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CYBERJAM: THE LAW AND ECONOMICS OF INTERNET CONGESTION OF THE TELEPHONE NETWORK

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I. INTRODUCTION

The growth of Internet usage has created evident strains on the capacity of the public switched telecommunications network (PSTN)[1] as computer users employ the telephone system to access Internet service providers (ISPs). Through its enactment of the Telecommunications Act of 1996,[2] Congress established a public policy priority "to preserve the vibrant and competitive free market that presently exists for the Internet and other interactive computer services, unfettered by Federal or State regulation."[3] Later that same year, however, the Federal Communications Commission (FCC) asked in a notice of inquiry (NOI) whether, in light of the agency's policy of exempting enhanced service providers (ESPs) from paying interstate access charges, that "vibrant and competitive free market" will be preserved.[4] In May 1997, the FCC answered that question in the affirmative, in a brief passage in its report and order on reform of interstate access charges: ISPs would continue to enjoy the ESP exemption.[5] The FCC's short discussion of the ESP exemption in its report and order essentially repeated the reasoning supporting the agency's tentative conclusions in its NOI. For that reason we often refer in this Article to the rationale contained in the FCC's NOI. Using economic and legal analysis, we show that the FCC's Internet access policy is misguided.

We evaluate here the economic and legal implications of allowing ISPs to avoid paying for interstate access by taking advantage of the FCC's access-charge exemption for ESPs. We agree with the FCC's conclusion that the dramatic growth of Internet usage and Internet services "create significant benefits for the economy and the American people."[6] The ESP exemption, however, creates traffic jams at the on-ramps to the information

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1. For a complete list of the many acronyms used throughout this Article, see Appendix: Glossary of Acronyms, *infra*.

2. Pub. L. No. 104-104, 110 Stat. 56 (codified as amended in scattered sections of 15 U.S.C.A., 18 U.S.C.A., and 47 U.S.C.A. (West Supp. 1998)).

3. 47 U.S.C.A. § 230(b)(2) (West Supp. 1998).

4. Usage of the Public Switched Network by Information Service and Internet Access Providers, Notice of Inquiry, 11 F.C.C.R. 21,354 (1996) [hereinafter *Notice*].

5. 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, CC Dkt Nos. 96-262, 94-1, 91-213, 95-72, 12 F.C.C.R. 15,982, 16,131-35 ¶¶ 341-48 (1997) [hereinafter *Report*].

6. *Notice*, *supra* note 4, at 21,477 ¶ 282.

superhighway—what we call a "cyberjam." If access were priced efficiently, consumers would make efficient demand decisions, there would be incentives for the supply of additional capacity, and suppliers of transmission access would have incentives to choose the best transmission technologies. The cyberjam would abate. Our principal economic conclusions are as follows:

- Voice transmission and data transmission represent distinct types of demands requiring different pricing methods to alleviate adverse selection problems and to address the costs of serving those demands.

- Continuation of the ESP exemption is a subsidy that comes at the expense of the incumbent local exchange carrier (LEC), a subsidy that promotes free riding on the PSTN by ISPs and their customers.

- Continuation of the ESP exemption creates pricing distortions that result in inefficient consumption decisions, inefficient investment incentives, and congestion externalities.

- The FCC should exercise forbearance by decontrolling access prices and allowing the competitive market for access services to determine access pricing on the PSTN. The FCC should refrain from picking technology winners and allow markets to determine the best access technologies.

In our view, the FCC's NOI fails to address adequately the economic consequences that flow naturally from the agency's existing policy on the pricing of access for ESPs.

Until recently, research on congestion and Internet usage addressed congestion *of the Internet*—congestion of the routers and fiber-optic backbones that constitute the network.[7] The rapidly growing literature on Internet pricing and congestion makes little mention of Internet access problems.[8] However, telecommunications companies, Internet access providers, and public policy makers have become concerned over congestion of the loops, switches, and trunks of the PSTN that are used when consumers gain access to the Internet through their LECs. As we shall demonstrate, the recent shift from concern over congestion

7. *See* Jeffrey K. MacKie-Mason & Hal R. Varian, *Economic FAQs About the Internet*, J. ECON. PERSP., Summer 1994, at 75. It is evidence of the speed at which Internet usage has congested the PSTN that the article by MacKie-Mason and Varian considers only congestion and the pricing of the Internet itself.

8. *See, e.g.*, INTERNET ECONOMICS (Lee McKnight & Joseph P. Bailey eds., 1997).

of the Internet to concern over congestion of the PSTN underscores a number of questions of law and economics that have great relevance to the FCC's formulation of sound public policy. Those questions arise from the fundamental differences between the circuit-switched technology of voice telephony over the PSTN and the packet-switched technology employed to transmit data over the Internet.

The problem of congestion of the PSTN due to Internet usage has an obvious solution: the pricing of access to the Internet over the PSTN must depend on both capacity and usage. Currently, however, regulatory intervention makes it impossible to make LEC end users pay usage-sensitive rates for local access to their ISPs. Flat rates for local service result in unmetered local usage for both voice and data access. Moreover, as stated in the NOI, the FCC's policy since 1983 has been "that, although enhanced service providers (ESPs) may use incumbent LEC facilities to originate and terminate interstate calls, ESPs should not be required to pay interstate access charges."[9] The FCC evidently believes that the subsidy from incumbent LECs to ESPs that is inherent in the ESP exemption is in part responsible for the growth of the Internet.[10] Even if the FCC is correct in its assumption about the consequences of its access subsidy for the growth of ISPs, it does not follow that a continuation of that subsidy is necessary today and reconcilable with Congress's intent in the Telecommunications Act of 1996 to make subsidies explicit and competitively neutral in their funding.[11]

The proposition that access to the Internet over the PSTN should be priced on the basis of economic costs is not necessarily at odds with the proposition that the development of the Internet needs to be subsidized. Although the merit of such a proposition is debatable, such subsidies should be explicit to avoid distorting prices. If the government wishes to subsidize the development of the Internet, it should do so through more efficient means than the FCC's current policy. Embedding a subsidy in the pricing of

9. *Notice, supra* note 4, at 21,478 ¶ 284 (citing In the Matter of MTS and WATS Market Structure, Memorandum Opinion and Order, 97 F.C.C.2d 682, 711-22 (1983) (Access Charge Reconsideration Order); Amendments of Part 69 of the Commission's Rules Relating to Enhanced Service Providers, Order, 3 F.C.C.R. 2631 (1988) (ESP Exemption Order)); *accord, Report, supra* note 5, at 16,131 ¶ 341.

10. *Notice, supra* note 4, at 21,478-79 ¶ 285; *accord, Report, supra* note 5, at 16,133 ¶ 344.

11. *See* 47 U.S.C.A. § 254(e) (West Supp. 1998).

network usage—or, alternatively, *failing* to place any price on an important and growing form of usage of the PSTN—can only have negative effects for the long-term quality of the PSTN. If the FCC continues to allow ISPs to avoid access charges under the exemption for ESPs, the natural and unavoidable implication would be a reduction in LEC investment and a deterioration of the PSTN. That network deterioration, in turn, would hinder the "vibrant and competitive free market" for Internet services that Congress seeks to promote. In short, the substantial benefits that can be derived from the Internet should not cause policy makers to ignore the significant costs that this powerful communications technology imposes on the operators and users of the nation's voice telephony network.

The larger question posed by the NOI, which we examine in Part II, concerns the role that competitive prices play in influencing supply and demand in the market for access to Internet services over the PSTN. The FCC emphasizes measures that it might undertake to expand the supply of network capacity yet ignores the role that prices play in rationing demand for such capacity. In contrast, we present an economic analysis of the demand for and supply of transmission services. We show that the demand to transmit voice and the demand to transmit data are distinct, and that the current pricing regime for access to the Internet over the PSTN is socially costly because it encourages adverse selection.

In Part III, we examine the economics of network congestion. We show that the discussion of Internet congestion typically obscures the fact that portions of both the PSTN and the ISP's own network are subject to congestion caused by untimed usage of the Internet. Congestion at any one node in that network can cause externalities for the PSTN. Thus, even the internal pricing decisions of an ISP can directly affect the congestion of the PSTN. The ESP exemption creates congestion externalities that can only worsen and thus threaten the integrity of the PSTN.

In Part IV, we examine the pricing of access to ISPs over the PSTN. We show that the FCC should end the current subsidy to ISPs because it induces free riding on the PSTN. LECs should have flexibility in setting market-based access charges. The market for access, not a government regulator, should choose the best technologies for data transmission. We explain why the ESP exemption is a zero price for data transmission. We show that

average incremental cost pricing of network access is inefficient. We then discuss how data transmission should be priced.

In Part V, we consider property rights issues associated with the costs of the FCC's tentative conclusion to continue the "temporary" ESP exemption. We note the relevance of the Supreme Court's 1915 decision in *Northern Pacific Railway Co. v. North Dakota*,[12] which emphasized that, if private property that a regulated utility has dedicated to a public purpose is subsequently appropriated by the government for a different purpose, the government must pay just compensation for the utility's diminished opportunity to recover the cost of the investment it made to discharge its original public purpose. We further observe that the FCC's ESP exemption precipitates a government-mandated physical invasion of the PSTN that constitutes a per se taking of the incumbent LEC's property under the Supreme Court's 1982 decision in *Loretto v. Teleprompter Manhattan CATV Corp.*[13] Congestion of the PSTN occurs because regulators send distorted price signals that induce consumers to use that network to send and receive transmissions of data packets over the Internet. The congestion from the FCC's inefficient pricing excludes other uses of the PSTN or degrades consumers' quality of service. The outcome is vastly more consequential for the property owner (and the public) than was the permanent physical occupation that the Court found unconstitutional in *Loretto*. In addition, we explain that the revenues from second lines do not give the incumbent LEC just compensation for the costs imposed by the FCC's mandate that the LEC provide customers unpriced access to ISPs over the PSTN. We contend that the States would be vicariously liable for the taking of the incumbent LECs' property that would result from the FCC's forced subsidization of ISPs by incumbent LECs.

In Part VI, we argue that is it is unlawful for the FCC to order incumbent LECs to continue subsidizing ISPs through the perpetuation of the currently "temporary" ESP exemption from interstate access charges, or through any other artifice. The FCC's subsidy to ISPs flouts Congress's decision in the Telecommunications Act of 1996 to make subsidies, if they are to be permitted at all, explicit and competitively neutral. The FCC

12. 236 U.S. 585 (1915).
13. 458 U.S. 419 (1982).

has no roving mandate to subsidize Internet usage, and its current subsidy for ISPs is contrary to the public interest because it undermines the quality and affordability of universal voice telephony.

II. THE DEMAND FOR AND SUPPLY OF TELEPHONE NETWORK TRANSMISSION

In this Part, we present an economic analysis of the demand for and supply of transmission services. We show that there are two basic types of consumer demand for transmission services—voice and data. There are also two basic types of supply of transmission services, one suited for voice and another for data. The PSTN as currently designed is suited for voice transmission and is poorly equipped to handle both voice and data efficiently. The flat-rate pricing of local service and the zero access charge for ESPs together create incentives for inefficient usage on the part of consumers and discourage investment on the part of suppliers. Those price distortions are created by state and federal regulations and cause inefficient outcomes in the market for transmission services. If left in place, those pricing policies will severely damage the quality of the PSTN while retarding the growth of information services.

A. *The Demand for and Supply of Transmission*

1. *The Market Demand for Transmission*

Market demand for transmission services can be divided into two categories: demand for voice transmission ("voice demand") and demand for data transmission ("data demand").[14] Voice demand refers to traditional demand for voice telephony. Data demand refers to access to the Internet, including access to Internet providers, connection to proprietary services (America Online, Compuserve, and others), file transfers, and usage of electronic bulletin boards. Data demand also includes the use of

14. *Demand* is defined as a schedule of prices and quantities that describes the total amount of a good or service demanded at each price level. As prices fall, the quantity demanded of a service increases. The *market demand* for a good or service is the sum of individual consumer demands for that good or service. Changes in the quantity demanded in response to price changes reflect the underlying possibilities for purchasing substitute goods and services that are available for consumers. Thus, market demand is a highly useful tool for representing consumer choices at alternative prices.

an employer's computers by those working at home, telecommuting, home banking, and on-line services calls. Those types of calls have characteristics similar to Internet access.[15] Data demand for access includes the sending and receiving of digitized information, such as documents, e-mail, Internet telephony, and video transmission.

The total demand for transmission access services is the summation of voice demand and data demand. Therefore, consideration of demand for access to the PSTN must address both types of demand. Those two types of demand have fundamentally different characteristics. According to Drs. Amir Atai and James Gordon of Bellcore, the Internet-related traffic's "qualitatively new characteristics are challenging the engineering, forecasting, planning and operational procedures established by the former Bell System over the past 80 years."[16] Clearly, the different characteristics of these types of demand require different technologies to provide services. We will demonstrate that they require fundamentally different pricing methods.

2. *Technology and the Supply of Transmission*

Transmission technology also can be divided into two broad categories: circuit-switched networks and packet-switched networks. Generally speaking, circuit-switched networks are designed to provide voice transmission and are best suited for that purpose. Packet-switched networks are designed to provide data transmission and are best suited for that purpose, although technological advancements introduce some important subtleties.

This distinction between circuit switching and packet switching suggests the need to separate voice traffic from data traffic and to upgrade networks to handle the two types of services in an integrated manner. Transmitting data on circuit-switched networks represents an inefficient use of that network. Such inefficient usage is encouraged by the States' current regulated pricing of local service and the FCC's current regulatory controls on interstate access charges.

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15. *See* Amir Atai & James Gordon, Bell Communications Research, Inc., *Impacts of Internet Traffic on LEC Networks and Switching Systems* (1996) (on file with *Journal*).

16. *Id.* at 1.

A *circuit-switched* network establishes a fixed-capacity end-to-end connection that remains in place for the duration of the call.[17] The traditional plain old telephone service (POTS) employs a circuit-switched network that is designed for analog transmission of voice telecommunications. The callers control the line until the call is completed.

A circuit-switched network also can handle data transmissions. The data transmission travels on the end-to-end circuit, which is not shared with other data transmissions while the call is in progress. The drawback of using a circuit-switched network for data transmission is that the data communication ties up more scarce transmission capacity than is needed to send the data. Moreover, in a circuit-switched network the originating and terminating devices must transmit and receive at the same data rate, which limits interconnection of computers and terminals.[18] Thus, a circuit-switched network is an inefficient means for transmitting data.[19]

In contrast, a *packet-switched* network breaks down the data stream being transmitted into "packets" comprised of a number of bytes that are independently routed to their destination, where the message being transmitted is reassembled.[20] Packet-switched networks are designed to handle data transmission, using network systems efficiently by allowing multiple data communications to share the same line and by sending data packets from the same transmission along possibly different routes to the destination to take advantage of available network capacity.[21] As Bellcore has noted, packet-switching technology

> is particularly well-suited for applications characterized by short *bursty* transmissions. Such applications take full advantage of packet switching's ability to share transmission facilities efficiently among multiple conversations, even when the throughput demands of each conversation vary widely over time. Typical applications with short, bursty traffic characteristics are database queries, credit authorization

17. *See* William STALLINGS, NETWORKING STANDARDS: A GUIDE TO OSI, ISDN, LAN, AND MAN STANDARDS 277 (1993); DANIEL MINOLI, TELECOMMUNICATIONS TECHNOLOGY HANDBOOK 54 (1991).

18. *See* STALLINGS, *supra* note 17, at 277.

19. *See id.*

20. *See* MINOLI, *supra* note 17, at 55-56.

21. *See, e.g.*, JOSEPH A. PECAR ET AL., THE MCGRAW-HILL TELECOMMUNICATIONS FACTBOOK 210-13 (1993).

