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Before the
Federal Communications Commission
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	
Petition of Bell Atlantic for Relief From Barriers to Deployment of Advanced Telecommunications Services	CC Docket No. 98-11
Petition of U S WEST for Relief From Barriers to Deployment of Advanced Telecommunications Services	CC Docket No. 98-26
Petition of Ameritech for Relief From Barriers to Deployment of Advanced Telecommunications Services	CC Docket No. 98-32

REPLY COMMENTS OF COMCAST CORPORATION

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REPLY COMMENTS OF COMCAST CORPORATION

1. Introduction and Summary.

Comcast Corporation ("Comcast") files these reply comments in the above-captioned matters. Comcast has a strong interest in the development of the nation's competitive communications infrastructure, reflected in Comcast's ownership of cable systems (including systems that have deployed the Comcast@Home high-speed Internet access service) and wireless telephone systems, and its provision of local exchange and interexchange telecommunications.

Petitioners rely on Section 706 of the Telecommunications Act of 1996 ("Section 706") to justify what amount to waivers of the interLATA ban in Section 271 and various requirements of Section 251(c) of the Communications Act of 1934 (the

"Act").[1] Petitioners want to provide in-region interLATA Internet "backbone" transport and routing services, and to offer an Internet access/high-speed transport service free from the unbundling and resale requirements of Section 251(c). The interLATA (Section 271) relief would address supposed backbone "congestion," while the local market (Section 251(c)) relief would supposedly give Petitioners improved incentives to invest both in xDSL technology and in the backbone itself.[2]

The record shows that the Commission lacks legal authority to grant the requested relief.[3] The more fundamental issues, however, are not the legal niceties of the relief sought, but rather the core questions the Petitions raise: (a) Is there a shortage of Internet backbone capacity? (b) Is the deployment of mass market high-speed Internet access proceeding too slowly? (c) If so, are there actions the Commission should take to ensure that consumers have a broad array of competitive choices to meet their demand for high-speed Internet access?

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[1] Petition of Bell Atlantic (filed January 26, 1998) ("Bell Atlantic Petition"); Petition for Relief [filed by U S WEST] (filed February 25, 1998) ("U S WEST Petition"); Petition of Ameritech Corporation (filed March 5, 1998) ("Ameritech Petition"). Bell Atlantic, U S WEST and Ameritech are collectively referred to here as "Petitioners."

[2] The term "xDSL" refers to any of the various forms of Digital Subscriber Line ("DSL") technology. These include, but are not limited to, Asymmetric Digital Subscriber Line ("ADSL"); High-Speed Digital Subscriber Line ("HDSL"); and Rate-Adaptive Digital Subscriber Line ("RADSL") technologies. These technologies all use digital signal processing techniques to send digital information at high speeds over twisted pair copper circuits.

[3] There are two key legal problems with the Petitions. First, Section 706 itself does not grant the Commission any authority; it directs that existing authority be used to accomplish certain goals. As a result, the Commission's forbearance authority is limited by Section 10(d) of the Act, which bans forbearance from Section 271 or Section 251(c) until they have been fully implemented. Second, even if Section 706 is a separate grant of authority, Commission actions under it must be pro-competitive. Sections 271 and 251(c) are themselves pro-competitive, so Section 706 cannot be used as a basis to waive them. *See, e.g.*, AT&T Comments in CC Dkt. No. 98-11 (Bell Atlantic) at 4-10; MCI Comments in CC Dkt. No. 98-26 (U S West) at 28-35; Commercial Internet Exchange ("CIX") Comments in CC Dkt. No. 98-32 (Ameritech) at 20-21; Electric Lightwave Comments at 29-31; TCG Comments at 3-6; XCOM Comments at 9-14; Level 3 Comments at 5-7; Comments of APKNet, *et al.* at 6-8; WorldCom Comments at 25-31. Comcast concurs in these legal arguments.

As described below, any shortage of backbone capacity is a transitory issue that the market is solving. Similarly, many high-speed Internet access technologies, such as xDSL-based services, cable modem services, satellite services such as DirecPC, and "wireless fiber" (*e.g.*, Advanced Radio Telecom Corp.'s 38 GHz service) are already vying for market acceptance. Moreover, the record suggests that Petitioners may be impeding efforts by Internet Service Providers ("ISPs") and competing local exchange carriers ("CLECs") to deploy xDSL services. If this is true, then the most effective steps the Commission could take to encourage xDSL deployment would include specific directives to ILECs to streamline the collocation process[4] and to make xDSL-capable copper circuits available to ISPs and others at cost-based rates.[5]

The fact that the Petitioners have not proven their case, however, is only the beginning of the inquiry. Section 706 directs the Commission to commence a Notice of Inquiry to determine whether "advanced telecommunications capabilities" are being deployed at a reasonable pace. Absolutely nothing suggests that this inquiry should be limited to the efforts of regulated common carriers; nor, for that matter, should it be limited to a review of network providers. To the contrary, Section 706(c)(1) specifically defines "advanced telecommunications capabilities ... without regard to any transmission media or technology." A full Section 706 inquiry, therefore, will embrace all of the different technologies to deliver these capabilities that are already available and that are developing on the horizon by virtue of market-driven investment and innovation.

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[4] DSL Comments at 21-22; COVAD Comments at 13-18; MCI Comments in CC Dkt. No. 98-32 (Ameritech) at 13-14.

[5] *See, e.g.*, Comments of APKNet *et al.* (requesting an affirmative requirement on Petitioners and other ILECs to offer xDSL-capable copper circuits to end users at cost-based rates and technically non-discriminatory terms). If (as Petitioners assert) Section 706 is an independent grant of authority to the Commission, then the Commission may direct the Petitioners and other ILECs to provide particular interconnection arrangements at Commission-specified prices, since the 8th Circuit's ruling depriving the Commission of such pricing authority was based on Sections 251 and 252, not the supposedly "independent" Section 706. *See* MCI Comments (Ameritech) at 13-17.

