INFORMATION TECHNOLOGY INDUSTRY COUNCIL

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April 22, 2002

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
The Portals
445 Twelfth Street, S.W.
Washington, DC 20554

Re: Errata, *Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers, Implementation of the Local Competition Provisions of the Telecommunications Act Of 1996, Deployment of Wireline Services Offering Advanced Telecommunications Capability,* CC Docket Nos. 01-338, 96-98, 98-147

Dear Ms. Dortch:

On April 5, 2002, the High Tech Broadband Coalition ("HTBC") timely filed comments in the above-captioned proceeding. HTBC recently discovered that a quotation was omitted from the conclusion of the economic study ("*The Disincentives for Broadband Deployment Afforded by the FCC's Unbundling Policies*") attached to its comments. Attached please find a corrected version of the study. Please replace the copy of the study attached to HTBC's comments with the attached corrected version.

Please do not hesitate to contact the undersigned should you have any questions.

Sincerely,

/s/ Matthew J. Tanielian
Matthew J. Tanielian
Vice President, Government Relations
ITI–Information Technology Industry Council

Enclosure

STRATEGIC POLICY RESEARCH

THE DISINCENTIVES FOR BROADBAND DEPLOYMENT AFFORDED BY THE FCC'S UNBUNDLING POLICIES

JOHN HARING AND JEFFREY H. ROHLFS[1]

APRIL 22, 2002

1. INTRODUCTION

The Federal Communications Commission's ("FCC's") unbundling policies have been criticized from many perspectives. Some of the criticisms are as follows:

a) By facilitating the leasing of facilities by competing local exchange carriers ("CLECs"), the policy affords disincentives for CLECs to make infrastructure investments. To the extent that CLECs respond to this disincentive, competition will be restricted to a limited portion of total value-added.

b) The policy provides no exit strategy for regulation. On the contrary, regulators will be needed for the indefinite future to police the pricing of a large set of unbundled network elements ("UNEs").

c) The policies tend toward an overall network design that increases costs and is vulnerable to quality-of-service problems. See, for example, Joseph H. Weber, "The Fragmentation of America's Telecommunications System."[2]

[1] Principals, Strategic Policy Research, Inc. Dr. Haring formerly served as Chief Economist and Chief, Office of Plans and Policy, at the Federal Communications Commission. Dr. Rohlfs formerly served as Head of Economic Modeling Research at Bell Labs.

[2] Available online at http://www.spri.com/pdf/reports/perspectives/perspectivesfragment2-26-02.pdf.

d) The FCC's total element long-run incremental cost ("TELRIC") costing standard has been criticized because prices are based not on incremental costs that might actually accrue, but on an artificial construct.[3]

e) The FCC's total reliance on bottom-up cost-estimation methods, with no real-world validation, is likely to underestimate costs.

All these criticisms may have merit. Nevertheless, we focus herein on yet another defect of the FCC's unbundling policies—a defect that has gotten less attention than the ones cited above but may have equally serious adverse consequences.

That defect revolves around uncertainty. Even if the FCC's unbundling policies worked well in markets with little risk, they are certain to work poorly where risks are large; e.g., in the current broadband market. The reason is that unbundling policies inherently diminish the upside potential of risky investments but do not afford comparable protection on the downside. They thereby substantially reduce the expected returns from such investments.

This phenomenon is a type of "real-option effect." Real options have been a topic of some interest by economists in recent years, and the underlying theory can be quite complex and mathematical.[4] Nevertheless, the basic principle is straightforward, as illustrated in the following example:

> Suppose that a hypothetical Federal Oil Commission ("FOC") imposed unbundling requirements on incumbent oil companies ("IOCs"). In particular, if an IOC drills a well, competing oil companies ("COCs") can get the oil by compensating the IOC for its drilling and operating costs (calculated according to a bottom-up cost model).
>
> In this example, COCs would, of course, be interested only in wells that struck oil. They would not pay any costs (TELRIC or otherwise) for holes turned out to be dry. Thus, IOCs would bear the entire loss from dry holes, while losing much of the compensating benefits from wells that strike oil.
>
> It is completely obvious that the unbundling requirements in this example vastly reduce the incentives of IOCs to drill for oil. The requirements would reduce incentives even if the FOC's costing methodology (unlike the FCC's) significantly *overestimated* the incumbent's costs.

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[3] *See Whom the Gods Would Destroy, or How Not to Deregulate*, AEI Brookings Joint Center for Regulatory Studies, Washington, D.C., 2001, for a scathing criticism of this costing standard.

[4] *See, for example,* Lenos Trigeorgis, *Real Options: Managerial Flexibility and Strategy in Resource Allocation*, Cambridge, Massachusetts, 1996, and *see* A. K Dixit and R. S. Pindyck, *Investment under Uncertainty*, Princeton University Press, 1994.

The primary point of this paper is that the FCC's unbundling requirements afford disincentives similar to those of the FOC's policies in the example. In options terminology, the FCC, through its unbundling policies, has expropriated a valuable call option from the ILEC and bestowed it on CLECs. As a result, the CLECs, like holders of call options in general, get much of the upside potential of the ILEC's investments but do not bear the downside risk. The expected return of the ILEC's investment is reduced by precisely the value of this call option. In this way, unbundling requirements afford a strong investment disincentive for the ILEC.

Real options are actually a more modern and rigorous restatement of a concept advanced more than a half-century ago by Joseph Schumpeter. Schumpeter observed that, in order for firms to have an incentive to bear risks, they must have the prospect of earning supra-competitive profits if the venture turns out to be successful.[5] It follows that unbundling requirements which erode such profits also erode the incentives to make the risky investments in the first place. Thus, it can be said that unbundling requirements in risky markets are suspect from the perspective of both new and older accepted economic theory.

In general, unbundling requirements expropriate much of the upside potential of ILEC broadband investments. In addition, sub-loop unbundling requirements (i.e., requirements to offer portions of loops as UNEs) bestow a second type of real option on CLECs. In particular, CLECs are given the option to purchase sub-loop UNEs at TELRIC rates that usually do not include the cost of retrofitting remote terminals that were not designed for that purpose. That is, ILECs are required to construct at the remote terminal a point of interconnection ("POI") that is capable of accommodating CLECs' leasing of sub-loop UNEs. The costs of doing so are substantial, especially where space at the remote terminal, which may simply be a pedestal, is limited. The additional investment will be unproductive if CLECs choose not to exercise their option to lease the sub-loop UNEs. The return from deploying fiber to the remote terminal is thereby reduced by the value of the call option expropriated for CLECs.

