America – 2d Edition*, May 2011, table 5, p. 42. The authors note that the report is the authors’ rather than an official CITI publication, because CITI does not author or publish reports.

⁴⁰ Company financial reports for those that are publicly owned and estimates for the remainder.

⁴¹ Industry statistics on NCTA website.

⁴² Atkinson et al, table 5, p. 42. We are making the simplifying assumption that the RBOC legacy capex as % of total capex ratio is typical of the entire ILEC industry.

⁴³ Estimates of total capital and network operating expenditures based on companies’ public financials. Assumes 38% legacy, using a trendline based on the Atkinson data.

in cash network-operating expenses (net-opex) to run their networks.⁴⁴ This figure does not include the additional cash cost of SG&A (sales, general and administration) nor the additional non-cash D&A (depreciation and amortization). This is the annual cash cost of operating the networks themselves.

Two factors raise the ILECs' network-operation cost. One is the higher cost of operating legacy, rather than state-of-the-art plant. FTTH Council, for example, estimates that fiber-to-the-premise brings 20% savings in operating cost.⁴⁵ Another factor is network duplication, i.e., continuing to run a circuit-switched copper network alongside an upgraded IP-broadband network. In the first case, there is the cost of running an inefficient network. In the second case, there is the cost of running two networks—one efficient and one inefficient—in tandem.

Because various ILECs' networks are at different points on the upgrade path, it is difficult to quantify how much of that \$72 billion in annual network-operations cost is spent on inefficiency and duplication. But it is possible to at least attempt to size the issue. Given that half the capital spent in the 2006 through 2012 period was spent on legacy plant—and that far more than half the capex in the earlier period was spent on legacy plant—it is fair to assume that more than half the infrastructure in place today is legacy and less than optimally efficient. That implies that more than half of that \$72 billion, i.e. more than \$36 billion, is being spent to operate legacy plant.

Every percent of savings on operating expense that could be obtained by upgrading that legacy plant would provide an annual saving of roughly \$0.4 billion. A saving of 10% on the remaining legacy plant would free up roughly \$4 billion in cash operating expense. That saving would not only provide funds to be reinvested in further upgrading the networks, the potential for further savings would provide incentive to do so.

If the goal is a competitive wired-broadband infrastructure in the U.S., then the best solution is to free the ILECs from the financial drag of an obsolete—and at times duplicative—network. That would enable them to redeploy their capital into expansion of the fiber-based IP networks consumers clearly want and enhance their ability to compete with cable.

The Google-Fiber model v. the ILEC model

From a regulatory perspective, there cannot be a greater contrast than the treatment of the ILECs v. the treatment of Google, a new entrant to the broadband-access market which has begun to deploy a fiber network in Kansas City (KSC).

In Figure 11, we illustrate the economics of its capital investment, based on estimates provided by Dr. Kirjner of Bernstein Research⁴⁶ in a report that examines the economics of Google's Kansas City

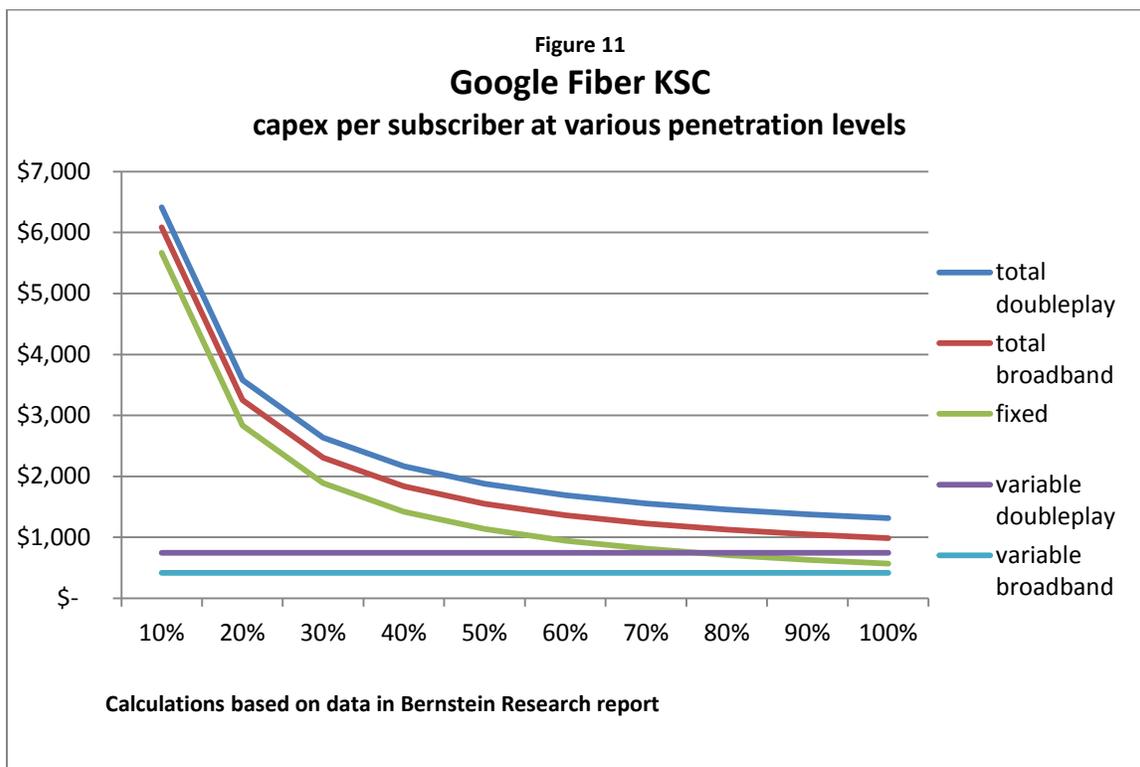
⁴⁴ Operating expenses on carriers' financials include cost of network operations (called cost of revenue or cost of services and products) as well as SG&A or D&A. Our net-opex numbers include only cash cost of network operations, not SG&A or D&A.

⁴⁵ Fiber to the Home Council Americas, *FTTH Progress in North America*, April 2, 2013, p. 10.

⁴⁶ Bernstein, *Google Fiber: A Good Shot at Being Profitable and at (Very) Slowly Boiling the Incumbent Frog*, 05-28-2013. The base case is on p. 9.

venture and concludes that it may become profitable. Dr. Kirjner runs a full financial model in his report, taking into account both operating as well as capital investment (capex), and running the model under various assumptions.

Our graphic is based only on the capex numbers in Dr. Kirjner’s base case, which may or may not ultimately prove to be correct.⁴⁷ Dr. Kirjner himself also provides a more conservative case. We seek only to explain why Google has designed its business model for KSC the way it has, not to attempt to



predict whether the venture will ultimately be profitable. As Dr. Kirjner explains and demonstrates in his models, that depends on the level of penetration Google reaches as well as the mix of its customers taking various services at various prices, with associated operating expenses.

In his report, Dr. Kirjner points out that the Google effort cannot be compared to FIOS for several reasons. On the cost side, one difference is that Google benefits from the technology and cost advances that have occurred since FIOS. In other words, FIOS drove the equipment industry’s learning curve, and Google and others who have followed FIOS can benefit from that. He also points out that Google is not using a unionized workforce, so that it has lower labor cost. It is not building in areas where the fiber has to be buried or placed in underground urban conduits. Google is also benefitting from the city’s facilitating its buildout to minimize delays and to provide access to rights-of-ways and poles.

⁴⁷ Doubleplay customers take both broadband and video, while broadband customers take only that service.

On the demand side, Dr. Kirjner points out that Google's product is somewhat different, in that it offers symmetrical 1 Gbps service, so that it provides not only faster downloading but much faster uploading. He expects more attractive interfaces and better service. He points to Google's partnership with the city and with community organizations. He expects that these factors will help drive higher penetration.

As Dr. Kirjner points out, Google has been able to choose the neighborhoods in which it is deploying, based on its pre-marketing, which has helped it to determine where it might achieve the penetration levels necessary for viability. Community groups in some cases conducted presubscription drives to reach the minimal subscription levels that Google required in order to deploy in a neighborhood.

All of the points that Dr. Kirjner makes matter, but—from our perspective—it is this last point that is most crucial. Unlike the ILECs, Google has no regulatory obligations. It chose not to provide interconnected VOIP precisely to ensure that regulators would not be able to touch it.⁴⁸ It is using this freedom to create a rational business plan—i.e., it has pre-marketed both to incite interest in its service and to determine where demand lies. It is deploying only to those neighborhoods that it believes will provide adequate penetration levels to bring its costs in line with its projected revenues.

Contrast that model with the ILEC broadband deployment model. Let us forget for the moment the extraordinary level of welcome with which KSC has greeted Google, and focus on the basics:

- Unlike the ILECs, Google is building a single network—it does not have to provide a duplicate copper-circuit-switched network. Indeed, it is allowed to avoid providing voice service even on this network.
- Unlike the ILECs, Google can pick its “fiberhoods.” It can choose the neighborhoods whose cost characteristics are inherently most appealing (overhead rather than underground wiring, for example) and where it has predetermined that there is adequate demand.
- Unlike the ILECs, Google does not have to stand ready to serve all housing units, occupied or not, interested in its service or not.

Clearly, Google's model was not created to provide universal service. It is easy for such a model to avoid serving poor neighborhoods and such a model inherently avoids serving high-cost neighborhoods, unless it can price higher for its service to cover its cost in those. It is certainly not a COLR model.

Yet, even though it avoids these expensive obligations and even with the advantage of having had FIOS take the worst pain out of the fiber-access learning curve, it is a very expensive model, as our graphic points out. As Figure 11 above shows, even at 40% penetration (the level Dr. Kirjner estimates FIOS has reached), the total capital cost invested in each Google double-play subscriber is nearly \$2200, or, alternately, in each broadband subscriber more than \$1800.

⁴⁸ Alyson Raletz, “Google considers but drops plans to include phone service, too,” *Kansas City Business Journal*, December 4, 2012.

Whether or not Google's KSC venture turns out to be profitable is unlikely to matter much to Google's financial well-being.⁴⁹ Dr. Kirjner's base case indicates an estimate that Google will spend roughly \$127 million in capital over five years on the KSC project. That is not a negligible amount to most businesses, but it is minimal to Google, which had \$48 billion in cash on its balance sheet at year-end 2012 and generated about \$10 billion in net free cash flow.⁵⁰

The carriers who provide America's broadband infrastructure invest more than 500 times Google's total KSC investment each year. Over the last decade, the ILEC networks have spent \$21-28 billion each year, cable networks have spent \$10-\$15 billion each year, and the wireless networks have spent \$19-\$26 billion each year for capital investments.

