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THE IMPACT OF ALTERNATIVE TECHNOLOGIES ON UNIVERSAL SERVICE AND COMPETITION IN THE LOCAL LOOP

by

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EXECUTIVE SUMMARY

American telecommunications during the past decades has been marked by the steady introduction of competition into the public switched network. What was once a seamless network of services provided by the Bell System and the independent telephone companies is being replaced by a variety of services offered by a variety of providers. Today customer premises equipment (CPE) is available in discount stores as well as from the local telephone company. Customers choose from a wide selection of long distance competitors for interLATA, and often intraLATA, toll services.

The formerly seamless network has, in effect, been eroded at the edges. CPE and inside wire are connected at one end of the network; long distance traffic is routed to various interexchange carriers connecting at the other end. In the middle is the heart of the public network -- the class 5 office (which provides the subscriber with a unique telephone number, or address, on the network and the mechanism for connecting to other subscribers) and the local loop connecting the customer to the class 5 office. Up until now, that section of the network has remained a monopoly, the local bottleneck. The forces of competition now are seeking entry into that local bottleneck as well.

The successful introduction of competition into the CPE and long distance markets has made it almost inevitable that competitors would also emerge for local loop services. CPE and long distance competition have resulted in the introduction of feature-rich CPE and in substantially lower toll charges. Now new technologies and new service providers are promising to provide those same benefits of expanded services and lower prices at the local service level. New technologies such as cellular service and personal communications services (PCN/PCS) offer customers mobility, a feature which the wireline loop cannot provide. Fiber optics promise increased bandwidth, and alternative local service providers promise to offer bandwidth at lower costs than the local telephone companies. Cable television providers seek to include

the provision of voice and data services over the fiber optic facilities they are beginning to deploy in their own networks.

The seamless network was made possible by the twisted-pair copper line and existing switching technologies and by regulatory policies that encouraged monopoly provisioning of basic telecommunications services. Recently, both the underlying technologies and regulatory policies have changed in ways that seem likely to radically alter the seamless nature of the public switched network. This report focuses primarily on the impact of five technologies on the local loop from a regulatory perspective.

Competition in the CPE and long distance markets was made possible by policies and procedures which assured competitors interconnection to the public network and access to their customers, and which began to unbundle public network services so that competitors would purchase only those services they needed. Interconnection for CPE was assured by the FCC's Part 68 Rules; access to customers for long distance carriers was guaranteed by equal access rules; unbundling of network elements has been a goal of the Open Network Architecture proceedings.

The same process of introducing interconnection, unbundling, and access has begun in local loop services. Cellular service providers are accorded interconnection to the public network through FCC action. Alternative Local Service providers in New York City are being granted interconnection *and colocation* inside the local telephone company office by Public Service Commission mandate.

While local service competition appears to be following the same route as CPE and long distance services, there are significant issues surrounding local competition which must be addressed by U.S. regulators and policy makers.

The introduction of competition into the public network, while it has resulted in enhanced services and lower prices, has also had an impact on the provision of universal service. The seamless public switched network was based on the monopoly provision of services and on a complex system of cross-subsidies designed to keep local rates low and local service ubiquitous. Competition in CPE and long distance services has disrupted the prior system of cross-subsidies. In an effort to maintain universal service, regulators have developed such mechanisms as the Universal Service

Fund to continue to subsidize local rates. If the introduction of competition into CPE and long distance services has disrupted the system of subsidies intended to maintain low local rates, and so universal service, the introduction of competition into local services themselves will have an even more significant effect on local service rates. Regulators will have to examine the viability of developing new types of subsidies. They will have to examine what -- if any -- universal service obligations should be borne by alternative local service providers. And they may have to examine the efficacy of developing means other than service subsidies to maintain universal service in this country.

The introduction of local service competition may, much more than CPE and long distance competition have done, call into question the continued viability of the public switched network. Competitive CPE services and competitive interexchange carrier service all, for the most part, connect into the public switched network at some point in the provision of service. Such may not be the case with some competitive local services, especially if various competitive providers pool their resources. A PCN provider partnering with a cable television company and with an alternative fiber optic provider can create a network parallel to the public network and seldom in need of interconnecting with it.

The feature-rich quality of the services offered on such an alternative network, and the pricing of such services, raise questions, not only about the continued viability of universal service, but also about its very definition. As more and more customers, most often business and urban residential customers, leave the public network for the more sophisticated services available from alternative providers, those left on the public switched network will be left to pay what could be higher rates for feature-poorer services. Whether such feature-poorer service constitutes universal service is a question regulators and policy makers will have to ponder.

This report provides the basic information needed to consider these issues. The report describes the technical capabilities, current deployment, and current regulatory treatment of the existing copper local loop and four of the technologies that have allowed, in part, competitors to the local loop to emerge: cellular service, existing cable facilities, fiber optics, and PCN/PCS. The report then discusses the

policy issues which should be evaluated in considering universal service and competition as they relate to the local loop and local services. Three potential competitive scenarios are analyzed from various policy perspectives. The report concludes by emphasizing the importance of the challenges facing regulators and policy makers as they strive to balance the benefits of competition with the requirements of universal service as competition is introduced into what has been the last remaining stronghold of monopoly in the public network.

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FOREWORD

The impact of new technologies upon the local loop is an important issue because of the promise these technologies may hold in breaking the local bottleneck control of the local exchange company. Important regulatory issues are analyzed by the authors in order to provide state commissions with objective information about the impact on ratepayers and the emergence of competition.

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CHAPTER 1

AN INTRODUCTION TO THE ISSUES SURROUNDING LOCAL LOOP COMPETITION

American telecommunications is facing a period of unprecedented upheaval. Technological developments are creating new delivery media for voice, data, and video services. New industry players are seeking entry into markets traditionally controlled by local telephone companies. The ultimate outcome of all this upheaval is by no means clear. Neither is its eventual effect on the continuing health of the telephone industry and on a concept which is a cornerstone of telecommunications policy in this country: universal service. Amidst the influx of new competitors and new competitive services, the last portion of the public network to be kept free of competition in the name of preserving affordable, ubiquitous telephone service, the local loop may be opened to competition, a prospect to which regulators and policy makers increasingly are directing their attention.

Technology has helped create new local loop services and alternative local loop providers. Telephone companies and cable television providers alike are acting to provide broadband services to U.S. households, either through fiber-to-the-home or fiber-to-the-curb methods. Cellular companies already provide mobile service to all of the nation's large cities and are now seeking to fill in rural areas. Developers of personal communications networks and personal communications services (PCN/PCS) hope to offer a range of voice, data, and eventually video service unfettered by a wireline connection. Cable companies talk about getting into the telephone business; telephone companies want to get into cable television enterprises. Meanwhile, alternative local transport providers are burying fiber optic cable rings in major metropolitan areas and are asking to be connected to the public network inside local telephone company central offices.

All of these competing technologies and competing service providers inevitably reach the most significant bottleneck in the public switched network: the local loop and its connection to the class 5 office.

During the last few decades, eager competitors took advantage of technological advances to break down the monopoly in the customer premise equipment and long distance markets. By the 1980s customers were free to purchase their choice of telephones from the telephone company, supermarkets, or discount stores. Customers also had a choice of interLATA (and in some cases intraLATA) long-distance service providers.

In the 1980s, however, customers for the most part still had little choice about how they were connected to the public switched network. Physical connections, usually over twisted copper pairs, were offered by the local telephone company to the nearest telephone company office. Along with that physical connection, customers received a telephone number and a connection to a local exchange company (LEC) class 5 switch. That line and that connection constituted the local bottleneck; that part of the network most clearly provided as a monopoly service.

Customers in the 1990s will have alternatives to local loop, monopoly service. Alternatives may be provided by cable companies, PCN providers, or alternative local transport providers. Just as the transition to competition in the CPE and the long-distance markets created confusion, disruptions, and profound changes in regulatory approaches and methods, so too will alternatives to local loop services bring a certain amount of chaos and a need to consider policy decisions carefully.

This report addresses the effect of new technologies on local loop services, on universal service, and on the way services are provided today. This report raises questions, discusses the lessons learned from the CPE and long-distance experiences, identifies and addresses the relevant issues, and considers the various options for dealing with the latest round of technological advances and latest introduction of competition into what was once considered to be exclusively a monopoly service.

The Growing Trend toward Competition: A Statement of the Issues

A discussion of local loop competition marks a natural progression in the course of telephone regulation during the past several decades. From a regulatory policy which regarded telephone service as a natural monopoly poised to provide the

same service to all, regulators and the courts have developed a set of policies which now include the objectives of encouraging and accommodating competition. This change in regulatory policy has been evident in the CPE market and in long-distance services. It is almost inevitable that change should now be approaching the local loop and its attendant end office.

In the early days of telephony, the focus of regulatory policy was the provision of universal service.[1] The multitude of early telephone companies was replaced with holders of exclusive franchises, who, in return for their franchise monopolies, agreed to provide nondiscriminatory service to all takers and to price according to an elaborate set of tariffs designed to keep residential rates low and toll rates geographically averaged.

The public network which emerged from this regulatory scheme was, for all practical purposes, seamless. The Bell System and the hundreds of independent telephone companies which made up the network were the exclusive, end-to-end providers of service. Anyone attempting to break into any part of this seamless network faced formidable telephone company and regulatory barriers to entry, in addition to technical barriers. The existence of one unified national telephone network made it possible to price services not according to cost but according to social policy. One unified network also made it possible to route calls efficiently, with questions of interconnection mostly centering on compensation issues between Bell and non-Bell telephone companies.

In recent years, however, the focus of regulatory policy has broadened to include more than the social policy of concern for universal service. Issues of innovation and the relationship between price and cost have also become regulatory concerns. As technological advancements have created new services and new service

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[1] In "The Public Policies Which Changed the Telephone Industry into Regulated Monopolies: Lessons Learned from around 1915," in *Rural Telephony in the Information Age* (January 1987), Warren Lavey notes that the telephone industry moved from a competitive situation to a regulated industry in order to accomplish five major policy goals: (1) accomplishing the efficient supply of services; (2) making sure providers got reasonable revenues; (3) extending service to remote areas; (4) having averaged rate structures; and (5) maintaining below-cost pricing for residential services. The last three goals were central to the achievement of universal service.

providers, the concept of a seamless network has eroded. New services not available through the public network have emerged. Perhaps more significantly, new companies able to provide services which were once obtainable through the public network have emerged as well. Competition is now technically viable through much of the network. As we know, competition poses difficult policy decisions for regulators charged with oversight of the traditional local loop monopoly.

Currently, it has become almost a truism that regulation is a poor substitute for competition.[2] Competition promises efficient prices, production efficiency, and innovative services. In a totally competitive industry, the benefits are clear. United States telephony is not an entirely competitive industry, however. Parts of the former unified network are still offered as monopoly services and the complex systems of tariffs and subsidies which have been seen as the underpinnings of universal service are still in place. Policy makers face the difficult task of balancing the push for pricing efficiency from competition with the ongoing requirement that the interests of universal service be served. This is no simple task.[3]

Now that competitive entrants are eyeing the local loop, it may be useful for regulators faced with the question of local loop competition to review the lessons from the CPE and long-distance experiences.

Perceptions of CPE's use in the public network have changed drastically since the time a customer couldn't attach as much as a plastic cup to a telephone for fear it would harm the network.[4] Now, following creation of Part 68 Rules which specify the technical requirements for CPE to meet before it can be connected to the public

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[2] See, for example, Clair Wilcox, *Public Policies Toward Business* (Homewood, Ill.: Richard D. Irwin, Inc., 1960); and Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions* (New York: John Wiley, 1970).

[3] John C. Panzar, "The Continuing Role for Franchise Monopoly in Rural Telephony," in *Rural Telephony in the Information Age* (March 1987), offers a discussion of the tension between competitive entry and the continuation of natural monopoly and the attainment of the goals of universal service.

[4] The courts decided that customers could attach any equipment to the network, as long as it was not "publicly detrimental" *Hush-a-Phone Corp.* v. *United States,* 45 238 F.2d 266 (D.C. Cir. 1956),; *Hush-a-Phone Corp.* v. *AT&T,* 22 FCC, 112 (1957).

switched network and the replacement of hard-wired connections with modular jacks, customers routinely connect nontelephone company CPE with no ill effects to the network.

Further into the network, hundreds of non-AT&T long-distance interexchange carriers connect to the local network either through direct trunks or a local exchange carrier access tandem. Once considered the exclusive right of AT&T Long Lines, connection to local telephone company networks has been taken for granted since the 1984 divestiture and the establishment of equal access and an access charge structure. The historical lesson is that once the old unified network is gone, service continues and customers are still served in a new public switched network.

Once the network has been split up, with little perceived ill effect in the CPE and long distance arenas, it seems almost inevitable that the trend will continue into the local loop. If new technology makes it possible to reach a variety of long-distance companies by making multiple connections at the trunk side of the local telephone office, it is hard to argue the impossibility of new technologies providing a choice of connections at the loop side as well. This trend is all the more likely and sustainable, in part because many customers have seen possible benefits from both of these incursions into the network, either through a wider choice in CPE or lower long-distance rates.

In addition to technological advances, connection into the network by non-telephone company service providers has been facilitated by (1) an unbundling, or restructuring of rates and services and (2) a method of assuring equal access to alternative service providers for the customer. Competition in CPE was enhanced by unbundling the telephone set and inside wire from the telephone line rate and by the providing modular jacks in each residence. These important regulatory and technical changes in large part were responsible for the high level of competition that is now accepted as an integral component of the CPE telecommunications market. Competition in long-distance services was similarly made possible by the creation of access charge rates, by requirements for presubscription and the provision of equal access services, and by the technical conversion of offices to "1-plus" equal access. For local loop competition to be viable, unbundling local rates and providing for

comparable access at a minimum will be necessary in addition to the options made possible by the various technologies now available.

Once a competitor is allowed to provide service in parallel with the former monopoly provider, it is difficult if not impossible to limit the range of services the competitor may provide. In the long-distance arena, alternative providers began by offering private line services only. The Federal Communications Commission (FCC) first allowed shared use and resale of telephone company private line services, but shortly thereafter extended resale and shared use provisions to message toll services. MCI, though seeking at first to offer private line services, actually offered message toll services through its Execunet offerings.[5] The beginning of this same type of process is already being seen at the local level in Illinois and New York. In those states, alternative service providers have received approval to connect to the local switched network to offer intrastate private line services and are asking for permission to offer switched services as well. The ability to offer switched services allows a new company to cross an important barrier to provide the same type of distinctive services -- switched access -- that are the main economic underpinning of LECs.

As incursions are made into what was once a unified network, the complex system of subsidies underlying service pricing is eroding. If regulators and other policy makers still regard these subsidies as crucial to maintaining universal service, alternatives to them must be sought. In the case of long-distance services, for example, the former toll-to-local subsidy found in long-distance rates has been replaced with the Subscriber Line Charge, Lifeline Rates, and a Universal Service

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[5] See *Resale and Shared Use,* 60 FCC 2d 261, modified, 60 FCC 2d 588 (1976), amended on reconsideration, 62 FCC 2d 588 (1977), aff'd sub nom. *AT&T* v. *FCC,* 572 F.2d 17 (2d Cir.), cert. denied, 439 U.S. 875 (1978), which initially applied to private line only. In *Resale and Shared Use,* 83 FCC 2d 167 (1980), the FCC extended unlimited resale and shared use to MTS/WATS type services. Finally, in its *MTS/WATS Market Structure,* 81 FCC 2d 177 (1980), the FCC decided that MTS and WATS would no longer be offered by one telephone company. The MCI proceedings are contained in *MCI Telecommunications Corp.* v. *FCC (Execunet I),* 561 F.2d 365 (D.C. Cir. 1977), cert. denied, 434 US 1040 (1978); *MCI Telecommunications Corp.* v. *FCC, (Execunet II),* 580 F.2d 590 (D.C. Cir), cert denied, 439 US 980 (1978) and in *Lincoln Tel. and Tel. Co* v. *FCC,* 659 F.2d 1092 (D.C. Cir. 1981) *(Execunet III).*

Element. Local loop competition will also require regulators to examine existing subsidy schemes.

A significant lesson to be learned from the development of long-distance competition is the importance of the local telephone company end office. Equal access long-distance service has been made possible by the routing capabilities of the local exchange class 5 office, the "end office." The class 5 office provides wire-line access to the customer through the local loop. Perhaps even more importantly, the office provides access to the customer through that customer's telephone number. Without this wire-line access to the customer and the customer's telephone number, long-distance carriers could not provide their toll services without building loop facilities to the customer and without developing addressing schemes to route calls. Long-distance providers such as MCI, AT&T, Sprint, and others assume that because of presubscription and equal access, the LEC class 5 office will respond to each customer's 1-plus or 10XXX dialed call and route each customer to his or her choice of carrier. Carriers also assume that, because of the North American Numbering plan scheme, their customers can be reached from anywhere in the world because they have an electronic address--a telephone number--on the network.

The class 5 office is a powerful routing tool. The telephone number which has usually been associated with a customer's telephone line is a powerful tool as well. Local telephone companies traditionally have been the administrators of local telephone numbers. Customers receive a directory listing as an indispensable part of their local telephone service. The class 5 end office is a significant component in a worldwide telephone addressing scheme. This scheme was not disrupted by the introduction of long-distance competition. Long-distance carriers in essence gained access to the customer and the customer's telephone number through access services and access charges. Indeed ANI (automatic number identification) is a feature of equal access service.

Local loop competition may disrupt this addressing scheme. Alternative local service providers will have to offer their customers telephone numbers. Where those numbers will come from, what format they will take, and what compensation, if any,

will be involved are all questions which to be addressed considering local loop competition.

The numbering issue is an indication that, with local loop competition, regulators are entering an arena that is different from the CPE and long-distance markets. However, there are ways in which local loop competition will create problems similar to those caused by CPE and long-distance competition. When CPE was deregulated, a certain amount of stranded investment was created on LECs' books. That investment was amortized to give LECs an opportunity to absorb the change. With local loop competition, LECs possibly will face significant stranded investment, since loop investment is such a large percentage of their total plant. The effect on local rates in the long term certainly will be of concern to regulators.