Sub-loop unbundling requirements are all the more perverse, because (as discussed below) the use of sub-loop UNEs is unlikely to be cost-effective. Consequently, CLECs are unlikely to purchase substantial sub-loop UNEs, regardless of the evolution of broadband services. Thus, the primary effect of the sub-loop unbundling requirement is to needlessly increase ILEC costs.

We demonstrate herein that the investment disincentives afforded by the FCC's unbundling policies are serious and are likely to substantially reduce ILEC investments in broadband infrastructure. We are also undertaking empirical research that will provide a rough quantitative measure of these effects.

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[5] *See* J. A. Schumpeter, *Capitalism, Socialism and Democracy* (New York: Harper & Row, 1942), 3rd ed, 1950, pp 81-106.

We will first estimate how much the unit costs of mass DSL deployment exceed current unit revenues. We will then evaluate whether future revenues are likely to be sufficiently large to make up for this short-term revenue shortfall.

We do not plan to estimate the upside profit potential *absent unbundling* for mass deployment of DSL. That potential is very large, but the (net present) values that will actually be realized are subject to great uncertainty. Nevertheless, we know that at least one large ILEC, namely SBC, placed a sufficiently high value on this upside potential to commit to mass DSL deployment through its Project Pronto.

We do plan to estimate the upside profit potential, after truncation through the FCC's expropriation of the real option. In particular, we propose to estimate the prices at which CLECs could profitably operate by purchasing UNEs and competing with ILECs to supply DSL service. For this purpose, we propose to use the Telcomp model that we previously developed and filed before the Commission.[6] The final step of our analysis will be to estimate the profits that ILECs could realistically expect to make, facing such competition from UNE-based CLECs.

We will additionally take account of the incremental costs of accommodating unbundling (while maintaining quality of service) at both the loop and sub-loop levels. These costs are additional offsets to the profitability of DSL deployment by ILECs.

Our preliminary analysis suggests that DSL's upside potential, after truncation by the FCC's unbundling requirements, cannot justify mass deployment of DSL. Consequently, SBC's withdrawal from Project Pronto can be interpreted as a rational response to the unbundling requirements. The bottom line is that the FCC's unbundling requirements have caused a substantial decline in DSL investment, to the detriment of the public.

2. CURRENT STATUS OF ILEC BROADBAND DEPLOYMENT

According to Cable Datacom News there were 7.2 million cable modem customers compared to 3.5 million DSL subscribers, in the U.S., at year end 2001. These data indicate that ILEC provision of DSL has become quite a significant business activity. Nevertheless, at the end of 2001, only approximately 3 percent of U.S. households had DSL.

Depending on one's perspective, one may regard the current pace of DSL deployment as fast or slow. G. Faulhaber has observed that the rate of growth has been more rapid than that of certain

[6] Strategic Policy Research, Inc., *Description of the TELCOMP© Model Version 1.4, and Results of its Application to the Atlanta LATA* (June 17, 1999). A working model of TELCOMP is available at http://www.spri.com.

other innovations in their early years; e.g., cellular service.[7] On the other hand, DSL growth has been much slower than that of cable-modem service, which is not subject to any unbundling requirements.[8]

3. DSL TECHNOLOGIES

DSL deployment to date has consisted largely of attaching DSL modems and DSL access multiplexers ("DSLAMs") on copper loops that can support DSL service. Various DSL technologies have evolved that can be used, depending on the capabilities of particular loops. These technologies include asymmetrical DSL ("ADSL"), high-speed DSL ("HDSL") and symmetrical DSL ("SDSL"). These are all characterized by different serving technologies, different data rates and different distance limitations. None of these services can operate on lines longer than 18,000 feet in the United States, since at this distance the lines typically contain loading coils that allow them to efficiently provide voice-band service. Loading coils are inductive devices that improve the ability of the line to carry low-frequency voice signals, but essentially eliminate the ability to carry the higher frequency DSL signals. Below 18,000 feet, achievable bandwidth increases as distance decreases, with about 12,000 feet generally considered the cutoff point for 1.5 Mbps service in one direction, the data rate necessary to support VHS quality television signals.[9] Furthermore, an increasing number of lines, some shorter than 12,000 feet, are being carried on subscriber line carrier ("SLC") systems for part of their length. Current SLC systems allow 64 kbps for each line and therefore cannot support DSL services without modification.

In addition to the issues of throughput for longer loops discussed above, other problems appear as deployment penetrations increase. One problem is the general non-uniformity of the loop plant. These wires, built to handle telephone conversations, and designed for easy rearrangement as customers connect and disconnect, contain numerous irregularities. Aside from the issues of splices (of which there are many) not being tight enough to provide solid low-resistance connections, and old wires that may have thin insulation in spots, there is the possibility of "bridge taps," extra sections of wire left on a line to facilitate easy reconnection later if necessary. Current practices often lead to reassignments of lines that are experiencing

[7] *See* Gerald R. Faulhaber, *Broadband Deployment: Is Policy in the Way?*, 2002.

[8] "Broadband Subscriber Base Doubles in 2001," *Cable Datacom News*, March 1, 2002 (www.cabledatacom-news.com/mar02/mar02-1.html).

[9] *See* Vassilios Mimis, *et al*, *Broadband Infrastructure (Services, Networks and Facilities)*, The National Broadband Task Force, Canada (http://broadband.gc.ca/English/resources/broad_infra.pdf) ADSL at 52; Computer Science and Telecommunications Board, National Research Council, "Broadband: Bringing Home the Bits," National Academy Press, at 125-129, and Appendix A, Broadband Technologies, pp. 259-262.

difficulties to other pairs of wires. This becomes more difficult to do as the DSL population expands. In addition, if too many DSL lines are placed on the same cable pair, it may be difficult to assign them to wires in a way that will avoid interference, or crosstalk, between services.

The combination of the line irregularities and the crosstalk potential makes it difficult to achieve the desired data rate, even on some lines that are shorter than the nominal maximum length for that data rate. Indeed, the history of DSL shows that getting the service running for a particular customer is often difficult.