Therefore, while the Commission should deny the Petitions, it should also initiate the Section 706 inquiry in a timely fashion. That inquiry should embrace not only the activities of the ILECs, the CLECs, and the interexchange carriers ("IXCs"), but should also include all segments of the Internet industry, from content creators to equipment suppliers to backbone providers to front-line ISPs. The record of such a proceeding would provide a much more robust basis for understanding how the market for high-speed Internet access is actually developing, as well as a sound rationale for determining whether any particular regulatory action by the Commission is necessary.

2. The Market Is Responding To Growing Consumer Demand For High-Speed Internet Access.

Section 706 directs the Commission to use its regulatory powers to encourage the deployment of "advanced communications capabilities."[6] The premise of the Petitions — particularly Bell Atlantic's — is that high-speed Internet access is caught in a vicious cycle. Congestion on the Internet backbone supposedly makes it impossible to reliably deliver Internet data at high speeds. At the same time, even if there were enough backbone capacity, an alleged lack of high-bandwidth "last mile" connections to consumers would negate its benefits. The lack of an established retail market supposedly frustrates investment in the backbone, while the lack of backbone capacity frustrates investment in high-bandwidth "last mile" facilities. Using this model, Petitioners conclude that only an integrated service including ***both*** high-speed local Internet access ***and*** additional backbone capacity can prime the high-bandwidth pump and fulfill the goals of Section 706. The regulatory relief they seek is designed to permit them to implement such an integrated service.[7]

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[6] Petitioners all assume (Comcast believes, correctly) that this includes high-speed Internet access. *See* Bell Atlantic Petition at 2, 14-15; Ameritech Petition at 4-8; U S WEST Petition at 23-24, 40-41. The comments appear to accept this assumption as well.

[7] *See* Bell Atlantic Petition at 4; Ameritech Petition at 4; U S WEST Petition at 2-3.

The supposed vicious cycle does not exist. As described below, firms are investing literally billions of dollars in an effort to develop and serve the market for high-speed Internet access. Clearly, there are strong market incentives to find ways to deliver faster Internet service to consumers. Under current rules, moreover, Petitioners are free to participate in this market in a large number of ways. Their stated reluctance to do so more aggressively reflects not a failure of the Internet infrastructure or the regulatory system but, instead, Petitioners' particular business and regulatory strategies.

a. Delays In Receiving Data From The Internet Are Caused By Many Factors, Not Simply A Shortage Of Backbone "Capacity."

Bell Atlantic is the key proponent of the idea that there is a problem with "congestion" on the Internet backbone.[8] It bases its claim on a study of end-to-end throughput data rates conducted by *Boardwatch* magazine and Keynote Systems during the summer of 1997.[9] As others have pointed out, however, Keynote updated the study in February 1998. The updated study showed that the average end-to-end throughput had increased by 60% over the comparable period a year earlier.[10] Bell Atlantic appears to have extrapolated a pervasive system-wide problem from a single data point — hardly an appropriate ground for long-term policy decisions by this Commission.

It seems logical that one reason for the improved performance in the more recent study is the massive investment in backbone capacity being made by existing and

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[8] There is no formal definition an Internet backbone provider. A leading trade magazine states that "when we refer to a 'national Internet backbone provider,' we are describing a company that has physically located a high-speed TCP/IP router in a number of cities, and then leased high-speed data lines from [IXCs] to link the routers — thus forming a national 'backbone' connecting those cities." J. Rickard, "The Internet — What Is It?" in *Boardwatch Magazine Internet Service Providers Quarterly Directory* (Winter 1998) at page 12. Retail ISPs buy Internet connectivity directly or indirectly from backbone providers.

[9] *See* Bell Atlantic Petition at 12-13, Attachment 2 ("White Paper") at 22.

[10] *See* WorldCom Comments at 46; XCOM Comments at 18.

new Internet backbone providers. The record shows that major backbone providers are taking steps to double their capacity approximately every three to four months.[11] This extraordinary capacity increase is possible for several reasons. First, it is often not necessary to dedicate additional physical fiber optic transmission links to the backbone in order to increase its capacity. Instead, the equipment attached to the ends of existing fiber can be upgraded to be able to send more data over the same physical facilities.[12] Second, to the extent that it is advisable in particular cases to dedicate additional fiber to the Internet backbone, spare fiber may be available for activation. Third, the record shows that firms like Qwest and Level 3, among others, actually are deploying entirely new optical fiber facilities for Internet backbone use.[13] Finally — and critically important in assessing whether a regulatory response is needed — the capital markets appear more than willing to fund these multi-billion-dollar efforts.

The Commission should recognize, however, that the issue is more subtle and complex than simply throwing bandwidth at the backbone. Delivery of data over the Internet is a process with many "moving parts," any one of which can cause delay.

Consider what happens when an end user seeks to "visit" a particular web page. The process starts when the end user's computer requests the files representing

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[11] *See* MCI Comments (Ameritech) at 34-36; CIX Comments (Ameritech) at 7-8, 10; WorldCom Comments at 47.

[12] The leading new technology with this capability is Wave Division Multiplexing ("WDM"). *See* C. Harler & J. Paire, "Service Providers Catch The Fiber Wave," *Inter@ctive Week* (February 16, 1998) at I-5. For a vendor's description of a current product offering, *see, e.g.*, www.ciena.com/products/firefly.html. Sprint Corp. has announced that it will use Ciena equipment to put 40 different wavelengths of light on a single fiber. *See Inter@ctive Week* (March 23, 1998) at I-1. It is estimated that the telecommunications industry invested approximately $1.5 billion on WDM equipment in 1997. R. King, "Bigger Pipes, Bigger Problems," *tele.com* (November 1997) at 86.