When such large amounts of private capital have to be raised, it matters that it not be wasted on obsolete plant. Yet, as the Atkinson study indicates, the ILECs spent more than half their capital expenditures during 2006 through 2011 on legacy plant, and that trend continues, albeit at a decreasing rate. ILECs also spend many billions of dollars each year in network-operating funds on legacy plant.

President Obama has set out a goal of \$5 billion to be spent to upgrade key institutions to gigabit speed. That has created a furious debate in Congress, between those who would like to see such an effort funded out of the Universal Service Fund (USF) and those who do not believe that is an appropriate source of funds. Perhaps, rather than raising the price of consumers' services via a higher USF levy to find \$5 billion for gigabit projects, regulators might simply phase out those rules that waste more than that amount in private capital and operating expenses each year. Freeing up those funds to be redirected by the ILECs to their broadband deployment would be a far more effective solution.

The *Telecom Act of 1996*, platform competition, and consumer choice

To understand how important the ability to innovate freely is in creating competition, one merely has to look at competition since the early 1990s, especially since the *1996 Act*. The most effective competition has come from technological evolution that enabled multiple platforms with different product-characteristics and economics to compete with each other. They, in turn, then forced each other into cycles of further innovation.

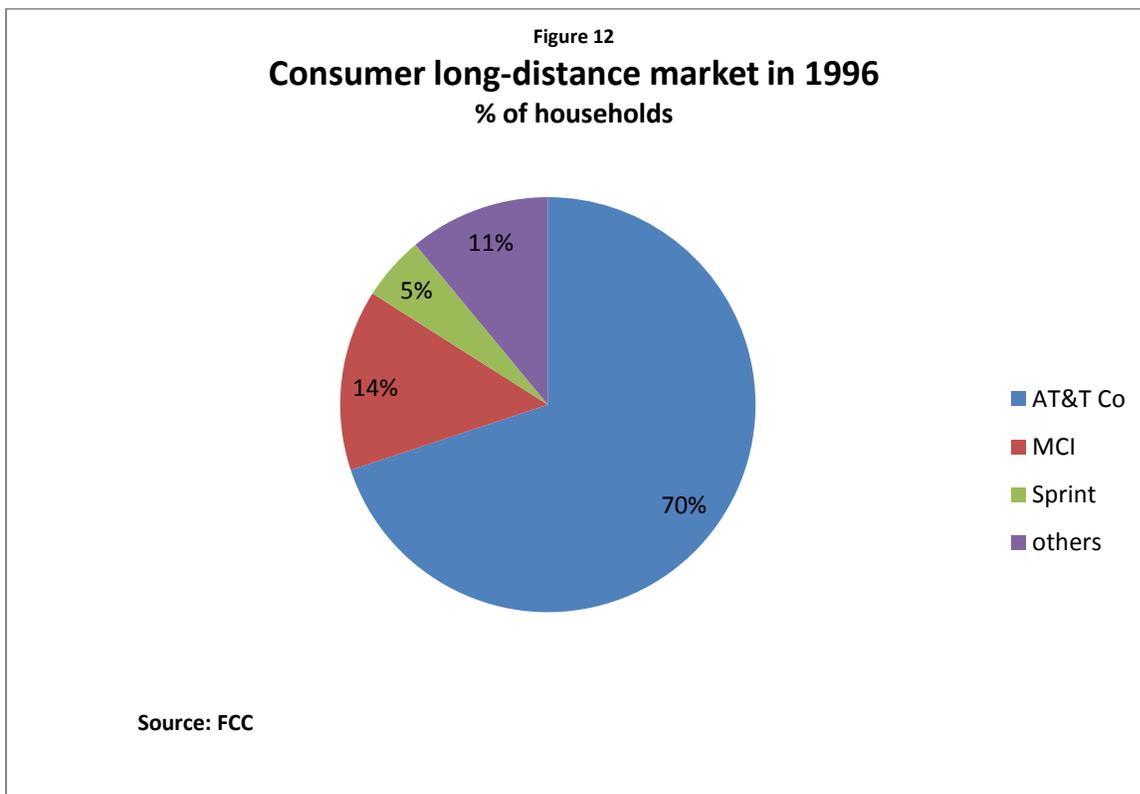
When the *Telecommunications Act of 1996* was enacted, there were hints of incipient competition in both the long-distance and video-distribution markets as a result of new technologies. Local

⁴⁹ Google is also taking over an existing fiber network in Provo UT, where it will pay to upgrade the network, but will not reimburse the city for its original investment. Google has also reached an agreement to deploy in Austin TX. Matthew S. Schwartz, "Struggling Provo Municipal Network Gets Boost from Google, Mayor Says," *Communications Daily*, April 22, 2013, p. 4.

⁵⁰ Google Inc., financial release for Q4 2012. We are including marketable securities with cash. We are defining net free cash flow as net income plus depreciation and amortization minus capex. If we also added back non-cash compensation of \$2.7 billion, net free cash flow would be \$13 billion.

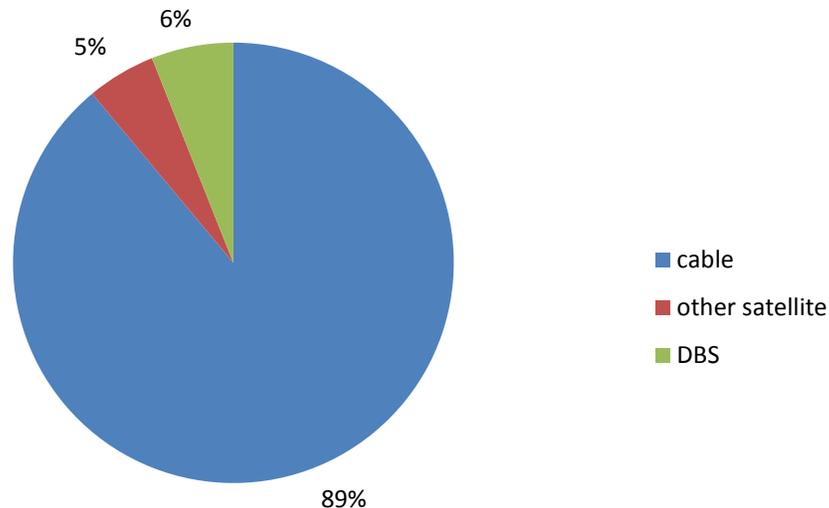
telephony was still essentially a monopoly. Although wireless was thriving, it was seen essentially as a purely mobile service.

The roots of long-distance competition had begun to take hold by 1996. Thanks to first microwave and then fiber technologies, the economics of long-distance communications had changed. Microwave made lower density routes economic, allowing competitors to enter the long-distance industry as early as the 1970s despite their initially low traffic. Fiber, by contrast, made it possible to carry far greater amounts of traffic than had been possible over copper. To some extent, it also had a variable cost component, in that carriers could light up individual fibers as needed and could upgrade capacity on lit fibers by changing out the electronics. Thus, new entrants could develop their customer and revenue base over microwave and change over to fiber once they had adequate demand. By the mid-1980's, MCI and Sprint had a foot-hold in the long-distance market, and Sprint was marketing the value of its fiber network with its classic "you can hear a pin drop" ads. By 1996, AT&T Corp.'s market share had fallen to 70%.⁵¹



⁵¹ FCC, *Statistics of the Long Distance Telecommunications Industry*, May 2003, table 14, p. 28.

Figure 13
MVPD market in 1996: inklings of video competition
(% of subscribers)



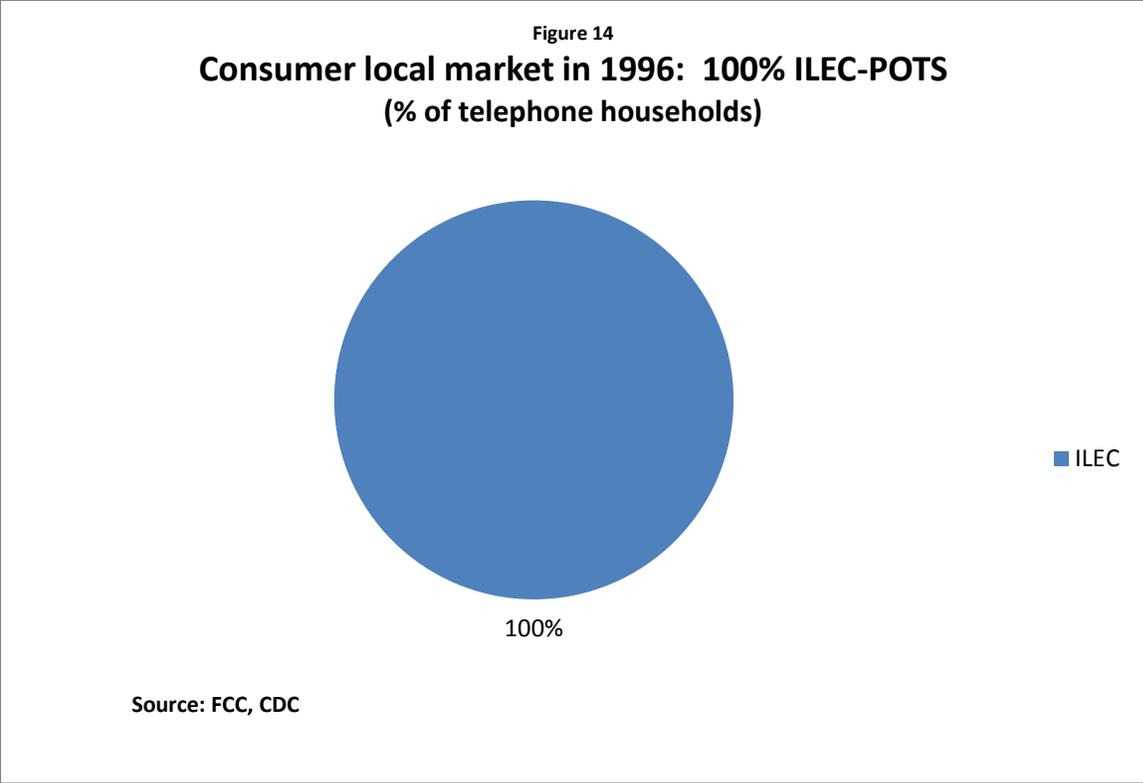
Source: FCC

The video entertainment business was also beginning to be transformed via new technology. By 1996, the cable industry had reason to take satellite competition seriously.⁵² DBS acquired its first customers in 1993 and grew quickly. Unlike earlier satellite competition, which featured large and unsightly dishes that cluttered lawns and provided few channels, DBS offered many channels—DirecTV offered 175 and EchoStar 140—via an unobtrusively small dish.