As mentioned above, the maximum bandwidth is a function of many technical factors, but most importantly the length of the copper line that must be used. In order for the broadband market to achieve its potential, video programming of at least VHS quality must be supported. There seems to be little doubt that this data rate cannot be carried over DSL on lines longer than about 12,000 feet. Even this may be questionable in some circumstances. In any event, this limitation, taken together with the current design of SLC systems, excludes a large fraction, perhaps as much as 50 percent, of the residential market unless appropriately configured fiber facilities are used to extend the loops and reduce the length of copper wire.

For these reasons, DSL growth to date should not be regarded as the early adoption of a service that may ultimately serve the mass market; i.e., be capable of reaching (say) 80 percent of residences. On the contrary, adding DSL on copper lines that can support DSL is an activity that will top out long before reaching the mass market.

The bottom line is that DSL, as it is usually deployed today, has limited reach and capacity. It cannot serve the mass market. In the next section, we examine what must be done if the mass market is to be served.

4. EXPANSION TO THE MASS MARKET

The limitations described in the preceding section do not inhere in broadband services supplied by ILECs. On the contrary, ILECs could supply services of high bandwidth to the entire mass market. Doing so, however, would entail large fixed investments.

As mentioned above, supply of DSL service to the mass market requires a substantial upgrade of the current network. Currently, telephone loops containing more than about 12,000 feet of copper cannot reliably carry VHS-quality television signals to end users. In order to reach the mass market, fiber optic systems capable of carrying 1.5 Mbps for every line connecting to them would need to be deployed throughout the network. These systems would be placed in the so-called "feeder" sections of the network, allowing the portion of the loop between the wire center and the remote terminal to utilize fiber optic facilities. Thus, the length of the copper portion of the loop is shortened by the length of the fiber. There is no technical limit on the reach of the fiber. The choice of how much fiber to deploy is an economic one, driven by the configuration of the particular wire center area. Although fiber cables have ample capacity to support the bandwidth, terminal equipment different from that now commonly used to support voice-grade lines needs to be deployed. As discussed above, a current SLC system is arranged to carry only 64 kbps for each copper wire it is connected to. This obviously is inadequate for 1.5 Mbps DSL services.

As discussed in detail below, transmission of video programming may turn out to be the single most valuable broadband application. If this application is to be supported, substantial additional investments must be made, over and above those of the transmission system itself.

In particular, since the DSL line can carry only a single video signal at a time, a video switch in the wire center is needed, as well as a broadband feed to the wire center from a "headend" carrying all the video programming to be distributed. The cable box at the customer's premises then must be able to initiate an upstream signal to select a channel for delivery over a particular line. If a large number of "movies on demand" are to be made available, it may be appropriate to archive these centrally, and dedicate 1.5 Mbps lines between the central archive and the wire center, where they can in turn be connected to the DSL line, for the duration of the movie. There may be other architectures for meeting this need, but none of them is simple and none of them is cheap.

According to Ken Twist of Ryan Hankins and Kent (discussing SBC's Project Pronto),

> [T]o deploy these services successfully, in all regions, SBC will have to upgrade their plant to handle burstable bandwidth, multicast (ATM and/or IP) to the edge, add headend servers, billing servers, OSS integration, etc. This entails more than simply re-selling a dumb pipe. Their network needs significantly more intelligence than it has. To do so will require significant capital investment.

All the investments required for DSL loops and systems, and video-distribution systems are largely irreversible. That is, most of the investment cannot be productively redeployed if the DSL market falls short of expectations. In particular, the ILEC will lose most of the value of its investments if demand for broadband services does not materialize or if the competitive battle is lost to other broadband suppliers.

More generally, all DSL investment over and above attaching DSL modems and DSLAMs to copper loops that can support DSL is risk capital. The ILEC making such investments has to be prepared to lose the productive value of virtually all this capital if things go badly. There needs to be substantial upside potential to counterbalance this risk.

In the next section, we examine the broadband applications whence cometh this upside potential.

5. BROADBAND APPLICATIONS

In this section, we examine what we believe are the four most important (generic) broadband applications that can be accommodated on DSL. They are: (1) transmitting large files; (2) advanced web pages; (3) downloading of music; and (4) downloading of video programming. Of special importance are the bandwagon effects associated with these applications.

5.1. TRANSMITTING LARGE FILES

An important benefit of broadband Internet access is to improve upon activities that already take place online. For example, email and the transmission of files (e.g., email attachments) is made easier through the use of broadband. Over a narrowband connection, the transmission of a large file can be a laborious task. Through the use of broadband, however, many files can be transferred in the time that it normally takes one file to be transferred over a narrowband connection.

Broadband connections can be especially useful in the transmission of large email attachments. In fact, broadband may allow email to evolve into a video, or audio based method of communication. As these files would be considerably larger than today's average email files, only broadband connections would allow them to be sent quickly and smoothly.

Nevertheless, for many Internet users, the value of these services does not justify the costs. DSL service is priced at approximately $47 per month.[10] To the average Internet user, this fee may seem too high for the added convenience. Time may be valuable, but it may not be valuable enough to justify the cost of DSL or cable-modem services for most Internet users.

5.2. ADVANCED WEB PAGES

Another advantage of broadband Internet access is the ability to access advanced websites, which often feature bandwidth-intensive features such as high-resolution graphics, animation, streaming audio, and active menus. Many businesses could utilize advanced websites to make their websites more attractive, informative, and easy to navigate.

Another feature of advanced web pages is streaming video; i.e., movie trailers, animation, news programs and product advertisements. Narrowband dial-up connections cannot accommodate streaming video very well. Video may appear jerky and slow. While some video may be tailored for narrowband access, it is of lesser quality and sophistication.

[10] McKinsey & Company and JPMorgan H&Q, *Broadband 2001: A Comprehensive Analysis of Demand, Supply, Economics, and Industry Dynamics in the U.S. Broadband Market* (New York, April 2, 2001), p. 72.

High-definition web pages are starting to be deployed, but they are not yet widely used. In particular, none of the Top 10 U.S. websites yet offer high-definition web pages.

The same point can be made about advanced web pages that we made about transmitting large files. The application certainly has value, but it is far from clear that it has *sufficient* value to the average user to justify the cost of broadband.