[13] *See* CIX Comments (Ameritech) at 7-8; WorldCom Comments at 43.

the page.[14] This request is a short message — "send [these files] to [this location]" — and will not take very long to transit the Internet.

The "host" computer on which the web page files reside must process and acknowledge the request. If that computer is slow (compared to consumer expectations) or overloaded, the start of the process of sending the file may be delayed. Similarly, if the host computer is slow or overloaded, it may take an inordinate period of time for the requested file to ***leave*** that computer and move on to the next step.

The file next passes through the routers of the ISP providing the connection to the Internet.[15] If the ISP has outdated (slower) routers, or if the routers are overloaded when the file arrives, there will be delays. Moreover, the capacity of the connection between the ISP's "retail" facilities (to which the host computer is connected) and the Internet backbone will also affect how quickly the file can reach the end user. If that connection is slow or overcrowded, it will be another source of delay.[16]

When the file reaches the backbone, it is true that congestion may delay it.[17] But even if transmission along the first backbone provider's network is unimpaired,

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[14] "Visiting" a web page is actually a misnomer. The consumer does not "go to" the web page. Instead, the files making up the web page are transmitted to the consumer's computer.

[15] This assumes that the file is stored on the computer of an ISP, acting as a web hosting service. An additional source of delay will arise if the server storing the file is located at, *e.g.*, the information provider's premises. In this latter case, the capacity of the connection between the computer storing the file and the ISP will also affect how quickly the requested files actually reach "the Internet" for transmission to the end user.

[16] These delays are not affected by whether the retail ISP and the backbone provider are owned by the same company. In any particular location, an independent ISP may have a backbone connection with fully adequate capacity, while an ISP "division" of a backbone provider may have underestimated demand and, therefore, have an inadequate connection.

[17] Developments in router technology should increase the speed of the backbone. *See* C. Wilson, "Optical Router Could Pump Up Internet Speeds," *Inter@ctive Week* (April 20,
(continued...)

additional delays can result if the file needs to be transferred to a different backbone provider's network.[18] If these connections are clogged, delivery will be slow even if both backbones are running smoothly.[19]

Finally, as the file approaches the end user, the possible delays addressed above may recur. Delivery will be affected by the speed of the connection between the backbone and the ISP, and by the capabilities of the ISP's router, as well as by the speed of the connection between the ISP and the end user.

Everyone involved understands that consumers think that "faster is better." This creates powerful market incentives to achieve just that goal, and there are a number of steps that can be taken to do so.

First, content providers will minimize the size of the files to be transferred, other things being equal.[20] Second, web hosting services will want to ensure that their computers and links to the Internet are fast enough to avoid causing their customers (the content providers) to appear especially slow to ***their*** customers (the consumers). Third,

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[17](...continued)
1998) at 14 (emphasis added) ("Avici Systems Inc. and Northern Telecom Inc. are combining to create what could be the first in a series of products that would boost the routing of data on Internet backbones to speeds in excess of a ***trillion*** bits of data per second.")

[18] This will occur if the end user requesting the file is served by an ISP who uses a different backbone provider than the ISP serving the web site provider's host computer.

[19] *See* WorldCom Comments at 44-46. *See also* R. Barrett, "Access Providers Look To Exchange Traffic, *Inter@ctive Week* (March 9, 1998) at 8 (noting that "[p]ublic interconnection points are overloaded and cause high packet loss ... ."); D. Bushaus, "No Time For NAPs," *tele.com* (December 1997) at 86 ("At peak times, up to 40 percent of the packets that hit the Internet's major network access points (NAPs) are dropped and must be re-transmitted, causing nagging network delays.")

[20] This might involve using simpler or fewer graphics; processing graphical materials such as photographs to allow the same visual experience in fewer bits (*e.g.*, using "dithering" to lower the number of colors and shades included in a picture); or file compression.

ISPs will want to keep their routers and links to the backbone of adequate size and capacity to handle their customers' needs. Fourth, ISPs will also want to develop and deploy technologies, such as caching, that provide a hedge against performance problems in other parts of the Internet.[21]

Finally, content providers with large amounts of data to deliver (*e.g.*, video clips or large software programs) will take various steps to maximize the speed with which consumers obtain the information. They will load their content on "fast" servers.[22] They will ensure that the routers connecting those servers to the Internet can handle the high demands their content creates. They will use the most advanced compression and "streaming" technologies to minimize the time required to deliver the content.[23] And if traditional backbone transport arrangements do not assure adequate throughput, the content providers will either build "private" backbones or negotiate

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[21] In a caching arrangement, an ISP maintains a local "cache server" on which it stores current copies of frequently visited web sites. When an end user requests a web page that is already in the cache, the ISP retrieves that page directly from the cache, so that the end user experiences none of the delays discussed above relating to obtaining the web page from a distant location. In this regard, entrepreneurs are developing innovative caching schemes, such as delivery of files for caching directly via satellite, that totally bypass the traditional "wired" backbone. *See, e.g.*, R. Barrett, "Caching Onto Satellite Service," *Inter@ctive Week* (March 2, 1998) at 30 (noting that two firms, Skycache and Intercache, are developing services that use satellite links to deliver data to individual ISP web caches); J. Rickard, "A Cache and Carry Internet," *Boardwatch* (February 1998) (describing Skycache service).

[22] *See* L. Ellis, "@Home To Open Software Store," *Multichannel News* (March 23, 1998) at 10 (noting that to ensure high-speed delivery of software, "@Home installed an FTP (file-transfer-protocol) server within its network, so that buyers don't encounter any bandwidth bottlenecks when buying or trying software.")