As with information services, local loop competition may create a situation in which the LEC is at once service provider and competitor. Local loop competitors will need to connect with the local network. That point of connection undoubtedly will be the LEC class 5 office. The LECs therefore will provide service to their own competitors. As the federal and state Open Network Architecture (ONA) proceedings illustrate, such a situation causes concerns about colocation, comparable interconnection, and customer information.[6]

Regulators must consider the very real prospect of local loop competition. As technology advances, some consumers will seek services they cannot get from the public network, or they will seek such services at a lower price. Competition in the CPE and long-distance markets emerged in response to such customer requests. Those requests already have begun to have a direct effect on the local loop. Some customers, for example, desire the mobility that cellular service providers now offer and that PCS/PCN providers promise for the future. Further, fiber system providers offer broadband services and cost savings at the local loop level beyond what LECs currently are providing.

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[6] The FCC orders which required such ONA services were "Filing and Review of Open Network Architecture Plans," CC Docket No. 88-2, Phase I, 4 FCC Rcd 1 (1988) (Boc ONA Order) recon., 5 FCC Rcd 3084 (1990) (BOC ONA Reconsideration Order), further order, 5 FCC Rcd 3103 (1990) (BOC ONA Amendment Order).

As the CPE and long-distance experiences show, competition is fostered by unbundling rates and providing equal access. Regulators will be called upon to provide such unbundling and access if local loop competition is to exist.

In facing the issue of local loop competition, regulators will have to deal with the old issue of how to provide the best means for insuring universal service while allowing greater competitive entry into the network. Regulators also will have to address issues that may be relatively new to them: interconnection, addressing schemes, and colocation.

Organization of this Report

The remainder of this report begins with an overview in Chapter Two of the specific technologies which will be offered in competition with current local loop service. The technologies discussed in Chapter Two include the currently deployed copper twisted pair, coaxial cable facilities, fiber optics, cellular services, and the proposed PCN/PCS services. This chapter includes technical specifics of these technologies, their current jurisdictional and regulatory treatment, services available through them and deployment issues.

Chapter Three contains a discussion of the various issues involved in an analysis of local loop services and the impact of technological developments on these services. Issues such as preemption, the tension between competition and monopoly in American telecommunications, the definition of universal service, the effect of bypass and private networks, the current push for interconnection, the effect of alternative technologies on the North American Numbering plan, separations, and pricing issues facing local telephone companies are examined.

Chapter Four considers the possible convergence of the various technologies poised to compete with local loop services. This chapter also presents three potential scenarios which assume that alternatives to the local loop are deployed. Drawing on the technical information provided in Chapter Two and on the issues reviewed in Chapter Three, various approaches and possible outcomes are evaluated. The intent

here is to allow regulatory policy makers the opportunity to think through their responses to each of these plausible scenarios before they occur.

The concluding chapter reiterates the basic issues, points toward areas of further study, and draws some conclusions about future regulatory developments.

CHAPTER 2

AN OVERVIEW OF LOOP TECHNOLOGIES AND THEIR CURRENT DEPLOYMENT

A discussion of the potential impact of new technologies on the local loop and on traditional local services should begin with what these new technologies are and what they can do, as well as a description of what the current loop is capable of delivering. This chapter provides such an overview.

The most likely incursions into the local loop arena will be made by cable television companies, alternative fiber system providers, cellular concerns, and providers of personal communications networks and services (PCN/PCS). Each of these competitors will push for a competitive advantage vis-a-vis the copper loop. The competitive advantage may be portability (something a wireline loop cannot offer), greater bandwidth, or lower price. In any case, each competitor for local loop service will strive to create a niche in a market which has been dominated by the traditional local telephone company.

The following sections provide a picture of these competitive technologies and of the copper loop. The technologies covered include PCN/PCS, cellular, fiber optic, and coaxial cable, as well as the copper twisted-pair loop itself. Technical details, service capabilities, current regulatory treatment, and deployment information are provided for each of these five technologies.

Twisted-Pair Local Loops

For comparison, we include here a description of the local loop as it is currently deployed by the LECs. The vast majority of loop plant today is based on twisted pair wire connections at the customer premise. Traditionally, each individual house is connected to the public switched network through one or more twisted wire pairs. The twisted pairs from each customer site are collected at curb-side pedestals

and connected to increasingly larger twisted pair bundles[1] along the route to the class 5 office, also called the serving wire center. As changes are made to the loop plant, the connection from the pedestal to the class 5 office -- fiber to the curb or FTTC -- is increasingly being replaced by fiber optic cable. In large metropolitan areas where traffic densities are high, fiber optic cable may eventually be deployed to the end-user site (fiber to the home, or FTTH). (These two options are discussed further below).

The properties of the twisted pair local loop are determined not only by the physical medium installed, but also by the system of loading coils and repeaters that are deployed along the twisted pair wire runs. At least some of the capacity limitations of the twisted pair local loop discussed below are a direct result of the loop design which is aimed at the efficient transmission of voice traffic.

As shown in figure 2-1 below, end users (A) typically connect to the public switched network (PSN) via twisted pair local loops which terminate at the class 5 office (B). All addressing functions are performed in this office. The LEC intraLATA network provides access to the class 4 toll office (C) and the interLATA facilities of the interexchange carriers (IXCs) at the designated Points of Presence (D).

The shared use of the subscriber loops and the LEC intraLATA network for intraLATA, interLATA intrastate, and interstate traffic leads to a complex set of policy issues and regulatory systems designed to properly allocate revenue and to set desirable incentives for the LEC's investment into the subscriber loop and intraLATA network facilities.

Interconnection into the Twisted-Pair Local Loop

Customers now connect to the twisted pair loop using a set of well-defined, generally voice-grade, equipment standards. The loop may be configured for single lines, as Centrex lines to individual voice terminals, or as PBX trunks for connection

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[1] The layout of the twisted-pair local loop plant has been widely discussed. See, for example, AT&T Bell Labs, "Engineering and Operations in the Bell System," (Holmdel, N.J.: Bell Telephone Laboratories, Inc., 1977).

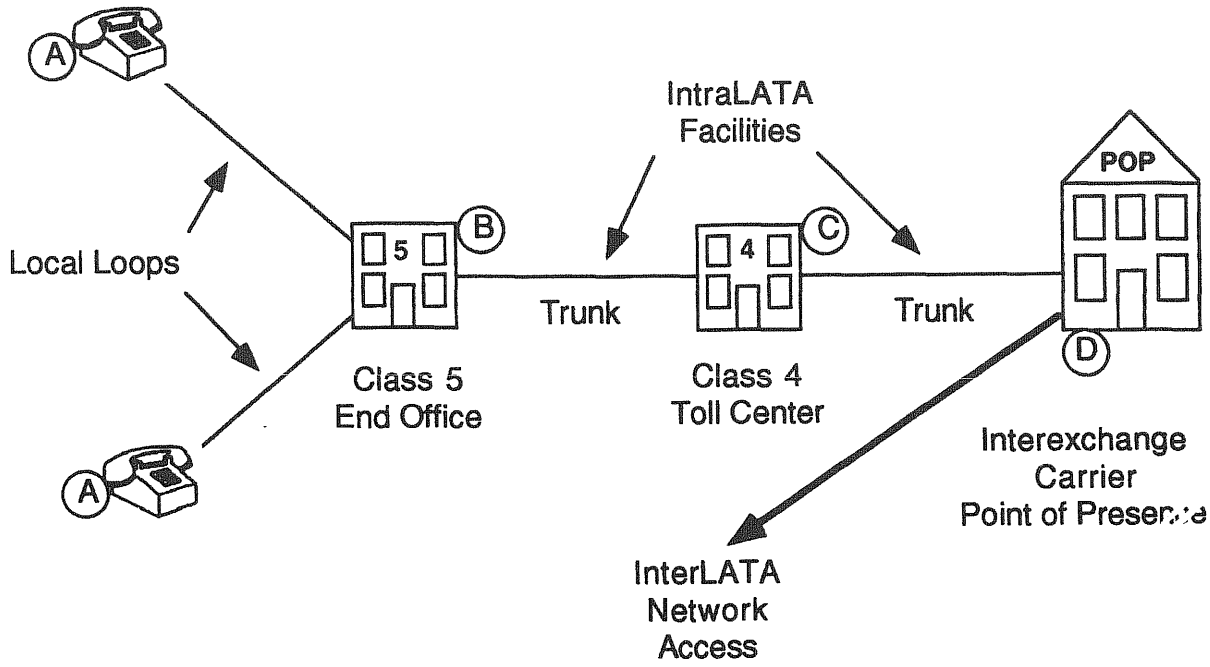

Fig. 2-1. The base architecture of a LEC network, showing the positioning of the local loop and the class 5 office in relation to the remainder of the LEC network and to the IXCs.

of customer-owned switching equipment. These voice grade connections also permit analog low-speed data transmission.

Alternatively, the copper loop may be configured for digital transmission of voice or data using the DS1 digital transmission standard, or a subrate standard usually referred to as DDS (digital dataphone service[2]). The use of the DS1 level connection in the local loop also permits the utilization of the ISDN (Integrated Services Digital Network[3]) signaling standards.

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[2] AT&T trademark

[3] See, for example, Williams Stallings, "Business Data Communications" (New York: McMillan, 1991).

Capacity

The voice or analog data connections over voice-grade lines offer an analog bandwidth of 4kHz. This allows for the following services shown in table 2-1 to be provided:

TABLE 2-1
TRANSMISSION CAPABILITIES OF A LOCAL LOOP
WHICH IS INSTALLED FOR VOICE GRADE SERVICE
(One of these transmission types can be utilized at a given time.)

Voice Transmission	One conversation per twisted pair local loop.
Data Transmission	Up to 19.2 kbits/sec
FAX Transmission	Up to Group III speeds
Image Transmission	Low volume only
Video Transmission	Only low quality freeze-frame transmissions.
ISDN	Basic Rate Interface is available; 2 voice or 64kbits/sec data channels.

If the copper local loop is configured to provide DS1 access into the PSN, the services shown in table 2-2 are possible:

TABLE 2-2
TRANSMISSION CAPABILITES OF A LOCAL LOOP
WHICH IS INSTALLED FOR DS1 SERVICE
(One of these transmission types can be utilized at a given time.)

Voice Transmission	Up to 24 conversations per twisted pair local loop.
Data Transmission	Each local loop can provide either a single 1.544 Mbits/sec data channel, or up to 24 56kbits/sec data channels.
FAX Transmission	Up to Group IV speeds
Image Transmission	Possible at high volume
Video Transmission	Low quality transmission which does not show moving subjects very well.
ISDN	Primary Rate Interface is available; 23 voice or 64kbits/sec data channels.

Two key trends are affecting the twisted-pair local loop at this time. On the one hand, new uses such as full motion video and high-speed data transmission are possible now and demand ever increasing bandwidth from the local loop. On the other hand, increases in the bandwidth available over the copper local loop are being made at a much slower rate. ISDN is an example of such increases in available bandwidth. Other innovations are sure to follow, but it is likely that the bandwidth for copper twisted-pair will be constrained by an upper limit that is dramatically lower than the theoretical upper limit of fiber cable.

The telecommunications industry is therefore faced with a decision between investments in improving the copper local loop and new investments in fiber optic local loops, which are known to provide almost unlimited bandwidth. At this time the copper, twisted pair subscriber loop facilities are provided by the LECs in a regulated monopoly environment, except as noted in the section on fiber optic cable.

Addressing Requirements and Impact on the Numbering Plan

The PSN addressing scheme is based on the identification of individual subscriber lines through the use of area codes (NPAs), office codes (NXXs) and line numbers. The LECs are charged with the administration of the North American Numbering Plan[4]; this responsibility is currently assigned to Bellcore. The original numbering plan stipulated that NPAs must use "0" or "1" as the middle digit, and that NXXs must not duplicate area codes. A severe shortage of NXXs has led to changes in these rules in an attempt to more fully use the available numbers.[5]

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[4] The Need to Promote Competition and Efficient Use of Spectrum for Radio Common Carrier Services, Memorandum Opinion and Order *(Interconnection Order)*, FCC Policy Statement on Interconnection of Cellular Systems, 59 RR 2d, 1283-4.

[5] This will be discussed in more detail in a subsequent section of this report.

Fiber Optic Cable

Fiber optic cable consists of one or more strands of glass encased in a protective coating. The glass strands have about the width of a human hair. Light from a light-emitting diode, or a laser, can be transmitted along these glass strands for long distances with very little loss of intensity and minimal interference. The small loss and interference allow much longer cable runs without repeaters or amplifiers than would be possible with a copper twisted pair wire.

Compared to the radio frequencies used for transmission on copper twisted pair and coaxial cable, the use of light for the transmission of information results in a much higher capacity for a single fiber optic strand.

Replacement of copper-wire local loop plant is only one application of this technology. Fiber optic cable deployment will impact the local loop in two ways. The first is through the deployment of replacement local loop facilities by the LECs with the aim of providing larger bandwidth for data, video, and image transmission. The second is through the emergence in some areas of secondary local loop and access providers installing plant in parallel with the LEC facilities.

Figure 2-2 indicates one possible long-term architectural change in the local loop as a result of installation of fiber optic cable by the LEC, namely the change from the "tree"-like local loop used in twisted pair installations to a fiber ring.[6] In this architecture, subscribers are located along the periphery of a dual fiber ring, which provides automatic protection against single-site fiber cuts, as well as flexible allocation of the available bandwidth among users with different communications needs.

Figure 2-3 describes a different scenario, namely the deployment of fiber optic transmission facilities by an alternate access provider, for example Metropolitan Fiber in New York City. In the architecture shown below, the alternate access provider replaces both the subscriber loop facility and the LEC intraLATA network. Due to

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[6] This topic is extensively discussed in the proceedings of the National Communications Forum meeting, Chicago 1991, published by the National Engineering Consortium.

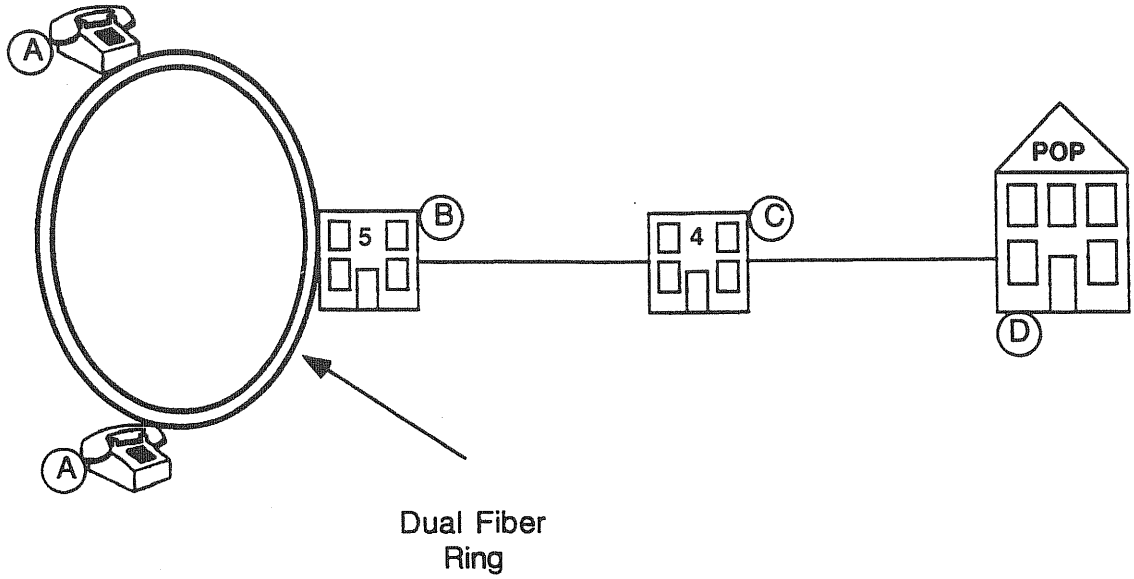

Fig. 2-2. A possible implementation of a fiber-based local loop using a dual ring architecture.

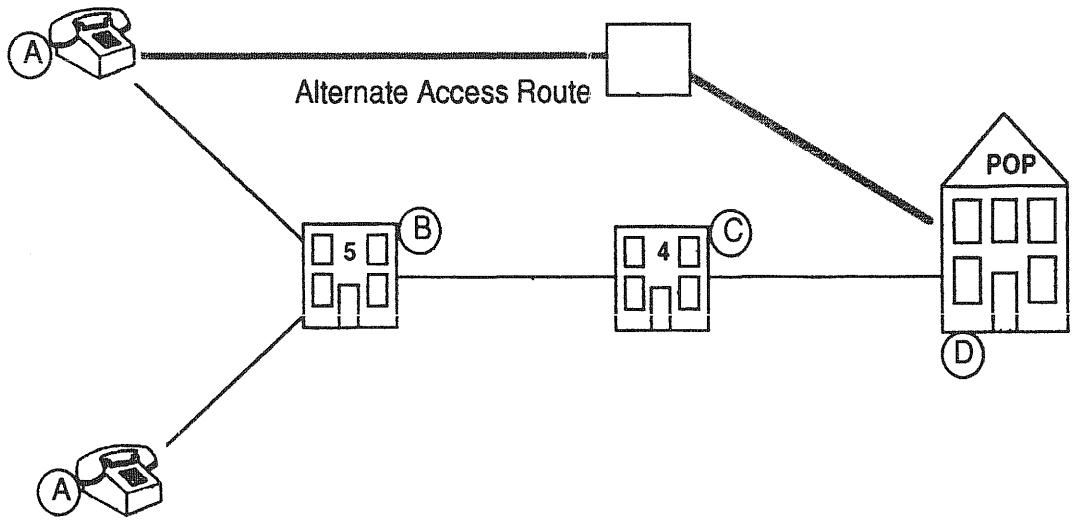

Fig. 2-3. Use of an Alternate Access Provider to directly connect a user premise with an IXC network using no LEC facilities.

the high cost of obtaining right-of-way and installing the fiber runs, this approach has economic appeal where the service provider can contract with large individual end-users or with a group of co-located end users, for example in a high-rise office building.

Unless a net significant and sustainable growth in demand occurs, the long-term impact on the LEC from this type of alternative access provider deployment is the

loss of local loop and intraLATA access revenue from the largest clients in the LEC's serving area. Depending on the market penetration by the alternative access provider, this development may have a profound impact on the pricing of local loop and intraLATA network facilities for the remaining users.