5.3. BANDWAGON EFFECTS

Bandwagon effects introduce additional uncertainty into the broadband market. Several important broadband applications are subject to bandwagon effects; i.e., the value of the application to a user depends on the number of broadband subscribers. Bandwagon applications include advanced web pages and several applications involving transmission of large files, e.g., photographs. As with many bandwagon products, there is a chicken-and-egg problem. In particular, applications suppliers (e.g., proprietors of web pages) are reluctant to use broadband, because so few consumers have broadband access. At the same time, users who would value such applications are not induced to get broadband Internet access, because so few applications are available. A similar chicken-and-egg problem exists for transmission of photographs. The demand for digital cameras is limited, because it takes so long for narrowband Internet users to receive photographs. At the same time, narrowband users do not have much incentive to upgrade to broadband to receive photographs, because so few persons have digital cameras.

It is possible that this chicken-and-egg problem will ultimately be solved, and broadband bandwagon applications will become commonplace. Conceivably, demand for broadband access will become subject to positive feedback, after these applications achieve critical mass.[11]

Nevertheless, the future of these applications involves considerable uncertainty. There is certainly no guarantee that critical mass will be achieved anytime soon.

5.4. DOWNLOADING OF MUSIC

The possibility of distributing music over the Internet offers the potential efficiency of the purchaser's being able to browse and sample from a huge selection of music from his/her home or office. This approach provides a very cost-effective means of distributing music purchases—it increases selection and convenience to the consumer and saves tremendously on overhead costs (e.g., store building, staff, etc.) to the seller. For this reason, downloading of digital music has the potential to become the preferred method of distributing pre-recorded music.

[11] *See* J. H. Rohlfs, *Bandwagon Effects in High-Technology Industries* (The MIT Press, 2001) for discussion of bandwagon effects; in particular, the chicken-and-egg problem, critical mass, and positive feedback.

Broadband access provides a much more convenient means of selling music via a download over the Internet than is possible with narrowband access. Music downloads are much quicker with broadband. One recent estimate is that a typical digital format MP3 music file takes 10 minutes to download with narrowband, but only one minute with broadband.[12] The inconvenience of narrowband is all the greater if the user wishes to download a larger quantity of music.

At present, however, copyright holders are reluctant to give permission for their music to be downloaded. The convenience and accessibility to music over the Internet threatens the copyright-holder's ability to monitor copies (and thereby collect royalties) on any copies made of the music. Furthermore, copyrights have historically been strongly defended. Prior to the advent of sharing facilities (and even prior to the advent of the Internet) the entertainment industry had been protective of its video and music products. Earlier technology and products such as audio and video tape recorders caused great apprehension among artists and copyright owners, who relied upon retail sales of their products and anticipated that copying their products would decrease sales. The music industry's experience with Napster has only heightened its concerns about unauthorized copying.

There is some movement toward a solution of the copyright problems associated with downloading music. Recently, a number of record companies, including Sony, AOL Time-Warner, EMI, and Bertelsmann, have begun, or announced plans to begin music download services. Nevertheless, further progress needs to be made before a broadband supplier could depend on being able profitably and legally to offer music for downloading.

Currently, it is difficult to protect copyrights while distributing music online. The digital format makes it extremely easy to copy and share individual songs. It also allows users to create their own CDs using writable CD drives. The music industry has recently devised a number of methods that would allow users to download songs, but prevent them from copying files to either a CD, a portable player, or to the hard drive of a peer. Unfortunately, such restrictions may dissuade potential users from using download services. Although the users would benefit from the savings in time and money, they also may feel the restrictions outweigh the benefits. Listeners enjoy being able to take their music with them. The restrictions may persuade music listeners to avoid digital music and continue to purchase music through traditional methods, or obtain music for free, peer-to-peer, over the Internet.

All in all, downloading of music is an application with great upside potential. It could generate substantial demand for broadband services, but the extent of demand is not known. We know from the experience of Napster that many users are willing to download a very large quantity of music if the price is zero. We do not know how much they would download, if they had to make a payment to copyright holders, as well as paying for broadband service.

[12] "European Telcos Take Lead Over Cable in Broadband Race," Dow Jones International News (1/5/2002).

5.5. DOWNLOADING OF VIDEO

Another application for which broadband access might be valuable is the downloading of video entertainment, particularly, movies. This application is very awkward using narrowband technology, because the downloading takes many hours. During the entire downloading period, the user's narrowband Internet channel is congested; so other Internet applications are degraded.

Some entertainment movies are beginning to become available. In the top 35 U.S. markets (i.e., largest metropolitan areas), MSN has worked with SBC, Verizon and Qwest to provide MSN Broadband service to make some movies available on-demand through the company *Intertainer*, owned by Microsoft, Sony, NBC and Intel. Users may access the *Intertainer* service through any ISP or cable operator.[13] But these activities are just getting started. As of now, relatively little video programming has been made available on the Internet.

In addition to limited availability of content, downloading of video programming faces potential copyright complications. The recent experience with Napster and users' downloading and swapping music files without copyright permission concerns the movie industry. Possible solutions to these concerns in the form of securing copyright protection are in the works. For example, this summer, five movie studios announced a joint venture to provide video-on-demand services over the Internet and encoded by Sony's "Moviefly" digital rights management technology.

Once video-on-demand services are finally established, they are bound to experience a great deal of competition from incumbent multi-channel video programming providers. Cable companies have already entrenched their services into most residential areas. They control a majority of the multi-channel video programming market, followed by the direct broadcast satellite industry. A new entrant, supplying video-on-demand service would provide competition in this market, much to the benefit of consumers. Nevertheless, a new entrant might find it difficult to compete with these incumbent multi-channel video programming suppliers, as they already have an established customer base. In addition, much of the cost of incumbent multi-channel video programming suppliers consists of sunk costs; so short-run marginal costs are very low. The incumbent suppliers could profitably offer very low prices rather than lose customers to a new broadband entrant.

We believe that downloading of video programming could potentially be an enormously profitable enterprise. On the other hand, many things must happen before this application can succeed: additional copyright problems must be solved, and the broadband supplier must meet serious competitive challenges from incumbent multi-channel video programming suppliers.

[13] Jefferson Graham, "Companies Finally Get Busy Selling Downloadable Vides-on-Demand," *USA Today* (November 12, 2001) at 6E.