[23] *See,e.g.*, "RealNetworks Nails Cable Nets," *Multichannel News/Broadband Week* (April 13, 1998) at 70 (describing RealNetworks' product as "streaming media that enables the viewing and delivery of realtime multimedia over the Internet, with full-screen video resolution at 100 kilobits per second to 300 kbps.")

special deals with existing firms. Finally, they will encourage ISPs delivering their content to maintain adequate caching capacity.[24]

The foregoing shows that data speed involves a broad and complex spectrum of engineering and economic trade-offs. Moreover, the Internet is a network of computers,[25] so the relevant trade-offs include not only bandwidth, but also memory and processing power.[26] This means that the trade-offs will be more complex — but also more susceptible to innovative approaches — than in the design of a simple telecommunications network.

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[24] *See* F. Dawson, "Road Runner Launch Offers Glimpse Of Future," *Multichannel News/Broadband Week* (March 30, 1998) at 73, 78 (describing dedicated data network with OC-48 SONET rings and Cisco gigabit switch routers); J. McGarvey, "Cisco, MediaOne To Team," *Inter@ctive Week* (March 2, 1998) at 9 (Cisco "will announce an agreement with MediaOne Inc. to supply equipment for the construction of the cable modem service's broadband network ... ."). *See also* L. Ellis, "Arepa, @Home Detail CD-ROM Plan," *Multichannel News/Broadband Week* (April 27, 1998) at 145, 159 (innovative technology for pay-per-use access to interactive CD-ROM games relies on both local caching and a transmission protocol "that is 'several times faster' than existing Internet protocols").

[25] *See* 47 U.S.C. § 230(e)(1) (defining the "Internet" as "the international ***computer*** network of both Federal and non-Federal interoperable packet-switched data networks").

[26] For example, data compression and streaming technologies use computer processing power (at both ends) to allow the same information to be transmitted in less bandwidth. Caching uses memory to lower the overall bandwidth needed to deliver files of any given size ***at the time the consumer wants them*** (and can therefore substitute for both bandwidth and compression). More powerful routers depend on computing power (broadly conceived) to route packets more quickly and to send them along more optimal routes. *See* Prepared Testimony of Jeffrey A. Eisenach (President, Progress and Freedom Foundation) Before The Senate Commerce, Science, And Transportation Committee, Subcommittee on Communications (April 22, 1998) (available via LEXIS) ("Eisenach Testimony") (trying to blame particular participants for slow Internet data speeds is not useful because "the Internet is a seamless web ... beginning inside the computer ... and ending at the server from which the information originates. The network is comprised of software as well as hardware, of telephone switches as well as modems, of routers as well as servers — of hard drives, busses, fiber, coaxial cable, fiber optic cable, computer chips and Ethernet boards.")

The real challenge for entrepreneurs is to find a ***mix*** of bandwidth, computer power and memory that works from both an economic and engineering perspective. Petitioners have not even addressed these trade-offs, much less shown that the best approach is to give them incentives to add bandwidth to the mix.

From this perspective, Petitioners' view of the Internet appears to be distorted by the fact that, "when all you have is a hammer, everything looks like a nail." Petitioners sell bandwidth. Having discerned a "problem" with the Internet, their solution is — understandably — bandwidth, provided by them. Other things being equal, more bandwidth is certainly better than less.[27] But other things being equal, more processing power (better compression and streaming) and more memory (better and more extensive caching) are also better than less. The optimal solution in the market will certainly be more complex — but also more effective at meeting consumer demand — than the Petitioners' bandwidth-centric proposal.

b. The Market Is Developing And Delivering Many Technologies To Enable High-Speed Internet Access For The Mass Market.

There is widespread recognition that consumers want faster Internet access. In this regard, many consumers already experience relatively high data rates when they access the Internet during working hours by means of a corporate or other organizational local area network ("LAN"). LANs typically transmit data at effective rates of more than a megabit per second to an individual personal computer. When these networks are

[27] In this regard, different types of bandwidth will be useful to different degrees in different situations. The wire-delivered bandwidth Petitioners seek to promote may or may not be useful at all in particular cases. For example, satellite-delivered content with extensive caching may be the best solution in some rural areas; spread-spectrum wireless connections may be preferable in others; while xDSL and/or cable-delivered service may indeed be optimal in others. *See infra.*

connected to the Internet by means of an ISDN or T1 line, the user experiences faster response times than available using a dial-up connection with an analog modem.[28]

It is to be expected that individuals who have experienced higher data transport rates in one location would be interested in obtaining faster connections in their homes. Moreover, other things being equal, a content creator can increase the value of a consumer's experience (better graphics, audio or visual content) if faster speeds are available, so a high-speed connection to the Internet will be more valuable to consumers than a low-speed connection. As a result, it is not surprising that material before the Commission suggests that well above 10 million households will demand high-speed Internet access by the year 2000.[29]

There are several competing technologies that can be used to meet this growing consumer demand. Broadly speaking — and with due allowance for "hybrid" approaches — these technologies can be divided into telephone-based systems, cable-based systems, terrestrial wireless systems, and satellite systems:[30]

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[28] Today, roughly 60% of individuals with Internet access reach the Internet primarily at home, while 40% reach the Internet primarily at work. *See* J. Rickard, "The 56K Modem Battle," *Boardwatch Magazine* (March 1998) at 24. Moreover, many individuals obtained Internet access while students through their college's system. Many colleges and universities have the equivalent of high-speed LAN access to the Internet, so new generations of Internet users expect high-speed access. Market participants are aware of these effects. *See* J. Ascenzi, "GTE To Launch Information Autobahn In 4 Area Cities," *The Business Press* (April 20, 1998) at 3 (DSL equipment vendor notes that "[w]hat we're hoping is that people get spoiled at work, and that they're going to want access to the Internet at home that is virtually as fast as what they have at the office.")