> transactions, certain health care transactions, Automated Teller Machine . . . transactions, and reservation/shopping transactions.[22]

It is telling that Bellcore's assessment of the application of packet-switching, published in 1994, did not even mention the Internet by name.[23]

A packet-switched network is not necessarily the best means of transmitting voice, without additional enhancements. Dr. Vinton G. Cerf, Senior Vice President for Internet Architecture of MCI Communications Corp. and founder of the Internet, has observed that "the Internet isn't free," and although the Internet is well suited for e-mail and non-real-time services,

> it will cost more to service interactive voice calls than it does to handle other forms of Internet traffic. Depending on the volume of various demand, Internet could well end up having to differentiate among the various services and charge more for those that use up more capacity. Current analyses suggest that the cost of handling domestic voice traffic is actually about the same, whether it is handled by conventional circuit switching or by Internet packet switching.[24]

Thus, Cerf recommends the separation of voice and data traffic on the Internet. He has also observed that the "attraction of Internet voice is partly a consequence of the difference between access charges levied by local exchange carriers for voice calls versus the no-access charge for data calls."[25]

In broadband integrated services digital networks (ISDNs), circuit switching and packet switching are endpoints of a continuum of alternative techniques, ranging from circuit switching at one end, to multirate circuit switching, to cell relay (asynchronous transfer mode), to frame relay, and finally to packet switching at the other end.[26] Cell relay uses packets of fixed length called "cells," while frame relay uses packets of variable length called "frames."[27] Cell relay or asynchronous transfer mode

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22. BELL COMMUNICATIONS RESEARCH, BOC NOTES ON THE LEC NETWORKS—1994, at 14-100 (1994).

23. *See id.*

24. Vinton G. Cerf, *The Internet Isn't Free*, On Technology, MCI Communications Corp., <http://www.mci.com/aboutyou/interests/technology/ontech/cerfreport0996.shtml>.

25. *See id.*

26. *See* STALLINGS, *supra* note 17, at 275 (*citing* MARTIN DE PRYCKER, ASYNCHRONOUS TRANSFER MODE: SOLUTION FOR BROADBAND ISDN (1991)).

27. *See id.* at 278.

(ATM) allows the creation of virtual channels and "is the culmination of all the developments in circuit and packet switching over the past twenty years."[28] In a switched broadband network with fiber-optic access (fiber-to-the-curb), voice and data can be sent over the same network with voice and data switching, and efficient connections to Internet service providers, interexchange carriers, and other networks. Until the development and installation of such networks, it is inefficient to combine voice and data transmission on the same circuit-switched network.

There are many different technologies available for the supply of transmission access, and many different solutions to the problem of congestion.[29] These options include:

- continued reliance on the existing circuit-switched PSTN (the status quo);
- modification of the PSTN to handle data traffic by reducing congestion in the trunking network and terminating switches (dialed number triggers used to reroute data traffic, or modem pools maintained by LECs with data transported to ISPs over a data network);
- modification of the PSTN using preswitch equipment to reroute calls to the ISPs onto a data network bypassing the LECs switch;
- modification of the PSTN using ISDN lines between the subscriber and the switch;
- modification of the PSTN using asymmetrical digital subscriber lines (ADSLs) between the subscriber and the switch;
- bypass of the PSTN for data transmission using cable modems and cable television system transmission for access to ISPs; and
- bypass of the PSTN for data transmission using wireless access to ISPs.

Which of those technological solutions is best? The answer is not one for the FCC to supply. As Gregory Rosston and Jeffrey Steinberg of the FCC similarly noted in their January 1997 report

28. *Id.* at 277.

29. *See* Atai & Gordon, *supra* note 15, at 3-4.

on spectrum policy: "No government agency . . . can reliably predict public demand for specific services or the future direction of new technologies."[30] Moreover, noted Rosston and Steinberg, markets surpass central planners in their ability to evaluate rival technologies even when those markets are less than perfectly competitive:

> In a perfectly competitive market, firms will produce the combination of goods and services most desired by consumers in the most efficient manner, and will offer these goods and services at competitive prices. In this way, the market achieves technological and allocative efficiency. Furthermore, entrepreneurs have an incentive to enter, where feasible, into production of goods and services that have been provided on a less than fully competitive basis, since these products tend to offer the greatest opportunities for profits. Thus, if reasonably competitive conditions exist and significant market failures do not occur, the market achieves economically efficient use of resources more quickly and more reliably than government regulation.[31]

The FCC focuses on particular technological fixes to expand capacity, such as routing data traffic around LEC switches and installing ADSL access lines.[32] However, transmission capacity will fill up as long as the demand to gain access to the Internet over the PSTN is not rationed by price. The FCC should recognize, as do Rosston and Steinberg with respect to spectrum policy, that technological solutions to the congestion of the PSTN must be chosen through the interaction of customers and suppliers, not through administrative decisions that select technological winners without regard to the operation of markets.

B. *Different Characteristics of the Two Types of Demands*

Voice demand and data demand for transmission services have significantly different characteristics because they represent demand for different services. Those characteristics are important because they affect the price responsiveness and quantity of services demanded at each price.

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30. GREGORY L. ROSSTON & JEFFREY S. STEINBERG, USING MARKET-BASED SPECTRUM POLICY TO PROMOTE THE PUBLIC INTEREST 4 (1997).

31. *Id.* at 5 (footnote omitted).

32. *See Notice*, *supra* note 4, at 21,491 ¶ 313; *accord*, *Report*, *supra* note 5, at 16,134 ¶¶ 347-48. In the *Report*, however, the FCC elects not to refer to specific technologies such as ADSL.

Therefore, when the two services are priced in the same manner, the characteristics of the two types of demand will vary significantly, so that the cost of providing service will differ substantially as well. In a competitive market, when there are clearly identifiable differences in demand for such different services, firms will price the services differently. Such price differences are efficient because they match consumers' willingness to pay the costs of service.

There are several main differences between the demands for voice and data transmission: the pattern of demand over time; the level of demand at a given price and price responsiveness of demand; and the rate of growth (shifts of the demand curve over time). Those demand differences have profound implications for access pricing.

1. *The Pattern of Demand over Time*

The time patterns of usage over the PSTN for voice demand and for data demand are considerably different. Among the ways in which those patterns differ are average call duration, distribution of call holding times, and the arrival rate of calls.[33]

Consider first the average call holding time. According to studies, the average call holding time for voice calls is three minutes, whereas Internet calls average twenty minutes in duration.[34] Thus, calls involving Internet access can last a very long time as computer users surf the Internet, talk on chat rooms, or check online news services. Indeed, Internet users may leave their unmetered local telephone connections on for many hours at a time, or even around the clock.

That phenomenon of longer holding times for Internet calls manifested itself *before* the widespread usage of flat-rate pricing (with unmetered Internet access), such as that introduced by America Online in December 1996.[35] It is apparent that *after* the introduction of flat-rate, "all you can eat" pricing of Internet access, the average holding time for Internet calls is increasing still further. For example, *Fortune* reported in January 1997 that "[u]sers of popular 'broadcast'-style data services like Pointcast often leave their computers connected 24 hours a day—for the

33. *See* Atai & Gordon, *supra* note 15, at 1-2.

34. *See id.*

35. *See America Online Revises Price-Change Plan*, N.Y. TIMES, Nov. 25, 1996, at D9.

price of a single local call."[36] As a result, typical Internet sessions can last "ten times as long as the average phone call."[37] As data demand grows and voice demand retains its traditional characteristics, that relationship can only worsen unless regulators permit LECs to change fundamentally the pricing of access to the Internet over the PSTN.

The shape of the distribution of call holding times also differs for voice and data. Whereas the statistical call holding time distribution for voice calls can be represented by an exponential distribution, the distribution for data calls does not appear to be exponential.[38] That difference is due not only to the greater average duration of calls, but also to the duration of calls in the upper "tail" of the distribution, where calls of extended duration (twelve to twenty-four hours) are likely for consumers engaged in data transmission.

Finally, the arrival rate of voice calls can be represented as a Poisson arrival process, with residential and business subscriber lines generating an average load of about five to ten minutes per hour (that is, a load per hour of three to six centum call seconds (ccs), where a ccs is one hundred seconds).[39] In a Poisson arrival process, the number of telephone calls received in a given period at a given switch are independently distributed according to the Poisson probability distribution.[40] The systematically greater

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36. J. William Gurley & Michael H. Martin, *The Price Isn't Right on the Internet*, FORTUNE, Jan. 13, 1997, at 152.

37. *Id.*

38. *See* Atai & Gordon, *supra* note 15, at 2. The exponential distribution is a probability distribution of a random variable x with a probability density of the form $f(x) = a \exp(-at)$, where a is a positive parameter. If t represents the call holding time, then $a \exp(-at)$ represents the probability that the holding time is of duration t.

Note that with two classes of customers (say, voice and data) even if both had exponential service times, the overall service time will not have an exponential distribution. If the exponential distributions for the two customer classes have different means, the overall distribution would be a mixture of exponential distributions that can have much greater variability. *See* Jimmie L. Davis et al., *Sensitivity to the Service-time Distribution in the Nonstationary Erlang Loss Model*, 41 MGMT. SCI. 1107, 1108 (1995).

39. *See* Atai & Gordon, *supra* note 15, at 2; *see also* 3 BELL COMMUNICATIONS RESEARCH, TELECOMMUNICATIONS TRANSMISSION ENGINEERING 131-46 (3d ed. 1990). One hour of continuous use of a circuit would consume 3,600 seconds, or thirty-six ccs.

40. *See* MORRIS H. DEGROOT, OPTIMAL STATISTICAL DECISIONS 35 (1970); WILLIAM FELLER, AN INTRODUCTION TO PROBABILITY THEORY 157 (3d ed. 1968). The Poisson probability distribution is often used to describe the time interval between successive events such as telephone calls. If the number of events in a fixed time interval has a Poisson distribution, then the length of the time interval between successive events has a Poisson distribution. The (discrete) random variable n has a Poisson distribution if the

duration of Internet calls, however, qualitatively changes the statistical representation of the arrival process for calls over the PSTN.

Empirical studies reinforce these three general observations about the difference between voice calls and data calls. A 1996 study by NYNEX showed that holding times for data traffic were twenty to forty minutes, as compared to five to ten minutes for voice traffic.[41] Those results were based on observations occurring before the change from usage-sensitive pricing to flat-rate pricing offered by the major ISPs.

A 1996 study by U S WEST covering Colorado, South Dakota, Utah, and Washington examined ISPs, value-added networks (VANs), on-line providers (OLPs), and bulletin board services (BBSs).[42] The report found that the average holding time per data call was three to eight times longer than the average holding time for the typical residential or business voice user.[43] The U S WEST study also established distinct differences between the peak periods for data demand and voice demand.[44]

A 1996 study by Bell Atlantic found that the average length of ISP calls was 17.7 minutes as compared with an average of four to five minutes for all other calls on its network.[45] Moreover, Bell Atlantic found significant differences between the peak periods of voice demand and those of data demand.[46]

How can the consistent differences between voice and data demand be explained? Economic reasoning suggests that the fundamental differences in the two activities provide an explanation. Voice users are limited in terms of telephone call duration because of the opportunity cost of time of the two callers. Even though they pay a flat rate, so that staying on the line is free otherwise, calls are limited in duration by the time cost of

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density of n is $(\lambda t)^n \exp(-\lambda t)/n!$ for $n = 0, 1, 2 \ldots$. The term $\exp(-\lambda t)$ is the probability that no telephone call arrives within a time interval of length t. *See* FELLER, *supra*, at 446.

41. *See* Letter from Kenneth Rust, Director of Federal Regulatory Affairs, NYNEX, to James D. Schlichting, FCC, and attached report (July 10, 1996) (on file with the authors).

42. U S WEST COMMUNICATIONS, ESP NETWORK STUDY [hereinafter U S WEST STUDY], *attached to* Letter from Glenn Brown, Executive Director of Public Policy, U S WEST, to James D. Schlichting, FCC (Oct. 1, 1996) (on file with the authors).

43. *See id.* at 1.

44. *See id.* at 1-2.

45. *See* BELL ATLANTIC, REPORT ON INTERNET TRAFFIC (Mar. 1996), *appended to* Letter from Joseph J. Mulieri, Director of FCC Relations, Bell Atlantic, to James D. Schlichting, FCC (June 28, 1996) (on file with the authors).

46. *See id.* at 3.

remaining on the line and the effort expended to carry on a conversation. The need to use the telephone to place another call, or the chance of missing an incoming call, may also play a role in limiting the duration of calls. Those latter concerns are indicated to some extent by the demand for call-waiting services and the demand for second lines for voice usage, respectively.

Some of those concerns are conspicuously absent in data calls. The computer is left connected to the telephone line, so that the caller's opportunity cost of time is not affected because the person does not have to spend time on the telephone. Nor does the person need to spend any effort to remain connected. The termination of calls by ISPs due to the passage of some period of inactivity during the on-line session creates some cost of effort for the user to remain connected, although those automatic cutoffs can be thwarted by software that gives the illusion that the connection is in use and thus obviates any human effort by the user to remain on line. Admittedly, the need to place other calls and the concern over missed calls also apply to data traffic. Those concerns, however, explain the great increase in demand for second lines that are then used for data calls. Once data traffic is moved onto a second line, the duration of data calls is no longer limited by the need to make or receive voice calls because they can be made on the user's primary line.

When demand varies over time for a service provided with scarce capacity, the standard economic recommendation is peak-load pricing.[47] Pricing based on time of use sets high prices during the peak periods and lower prices during off-peak periods. Such pricing shifts some of the load from the peak periods to off-peak periods as consumers change their time pattern of usage in response to price incentives. The differences in the pattern of demand over time between voice calls and data calls suggest that the pricing solution is not peak-load pricing. Although it may make sense for there to be peak-load pricing of some types of voice traffic to smooth the peaks and troughs—and similarly there may be a need for peak-load pricing of some types of data traffic—such pricing alone is not sufficient to address the problem of combined traffic, with the possibility of data traffic creating congestion for voice traffic. Peak-load pricing of generic

47. *See, e.g.*, ROGER SHERMAN, THE REGULATION OF MONOPOLY 94-109 (1989); DANIEL F. SPULBER, REGULATION AND MARKETS 174-77 (1989).

transmission over the circuit-switched network does not answer the need to transmit those two types of traffic separately.

2. *The Level of Demand at a Given Price and the Price Responsiveness of Demand*

Many data-related calls take place over the local exchange because dial-up access of ISPs generally is billed to the end user as a local call. Because there is flat-rate pricing of local service, the marginal cost of calls is zero to the user, whether the consumer is making a data call or a voice call. Thus, because the price of the two calls is zero, it is possible to compare the demands for the two calls at the same price. Because the characteristics of the two types of demand differ substantially, as noted previously, it is possible to conclude that the level of demand at a given price will generally be substantially different, judging from a comparison of demand at the zero price.

The price elasticity of demand for data traffic appears to be significant.[48] When America Online switched from metered service to flat-rate pricing, it experienced a significant increase in demand. The increase in demand became evident by the significant congestion of its existing capacity that followed the change in its pricing policy. Previously, the company had charged a lower fee but billed by the hour when customers exceeded a monthly limit on the number of hours of use.[49]

The evidence on the duration and frequency of data calls suggests that the price elasticity of demand for voice calls and the price elasticity of demand for data calls differs considerably. Although additional study would be required to compare the elasticities of demand of data calls and of voice calls, one useful indicator of the difference between the two demands is the responsiveness of data demand to changes in the price of on-line services. According to America Online, the introduction of flat-rate pricing in late 1996 raised daily usage *per member* from approximately twelve minutes to approximately thirty-one

48. Economists refer to the price responsiveness of demand as the price elasticity of demand, which is measured as the percentage change in quantity demanded of a good divided by the associated percentage change in the price of the good.