6. THE BROADBAND MARKET IS POTENTIALLY QUITE LUCRATIVE BUT INVOLVES LARGE RISKS

The preceding discussion makes plain that ILEC broadband deployment has enormous upside potential. It could conceivably be the technological successor to the cable-television industry, videocassette rental stores, and record (CD and audio-tape) stores—in addition to speeding up and improving Internet access.

At the other extreme, broadband could be a commercial failure—at least for a long time into the future. The copyright problems for downloading video programming and music may not be satisfactorily solved. Even if they are solved, the hoped-for demands may fail to materialize for other reasons; e.g., consumer inertia, intensified competition by incumbent multi-channel video programming suppliers and/or the development of still newer technologies.

Meanwhile, if ILECs are to exploit this opportunity, they must make very large fixed investments before the extent of demand becomes known. The investments are largely irreversible and will be largely unproductive if demand does not materialize. The telephone plant of the ILECs is generally fixed in space. The loops, whether they are made of glass or copper, or some combination, are typically installed in ducts, in the ground, or (less frequently) on poles. They need to be pulled into place and spliced at frequent intervals. The terminal equipment is usually hard-wired into place at remote terminals. Furthermore, the cost of installing the equipment is usually a large part of the total cost of the facility. The cables, in particular, are not generally reusable in a different location (they would need to be cut and respliced—not an attractive idea). Salvage value is practically negligible. Thus, a large part of the investments will need to be written off if the broadband venture is not successful.

This situation is not at all uncommon in the high-technology world, which is not for the faint of heart. Players in this high-stakes game are required to put huge amounts of risk capital on the table. Success can lead to fabulous wealth, but many players lose their shirts.

7. WILLINGNESS OF ILECs TO BEAR THE RISKS

Some ILECs have indicated that, in the absence of unbundling requirements, they would be willing to put up the large amount of money required for a seat in this high-stakes game. In particular, in October 1999, SBC announced "Project Pronto," its ambitious plan "designed to transform SBC into a broadband service provider capable of meeting customers' needs for data, voice and video products" in its 13-state territory on an accelerated three-year schedule, at a cost of $6 billion.

One element of Project Pronto was the deployment of next-generation digital loop carrier ("NGDLC") at "neighborhood gateways" or remote terminals designed to eliminate loop length and network condition limitations on DSL and make high speed broadband services available to 80 percent of its residential customers.

In September 2000, SBC published a notice[14] providing a technical description and initial targeted sites for the ADSL capable neighborhood gateways and invited interested CLECs to contact SBC. The document defined the technology specifications: use single-mode fiber, support POTS and xDSL services, and support OC3 SONET transport between nodes. Separate, dedicated OC-3cs were planned for voice and data, with the data OC-3cs terminating on an Optical Concentration Device ("OCD") in the central office. Additionally, the OCD routes packetized data traffic to the appropriate ATM network. New element management systems would be deployed to manage these network elements, with flow-through provisioning of the OCD and RT for end-user service orders. During 2000 and early 2001, SBC launched several marketing initiatives to expand its DSL business. By January 2001, it had installed 2,000 residential gateways.[15]

Project Pronto was an event of great significance with respect to broadband. It had the potential to offer broadband Internet access and other broadband applications to the great majority of SBC's subscribers. Project Pronto goes beyond attaching DSL modems and DSLAMs to copper wire that can support DSL. It is a large first step in offering broadband services to the mass market, much of which cannot be served by attaching DSL modems and DSLAMs to existing copper wires.

A key point in assessing Project Pronto is that broadband investments, if unregulated, necessarily benefit consumers. As a result of such investments, consumers will have the option of purchasing broadband services, and some will choose to do so. Consumers benefit even if the investment does not recover the full amount of the ILEC's cost of capital, because in that case ILEC stockholders bear the loss. Conversely, consumers necessarily lose if unbundling requirements cause ILECs *not* to make the investment.

In summary:

> Broadband investments are a risk that may or may not pay off for ILECs. Public policies (such as unbundling requirements in risky markets) that cause such investments not to be made are sure losers, in the sense that they are certain to be detrimental to consumers.

[14] Project Pronto Notice, Issue 2.1, September 1, 2000.

[15] *See* Matt Stump, "Telcos' Dilemmas a Good Sign for Cable," *Broadband Week* (December 3, 2001).

8. NEGATIVE IMPACT ON ILEC BROADBAND INVESTMENT

ILEC investment in broadband has been substantially negatively affected by the FCC's unbundling policies.

8.1. SLOW-DOWN OF DSL DEPLOYMENT

There are strong indications that DSL may not grow nearly as rapidly in the future as it has in the past. According to Internetnews.com, three of the largest ILECs (Verizon, Qwest, and SBC) have "either abandoned DSL entirely or significantly slowed their deployment rate in their coverage areas."[16] On December 13 2001, Qwest announced that it planned to scale back the rollout of its high-speed data services. The company stated that it would now concentrate its efforts on expanding its DSL services in the areas where it is already available. Qwest did not expect to expand its service area into new regions. In other words, Qwest will focus on expanding its subscriber base, but will no longer lay new lines. Internetnews.com reported that Verizon has decided to scale back its DSL expansion plans. Instead the company will focus on retaining its current customers and improving customer service.[17] Finally, SBC also announced a slowdown in DSL expansion. As part of its Project Pronto plan, the company increased its DSL-capable locations to 25 million, allowing its coverage area to increase by 6.7 million customers.[18] Internetnews.com reports that Project Pronto has been "all but given up on."[19] This event is discussed in more detail below.

These developments can be easily understood in light of our findings in this study. As we discuss in detail below, current broadband applications justify only limited deployment of DSL. Any further DSL deployment must be justified, in large measure, by the prospect of supra-competitive returns on new broadband applications. Unfortunately, as we demonstrate in this study, those prospects are substantially diluted by the FCC's unbundling requirements.

8.2. THE DEMISE OF PROJECT PRONTO

In early 2001, SBC delayed by one year the target date for completion of its DSL deployment. In October 2001, two years after the original announcement of Project Pronto, SBC made the

[16] *Ibid.*

[17] Jim Wagner, "BellSouth: A DSL Success Story," downloaded from http://www.internetnews.com/isp-news/article/0,,8_948321,00.html (January 3, 2002).