[29] Comments of Economic Strategies Institute, CC Docket No. 98-15 (response to Petition of the Alliance for Public Technology), Attachment 1 at 22. This same source indicates that for many teenagers, access to the Internet is of greater importance to them than is access to television. *See id.* at 21. This also suggests that over the next decade, demand for high-speed Internet access will substantially increase.

[30] It is also possible to deliver high-speed Internet data over electric power lines, although the technology is more readily adapted to European and Asian power systems than (continued...)

Telephone-Based Systems. The focus of the record in this proceeding is xDSL technology. xDSL technology transmits digital information in high frequency bands over twisted pair copper wires, typically telephone company loop plant. It does not work on loops that have multiplexing systems (whether optical or electrical) in the feeder portion; it does not work on loops that have "load coils" on them; and beyond a certain point, xDSL delivers progressively lower data rates as circuit length increases until, ultimately, it does not work at all. Moreover, there are apparently significant potential signal interference issues that arise if too many copper pairs within a single cable sheath are being used for xDSL, and in some situations customer premises wire carrying xDSL signals can experience interference from the ingress of radio-frequency signals. With those limitations in mind, however, when it works, xDSL technology can be used to deliver data rates of several megabits per second downstream, and lower but still "fast" data rates upstream.[31]

Cable Systems. Cable systems can be configured so that one or more channels carries data, as opposed to analog video programming. These channels can be used to transmit Internet data to end users. In this approach, the cable system is technically similar to a traditional corporate LAN. For the service to work, the cable operator installs a cable modem to translate the signals and a standard LAN card in the end user's computer.[32] If the cable system has been upgraded to two-way capability (a

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[30](...continued)
those in the United States. *See* F. Dawson, "More Utilities Mull Data Over Power Lines," *Multichannel News/Broadband Week* (March 30, 1998) at 76. Even so, an executive at Nortel, which developed the technology, states that "what we've done so far tells us that we can move this technology into the mass market in North America." *Id.*

[31] In addition, ISDN service offers a lower-speed (128 kilobit/second) alternative to xDSL. Although ILECs have been widely criticized for their past marketing of ISDN, the technology itself appears to be well-established and reliable.

[32] More advanced systems now under test will allow the connection to the individual's personal computer to be made using a Universal Serial Bus interface, which is expected to become standard equipment on personal computers over time.

fairly expensive process), then the signals from the customer to the Internet are carried on the cable system. Otherwise, the customer must establish a dial-up telephone connection with the cable operator/ISP in order to send information out (as opposed to merely receive it). Unlike an xDSL-based service, moreover, the bandwidth of a cable-delivered Internet service is shared among many users. This means that effective per-customer data rates can potentially decline as the number of users increases.[33]

Terrestrial Wireless. Different terrestrial wireless technologies have been proposed or implemented to permit Internet access at various data rates. At the low end, cellular and PCS systems can be used to transmit digital data as well as voice traffic, while Metricom's "Ricochet" system (operational in several areas, including the San Francisco Bay area and Washington, D.C.) presently accommodates data rates of approximately 30 kilobits/second.[34] Other services, such as WebTV, encode Internet data into unused portions of a standard television broadcast signal.[35] "Wireless cable" frequencies are also being used as a high-speed Internet delivery mechanism,[36] although

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[33] This problem can be addressed within a cable system in various ways. For example, as the number of cable modem subscribers grows, the system can be configured so that the channel carrying the Internet data in one segment of the system only carriers data for subscribers served by that segment, while the same channel in other parts of the system carries data for other subscribers. Moreover, if subscribership reaches a high enough level, additional channels can be devoted to the delivery of Internet access service.

[34] *See, e.g.*, R. Needleman, "Ricochet SE Wireless Modem: the coolest toy," *C|NET Reviews* (June 5, 1997), available in www.cnet.com/Content/Reviews/JustIn/Items.

[35] *See* G. Arlen, "Cheap Backlog, Terabytes of Dreams," *Multichannel News/Broadband Week* (April 27, 1998) at 158. WebTV will combine the bandwidth in broadcast television signals with very large set-top-box storage devices to produce a large "cache" of Internet and other data in each subscriber's home. *Cf.* nn. 25 & 26, *supra,* and accompanying text.

[36] *See, e.g.*, PR Newswire, "QuadraVision Launches High-Speed Internet Service Package From Online Systems Services; Nevada Wireless Provider Offers New Service In Two Major Markets" (April 16, 1998); Online Newsletter, "SpeedChoice: New Wireless Internet Service Debuts In Phoenix" (April 1, 1998) (SpeedChoice uses MMDS frequencies for high-speed Internet downloads); S. Yim, "Company Courts Net Speeders," *The Oregonian* (March 11,
(continued...)

line-of-sight problems (including interference and blockage from buildings and trees) may limit the number of customers that can actually receive the signals.[37] "Wireless fiber" utilizing the 38 GHz band is presently providing two-way data service in numerous markets,[38] and the Commission just completed the auction of LMDS spectrum, which can also be used for this purpose. In addition, the Commission has held that broadcasters may use HDTV spectrum to deliver high-speed Internet access.[39] Finally, spread-spectrum techniques in unlicensed spectrum bands can provide high-speed Internet connectivity.[40]

Satellite Systems. The DirecPC service, offered by Hughes, is an operational service that downloads Internet data at speeds of 400 kilobits/second to subscribers who obtain relatively small satellite receivers for their homes or offices.[41] Like a one-way cable system, however, a telephone return path is presently required for

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[36](...continued)
1998) at B1 ("American Telecasting Inc., a wireless cable company based in Colorado, quietly started testing its version of high-speed Internet access with Portland-area users in January. It officially rolled out the service [in late February], promising a minimum download speed of 750 kilobits per second ... .").