Consumer local telephone markets, on the other hand, were still monopolies in 1996⁵³. There had been some movement to introduce competition on the business side. But the consumer side, which was characterized by artificially low prices supported by subsidies from other services—created to encourage universal service—had little inherent appeal for competition.

⁵² FCC, *5th Video Competition Report*, released December 23, 1998, table C-1.

⁵³ FCC, *Local Telephone Competition at the New Millennium*, as of December 31, 1999, released August 2000, table 6 shows that CLECs had 1% share of the local market, but those competitors targeted the business market.



The goal of the *Telecommunications Act of 1996*, which passed in this environment of technological transformation, was to increase competition in the communications markets. First and foremost, it attempted to do so by tearing down the artificial walls that had kept competitors out of the wireline telephony and cable markets. Those had been franchised monopolies and the *Act* now allowed entry into those markets. It left information services, into which the Internet falls, almost completely unregulated. It left wireless also largely unregulated.

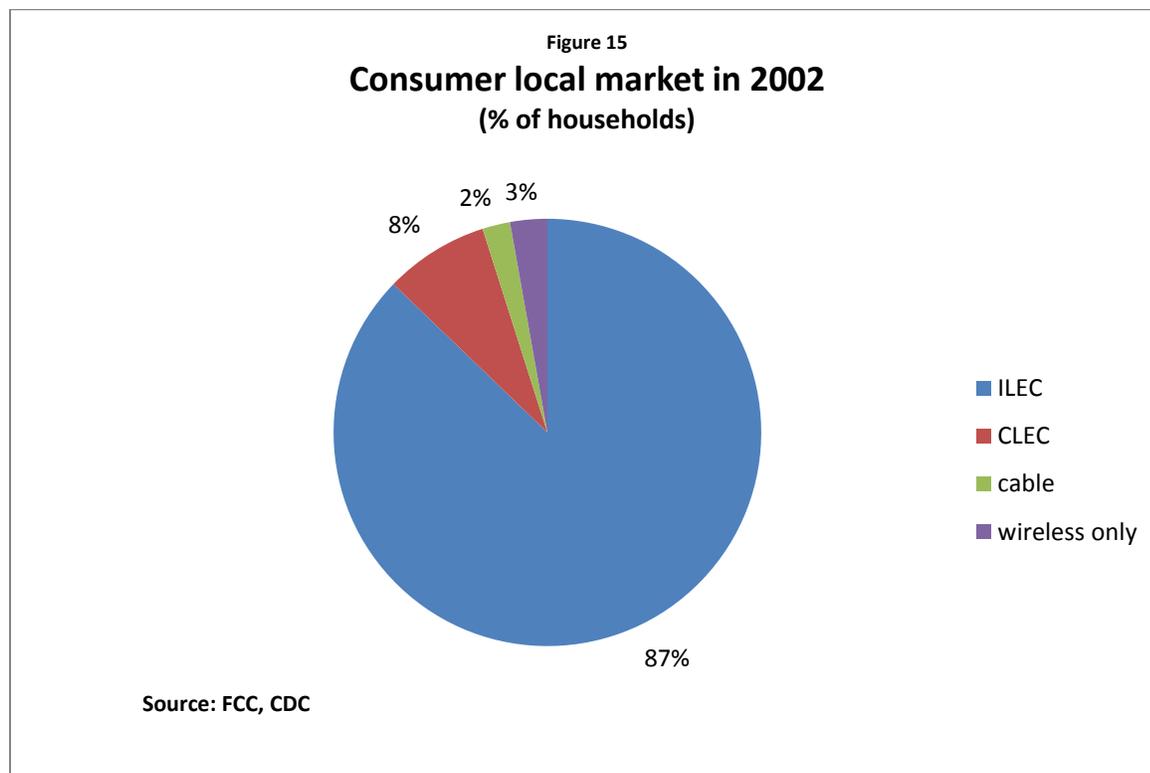
The failure of mandated network sharing

The *Act* took a much more proactive—and ultimately unsuccessful—approach to bringing competition into local telephony. By 1996, the long-distance market was open to competition, with MCI, Sprint, and others vying against AT&T Co.⁵⁴ But AT&T Co still retained 70% of the residential long-distance market in 1996.⁵⁵ On the local side, the RBOCs and other ILECs had monopolies. The *Act* opened all of the ILEC markets to competition, but the focus was on the RBOCs. To facilitate entry into the RBOCs’

⁵⁴ AT&T had originally been a nationwide network providing both local and long-distance service to most of the United States. It was broken up by a consent decree in 1984, and became primarily a provider of long-distance service, while its local operations were split among the seven Regional Bell Operating Companies (RBOCs). In December 2005, it merged with Southwestern Bell (SBC), one of those RBOCs, which had itself already merged with two others, Pacific Bell and Ameritech. We refer to AT&T during 1984-2005 period when it was a long-distance carrier that was in the process of entering local markets as AT&T Co., to differentiate it from the post-2005 AT&T which had merged with SBC. Their SEC filings are listed under AT&T Corp. and AT&T Inc. respectively.

⁵⁵ FCC, *Statistics of the Long Distance Telecommunications Industry*, May 2003, table 14, p 28, measured in share of households. AT&T had 63% of direct-dial InterLata minutes. (Hereafter referred to as FCC, *Long Distance*.)

markets, the Act required them to make their networks available to competitors at regulated prices, via resale and via unbundling. In return they would be allowed to enter the long-distance market, immediately out-of-Region and then in-Region once their local markets were deemed competitive.



Over the next several years, the FCC and states established rules and rates for resale and unbundling, and oversaw interconnection agreements. By the end of 2002, RBOC markets in 35 states covering 75% of RBOC access lines had been deemed sufficiently competitive to allow the RBOCs to enter long-distance, largely based on competition in the business markets.⁵⁶ On the consumer side of the local market, the picture was still fairly bleak, although the long-distance side had become much more competitive. By 2002, the competitors had gained only 10% share of the consumer local market. About 8% share went to CLECs via UNEP (unbundled network element platform), which in 2002 was the source of most residential competition. However, cable companies had begun to enter the market as well, taking roughly 2% share of the market.⁵⁷ Roughly 3% of households had cut the cord.⁵⁸

The Act provided two sets of prices under which CLECs could lease the ILECs' networks. Resale was discounted by the amount of cost that the ILECs would avoid by not retailing service to their customers themselves. Resale discounts ranged at 10%-20% below retail in most states. Unbundling,

⁵⁶ FCC, *Long Distance*, 2003, table 12, p. 24.

⁵⁷ FCC, *Local Competition* as of December 2002, tables 2, 4, and 5.

⁵⁸ CDC, *Wireless Substitution* as of July-December 2006, released 5/14/2007.

which made the individual elements of the ILEC networks available to CLECs either separately or combined into UNEP, provided deeper discounts in many cases.

UNE (unbundled network element) prices were set by each state under the FCC's TELRIC (total element long run incremental cost) standard. UNEP allowed CLECs to lease the combined loop, switching and transport without having to provide any facilities of their own. UNE and UNEP rates varied from state to state, and within the states there were also several different loop rates, with the most urban areas having the lowest loop rates and the most rural having the highest. In November 2002, the national average UNEP rate was \$20.28, with a range of \$12.05 in Indiana to \$44.02 in West Virginia.⁵⁹

The economics of UNEP were problematic to both ILECs and CLECs. For example for BellSouth, the average UNEP rate was \$23.10. According to the FCC's ARMIS database, which tracked average embedded network costs, BellSouth's cost per line was \$33.94. Its average consumer retail revenue per line was \$30.52. Thus, BellSouth was providing UNEP at a \$10.84 discount from its average embedded cost and at a \$7.42 discount from its average consumer retail price, which in turn was \$3.42 below its embedded cost. From the perspective of the CLECs, this looked like a line costing \$23.10 with a gross margin of \$7.42 below the \$30.52 retail price against which they had to compete. That \$7.42 had to cover their own cost of marketing, customer service, billing, etc. as well as any price discount they might offer against BellSouth. Needless to say, these economics were not favorable to either party. The consumer retail price AT&T Co. offered against BellSouth was \$30.29.

BellSouth was the most extreme case, because its average consumer retail price was the lowest among the RBOCs. UNEP discounts from retail at other RBOCs averaged from \$17.26 at Bell Atlantic to \$21.96 at Ameritech. AT&T Co.'s retail price in these cases was \$28.28 against a Bell Atlantic retail price of \$36.96 and at Ameritech \$28.40 against \$36.00. That left AT&T Co. with \$8.58 to cover its own costs in the Bell Atlantic case, and \$14.36 in the Ameritech case.

In all RBOC territories, UNEP rates were deeply discounted from the embedded costs defined in ARMIS. For example, the Ameritech ARMIS embedded cost was \$28.60. Obviously, the below-cost UNEP discounts were painful to the RBOCs, and they did not rush to welcome the CLECs. But UNEP prices generally did not provide enough margin for profitable operations for the CLECs either.

Bottom line, UNE-based competition failed in the consumer market, even though it provided CLECs with the opportunity to enter the local market at prices below the incumbents' own cost, because retail prices in the consumer market were kept artificially low by regulators to promote universal

⁵⁹ Anna-Maria Kovacs, "The Status of 271 and UNE-Platform in the Regional Bells' Territories," Commerce Capital Markets, November 8, 2002, exhibit 1, p. 10. All of the UNE rates are from this paper, pages 10-22.

service. Simply put, there was not enough margin in consumer prices to sustain the CLECs.⁶⁰ The poor economics combined with regulatory uncertainty to ultimately doom UNEP.⁶¹

Indeed, while AT&T Co. also pursued regulatory avenues to attempt to obtain favorable UNE prices, its largest investment was in the acquisition of incumbent cable systems. It acquired TCI in 1999 and MediaOne in 2000. One of its goals was to run IP over these cable networks, as it explained in the 1998 AT&T Co. 10K in which it noted the pending TCI acquisition.⁶² AT&T Co. sold its cable operations in 2002 to Comcast, which did become a provider of VOIP once that technology matured. Comcast also provided broadband Internet access, as AT&T Co. had done over its cable network.

Inter-platform competition succeeded

In contrast with the UNEP-dependent local telephony market, by 2002 competition was flourishing in the long-distance, video, and Internet-access markets which relied on inter-platform competition. Competition between technology platforms had two critical advantages. It could bring new capabilities and economics to bear. And it did not have all the uncertainties that accompany the regulatory process, in which rules can be litigated and, perhaps, overturned by courts, often after long delays.