[18] SBC Investor Briefing, "SBC Fourth-Quarter Diluted Earnings Per Share Increase 12.3% to $0.64 Versus $0.57 a Year Ago, Before One-Time Items," January 24, 2002.

[19] Jim Wagner, o*p. cit.*

following announcement—disheartening to those who hoped to see a rapid rollout of broadband technology.

> Since the announcement of Project Pronto, federal and 10 out of the 13 state regulators in SBC's territory have imposed or are considering additional unbundling and other requirements. In October 2001, faced with ever-increasing regulatory risk and uncertainty combined with a severe economic slowdown, SBC announced that it would reduce capital spending by 20% in 2002 and scale back its original deployment schedule for Project Pronto.[20]

Recently the Chief Technology Officer of SBC announced a shift in focus from DSL to passive optical networks ("PONs") and a massive scale down of Project Pronto due to "the headaches involved with Project Pronto and the cost and difficulty of managing active electronics in 40,000 'huts' or 'neighborhood gateways', all requiring remote power management."[21] Of course, SBC's willingness to endure these "headaches" is much reduced, given that the FCC's unbundling policies expropriate much of the upside potential of the investments.

The demise of Project Pronto is discussed further in Section 9, as it relates to sub-loop unbundling.

8.3. OTHER ILECS

SBC is not the only ILEC that has cut back its planned broadband investments, largely as a result of regulatory unbundling requirements. As discussed above, Verizon and Qwest have also scaled down their planned investments. These two ILECs, together with SBC, account for a substantial majority of access lines in the U.S. Thus, the overall impact is quite large.

A notable exception in this regard is BellSouth, which is continuing to rapidly expand its supply of DSL. BellSouth has long had a corporate policy of deploying fiber on loops over 12,000 feet, resulting in 4.3 million lines served by remote terminals, the highest percentage in the industry. Many of them are in rural areas (serving less than 100 customers each). Relative to other ILECs, BellSouth can more easily expand its supply of DSL without making additional fiber investments (but the SLC systems previously carried on existing fiber were not configured to support DSL services).

Nevertheless, BellSouth can be expected to encounter problems as it continues to expand its supply of DSL. Much of BellSouth's past DSL deployment has been accomplished by placing

[20] *SBC Communications Inc. Comments*, filed before the National Telecommunications and Information Administration ("NTIA"), U.S. Department of Commerce, *In the Matter of Deployment of Broadband Networks and Advanced Telecommunications Services*, Docket No. 011109273-1273-01, December 19, 2001.

[21] Ross Ireland, in keynote address at the IEEE Globecon Conference (November 26, 2001).

DSL equipment at remote terminals that have enough space for such equipment. To continue expanding its supply of DSL, BellSouth will have to utilize remote terminals that have less and less available space. Modern technology provides ways to deal with such space limitations. It does not, however, provide any cost-effective way to supply DSL *and* accommodate UNE-based CLECs at remote terminals with limited space.[22] Consequently, unbundling requirements will (if continued) have a negative impact on BellSouth's DSL investment, as well as that of the other ILECs.

9. REAL OPTIONS ASSOCIATED WITH SUB-LOOP UNBUNDLING

Although all unbundling requirements pose a profound disincentive to broadband investment, the requirement for sub-loop unbundling is especially onerous and counterproductive. The concept behind sub-loop unbundling is presumably that CLECs will bring their own facilities out to a remote terminal, where they will be able to somehow connect to the ILEC copper distribution facilities. If contrariwise, CLECs lease ILEC facilities to reach the remote terminal, sub-loop unbundling is simply an extraordinarily costly way to enable arbitrage.

Accommodating sub-loop unbundling is costly, because remote terminals are often little more than pedestals in residential neighborhoods. Because of space limitations, accommodating multiple carriers is physically quite difficult and consequently expensive.

In options terminology, ILEC provision of UNE points of interconnection at remote terminals conveys a call option on CLECs. CLECs can purchase sub-loop UNEs if the broadband market develops favorably but are not obligated to do so if the market develops unfavorably.

Unbundling requirements are even less defensible at the sub-loop level than at the loop level. It is quite possible, indeed likely, that CLECs will never demand many sub-loop UNEs—no matter how the broadband market evolves.

Nevertheless, CLECs, particularly those that also provide cable-modem service, have an incentive to insist that connections at remote terminals be made available to CLECs. Doing so raises the ILEC's cost of doing business, with little penalty to the CLEC, which would not in fact need to actually utilize the connection. (If the CLECs were required to make a bona fide request, they could do so, and then cancel, paying a modest penalty.) Sub-loop unbundling requirements

[22] *Comments of BellSouth Corporation*, filed before the NTIA, U.S. Department of Commerce, *In the Matter of Deployment of Broadband Networks and Advanced Telecommunications Services*, Docket No. 011109273-1273-01, December 19, 2001.

in this case are nothing more than a successful regulatory strategy by CLECs (and cable-modem suppliers) to raise rivals' costs.

Sub-loop unbundling requirements have been especially important in causing ILECs to scale back their plans for DSL deployment. SBC, in particular, cited two important examples where SBC earlier suspended its Project Pronto buildout in Illinois following a ruling by the Illinois Commerce Commission on sharing the remote terminals which makes the expansion too costly and maybe even impossible from an engineering standpoint.[23]

The bottom line is that sub-loop unbundling requirements substantially amplify the investment disincentives afforded by unbundling requirements in general.

10. QUANTIFYING THE NEGATIVE EFFECTS OF UNBUNDLING REQUIREMENTS

This section describes our methodology for quantifying the negative effects of unbundling requirements. It also states our preliminary results.

A recent study by McKinsey and J. P. Morgan estimated the average revenues and costs of mass DSL deployment by a large ILEC. Average revenues for 2002 are estimated to be $47 per customer per month, declining to $43 per customer per month in 2005. Cost is estimated to be $65 per customer per month in 2002, declining to $38 per customer per month in 2005. These costs do *not* include return to capital or income taxes. [24]

According to these estimates, mass DSL deployment is expected to earn a negative rate of return in 2002. The return will improve through 2005, but even then, as shown below, revenues will fall short of covering all costs, including the cost of capital. It follows that such DSL investments will earn large short-run losses, in the relevant economic sense.