Based on requests by alternate access providers in New York and Illinois another possible scenario has emerged. Assuming that the alternate access provider is granted interconnection to the LEC network through virtual or physical colocation[7] of its equipment with the LEC class 5 office, alternate facilities can be provided which use the LEC subscriber loop but bypass the LEC intraLATA facilities. This situation is shown in figure 2-4.[8]

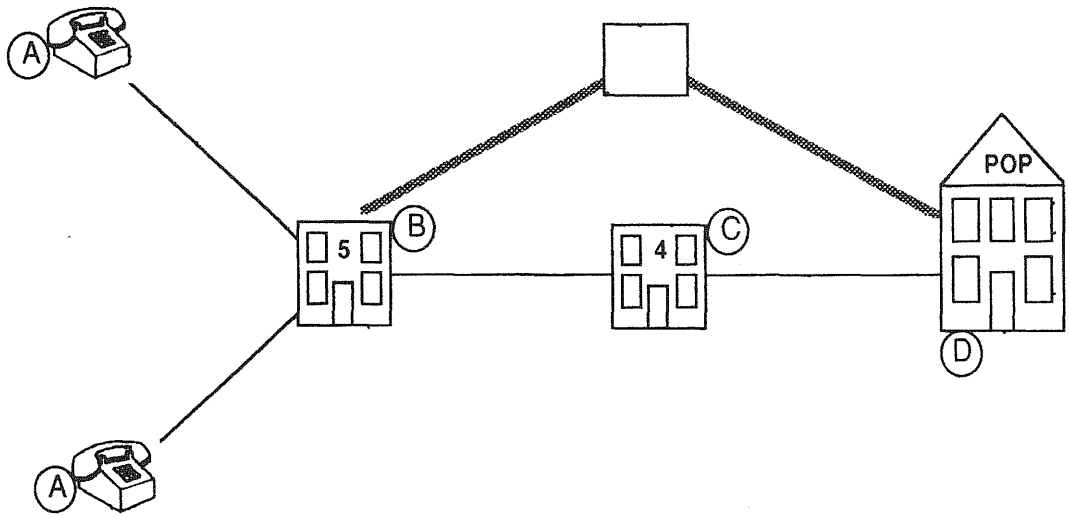

Fig. 2-4. The expanded interconnection concept in which a user premise is connected to the IXC network using the LEC local loop between the user premise and the class 5 office, and the Alternate Access Provider facilities between the class 5 office and the POP.

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[7] Under a physical collocation arrangement, the alternate access provider places interface equipment into the LEC central office. Handoff of traffic between the LEC and the provider will be accomplished via intrabuilding connections between the LECs and the alternate access provider's equipment.

[8] This architecture could be created with copper twisted-pair wire as well. However, the lower cost and much higher capacity of fiber optic cable (compared to deployment of new copper twisted pair facilities) mean that alternate access provider networks rely almost exclusively on fiber optic cable.

Because the subscriber loop and the LEC class 5 office aggregate traffic, the alternate access provider can use the architecture in figure 2-4 to attract smaller users which could not be connected economically before. Note that the competition in the intraLATA access facilities could potentially cause the LEC to have stranded investment and ultimately put price pressure on the local loop facilities even though these facilities seem to be unchanged.

Interconnection to Fiber Optic Cable

To facilitate true fiber terminations,[9] as in figures 2-2 and 2-3 above, optical transducers and high-speed multiplexers are needed to replace the more conventional termination equipment used for the twisted pair local loop. To appeal to the small user, the service provider will need to offer interconnection at the DS0 (digital voice grade 64kbps) or DS1 level. The transmission standards permit this to occur. However, even in the case of a DS0 level termination, analog to digital conversion must occur for voice-grade services.

Capacity

Fiber optic cable offers almost unlimited bandwidth. To use effectively this bandwidth, a single standard is needed which will accommodate various bandwidth demands from voice transmissions at 64kbits/sec to full motion video at 45Mbits/sec. In addition, the standard must allow the channels from various users to be combined into larger transmission channels. In this process, the individual user channels must remain fully accessible for switching and rerouting.

The primary transmission standard which meets these requirements, and is expected to emerge in central office applications using fiber transmission, is the

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[9] Since light is used to transmit information on the fiber optic cable, special equipment is needed to receive the light signal and convert it back to the electric impulses needed to connect to a more traditional piece of equipment like a PBX line card or a multiplexer.

SONET (synchronous optical network)[10] standard. SONET is designed to be compatible with current DSN multiplexing schemes used in North America, as well as the equivalent European standards.

The basic transport unit in SONET is an STS-1 frame which provides transmission at 51.54 Mbps. This frame includes fault isolation and network management services. The SONET standard defines the mapping from DS1 and DS3 level signals to the STS-1 frame. Provisions are made to keep individual DS1 signals accessible; this will simplify the design of loop connections where multiple DS0 or DS1 level tributaries must be combined, extracted, or cross-connected.

SONET specifically allows for variations of element clock rates, again making it simpler to combine tributaries from various sources. Transmission with the network may occur at the STS-1 level, or at multiples of the STS-1 frame. Loop applications are expected to use STS-1 to STS-12.

The service capacities of fiber optics available are summarized in table 2-3 below.

TABLE 2-3

TRANSMISSION CAPABILITIES OF FIBER OPTIC CABLE

Voice Transmission	As high as 15,000 voice conversations on a single fiber
Data Transmission	A fiber strand can provide 1Gbits/sec or more of total bandwidth
FAX Transmission	Up to Group IV speeds
Image Transmission	Very high volume possible
Video Transmission	A single fiber strand can carry 20 digital, high quality video channels

[10] Paul J. Nicholson, "An Overview of the Synchronous Optical Network", *Microwave Journal* 12 (December 1991): p. 24.

Addressing Requirements and Impact on the Numbering Plan

At this time, none of the scenarios shown above alters the addressing requirements currently in effect. However, this may change when the alternate access providers sell switched services.

At the time when the architecture shown in figure 2-3 above is extended to permit switched access, the alternate access provider's network will likely have to be elevated to include one or more class 5 offices with their own NXX identification. The impact of this change should be roughly comparable to the current situation found in the cellular industry.

Cellular Telephony

Cellular telephony is a "non-wireline" technology that uses radio transmissions to send and receive messages. It was developed from traditional mobile telephone services. Technically, it achieves efficiency through the use of linked cells, which significantly increases the number of simultaneous users which can be supported on the system. While cellular phones are most often found in vehicles, hand-held cellular equipment is becoming more widely used.

Figure 2-5 below shows the operation of a "Type 1" cellular carrier. Mobile stations (that is, cellular service subscribers) communicate with the Mobile Telephone Service Office (MTSO) through the use of several transceivers; the geographical distribution of these transceivers defines the "cell" structure of the service. Mobile station users are connected to the PSN via subscriber lines at a LEC class 5 office.

Figure 2-6 shows how the area covered by cellular service is divided into cells. The same frequency ranges may be reused in cells which do not border each other.

Figure 2-7 shows the operation of a "Type 2" cellular provider. The MTSO (G) provides all addressing functions of a class 5 office. Subscribers are assigned addresses (phone numbers) by the cellular provider. The connection to the PSN is made via trunk-side connection to a LEC class 4 or class 5 office.

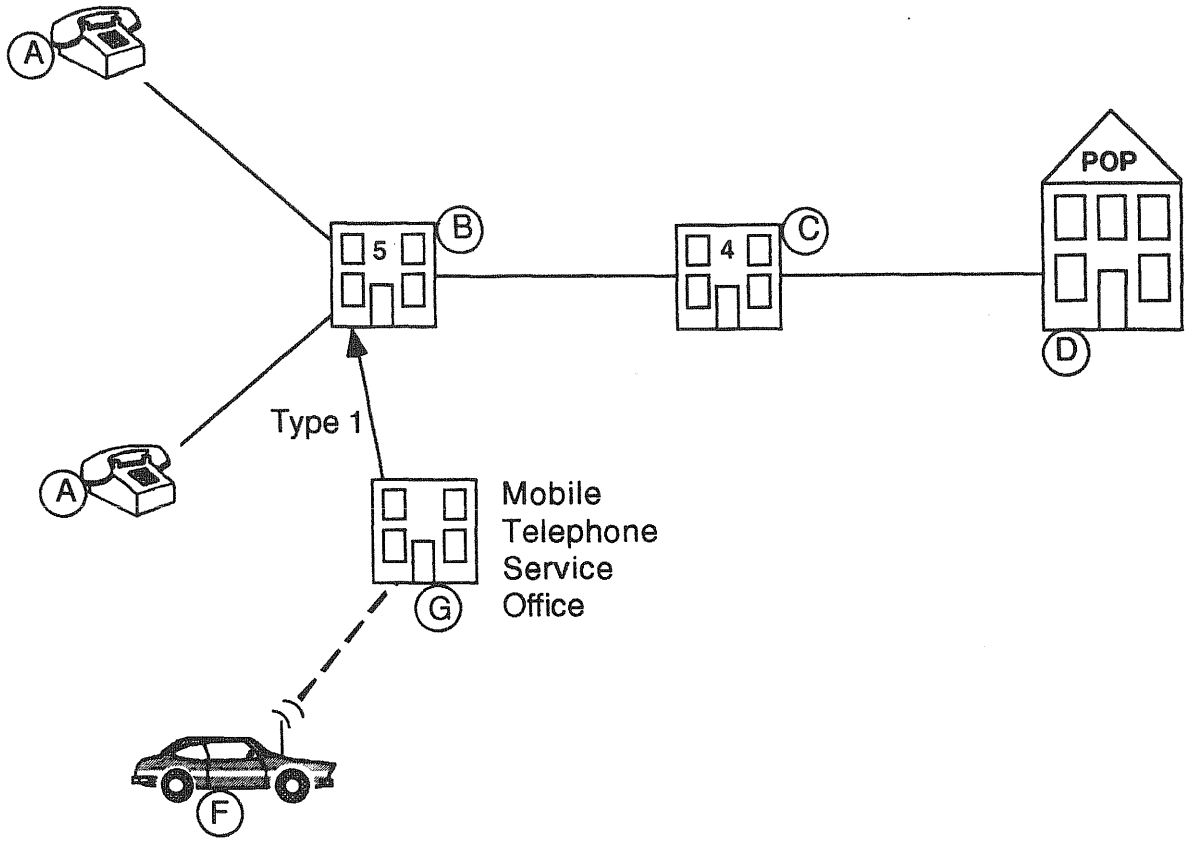

Fig. 2-5. The architecture of a "Type 1" cellular network. The LEC class 5 office is used for all switching and routing.

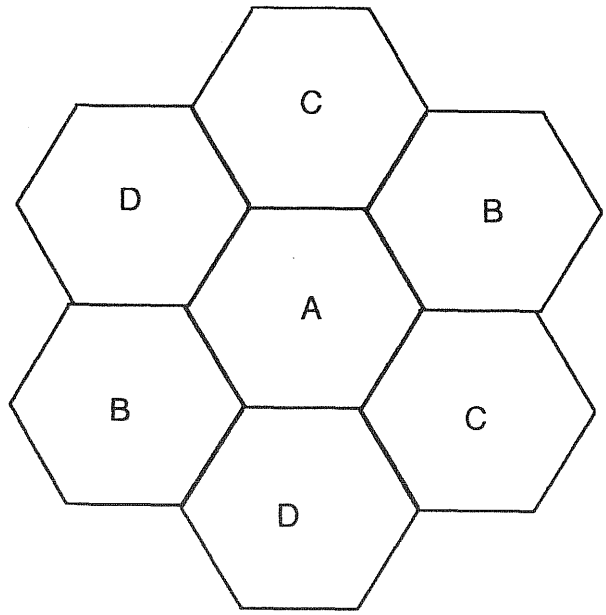

Fig. 2-6. A four-cell frequency reuse arrangement for cellular telephone. Cell diameters vary depending on the location of the cells (rural or urban). Note: A, B, C, and D represent different sets of frequencies. A frequency set may be reused if no two neighboring cells use identical frequencies.

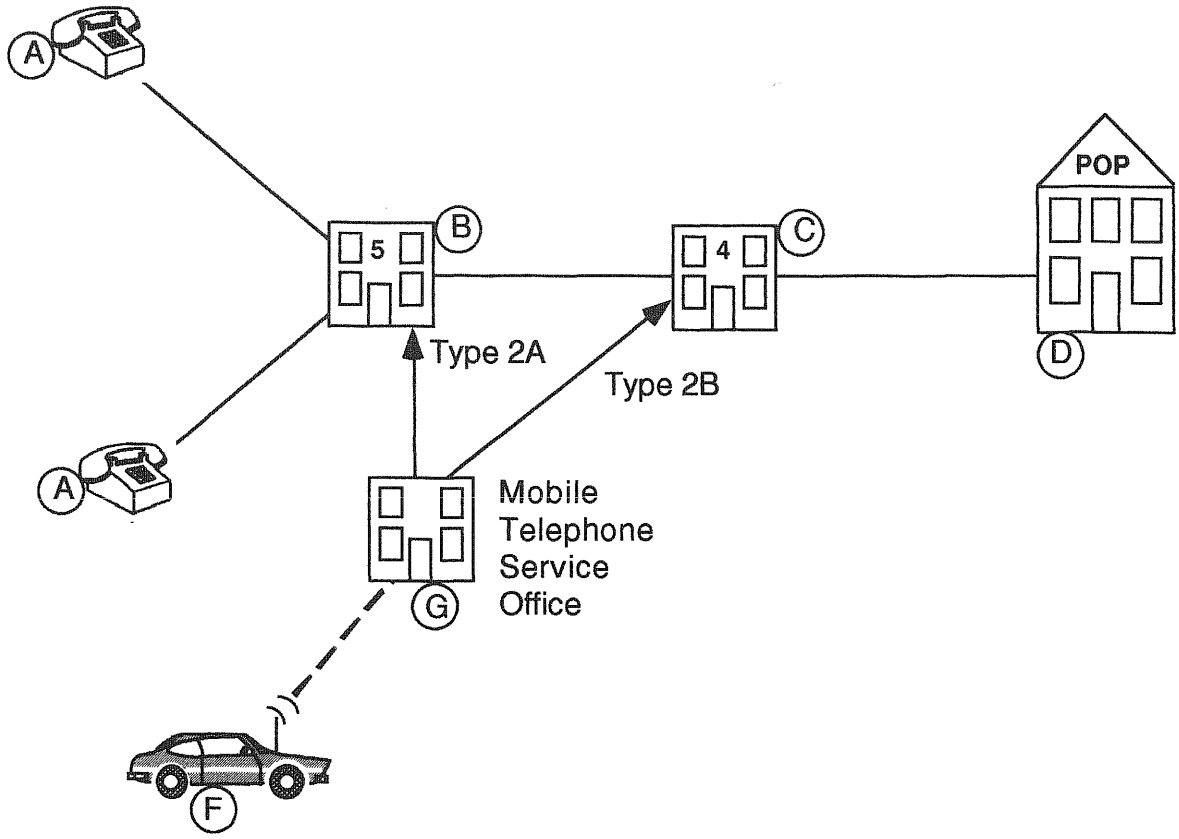

Fig. 2-7. The architecture of a "Type 2" cellular network. The Mobil Telephone Service Office provides all routing functions of a class 5 office. The cellular service provider can be regarded as an independent local carrier. Connections to the LEC network may be made at a class 4 or a class 5 office.

Interconnection to the Cellular Network

Access to the cellular service must be obtained through a compatible mobile station. The vast majority of cellular service subscribers are voice users; however, cellular modems and FAX machines are seeing wider use. These devices operate over the voice channel and, for the service provider, are indistinguishable from voice conversations.

In the United States, cellular service has been deployed using analog transmission standards. Increasingly, cellular service providers are switching to digital cellular systems in order to increase capacity. This change requires that the cellular service subscriber purchase a new, compatible mobile transceiver. Several equipment

providers are marketing dual-mode devices, which will work on both analog and digital cellular systems. Further discussions of these developments may be found in the section on PCN.

Capacity of Cellular Systems

Spectrum allocations for cellular service dictate that each service area has access to 832 channels, which are assigned an analog bandwidth of 30kHz. Due to high levels of noise interference on these channels, data transmissions are typically limited to the 2-4kHz range for each channel. Future developments in the technology for cellular telephony are discussed in the section on PCN, below. Table 2-4 summarizes the cellular services available.

TABLE 2-4
TRANSMISSION CAPACITY OF A CELLULAR SERVICE CHANNEL
(One of the transmission types listed can be used at a given time.)

Voice Transmission	Voice transmission is analog; one conversation per station; several hundred conversations can be in progress at once in each cell.
Data Transmission	Low speed only (around 2.4kbits/sec).
FAX Transmission	Below Group III speeds
Image Transmission	Very low volume only
Video Transmission	-- no --

Jurisdictional Issues

Citing its fear that "state and local regulation might conflict with and thereby frustrate our federal policy of introducing cellular service in a competitive environment without significant delay" the FCC asserted federal primacy over the

major aspects of cellular services.[11] The FCC, in asserting the basis for this primacy, cited federal court proceedings which found that the federal government "occupied the field of radio licensing and regulation," and further cited Section 301 of the Communication Act regarding licensing of radio facilities, as well as Title II of the Act regarding the regulation of common carriers.[12]

The FCC was convinced that there was a great demonstrated need for cellular service, and that, for the service to be effective, it had to be offered on a totally compatible, nationwide basis. To attain ubiquitous compatible service, the FCC preempted the states in three areas: technical standards; market structure; and state certification.[13] In preempting technical standards, the FCC sought to assure nationwide compatibility. In specifying a market structure, the FCC wanted to assure that cellular service would be provided ubiquitously, despite any local franchising requirements for demonstrations of public need or other possible roadblocks. By not requiring potential cellular providers to acquire state certification before seeking federal licensing, the FCC hoped to circumvent any time-consuming state certification proceedings.

Having set up the market structure and the technical parameters for the initial service, the FCC has offered some further clarification of its jurisdiction. Finding that costs for interconnecting the cellular network with the public network are jurisdictionally severable, the FCC has asserted its jurisdiction over the interstate costs of interconnection. Further, the FCC cites its authority to require telephone companies to provide NXX codes to cellular providers, as well as its authority to require that telephone companies negotiate in good faith with cellular carriers.[14]

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[11] An Inquiry Into the Use of the Bands 825-845 MHz and 870-890 MHz for Cellular Communications Systems; and Amendment of Parts 2 and 22 of the Commission's Rules Relative to Cellular Communications Systems, Report and Order, 86 FCC 2d at 503 (hereafter *Cellular Order*).

[12] *Cellular Order,* at 504.

[13] Memorandum Opinion and Order on Reconsideration, 89 FCC 2d at 95, 96.

[14] The Need to Promote Competition and Efficient Use of Spectrum for Radio Common Carrier Services, Declaratory Ruling, 63 RR 2d (P&F), 13.

The states are not totally left out of the cellular arena. States maintain jurisdiction with regard to intrastate charges, classifications, practices, services, facilities or regulations for services by licensed carriers.