On the long distance side competition had flourished, as much among the traditional IXCs as between the IXCs and the RBOCs. By 2002, AT&T Co.'s share had fallen to 37% of consumer households, from 70% in 1996.⁶³

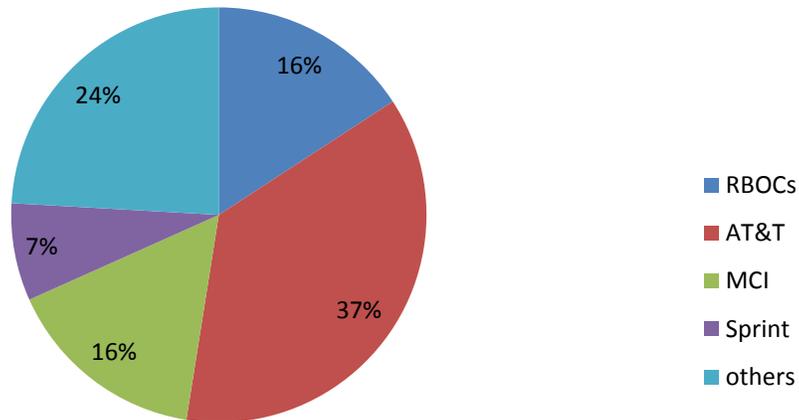
⁶⁰ The business market, where retail rates were kept artificially high to cross-subsidize the consumer market, was much more appealing. AT&T and WorldCom acquired TCG and MFS, respectively, to jump-start their entry into the business CLEC markets.

⁶¹ The FCC's rules were litigated repeatedly from 1996-2006. UNEP was ultimately found by the D.C. Circuit to no longer be necessary in many markets and its phase-out began in 2005 with the Triennial Review Remand Order (TRRO), as we discuss below.

⁶² TCI (including the @Home broadband service) was acquired by AT&T Co. in March 1999. AT&T Co.'s 1998 10K indicated that it would focus on providing service over its new cable plant as well as via a joint venture with Time Warner Cable, initially using circuit-switching but moving to IP beginning in 2000 (AT&T Corp. 10K for 1998, pp. 3,4,13). AT&T Co. acquired MediaOne in June 2000. AT&T Co. restructured in 2000 and the cable operations--now named AT&T Broadband--became one of its tracking stocks. AT&T Broadband was spun off and merged into Comcast in November 2002 (AT&T Corp 10K for 2002, p. 1).

⁶³ FCC, *Long Distance*, 2003, table 14, p. 28.

Figure 16
Consumer long-distance market in 2002
 (% of households)



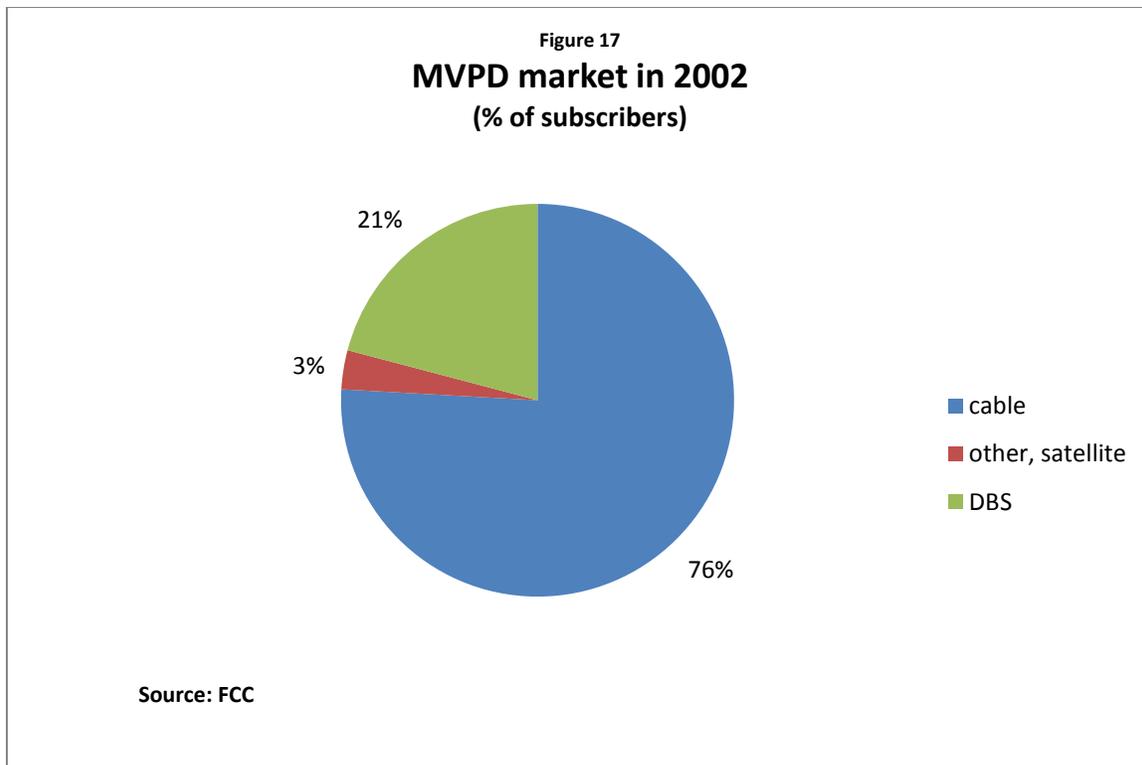
Source: FCC

The video market was also becoming more competitive by 2002, thanks to steady gains by DBS. While the phone companies were free to enter the market, they had made almost no inroads at this point as overbuilders. AT&T had, of course, entered as an incumbent, by buying out TCI and MediaOne in 1999 and 2000. DBS, however, was making an impact. Between 1996 and 2002, DBS had increased its market share from 6% to 21%.⁶⁴

Cable systems paid attention to the energetic new competition and responded by installing fiber-to-the-node in their networks and upgrading their systems to digital, greatly increasing their own capacity. In 1996, 77% of cable systems, covering 98.2% of subscribers, had at least 30 channels and 16% had more than 54 channels. By 2001, cable systems averaged 170 or more channels.⁶⁵

⁶⁴ FCC, *7th Video Competition*, released January 8, 2001, table C-1, p. 106 and *10th Video Competition*, released January 28, 2004, table B-1, p. 115.

⁶⁵ FCC, *5th Video Competition*, released December 23, 1998, pp. 11-13 and tables B-3 and B-4, and *10th Video Competition*, released January 28, 2004, table 3, p. 21.

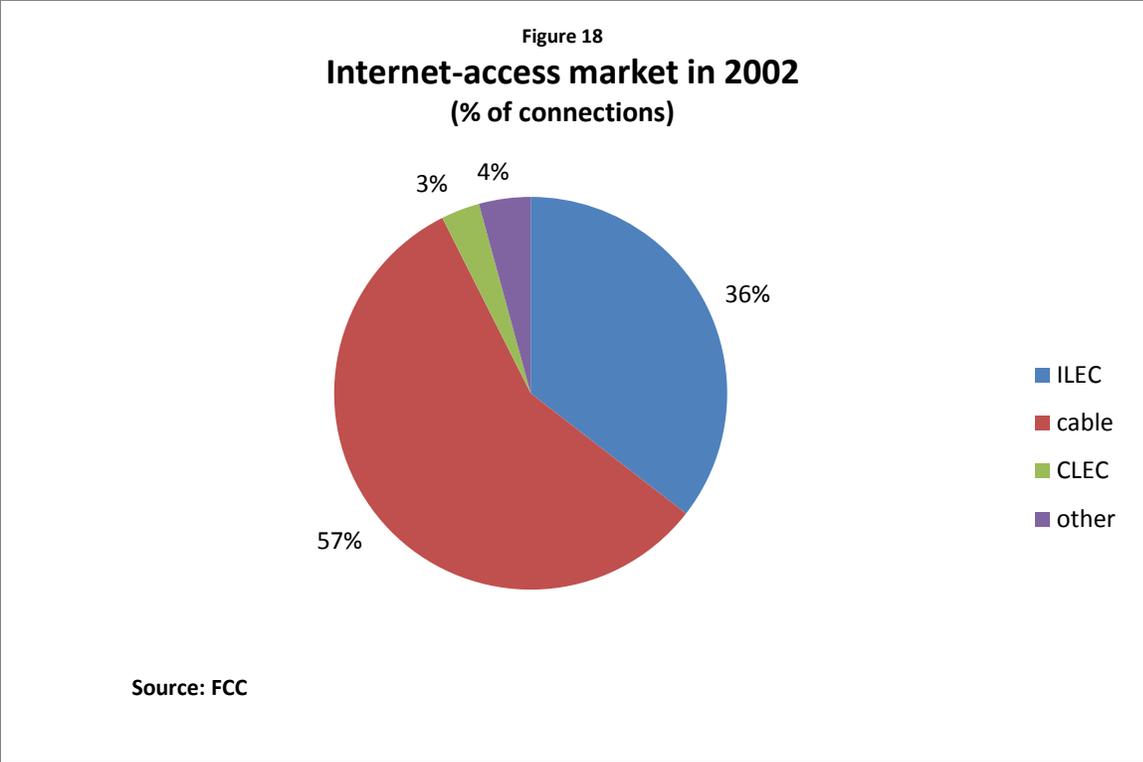


One of the incidental benefits of cable system upgrades was excess capacity, some of which could be used to provide Internet access. In 1997, the first roughly hundred thousand cable modems were installed. Responding, in turn, to the threat from the cable industry, phone companies began to deploy DSL (digital subscriber line) as their version of broadband Internet access. By the end of 1999, roughly 1.4 million cable modems and roughly 0.4 million DSL modems were installed.⁶⁶

Indeed, the wired market that was by far the most competitive in 2002 was the new broadband Internet-access market. Cable had a head start, but the ILECs quickly entered the market. So did some CLECs, using unbundled copper loops as a whole or via the more-deeply-discounted line-sharing, but their share of the market was very low. By the end of 2002, the market was split 57/36 between the cable companies and ILECs, with CLECs and satellite also taking small shares.⁶⁷

⁶⁶ FCC, *Internet Access* as of December 31, 2000, table 1.

⁶⁷ FCC *Internet Access* as of December 2002, table 5.