[37] *See* Online Newsletter, "SpeedChoice: New Wireless Internet Service Debuts In Phoenix" (April 1, 1998) (noting line-of-sight issues with MMDS frequencies).

[38] *See* C. Wilson, "Latest Work of ART: Data Network," *Inter@ctive Week* (March 30, 1998) at I-1 (describing Advanced Radio Telecom Corp.'s 38 GHz wireless data network services).

[39] Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service, 12 FCC Rcd 12809 at ¶20 (1997); *see also* Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service, *Fourth Report & Order*, 11 FCC Rcd 17771 (1996).

[40] *See, e.g.*, D. Hughes & D. Hendricks, "Spread-Spectrum Radio," *Scientific American* (April 1998).

[41] *See* R. Barrett, "DirecPC To Ride On Epoch Pipes," *Inter@ctive Week* (March 9, 1998) at 12.

DirecPC.[42] Other announced satellite communications systems, such as Teledesic and Celestri will also be suitable for relatively high-speed Internet connections, and can be particularly effective in rural and remote areas.[43]

Entrepreneurs are working to meet the growing market demand for high-speed Internet access using these different technologies. As noted above, backbone providers are increasing network capacity. LECs are rolling out various xDSL-based services.[44] Cable companies are marketing cable-delivered high-speed Internet services.[45] At least one satellite system is operational and others are nearing operational

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[42] *See id.*

[43] *See* A. Hickman, "Surfing By Satellite: Countdown To Internet-In-The-Sky Services From Teledesic And Celestri," *PC Magazine* (May 5, 1998) at 30; Prepared Testimony of Russell Dagget (President, Teledesic L.L.C.) Before The Senate Commerce, Science, And Transportation Committee, Subcommittee on Communications (April 22, 1998) ("Dagget Testimony") (available via LEXIS) ("It will be no more difficult or costly for Teledesic to serve remote regions of Alaska or Montana than to serve midtown Manhattan or Downtown Washington, D.C.")

[44] ILECs including U S WEST, Ameritech and GTE have all announced major ADSL rollouts. *See* F. Dawson, "GTE Plots Huge ADSL Rollout," *Multichannel News/Broadband Week* (March 23, 1998) at 47-48 (noting that U S WEST "has already announced plans to provision central offices serving 5.5 million lines"). This strongly suggests that Petitioners do not need the special regulatory arrangements they are seeking in this proceeding in order to provide them with adequate incentives to invest in high-speed Internet access facilities and services. Moreover, xDSL equipment vendors, along with ILECs (including Petitioners) have formed a consortium, the Universal ADSL Working Group, "whose charge is to propose a simplified version of ADSL, knows as G.Lite or 'universal' ADSL, to the International Telecommunications Union (ITU) for standardization." *See* P. Bernier, "Eliminating the Barriers to ADSL," *X-Change* (March 1998) at 6. While this version of xDSL service provides less bandwidth than traditional ADSL, it eliminates the need for a "splitter," which is "the device that separates the telephone conversation from the data stream on ADSL links." This results in substantial installation cost savings for telephone companies, since there is no longer a need for a service technician to visit the home. *Id.*

[45] *See* C. Weinschenk, "Modems For The Masses," *tele.com* (December 1997) at 35-36 (describing San Diego rollout of Time Warner's Roadrunner service and Cox@Home service).

status.[46] With this activity underway, even Petitioners were correct that regulation is slowing down the deployment of xDSL (and the record suggests that they are quite wrong), it is impossible to determine whether this indicates that there is any real problem with the pace at which high-speed Internet access technologies as a whole are being rolled out — the only relevant inquiry under Section 706.[47]

In these circumstances, there are no reasonable grounds for Commission intervention in the market to improve the "incentives" of one particular group of competitors to deploy their currently favored high-speed Internet access technology, particularly at the expense of fundamental, pro-competitive statutory policies. Nothing in Section 706 suggests that the Commission should be concerned with which segments of the communications industry (broadly construed) deliver "advanced communications capability." Quite to the contrary: the "advanced communications capability" that Section 706 directs the Commission to encourage is defined in a thoroughly technology-neutral way. Congress expected that many different industry segments will participate in the process, and expected that the FCC would not favor any industry segment or company in implementing Section 706.[48]

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[46] *See* note 43, *supra.*

[47] Moreover, the record is replete with evidence that xDSL technology would have been deployed much faster (whether by end users or competing carriers) if Petitioners and other ILECs had been working to facilitate the overall deployment of this technology. *See, e.g.,* DSL Comments at 5-6, 18-19; COVAD Comments at 7-11; WorldCom Comments at 37-39; MCI Comments (Bell Atlantic) at 15-16. In fact, the record suggests that Petitioners and other ILECs have been attempting to delay the deployment of the technology and to shape its evolution in a manner that favors their own use of it as an end-office-based service, as compared to different configurations that would facilitate competitive provision of xDSL. *Id.; see also* Comments of APKNet, et al. at 9-10.

[48] *Cf. Brunswick v. Pueblo Bowl-O-Mat*, 429 U.S. 477, 488 (1977) (antitrust laws protect competition, not individual competitors). *Accord,* In the Matter of Access Charge Reform; Price Cap Performance Review for Local Exchange Carriers; Transport Rate Structure and Pricing End User Common Line Charges, *First Report and Order,* 12 FCC Rcd 15982 (1997) at ¶ 180 ("our rules should promote competition, not protect certain competitors"); In the (continued...)