Type of Services Offered

In opening up the cellular market, the FCC made 40 MHz of frequency available for cellular services. The FCC determined that a duopoly structure was the most efficient for quickly providing ubiquitous service and so divided the 40 MHz into two blocks. One of the blocks was reserved for landline carriers -- the local exchange carrier -- and the other for non-wireline carriers. This reservation lasted for two years, after which time any one could vie for a license in either frequency block in any unserved areas.

To deploy cellular service the FCC divided the nation into MSAs (Metropolitan Statistical Areas) and RSAs (Rural Service Areas) and numbered them in ascending order according to population size. Licensees were chosen for the top 30 markets through a series of abbreviated comparative hearings. These hearings were deemed abbreviated because they were conducted on paper.

Having found the comparative hearing process time-consuming, the FCC specified a lottery system for the rest of the cellular markets. To stop potential abuses of "application mills," the commission has taken subsequent actions to tighten requirements for potential licensees.

While cellular providers have quickly come forward to serve high-density markets, rural markets have not been served so rapidly. Many rural markets do not yet have any cellular service, and cellular service is spotty in some rural areas, despite the FCC's efforts to encourage cellular providers to "fill in" contiguous areas. Cellular service is a form of mobile telephone service. Initial cellular service involved equipment provided in automobiles; today cellular service encompasses hand-held equipment as well. In essence, cellular service presumes that anyone using a cellular telephone can reach any other cellular telephone, or any landline telephone. Conversely, any landline telephone can reach any cellular unit.

Today, to make this service possible, cellular providers must connect with the public switched network. They have three options for interconnection. A Type 1 connection is analogous to a PBX trunk. Type 2 connections are more complicated because they assume that the cellular provider looks like any other telephone company. A Type 2A connection connects the cellular provider's MTSO to the local telephone company's class 5 office; the Type 2B connection connects the MTSO to the telephone company's access tandem.

For the service to be nationally available to customers, cellular providers must be able to provide roamer service, or the ability for a cellular customer to get cellular service in any cellular service area. This requires the ability for cellular providers to "hand off" traffic to one another, to recognize each other's customers, and to coordinate billing arrangements.

Regulatory Structure

As with most other telecommunications services, cellular service falls under dual jurisdiction. At the federal level, cellular providers obtain their licenses from the FCC; they are also bound by Part 22 of the FCC Rules and Regulations. These rules encompass technical issues, specify that telephone companies must provide cellular service through a separate subsidiary, and govern lottery arrangements. They do not include rate regulation.

At the state level, the regulatory entity has the ability to regulate rates and services of state traffic and the compensation arrangements agreed upon between the cellular provider and the LEC. The level of regulation varies from state to state. A recent study of state regulation of wireless communications notes that state regulators do not regulate cellular services in 25 states.[15] In the other 25 states the level of regulation varies. Eighteen states require that a state license be acquired and tariffs be filed. The amount of scrutiny accorded these tariffs varies by state, as well as

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[15] Herb Kirchoff, *State Regulation of Wireless Communications,* TPG Briefings (Alexandria, Va.: Telecom Publishing Group, 1991).

whether the state regulates wholesale providers only, or both wholesalers and retail resellers.[16]

Impact on the Numbering Plan

Cellular service has had a profound impact on the numbering plan. In its cellular proceedings, the FCC determined that the cellular provider should be regarded as a carrier and treated as possessing a class 5 office if the cellular provider chose a Type 2A or a Type 2B connection. Such a connection, the FCC specified, would make it necessary for the cellular service provider to be allocated an NXX for its own use.

The FCC was explicit in requiring the provision of NXX codes for cellular use, stating that telephone companies do not own telephone numbers but rather administer their distribution: "We expect telephone companies responsible for the administration of the numbering plan to accommodate the needs of cellular carriers for NXX codes and telephone numbers in accordance with the status of cellular companies as providers of local exchange service."[17]

The requirement that cellular providers be allocated NXX codes adds to the problem of number exhaustion, and adds some administrative burden to other carriers, who have to update their switches for these additional codes.

Policy Issues

One major policy concern is the relationship of cellular service to local service. In establishing cellular service, the FCC realized that it could someday be a competitor for local exchange service but did not think that would be possible until a light hand-held set were available and limitations of existing spectrum could be

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[16] Ibid.

[17] *Interconnection Order*, at 1283-4.

overcome so that such service could expand.[18] That day may fast be approaching, especially with the introduction of PCS/PCN.

In its subsequent proceedings, the FCC showed some realization that cellular service could potentially replace local service, especially in remote areas, and could, thereby, deprive telephone companies of revenues: "Ultimately, this diversion may cause rural companies to lose revenues, and inhibit their ability to provide local exchange landline service at affordable rates so that many individuals may be forced to forego telephone service."[19] While the FCC focused its concern on rural telephone companies, that concern may eventually apply to urban companies as well. Cellular service, and the PCN/PCS service which is its logical extension, offers customers mobility, a feature not available with a physical loop. Should that feature prove attractive enough to replace significant amounts of service, the implications for stranded loop investment and continuing affordable local rates could be serious.

Cellular service utilizes a structure which has profound implications for telephone companies. In the cellular scenario, a non-telephone company is accorded class 5 telephone company status, complete with NXX codes. The cellular network is put on a par with the local telephone company network. Indeed, the FCC has specified that cellular providers be treated, in terms of interconnection arrangements, just like another telephone company. In most respects, cellular service becomes a viable competitor for local exchange service. If this interconnection model can work, other types of interconnection may be viable as well for fiber, PCN/PCS, and cable TV.

Compensation arrangements have been a difficult issue in the provision of cellular services. Since cellular providers terminate some landline traffic and landline providers terminate some cellular traffic, compensation is definitely an issue for each company. These compensation arrangements may be an issue for policy makers as

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[18] *Cellular Order*, at para. 32.

[19] Amendment of the Commission's Rules to Allow the Selection from Among Mutually Exclusive Competing Cellular Applicants Using Random Selection or Lotteries Instead of Comparative Hearings." Report and Order (hereafter *Cellular Lottery Rulemaking*), 98 FCC 2d at para. 35.

well. If a significant amount of traffic is involved there may be some impact on the telephone company's revenue and pricing situation.

Personal Communications Networks and Services

Technical Specifications

The terms PCN (Personal Communications Network) and PCS (Personal Communications Services) are often used interchangeably in the literature.[20] PCS often refers to a range of technologies which make communications easier for the individual user, such as smaller and more lightweight telephones. Cordless telephone technology falls into this category.

For the purpose of this report, we will focus on the concept of PCN, which describes the shift from a land-line based addressing scheme to a truly personal addressing mechanism. Today we call telephone numbers which are usually attached to a specific location like a home or office. In the future an address (that is, telephone number) will always refer to the same person, regardless of his or her location in the country, or indeed the world. Calling a person's number will connect you to this person over a worldwide communication network consisting of both land-line and wireless components.

Precursors to both PCS and PCN exist today. PCS started with the single-user cordless phone (often referred to as the *first generation* cordless telephone) where a user obtains both a base station and a cordless phone. The base station serves as the connection to the land-line based Public Switched Network (PSN), for this one user only. Second generation cordless telephones allow multiple users to share a base station. (We will return to this development below.)

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[20] For a further discussion of these and related topics, see Theodore S. Rappaport, "Wireless Personal Communications: Trends and Challenges", *IEEE Antennas and Propagation Magazine* 33 (October 1991).

Current cellular telephony can be regarded as the beginning of PCN.[21] Within the "home" service area of the cellular service subscriber, a call placed to the telephone number of the cellular phone will reach the desired person regardless of location. Current cellular service differs from PCN in that a subscriber cannot usually be reached while traveling outside his or her service area (although calls can usually be placed). Furthermore, the capacity available in the current cellular system is insufficient to accommodate a market where a substantial portion of the population relies on PCN as their primary method of attaching to the public switched network.

The three figures below illustrate the possible developments of current technologies into various forms of PCN.

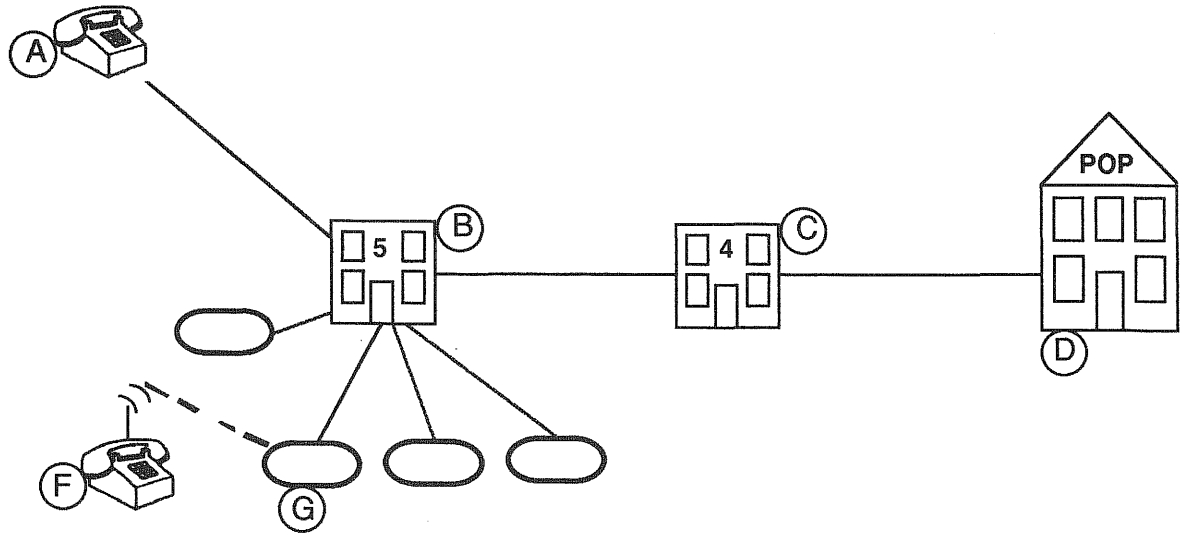

Fig. 2-8. The architecture of a Personal Communications System. These systems are based on cordless telephone technology, and are sometimes referred to as "cordless payphones."

Figure 2-8 shows the deployment of the multi-user cordless telephone concept. The base stations (G) (now usually called "telepoints") are connected to the PSN via the same type of subscriber lines commonly used for payphones. In fact, this architecture has been deployed in Great Britain using the CT2 (Cordless Telephone 2nd

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[21] A good discussion of this evolution may be found in Richard J. Lynch, "PCN: Son of Cellular?" *IEEE Communications Magazine* 2 (February 1991).

Generation) standard; it is often referred to as a system of "cordless payphones".[22] It is important to note that the CT2 technology allows the cordless phone (F) only to originate calls, not to receive them. A competing standard used in Europe, namely the DECT (digital European cordless telephone), goes beyond these limitations to allow both call origination and termination, as well as "roaming," that is, the ability to move from the vicinity of one telepoint to the next without interrupting the call in progress. While DECT is much closer to the concept of PCN than is CT2, currently only CT2 equipment is readily available at an attractive subscriber cost.

It should also be noted that the deployment of CT2 extends the local loop, rather than replaces it. Due to its limitations, CT2 is not likely to cause a widespread shift of subscribers away from dedicated local loops to the shared telepoints. DECT technology is expected to be deployed first in office environments, replacing traditional PBXs with wireless ones which would, however, still attach to traditional local loops. In the United States, deployment of PCN is more likely to follow the architecture of the current cellular service, as shown in figure 2-9. The distinction between cellular service and PCN is in this case one of degree and technical detail. Figure 2-9 shows the PCN subscriber (F) accessing one of many cellular-type transceivers (H) which are tied to a simple PCN switch (G) which provides the tie-in to the PSN through the class 5 office (B). While this figure looks deceptively like the one shown before in the discussion of cellular telephony, two major differences should be noted.

Cell sizes for PCN will be much smaller than those for current cellular service. The PCN cells, often called "microcells", could be as small as 500-1000 feet in diameter. Coupled with a digital encoding scheme (as opposed to the analog scheme in current cellular phones), these smaller cells provide the drastic increase in capacity needed for the expected market penetration of PCN. The smaller cell sizes also permit the PCN terminal equipment (telephones) to be much smaller and lighter since PCN terminals will operate using much lower power levels than cellular phones.

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[22] Further discussion of the deployment of cordless and cellular telephone networks in Europe can be found in Matthew Dosch, "Personal Communications" (Alexandria, Va.: Telecom Publishing Group, 1990).

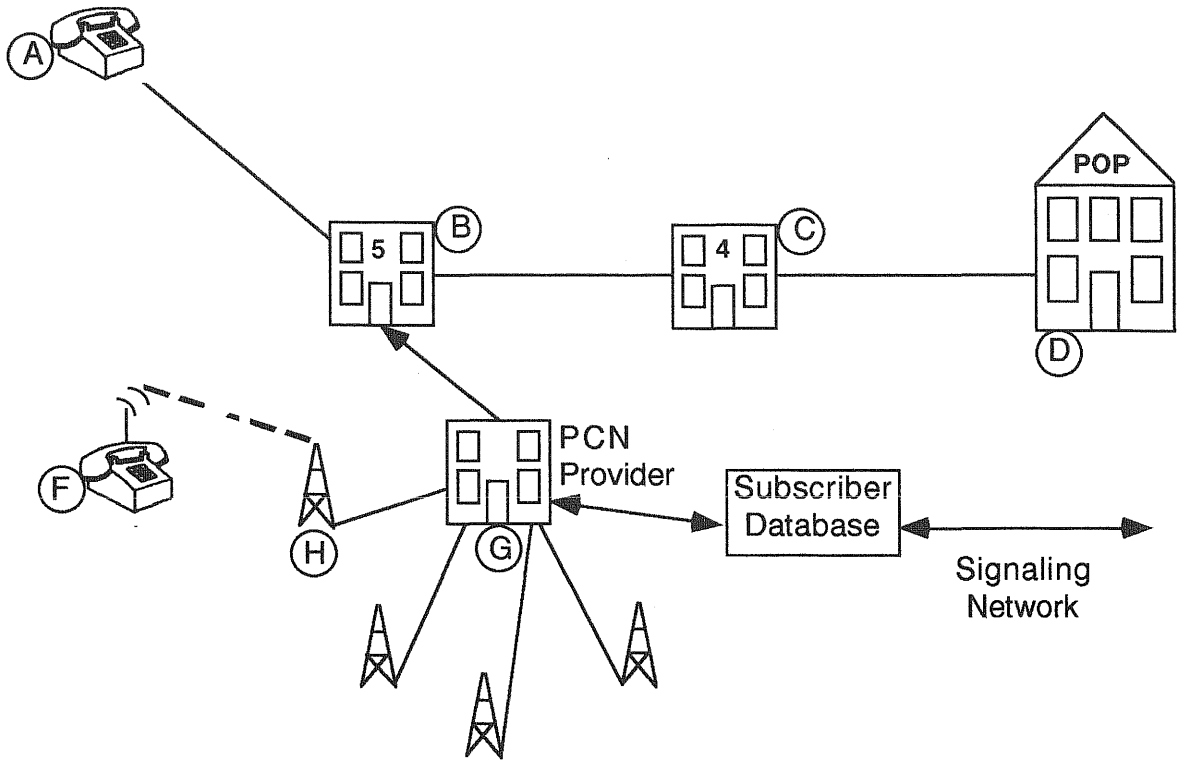

Fig. 2-9. The architecture of an early Personal Communications Network (PCN). The architecture is very similar to the Type 1 cellular systems; PCN adds a subscriber database and signaling network, however.

The second major difference between current cellular service and true PCN is the existence of a signaling and database system which permits the PCN to locate a subscriber anywhere in the area covered by the PCN, regardless of the carriers/providers involved. Given the current emphasis in field trials and academic research on the establishment of the microcell architecture, we expect that PCN will initially be deployed in "islands", much like cellular service now. The ability to locate a subscriber, even when he or she is located outside the "home" service area, is crucial, however, to the development of true PCN service.

Note that, in contrast to CT2, the impact on LEC local loops will potentially be quite noticeable. A fully deployed PCN, even with limited signaling ability between systems, can provide all the services of the current residential or business line. If the pricing structure for PCN service can approach the cost of traditional

residential or business service[23], one would expect a usage shift where subscribers begin to abandon traditional land-line services in favor of PCN. Existing local loops could become idle unless they can be successfully redeployed for the transmission of high-bandwidth data, image, or video services.

Figure 2-10 shows the further development of the PCN concepts along the lines of the type 2 cellular service. This figure differs from figure 2-9 in that the PCN serving office (G) now assumes all functions of the class 5 switching office. It is likely that these PCN offices will be connected by their own signaling system in order to exchange information about the location and billing status of PCN subscribers. The connection to the PSN will be made via the LEC class 4 toll office (C) as well as directly to long-distance carriers (D) via facilities owned by the PCN provider or leased from alternate access providers. At this stage, PCN will be a full competitor to the existing LEC, with subscribers split between those who use land-line services and those who choose the PCN. Some subscribers may maintain services from both providers.

Finally, it should be noted that the deployment of PCN will place a heavy strain on the capacity of the North American Numbering Plan (NANP). Due to initial limitations in the services offered by PCN, it is expected that a large number of subscribers will initially obtain PCN service in addition to their existing land-line service. In major metropolitan areas, where PCN is certain to be deployed first, the available addresses under the NANP are already near exhaustion due to the demand of local loops, paging services, and cellular telephony. Administration of the NANP by the LEC-owned Bellcore is certain to be challenged by the providers of the new services, since a restricted allocation of addresses could be used as a formidable competitive barrier by the LECs. Regulatory action may be required to adequately resolve this issue. It should further be noted that the existing technical means for expanding the capacity of the NANP involve removal of the existing restrictions on

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[23] Note that current cellular service pricing is quite unfavorable when compared to residential or business lines. The main reason for this is the charge for "air-time" (use of the spectrum), which is charged to the cellular subscriber on a per-minute basis, for originating *and* terminating calls.