49. *See* Gurley & Martin, *supra* note 36, at 152.

minutes, and total daily usage from one million hours to over four million hours, comparing December 1995 with January 1997.[50]

A customer's minutes of use of the on-line service is equal to the customer's minutes of use of the LEC's network. Thus, the elasticity of usage of the on-line service with respect to the price of using the on-line service indicates the effects of changes in the per-minute pricing of network access. There are two implications of the jump in demand experienced by the on-line services. First, data demand is highly price-sensitive, so that access charges would affect usage of on-line services. Second, with flat-rate pricing of local exchange service providing access to ISPs and flat-rate pricing of on-line and Internet access services themselves, the usage of those services indicates the current level of data demand at a zero marginal usage price. Observed demand can be expected to increase further over time as customers discover what services are available, as more consumers purchase computers, and as the on-line services upgrade the quality of their services.

In competitive markets, the vast difference between the elasticities of demand for the voice segment and the data segment of the market would cause differences in pricing. Companies would have an incentive to separate those two types of demand for transmission services, with their distinct usage characteristics, and price accordingly. Differences between voice demand and data demand, accompanied by common flat-rate pricing of PSTN transmission and zero access charges, create an opportunity for ISPs to free ride on the LECs.

3. *The Rate of Growth of Demand*

Growth of demand is defined as an increase in the entire schedule of quantity demanded at each price.[51] When transmission prices are relatively stable, increases in the quantity demanded are sufficient to indicate that the demand curve itself is shifting "outward." (Such outward shifts of the demand curve are in contrast to the quantity increases that are associated with movement *along* the demand curve.) An examination of the growth of Internet traffic in 1996 strongly suggests that the

50. *See* David S. Hilzenrath, *At This Rate They'll Be Swamped*, WASH. POST, Jan. 24, 1997, at D1.

51. A graphical representation of demand growth is a rightward shift of the demand curve.

demand curve is shifting outward: market demand for data transmission is growing.

There are many different measures of the growth of data demand on the PSTN. One measure is the growth of ISPs themselves. The *Directory of Service Providers*, published by *Boardwatch Magazine*, counted 1,455 ISPs in March 1996 and 3,068 ISPs by the fall of 1996, more than double the number of providers in less than a year.[52] *Boardwatch Magazine* listed approximately 4,000 ISPs in 1997.[53]

Overall Internet usage exhibits continued growth. The number of users is doubling every year, while traffic on the Internet backbone was growing by a factor of five in 1996.[54] The Yankee Group has estimated that the number of households connected to the Internet will grow from fifteen million in 1997 to forty-three million within four years.[55] That explosive growth is currently concentrated in dial-up access over the PSTN (using POTS and ISDN). That concentration will continue according to Drs. Atai and Gordon of Bellcore, who note that "while new technologies such as ADSL and cable modems will grab a segment of the [I]nternet access market, the PSTN will carry most [I]nternet access traffic for at least the next 5 years."[56]

The continued growth in demand for data transmission will be driven by improvements or price reductions for products that are complementary to data-based services: computers, software, and information services. The continuing drop in prices for computers and the development of inexpensive web appliances for connecting to the Internet over telephone lines will further stimulate data demand. Increasing competition between software providers for Internet browsing and Internet-enabled "groupware" (including Microsoft and Netscape) promises to attract more customers and further increase the demand of existing customers,

52. *See ISPs: A Growing Concern*, BUS. COMM. REV., Dec. 1996, at 12.

53. *See* Jack Rickard, *Introduction* to BOARDWATCH MAGAZINE BIMONTHLY DIRECTORY OF INTERNET SERVICE PROVIDERS, July-Aug. 1997, at 4.

54. *See* John M. McQuillan, *Rebuilding the Public Infrastructure for Data*, BUS. COMM. REV., Dec. 1996, at 14.

55. *See* Steve Lohr, *Refunds Planned by America Online in Network Jam*, N.Y. TIMES, Jan. 30, 1997, at A1.

56. Atai & Gordon, *supra* note 15, at 1.

as capabilities for e-mail, accessing information, and on-line discussion are enhanced.[57]

C. *Matching Supply and Demand*

Markets match customers and suppliers. In an efficient market, demand and supply options are matched efficiently. For example, in the housing market, buyers seeking two-story houses in a particular price range are matched with sellers offering two-story houses in that price range. Thus, the phenomenon of market clearing represents more than total supply equaling total demand. The specific needs of buyers are matched with the characteristics of services offered by sellers.

In the same way, an efficient market for telecommunications would match the transmission needs of consumers with the transmission services of communications companies. Given current transmission systems, efficient resource allocation would mean that the market should make the two following matches. First, the demand for voice transmission would be matched with the supply of circuit-switched transmission. Second, the demand for data transmission would be matched with the supply of packet-switched transmission. Such matching has already occurred for large businesses and large organizations that connect to regional ISPs. The same matching has not occurred for residential and small-business customers using the PSTN because the voice transmission alternative is priced too low due to the flat-rate pricing of local services and zero access charges for ESPs.

Price regulation forces the prices for voice services and data services to remain identical. Flat-rate pricing of local service and zero access charges eliminate the incentives for consumers to distinguish between voice demand and data demand in their usage of the PSTN. Moreover, price regulation creates incentives for ISPs to rely on the PSTN to connect customers with their points of presence. As we will demonstrate, differences in the costs imposed on the PSTN by the two types of usage may create incentives for the LECs to separate the traffic and thus better match demand and supply alternatives. The FCC's zero access charge regulation, however, reduces the incentives for the LEC to invest in the required facilities.

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57. *See* Jon Udell, *Net Applications: Will Netscape Set the Standard?*, BYTE, Mar. 1997, at 66.

D. *Adverse Selection*

The combined usage of the circuit-switched local system by voice demanders and data demanders is a classic case of "adverse selection." Adverse selection, a term that economists have borrowed from the insurance industry, refers to a particular type of market distortion that can arise as a consequence of information asymmetries between buyers and sellers.[58] The classic example of adverse selection in economics is the "market for lemons."[59] In insurance, if the price of the contract reflects the *average* quality of the applicants, there will be a tendency for the high-quality applicants to self-select out of the market, such that the firm will be left with the low-quality applicants. Similarly, in a market for used cars, where the sellers have better information about the quality of the cars than the buyers, if the price reflects the average quality of the cars, there will be a tendency for the owners of high-quality cars to leave the market. Thus, a "pooling" contract that attempts to price to the market average can be problematic for the firm: after self-selection occurs, the firm will not face the "average" customer, and the contract will no longer be economically viable for the firm. In competitive markets, firms counteract the problem of asymmetric information and the corresponding adverse selection by offering menus of contract options (or by specializing in serving market segments) so that buyers "self-select" the pricing and service options that best suit their needs.

The adverse selection problem pervades local exchange telephony. The LEC cannot distinguish between a voice demand call and a data demand call, although the callers know what type of transmission they are seeking. Thus, both types of calls appear as voice calls to the LEC. Voice and data demand for PSTN transmission services are pooled by LEC pricing.

The combined usage of the PSTN by voice demanders and data demanders represents a particularly serious adverse selection problem. The pricing and operation of the PSTN represents pricing based on the average *voice* user, whose demand patterns fundamentally differ from those of the average *data* user. The fact that many people are both voice users and data users does not

58. *See, e.g.*, JOSEPH E. STIGLITZ, ECONOMICS 154-57 (1993).

59. George A. Akerlof, *The Market for "Lemons": Qualitative Uncertainty and the Market Mechanism*, 84 Q.J. ECON. 488 (1970).

affect the comparison. Thus, contracts intended for voice users are being offered and accepted by data users. The offering that was economically viable for one group is not so for the pooled group. The situation is more serious than the standard adverse selection problem because the initial contract for voice users was based on averages for a single group, not the population of both types of users; the outcome therefore is likely to differ fundamentally from the outcome without the data user group.[60]

The contract for local service, with flat rates for usage and no access charges for connection to ISPs, does not effectively ration either voice usage or data usage. Rather, it encourages practically unlimited data usage of the local exchange network. In time, such data usage has the potential to displace voice traffic. The ultimate effect of adverse selection is that some voice users are discouraged from use of the system. Another facet of adverse selection is that, as data usage degrades the quality of service by affecting call completion rates, both voice users and data users with a high willingness to pay for telecommunications services will be driven from the system.

The solution is *not* to redesign the contract so that it satisfies the requirements of the *average of voice and data users.* That prescription would place the access problem squarely into the adverse selection framework. The resulting contract could drive one group or the other, or some members of each group, from the market, so that the contract would again be flawed because its design would be predicated on an average of users. Rather, as in competitive markets, the efficient result is to design contracts and services that allow data users and voice users to select those contracts and services that are individually tailored to their respective requirements.

In short, the adverse selection problem implies that the solution is not simply one of metering usage and charging prices based on usage, although that would certainly be an improvement over the current situation. Instead, the solution entails the identification

60. It is evident that the telephone service contract was designed for voice users only because it predates data usage. The differences in demand between the two groups imply that the two types of customers will have different consumption patterns when faced with the same contract. John McQuillan observes: "Today, roughly 60 percent of worldwide telephone revenues are based on usage but virtually none of the ISP's revenues are. Moreover, telephone charges are regulated, while ISP prices are unregulated. To anyone with an eye for financial opportunity, this is a setup ride for arbitrage." McQuillan, *supra* note 54, at 14.

and separation of the two classes of demand to the greatest extent possible through contracts and usage restrictions.

III. CONGESTION EXTERNALITIES, TRANSMISSION TECHNOLOGY, AND PRICING SOLUTIONS

Many will recall the frustration of gas lines at service station pumps in the 1970s that resulted from federal price controls on gasoline following the oil embargoes. Price controls on access to the Internet over the PSTN create the equivalent of gas lines along the access roads to the information superhighway. Price controls fail to ration demand, fail to stimulate supply, and thus prevent markets from clearing. The inevitable result is rationing by congestion.

Congestion is an inefficient form of resource allocation because the resource is allocated by waiting time. The resource goes to those who value the service net of the opportunity cost of waiting for the service. Often that allocation rule means that those with the lowest opportunity cost of time receive the service rather than the highest-value user of the service itself. The FCC's discussion of packet-switched data networks versus circuit-switched voice calls focuses on the supply side of the market, but not the demand side, which is politically far more controversial. Economists are very familiar with political preferences for (and the inefficiency of) rationing through queuing rather than through prices. As congestion worsens, it becomes apparent that price regulations are the root of the problem.

In Part II we established the fundamental differences between voice demand and data demand for access services. We now consider the implications of access pricing for usage of the PSTN. Although data demand may currently be creating congestion externalities only in specific locations, the long-term trend is evident. Unless access pricing is reformed and the ESP exemption is ended, data traffic will create network congestion that will crowd out not only other data traffic, but also voice traffic.

Among the functions served by market prices are the provision of incentives to consumers for efficient demand decisions; incentives for efficient investment by suppliers; incentives for efficient matching of buyers and sellers; and incentives for the market to select the best access option. There are many different technological ways to reduce the existing and potential congestion

of the PSTN that comes from voice traffic and data traffic sharing the same network. The most desirable way to find that solution is not to depend on a regulatory choice of the "best" technology. Rather, the best way to proceed is to let markets set access prices competitively, and to let market competition determine the best technology. Maintaining the ESP exemption will increase congestion and eliminate incentives for the market to select the best access option.

A. *Congestion Externalities from Data Transmission*

Together, the use of flat-rate pricing for local service and the exemption for ESPs have created congestion on the PSTN. The growth of Internet usage for commerce, entertainment, and other forms of communication will only worsen the congestion problem over time. Unless local pricing or access pricing reflects usage, the end result will be more congestion that will degrade service quality on the PSTN, with eventual crowding out of voice traffic and impediments to call completion.

State regulation continues to govern local usage rates of the LECs. Subject to regulatory constraints, many LECs offer flat-rate pricing for local service, so that local usage of the PSTN is not metered. The incentives for LECs to charge for local usage is tempered by traditional usage of flat-rate pricing of local voice telephony. However, metering of local exchange usage is not sufficient to eliminate the inefficiencies that result from differential treatment of access to the local exchange by long distance carriers and ESPs. Were access charges in place, ISPs would have an incentive to pass on those usage charges to their customers. Many ISPs offer flat-rate pricing to their customers, apparently lacking other incentives to meter usage of their services.

The PSTN was engineered to handle traditional voice traffic. Even with flat-rate pricing of local service, the system did not become overloaded. As noted previously, the opportunity cost of time limited the length and frequency of calling. Moreover, usage of the local exchange for long-distance and wireless communication is limited because long-distance and wireless services are metered and customers are charged for their usage of those services.

The ISPs discerned an attractive loophole created by telecommunications pricing and regulation. By locating points of

presence in the local exchange, ISPs could ensure that their services could be accessed by unmetered local calls. Next, the ISPs benefited from the ESP exemption to avoid access charges, paying only for connection to the local exchange.

The ISPs were able to obtain a free ride on the local exchange, avoiding access charges paid by long-distance companies. Thus, given flat-rate pricing of local exchange service combined with flat-rate pricing of ISP service, customers of the ISPs can use the Internet at a zero marginal cost, taking advantage of the free ride on LEC networks. Some ISP customers may even leave their lines connected for twenty-four hours a day, effectively converting their local service to private-line service without paying the associated costs.

The total demand for transmission is the sum of traditional voice demand and new data demand. Although, there are some substitution possibilities for some consumers (that is, a consumer may choose to send an e-mail or consult an on-line service rather than make a telephone call, or vice versa), it is evident from the growth of total demand that much of data demand is incremental. The growth in total demand and the significantly different features of voice demand and data demand place significant strains on LEC network capacity. Those strains on the network can only increase with further expansion of data demand. The telecommunications network is not engineered to handle usage with the characteristics of data demand because they are so different from traditional voice demand.

The combination of exploding growth of demand for Internet services combined with zero pricing has created a situation of increased demand for the local exchange that in some cases exceeds available capacity. There is no question that growth of demand for data transmission will continue, so that the congestion problem can only worsen. The consequences of that congestion are manifest. Call completions will become difficult during peak usage periods, thus degrading that important aspect of service quality. The increased load will affect the "safe operating point" for switches and trunks: "[s]evere difficulties have already been encountered in load balancing switches carrying significant levels of Internet traffic."[61] Congestion thus exists not only at the end user's loop, but also at the LEC's central

61. Atai & Gordon, *supra* note 15, at 3.

office switches and trunks. LECs must then decide whether to tolerate a higher probability of blocked calls or upgrade their system.

In implementing metered usage, the costs of congestion should be compared with the transaction costs of metering usage. With voice demand it was feasible, although not necessarily optimal, to maintain excess capacity in the telephone system and employ flat-rate pricing to avoid metering costs. However, even in voice telephony, there is metering of long distance and local tolls, and in some areas, all local calls are metered. Thus, the notion of "too cheap to meter" does not necessarily apply even to traditional telephone service. With the continuing growth of data demand, the argument that usage of the PSTN is "too cheap to meter" cannot be sustained.

Congestion is inefficient in a number of ways. The uniform (zero) pricing of incremental use of the Internet prevents high-valued uses from dominating low-valued uses, contrary to basic economic principles. The uniform zero pricing of access to the Internet over the PSTN does not distinguish between voice usage and data usage of the PSTN, so that scarce capacity is not allocated to the highest-valued use. As noted previously, rationing by waiting makes capacity allocation depend on the user's opportunity cost of time rather than the value of the transmission service. High-value users have an incentive to seek bypass opportunities that may result in duplicative or inefficient facilities.