While competition in the Internet-access market was robust, subscribership levels were still low. There were only 20 million broadband Internet-access connections in 2002.⁶⁸

The wireless market, in the meantime, had grown and become very competitive. It was also beginning to compete with wireline. Wireless subscribers had more than tripled between 1996 and 2002, from 44 million to 141 million.⁶⁹ Cell sites had nearly quintupled in that time and the industry had moved to CDMA and GSM, second generation technologies (2G) capable of data as well as voice transmission.⁷⁰ Price per minute had declined from \$0.38 in 1996 to \$0.11 in 2002.⁷¹ All major carriers were offering all-distance plans with buckets of minutes, a concept AT&T Co. had introduced in 1998. In 2002, 95% of consumers had access to three or more wireless carriers and 83% had access to five or more.⁷² The service was penetrating the consumer market to the point that by the first half of 2003, just under 3% of households had cut the cord and were wireless-only.⁷³ Wireless had begun to offer data as well as voice service.⁷⁴

In December 2001, the FCC opened the Triennial Review to reconsider some of the rules the agency had made for opening the RBOC markets. The FCC issued the *Triennial Review Order (TRO)* in August

⁶⁸ FCC *Internet Access* as of December 2002, table 5. Broadband is defined as connections at a minimum of 200 kbps in at least one direction.

⁶⁹ CTIA, *Wireless Survey*.

⁷⁰ FCC, *8th Wireless Competition*, table 7.

⁷¹ CTIA, *Wireless Survey*.

⁷² FCC, *8th Wireless Competition*, table 5, p. D-9.

⁷³ CDC, *Wireless Substitution*, July-December 2006, released 5/14/2007, table 1.

⁷⁴ FCC, *8th Wireless Competition*, table 2, page E-3.

2003⁷⁵ and, after review by the U.S. Court of Appeals for the District of Columbia Circuit, the *Triennial Review Remand Order* (TRRO) in February 2005.⁷⁶ The new rules ultimately eliminated UNEP, eliminated unbundling of packetized switching, and largely eliminated unbundling of fiber and hybrid-fiber loops, while continuing to permit some unbundling of copper loops.

What had become apparent by 2003 was that the most successful competition was intermodal, i.e. competition between network platforms that was induced by technological evolution. In none of the markets in which competition was flourishing—long distance, cable, or wireless—were the incumbents forced to make their networks available to their competitors under the draconian terms that prevailed in the RBOC local markets.⁷⁷ Indeed, cable networks did not have to share or interconnect their networks at all.

By 2002, wireless had evolved tremendously, but was still a complement rather than competitor to landline telephony. However, cable had become a competitor. Cable, stimulated by DBS, had upgraded its video capacity enormously, and that upgrade had also enabled it to compete over its own platform very effectively for broadband Internet access. Voice competition over the cable platform via VOIP was now also beginning. This, in turn, had stimulated the phone companies to deploy DSL. However, to compete fully with cable in the broadband market and, ultimately, in the video market, the ILECs would need to deploy fiber much closer to the home. That would require enormous investment that could not be justified as long as the threat of unbundling the newly-built network remained.

The FCC's goal in 2003 was, as the Commission's goal had been since passage of the *Act*, to increase competition in all the communications markets. This FCC majority's belief was that the most sustainable competition would be facilities-based. The hope was that the RBOCs would invest in upgrading their networks if they did not have to lease them to competitors at regulated prices that amounted in many cases to marginal cost.⁷⁸ That would enable them to compete with cable in both the broadband and video markets. Thus, the new rules exempted fiber and hybrid-fiber loops from unbundling, as well as packet-switched facilities and services.⁷⁹

The strategy was effective, although it came somewhat late in the day, relative to cable's broadband upgrades. By the end of 2005, Verizon was fully committed to FIOS, its fiber-to-the-home deployment, and announced that it had passed 3 million homes. Verizon ultimately decided to pass 18 million homes with FIOS, came close to that by 2010, and has now largely completed the buildout. The venture was expensive, but worthwhile. Like the other ILECs, Verizon is losing DSL customers. However, it continues to gain FIOS subscribers. The July 16th Nomura report referenced above in

⁷⁵ The Order was voted on February 20th and issued on August 21, 2003. The NPRM had been initiated on December 12, 2001.

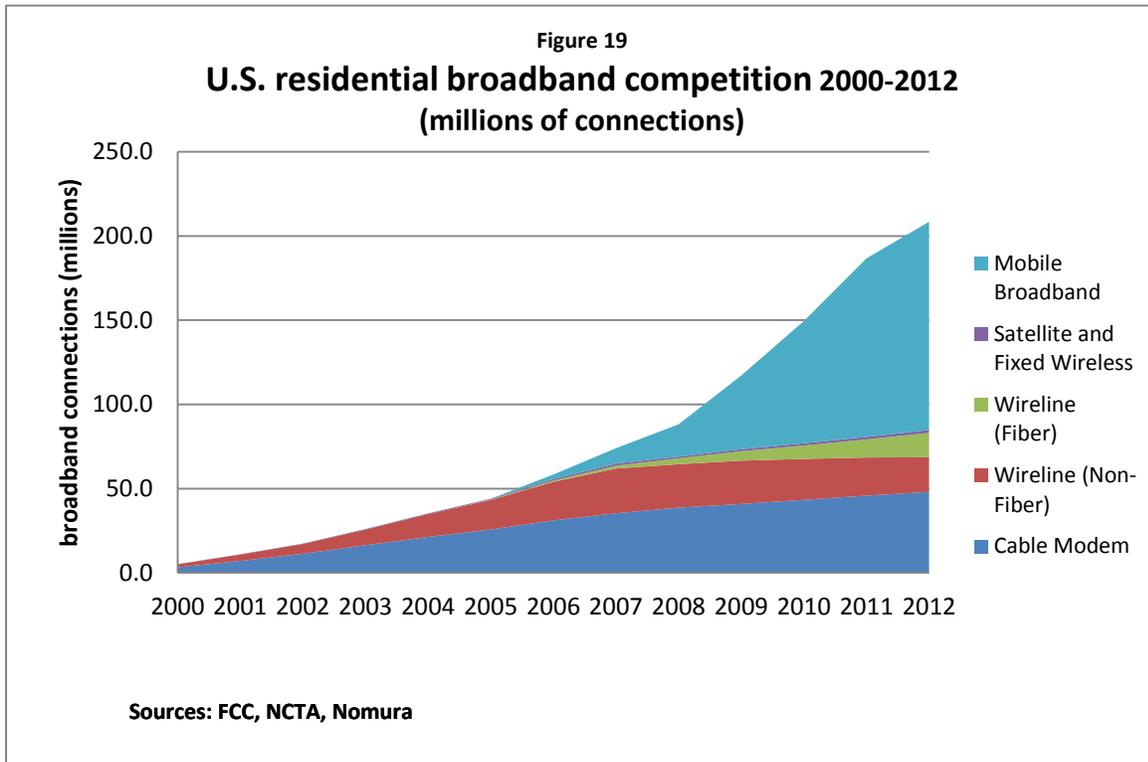
⁷⁶ Voted December 15, 2004, issued on February 4, 2005.

⁷⁷ Long distance and wireless had to interconnect and carry traffic for others.

⁷⁸ Rates were set by states and varied enormously from state to state, depending on their interpretation of the methodology the FCC had set, which was TELRIC (total element long-run incremental cost).

⁷⁹ FCC, News Release on February 20, 2003: *FCC Adopts New Rules for Network Unbundling Obligations of Incumbent Local Phone Carriers*, p 1.

relation to Figure 6⁸⁰ shows that in 2011-2013 Verizon added 1.5 million FIOS subscribers while it lost 1.1 million DSL subscribers. AT&T made its own commitment, to a fiber-to-the-node architecture it called U-verse. Like Verizon, AT&T continues to lose low-speed DSL customers but is gaining high-speed U-verse customers.⁸¹ Nomura's figures show that AT&T gained 5.8 million U-verse subscribers and lost 5.2 million DSL subscribers during 2011-2013. AT&T has sharply accelerated the process of upgrading its DSL lines to U-verse as well as increasing the speed of the lines that are deployed.



Deutsche Bank's August 2nd report shows that Verizon and AT&T now both have low-30s% broadband penetration of homes passed with FIOS and U-verse. That is about equal to Charter's penetration and is gaining rapidly on Comcast and Time Warner Cable.⁸² Morgan Stanley, on the other hand shows that FIOS' penetration is 40%.⁸³

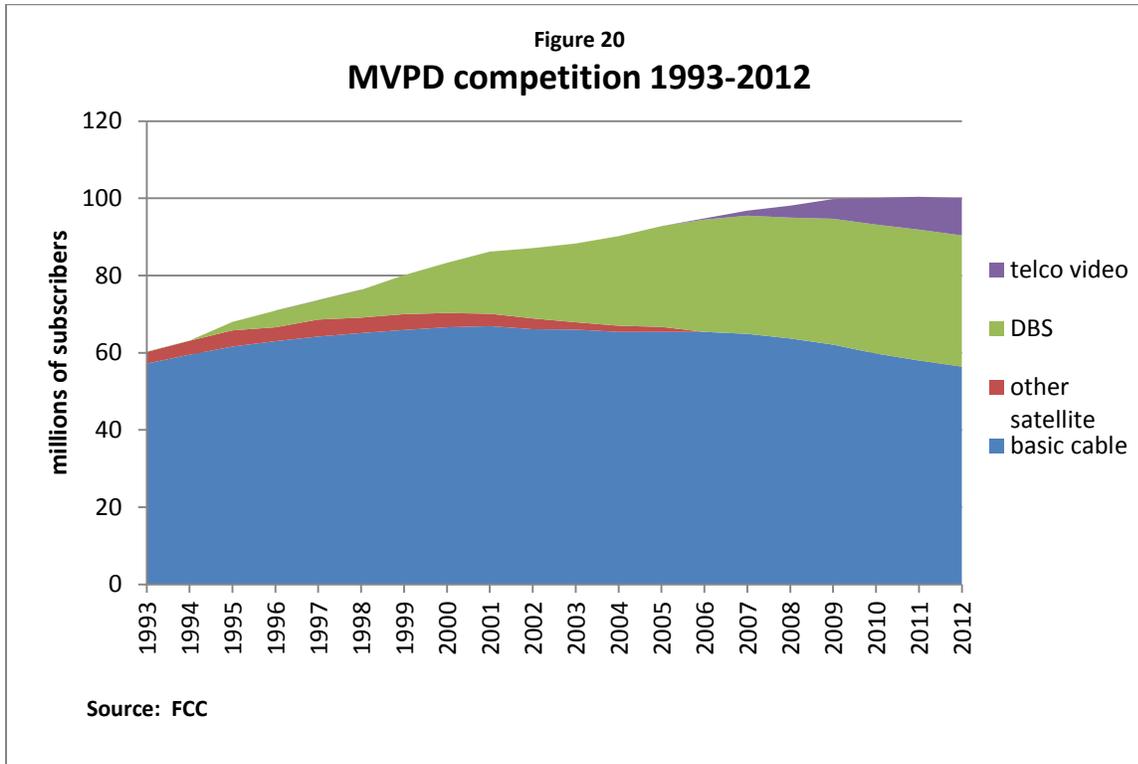
⁸⁰ McCormack, "2Q13," Nomura, figure 2.