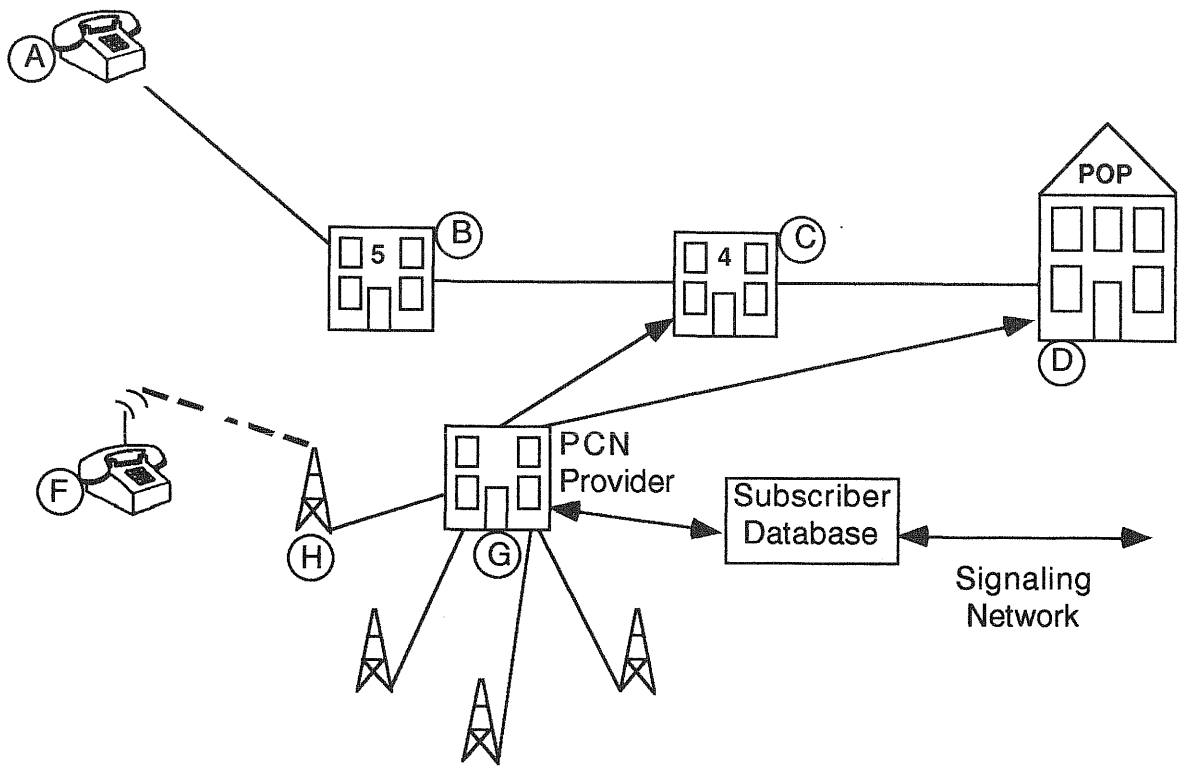

Fig. 2-10. A fully deployed PCN. The interconnection to the LEC network follows the concept of the Type 2 cellular network. The PCN provider's switch assumes all functions of the class 5 office. Also shown in this figure is the possibility of a direct (i.e., non-LEC connection between the PCN switch and the IXC network. This connection could be owned by the PCN provider, or leased from an Alternate Access Provider.

the selection of NPAs (Area Codes). If these methods are used to extend the available numbers in the NANP, large capital expenditures and accelerated depreciation will result for many LECs (and IXCs) due to the inability of older central office equipment to recognize non-traditional NPAs.

Since efforts to develop standards for PCN are far from complete, any estimate of the system or transmission capacity of a PCN implementation must by necessity be speculative. It is likely, however, that a U.S. version of PCN will build upon the current analog cellular systems, which use a 30kHz full-duplex transmission channel. One proposed standard which makes this transition is the interim North American

Standard IS-54.[24] In this standard each analog 30kHz channel will carry three user signals with an effective transmission speed of 13kbits/sec per user.

Expected PCN capabilities are summarized in table 2-5:

TABLE 2-5
PROJECTED TRANSMISSION CAPABILITIES OF A
CHANNEL IN A PERSONAL COMMUNICATIONS NETWORK
(One of the transmission types listed can be used at a given time.)

Voice Transmission	Digital using full channel bandwidth
Data Transmission	Up to 13kbits/sec
FAX Transmission	Up to Group III speeds
Image Transmission	Low volume only
Video Transmission	-- no --

Regulatory Issues Surrounding the Introduction of PCN/PCS

The regulatory treatment of personal communications services and networks is still under significant debate by the FCC.[25] The FCC has made clear that it "intends to broadly define personal communications services and make available an adequate

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[24] For a discussion of this and a variety of other wireless standards, see David J. Goodman, "Trends in Cellular and Cordless Communications", *IEEE Communications Magazine* 6 (June 1991).

[25] The FCC, shortly after the completion of this report, issued a Notice of Proposed Rulemaking in the General Docket No. 90-314 proceeding. That NPRM left unanswered many of the questions pending about the deployment of PCN/PCS services. The number of licensees per service area, the definition of service area, the method for selecting licensees, and whether PCN/PCS would be treated as private or common carrier services were all issues set out for further comment. The treatment of existing cellular providers and of local telephone companies in the licensing process was also left for further discussion. The Commission did propose to allocate 20 MHz in the 1910-1930 MHz band for nonlicensed PCS service which would fall under the FCC's Part 15 rules for radio devices. Services such as wireless PBX, cordless phones, and high-speed and low-speed personal computer data transfers would come under this category.

amount of spectrum to foster the development of innovative and competitive markets for these services."[26] As was the case with the introduction of cellular service, the FCC is assuming jurisdiction over questions of deployment and licensing of PCN/PCS providers.

In an *en banc* hearing, the FCC addressed four basic issues about the treatment of PCN/PCS.[27] In addition to the matter of defining personal communications services, which the FCC intends to define broadly in order to foster innovation, the FCC considered spectrum requirements, technologies, and a variety of regulatory issues. The resolution of these regulatory issues will be key to the successful introduction of PCN/PCS in the United States.

Among these issues are the assigning of licenses, the appropriate geographic scope for licenses, the relocation of existing spectrum users, the merits of exclusive versus non-exclusive assignment of licenses, privacy implications, terms and conditions of interconnection to the public switched network, the need for a new numbering plan, the need to accommodate roamers, licensee eligibility, jurisdiction, and appropriate regulatory treatment. Many questions exist about all of these areas.

The FCC must determine what the geographic scope of licenses will be. In the cellular scenario, MSAs and RSAs were established and a duopoly approach was taken to granting licenses. The same geographic scope may not be appropriate here, since these services work in tighter microcell ranges. The FCC may determine that a duopoly, with one license set aside for the wireline provider, may not be appropriate. Indeed, to encourage innovation, the FCC may adopt a "pioneer preference" strategy. For those who can demonstrate the creation of a new service or the substantial enhancement of an existing service, the FCC can allow the potential licensee to file without competing applications.[28]

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[26] *Amendment of the Commission's Rules to Establish New Personal Communications Services,* Policy Statement and Order, Gen. Docket No. 90-314, 6 FCC Rcd No. 23, 6601 (1991), at paragraph 3. (hereafter *PCN Policy Order).*

[27] *PCN Policy Order,* at paragraph 8.

[28] *Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation of New Services,* Report and Order, 6 FCC Rcd No. 12, 3488 (1991).

The FCC's current methods of awarding licenses may not be utilized in the licensing of PCN/PCS providers. Currently, the FCC relies on comparative hearings and on lotteries. As mentioned earlier, both approaches were used in awarding cellular licenses, with varying degrees of success. The comparative hearing method proved time consuming. The lottery method led to a good deal of unintended speculation. The FCC is awaiting legislation which would allow the use of auctions to award licenses.[29] Whether a license would be reserved for LECs is not yet clear.

Spectrum Allocation

The FCC is facing some difficulties in allocating spectrum for new PCN/PCS services because the frequencies under consideration are already in use. The FCC plans to allocate spectrum in the 1800 to 2200 MHz range; however, that range is currently allocated for private operational fixed microwave, government use, auxiliary broadcast and cable TV, and public fixed microwave. The FCC is considering several options to accommodate new PCN/PCS services while protecting the needs of existing users. Options being considered include sharing frequencies through spread spectrum and other methods; relocating existing users to other frequencies; allowing public safety fixed microwave users to stay in their current frequencies indefinitely, but specifying that other existing users be demoted to secondary user status (without protection from interference from primary users of the frequency) after 10-15 years; and reallocating at least 200 MHz of unused government spectrum space to commercial use for PCN/PCS. To facilitate the introduction of these new services, the FCC will also encourage developments in less congested frequency bands and will quickly license future experiments which propose to use unused frequencies.[30]

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[29] See Thomas A. Monheim, "Personal Communications Services; the Wireless Future of Telecommunications," *Federal Communications Law Journal* 44 (March 1992): pp. 335-362, for a discussion of the pros and cons of the auction method.

[30] See Monheim for further details regarding frequency assignment issues.

Interconnection Issues

In establishing the ground rules for cellular service, the FCC made clear the method by which cellular providers were to be accorded interconnection to the public network. The cellular provider could connect at a PBX trunk level, or could connect on a class 5-to-class 5 or class 5-to-class 4 basis. Whether PCN/PCS providers would connect in a similar manner is not yet clear. However, it is certain that some form of interconnection will be necessary.

Along with interconnection to the public network, cellular providers were allotted their own NXX codes and were to be regarded as equivalent to another independent telephone company. A distinct NXX code may not be sufficient. The basis for PCN will be number portability. An NXX code designates a specific geographic area. PCN users will not be tied geographically. The FCC inclusion of a new numbering plan in its *en banc* hearing suggests that the FCC recognizes the need for a new approach to numbering schemes if PCN services are to be ubiquitously licensed. It may be necessary to create a numbering scheme which identifies the PCN provider or specific PCN service in order to reach the PCN customer.

Service Providers

The treatment of PCN/PCS providers is also not clear as yet. The FCC has noted that:

> Mobile services traditionally have been provided pursuant to both common carrier and private regulatory schemes. Each has its advantages and disadvantages. We lack sufficient information now to determine whether common carriage, private carriage, or some combination of both concepts will be optimal for PCS. The regulatory scheme we eventually decide upon will depend in part upon public interest factors such as our desire to promote the rapid development of this service and our interest in promoting competition in PCS and in telecommunications generally.[31]

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[31] *PCN Policy Order,* at paragraph 7.

The status of PCN/PCS providers as common carriers or private service providers will have ramifications for questions such as obligation to serve, amount of oversight by state commissions, pricing concerns, and other regulatory issues.

Which companies will be eligible to be PCN/PCS providers is also not as yet certain, nor is the exact nature of this service.[32] If PCN/PCS is merely an extension of cellular service, current cellular providers would appear to be natural providers. If PCN/PCS is a wireless extension of local loop services, LECs would appear to be in line as providers. Cable companies have expressed an interest in entering the PCN/PCS markets; however, their ability to provide service may require changes to the cable/telco cross-ownership ban.

In short, regulatory treatment of PCN/PCS service is by no means determined. The status of the providers as common carriers or private service providers, the type of industries that will be involved, the method of licensing providers and their eligibility requirements, the geographic scope of the licenses, and the terms of interconnection to the public network are all questions yet to be answered. The answers which are ultimately formulated will have a great impact on the final definition and deployment of these new services.

Cable TV

Cable distribution systems were installed as early as 1948 in order to "import" broadcast television signals into areas which could not otherwise receive them.[33] Since then, they have been deployed in increasing numbers. At this time about 10,000 cable systems are serving about 53 million subscribers, representing a 59 percent penetration of the potential markets[34].

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[32] Monheim, "Personal Communications Services," p. 356.

[33] See for example, Edgar Willis and Henry Aldridge, *Television, Cable, and Radio; A Communications Approach* (Englewood Cliffs, N.J.: Prentice-Hall, 1992).

[34] Ibid.

Due to the history of cable systems, they currently represent a broadcast (rather than a two-way communications) related architecture. A typical system layout is shown in figure 2-11 below.

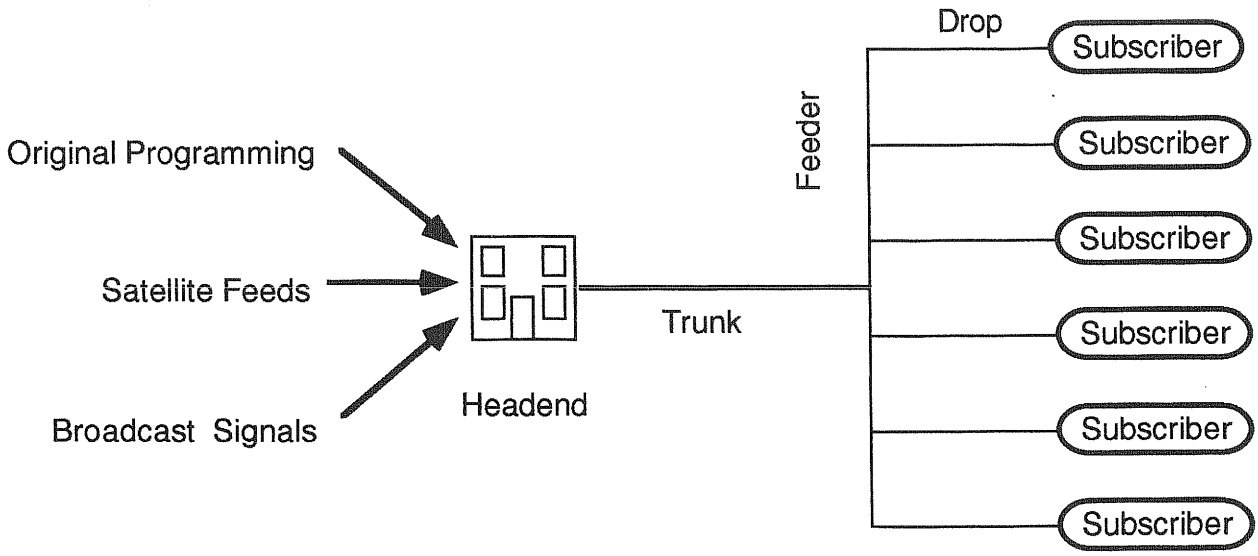

Fig. 2-11. A typical layout of a cable TV distribution system.

A program for the cable subscribers on a single system originates at the headend; here broadcast signals are received and satellite downlinks are set up. The headend may also house studios for locally produced programs. The programs are multiplexed (using frequency division multiplexing) onto the analog carrier system and sent out over the single trunk. (In large systems, microwave links may be set up to feed trunks originating from remote hubs).

The single trunk is then connected to multiple feeder circuits from which individual subscriber drops originate. Amplifiers are placed along the trunks and feeders. They operate in one-way mode, amplifying signals from the headend towards the subscribers. In some systems a portion of the available bandwidth is set aside for a return path from the subscribers to the headend, using appropriate reverse amplifiers.

Trunk and feeder lines were originally deployed using coaxial cable; today fiber optic cable is increasingly substituted.[35] Cable TV distribution plant does not attempt to provide dedicated bandwidth to each subscriber. Rather, the tree architecture used here is very similar to many local area network architectures, where bandwidth is shared among all stations connected to the network. However, in the case of the cable TV plant, bandwidth is primarily available in one direction only.

Infrastructure

Cable TV distribution systems today are not set up to immediately provide two-way communication service. The main barriers are the one-way nature of most systems, as well as the fact that the headend is equipped for signal broadcast, not for switching of interactive communication sessions.

In effect, the cable TV systems are missing the equivalent of the LEC class 5 office, or the cellular MTSO (Mobil Telephone Serving Office). It should be noted, however, that a comparison of the cellular service companies and the alternate access providers suggests that the lack of a switching infrastructure is a much smaller entry barrier than the lack of a distribution architecture.

Taking the comparison with the cellular and alternate access industries one step further, one would expect that the cable TV providers can successfully enter the local loop market provided that they are given access to the same interconnection and colocation opportunities now available to the other LEC competitors.

The existing cable TV distribution plants have the following capacity attributes: Most systems operate in an analog mode, using carrier frequencies between 54MHz and 294MHz.[36] Some systems provide subscriber to headend (reverse) channels in the 5MHz to 50MHz frequency band. Figure 2-12 shows attributes of a typical cable TV system. Note that each TV channel occupies a 6MHz band, or the equivalent of 1500

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[35] James Chiddix, "Fiber Backbone Trunking in Cable Television Networks," *IEEE LCS Magazine* 2 (February 1990).

[36] John E. Cunningham, *Cable Television* (New York: Howard W. Sams Co., 1986).

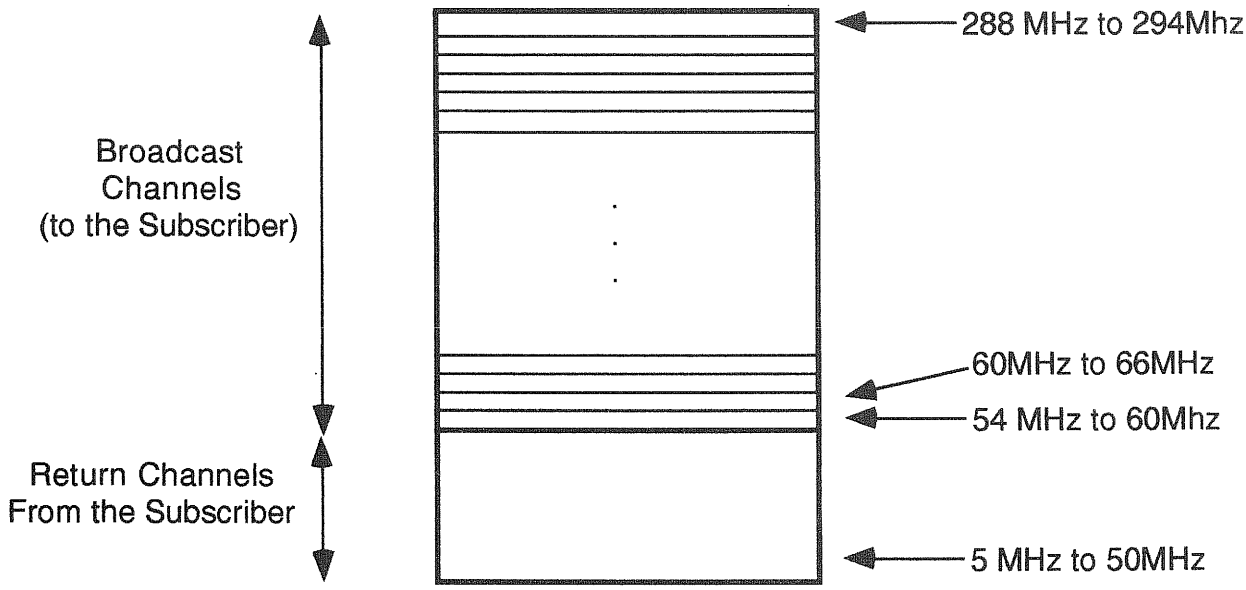

Fig. 2-12. A common frequency allocation scheme for cable TV systems.

analog voice channels. An estimate of the (digital) data transmission capacity can be derived from Shannon's information theory.[37] Using the 240MHz (54 to 294) bandwidth and the generally accepted design standard of a 36dB signal-to-noise ratio[38], the theoretical maximum capacity for the medium and amplifiers is 2.9 Gbps. Assuming that a practical implementation can reach about 30 percent of that goal results in an estimated 800 Mbps estimate of capacity. This figure agrees well with other authors' conclusions[39].