Congestion has another effect on users of the PSTN. The possibility of congestion reduces the expected likelihood of call completion. That degradation in turn lowers the *option value* of access for all users of the PSTN, whether for voice transmission or data transmission.[62] Degradation of the quality of service in terms of higher blocking probabilities thus lowers the net benefits of all users of the PSTN, even if they do not actually experience a delay.

Congestion is an example of an "external diseconomy" or externality. The situation is analogous to air pollution or degradation of natural resources. When a resource is owned in common, it is owned by no one. Thus, when access is not rationed, usage cannot be excluded. Moreover, users of the

62. The option value of access refers to the value that customers of a telephone system place on the availability of phone service—that is, the right (but not the obligation) to place a call successfully.

resource do not have an incentive to conserve the resource because its value has been reduced by the absence of excludability. The data demand of ISP customers constitutes an externality because it imposes a cost on other users of the PSTN, whether they are other data users or voice users. When capacity is scarce (that is, when total usage exceeds available capacity), users compete to be the first to have access to the transmission capacity. They have incentives to increase their use of capacity—for example, by tying up telephone lines to maintain a connection because they are concerned about renewing that connection if congestion has lowered the call completion rate.

The solution to congestion of the PSTN, as with most other types of congestion externalities, is to ration access to the resource through pricing. Efficient prices match demand to available capacity and therefore allocate the resource to the highest-valued use. Pricing also creates incentives for rational usage. In contrast, the current situation of zero marginal pricing will cause eventual degradation of the quality of the PSTN.

B. *Pricing Regulations and the ESP Exemption Exacerbate the Congestion Problem*

Some ISPs argue that congestion is not a serious problem because it occurs only during limited time periods or in specific locations. For example, in comments submitted to the FCC on behalf of the Internet Access Coalition, Lee L. Selwyn and Joseph W. Laszlo suggest: "Far from having their entire networks threatened by data traffic overload, congestion and blocking is likely to occur at only a few distinct points in the network, primarily end offices that serve large ESPs, and possibly the particular interoffice trunks that serve those end offices."[63] That assertion misses the basic problem. Because the LEC must meet quality of service requirements, it must create sufficient capacity to meet its service obligations. Thus, even if congestion problems are limited in time, capacity must be added to meet peak demand. To some extent the congestion problem can be exacerbated by peaks because excess capacity is then idle off peak.

63. Lee L. Selwyn & Joseph W. Laszlo, Economics and Technology, Inc., *The Effect of Internet Use on the Nation's Telephone Network* 51 (1997), *attached to* Comments of Internet Access Coalition (on file with the authors).

Regulation requires LECs to be the carrier of last resort and to meet overall quality of service levels. Unlike competitive local exchange carriers (CLECs), the LECs cannot choose what customers to serve or when to serve them. Moreover, unlike ISPs such as America Online, the LECs cannot simply ration customers by declining to install sufficient capacity to meet demand. Rather, the LECs must hold sufficient capacity to meet traffic requirements *at all times and at all locations.* Selwyn's and Laszlo's criticism of studies by Bell operating companies (BOCs) completely ignores the regulatory obligations imposed on incumbent LECs to meet their peak demands for capacity: "In their studies, the BOCs significantly overstate the costs they incur as a result of data traffic. Data traffic has caused only a small number of problems that have required the BOCs to add or upgrade central office equipment."[64] Although congestion can occur initially only at limited times and at a few locations, the capacity costs of alleviating that congestion can be substantial. Moreover, the BOC studies, as we previously noted, indicate that congestion problems are significant, pervasive, and increasing.[65]

Because of the way that local access is priced, avoiding congestion would require the incumbent LEC to expand capacity of the PSTN to accommodate peak traffic. Holding capacity to meet peak demands means that there is excess capacity the rest of the time. There are three aspects of pricing that are related to peak-load problems. First, there are no charges for local exchange usage. It is well known that usage-sensitive pricing would moderate demand at any point in time. Such moderation of demand would reduce usage at the peak period and reduce total capacity requirements. Second, peak-load pricing of access, particularly for data transmission, would serve to redistribute demand over time, which also would reduce peak loads and lower capacity requirements. Third, it has been observed that usage is not distributed uniformly across the LEC's service area. For example, Pacific Bell experiences congestion due to heavy demand from Silicon Valley. Yet, prices are uniform throughout the service territory due to geographic averaging of prices.[66] Therefore, to avoid congestion requires tailoring capacity to

64. *Id.*

65. *See* BELL ATLANTIC, *supra* note 43.

66. *See* McQuillan, *supra* note 54, at 14.

deal with localized congestion. In the absence of usage-sensitive pricing, peak-load pricing, and geographically deaveraged pricing, congestion during limited time periods translates into significant capacity requirements.

Having suggested that congestion problems on the PSTN are overstated, Selwyn and Laszlo advance the somewhat contradictory argument that the PSTN provides *inadequate* capacity for data traffic. They suggest that, because the LEC networks are circuit-switched and optimized for voice conversations, and despite advances in modem rates, "with the proliferation of graphics, animation, video and other high-bandwidth applications, even these higher data rates will prove inadequate."[67]

Accurate price signals are necessary not only for consumers to make efficient decisions, but also to provide investment incentives for suppliers of capacity. The combination of flat-rate pricing for local access and zero access charges for ISPs fails to provide efficient investment incentives for incumbent LECs and for CLECs. Incumbent LEC investment is discouraged because zero access prices certainly do not allow cost recovery. CLEC creation of bypass alternatives is discouraged as well because it is hard for any firm to compete with a free ride.

The study by U S WEST covering Colorado, South Dakota, Utah, and Washington mentioned previously showed that the incremental usage costs for ISPs were eight times that of a business line, without including incremental investments required to service the ISP such as dedicated lines and excess construction charges.[68] The 1996 study by Bell Atlantic found that the prices of its lines offered to ISPs were well below its cost of service because increased usage of the local exchange system due to Internet usage had required Bell Atlantic to add new equipment to central offices, increase the number of trunk lines, deploy more efficient Internet transport technologies (such as switched multimegabit data service), and increase maintenance expenditures.[69] Although long-run solutions to the problems of network congestion posed by Internet usage will require the use of more advanced network

67. Selwyn & Laszlo, *supra* note 63, at 52.

68. *See* U S WEST Study, *supra* note 42, at attachment 10.

69. *See* BELL ATLANTIC, *supra* note 45; *see also* Timothy K. Stevens & James E. Sylvester, *Superhighway Traffic Taxes Current LEC Networks*, TELEPHONY, July 29, 1996, at 35.

architecture tailored to data transmission, ISPs use the FCC's ESP exemption to purchase primary rate ISDN lines, business dial-tone lines, and other facilities. By doing so, the ISPs receive access to the local telephone network without charge and obtain a dedicated direct connection to the switch, eliminating the ISPs' incentives to seek alternative access.[70]

The ESP exemption interferes with market incentives for efficient matching of buyers and sellers. Because data are better handled on packet-switched networks, a free ride for ISPs on the PSTN reduces incentives for matching data users with the best access alternatives. ISP customers have greatly reduced incentives to seek out access alternatives. Some users who are concerned about congestion or about the speed of transmission on the PSTN will seek out other solutions (including ISDN service or bypass alternatives) and leave lower value users on the PSTN. Regulatory price controls such as the ESP exemption deprive the LEC of incentives to upgrade its networks to serve data users with specially tailored services; moreover, such controls create incumbent burdens that impede the LEC's competition with ISPs. What should instead emerge is a menu of access alternatives with different price-quality alternatives. The ESP exemption delays market innovation by offering ISPs an enticing free ride.

C. *Congestion on Data Networks*

Although the FCC and the ISPs believe that the answer to congestion lies in installing more capacity and in reconfiguring the PSTN to accommodate data, it should be remembered that the Internet and ISP systems also are subject to congestion. The important implication is that congestion of LECs from data traffic is not due solely to the less efficient transmission of data on networks designed to handle voice traffic. Rather, data networks themselves are subject to congestion when priced improperly. Consequently, no amount of system redesign in the local exchange, without changing pricing policies, can solve the congestion problem. Rather, the problem is *the ESP exemption and regulatory price controls.*

It is important to note that congestion also exists outside of the LEC network itself. There are at least four points of

70. *See id.*

congestion. First, there is congestion at the modems that are the gateway to the ISPs. If too many customers call in at the same time, there will not be enough modems to serve them. For example, America Online has estimated that it can only accommodate 3.5 percent of its eight million members at the same time.[71] This type of congestion is manifested as busy signals for those customers trying to call the ISP. In addition, the ISP's routers can become congested, which will cause delay for users.

Second, the ISPs are connected to regional Internet access providers, which also have limited transmission capacity on their trunks and routers.

Third, the regional Internet access providers are connected to the Internet backbone, which is itself subject to congestion. The Internet backbone is operated by companies such as MCI, Sprint, ANS, PSI, UUNET, and IBM Global Link.

Finally, at the interconnect level, there are private exchanges and National Access Points (NAPs), which are also subject to congestion.

Congestion on the Internet itself is manifested in the form of transmission delays and "dropped" packets. The growth of commercial development, applications such as real-time video and audio, and increased usage generally are taking place alongside capacity enhancements. The problem, however, is that usage on the Internet is not rationed by price; consequently, once a user has gained access, his usage appears to him to be free at the margin. Thus, a commons is created among users without any pricing mechanism for rationing usage. The economic consequences of such an arrangement are well known. There is little to prevent one person's usage from crowding out that of another. Vinton Cerf has vividly described this problem of the commons that exists on the Internet: "The hill is overgrazed, there's no more grass, and the sheep die."[72] Similarly, *The Economist* reports that "[d]elay, break-downs and glacial transmissions are part of everyday Internet life," and it adds that "intersections between networks are usually where the traffic backs up."[73]

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71. *See* Hilzenrath, *supra* note 50, at D1.

72. Gurley & Martin, *supra* note 36, at 152 (quoting MCI Internet guru Vinton Cerf).

73. *The Economics of the Internet, Too Cheap to Meter?*, THE ECONOMIST, Oct. 19, 1996, at 23.

The lesson to be learned from the experience to date is that data networks themselves are subject to congestion as a consequence of the manner in which usage is priced. Thus, it is not simply the case that a circuit-based system becomes congested because it is not designed for data usage. Even a network engineered for data transmission is subject to congestion. Increasing capacity is not the solution to congestion. The problem stems from distorted pricing. If capacity is underpriced, users will continually find new ways of consuming capacity—such as video transmission—and suppliers of that capacity will not have an incentive to keep pace with the expansion in usage. Moreover, when the resource is underpriced, quantity-rationing mechanisms inevitably take over. The cost of rationing by waiting is inefficient allocation of scarce capacity and underinvestment in capacity expansion.

D. *The ESP Exemption Contributes to Shifting Internet Congestion onto the PSTN*

The ESP exemption creates congestion on the PSTN in another important way. A common phenomenon during rush hour is the congestion of streets near freeways as on-ramps become jammed. In some cases, freeway congestion is alleviated by stoplights at the on-ramps, which serve to create traffic jams on streets approaching those on-ramps as traffic backs up. A similar phenomenon occurs due to the ESP exemption: Traffic that is jammed up at the gateways to the ISPs is shifted onto the PSTN.

Congestion on an ISP's system occurs when demand for connection outstrips the ISP's lines and modems. Callers encountering busy modems at the ISP then can worsen local exchange congestion as the queue is shifted onto the local exchange.

The pricing of Internet service contributes to congestion in the local exchange in a number of ways. When ISP lines become jammed and callers encounter busy signals, they will repeatedly call to try to get a free line. That repeated dialing places additional strains on the local exchange. Effectively, the queue for access to ISPs is moved onto the PSTN; thus the costs of handling the queue are shifted to the LEC. A World Bank study of telecommunications in less-developed countries has observed that phenomenon and has noted that congestion results not only from telephone exchanges and trunks not being able to handle call

traffic, but "also . . . from the high proportion of time that the telephone called is engaged; thus subscribers repeatedly attempt to place calls, which, when added to the repeat calls resulting from equipment congestion, further strains the network's capacity."[74]

The busy signals experienced by eight-million America Online users did not impose costs only on users. They also shifted costs onto the local exchange as users dialed repeatedly to obtain a connection. Thus, the congestion externality is not simply data traffic crowding out voice traffic on the local exchange network. It is also congestion on an ISP's system being shifted back onto the local exchange.

That queuing problem means that the cost of congestion at an ISP is not simply the waiting time of the ISP's customers. Rather, some of the congestion is exported back to the PSTN through call attempts. The ISPs do not pay for any of the incremental costs they impose on the PSTN because access charges are zero. Moreover, the current structure of rates charged to the ISPs for access lines gives them an incentive to move their queue onto the PSTN rather than handling it through adjustment of their usage pricing and through investment in increased capacity. Thus, ISPs free ride in another way on the PSTN: they use the PSTN as a rationing device for their own systems. Without that convenient way to "park" their customers, the ISPs would have an incentive to invest in greater capacity.

IV. PRICING INTERNET ACCESS TO ISPS

Continuing the ESP exemption is a form of access price regulation that sets the access price at zero for ISPs. The consequences of such price regulation is evident: (1) adverse selection among voice users and data users of the telephone system; (2) congestion externalities that appear on the local exchange at certain locations at certain times, but threaten to degrade service quality; (3) inefficient consumption decisions; (4) inefficient investment decisions by incumbent LECs, CLECs, and ISPs; and (5) inefficient incentives for innovation.

Those problems raise a number of questions. How should access to ISPs be priced? How should access pricing be regulated?

74. ROBERT J. SAUNDERS ET AL., TELECOMMUNICATIONS AND ECONOMIC DEVELOPMENT 15 (2d ed. 1994).

What is the best access technology? How should regulators approach the question of access technology? Those four questions are intimately connected. Regulation of access pricing will have a substantial impact on access technology and thus will create unintended consequences. Such consequences are similar to those observed for the ESP exemption. A pricing policy that was intended to stimulate development of Internet access may actually retard the process while reducing the quality of the PSTN. Similarly, having regulators "pick winners" in access technology will have a substantial impact on pricing, again with the possibility of unintended consequences. Innovation may be slowed down by a command-and-control approach with the end result being higher costs for consumers and fewer access options.

The main point is that pricing and access technology options are closely connected and determined together. Technology presents a menu of options for data transmission: the status quo PSTN, narrowband ISDN integrated within the existing system, ADSL and high-bit-rate digital subscriber lines (HDSL) on copper loops, bypass alternatives using coaxial cable or wireless transmission, or broadband networks with fiber-to-the-curb. It is too soon to choose the best technology for data transmission; and, in any case, choosing is beside the point. The choice is not an administrative regulatory decision. It is not the FCC's choice to make. Although it is certainly entertaining to imagine the possibilities created by technological innovation and to speculate on emerging technologies and their capabilities, the information involved in sorting out the various options far exceeds the capabilities of any single customer, telecommunications company, or even a federal regulatory agency.

The choice of technologies is best left to market competition. In fact, the different transmission access options have different cost and performance characteristics, so that it is most likely to be the case that multiple access solutions are desirable. Many or all of the available solutions involve *cost-performance tradeoffs*. The outcome to be avoided is for the FCC to select a one-size-fits-all approach, which would do nothing less than stifle innovation and impede investment.

Correspondingly, the choice of access pricing is best left to market competition. Because the different access options for data involve cost-performance tradeoffs, restrictive price controls would bias the technological outcome, as the ESP exemption already has

done. The goals of product variety, consumer choice, and producer innovation call for relaxing price controls on access. That means that access options offering greater bandwidth and reliability at a higher cost should be available to those customers that require higher quality data connections for Internet access, work at home, or other uses.