Why, then, should ILECs make such investments in mass DSL deployment? Any positive answer to this question must rely on the expected future profitability of the investments. In particular, to justify such investments, ILECs would need to envision a reasonable chance for large profits, over and above the cost of capital. Such upside prospects are all the more necessary, when one considers that the DSL market, like many high-technology markets, faces

[23] Ann Keeton, "Ameritech Halts Buildout Of Pronto Broadband SBC In Ill.," Dow Jones News Service (March 7, 2001).

[24] McKinsey & Company and JPMorgan H&Q, *op. cit.*

the risk of turning south after a few years. For example, DSL might lose market share to new packet-based wireless services, as well as to cable-modem service.

Little, if any, gain in profits can be expected from further cost declines. The McKinsey-J.P. Morgan cost estimate of $38 per month in 2005 includes only $12 per month for depreciation. Remaining costs are primarily operating costs, which are not especially susceptible to reduction through technological progress. Moreover, cost reductions resulting from technological progress may be accompanied by lowering of the demand curve for DSL. DSL's main competitor, cable-modem service, benefits from similar technological progress, and its price may decline as its unit cost declines.

It follows that any substantial increase in profitability must derive primarily from increases in revenues per line. Such increases could, quite possibly, derive from the broadband applications, discussed above. Unfortunately, with the FCC's unbundling policies, ILECs can expect to enjoy only a small part of the potential gains from such broadband applications.

10.1. TELCOMP© MODEL

The TELCOMP© model was designed to evaluate the profitability of a CLEC that has its own switch but otherwise relies on UNEs to serve its customers. The results of the model were filed in 1999 and were based on actual UNE prices in Georgia at that time.

The model determined that a UNE-based CLEC could operate profitably (rate of return of 39 percent) supplying local services to the mass market. Higher rates of return (up to 114 percent) were, however, possible by:

- Supplying long-distance, as well as local, services; and
- Targeting high-revenue customers; in particular, all business customers and the upper three deciles of residential customers.

10.2. IMPLICATIONS FOR DSL

DSL can greatly improve the profitability of UNE-based CLECs. As shown in TELCOMP©, UNE-based CLECs can make ample profits on voice services alone. The addition of DSL service offers the potential of significant increases in profits. In particular, any scenario where DSL applications evolve favorably and lead to sizable ILEC profits is all the more favorable for UNE-based CLECs. Since UNE-based CLECs need not invest in infrastructure upgrades, their costs will be significantly less than the ILEC's.

If an ILEC has made the infrastructure investments necessary to serve the mass market, these incremental costs would be large. They would in some cases include investments in new fiber-optic cables and systems. In other cases, they would involve replacing carrier systems that are already in place. Additionally, the copper portion of the loop would in many cases need to be upgraded to support DSL at a speed of 1.5 Mbps. We estimate that the cost of these infrastructure investments would average over $10 per month for loops that require infrastructure investments to support DSL at 1.5 Mbps and are longer than 12,000 feet.

The economics of ILEC mass deployment of DSL are illustrated in the two scenarios in Table 1:

Scenarios for Mass DSL Deployment: 2005		
($ per customer per month)	**Scenario 1**	**Scenario 2**
ILEC price, absent UNE-based CLEC competiton	43	66
ILEC cost, apart from cost of capital and income taxes	38	38
ILEC cost of debt*	3.6	3.6
ILEC cost of equity*	5.4	5.4
ILEC income taxes**	0.6	9.8
Total cost	47.6	56.8
ILEC profit, absent UNE based CLEC competition	**-4.6**	**9.2**
Cost of UNE-based CLEC (including cost of capital and income taxes)	NA	46.8
Price of UNE-based CLEC with profit of $10 per month	NA	56.8
* Calculated from McKinesy - J.P. Morgan estimates, assuming 6-year remaining depreciation life, debt-equity ratio of 1, 10 percent cost of debt, 15 percent cost of equity. ** Calculated assuming a 40-percent tax rate.		

Table 1

In Scenario 1, broadband applications do not develop, and the price is $43 per customer per month, as estimated by McKinsey-J. P. Morgan. In Scenario 2, successful broadband applications do develop, and the price is assumed to be $66 per customer per month, absent UNE-based CLEC competition.

In both scenarios, the cost, apart from cost of capital and income taxes, is $38 per customer per month. Also, in both scenarios, the cost of capital (debt plus equity) is estimated to be $9 per customer per month. Income taxes are estimated to be $0.60 per customer per month in Scenario 1 and $9.80 per customer per month in Scenario 2.

It follows that the ILEC's economic profits, absent UNE-based CLEC competition, are -$4.60 per customer per month in Scenario 1 and +$9.20 per customer per month in Scenario 2. Thus, the venture would be profitable for the ILEC, so long as the probabilities were at least one-third for Scenario 2 and not more than two-thirds for Scenario 1. The venture would therefore be attractive to an ILEC that was optimistic about the future of broadband applications.

Unfortunately, the economics become impossible, given the prospect of UNE-based CLEC competition. As illustrated in the table, such CLECs could undercut the ILEC's price by $9.20 per customer per month ($66 less $56.8) and still make a profit of $10 per customer per month—over and above the significantly positive profits that the UNE-based CLEC could make by supplying voice services alone. Obviously, the demand for the ILEC's DSL offering would be much reduced, given that a competitor has a very similar offering with a discount of $9.20 per customer per month. Consequently, the profitability of Scenario 2 is much reduced. It is reduced all the more when one considers that the ILEC loses over $10 per customer per month (the cost of unrecovered infrastructure investments) on the sale of DSL UNEs.

It follows that mass DSL deployment would definitely *not* be profitable in this example, unless the probability of Scenario 2 were far greater than one-third. Indeed, if the ILEC has to meet or beat the CLEC's price in order to attract customers, it cannot make positive profits, no matter how high the probability of success of broadband applications.

More generally, UNE-based CLECs can be expected to offer stiff competition long before ILEC profits reach a level that would provide reasonable compensation for the short-term losses that the ILEC previously incurred. As a result, the ILEC could not realistically expect to receive adequate compensation for those short-term losses. The only reason that such UNE-based competition would *not* appear is that the DSL market evolved unfavorably—in which case ILECs would absorb the losses alone.