Moreover, there does not appear to be any practical, market-based reason to promote xDSL deployment in comparison to other high-speed access technologies. This is because neither xDSL nor any of the other technologies discussed above is perfectly suited to deliver high-speed Internet access to the mass consumer market.[49] In addition, it is not yet clear at what price high-speed Internet access services will obtain broad market acceptance.[50] Perhaps for these reasons, at any given time industry observers have different views about which of these systems is best-suited to meet mass consumer demand. Comcast believes that meeting the objective of Section 706 — the delivery of advanced communications capabilities to ***all*** Americans — will undoubtedly require a mixture of different technologies to accommodate different circumstances.[51]

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[48](...continued)
Matter of Private Line Rate Structure and Volume Discount Practices, *Report and Order*, 97 F.C.C.2d 923, 945 (1984).

[49] To list a few of these difficulties: multiple xDSL services carried in a single cable sheath may interfere with each other and/or with accompanying voice telephone services; cable-delivered services allow multiple users to share the same bandwidth, which may affect throughput as subscribership increases; many wireless options encounter line-of-sight problems such as interference from buildings and trees; current satellite options such as DirecPC do not permit a direct consumer-to-satellite return path, and some satellite options may encounter unacceptable latencies in the context of real-time interactive services.

[50] For example, press reports indicate that Ameritech is pricing its xDSL service at approximately $70 per month (although that may include a voice telephone service on the same line). Typical cable modem service costs less. For example, Time Warner's Roadrunner service in San Diego costs only $45-$50, while the Cox@Home service can be obtained for as low as $29.95 per month. *See* C. Weinschenk, "Modems For The Masses," *tele.com* (December 1997) at 35 (chart: "San Diego Cable Modem Matchup"). *See also* Eisenach Testimony, *supra* note 26 ("We know the technologies work, but we know a lot less about robustness, costs, business models and — the most important factor of all, consumer willingness to pay.")

[51] It seems quite likely, for example, that either satellite or terrestrial wireless systems (perhaps supplemented by a "wired" telephone return path) will be better suited to provide high-speed Internet access to extremely rural areas than either a telephone-based or cable-based "wired" system. *See* Dagget Testimony, *supra* note 43. In this regard, if existing wired backbone providers cannot economically serve highly rural portions of U S WEST's territory, it is hard to see how U S WEST could do so.

c. Petitioners Have Many Options For Entering The High-Speed Internet Access Market.

Petitioners have made no real effort to identify the various technologies (summarized briefly above) that they and others can use to deliver high-speed Internet access to consumers, much less any effort to assess the relative merits of those technologies from the perspective of cost, widespread availability, or technical suitability. Instead, Petitioners started from the assumption that xDSL technology is the most appropriate means to achieve the purpose of Section 706, and then focused on the (supposed) regulatory disincentives to xDSL deployment. The main focus of comments was on xDSL as well. In assessing the Petitions, however, the Commission should consider available alternatives prior to giving any serious consideration to the grant of what amounts to a waiver of two of the key pro-competitive provisions in the Act.

For example, nothing prohibits Petitioners from building cable or OVS systems and using them to deliver high-speed Internet access, both within and outside their regions.[52] Similarly, nothing prohibits Petitioners from obtaining certain broadband spectrum and using it to deliver high-speed Internet access. Also, to the extent that television broadcast signals, either present or future, can be used to deliver high-speed Internet access, Petitioners are free to purchase over-the-air television stations. To Comcast's knowledge, however, none have made any effort to do so.

Moreover, under Section 271(g)(2) of the Act, since enactment of the 1996 Telecommunications Act, Petitioners have been free to offer interLATA Internet services using dedicated facilities to elementary and secondary schools. As far as Comcast is

[52] The rules governing the operation of OVS systems are much less restrictive than the rules governing cable systems. Moreover, there are no current cost allocation rules regarding OVS. As Congress and the Commission found, these factors should make OVS an attractive entry vehicle for firms such as Petitioners.

aware, they have not done so — even though the text and legislative history of Section 706 suggests that these schools were a primary focus of Congressional concern.

In fact, Petitioners are all free to operate as combined CLECs/IXCs outside of their regions to sell an integrated xDSL/backbone service such as that for which they seek in-region authority here. None, however, has done so.[53] If none of the Petitioners has even tried to implement their (apparently) now-favored integrated xDSL/backbone service anywhere, despite having had the legal authority to do so for more than two years, this suggests that their basic approach may be flawed. On the other hand, it may suggest only that Petitioners themselves are aware of the difficulties in using unbundled loops and collocation to compete with an ILEC-offered xDSL service.[54]

It is highly significant that Petitioners have not pursued any of these alternatives. Ameritech, for example, has been free since February 8, 1996, to deploy an integrated xDSL/backbone service from New York to Miami, from Houston to Atlanta, and elsewhere. And, under Section 271(g)(2), it could have linked that network to an in-region interLATA network integrating Internet access and backbone service dedicated to elementary and secondary schools — a network that could have been

[53] For example, while U S WEST has apparently pursued out-of-region backbone activities, it has not combined those activities with xDSL services delivered over (for example) unbundled local loops obtained from BellSouth, Ameritech or other ILECs.