⁸¹ U-verse does not carry fiber all the way to the home, but to a neighborhood node.

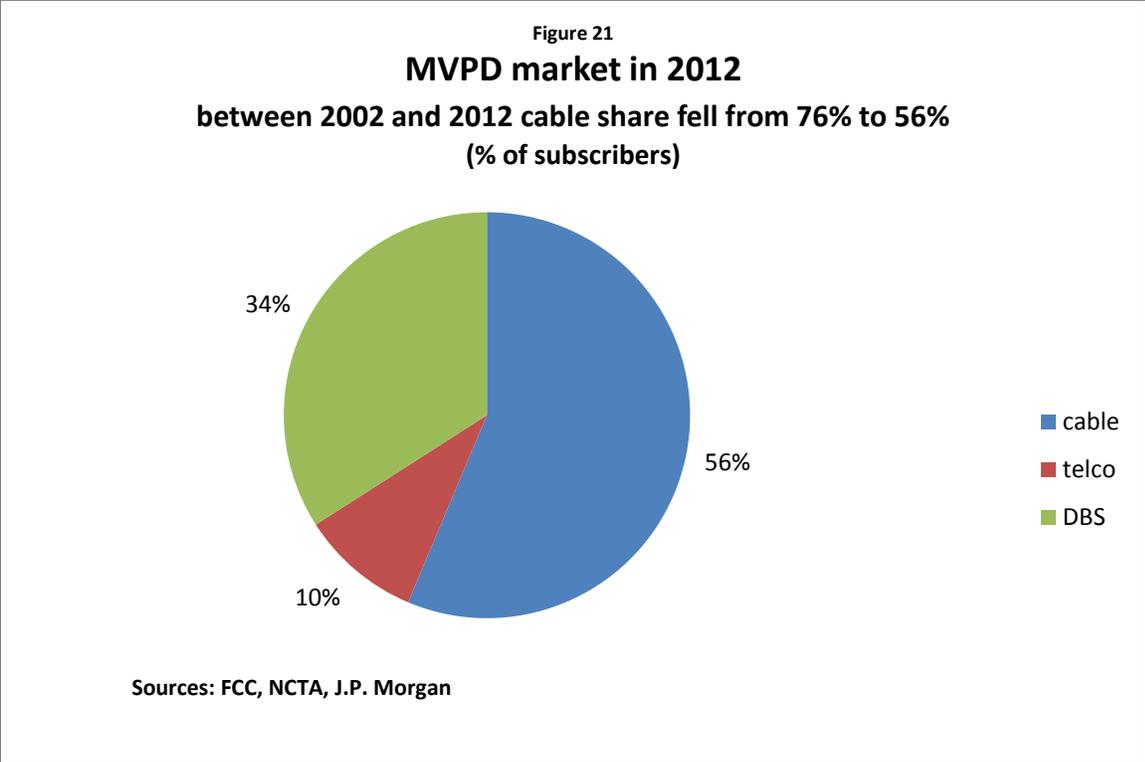
⁸² Doug Mitchelson, *Time Warner Cable*, Deutsche Bank Market Research, August 2, 2013, figure 27.

⁸³ Simon Flannery, *Verizon Communications*, Morgan Stanley, July 19, 2013, exhibit 1, p. 5 (7.208 million subs out of 18.032 homes passed).

Post-Triennial, thanks to their network upgrades to FIOS and U-verse, respectively, Verizon and AT&T have also steadily gained video subscribers. By the end of 2012, they had 4.5 million and 4.7 million video subscribers, respectively.⁸⁴



⁸⁴ Horan, *2Q 13 Preview*, Oppenheimer, July 16, 2013, exhibit 13, p. 17.



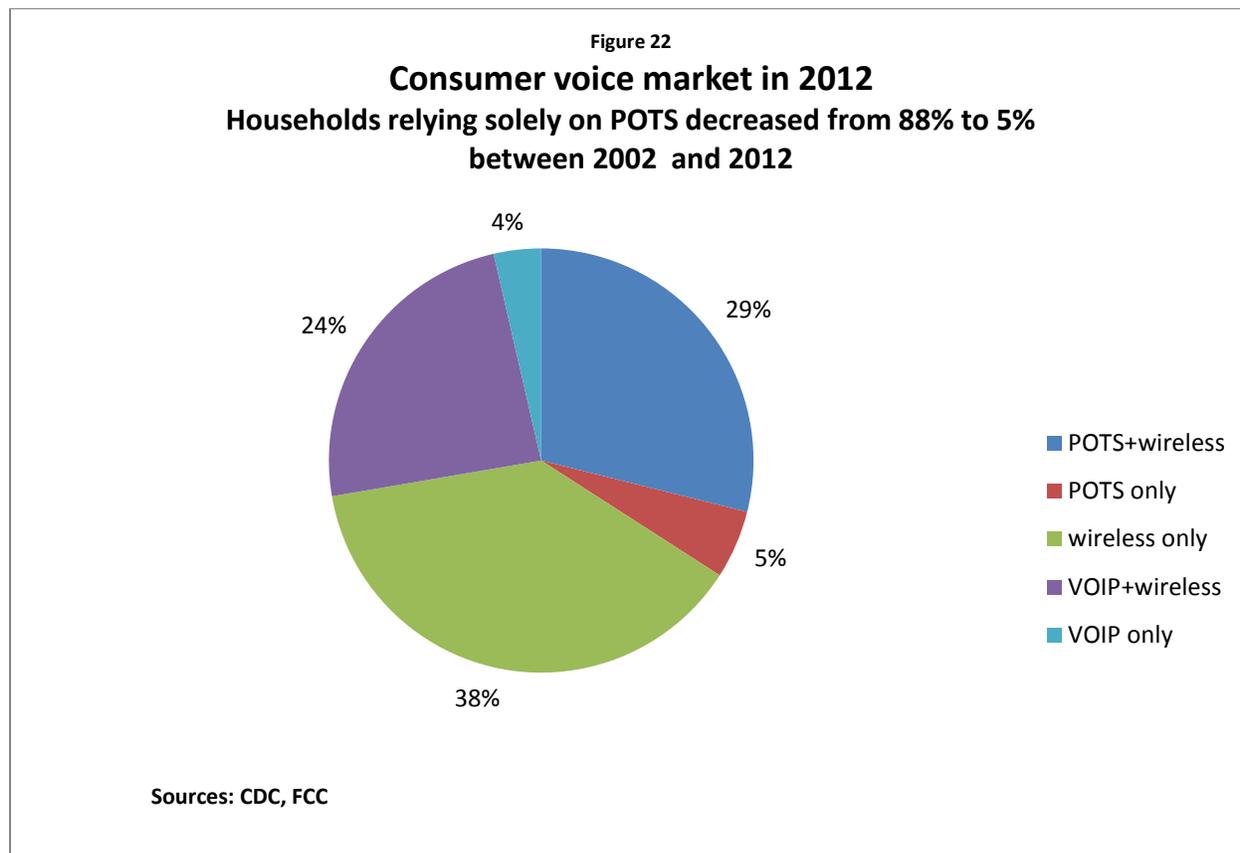
Cable, in turn, has responded aggressively. It has upgraded its network repeatedly to provide higher broadband speeds. It also entered the consumer voice market with a vengeance. As VOIP became operational, it provided cable systems with a technology they could deploy to provide voice service over their own networks. By the end of 2012, cable had nearly 27 million voice subscribers,⁸⁵ i.e. more than a quarter of the consumer landline voice market. Because it is able to provide discounted bundles that include broadband, video and voice, it has an advantage for a considerable segment of the consumer market against competitors that cannot match that offering. FIOS can do so across the board. In many markets, U-verse can also do so. DBS by itself cannot, and in markets where the ILECs cannot provide video, they have teamed up with DBS to offer a triple-play. Indeed, one question worth contemplating is whether DSL is losing share against cable merely because of its lower speed or because it cannot offer the same bundle of services all over a single connection.

Important as VOIP has become as a competitor in the consumer voice market, it is still exceeded by wireless. Wireless connections outnumbered consumer wired connections in 2012 by a factor of nearly four.⁸⁶ In early 2003, only about 3% of households had “cut the cord,” i.e., relied entirely on a wireless phone. By the end of 2012, that number had risen to more than 38%. By contrast, fewer than 10% of households rely on landline alone, i.e. have no wireless phone at all. About 60% of

⁸⁵ Industry statistics on NCTA website.

⁸⁶ FCC, *Local Competition* as of June 2012, table 18, p. 29 and table 10, p. 21.

households have both wireless and either POTS or VOIP, but roughly a quarter of those say they rely on “wireless mostly,” indicating that they are also ripe for cord-cutting.⁸⁷

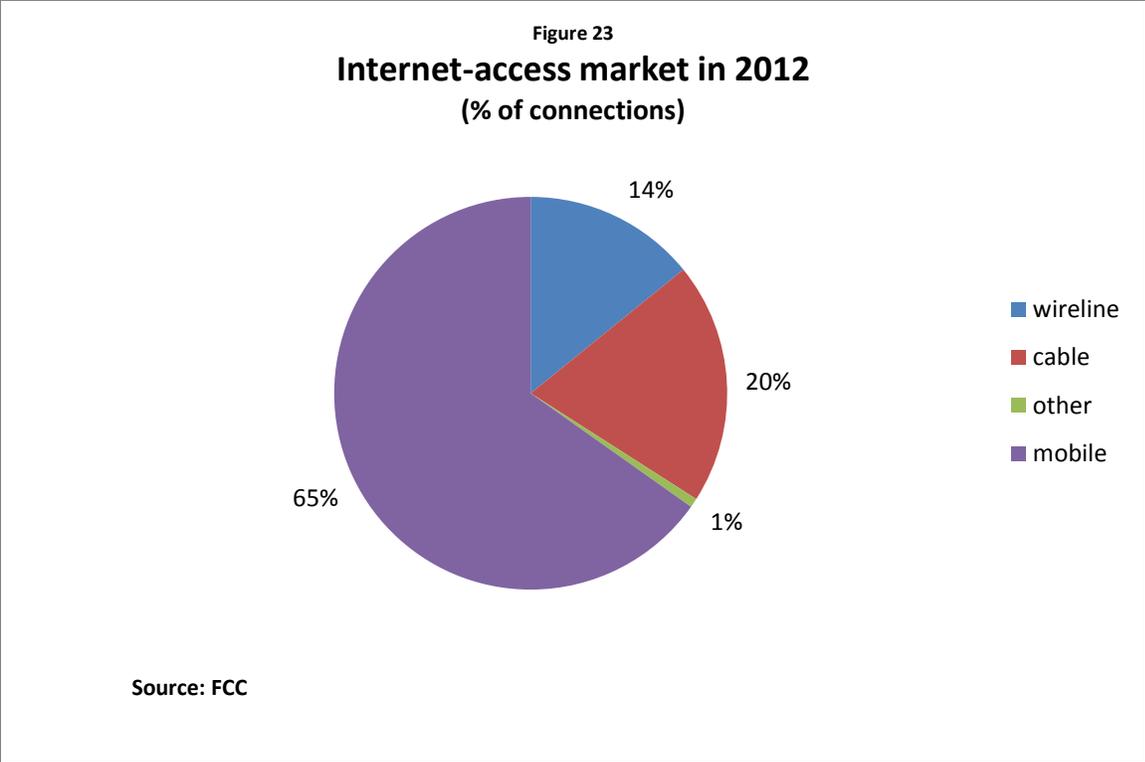


Wireless is not only a powerful force in the voice market, it has become a—and in some cases *the*--broadband connection to the Internet for many consumers. The first few mobile-broadband subscribers appeared in 2005,⁸⁸ but the trend accelerated greatly with the introduction of the iPhone in 2007, followed by Google’ entry with the Android operating system. By year end 2012, mobile wireless constituted 65% of broadband connections and 59% of residential broadband connections.⁸⁹

⁸⁷ CDC, *Wireless Substitution*, released 6/2013, table 1.