For this reason, it is completely understandable that SBC withdrew from Project Pronto and other ILECs are scaling back their DSL investment programs. Indeed, one might ask why they did not wise up sooner. The answer is probably that the ILECs had confidence that the FCC would abandon its ill-conceived unbundling policies with respect to broadband services. From the standpoint of ILEC stockholders, any further substantial DSL investments would be hard to justify if the FCC, in this proceeding, affirmed its unbundling requirements for broadband services.

A lower bound on the investment that would be lost as a result of unbundling requirements is the $6 billion that SBC was willing to invest, absent such requirements. To obtain an upper-bound estimate, we would multiply this number by approximately three to include ILECs other than SBC. We would also need to consider investments that might be made if broadband applications turn out to be successful. The largest of these potential investments would be associated with provision of video entertainment services over DSL. All in all, the upper-bound estimate would be substantially in excess of $20 billion.

These investments, and the associated stimulation of economic activity will be largely forfeited unless the FCC abandons its counterproductive unbundling policies for broadband services.

11. CONCLUSIONS

There is currently a disconnect between putative regulatory objectives and the FCC's unbundling regime that has been adopted to implement those objectives. On the one hand, policy posits as its objective the stimulation of technological advance and innovation to promote enhanced economic productivity and growth; on the other hand, policy limits the rewards investors can rationally anticipate appropriating in the event of success and, thus, deters the necessary capital investment and risk-bearing by private enterprises.

Under the current regulatory regime, ILECs are required to unbundle network service elements and offer them for sale to CLECs at TELRIC-based prices, where there is a determination that unbundled element supply is necessary and its absence would impair competition. Creation of new network service capabilities, in general, entails sunk/irreversible investments in physical, intellectual and human capital whose economic value is uncertain and difficult to anticipate in advance. The ILEC must make such investments before market uncertainties are resolved. The CLEC, on the other hand, can wait until the uncertainties are resolved before choosing whether to purchase UNEs.

The current regime thus affords CLECs with a valuable real option—by exercising that option in a particular circumstance, a CLEC can offload investment risk on the ILEC. The real option is analogous to a call option in financial markets. The CLEC can see whether the assets appreciate in value before deciding whether to purchase them at cost.

This one-sided regulatory policy is apparently an attempt to promote competition by bestowing the call option as a "free lunch" upon CLECs. The hope is that the CLEC will be encouraged to enter the market and expand its operations if it can eat lunch without paying for it. Given that the ILEC's DSL ventures are unregulated, ILEC ratepayers cannot be called upon to pay for the lunch, either.

The only catch—but in this case it turns out to be Catch 22—is that there is not really any free lunch. In this case, the value of the call option is expropriated, in an expected-value sense, from ILEC stockholders. The ILEC is expected to pay for lunch but not eat it.

Incumbent exchange carriers are required to offer rivals access to various 'unbundled' network service elements at rates that (it is, in our view, plausibly contended) fail to afford sufficient remuneration to make the needed capital investments economic. Moreover, the current rules, at least as heretofore interpreted by the FCC, require a variety of 'extreme' forms of service element unbundling that, while posing numerous technical difficulties and serious threats to service integrity, produce little by way of genuine operating advantage.

The current regulatory regime thus offers incumbent telcos a "coin flip" any rational economic actor would presumably prefer not to make: if their risky investments in new technology turn out to be an 'incomplete success,' they and their shareholders are left holding the proverbial bag; if the risky investments turn out to be a (complete!) success, the regulator's technology "sharing" rules rule out big rewards sufficient to warrant the requisite risk-taking in the first place. It is a clear case of 'heads, you lose' and 'tails you don't win,' so why bother?

The point of this paper is that ILECs, faced with the prospect of this expropriation, are likely to respond by not making the investment in the first place. The regulatory regime offers would-be ILEC investors very unattractive odds that no rational investor would voluntarily entertain.

The situation is summed up as follows by Malcolm Andrew, Senior Policy Advisor, Telecommunications Policy Branch, Industry Canada, in "Legislative and Regulatory Considerations Affecting Broadband Deployment," prepared for the National Broadband Task Force, March 2001. Mr. Andrew's comments focuses precisely on the perverse real-option effects of the FCC's unbundling policies:

> In establishing a framework for local competition, the CRTC determined that efficient and effective competition in this market would be best achieved by *facilities-based service providers*, and that such providers should not be simply customers of the incumbents, but co-carriers, equal in status. Consistent with this approach, the CRTC established comprehensive rules governing the interconnection of the networks of the Incumbent Local Exchange Carriers (ILECs) with those of Competitive Local Exchange Carriers (CLECs), designed to ensure competitive equity and full interoperability. The CRTC also ruled that CLECs be allowed to resell the local service of ILECs, *but did not require that they be provided a wholesale discount*…
>
> The CRTC also regulates the provision of DSL and cable modem service in a manner designed to foster competition and thus speed the development of these services as a means of providing relatively inexpensive, relatively high-speed Internet access. In order to provide DSL Internet access service, Internet Service Providers (ISPs) may lease all of the necessary local network facilities from local exchange carriers. In addition, DSL providers may co-locate their own equipment *in ILEC central offices and resell local loops on the same terms and conditions as apply to CLECs*. The CRTC is currently in the process of finalizing a regime requiring cable television undertakings that offer cable modem service to provide ISPs with access to the necessary cable network facilities to enable them to provide an equivalent competing service…
>
> To varying degrees, current systems hold the potential to be upgraded to operate at faster than today's standards, but the cost and feasibility of doing so would vary considerably for each system depending on the speeds chosen. Ideally, any government intervention should be designed so as not to artificially penalize any of these systems, which have been and are being deployed in good faith by private enterprise. [Emphasis added.]

If ILECs do not make DSL investments in the first place, no one eats any lunch. The ILEC gets no benefit and falls further behind in the broadband contest with the increasingly dominant cable-television industry. CLECs cannot purchase UNEs, because the underlying ILEC facilities do not exist. Most importantly, the public also comes up empty. Telecommunications users reap none of the benefits that would be expected from ILEC broadband deployment. Also, the economy does not benefit from the stimulation that would result from ILEC investment.

In short: Unbundling requirements in risky markets are counterproductive, because they expropriate a valuable real option from the investor. Their primary effect is likely to be a reduction in investment.