[54] In this regard, while COVAD compellingly details its difficulties in obtaining xDSL-capable loops from Bell Atlantic, it appears to have had more success with Ameritech and Pacific Bell. *See* COVAD Comments at 8-11, 14; R. Barrett, "California Customers Love Their XDSL Service," *Inter@ctive Week* (February 16, 1998) at I-13. *See also* DSL Comments at 12-14; AT&T Comments (Bell Atlantic) at 16-19; Level 3 Comments at 11; *id.*, Exhibit A at 6; WorldCom Comments at 19-21, 36. If the real source of any problem with xDSL deployment is ILEC resistance to collocation and related requirements, then any Commission regulatory efforts to spur xDSL deployment should be directed to solving ***that*** problem, as opposed to granting special regulatory relief to the firms that are causing it. As one observer noted, "competition with the telcos' DSL initiatives will depend on the ability of [IXCs, CLECs and ISPs] to force unbundling of the telcos' services in a timely manner, so competitors can create their own service[s]." C. Carr, "DSL Gets Down To Business," *tele.com* (November 1997) at 44.

expanded after Ameritech was granted full interLATA authority. The other Petitioners have had similar opportunities (each with slightly different geographic configurations). Their decision not to more fully exploit these opportunities may simply indicate that (as noted above), under present rules, deploying xDSL service as a non-incumbent is more difficult than Petitioners imply.[55] At a minimum, however, it strongly suggests that their claimed interest in a regulatory environment that encourages the deployment of high-speed Internet access service may not reflect their actual business or regulatory goals.[56]

3. The Commission Should Comprehensively Address Issues Of Access To Advanced Telecommunications Capabilities — Without Regard To Any Transmission Media Or Technology — In The Notice Of Inquiry Contemplated By Section 706

The discussion above shows that the issue of how best to deliver high-speed Internet access to consumers is complex. It is bigger than xDSL technology. It is bigger than ILECs, CLECs, and IXCs. It includes, at a minimum, telecommunications carriers, ISPs, cable television operators, broadcast and non-broadcast wireless operators, satellite service providers, analog and xDSL modem manufacturers, switch and router manufacturers, and computer, set-top box and television manufacturers.[57] It also includes software engineers and others whose innovations create more advanced data compression and streaming technologies, as well as improved Internet protocols

[55] *See* Ameritech Petition at 17-18; U S WEST Petition at 51-52.

[56] *See, e.g.* Level 3 Comments at 12; *id.*, Exhibit A at 6-8.

[57] It is not clear today whether consumers will prefer to obtain high-speed Internet access via their computers, via their televisions, via both, or via some hybrid device.

that — when implemented in the routers that switch Internet traffic — will facilitate the delivery of time-critical, high-bandwidth services over the Internet.[58]

From this perspective, it is clear that the simplistic proposals in the Petitions — let the Petitioners into the interLATA Internet business, and give them control over local xDSL-based Internet service to a degree not permitted by Section 251(c) — will do little to address any "problem" with high-speed Internet access that might actually exist. As noted above, the market is plainly responding to the need for more raw "capacity" on the backbone, as well as to the other, subtle issues that may actually contribute more directly to data delivery delays.[59]

More fundamentally, the effect of Petitioners' proposals would be to favor their particular technology. Indeed, Petitioners seem interested not only in favoring xDSL over other technologies; they appear to be interested in encouraging the development of xDSL technology in carrier-centric way, so that xDSL equipment is almost necessarily embedded in central office-based applications.[60] For these reasons, adopting Petitioners' proposals would not accelerate the overall deployment of high-speed Internet access service. Instead, such a course would inevitably deprive

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[58] For example, new Internet protocols support the assignment of different priorities to different packets, depending upon whether the delivery of the packet is time-critical (*e.g.*, part of a video stream) or not (*e.g.*, part of an email message). *See, e.g.*, V. McCarthy, "The Year To Unlock The Internet," *Telephony* (December 15, 1997); C. Perey, "Learn From The IP Video Pros," *Network World* (October 20, 1997) at 57 ("The Resource Reservation Protocol (RSVP) provides a mechanism to reserve bandwidth for a particular end-to-end intranet or Internet-based session. It will address the bandwidth allocation need to some degree when it's phased into existing newtorks over the next few years.")

[59] *See, e.g.*, WorldCom Comments at 42-43; Intermedia Comments at 17.

[60] *See* F. Dawson, "GTE Plots Huge ADSL Rollout," *Multichannel News/Broadband Week* (March 23, 1998) at 47-48 (noting that U S WEST "has already announced plans to provision central offices serving 5.5 million lines"). *See also* "Random Access," *Inter@ctive Week* (February 16, 1998) at 25 ("Industry insiders say remote access equipment is headed for the central offices (COs) of telecommunications carriers.")

consumers of the benefits of a more robust array of market-driven alternatives for high-speed Internet access.

In these circumstances, the Commission should reject the Petitions not simply on "legal" grounds, but because they are wrong on technical and economic policy grounds. The Petitions misidentify both the nature and scope of the Internet access "problem," and the importance of Petitioners' own favored xDSL technology to the solution of any problem that might exist. Stated bluntly, the analysis in the Petitions is both carrier-centric and bandwidth-centric, when providing high-speed Internet access to "all Americans" involves much more than carriers and much more than bandwidth.

As described above, many different technologies are vying for consumer acceptance. Consequently, there will almost certainly be many different ways to meet Section 706's challenge to deliver high-speed Internet access to "all Americans." Each solution will involve different compromises among the fundamental elements of bandwidth, memory, and computing power. It is highly unlikely that one particular approach will ever be "best," given the continuous innovation in the relevant technical disciplines, as well as the vastly different situations of different consumers (*e.g.*, a dense suburb near a telephone company central office and a cable headend, vs. a highly rural ranch or farm). Instead, a mix of solutions will be required.

As a result, while the present Petitions should be dismissed, Comcast suggests that the Commission should initiate the inquiry called for by Section 706 in a timely fashion, consistent with the requirements of the law itself.[61] The Commission should frame that inquiry broadly, and invite and encourage all relevant groups to participate. Such an inquiry will allow the Commission to develop a full and robust record that addresses all facets of the issue, and, therefore, will allow the Commission

[61] Section 706 directs the Commission to begin the relevant Notice of Inquiry by August 8, 1998 and to complete it by February 7, 1999.