⁸⁸ FCC, *Internet Access* as of December 31, 2005, table 1.

⁸⁹ FCC, *Internet Access* as of June 30, 2012, table 11 and as of December 31, 2011 table 6. Linear projection to year-end 2012 in both cases.



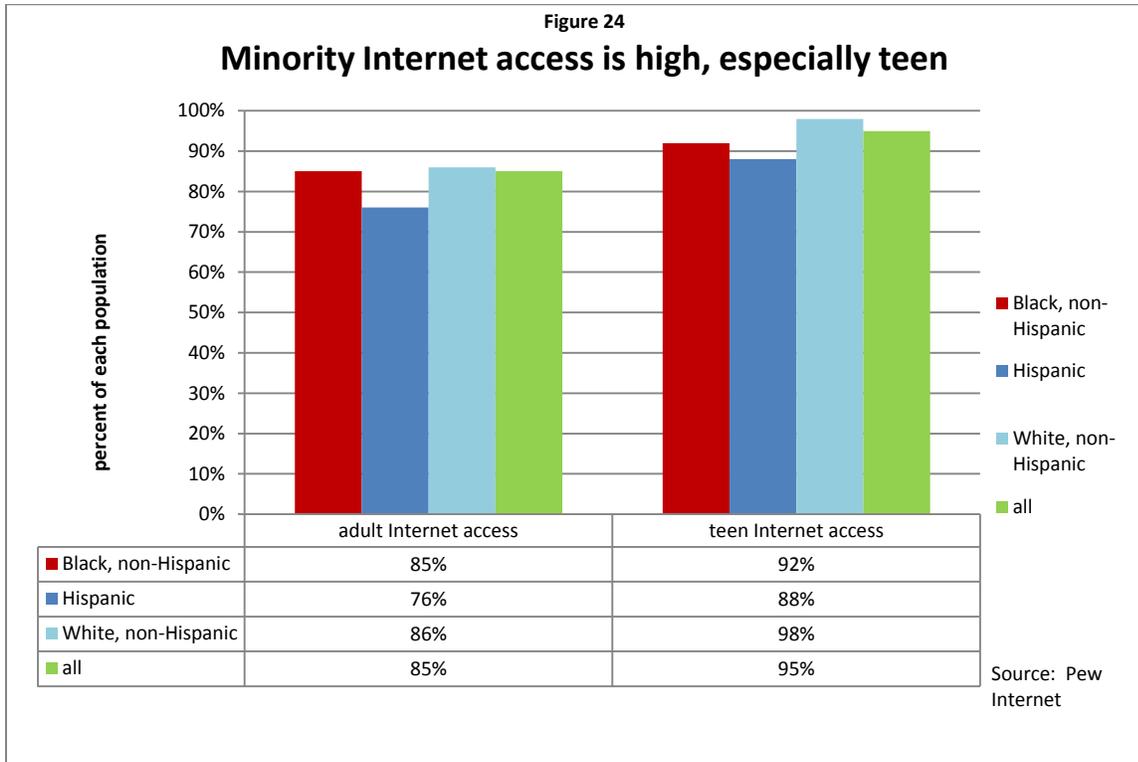
Wireless broadband is particularly important in bringing Internet access to minority consumers. The most recent report from Pew Research shows that 70% of American adults have broadband Internet access at home.⁹⁰ And the number rises to 80% when smartphones are included in the mix.

The impact of smartphones is particularly important for minorities. Home broadband subscription is highest among non-Hispanic Whites, 74% of whom have home broadband. Among non-Hispanic Blacks, only 64% have home broadband and among Hispanics, only 53% have home broadband. However, once smartphones are added into the mix, Internet access becomes available to 80% of non-Hispanic Whites, 79% of non-Hispanic Blacks, and 75% of Hispanics. Wireless broadband is key as a form of Internet access to minorities. Among those who use a cellphone to access the Internet, 60% of Hispanics describe themselves as mostly going online using their cellphone, 43% of non-Hispanic Blacks do so, and only 27% of non-Hispanic Whites do so.⁹¹ Indeed, smartphones increase Internet access for all groups, but have the least impact on those over age 65.

⁹⁰ Kathryn Zickuhr and Aaron Smith, *Home Broadband 2013*, Pew Research Center’s Internet & American Life Project, August 26, 2013, figure on p. 2 and table on p. 5. (Hereafter referred to as Pew.)

⁹¹ Maeve Duggan and Aaron Smith, *Cell Internet Use 2013*, Pew, September 16, 2013, table on p. 9.

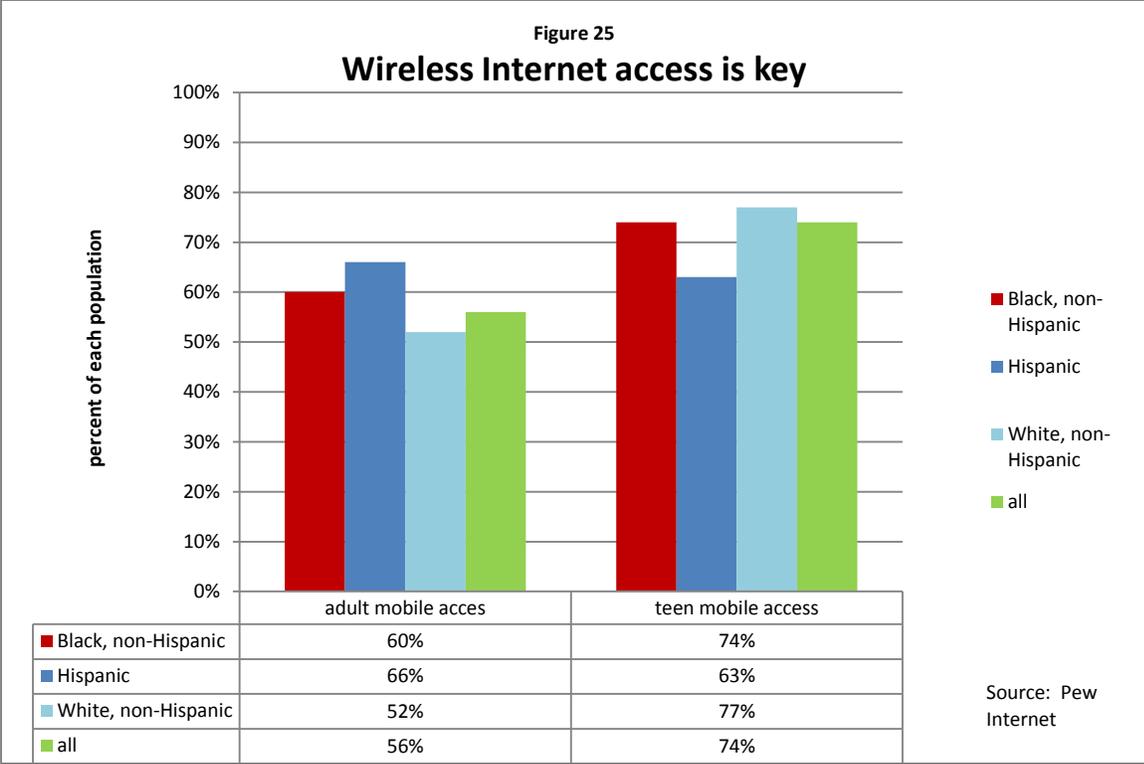
The *Home Broadband 2013* paper confirms earlier findings. Pew Research showed that 85% of adults⁹² and 95% of teens⁹³ have Internet access of some type, including access away from home, with wireless serving as the only form of access for some.⁹⁴



⁹² Mary Madden, *Technology use by different income groups*, Pew, May 29, 2013, slide 4. See also Kathryn Zickuhr, *Who's not online and why*, Pew, September 25, 2013. The latter shows that of the 85% of American adults who go online, 9% do so away from home. The number is higher for non-Hispanic Blacks and for Hispanics, at 15% and 13%, respectively.

⁹³ Mary Madden, Amanda Lenhart, Maeve Duggan, Sandra Cortesi, and Urs Gasser, *Teens and Technology 2013*, Pew Research Center's Internet and American Life Project and the Berkman Center for Internet and Society, March 13, 2013, table on p. 4.