A. *Pricing Access*

Access is not priced in a vacuum because it reflects not only the cost of connecting to the network, but also the capacity costs that usage of the network entails. That point bears emphasis when considering demand for data transmission. One question is whether access to ISPs is provided over the PSTN or bypasses some or all of the local network.

Access to the local exchange network, as defined by John T. Wenders, refers to "the *right* to be connected to the network and make calls at whatever price is charged for usage," where usage denotes outgoing calls only.[75] He further observes that access can include the right to receive calls. In addition to the connection to the network at the time of use, the right of access also includes the *option* to receive calls or to purchase calls at existing prices.[76] Thus, access to the local exchange network includes both a connection and option component. There are costs associated with providing both connections and standby capacity to supply the option to achieve a connection. The costs of standby capacity are capital costs of network capacity that are similar to the merchant's cost of holding inventory to provide "immediacy" to customers.[77] Clearly, the pricing of access to the local exchange network depends on the price of usage. Flat-rate pricing effectively sets the price of usage at zero and requires cost to be covered from the price of flat-rate service and the price of access.

The services of the local exchange network are an input to various network services. Access to the local exchange network, which includes both connection and option components, is used to obtain services such as interconnection with other networks.

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75. JOHN T. WENDERS, THE ECONOMICS OF TELECOMMUNICATIONS: THEORY AND POLICY 46-48 (1987).

76. *See id.* at 47-48.

77. For a discussion of immediacy, see Daniel F. Spulber, *Market Microstructure and Intermediation*, J. ECON. PERSP., Summer 1996, at 135, 145. Immediacy refers to ready availability of products and services.

Connection to an ISP for a customer of the local exchange requires access to the local exchange network. It also includes *usage* of the local exchange network, including local loops, switching, transport, and other network services required to reach the ISP's point of presence. In other words, originating the connection to an ISP's point of presence using the local exchange network includes three components: (1) connection to the LEC's network itself; (2) the option value of that connection; and (3) usage of the LEC network to reach the ISP's point of presence. Pricing the connection to the ISP should reflect the costs of those three components. The customer of the LEC originating a data call already pays for access (that is, the right to connect and the option value of the connection). The customer of the LEC should also pay for the usage of the network in connecting to the ISP's point of presence.

Calls on the PSTN to ISP points of presence clearly entail usage costs and make claims on scarce capacity. The pricing of calls to the ISP points of presence should reflect those costs. That principle applies whether the additional charges are placed directly on callers through usage charges or on the ISP itself through access charges.

Moreover, because data calls require different equipment and represent different patterns of usage, connection to ISP points of presence should be different from usage of the network for local calls. Because ISPs receive calls that originate on the local network and generally do not use terminating access, the costs imposed by data traffic should be recovered from the originating access on the local exchange network. Because a local loop can be used for both voice and data calls, the costs imposed by data calls should be recovered through usage charges on the consumer and access charges on the ISP for originating access.

That discussion implies that pricing of access to ISPs should include separate components that reflect the costs of connection and usage. Those costs can be divided in some manner between end-users and ISPs. Regulation should be sufficiently flexible that customers can choose different forms of access involving different transmission technologies and be charged accordingly. Moreover, customers should be able to choose different service quality levels and be charged accordingly. All customers using the PSTN should bear the capacity costs that their usage causes.

Just as interexchange carriers pay access charges, so should ISPs, particularly given the high network usage costs associated with data transmission. Because data transmission over the PSTN consumes scarce transmission and switching capacity, those costs should be reflected in ISP access charges. Moreover, the access charges should reflect the costs imposed on the local exchange network by the configuration of the ISP in terms of the number of access lines per customer, the pattern of usage of ISP customers, and the queuing and repeated calls that occurs over the PSTN.

B. *LECs Should Have Flexibility in Setting Market-based Access Charges*

Regulators face a difficult problem in attempting to select efficient prices. Rather than trying to mimic market processes through command-and-control regulation, regulators should rely as much as possible on market forces to set prices. Prices for originating and terminating access should be capped by existing market alternatives. Access prices include both nontraffic-sensitive and traffic-sensitive portions reflecting the costs of transmission between the point of presence and the origination or termination point on the local exchange network. The usage-based component should depend upon such cost-causing factors such as time and distance. To ensure that prices reflect cost causation, it is necessary to eliminate flat rates, geographic rate averaging, and other cross-subsidies in the rate structure. Access prices should cover the incremental cost of providing access to the ISPs plus a *market-allowed* contribution to common costs. That contribution should reflect the opportunity costs to the LEC of capacity that is used for data traffic. LECs should be given flexibility in setting access prices.

For many of an LEC's customers, there are competitive benchmarks for pricing access that serve to lessen or eliminate any monopoly power on the part of incumbent LECs. With competing access alternatives, customers can choose the least-cost alternative. Thus, if the price charged to customers for access to ISPs by the LEC is too high, the customer has several alternatives. First, the customer can obtain wireless access from a cellular carrier or digital provider of personal communications services (PCS). Such access serves to place an upper limit on what can be charged for originating access. That limit obviously can be expected to fall as multiple PCS providers commence service in a given geographic

market. Second, for those customers who generate most of the net revenues of the LEC, the price for originating access is bounded by the market prices of competing carriers offering access, including competitive access providers (CAPs) operating fiber optic networks in a large number of city centers. Third, cable television operators can provide ISP access through cable modems. Fourth, with the passage of the Telecommunications Act of 1996, entrants can provide local access services through resale of the incumbent LEC's local service or through the operation of certain facilities combined with purchasing the services of the incumbent LEC's unbundled network elements.[78] Regulation of the prices of resale and unbundled network elements continues in force. Interexchange carriers and other entrants can construct virtual networks for the provision of access. The pricing of access thus cannot exceed the cost of self-provisioning of access.

Another concern of the LECs if regulators set too high a price to ISPs is that the ISP will obtain access from a CLEC who will then terminate traffic from the incumbent LEC's PSTN. The incumbent LEC will continue to originate the bulk of the traffic going to the Internet access providers, with all the associated network costs that we already have identified. However, because the CLEC is terminating the traffic, the incumbent LEC will be *paying* access charges for Internet traffic to the CLEC. That situation does little to change the traffic patterns or costs, but effectively raises the cost of providing Internet access to the incumbent LEC. Moreover, the CLEC will provide access services using resale and unbundled network elements obtained from the incumbent LEC (at discounts or pricing regulated by the state commissions and subject to the 1996 Telecommunications Act's interconnection provisions). Thus, as a consequence of the interconnection requirements of the Act the incumbent LECs may actually prefer receiving a zero price for providing access to ISPs, as opposed to paying another carrier for terminating access for the same traffic.

The incentives of CLECs to divert traffic from the incumbent LECs so as to receive terminating access charges exists even if the ISP exemption is continued. To carry that out, all the CLECs need to do is to sign up ISPs as their customers, charge the incumbent

78. As we note *infra*, however, access competition in the form of resale or unbundled network elements may still create serious congestion of the incumbent LEC's network.

LECs for terminating access and rebate a portion to the ISPs as an incentive to leave the incumbent LECs.

A positive price for access that is adjusted for bypass alternatives available to ISPs would serve to create the proper incentives for access provision. Incumbent LECs and CLECs should compete in the provision of access based on the quality and cost of alternative transmission services, not on the returns to arbitrage created by regulatory price distortions. The ISPs and their customers will benefit from the provision of access facilities tailored to transmission of data traffic that bypasses the PSTN, whether provided by the incumbent LEC or by facilities-based CLECs. Such diversion of traffic will also benefit voice customers of the PSTN. Because data transmission facilities provide enhanced quality of service by handling data faster and avoiding congestion, customer willingness to pay for such service will be higher that for slower or less reliable service. However, diversion of data traffic by creating a quality-differentiated service may not be sufficient to alleviate the congestion of the PSTN. Competition in the provision of data transmission will only arise if the pricing of access over the PSTN adjusts to competitive levels rather than appearing to be a free good.

In light of the accelerating facilities-based market competition in the local exchange, the presence of unbundled network element alternatives provided to entrants under the Telecommunications Act, and the economic incentives of LECs to supply access competitively, the FCC should rely on market forces to adjust the connection and usage portions of the access charges from their current levels.

The FCC should dismiss concerns that removing the ESP exemption will create excessive prices for access to ISPs. The competitive alternatives just cited and the incentives of the LECs to provide access are sufficient for light-handed price controls to achieve the desirable objectives, with the removal of price-caps as interconnection agreements are approved.

The FCC also should dismiss concerns that removing the ESP exemption will slow the development of the "information superhighway." The burgeoning demand for information transmission will continue apace, driven by advances in computers and communications technology, and the accompanying developments in software, communications protocols, and commercial, educational, medical, entertainment, and other

applications. The issue at hand is the development of effective access—the *on-ramps* to the information superhighway. Underpricing access through the ESP exemption or other restrictive price controls will harm customer choice, and hold back the incentives for incumbent LECs, CLECs, and others to upgrade or supplant existing access options.

C. *The ESP Exemption Is a Zero Price for Data Transmission*

Without question, the ESP exemption is a zero price for data transmission. The LECs are being forced to subsidize the ISP by carrying costly data traffic for free. Presumably, they are supposed to "make it up on volume." Such a situation entails very serious economic inefficiencies and large scale subsidies.

Reed Hundt, the former chairman of the FCC, indicated his intention in 1997 to maintain the ESP exemption on the grounds that there was insufficient information available: "I just don't think the FCC knows enough at this time to alter the current ESP exemption."[79] How much more information is needed to understand the consequences of pricing at zero? The effects of rent control on the quality and availability of housing are well known. The effects of access to common property resources at a zero price also are well understood. There is no need to study technological change in the communications industry to understand such a basic lesson of economics: pricing of scarce resources at zero is inefficient. Chairman Hundt continued in the same speech:

> But I do think we know one important thing: our best bet for promoting Internet solutions will be our overall competition policy.
>
> The Telecommunications Act of 1996 should really be called the Big Bandwidth Act, because that's what it will mean if we do our job right.
>
> To have big bandwidth networks, we will need to see the kind of competition that characterizes, for example, the pizza delivery business. Like pizza, bandwidth will be delivered piping hot to your door, in small, medium, or large size. You'll be able to get . . . anything you want on it—voice, video, or data, in any combination.[80]

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79. Reed E. Hundt, *Convergence or Collision: Telecommunications Regulation and the Internet*, <http://www.fcc.gov/Speeches/Hundt/spreh712.html> (text version of speech delivered in Berkeley, California, Mar. 7, 1997).

80. *Id.*

Although the analogy is tantalizing, there is no free lunch, even in the pizza business. Imagine Domino's Pizza being told that computer users can have pizza delivered free to their door as a means of promoting development of the information industry. Everyone would have an incentive to purchase a computer just to receive the free pizza. The free pizza, by federal mandate, would certainly make it more difficult for others to compete. And where would the subsidy for the free pizza come from? No firm could stay in business for long delivering services for free, be it pizza or bandwidth.

Price controls are not good competition policy. Sound competition policy means elimination of price controls and the exercise of forbearance. Moreover, because competitive markets cannot tolerate cross subsidization, sound competition policy means the elimination of subsidies such as those embodied in the ESP exemption. Competition policy should mean impartiality. The creation of subsidies for ISPs at the expense of the LECs is a clearly biased policy intended to "pick winners" rather than to unleash competition.

In another speech in 1997, Chairman Hundt drew an analogy between transmission of data and utility services:

> At the forum, Les Vadasz from Intel described how he would solve the bandwidth problem. As he pointed out, you can turn on your tap and get water, you can put a plug in a socket and get electricity, you turn on your TV and get cable. Why can't you just connect your PC to an outlet and get data?
>
> He laid out seven requirements for this data service. Number one, of course, is bandwidth. Number two, is instant access—no dialing in. Number three, plug and play service, just like cable. Number four, multimedia capability—voice, video, data. Number five, store-and-forward capability, so that voice mail and E-mail are easy and reliable. Number six, security. And, number seven, affordability.[81]

Chairman Hundt evidently believed that Internet access should flow to the consumer like water. But if water flowed freely from the tap, there would be no incentive to conserve in its use. If electricity were priced on an unmetered basis, air conditioners would be set at 68 degrees and run continuously in August in

81. Reed E. Hundt, *Bandwidth and Pizza,* <http://www.fcc.gov/Speeches/Hundt/spreh711.html> [hereinafter Hundt, *Bandwidth and Pizza*] (text version of speech delivered to the ACM97 Conference, San Jose, California, Mar. 4, 1997).

Washington, D.C. And if smoke could be freely released from factories, there would be no incentive to conserve on clean air by reducing emissions. The fact that people have become accustomed to free data transmission on the PSTN does not make efficient pricing of Internet access any easier politically. Markets, however, have little tolerance for ill-considered public policy that attempts to provide "free" water, electricity, pollution, or even data transmission.

Moreover, the affordability of Internet access should be achieved by competition, not by regulatory price controls. Chairman Hundt, however, concluded:

> I don't think the right approach to achieve those goals is for local phone companies to impose access charges on Internet service providers. The Internet shouldn't contribute to the subsidies that access charges represent. But the Internet also shouldn't be subsidized in the form of below-cost second lines. If someone wants to buy a second line to access the Internet, the phone company should be entitled to charge them what that line costs.[82]

To suggest that charging ISPs for access contributes to a subsidy for the local exchange turns on its head the fact that a zero price of access is a subsidy to ISPs and their customers. Although access charges may have reflected regulatory cost allocations in the past, the solution is not to eliminate those charges completely. Rather it is necessary to allow prices to reflect resource scarcity. A zero price cannot accomplish that objective.

The suggestion that the price of second lines should be decontrolled sounds appealing if it indicates a general willingness to remove regulatory price controls on access. The pricing of lines, however, is a matter that is subject to state jurisdiction. Moreover, it is difficult to identify which of the two lines serving a household is the "second" line. Should access charges be applied to only one line? Such a distinction is impractical. Far better to decontrol access charges altogether. Zero access charges for connection to ISPs is unquestionably below-cost pricing.

D. *The Pricing of Data Transmission*

The pricing of data transmission on the LEC network should be deregulated in light of competitive access alternatives. We

82. *Id.*

recommend elimination of the ESP exemption with decontrol of access pricing for ISPs to the greatest extent possible, allowing the market for access to determine the price of access services.

The many alternative technologies for access to ISPs and the many alternative designs of prospective data networks suggest the need for market-determined pricing. Moreover, the pricing of transmission on data networks such as the intranet is far from settled. There are substantial transactions costs in metering the transmission of data packets. Some economists recommend that priority pricing of packet delivery be based on a system of real-time auctions with bids chosen by the local administrator who controls access to the net, by the user of the computer, and by the computer software itself.[83] Generally, Internet transmission remains a best-efforts delivery system without priority pricing methods. Those users seeking increased reliability or speed transmit on private commercial systems.

The pricing of data networks is a difficult and largely open question, which suggests additional reasons for caution and regulatory forbearance. The best approach to pricing access for ISPs is regulatory decontrol, applying a market-based solution that allows the pricing of access service to be market-determined.

V. PROPERTY RIGHTS AND THE COST OF TELEPHONE NETWORK CONGESTION

We consider now the property-rights implications of the ESP exemption and the costs that congestion imposes on the PSTN. The FCC's proposals to price interstate access and unbundled network elements (UNEs) at levels based on total element long-run incremental cost (TELRIC) would cause the LEC's total revenues from regulated services to fall short of the total costs of providing those services.[84] The FCC's conclusion to continue

83. *See* Jeffrey K. MacKie-Mason & Hal R. Varian, *Some Economics of the Internet* (University of Michigan, rev. version Feb. 17, 1994).