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[37] William Stallings, *Data and Computer Communications* (New York: McMillan 1992).

[38] Cunningham, *Cable Television.*

[39] William Stallings, *Business Data Communications* (New York: McMillan 1991).

Given that a single trunk may serve 5,000 to 10,000 households, each subscriber on average could access about 100 Kbps. This is substantial bandwidth for applications such as videotext, sound, and graphics. Full interactive digital transmission of video information, however, will require on the order of 50 Mbps per subscriber[40], and therefore necessitate upgrading of the existing local loop facilities of both LECs and cable TV providers.

Cable/Telco Cross-Ownership

The issue of introducing competition into the voice local loop is complicated by the desire of many telephone companies to provide video programming and the new non-voice services of the future, and by the corresponding interest of cable TV interests to keep utilities out of the market. In a sense, the definition of "local loop" is now expanded in this policy debate to include video services in addition to the traditional voice and data services. The telephone companies argue that without the ability to provide video programming there would be little incentive to modernize their facilities. They argue that modernization of their facilities is essential for providing the infrastructure for tomorrow's new information services, but whether and how fast this modernization occurs may depend on whether LECs are permitted to provide video programming.

Simultaneously, Congress has shown increasing concern about cable subscriber costs and cable diversity in programming (as well as the modernization of American telecommunications infrastructure).[41] The FCC has argued that these problems can

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[40] Gary Nelson, Ameritech, session TEC10 presented at the National Communication Forum, Chicago, 1991.

[41] Two new pieces of legislation were recently introduced: "The Telecommuting Infrastructure Act of 1991," S 661, 102d Cong., 1st Sess. (1991) would authorize telephone companies to provide video programming directly to subscribers. The Departments of Commerce and Justice called for similar legislation last year. "The Communications Competitiveness and Infrastructure Act of 1991," S 1200, H.R. 2546, 102d Cong., 1st Sess. (1991) would take a more restrictive approach to stimulate program and facilities investment and complement video dialtone by the LECs without authorizing unfettered entry into video programming.

be attributed to the lack of competition in the cable industry. One proposed solution to all of these problems is to allow the telephone companies to compete with cable providers in the provision of video programming. Depending how events unfold, cable and telephone companies could become direct competitors in the "new" local loop.

Regulatory Barriers To Cable/Telephone Competition

Before the telephone companies and cable companies can compete in this new local loop on a reasonably level field, however, there are several regulatory barriers to competition that must be removed. These regulatory barriers were erected to protect the cable industry from the telephone companies when the cable industry was still in its youth. Several pieces of regulation and legislation were created to prevent unfair and predatory practices by the telephone companies: regulation of conduit and pole attachments to prevent telephone companies from abusing their rights-of-way, prohibition of telephone/cable cross-ownership arrangements, and prohibitions on telephone companies from providing "video programming."

Using its ancillary jurisdiction, the FCC crafted a set of regulations which prohibited telephone companies from owning cable companies.[42] These regulations were later codified into law as part of the Cable Communications Act of 1984.[43] The law also forbids common carriers from providing "video programming directly to subscribers in its telephone service area."

In addition to this legislation, the AT&T Consent Decree also had two effects on the ability of telephone companies to provide video programming services.[44] In the consent decree, the court expressly prohibited RBOCs from providing information

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[42] Cross ownership restriction (prohibits from providing video programming 47 C.F.R. 63.54(a); prohibits providing pole and conduit space to affiliates and providing video programming to the public 47 C.F.R. 63.54(b); "affiliate" defined in 47 C.F.R. 63.54, Note 1(a); exception to above for rural areas 47 C.F.R. 63.58; other waivers under certain conditions 47 C.F.R. 63.65)

[43] 47 U.S.C. Section 533(b).

[44] *United States* v. *Western Electric Co., Inc.,* 552 F.Supp. 131 (D.D.C. 1982), *aff'd sub nom. Maryland* v. *United States,* 460 U.S. 1001 (1983).

services and from providing telephone service outside of their service area. Video programming certainly qualified as information services. Only recently, however, has the court lifted the ban on telephone companies providing information services.[45] The court, however, still has a BOC restriction on interLATA provision of services.[46] To the extent that a competitive telephone company would have to establish a separate facility for each LATA, the consent decree might still be an encumbrance to vigorous competition between the cable companies and the telephone companies in providing video programming.

Under the protection of the Cable Communications Act and the Consent Decree, the cable companies have been able to grow and prosper -- some say unduly.

Video Dialtone

In response to these new developments, the FCC has proposed the broad outlines of a new regulatory model called "Video Dialtone."[47] The video dialtone model is in its early conceptual stages and consequently is unclear, with many possible implementation schemes and problems. Essentially, however, the model simply calls for video programming to be carried, like voice, as a common carrier service.[48]

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[45] *United States* v. *Western Electric Co., Inc.,* 767 F.Supp. 308 (D.D.C. 1991).

[46] Ibid.

[47] FCC, Further Notice of Proposed Rulemaking, First Report and Order and Second Further Notice of Inquiry on Telephone Company-Cable Cross Ownership Rules, Sections 63.54-63.58, CC Docket No. 87-266 (November 22, 1991).

[48] The Further Notice of Proposed Rulemaking proposed a "two-level" approach in regulating this common carriage of video signals. This model is structured to achieve the FCC's goals of: (1) facilitating competition by ensuring nondiscriminatory access to the common carrier service by information providers; (2) making video dialtone easy for consumers to use; and (3) making sure that the regulatory structure is flexible to new technological developments. Under the "first-level," the LEC would be limited to providing "an 'electronic platform' or 'window' that opens to a broader network, giving the user access to video and non-video communication services provided by a multiplicity of competitive service providers." This service would be common carrier and regulated under Title II of the Communications Act. Services included within the second level would not be regulated and would be subject to

According to the FCC, this service could be intrastate or interstate and could be delivered through a private line, point-to-multipoint or it may be switched. The video programming could run parallel to or be integrated with the switched narrowband network. The market is left with the decision on how to implement this network.

In its order, the FCC essentially ratified the regulatory framework in its earlier video dialtone proposal. It also allowed telephone companies to own five percent of a video programming provider as well as a "passive" "nonownership relationship" with videoprogrammers as long as that interest does not give a controlling interest to the LEC of the programming provider. Examples of these "nonownership relationships" include debtor/creditor relationships and the selling of enhanced services related to video programming by the LECs to videoprogrammers. These relationships are to be judged case by case. The FCC reaffirmed an earlier ruling that telephone companies need not obtain a franchise in order to provider videoprogramming services. In order to preserve competition, the FCC is prohibiting LECs from purchasing existing cable facilities in their own service area for the purpose of providing video dialtone. The order also prohibits LECs from being involved in the pricing of services and recommends to the Congress removing telephone/cable cross-ownership restrictions. Before LECs can build video dialtone facilities, they must be reviewed under the Section 214 facilities review process. Finally, the FCC will make a comprehensive review of the video dialtone rules in three years.

Before the video dialtone concept could obtain the green light to proceed, the FCC had to consider their proposal in light of the existing regulations and statutes discussed above. Either the FCC had to find that its video dialtone model did not contradict the Communications Act or, if it did, that the FCC ought to make recommendations to the Congress to make changes to the Communications Act.

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competition. These services would include "advanced video gateway" that provide "advanced navigational aids of the gateway provider's own design.... Thus, while we cannot know the exact range of such features at this early stage, a gateway provider could provide for menus and key word and subject matter search capabilities that could be tailored to an individual consumer's preferences. Such services also could include the capability to permit the consumer to preview all programs on a particular topic or at a particular time or date" (pp. 15-20).

Obviously, the first course of action is much easier, especially in light of the broad presumptions that courts now give to agencies in interpreting the intent of their enabling legislation.[49] While the FCC has already issued interpretive rulings on most of these issues, the discussion is not conclusive since legal challenges have not yet been made and therefore the courts have not given their last word.

The FCC's video dialtone proposal has the effect of introducing common carrier service as a competitor to the cable provision of wireline-based video programming. In doing so, "introducing competition into the local loop" has taken on new meaning because the local loop has been expanded to include the provision of video programming services.

Several questions remain. Do the cable companies suffer an unfair disadvantage vis-a-vis the telephone companies where only the cable companies are required to obtain franchise agreements? Is there an unfair or uneven playing field? Should the Congress overhaul its whole approach to regulating cable television? What affect would this have on services, contractual expectations and revenue streams of existing franchising authorities? Who would be the new regulator of cable? As mentioned later in this report, one of the central tensions throughout the communications regulation is the question of jurisdiction and preemption. To what extent does the viability of video dialtone depend on uniform regulatory structures and so require the FCC to use its power to preempt state regulation? Is FCC preemption of state regulators now possible given the Ninth Circuit Court of Appeals opinion in *California* v. *FCC*? [50]

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[49] *Chevron, USA, Inc.* v. *National Resources Defense Council* 467 US 837 (1984).

[50] *United States* v. *Western Electric Company, Inc.* 767 F. Supp. 308 (1991). In this case, the court held that the FCC had failed to provide support in the record for its conclusion that accounting safeguards along could, in the absence of structural separation, adequately constrain the BOCs ability to engage in cross-subsidization. The court also found that Section 2(b)(1) of the Communications Act limits the FCC's power to preempt state regulation of services provided "in connection with intrastate communications services by wire or radio of any carrier." The preemption was declared to be overly broad in the absence of a showing that any such state requirements would "thwart or impede" valid federal policies.

Up until now the discussion has been on LEC common carriage of video signals. Some LECs, however, argue that even the ability to provide video signals may not be enough of an incentive for telephone companies to construct advanced, switched broadband networks. In addition to the ability to carry video signals as common carriers, the telephone companies would like the ability to produce and distribute the programming services themselves. In a Second Further Notice of Inquiry[51] the FCC sought comments from the public on whether it should recommend to Congress to remove the 613(b) prohibition against LECs directly providing programming services.

If LECS were allowed to provide programming services to be transported using the common carrier services, there is a concern that they could use their control of these "bottleneck" common carrier facilities to favor their programming services over their competitors. The FCC, obviously, is very interested in knowing what safeguards are necessary when LECs are allowed to offer video services. One immediate concern is whether cross-subsidization could be detected and prevented. Another issue is whether attention should be devoted to the sequence with which LECs are first allowed to provide video dialtone service (thus giving programming providers an opportunity to grow) before letting the LECs provide their own video programming.

The FCC is also concerned that before LECs will invest in integrated broadband networks other areas will need additional statutory or regulatory changes in order to expand investment incentives for video dialtone. Some options include having higher depreciation rates, allowing cooperative investment by cable TV and telephone companies and tax law changes, or allowing cables to own a share of video dialtone services. Other commentators have argued for more flexible "good cause waivers" of the cross-ownership rule where the LECs promise to provide a switched fiber optic system and be able to deliver several video signals into the home.[52]

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[51] Second Further Notice of Inquiry on Telephone Company-Cable Cross Ownership Rules, Section 63.54-63.58, CC Docket No. 87-266 (November 22, 1991).

[52] Jane A. Strachan, "Untangling the Regulatory and Legal Wires to Telephone and Cable Television," *Bridgeport Law Review* 11 (November 1991): pp. 599-622.

TABLE 2-6
OVERVIEW OF THE DEPLOYMENT, CAPACITY, AND MOBILE COMMUNICATIONS CAPABILITY OF FIVE TECHNOLOGIES

	Twisted Pair Local Loop	Fiber Optic Local Loop	Cable TV Coaxial Cable	Cellular Telephony	PCN
Availability	Universal	Metropolitan Areas	Widely Available	Widely Available	Not yet Deployed
Capacity for Voice Transmission	Low to Medium	High	Medium	Low	Low
Capacity for Data Transmission	Up to 1.5 Mbits/sec	45Mbits/sec or higher	around 150kbits/sec (two-way)	up to 4.8kbits/sec	up to 13kbits/sec
Capacity for Image Transmission	Medium	High	High	Limited	Limited
Capacity for Video Transmission	Freeze-Frame only	Full Motion Possible	Full Motion Broadcast	not available	not available
Mobility of terminal equipment	No	No	No	Yes	Yes

Deployment of Current Technologies

The vast majority of Americans still picture communications relatively simply: the LECs provide voice service through twisted pair, the IXCs provide the long-haul traffic through fiber optics and the cable companies provide local videoprogramming through coaxial cable. Consumers have "wireless" cordless phones in their homes but these are merely "an extension" of the phone system. Some people have cellular radio but this is exclusively used by those people who truly are away from their desks.

This view is basically correct as an understanding of how telecommunications services are now delivered and will be delivered in the near future. But with the appearance of new technologies and the changing policies of regulators, the simple model of particular services being provided by particular companies through particular technologies may no longer explain the telecommunications industry.

Reducing entry barriers through regulatory action and technological advancement have meant increasing the number of competitors providing a particular service but also allowing different technologies to compete in providing a particular local loop service. Already LECs are providing competitive cellular telephone voice services in competition to their own traditional twisted pair voice services.

What will be interesting are the directions that RBOCs, cable companies, ALTs (alternative local telephone suppliers), IXCs, wireless (cellular and in the future PCS/PCN) providers will take through head-to-head competition, acquisitions, mergers, joint collaboration and influencing the regulatory process. To some extent, the current moves predict the directions that some of these players intend to take. A number of general factors are causing the traditional telecommunications market to be dynamic and fluid. In the first place, it is unclear which technologies will prove to be the better way to provide a service. To hedge their bets, companies are becoming involved in many different technologies. Second, businesses engage in strategic alliances in order to take advantage of a partner's technical expertise, financial or political capital, goodwill or because the businesses and technologies of the respective partners have synergistic benefits. There are four interesting sets of providers which can provide alternatives to the current local loop: the ALTs (alternative local telecommunications), the cellular and PCN/PCS providers, cable TV companies, and IXCs.

The ALTs (for example, Metropolitan Fiber Systems and Teleport) have moved into the provision of bypass service because of the opportunities of economic and uneconomic bypass. In most cases, the ALTs use fiber optics although a few companies like LOCATE use microwave technology. The early success of the ALTs was through providing more secure, or cheaper, or more responsive services than could be provided by the local telephone service. The ALTs can provide these services more cheaply because the LEC does not always provide cost-based services. This means that some services provided by the LECs are above costs (urban, business services) so that other services can be provided below their costs (rural, residential service). The ALTs select the highly profitable urban and business routes and can easily undercut the more expensive LEC prices. The ALTs are also able to bypass

the LECs economically. A report by Donaldson, Lufkin & Jenrette indicates that the LECs have a higher cost structure than do the ALTs.[53]

This means that even if the tariffs were based on costs and all cross-subsidies were removed, the LEC costs would still be higher than the ALT costs for specific routes and there would be economic bypass. Finally, the ALTs have also had success because of noneconomic bypass services. While the early success of ALTs can be attributed to price advantage, either through economic or uneconomic bypass, the industry is now focusing upon service. While price is an important consideration in selecting a telecommunications provider, high volume users are looking for reliable and quality service. With the recent increase in service interruptions (one outage every other day as reported by the FCC's Network Reliability Council), many are looking for an alternative provider as insurance against a telecommunications breakdown. Quality of service also means providing services that match user needs. Some businesses do not have a need, for example, for a DS-1 connection, even though in some cases, that might be the only way that data communications services are offered by a LEC. "Service" also includes responding to a service request in a short period of time or providing support services like remote data backup as one complete package.

Although the industry is young and there are new entrants every day, there are approximately twenty ALTs. There are two major ALTs providers, Metropolitan Fiber Systems and Teleport. According to the FCC's Fiber Deployment Update, End of Year, 1991, MFS has about 273 sheath miles of fiber connecting 629 buildings and 3,489 customer locations. Teleport has 485 sheath miles connecting 511 buildings and 1,295 customer locations. Most of the mileage accumulated by the ALTs has been in high-density downtown business areas. Almost all of the ALTs are privately held so it is difficult to know what their revenues are and whether they are making a profit, but it seems reasonable to estimate that the entire industry has revenues of between $100

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[53] Joel Gross and Suzanne Becker, *Local Telephone Competition Intensifies as Strategic Competitors Converge: Could This Become the Telephone Company's Nightmare?* (Donaldson, Lufkin, & Jenrette, May 18, 1992). According to this report, "the typical ALT has about 2 to 4 employees per 10,000 access lines whereas the typical large telco has about 40 employees per 10,000 access lines" p. 28.

million and $200 million. This is incredibly small when compared with the $200 billion local service market. Although the subject of much speculation, ALTs are now targeting for eventually obtaining 1-2 percent of the $200 billion market for the near term.

But ALTs are not the only providers putting in fiber optics. Cable companies are installing fiber optics into their systems as a way to improve signal quality, increase channel capacity, especially for the bandwidth requirements of high definition television (HDTV), and the ability to provide new services like interactive television. One investment bank report suggests that the incremental cost to their fiber networks in providing two-way switched services (for example, voice, data and video) is relatively small-about 20-30 percent.[54] Suddenly the cable companies are in potential competition with the telephone companies.

To take advantage of these new opportunities in voice and data, the cable companies will have to face obstacles: improving rapport with their customers, establishing credibility for quality and reliability (cable companies have also had their share of failures), and learning the switching function. One solution by the cable companies has been to join up with an ALT so they obtain access to telecommunications expertise, switching and customer credibility as a telecommunications provider. In return, the ALT obtains access to the large fiber distribution network deployed throughout the suburbs that can be linked to its urban fiber system and switching facilities. Cable companies are seeing the opportunities and starting to make the investments; for example, Teleport, the second largest ALT is now jointly owned by Cox enterprises (50.1 percent) and Tele-Communications Inc. (49.1 percent).

Another competitor to the traditional LEC provision of services is "wireless" communications: cellular telephone and PCS/PCN. In the U.S., "wireless" telecommunications offers a viable technical alternative to the traditional twisted pair delivery of voice services. Today, wireless services are delivered via "cellular telephone services" as opposed to the microcellular services delivered by PCS and

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[54] Ibid., p. 3.