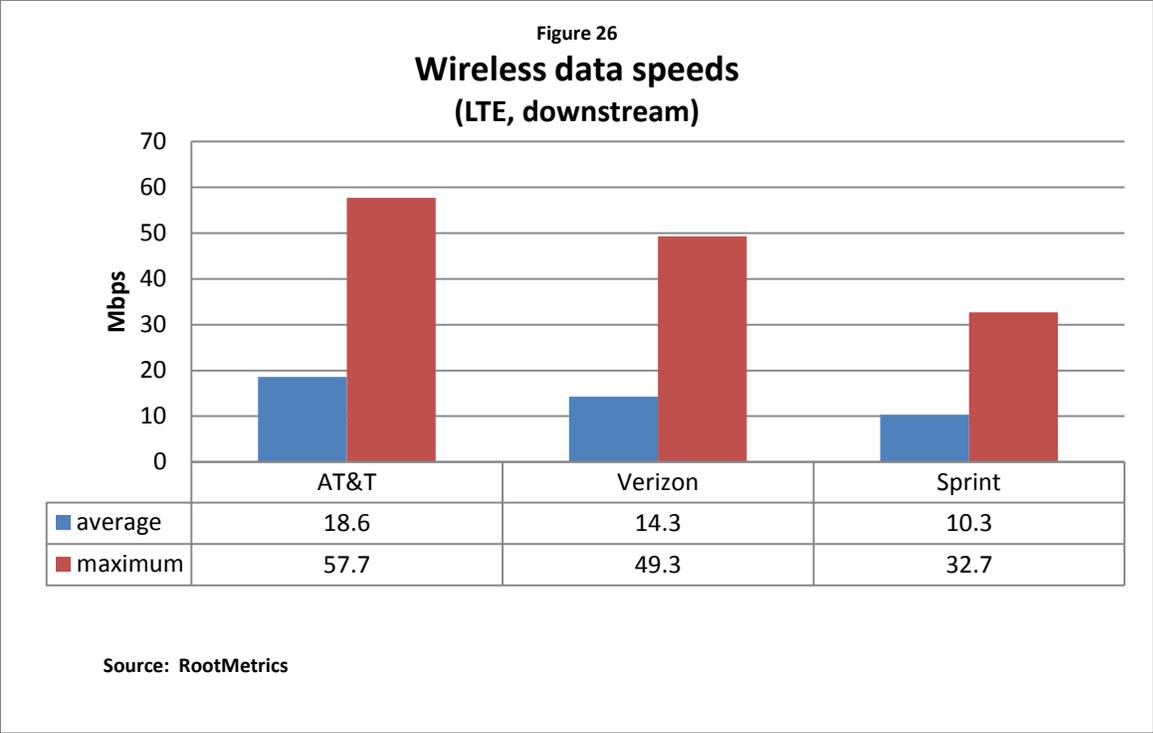
⁹⁴ Madden et al., *Teens and Technology 2013*, table on p. 4.



The reliance of so many consumers on wireless broadband makes it especially significant that all four national wireless networks are upgrading to LTE, an IP-based wireless technology that operates at very high speeds. RootMetrics tested the national carriers’ LTE performance in 77 cities in the second half of 2012. It found that AT&T had the highest average LTE download speed at 18.6 Mbps and 57.7 Mbps maximum speed. Verizon offered 14.3 Mbps average speed and 49.3 maximum speed. Sprint offered 10.3 Mbps average and 32.7 Mbps maximum speed. T-Mobile at that time did not offer LTE, but has since begun to deploy.⁹⁵ Verizon has completed its build-out, which is expected to reach 300 million Americans,⁹⁶ and AT&T will reach 270 million by the end of this year and 300 million by mid-2014. Both are still also investing heavily to densify their networks to increase capacity and speed. T-Mobile has expressed an intention of reaching 225 million Americans in 2013 and Sprint 200 million in 2014 with LTE.

⁹⁵Patrick Linder, *Lightning-fast data speeds and expanding coverage: A 4G LTE performance review*, RootMetrics, March 11, 2013.

⁹⁶VZ, T, TMUS, S second quarter 2013 analyst conference calls.



Given all the recent concern about the need for gigabit broadband access, an obvious question is why wireless broadband is so popular. Clearly, one answer is convenience—the smartphone or tablet is handily available when a fixed connection may not be. But the other answer relates to the actual speeds that applications make available to consumers.

Here Netflix’ August 2013 survey of the performance of its video streaming over various fixed-ISP is both shocking and enlightening. Netflix’ average speed over Google fiber was 3.6 Mbps—that’s megabit not gigabit—i.e. roughly one three-hundredth of Google fiber’s theoretical speed. The various cable platforms as well as FIOS and U-verse operated at about 2 Mbps. Netflix points out these speeds, which are well below the maximum capability of the platforms, is determined by Netflix’ own encoders, the capability of home WiFi (or other network), and of the devices used by the Netflix customers. In other words, speed experienced by the consumer is sufficiently degraded by so many factors unrelated to the access platform that the theoretical maximum speed of the access platform can become irrelevant as a competitive factor. Not only LTE, but even most DSL, can compete in the Netflix scenario. AT&T’s DSL came in a 1.4 Mbps on the Netflix test, a rate which can compete reasonably well against Google fiber’s 3.6 Mbps speed—although it would not be able to compete well against gigabit speed.⁹⁷

The other question that often arises with regard to wireless broadband relates to usage. Because of spectrum constraints, wireless broadband capacity is more limited than fixed broadband capacity, as reflected in lower caps. Sandvine’s⁹⁸ survey for the first half of 2013 shows that median fixed network

⁹⁷ Netflix ISP Speed Index, August 2013.

⁹⁸ Sandvine, *Global Internet Phenomena*, 1H 2013, table 1, figure 2, and table 2.

consumption in North America is 18 GB. Indeed, Sandvine points out that while the top 1% of Internet users consume 34% of the upstream capacity and 10% of the downstream capacity, the bottom 50% of Internet users consume only 6% of the total capacity. The heaviest upstream application is BitTorrent, i.e. filesharing, while the heaviest downstream applications are video streaming—Netflix and YouTube being the top two downstream applications.

Sandvine shows much lighter usage on the mobile broadband side. Median usage on mobile networks in North America is 58.7 MB, i.e. roughly one three-hundredth of the 18 GB average usage on fixed networks. But what is particularly interesting about this figure is that it is also much lower than the lowest data-allowances available on wireless data plans, which are either 300 MB or 500 MB.⁹⁹

Like fixed networks, mobile networks have very skewed usage. In the mobile case, the top 1% of subscribers use about 20% of the network capacity, while the bottom 50% use about 1% of the capacity. Filesharing is not prevalent on mobile broadband, so the downstream and upstream usage patterns are more similar than they are on fixed networks, where BitTorrent is the top upstream application, by far.¹⁰⁰

The bottom line from the Sandvine data is that for nearly half the users of fixed broadband Internet access, mobile wireless Internet access may well be competitive with fixed wireless access on usage. The Netflix survey and the RootMetrics data show that LTE may also be able to compete with fixed broadband networks on speed, because of the constraints that applications place on all networks' performance.

The explosively rapid adoption of tablets is one indicator that confirms users' willingness to rely on mobile wireless Internet access for more than just casual use. Mary Meeker's 2013 presentation¹⁰¹ shows that the iPad is being adopted almost three times as fast as the iPhone was. Just three years after its introduction, the iPad has sold 140 million units across the globe.

⁹⁹ Mean usage of 390 MB falls into that range. Sandvine, table 3.

¹⁰⁰ Sandvine, table 3, figure 4, and table 4.

¹⁰¹ Mary Meeker and Liang Wu, *Internet Trends*, KPCB, May 29, 2013, slide 44.

Summary

Thus, consumers today enjoy an extraordinarily rich communications environment. The new mother who could only communicate with her Mom in 1996 via carefully budgeted long-distance calls today can show off the baby or get advice not only via a call from her landline or cellphone, but can Skype, text, email, tweet, use Facebook, or connect via myriad other ways that combine voice, data and video seamlessly, generally over the Internet.

The Internet, barely mentioned in the *1996 Act*, has become the force that is transforming almost all aspects of life in 2013. Mostly for the better, but sometimes for the worse, it is ubiquitous. Education is rapidly moving online, both through degree programs and free MOOCs (massive online open courses). It is enhancing healthcare by enabling remote diagnostics, and even remote surgery, as well as better access by consumers to information about everything from symptoms to health-care providers. It is an integral part of every job search, with most employers posting jobs on-line and requiring applications and resumes on-line. It is a part of everyday life. Want to go shopping? Go online first to find the best deals and coupons. Want to go to dinner? Check menus, make reservations, and even pay on-line. Want to check on the baby? Access your webcam on-line.

What the Pew and Sandvine statistics show is that there is no longer “a consumer,” a homogeneous group that has one set of desires that regulators can try to force vendors to fulfill. Rather, consumers’ desires vary enormously and they benefit greatly from an environment in which multiple platforms with different technical capabilities and different economics can provide a variety of products and services. The regulatory requirements that were protective of consumers in the old monopoly, one-size-fits-all technologies, are likely to be very destructive in a multiplatform ecosystem capable of rapid innovation and rapid expansion of supply.

It is clear from the ILECs’ rapid share loss in their highly-regulated voice market that regulators’ views and consumers’ views of what consumers want is radically different. Consumers are rejecting the services and the standards regulators insist on. A regulatory framework which was effective in a “one-size-fits-all” world of few or no choices is no longer effective in a world of myriad choices.

There is no reason to believe that regulators would be any more successful in anticipating consumers’ rapidly changing desires in the broadband and video markets than they have been in the voice market. Instead, they are likely to introduce rigidity into an ecosystem that has thrived precisely because it has been flexible and responsive to its customers. Given the interdependence of other parts of the Internet ecosystem with the network infrastructure, that would not only harm innovation and growth at the core networks, but at the edge as well.

For example, IP infrastructure has accommodated rapid shifts in traffic among services and devices, both over time and between upstream and downstream. Peer-to-peer file-sharing dominates upstream IP traffic, but video dominates downstream.¹⁰² Non-PC-based traffic is supplanting PC-

¹⁰² Sandvine, figure 1, p. 5.

based traffic. WiFi will soon overtake hard-wired delivery, and mobile is the fastest-growing albeit still far the smallest delivery medium.¹⁰³

Thus far, the IP ecosystem has responded rapidly to these shifting trends. For example, consumers' desire to be untethered and mobile, which drives both WiFi and mobile wireless, has been accommodated at all levels. Networks have supplied the bandwidth to back up WiFi hotspots, wireless networks are migrating to LTE to accommodate rapid increases in mobile data, device manufacturers have provided increasingly portable devices ranging from super-lightweight notebooks to tablets, and content and application providers have found ways to port their products to these devices as well as invented new products. Inserting regulatory delay and rigidity into the network portion of this ecosystem would damage the device and application providers, as well as the network providers.

The lesson of the decade that followed the *1996 Act* is that *the most effective competition is competition between platforms that bring different economics and features to the market*. Today, consumers' requirements for voice, data, and video services are met over multiple platforms—cable, ILEC, wireless and satellite—that satisfy different needs at different times in a variety of ways.

All of these platforms are effective. The one that is considered the most endangered—the ILECs—competes successfully where the ILECs have upgraded their networks to IP over fiber-based broadband. Thus, it is important to free the ILECs' from regulations that force them to waste capital and operating funds on their legacy networks.

If the goal is to have a world-leading, competitive communications market that is responsive to consumers' needs and desires, the solution is not to hamstring those players that have been free to innovate, but to liberate those that have been hamstrung.

¹⁰³ Cisco VNI, *Zettabyte Era*, p. 8.