84. *See* J. GREGORY SIDAK & DANIEL F. SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT: THE COMPETITIVE TRANSFORMATION OF NETWORK INDUSTRIES IN THE UNITED STATES 304-42 (1997) [hereinafter SIDAK & SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT]; J. Gregory Sidak & Daniel F. Spulber, *The Tragedy of the Telecommons: Government Pricing of Unbundled Network Elements Under the Telecommunications Act of 1996*, 97 COLUM. L. REV. 1081 (1997); Reply Affidavit of J. Gregory Sidak & Daniel F. Spulber, *appended to* Reply Comments of the United States Telephone Association *in* Access Charge Reform; Price Cap Performance Review for Local Exchange Carriers; Transport Rate Structure and Pricing; Usage of the Public Switched Network by Information Service and Internet Access Providers, Notice of

subsidizing ISPs through the ESP exemption can only increase the revenue shortfall that makes cost recovery impossible for the incumbent LEC. The FCC's conclusion is thus a powerful signal that the agency is not credibly committed to mitigating the stranded costs that will arise from the transformation of local telephony mandated by the Telecommunications Act of 1996.

Despite its professed concern in the NOI about destroying incentives for investment in the local exchange,[85] the FCC has effectively announced its intention to engage in opportunistic behavior with respect to the incumbent LEC's nonsalvageable investments. The FCC has already ruled out using the most obvious and efficacious policy instrument at its disposal—the price system.[86] The continuation of the ESP exemption by the FCC would signal the absence of commitment to the mitigation of stranded costs associated with deregulatory takings. By virtue of its decision to force the incumbent LEC to subsidize the use of the PSTN by ISPs, the FCC in effect has commandeered a circuit-switched network designed for the delivery of voice messages and rededicated its loops, switches, and trunks to the transmission of data packets. The incumbent LEC did not design and construct the PSTN for that use. It is costly for the incumbent LEC to allow its facilities to be used as a substitute for a packet-switched data network. It is an unconstitutional taking for the FCC to dedicate the incumbent LEC's private property to a new public purpose that imposes costs on the LEC unless the FCC provides the LEC the reasonable opportunity to recover fully those costs.

A. *Redefining, Without Compensation, the Public Purpose to Which the LEC's Private Property Has Been Dedicated*

As we showed in the preceding sections, the use of the PSTN to transmit data traffic represents a fundamentally different service from the one for which the system was designed. The FCC in

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Proposed Rulemaking, Third Report and Order, and Notice of Inquiry, Federal Communications Commission, CC Dkt. Nos. 96-262, 94-1, 91-213, 96-263 (filed Feb. 14, 1997); Affidavit of J. Gregory Sidak & Daniel F. Spulber, *appended to* Comments of the United States Telephone Association *in* Access Charge Reform; Price Cap Performance Review for Local Exchange Carriers; Transport Rate Structure and Pricing; Usage of the Public Switched Network by Information Service and Internet Access Providers, Notice of Proposed Rulemaking, Third Report and Order, and Notice of Inquiry, Federal Communications Commission, CC Dkt. Nos. 96-262, 94-1, 91-213, 96-263 (filed Jan. 29, 1997).

85. *See Notice, supra* note 4, at 21,491 ¶¶ 313-14.

86. *See id.*

effect has ordered that a network originally designed and built to provide circuit-switched voice telephony shall be rededicated to the new public purpose of providing local access for data packets sent or received over the Internet.[87] Thus, the FCC, acting through its tentative conclusion to perpetuate the ESP exemption to accommodate Internet access over the PSTN, has retroactively redefined the public purpose to which the incumbent LEC's capital investment shall be dedicated.

The use of the PSTN for data transmission creates congestion costs that are borne by the LEC and both voice and data customers. As we showed earlier, the FCC's subsidy for Internet access over the circuit-switched voice telephony network will degrade the quality of service on that network and impair the incumbent LEC's ability to recover its economic costs. As a result, unless adequate compensation is paid to the incumbent LEC for the use of its network in that costlier manner, the FCC's new public purpose for the PSTN will deny the LEC any reasonable opportunity to recover its full economic costs of providing service. In that case, the FCC's perpetuation of the ESP exemption will be an exercise in regulatory opportunism that will have constituted a taking of the LEC's private property in violation of the Fifth Amendment.

The congestion of the PSTN due to the FCC's inefficient pricing of Internet usage exemplifies the problem that the United States Supreme Court addressed in its 1915 decision *Northern Pacific Railway Co. v. North Dakota.*[88] The decision emphasized that private property that a regulated utility has dedicated to a public purpose cannot be appropriated by the government for a different purpose.[89] In this case, the LEC's private property—switches, trunks, loops, and other capital investments—was dedicated to the public purpose of supplying a circuit-switched telephone network designed for voice communication.

The *Northern Pacific Railway* case involved a challenge by two railroad companies to a North Dakota statute setting maximum

87. Our analysis here assumes for the sake of argument that the FCC's subsidy to ISPs is intended to achieve a legitimate public purpose, rather than the strictly private and therefore illegitimate purpose of enriching ISPs.

88. 236 U.S. 585 (1915).

89. *See id.* at 595. For a more extensive analysis of *Northern Pacific Railway*, see SIDAK & SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT, *supra* note 84, at 262-68, 453, 470-71, 491; J. Gregory Sidak & Daniel F. Spulber, *Givings, Takings, and the Fallacy of Forward-Looking Costs*, 72 N.Y.U. L. REV. 1068, 1082-87 (1997).

rates on the intrastate carriage of coal. The railroads claimed that those rates forced them to carry coal at a loss or at an uncompensatory rate (taking into account a competitive return to capital) and therefore constituted a taking of private property. Although the North Dakota Supreme Court agreed that the rates forced the companies to carry coal at a uncompensatory rate, it nonetheless deemed those rates not to be confiscatory because the companies overall continued to earn a reasonable return on their intrastate business.

The Supreme Court reversed. It held that the statute was an attempt to take a carrier's property without due process of law in violation of the Fourteenth Amendment. Although the government enjoys broad power to regulate private property devoted to a public use, Justice Hughes, writing for the eight-member majority, stressed that, "the State does not enjoy the freedom of an owner."[90] That the government may reasonably regulate to ensure that a carrier fairly discharges the obligations of its charter does not mean that the government may redefine the public use to which the carrier's property is dedicated, even if the carrier's total business continues to earn a sufficient return:

> The fact that the property is devoted to a public use on certain terms does not justify the requirement that it shall be devoted to other public purposes, or to the same use on other terms, or the imposition of restrictions that are not reasonably concerned with the proper conduct of the business according to the undertaking which the carrier has expressly or impliedly assumed .... The public interest cannot be invoked as a justification for demands which pass the limits of reasonable protection and seek to impose upon the carrier and its property burdens that are not incident to its engagement. In such a case, it would be no answer to say that the carrier obtains from its entire intrastate business a return as to the sufficiency of which in the aggregate it is not entitled to complain.[91]

As an example, Justice Hughes stated that if the firm "has held itself out as a carrier of passengers only, it cannot be compelled to carry freight."[92] This simple example from 1915 has a contemporary analogy in the debate over the FCC's subsidy for

90. *Northern Pacific Railway Co.*, 236 U.S. at 595. The lone dissenter, Justice Pitney, wrote no opinion.

91. *Id.* at 595-96.

92. *Id.* at 596.

Internet access and the resulting congestion to the PSTN. Once the regulated firm has designed and built a circuit-switched network for providing voice telephony service to consumers, it cannot be compelled without just compensation to rededicate that network to providing service on an unmetered (and, hence, inherently unremunerative) basis to capacity-intensive data transmissions that are better suited to packet-switched networks.

The FCC evidently believes that subsidizing Internet access would provide some public benefit. *Northern Pacific Railway*, however, also established that the proposed redefinition of the public purpose to be served by the regulated private property is not made any more constitutionally permissible by the fact that a State intends the redefinition to serve an important public-policy goal that materially benefits the State's residents. The Court considered it beside the point that North Dakota believed that the rates would "aid in the development of a local industry," an industry whose "infancy" and potential "to confer a benefit upon the people of the State" were matters of sincere concern to the State.[93] North Dakota's goal of "making the community less dependent upon fuel supplies imported into the State"[94] could not justify its resorting to an appropriation of private property as the means to achieve that objective:

> [W]hile local interests serve as a motive for enforcing reasonable rates, it would be a very different matter to say that the State may compel the carrier to maintain a rate upon a particular commodity that is less than reasonable, or—as might equally well be asserted—*to carry gratuitously, in order to build up a local enterprise.* That would be to go outside the carrier's undertaking, and outside the field of reasonable supervision of the conduct of its business, *and would be equivalent to an appropriation of the property to public uses upon terms to which the carrier had in no way agreed.*[95]

For the FCC to order an incumbent LEC "to carry gratuitously" an ISP's interstate access traffic "in order to build up" the Internet "would be equivalent to an appropriation of the property to public uses upon terms to which" the LEC "had in no way agreed."

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93. *Id.* at 598.
94. *Id.*
95. *Id.* (emphasis added).

B. *Congestion and Physical Invasion of the LEC's Network*

Distinct from the notion of alternative usage of private property dedicated for public usage is the concept of "physical invasion" of private property. As with changes in usage, physical invasions impose costs on property owners, particularly in terms of the economic value of opportunities lost as a consequence of that physical invasion. The Supreme Court has held that a physical invasion of property that is compelled by government action gives rise to an absolute right of compensation under the Takings Clause of the Fifth Amendment.[96]

The FCC's ESP exemption effects a physical invasion of the incumbent LEC's local access network in the form of electrons or photons that convey packets of information going to or coming from the Internet. The simple confirmation that such physical occupation is occurring is that the incumbent LEC's network is congested. The occupation of the PSTN by data packets going to and from ISPs entails opportunity costs because it excludes other uses of the network—most importantly, voice calls. By definition, the ESP exemption from interstate access charges means that the incumbent LEC receives no compensation for the physical occupation of the PSTN by customers of ISPs seeking access to the Internet. If the FCC were to perpetuate the ESP exemption, as it tentatively concluded in the NOI it will do, the FCC would effect an unconstitutional taking of property.

The leading decision on takings arising from physical invasions of property is the United States Supreme Court's 1982 decision in *Loretto v. Teleprompter Manhattan CATV Corp.*, which defended the absolute right of compensation even in the case of "a minor but permanent physical occupation of an owner's property authorized by government."[97] The Court announced that "when the 'character of the governmental action,' is a permanent physical occupation of property, our cases uniformly have found a taking to the extent of the occupation, without regard to whether the action achieves an important public benefit or has only minimal economic impact on the owner."[98]

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96. *See* Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419, 421 (1982).

97. *Id.*

98. *Id.* at 434-35 (quoting Penn Central Transp. Co. v. New York City, 438 U.S. 104, 124 (1978)) (citation omitted). Under the most familiar takings cases concerning public utilities, Federal Power Comm'n v. Hope Natural Gas Co., 320 U.S. 591 (1944), and Duquesne Light Co. v. Barasch, 488 U.S. 299 (1989), which do not rely on the physical

The incumbent LEC is unable to exclude data packets from flooding the PSTN because of the FCC's policy of requiring incumbent LECs to subsidize the consumption of interstate access by ISPs. Because of the technological and economic complexity of mandatory network access in the telecommunications industry, it is easy to overlook the obvious: mandatory access constitutes a government-ordered, physical invasion of the property of the incumbent LEC. In 1995 the Oregon Supreme Court, relying upon *Loretto*, held unanimously that the state Public Utility Commission's order that enhanced service providers be allowed to co-locate their equipment on the premises of incumbent LECs constituted a physical invasion that violated the Takings Clause.[99] The court emphasized that "the facts that an industry is heavily regulated, and that a property owner acquired the property knowing that it is heavily regulated, do not diminish a physical invasion to something less than a taking."[100]

The relevance of *Loretto* to local telephony is not limited to the occupation of square footage in a central office. In the circuit-switched telecommunications network built for voice communications, the use of the transmission path is mutually exclusive because of the need for a dedicated line to carry voice traffic. The capacity of the telephone network in terms of the number of message-minutes depends on the total number of available circuits. That relationship means that the configuration of a telecommunication network's lines and switches inevitably places limits on the total number of telephone calls that can be simultaneously completed on the local exchange network. Because there are capacity limitations on the total number of telephone calls that can be carried on the network, it is necessary to price that scarce capacity to allocate access to the network efficiently. If the price of access is too low, there will be excess demand for access, which will cause network congestion. With the growth in demand to use the Internet, the FCC's ESP exemption causes usage of the PSTN to reach that capacity limit far more

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invasion theory, the FCC's decision to deny the incumbent LEC the right to charge an ISP *any* price for its usage of interstate access also is inherently confiscatory. For further discussion of *Loretto* and other takings cases relevant to mandatory access to the local exchange network, see SIDAK & SPULBER, DEREGULATORY TAKINGS AND THE REGULATORY CONTRACT, *supra* note 84, at 227-40.

99. *See* GTE Northwest, Inc. v. Pub. Util. Comm'n of Oregon, 900 P.2d 495, 501-06 (1995), *cert. denied*, 116 S. Ct. 1541 (1996).

100. *Id.* at 504; *accord*, Gulf Power Co. v. United States, 1998 U.S. Dist. LEXIS 3530, at *25 (N.D. Fla. Mar. 6, 1998).

quickly than if the network were used for voice traffic. An important consequence of such congestion is a delay for users of the network in obtaining a dial tone or completing a call. Such delays are analogous to a traffic jam. A delay in service is a rationing device that is, under general conditions, an inefficient means of allocating scarce capacity in comparison to the correct pricing of access.

Five years after *Loretto*, the United States Supreme Court considered a similar case. The Pole Attachments Act[101] authorized the FCC to regulate the rates, terms, and conditions of the attachment of cable television wires to utility poles if a State did not engage in such regulation, but the statute (at that time) did not mandate access. An electric utility challenged the statute as a permanent physical invasion of private property, but the Court ruled in *FCC v. Florida Power Corp.*[102] that *Loretto* did not apply. Justice Marshall, writing for the majority, reasoned that the statute merely regulated prices in consensual transactions. Unlike the New York statute in *Loretto*, which contained the "element of required acquiescence . . . at the heart of the concept of occupation," the federal law did not compel the property owner to submit to an involuntary transaction.[103] In 1992 the Court reinforced that rationale: property owners who "voluntarily open their property to occupation by others . . . cannot assert a per se right to compensation based on their inability to exclude particular individuals."[104] These subsequent decisions do not limit *Loretto*'s applicability to the FCC's subsidy for ISPs, for that subsidy was by definition not a transaction to which any incumbent LEC voluntarily submitted. The FCC *mandated* the subsidy.[105]

C. *Implicit Compensation from Second Lines and from ISP Rental of Lines*

In determining just compensation for a taking it is important to identify the *net* costs of the government action, counting all relevant costs and netting out benefits or avoided costs. ISPs argue

101. 47 U.S.C.A. § 224 (West Supp. 1998).

102. 480 U.S. 245 (1987).

103. *Id.* at 252.

104. Yee v. Escondido, 503 U.S. 519, 531 (1992).

105. *Cf. Gulf Power Co.*, 1998 U.S. Dist. LEXIS 3530, at *28 (applying *Loretto* to pole attachment provisions of the Telecommunications Act of 1996 and finding per se taking of property).

that an incumbent LEC's revenues from the end user's addition of a second line are sufficient to compensate the LEC for the costs arising from the untimed usage of its network by customers of ISPs. That conjecture is not credible for several reasons.