PCN. Cellular penetration in the US is currently low, only about 3 percent in 1991 with 7.5 million users and a revenue of $5.7 billion. Yet, this figure reflects a 35-45 percent growth over 1990. A Smith Barney, Harris and Upham Report predict that longer term, total penetration in the US will be around 7-8 percent by the mid-90s and 14-16 percent by the beginning of the 20th century. This would mean that 45 million people would be using cellular services by end of this century with revenues between $33 billion and $55 billion, although only a small percentage of these may abandon their existing landline connection.[55]

Wireless communications are more advanced in Europe. Sweden has a mobile telephone penetration rate of 7 percent with more than half of all new connection requests for mobile instead of fixed lines.[56] The United Kingdom is considered the leader in PCS/PCN technology with three companies currently building PCS/PCN networks. The cost of mobile telephone in these countries is falling due to decreases in service prices and equipment costs. Although the United States has not yet allocated spectrum for PCS, the FCC has issued 50 experimental licenses to RBOCs, non-wire line cellular service providers, manufacturers, cable companies, and various start-up companies.

Several large cable TV companies are already large cellular operators. They are also becoming involved in the new PCS technologies. A significant percentage of the PCS licenses from the FCC are for cable companies. As explained in the technology section, PCS uses lower power and smaller cells than traditional cellular telephony. To connect the thousands of transmitters that might populate a city, some kind of backbone network is needed. For example, Cox is presently conducting an experiment with a wireless telephone system in California that uses its cable network to connect radio antennae.[57] Here, the cable companies as well as the RBOCs see potential synergies with their present installed networks. Recalling the main point

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[55] Theodore S. Rappaport, "Wireless Personal Communications: Trends and Challenges," *IEEE Antennas and Propagation* 33, no. 5 (October 1991), p. 19.

[56] "Mobile Telephones: A Way of Life," *The Economist* (May 30, 1992), p. 19.

[57] Edmund Andrews, "The Local Call Goes Up for Grabs," *New York Times* (December 29, 1991), p. B-1.

that the new era of local telephone service also includes competition among services. AT&T has just introduced "virtual mobility" by which the customer punches in his location to tell the network where he can be found.

Long-distance carriers are increasingly becoming another player in the local loop, as evidenced by the Sprint-United merger. Recently, Sprint has also offered to buy Centel as a means to obtain increased traffic.[58] IXCs are also bypassing LECs to avoid access charges. Currently, access charges paid to the LECs for originating or terminating a call are the IXC's highest cost items. Even if IXCs do not become financially involved with ALTs, they still benefit through the competition that would result in lower access charges. Finally, by becoming associated with an ALT, the partnership offers a customer one-stop shopping.

The LECs and independent telephone companies have also been carrying on their own efforts at modernization. The LECs have been busy installing fiber rings in major cities around the country. The FCC's 1992 Fiber Update Report indicated that the RBOCs, GTE and United Telephone had deployed about 160,000 miles of fiber. This compares with the 2,071 miles of fiber installed by the twenty-odd ALTs. They have also been busy engaging in various experiments in deploying fiber-to-the-curb and fiber-to-the-home.

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[58] "The Loneliness of the Long-Distance Telephone Company, *The Economist* (June 6, 1992), p. 73.

CHAPTER 3

POLICY ISSUES AFFECTING LOCAL LOOP COMPETITION

Local loop competition is not simply a question of technical capability. Fiber optic facilities, coaxial cable, the air waves, and, of course, copper wire are all capable of carrying voice and data traffic to customer premises from a switch. There are important considerations beyond the technical which must be addressed in a discussion of local loop competition.

The local loop is, in many ways, the symbol of universal service in this country. The concept of an affordable, widely available link to the public switched network has been at the heart of the regulatory policy which stresses monopoly services, cross subsidization, and geographical averaging of rates. It is impossible to consider all the implications of local loop competition without addressing the concept of universal service.

It is also important to analyze such issues as cost-based pricing, the tension between competition and monopoly, federal preemption, and the impetus for bypass in order to understand the incursions of competition into the local services area.

Regulators must also look at some relatively new issues of concern: the impact of these new technologies on the NANP, the ability to maintain jurisdictional separations in an era of local loop competition, and the optimal method for instituting interconnection to the public network in the telephone company class 5 office.

The Fundamental Policy of Universal Service

"Universal service" is the central goal of national communications policy. Specifically, the Communications Act envisions the regulation of:

> interstate and foreign commerce in communication...so as to make available, *so far as possible, to all the people of the United States a rapid, efficient, nationwide, and worldwide*...communication service with *adequate*

facilities at *reasonable charges*...for the purpose of promoting safety of life and property through the use of...communication. (emphasis added).[1]

Pursuing universal service has a number of benefits. The communications network, for one, keeps and binds a society together.[2] Subsidizing the connection of users to the network also captures positive network externalities.[3] Each individual customer only considers his or her own costs and benefits when making the decision to subscribe to service but prospective employers and business also benefit through having the ability to reach that individual. Concerns for equity are another consideration. While there have been increases in local service rates, there are several programs specifically designed to ensure universal service: Lifeline Service, Link-Up America, and others. Finally, investments in telecommunications contribute to productivity[4] and are important to regional economic development. Adequate telecommunications services helps ensure that commerce in all regions can proceed smoothly.[5]

The FCC and state PUCs have attempted to foster the widest penetration of telephone service by ameliorating geographic, economic and technical barriers to that

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[1] 47 USC Section 151.

[2] Herbert S. Dordick, "Toward a Universal Definition of Universal Service," in *Universal Telephone Service* (Queenstown, Md.: Institute for Information Studies, 1991), pp. 109-39.

[3] National Telecommunications and Information Administration, U.S. Department of Commerce, *The NTIA Infrastructure Report: Telecommunications in the Age of Information* (Washington, D.C.: NTIA, 1991); M. Bridger Mitchell and Ingo Vogelsang, *Telecommunications Pricing: Theory and Practice* (New York: Cambridge University Press, 1991).

[4] DRI, *The Contribution of Telecommunications Infrastructure to Aggregate and Sectoral Efficiency* (New York: McGraw-Hill, 1991).

[5] One of the important areas of concern has been the rural areas because of their relatively high cost in providing telephone service. Under Section 201 of the Rural Electrification Act, telephone service is to be made available to the widest practical number of rural users without regard to their geographic location through the granting of loans.

development through cost support funds, average rates and service area obligations.[6] Over the last 60 years, as state commissions and the FCC have pursued the goal of achieving universal service, a complex system of cross-subsidies has grown which has enabled high-cost users like rural and residential users to be subsidized by lower-cost business and urban users. Only recently has the process of dismantling this complex system begun. With the break-up of the seamless telephone system and the increasing replacement of tariff regulation by competition as the preferred means to regulate industry, these cross-subsidies and, consequently, universal service itself could be under threat. Cross-subsidies are at the heart of some of the more difficult problems in telecommunications. As one commentator noted:

> [C]ross subsidization is probably the most fundamental problem in telecommunications policy for, if it did not exist, one seriously could entertain the notion that the entire field [should] be opened to competition.[7]

Cast in this light, introducing full competition into the telephone network can be seen to be in direct conflict with cross-subsidization and the provision of universal service.

The questions surrounding cross-subsidization and affordability are complex, but the basic structure of universal service is relatively simple. In simplest terms, universal service implies that any customer desiring telephone service will be provided, at reasonable rates and on a nondiscriminatory basis, a loop connection to a class 5 switch and a telephone number (or electronic address on the public switched network).

With a local loop connection to a switching office and with a telephone number, a customer can reach anyone on the public network and be reached by anyone else. There are several implications from this simple arrangement. One is

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[6] W.G. Lavey, "Universal Telecommunications Infrastructure for Information Services," *Federal Communications Law Journal* 42 (2) 1990: pp. 151-190.

[7] Leland Johnson, "Boundaries to Monopoly and Regulation in Modern Telecommunications," in *Communications for Tomorrow: Policy Perspectives for the 1980s,* Glen O. Robinson, ed. (Praeger: New York 1978).

that, in order for there to be universal service, a loop, or some equivalent of a loop, must run past every household and business in this country. It is the loop that connects the customer to the rest of the world in this scenario. Further, there is the implication that, in order to have universal service, all customers will be provided affordable access to the loop, and the class 5 connection and telephone number that come with it.

The assumption of affordability is at the heart of the cross-subsidies inherent in telephone service pricing. In rural areas, loops tend to be longer -- and therefore costlier -- than loops in urban areas. Moreover, there are fewer customers in rural areas to bear the cost of long loops and class 5 offices. Without some form of averaging, rural rates could increase beyond the level of "affordability."

As discussed later in this study, the increasing trend toward competition is eating into the system of cross-subsidies which have made averaged, affordable rates possible. The result is an increasing pressure on local rates to reflect their underlying costs, without benefit of subsidies from other services.

The Tension Between Competition and Monopoly

One of the main tensions underlying whether and how competition is introduced into the local loop is between competition and monopoly. The growth of the telephone industry has been influenced by wide pendulum swings in market structure, each of which have left an impression on how the industry has developed. A brief history is included here so that the reader can review how regulators and policy makers have attempted to receive the competing benefits and costs of competition and regulation.

The history of U.S. telephony has gone through phases of competition and monopoly. In its infancy, the industry was marked by competition; in its second phase, telephony turned to monopoly; now, in its current phase, the industry is moving back toward competition. This next section will briefly trace the history of this pendular swing between competition and monopoly, searching for lessons which can

be applied to the current situation in which new technologies are presenting challengers to the local loop.

There are various historical interpretations of the benefits of competition and monopoly in furthering universal service.[8] Proponents argue that it is only through regulation of natural monopolies that it is possible to obtain the means to cross-subsidize relatively inexpensive services with relatively high cost telephone service. Proponents of competition, meanwhile, argue that monopolies are inefficient and slow to introduce innovative new services and that costs and prices under monopoly will not be as low as they could be under competition.

The history of the telephone begins in 1876, when Alexander Graham Bell obtained his patents on the telephone. Within one year, commercial telephone service began in Boston and telephone service rapidly spread. Within a few years, states began regulating services and rates and by 1910, almost all of the states had some form of regulation.

In 1894 the Bell System had lost its patents. Thousands of independent companies entered into the business leading to intense competition with what was thought to be a natural monopoly industry. Pressler (1988) argues that much early legislation was intended to encourage consolidation by eliminating entry of competitors and eradicating wasteful and inefficient resource allocation. He also notes that this early legislation contained the germ of the universal service concept where telephone service had to be offered at low rates even if the rates were below the costs of providing service. At the same time that states and cities were regulating telephone service, many small telephone companies were set up in rural areas, although a few competed with Bell Telephone in the urban areas. As a consequence, service spread from the concentrated urban areas to more rural areas. According to the National

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[8] See, for example, Gerald Brock's procompetition history in contrast to Pressler and Schieffer's history of destructive competition. Gerald Brock, *The Telecommunications Industry* (Cambridge, Mass.: Harvard University Press, 1981); and Sen. Larry Pressler and Kevin F. Schieffer, "A Proposal for Universal Telecommunications Service," *Federal Communications Law Journal* 40 (3): pp. 351-375 (1988). See also U.S. Department of Commerce, National Telecommunications and Information Administration, *The NTIA Infrastructure Report: Telecommunications in the Age of Information* (Washington, D.C.: NTIA, 1991).

Telecommunications Information Agency (NTIA), at this time, "the actual achievement of universal service goals, ...was advancing much more rapidly under competition than it ever had under monopoly[9] Both competition and regulation sat side-by-side at this point. It is somewhat difficult, therefore, to isolate the contribution of competition or regulation to the dramatic growth in telephone service.

By 1910 AT&T had become a monopoly again through the continued acquisition of independent telephone companies. Congress responded by placing AT&T under the jurisdiction of the Interstate Commerce Commission. The Justice Department also became interested in the AT&T monopoly and exacted the Kingsbury Commitment in 1913 which required AT&T to ask approval of the Department of Justice (DOJ) before purchasing any more businesses and to interconnect the independent phone companies which met the appropriate technical standards. Between the Kingsbury Agreement in 1913 and the Willis-Graham Act in 1921, the Justice Department approved most of AT&T's acquisition requests. The Willis-Graham Act specifically overrode the Kingsbury Commitments and encouraged consolidation because a regulated monopoly was felt to be far better than destructive competition.[10]

In 1934, the Congress created the FCC under the Communications Act because of dissatisfaction with the Interstate Commerce Commission's poor oversight over the industry. During the next three decades, the FCC oversaw the creation of an integrated telephone network dominated by the AT&T system. AT&T was encouraged to build a monopoly over local exchange facilities, toll services and equipment. A vast system of cross-subsidies among these core areas developed with universal service as the central regulatory principle.

As the system of cross-subsidies and regulations was being built, there were several attempts at dismantling it. In the 1940s, a few private companies tried to use the new World War II microwave technologies to set up private communications systems to meet their internal needs. These efforts were unsuccessful because of

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[9] *The NTIA Infrastructure Report*, p. 289.

[10] Pressler and Schieffer, "A Proposal," p. 358.

failures to obtain regulatory approval.[11] By the 1950s, railroads, CATV, state governments, and rural broadcasters in remote areas not served by common carriers were able to set up their own microwave facilities. Licenses, however, were always under the threat of nonrenewal. A general policy was sought on access to the radio frequencies to develop microwave services. Meanwhile, the common carriers made the first bypass arguments against the requests by claiming that the new services would amount to "cream skimming" because smaller users would be burdened with higher rates since the fixed investment costs would be distributed over a smaller number of customers and revenues would be lower. The FCC, however, saw a need for private services and in 1959, In *re Allocations of Microwave Frequencies Above 890 MHz*, it authorized private ownership and operation of microwave transmission facilities. The rule was limited to private point-to-point communications.

In 1963, MCI filed applications to supply point-to-point specialized intercity common carrier service between Chicago and St. Louis. Again, the common carriers made the bypass arguments: (1) that the common carriers could provide the service more economically than MCI; (2) that MCI's microwave systems would be duplicative and a wasteful use of spectrum and (3) that MCI would "cream skim" since the company did not have any general service obligations and would select the most profitable routes. The FCC approved MCI's request, stating that there was a need for cheap microwave service. Within the next twelve months, thirty-seven more applications for providing specialized common carrier service were filed and the FCC made the logic behind the MCI proceeding a general policy in *Specialized Common Carrier.*[12] Competition was also introduced at this time into the customer equipment

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[11] W.G. Bolter, J.W. McConnaughey, and F.J. Lelsey, *Telecommunications Policy for the 1990s and Beyond* (Armonk, N.Y.: M.E. Sharpe, Inc., 1990).

[12] Competition for Specialized Common Carrier Services, 29 FCC2d 870, 22 R.R.2d 1501, *recon. denied* 31 FCC2d 1106, 23 R.R. 1501 (1971), *aff'd sub nom. Washington Utilities & Transportation Commission* v. *FCC,* 513 F.2d 1142 (9th Cir.).

market. In 1968 in the *Carterfone Decision*[13] the FCC allowed the attachment of customer-provided equipment to the network.

What is interesting is that the introduction of competition into the intercity and CPE markets occurred in an incremental fashion. With the *Carterfone* and *Specialized Common Carrier* rules, the FCC did not establish clear guidelines on how new policies should be implemented. The FCC left such specifics as prices, terms, and conditions to be worked out in the "free market." This incremental approach to policy making left many players in the field uncertain of its future directions during the 1960s and early 1970s.[14] This same incremental approach is being repeated in the FCC's attempt to introduce competition into the local loop in its special access and switched access interconnection proceedings.

The uncertainty was exacerbated by the failure of Congress to lay out specifics on the relationship between competition and regulation. As a result, the DOJ filed a second suit against AT&T. The DOJ had filed its first antitrust suit against AT&T in 1949 but was largely unsuccessful in its attempt to break up the system and divest AT&T of its equipment manufacturing business. In 1956, the DOJ settled this first suit with AT&T by limiting AT&T's activities to regulated services. This outcome did not cause AT&T to divest itself of its manufacturing business which had benefited from a unique set of interlocking subsidization policies. The second suit was filed in 1974 and averred that AT&T and its subsidiaries conspired to monopolize the three major domestic telecommunications markets: intercity telecommunications services, CPE, and telecommunications equipment.

The second suit against AT&T was successful. AT&T had to divest itself of its "bottleneck" local exchange facilities. These facilities were given to the BOCs. The BOCs, meanwhile, could not provide interexchange (interLATA) or information

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[13] Re *Use of the Carterfone Device in Message Toll Telephone Service,* 13 FCC 2d 430 (1968), *recon. denied*, 14 FCC 2d 571 (1968).

[14] Pressler and Schieffer, "A Proposal," p. 363. For an early example of how many of these policy decisions were worked out in the courts, see the *Execunet* decisions: Re *MCI Telecommunications Corp.,* 60 FCC2d 25 (1976), *rev'd*, 561 F.2d 365 (D.C. Cir. 1977). *cert denied sub nom. U.S. Independent Telephone Association* v. *FCC,* 434 U.S. 1040 (1978).

services. The BOCs were also prohibited from manufacturing and from engaging in electronic publishing.

In essence, the AT&T consent decree represents a conflict between the Communications Act (with its history of regulation and cross-subsidization) and the Sherman Act's emphasis on competition. To the extent that competition can be used in the service of promoting the goals of universal service under the Communications Act, the conflict is easily resolved. Where, however, the two acts disagree so that competition and universal service are at odds, it may be more difficult to resolve which should have precedence. In the AT&T case, although there are strong arguments to the contrary, it was argued and accepted that competition could serve universal service in the long distance and CPE markets.

The results of *Carterfone*, MCI's *Execunet* lawsuits, and the Modification of Final Judgment have introduced competition into the CPE market and the long distance arena. The facilities owned by the local exchange industry -- notably the local loop and the class 5 office -- still represent a bottleneck. Local exchange carriers still function as the gatekeepers for most of the traffic which traverses the public switched network.

The impetus of competition which has changed the CPE and long distance markets has not stopped at the local loop and the class 5 office. And the lessons learned from the introduction of competition are now being applied at the local loop level. Just as CPE competition depended upon the ability to interconnect equipment to the public network through a modular jack, so does local loop competition depend upon the ability of an alternative local service provider to connect to the LEC class 5 office through a port connection. Much of CPE competition was based on additional services not immediately available from the LEC-provided CPE. Local loop competition is also based on additional services, services based on technological developments. Wireless services (cellular and PCS) provide portability which wire loops cannot provide. Fiber optic facilities, and to some extent coaxial facilities, offer broader bandwidth than copper loops, thus providing a broader range of data and video services.