First, if the second line were a residential line, it would likely be priced by the state public utility commission at or below the incumbent LEC's TELRIC. Under current pricing, the second line would generate little if any contribution to the recovery of the LEC's common costs or revenue shortfalls on other services. As the percentage of households in a given area that obtain second lines increases, the LEC will incur additional capacity costs because the PSTN is configured on the basis of assumptions about the penetration of second lines under voice telephony.

Second, if the customer used the second line exclusively for local access to his ISP, that line would generate no revenues for the LEC from the provision of local toll calls, interstate access for long-distance calls, or vertical features. Consequently, the incumbent LEC could not expect to earn net revenues from such services and use those net revenues to offset the losses incurred on the provision of unmetered local service used to secure access to the Internet.

Third, if, to the contrary, the second line were a viable source of net revenues with which the incumbent LEC could offset losses from subsidizing ISPs, competitive local exchange carriers would immediately seek to serve the relevant customers through resale or through the purchase of UNEs. The same result would occur if the state commission were to "order that the second line to the home or business be deregulated as to price, and not be the recipient of any subsidy," as Chairman Hundt suggested in March 1997.[106] Given the preference of the FCC and many state commissions to set prices for resale and UNEs on the basis of TELRIC, however, CLECs would bid down any net revenues that might be available to the incumbent LEC from the provision of a second line.

Fourth, congestion of the PSTN is a common cost that would not be reflected in the TELRIC-based prices that CLECs would pay to the incumbent LEC for UNEs and wholesale services. CLECs could impose on the incumbent LEC the entire cost of

106. Hundt, *Bandwith and Pizza, supra* note 81.

alleviating congestion on the rationale that that cost is not incremental to the LEC's sale of any given UNE or wholesale service.

Finally, economic efficiency requires usage-based pricing of Internet access through a two-part or multi-part tariff. A two-part tariff would have a capacity charge and a usage charge. The current tariff design for a second line, however, in effect sets the capacity charge at the fixed monthly rate and the usage charge at zero. Even if the second line's fixed monthly rate generated positive net revenues for the incumbent LEC, that pricing regime nonetheless would be inefficient in terms of inducing congestion of the PSTN because the customer's marginal price for Internet access would still be zero. It is not clear *ex ante* whether or not the cost to the incumbent LEC of alleviating congestion would exceed the cost of forgone interstate access revenues under the ESP exemption.

It is also argued that the incumbent LEC receives compensation from its sale of access lines to an ISP. There are two flaws with that argument. First, there is no assurance that the incumbent LEC's revenue from the installation charge and monthly fees from all of the business lines supplied to an ISP will cover the total economic cost that the ISP imposes on the PSTN. An ISP does not use its business lines to make outgoing calls, which usually are priced on a metered basis. Rather, the ISP only receives calls on those lines, and the ISP pays no charge for incoming calls, as would a business that provided its customers a toll-free 800 or 888 number. It is, after all, a critical element of the ISP's business strategy to minimize the cost of access charges for its customers by making available to them ubiquitous local, toll-free access numbers. That is why, for example, the sign-on sequence for America Online enables the customer to search for local access numbers anywhere in the United States, and even in many foreign countries.[107]

Second, the ISP is free to purchase its access lines from a CLEC. In that case, the incumbent LEC receives absolutely no revenues from the ISP, even though the ISP imposes a substantial cost on the incumbent LEC's network. To make matters worse for the

107. As of April 1998, when one selects "New Local #" under "Select Screen Name" and double clicks "Sign On" on AOL's "Welcome" screen, a connection to AOL is established using an 800 number. Then the user is prompted to enter his area code to receive a local access number at a particular baud rate.

incumbent LEC, CLECs are demanding that the incumbent LEC pay a local interconnection charge whenever one of its own subscribers calls an ISP access number that is supplied by a CLEC. Despite the inherently interstate nature of such traffic, CLECs are in effect demanding that the incumbent LEC pay its competitors for the privilege of having its network congested with Internet traffic.[108] The FCC should ask ISPs to identify how many of their local access lines are supplied by CLECs and how many are supplied by the incumbent LEC. Similarly, the FCC should ask CLECs to identify how many of their total access lines are supplied to ISPs and how many are supplied to other firms that qualify for the ESP exemption. Moreover, the FCC should ask CLECs supplying access lines to ISPs to identify how their interconnection agreements with incumbent LECs specify compensation for terminating access for ISP traffic.

D. *Cost Allocation and Vicarious Liability of the States*

Acting jointly, the States and the FCC allocated the common costs of the local exchange network along arbitrary jurisdictional lines. That arbitrary allocation placed a disproportionate share of non-traffic-sensitive costs on interstate access services. It would have been unconstitutional for the States to allocate common costs to the interstate side of the LEC's books without any intention that the FCC would subsequently allow the LEC a reasonable opportunity to recover that arbitrary allocation of common costs. That in fact has happened. With respect to interstate usage of the PSTN by ISPs, the FCC has denied the incumbent LEC *any* opportunity to recover non-traffic-sensitive costs allocated to the interstate jurisdiction. The situation is even worse, for the FCC's ESP exemption denies the incumbent LEC any opportunity to recovery even the *traffic-sensitive* costs generated by subscribers using the PSTN to gain access to the Internet. Thus the FCC's policies have created a substantial exposure for the States because of their vicarious liability for takings.

108. The CLEC, on the other hand, would not expect the ISP to originate any calls over those lines that would terminate on the incumbent LEC's network. In this case, therefore, one would expect the CLEC not to propose bill-and-keep as the compensation scheme for local interconnection.

As we noted in our economic and legal analysis of the regulatory contract and of deregulatory takings in the *Access Reform* proceeding,[109] the LEC is entitled to receive the reasonable opportunity to recover *all* of its common costs. That obligation on the part of regulators does not depend on whether the common costs are classified as forward-looking or historic. Rather, the firm should receive the opportunity to recover the costs of discharging its past, current, and future regulatory obligations. Nor does the obligation depend on whether the common costs have been divided into two categories labeled "interstate" and "intrastate." As the name implies, common costs are common to the overall activities of the LEC. The arbitrary assignment of *X* percent of those common costs to services regulated at the state level and *Y* percent to services regulated at the federal level does not alter in any way the essential commonality of those costs.

The separations process was an arbitrary decision jointly made by the States and the federal government to advance shared goals concerning the structure of rates. As such, it was a modification of the regulatory contract. The practical effect of the jurisdictional separation of the common costs of the LEC was to interpose the federal government (represented by the FCC) as a party to the preexisting contracts between the States and the LECs. The allocation by state and federal regulators of a substantial share of an LEC's common costs to the interstate side of its books necessarily carried with it the representation that the FCC would afford the LEC the reasonable opportunity to recover, through its sale of interstate access at regulated rates, that portion of common costs (both operating costs and capital costs) that had been jurisdictionally designated as "interstate" in character.

For the FCC to order that ISPs shall receive interstate access for free would produce a shortfall in contribution to the recovery of that portion of common costs that have been jurisdictionally characterized as "interstate." If predictions of Internet telephony are correct, that shortfall could be substantial in the future. The incumbent LEC cannot offset that shortfall with "excess profit" earned on its intrastate activities. On the intrastate side, the States (through their unbundling arbitrations) and the FCC (through

109. *See* Reply Affidavit of J. Gregory Sidak & Daniel F. Spulber, *supra* note 84; Affidavit of J. Gregory Sidak & Daniel F. Spulber, *supra* note 84.

the *First Report and Order*,[110] if lawful) have already taken steps that will foreclose the recovery of the LEC's full forward-looking costs. Needless to say, if the incumbent LEC cannot recover all its forward-looking costs, it will be precluded from fully recovering its historic costs of investments that were not fully depreciated when Congress abolished entry restrictions into local markets and mandated the sale of unbundled access to the local exchange network. Moreover, neither the States nor the FCC so far have provided any competitively neutral mechanism for the incumbent LEC to recover either the forward-looking or historic component of its stranded costs. In short, the revenues from the intrastate side of the incumbent LEC's operations will fail to recover the portion of common costs jurisdictionally characterized as "intrastate." It follows that intrastate services will be unable to offset the revenue shortfall on the interstate side that would result from the FCC's compulsory subsidy of ISPs.

Consequently, the federal government and the States would be jointly liable for the taking that will occur if the FCC perpetuates the ESP exemption. Meanwhile, the States have failed to take steps to mitigate this interference with the LEC's ability to recover costs. In particular, the States have failed to price local calls for access to ISPs on the basis of usage. To the contrary, the States have continued to require that such calls be priced on a flat-rate, unmetered basis—despite the manifest inefficiency of such price regulation.

VI. IS IT LAWFUL FOR THE FCC TO ORDER INCUMBENT LECS TO CONTINUE SUBSIDIZING ISPS?

The FCC has no legal authority to award ISPs a subsidy by exempting them from the payment of interstate access charges. The Telecommunications Act of 1996 requires subsidies to be explicit.[111] The ESP exemption is not. In the absence of explicit authorization by Congress for the FCC to direct incumbent LECs to subsidize ISPs, the FCC has no implicit, preexisting legal authority to command the incumbent LECs to pay such a subsidy. Indeed, the FCC and the States recommended in November 1996

110. Implementation of the Local Competition Provisions in the Telecommunications Act of 1996 and Interconnection Between Local Exchange Carriers and Commercial Mobile Radio Service Providers, First Report and Order, 11 F.C.C.R. 15,499 (1996).

111. *See* 47 U.S.C.A. § 254(e) (West Supp. 1998).

that Internet usage did *not* merit a subsidy. The FCC could not now order such a subsidy without harming the integrity of universal voice telephony, which would plainly violate the public interest standard of the Telecommunications Act.

A. *Provisions in the Telecommunications Act of 1996 to Preserve the Quality of Service of Voice Telephony and to Make Subsidies Explicit*

In the Telecommunications Act of 1996, Congress directed the States and the FCC to work together to enunciate "policies for the *preservation* and advancement of universal service."[112] In particular, Congress specified: "*Quality* services should be available at just, reasonable, and affordable rates."[113] Congress further directed that the FCC convene a Federal-State Joint Board to recommend changes to the FCC's existing methods of funding universal service.[114] In turn, the Joint Board recommended, on the basis of "overwhelming support in the record," that "single-party service, voice grade access to the public switched telephone network . . . be designated for universal service support pursuant to section 254(c)(1)."[115]

The FCC's perpetuation of the ESP exemption would place the agency on a collision course with the Telecommunications Act and the recommended decision of the Joint Board. The FCC has a duty to preserve the quality of voice grade access to the PSTN. The congestion due to increased demand to gain access to the Internet over the PSTN is incompatible with the preservation of the quality of voice telephony. It is doubly alarming that the FCC's failure to discharge its duty under section 254 directly results from its own refusal to allow incumbent LECs to price usage of the PSTN by ISPs and their customers on the basis of the true economic costs that such entities impose on the network.

The fact that the FCC's subsidy to ISPs is a hidden subsidy rather than an explicit one only makes the FCC's tentative conclusion more lawless. Through the universal service provisions of the Telecommunications Act of 1996, Congress gave the FCC

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112. 47 U.S.C.A. § 254(a)(2) (West Supp. 1998) (emphasis added).

113. 47 U.S.C.A. § 254(b)(1) (West Supp. 1998) (emphasis added).

114. 47 U.S.C.A. § 254(a)(1) (West Supp. 1998); *see also* S. REP. NO. 104-230, at 131 (1996).

115. Federal, State Joint Board on Universal Service, Recommended Decision, 12 F.C.C.R. 87 at ¶ 46 (1996) [hereinafter *Joint Board Recommended Decision*].

only very limited authority to redistribute income. Section 254(e) requires that subsidies *to telecommunications carriers* for the provision of universal service be explicit:

> A carrier that receives such [universal service] support shall use that support only for the provision, maintenance, and upgrading of facilities and services for which the support is intended. Any such support should be explicit and sufficient to achieve the purposes of this section.[116]

There is a debate, of course, over whether ISPs are telecommunications carriers for purposes of the 1996 legislation. For the sake of argument, assume (contrary to the view of the ISPs and the FCC) that ISPs are telecommunications carriers. It would therefore follow from section 254(e) that the FCC could not lawfully direct incumbent LECs or any other entity to pay ISPs a subsidy for access to the PSTN unless that subsidy were explicit and were used "only for the provision, maintenance, and upgrading of facilities and services" that helped to preserve the quality of voice grade telephony. But, of course, it would be an implausible, contorted reading of section 254(e) to suppose that the FCC could order an incumbent LEC to pay a subsidy to an ISP that was causing the congestion on the LEC's own access network and thereby jeopardizing the quality of universal voice grade service. Moreover, the FCC could not order such a subsidy without contradicting itself, for it explicitly concluded in November 1996 that ISPs are *not* telecommunications carriers.[117] In effect, the FCC would be ordering a telecommunications carrier (the incumbent LEC) to subsidize use of the PSTN by a firm that the FCC believes is not a telecommunications carrier (the ISP); the subsidy would stimulate demand for a service that the FCC has recommended should not be subsidized (Internet access)[118] and impose a congestion externality on a service (voice grade telephony) for which the FCC has observed there is "overwhelming support" to subsidize.[119] The multiple contradictions that would underlie the perpetuation of the ESP exemption make clear that the FCC has no lawful basis for ordering an incumbent LEC to dispense subsidies to ISPs or their customers.

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116. 47 U.S.C.A. § 254(e) (West Supp. 1998).

117. *See Joint Board Recommended Decision, supra* note 115, at ¶ 69.

118. *See id.*

119. *Id.* at ¶ 46.

B. *The Joint Board's Recommendation Not to Subsidize Internet Usage*

In contrast to its recommended decision to subsidize voice grade local telephony, the Joint Board expressly recommended that Internet usage *not* be entitled to subsidization under the universal service provisions of the Telecommunications Act of 1996:

> We find that access to the Internet, to the extent that this implies non-toll access, is provided through voice-grade access to the public switched network. The Joint Board rejects the position of some commenters that the actual use of Internet services be supported. We find that the provision of Internet service does not meet the statutory definition of a "telecommunications service." In addition, we decline to support toll access to Internet providers. We predict, however, that increasing demand for Internet service will result in broader accessibility of Internet service providers. This should have the effect of reducing or eliminating the need for customers in rural areas to place toll calls to obtain Internet service.[120]

In other words, the FCC explicitly concluded in November 1996 that Internet access was not entitled to a subsidy under the specific program that Congress created in 1996 to finance telecommunications subsidies. It is inconsistent with that conclusion for the FCC subsequently to act as though it possesses some kind of implicit mandate to subsidize Internet usage. Such implicit authority to issue subsidies would have to be expansive enough to trump constraints to the contrary in the Telecommunications Act and the recommended decision of the Joint Board. The FCC has not identified the source of that implicit power. None exists. The perpetuation of the ESP exemption would therefore be *ultra vires.*

C. *The Joint Board's Recommendation to Make Subsidies Competitively Neutral*

The FCC's tentative decision to perpetuate the ESP exemption manifests institutional amnesia. As recently as November 1996 the FCC, through the Joint Board, stated that

120. *Id.* at ¶ 69.

> the Joint Board and the Commission may consider such "additional principles" as are necessary and appropriate for the protection of the public interest, convenience and necessity and are consistent with the 1996 Act. In addition to the principles specified in section 254(b), the Joint Board recommends that the Commission also be guided by the principle of "competitive neutrality" in that universal service support mechanisms and rules should be applied in a competitively neutral manner.[121]

The Joint Board found that competitive neutrality was a principle that permeated the Telecommunications Act of 1996:

> We believe this recommendation is consistent with the concept of competitive neutral contribution embodied in section 254(b)(4) and the explicit requirement of equitable and nondiscriminatory contributions in section 254(d), where Congress clearly articulated that all providers of interstate telecommunications shall contribute on an "equitable and nondiscriminatory" basis to universal service support mechanisms. We also note that section 254(h)(2) requires the Commission to establish competitively neutral rules relating to access to advanced telecommunications and information services for schools, health care providers and libraries. Competitive neutrality is also embodied in section 254(e)'s requirement that universal service support be explicit, section 254(f)'s requirement that state universal service contributions be equitable and nondiscriminatory and section 214(e)'s requirement that any carrier can be an eligible telecommunications carrier provided that it meets certain statutory criteria.[122]

As we showed in Parts III and IV, the ESP exemption is the antithesis of competitive neutrality. The exemption is a hidden subsidy ordered by regulators. It imposes an immediate cost on the incumbent LEC in terms of forgone access revenue and a subsequent cost in terms of network congestion that necessitates new investment in capacity to maintain the quality of voice grade service that regulators require. Those costs are either passed along to all users of the PSTN or borne by the LEC's shareholders. Meanwhile, the FCC also fails to treat ISPs with competitive neutrality. The agency permits an ISP to export to telephony consumers and LEC shareholders one of its principal costs of doing business.

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121. *Id.* at ¶ 3 (citing 47 U.S.C.A. § 254(b)(7) (West Supp. 1998)).

122. *Joint Board Recommended Decision, supra* note 115, at ¶ 23.

It is also clear that the FCC's tentative conclusion to perpetuate the ESP exemption violates the agency's earlier commitment, expressed in the recommended decision of the Joint Board, to refrain from picking technologies:

> We also believe that the principle of competitive neutrality encompasses the concept of technological neutrality by allowing the marketplace to direct the development and growth of technology and avoiding endorsement of potentially obsolete services. In recognizing the concept of technological neutrality, we are not guaranteeing the success of any technology for all purposes supported through universal service support mechanisms but merely stating that universal service support should not be biased toward any particular technologies.[123]

That goal is commendable. But the FCC's NOI instead manifests a preoccupation with technological fixes that would supposedly expand network capacity for Internet access over the PSTN—all while ignoring any consideration of the necessity of using the price system to ration, at *any* level of capacity, the demand for Internet access over the PSTN.

One possible rationalization for the FCC's equivocation on competitive neutrality would be to say that ISPs do not provide "telecommunications services" within the meaning of the Telecommunications Act of 1996 and that consequently they are not competitors of incumbent LECs. As a result, the lack of neutrality in the LECs' forced subsidy to ISPs does not engender a *competitive* imbalance between the two sets of firms. That reasoning is, of course, false. Regardless of whether an ISP is deemed for purposes of section 254 to supply "telecommunications services," it is clear that an ISP *already* supplies services that directly compete with some of those that the incumbent LEC currently supplies.

In an era of callback and access arbitrage, it is disingenuous and economically specious for the FCC to say that ISPs are merely using the LEC network to receive local calls from customers.[124] Internet users make those so-called "local" calls to ISPs specifically for the purpose of initiating a link to an interstate (indeed, international) network capable of providing substitutes for services that currently generate interstate access revenues for the

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123. *Id.*

124. *See Notice, supra* note 4, at 21,480 ¶ 288; *accord, Report, supra* note 5, at 16,132-33 ¶ 343.

incumbent LEC. Use of the Internet for e-mail and file transfers is already a highly cost-effective substitute for faxes. The untimed usage of the PSTN to gain access to the Internet therefore already denies the LEC access charges that, after adjusting for price effects, the LEC otherwise would earn through interstate access charges.[125] The ISP and the incumbent LEC clearly compete in that respect, and the effect of the FCC's perpetuation of the ESP exemption would be to deny any possibility of "neutrality" between those two competitors.

The imminent use of the Internet for long-distance telephony will exacerbate the LEC's shortfall in interstate (and intrastate) access charges. Internet telephony is rapidly evolving from prototype to commercial application. In March 1997, for example, Motorola announced that it would license and sell VocalTec software that links corporate telephony networks to the Internet for purposes of making long-distance calls.[126] Similarly, Bill Gates, chairman of Microsoft, observed in 1996:

> [T]he Internet threatens to take away much of the lucrative long-distance business that supports the telephone companies today. It's becoming more common for people to use the Internet for long-distance calls to other Internet users anywhere in the world—despite the poor quality of voice transmission. But as quality of service guarantees are incorporated into the Internet platform, the fidelity of both audio and video two-way calling will become quite impressive.[127]

If Gates is correct about Internet telephony, incumbent LECs could suffer a substantial displacement of access charges. The FCC's perpetuation of the ESP exemption could therefore have profound effects on congestion of the PSTN and the financial ability of incumbent LECs to continue to invest in capacity expansion. First, the incumbent LEC would lose interstate access charges on long-distance calls that migrate to the Internet. Second, the substantially lower price of making long-distance calls

125. The same reasoning applies to intrastate access.

126. *See* William M. Bulkeley, *Motorola to Sell VocalTec Software for Calls via Internet*, WALL ST. J., Mar. 3, 1997, at B6.

127. BILL GATES, THE ROAD AHEAD 120 (rev. ed. 1996). Gates does not address congestion of the PSTN caused by users substituting Internet telephony for conventional long-distance calls. But he does note that, if Internet telephony were to cause congestion *on the Internet*, possible solutions would be "to make everybody pay a higher flat rate" or "to find something to meter—whether time on the system, the distance over which bits are transmitted, the number of bits, or whatever." *Id.* at 121.

over the Internet would cause demand for such calls to rise above current levels, for it is well known that the demand for long-distance calls is substantially more price elastic than the demand for local access.[128] Third, long-distance calls made over the Internet would be initiated by the user's call to the ISP's local number, which would put additional strain on those trunks and switches of the incumbent LEC that are already taxed by current Internet access traffic. Fourth, ISPs could be expected to purchase local access lines from CLECs, which, under current interconnection agreements, would receive payments from the incumbent LEC for terminating access whenever one of the ISP's customers served by the incumbent LEC called the ISP's access number. The confluence of those factors would increase the likelihood that, by its own policies, the FCC would produce the unintended consequence of degrading the quality of voice grade telephony.

D. *Effect of the ESP Exemption on the Welfare of Voice Telephony Users*

Suppose that Congress as a matter of public policy decided to authorize a subsidy for ISPs and tasked the FCC with designing the optimal subsidy mechanism consistent with other, preexisting objectives in the Telecommunications Act. Would that mechanism resemble the ESP exemption? Surely not.

Economists generally oppose infant-industry policies. But as a practical matter governments do adopt such policies periodically. It is therefore useful to identify several considerations that would reduce the likelihood of harm to consumer welfare if Congress deemed it to be desirable government policy to subsidize access to ISPs over the PSTN. The question of whether an access subsidy should be given to ISPs is separate, of course, from the question of who should pay the subsidy. There is no reason that such a subsidy should be a wealth transfer from the incumbent LEC to the ISP. On economic grounds it would be preferable for Congress to fund any subsidies explicitly through its power to tax and appropriate funds from the public treasury. The universal service

128. *See, e.g.*, ROBERT W. CRANDALL & LEONARD WAVERMAN, TALK IS CHEAP: THE PROMISE OF REGULATORY REFORM IN NORTH AMERICAN TELECOMMUNICATIONS 92 (1995); LESTER D. TAYLOR, TELECOMMUNICATIONS DEMAND IN THEORY AND PRACTICE 294, 298 (1994).

provisions of section 254 are a real-world approximation of that ideal. In contrast, the FCC's approach has been (and evidently continues to be) to fund the subsidy to ISPs by distorting prices for use of the PSTN. The inefficiency of embedding subsidies in the rate structure of a regulated firm is well recognized.[129]

Some of the most notable statements by senior policy makers concerning the information superhighway have referred to "information haves" and "information have-nots."[130] Some might interpret those remarks to imply that any disparity in access to the Internet must be avoided as part of a technologically enlightened policy of universal service. There are several risks in viewing the ESP exemption through that lens, and it is instructive that the Joint Board explicitly recommended against Internet access being included in the definition of universal service under section 254. First, for the reasons already mentioned, it is doubtful that government policy makers will have better knowledge than private firms of the Internet services that consumers will ultimately demand. If we do not even know what the "information haves" are likely to demand, the government can hardly know what subsidies to prescribe for Internet access to improve the relative standing of the "information have-nots."

Second, consumer tastes are heterogeneous across the population. Consequently, it does not necessarily reflect a failure of government policy or an inequitable distribution of income that some consumers demand sophisticated telecommunications services while others do not.[131] If Internet usage is correlated with education and income to a greater extent than is usage of local voice grade telephony, then the FCC would have to overcome a presumption that the ESP exemption is a regressive redistribution of income. It is not clear, for example, that social welfare would increase if, through the perpetuation of the ESP exemption, the FCC were to force fixed-income retirees who make only occasional voice calls to subsidize the Internet access of computer-literate

129. *See, e.g.*, ROBERT W. CRANDALL, AFTER THE BREAKUP: U.S. TELECOMMUNICATIONS IN A MORE COMPETITIVE ERA 16-42 (1991).

130. Edmund L. Andrews, *The Media Business: New Plan For Phone and Cable*, N.Y. TIMES, Dec. 22, 1993, at D1 (reporting speech by Vice President Albert Gore).

131. *See* MILTON L. MUELLER, JR., UNIVERSAL SERVICE: COMPETITION, INTERCONNECTION, AND MONOPOLY IN THE MAKING OF THE AMERICAN TELEPHONE SYSTEM 173-74 (1997).

young professionals who nightly surf the World Wide Web for hours.

Third, the "information have-nots" may lack other important resources that impede their economic advancement, such as literacy, education, and work experience. If so, then the substantial cost of subsidizing Internet access may actually divert the public's attention and financial resources from other policies that would materially improve conditions for those persons in a shorter period of time. It may be counterproductive as well as foolhardy to oversell the ability of the Internet to cure social ills.

Fourth, if subsidized access to the Internet becomes the FCC's predominant public policy concern regarding the deployment and operation of interactive broadband networks, then the agency, in its attempt to use the Internet as a tool to redistribute income, may inadvertently foreclose the possibility of intermodal competition among rival suppliers of access to broadband networks to residential customers. Entrants do not rush into a market to compete in the supply of a service that regulators order to be sold below its economic cost. From the perspective of maximizing consumer welfare, it would be regrettable if the FCC's commitment to empowering disadvantaged segments of the population were to have the unintended effect of denying *all* consumers the substantial benefits that would flow from having two or more facilities-based providers of residential access to interactive broadband services rather than one. That point holds even more forcefully when one considers that the government has available to it less costly alternative means of ensuring that impoverished segments of the population have access to the Internet—such as through public libraries and schools.

Fifth, policy makers should consider that advertisers are, in a manner of speaking, a potential source of subsidies for access to, and usage of, the Internet. Advertisers, of course, have long subsidized the consumption of "free" programming offered by radio broadcasters and over-the-air television stations. Similarly, the presence of advertising on cable television enables consumers to pay a lower subscription fee than they otherwise would be charged. Moreover, the interests of advertisers are closely aligned with those of consumers of content in the sense that both groups seek policies that expand output and reduce prices for telecommunications services of all kinds, irrespective of the technological mode of transmission. Regulation that restricts

output or degrades service quality in telecommunications markets impairs welfare for both viewers and advertisers. That commonality of interests arises from the fact that the demand for broadcast programming—and, by extension, the demand for Internet services—is the vertical summation of two demand curves: users' demand for content or telecommunications services, and advertisers' demand for audiences. As in the case of any multiproduct firm, the provider of interactive broadband services will likely have common fixed costs of production that are high relative to incremental costs for either programming or infrastructure deployment. Those common fixed costs are optimally distributed in inverse relation to the elasticity of demand. Access charges and usage charges can be borne either by the advertiser or the subscriber. If, however, the advertiser has the more price inelastic demand, it is superior from the perspective of economic efficiency for the advertiser to bear the disproportionate share of those costs. That result may also be considered equitable in the sense that it advances the goal of expanding development of the Internet by keeping the prices of access to, and usage of, the PSTN for access to the ISP lower than they would be in the absence of advertiser support.

Finally, the FCC should not renew any subsidy for ISPs without stating the specific conditions under which the subsidy will end. The government's commitment to ending the ISP's infant-industry status at a certain date must be credible and binding—especially because ISPs are hardly tiny companies lacking access to capital markets. There is considerable evidence that subsidies are unnecessary. The rapid growth in information technology transmission capacity is widely distributed and has become far less geographically concentrated in the United States.[132] With regard to ISPs, a significant and growing proportion of the U.S. population already have access to one or more ISPs.[133] The FCC's

132. *See* SHANE M. GREENSTEIN ET AL., THE EVOLUTION OF ADVANCED LARGE SCALE INFORMATION INFRASTRUCTURE IN THE UNITED STATES (National Bureau of Econ. Research Working Paper No. 5929, 1997).

133. *See* SHANE M. GREENSTEIN, UNIVERSAL SERVICE IN THE DIGITAL AGE: THE COMMERCIALIZATION AND GEOGRAPHY OF U.S. INTERNET ACCESS (Northwestern University Working Paper, 1998). By early 1997, three-quarters of the U.S. population can access three or more providers in their own county, and 87 percent of the population can access at least one provider in their own county. *See id.*, table 1. Continuing rates of growth suggest that the level of access will have climbed significantly higher by the time of this Article's publication, approaching nearly universal service if one accounts for access to ISPs in neighboring areas.

characterization of the 1983 ESP exemption as "temporary" testifies to the fact that the political task of ending such a subsidy will not be easy to accomplish.

VII. CONCLUSION

The combination of state regulation of local rates and the FCC's ESP exemption promise worsening congestion of the PSTN as data demand continues its rapid expansion. One cannot expect incumbent LECs and competitive entrants to receive correct incentives for investment to alleviate the congestion in the PSTN resulting from Internet usage unless ISPs and their customers face the correct price signals to use the PSTN efficiently.

The ESP exemption sends the disturbing signal that the agency is not credibly committed to mitigating the stranded costs that will arise from the transformation of local telephony that is now taking place as a result of the Telecommunications Act of 1996. The FCC stated in the NOI: "Ultimately, a full and open debate about the relationship of information services to the public switched network will benefit all parties."[134] That debate, however, must begin by asking why the FCC has forsaken the price system. The consequences of sending distorted price signals through the perpetuation of the FCC's subsidy for ISPs are threefold. First, consumers of universal voice grade telephony service will face lower quality, higher prices, or both. Second, investment in transmission capacity to provide access to data networks is likely to be delayed by the availability of an underpriced alternative. Third, the FCC will effect an unconstitutional taking of the property of incumbent LECs by compelling their provision of unpriced interstate access to ISPs. The FCC has failed to ask how it can avoid these deleterious results.

134. *Notice, supra* note 4, at 21,492-93 ¶ 317. Curiously, the FCC did not reaffirm this call for "a full and open debate" in its *Report*.

APPENDIX: GLOSSARY OF ACRONYMS

ADSL:	asymmetrical digital subscriber line
ATM:	asynchronous transfer mode
BBS:	bulletin board service
BOC:	Bell operating company
CAP:	competitive access provider
ccs:	centum call second (one hundred seconds)
CLEC:	competitive local exchange carrier
ESP:	enhanced service provider
FCC:	Federal Communications Commission
HDSL:	high-bit-rate digital subscriber lines
ISDN:	integrated services digital network
ISP:	Internet service provider
LEC:	local exchange carrier
NAP:	national access point
NOI:	notice of inquiry
OLP:	on-line provider
PCS:	personal communications services
POTS:	plain old telephone service
PSTN:	public switched telecommunications network
TELRIC:	total element long-run incremental cost
UNE:	unbundled network element
VAN:	value-added network