The old telephone network provided a seamless service largely because the flexibility did not exist to break the network into pieces very efficiently. The advent of competitive use of microwave technology drove one wedge into the network. The development of Part 68 and modular connections for CPE was another wedge. The development of sophisticated software and digital switches has made it possible to break the network down into even more parts, as the introduction of equal access in the long distance market has so graphically shown. The LEC switch, through its software, is able to recognize and route traffic to a host of long distance carriers. That same switch will be able to recognize a variety of local service providers at the loop level as well as alternative providers like Teleport, or a cable company seeking interconnection at the LEC switch.

The LEC bottleneck is slowly being eroded. Through the development of new technologies which can function as an alternative to the local loop (wireless technologies for example); through the efforts of alternative service providers (such as Teleport and Metropolitan Fiber Service) to be collocated in the LEC class 5 office; and through policies like ONA (which mandate generous interconnection) inroads are being made into the local exchange bottleneck.

Bypass

One possible threat to the universal service provided by the ubiquitous presence of affordable local loops is the temptation to bypass the public network in order to obtain lower cost services or improved services from alternative vendors. The dynamic is simple. The public network has developed a system of cross-subsidies designed to lower costs for some users to promote universal service. At the same time these cross-subsidies have made service relatively more expensive for urban and business users than if they were not subsidizing the rural and residential user. When these users recognize that there are other firms willing to provide a cheaper alternative to the public network because the cross-subsidies do not have to be paid, these users bypass the public network for the cheaper alternative.

This bypass can occur because of costs or because of nonprice factors such as service quality, reliability, system features, availability, flexibility, and generally responsiveness to client needs.[15] Assuming that prices are based on costs (no cross-subsidies are included) "economic bypass" occurs where the costs of the alternative service are cheaper than the costs of buying the service from the public network provider. "Uneconomic bypass" occurs when prices are not based on costs. In this instance, the alternative provider can provide the service for less than the public network provider can because the public network provider has to absorb the costs of subsidization as well as the direct costs of providing the service. Most studies which have investigated the propensity to bypass have found that both cost (economic and uneconomic bypass) and noncost items are responsible for decisions by firms to bypass the network.[16] This suggests that LECs have more control over the bypass threat than might be first imagined. While LECs may have the added costs associated with wide service area obligations and their attendant subsidies, LECs do have control over quality and reliability of service.

LECs and regulators may also have more flexibility than it appears at first glance with regard to economic and uneconomic bypass. It may be difficult for regulators to fashion policy based on true economic costs because it is hard to distinguish between economic and uneconomic bypass.[17] The major problem is in the assignment of joint and common costs to a specific service, which often is arbitrary and far from accurate in determining "true" economic costs.

Measures to control bypass must also take into account the bypass methods used. "Facilities bypass" can occur when customers use non-LEC facilities to circumvent the local public network. In some cases, one alternate services telco could be offering services that are in direct competition to those provided by the local LEC. "Service bypass" occurs when the LEC provides flat-rated, or "special access," to switching facilities. The prices charged for these special access facilities do not make

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[15] Bolter, and others, *Telecommunications Policy for the 1990s and Beyond.*

[16] Ibid.

[17] Ibid.

the same amount of contribution to defraying the costs of the public network as do the switched access prices. It may be difficult for LECs to justify measures to prevent bypass when LECs themselves are involved in facilities bypass and service bypass activities.

States may have limited powers to prevent bypass because their actions might be preempted by federal law. The Communications Act talks about both a state and a federal role in the regulation of communications but this sharing of power is not clearly spelled out in either the Act or in case law interpreting it. As a result, the respective roles of the states and the federal government are unclear. In the latest round of preemption cases, the *ARCO* ruling permitted users to interconnect their private systems to the local exchange of their choice if the action can be demonstrated to be "privately beneficial without being publicly detrimental."[18] (See preemption section). The obvious implication of this ruling for state regulators is a very tough standard should they decide to place legislative restrictions on interconnections which bypass the public network.

The issue of bypass has serious implications for the local loop and for the continuation of universal service. There are lessons to be learned from existing bypass situations. In some cases of bypass, customers are looking for services not available from the public network provider. Many bypassers of the public switched network were looking for special data networking features.

At the local loop level, emerging technologies will have a major impact on local loop bypass. One technology that immediately emerges in any discussion of local loop competition is fiber optics. If LECs are not able to provide fiber to the home, or to the office, alternative providers are poised to come forward to fill that void. Cable companies who are planning to replace their existing coaxial cable with fiber will be able to enter, or at least pass, most homes in America. Teleport, which already has fiber rings around major metropolitan areas, has the ability to provide the loop connections between businesses and the LEC central office.

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[18] In Re *Atlantic Richfield Co.,* 3 FCC Rcd 3089 (1988), *aff'd sub nom., Public Utility Commission of Texas* v. *FCC,* 866 F.2d 1325, 1335 (D.C. Cir. 1989).

Cable companies and alternative access providers such as Teleport are much like MCI and Sprint. Just as MCI and Sprint offered a facilities bypass of the AT&T long distance network, so do Teleport and the cable providers offer a means of facilities bypass for the local loop. And just as MCI and Sprint garnered methods of interconnecting with the public network in order to compete with AT&T, so will these alternative providers ask for, and receive, interconnection to the public network from the loop side of the central office. Such interconnection will be occurring in some states, as discussed later in this study.

If LECs will be forced to offer interconnection to those engaged in facilities bypass, it is interesting to speculate on how they will react to service bypassers of the local loop. In effect, those who order T1 (or even T3) facilities between their premise and the LEC central office already practice service bypass. Instead of paying for 24 lines or 672 lines, these customers pay for T1 (24-voice grade circuits) or for T3 (672-voice grade circuits) at a total rate much lower than they would pay for individual lines. In either case, total revenue to the LEC is reduced.

In the case of facilities bypass, the LECs -- and the regulators -- must determine how best to price interconnection so that the interests of competition are served as well as the interests of universal service. In the case of service bypass, this same challenge must be faced as well.

Bypass can be regarded from two different perspectives. From a pro-competitive standpoint, it is the customer seeking to maximize his or her economic well being. The customer seeks the lowest price, and that price may often be offered by an alternative provider who does not have to worry about cross-subsidies. From a LEC perspective, bypass causes stranded investment and skims the cream off the public network, leaving a smaller number of subscribers behind to bear the costs of supporting the network. The ultimate result of such cream skimming, it is feared, may be damage to universal service.

The issue of local loop bypass will become more important for policy makers as technologies develop which make bypass more attractive and much easier to accomplish.

Responses to Bypass

One solution to prevent bypass is to "carve up" the telephone network so that there is a clean boundary insulating universal services from competitive services. In the period immediately following the consent decree, services were divided between the competitively provided CPE and long-distance market and the universal local telephone service. Access charges of long distance service ensured that local service rates could be kept low. But just as the powerful combination of new technology and a competitive ideology broke up the AT&T system, new technologies are now appearing which will make it possible to introduce competition at the local loop. It may be difficult to find a clean division of responsibility between competitively provided services and regulated services to insure universal service. The difficulty is that there will always be a complex system of cross-subsidies within the regulated services which seeks to provide universal service. This complex system of cross-subsidies makes it easy for competitors to find uneconomic bypass opportunities in addition to the economic bypass opportunities that might be found in a regulated system not exposed to pressures to keep costs down.

Another response to bypass, at least at the long distance level, has been to reprice telephone service so that bypass appears to be a less attractive alternative. An example of such an approach can be seen in access charges. In an effort to encourage interexchange carriers to stay on the network, the FCC, in its access charge scheme, shifted a large percentage of local loop costs allocated to the interstate jurisdiction away from interexchange carriers to the subscriber. As a result, subscribers pay a subscriber line charge so that interexchange carriers pay lower carrier common line charges for use of the LECs' local loop facilities.

The FCC and many state commissions have granted LECs greater flexibility in repricing services in order to combat bypass. Streamlined tariff proceedings allow LECs to respond to changing market conditions quickly and without having to complete lengthy tariff filings.

The problem that will be faced by LECs, and by those who regulate them, is that pricing the local loop to avoid local loop bypass is not a clear-cut process. The

LEC-provided local loop has always been used for a variety of services: local, extended area service, intraLATA toll, interLATA toll, switched access. The pricing of these services has contained cross-subsidies designed to keep local rates low. To facilitate competition for toll and switched access services, pricing has been adjusted, resulting in an increased burden on local ratepayers. Indeed, regulators have had to develop social programs (for example, Link-Up America, which is discussed in greater detail below) to assure that affordable rates, and so universal service, would be preserved despite these pricing adjustments. Now that a variety of competitors may be emerging who will be able to provide the last mile (or local loop) and whose loop will also be used for a variety of services (toll, access, and so forth) the picture becomes even murkier for regulators.

Regulators may be forced to develop more social programs as LECs strive to keep customers on the network. It is difficult to envision how a LEC, which has an obligation to serve all customers in its franchise, can compete with a PCS provider who can pick and choose. When the technological advantages (that is, portability) of PCS are added to an alternate provider's potential pricing advantages, the LEC's ability to compete is placed in even more question.

Social Tariffs

After the divestiture of AT&T, three programs were established to offset the increases in local telephone costs: (1) Lifeline Rates; (2) Link-Up America and, (3) the Universal Service Fund.[19] All of these programs were designed with the assumption that all local loop plant would be provided by LECs. Local loop competition was not envisioned, and the effect of such competition on these plans is not totally clear.

The Lifeline Program was started in 1985; its primary goal is to lower the cost of basic telephone service. In states with FCC-certified telephone rate discount programs, the FCC matches the monthly state-provided discounts to qualified

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[19] Mitchell, and Vogelsang, *Telecommunications Pricing.*

subscribers (limited, however, so that the total federal subsidy per line does not exceed the amount of the federal mandated subscriber line charge). The Lifeline Program includes a waiver of the federal subscriber line charge, plus a reduction of at least a comparable amount in local charges of some type.

The second program, Link-Up America, was started in 1987; its goal is to reduce the costs of connecting to the network. Under this program, funds from interexchange carriers pay for one-half of the connection charges for qualified new subscribers (up to $30) and pay the interest associated with payment plans (for new service) implemented by certified states. The contribution will cover the interest accruing on service-establishment costs (up to $200) when they are included in a deferred payment plan. No matching state contribution is required; as a consequence, the "link-up" program has been adopted by more states than the lifeline program. This program, because it focuses on reducing barriers to establishing local telephone service, may be a more powerful tool for fostering universal service than the Lifeline program.

Finally, there is the Universal Service Fund which was started in 1986 to subsidize the costs of high-cost LECs, typically, small independent telephone companies. Under this plan, telephone companies with especially high local loop costs receive larger subsidies from interstate services, but they receive these through the fund instead of through higher access rates. If these high-cost companies had to file appreciably higher access rates, they would encourage long distance companies to deaverage their rates or to bypass these companies totally.

In opening up the local loop to competition, one question to be answered is what will happen to the universal service programs? Who will pay for these programs? Will alternative local loop providers also be eligible for them? If not, then universal service and the social programs associated with universal service will be seen as the exclusive purview of LECs. If alternatives to the LEC loop offer richer features, will the poor be precluded from enjoying those features because no lifeline programs are in place for them? Should alternative providers be asked to contribute

toward such social programs? New York's interconnection order[20] makes provision for alternative access providers who offer trunk-side interconnection to pay Universal Service Elements to make a contribution toward the preservation of affordable basic service, but it is unclear how well this system will run as the number and types of competitors increase. It is also not clear whether alternative providers of line-side service will also be asked to pay Universal Service Elements. If the local loop is being subsidized, why should an alternative local loop provider pay a subsidy?

Historically, universal service in this country has been fostered by a variety of subsidies and social programs the costs of which have been spread over many services and service providers. For example, telephone services help defray the costs of providing hearing-aid compatible equipment and a TTY network for the hearing impaired. The advent of local loop competition may put greater pressure on regulators to ensure that LECs are not placed at a competitive disadvantage by having to provide all of the subsidies and social programs themselves.

Telephone Penetration Levels and Universal Service

Traditional measures of universal service indicate that since divestiture, access to basic telephone service has increased, thus implying that competitively provided telephone service supplemented with social tariffs has not threatened universal service.[21] Some have even argued that universal service is now a reality. Between 1984 and 1990, the number of households with a telephone has increased from 91.6 percent to 93.3 percent.[22]

But while telephone penetration has increased in this period of competition it still means that 6.7 percent of households are not served. In a nation of 240 million this percentage translates to millions of people without a telephone. Against which

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[20] State of New York Public Service Commission, Order Regarding OTIS II Compliance Filing, May 8, 1991.

[21] NTIA, *The NTIA Infrastructure Report.*

[22] Industry Analysis Division, Common Carrier Bureau, FCC, "Telephone Subscribership in the United States," February 11, 1991, Table 2, cited in Ibid., p. 295.

set of expectations should these figures be compared? 93 percent or 100 percent? Another set of statistics helps gain additional insight. Although the statistics are not directly comparable, OECD statistics on U.S. telephone penetration indicate that the U.S. figure of 65 telephones per 100 is high compared to Japan's 53.5 but is easily dwarfed by Sweden's 89 and Switzerland's 133 telephones per 100 individuals.[23] These alternative views of telephone penetration indicate that it is not so clear that universal service is a success since telephone service may not be as widely distributed "as possible" as called for in the Communications Act.

Upon closer inspection of these aggregate statistics it also becomes clear that penetration levels vary for different ages, income levels and ethnic backgrounds. Among the lowest 1990 penetration levels are those of African-Americans (66.4%) and Hispanic households (67.8%).[24]

Given these facts, policy makers who are interested in making sure that universal service remains the centerpiece of telephone regulation must examine whether and how universal service charges are to be provided in an era of competition or a mix of competition and regulation. A second concern is that these traditional indicators may give a sense of all is well, when in fact, the very notion of what is essential telecommunications services is undergoing rapid redefinition.

When competition comes to the local loop through a variety of sophisticated technologies, the very basis of universal service and connection to the public network (that is, the complex framework of pricing and subsidies) may no longer be viable. Policy makers may face greater demands to craft programs which will assure universal access to a wider range of services and technologies. The old definition of "plain old telephone service" may no longer be adequate to provide guidance in resolving these issues.

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[23] "Appendix: Basic Statistics: International Comparisons," *OECD Economic Surveys* (Paris: OECD, 1991).

[24] Common Carrier Bureau, Federal Communications Commission, "Telephone Subscribership in the United States," Table 2, cited in NTIA, *The NTIA Infrastructure Report*, p. 296.

The Changing Definitions of Universal Service

The concept of universal service was crafted and refined in a time when voice service was the principle concern of the telephone industry. It never made sense for the telephone industry to argue that they were really in the information distribution industry because providing telephone service was nearly the only service provided. Now, however, the situation is different. More and more of society's transactions are occurring through the telecommunications network and it is providing many voice services including caller identification, directory assistance, services for the disabled and non-English speakers, touch-tone services as well as emergency services, videotext service, data communications, and (possibly) even video programming. The question is whether universal service should be limited to the provision of cheap voice service?[25] Asking the same question from a technology instead of a services point of view, should the definition of universal services be expanded from delivering twisted pair to every household for a reasonable cost to one that includes fiber optic broadband networks, direct broadcast satellites, digital stored program control switching, Signaling System 7, and ISDN protocols and interfaces?[26]

Pressler and Schieffer argue that the Communications Act should be amended to reflect the changes in technology so that "universal telephone service" would become "universal telecommunications services" and include both basic telephone service and information-based service. Potentially, where critical information services are not universally available, the FCC would be delegated the power to encourage their widespread distribution. Difficulties with this approach include potential criticisms that the government should not enter the historically competitive

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[25] Herbert S. Dordick, "Toward a Universal Definition of Universal Service," in Universal Telephone Service (Institute for Information Studies, 1991) pp. 109-39; NTIA, *The NTIA Infrastructure Report*; Pressler and Schieffer, "A Proposal," pp. 351-75.

[26] Carl E. Hunt, *Defining and Costing POTS: A Common Carrier Approach Using the Joint Products Method* (Columbus, O.: The National Regulatory Research Institute, April 1992; and Patricia D. Kravtin, Lee L. Selwyn, and Paul S. Keller, *A Public Good/Private Good Framework for Identifying POTS Objectives for the Public Switched Network* (Columbus, O.: The National Regulatory Research Institute, October 1991).

information services industry to pick winners and losers; and, second, that the government should not get involved in the regulation of content because of First Amendment concerns.

Underlying this discussion is a tension between two key concepts: the obligation to serve, and the play of the free market. A basis for utility regulation has been that a utility receives a franchise in return for fulfilling its obligation to serve all willing and able customers. The various cross-subsidization schemes adopted by the industry have been in pursuit of fulfilling that goal through affordable services. That obligation to serve has been applied to basic telephone service. The approach to the deployment of information services has been through the free play of the market. Services are provided to those who are capable of paying. Providers concentrate on areas and customers who are most likely to want and afford the service. Pricing is based on underlying cost and market value. Cross-subsidization is not part of the approach. Business customers are not subsidizing residential customers; urban customers are not providing subsidies to rural areas through geographically averaged rates.

If the definition of universal service is extended to include information services, the basis for that deployment will be changed. And the nature of the service providers may be changed as well, with information service providers facing the prospect of regulation.

Lavey[27] argues that two different approaches should be taken to providing universal infrastructure and universal information services. Echoing the approach taken by the Computer Inquiries, Lavey argues that regulation and government loans should continue to insure that telecommunications infrastructure is available but that, for now, information services should be competitively provided. States and the federal government should monitor the availability of services should they not be widely available. However, just as the Computer Inquiries have not been workable due to the difficulty in clearly separating basic services from enhanced services, Lavey's

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[27] W.G. Lavey, "Universal Telecommunications Infrastructure for Information Services," *Federal Communications Law Journal* 42 (2) (1990): pp. 151-190.

approach may be caught up from the outset in trying to differentiate between a basic service and an information service.

The definition of basic service may also have an impact on the deployment of the various underlying loop technologies. If basic service continues to be defined as voice telephony, existing copper loops remain an attractive, affordable medium. Indeed, the attractiveness of PCS is enhanced as well, since PCS offers portability to voice services. If basic service is expanded to include more than voice telephony, fiber and its deployment take on a new importance.

The NTIA Infrastructure report[28] also addresses the question of what universal services should include. The centerpiece of the NTIA approach to universal service, "Advanced USA," is competition. The NTIA argues that it is through competition that basic service costs are reduced and that new players can enter the market and provide new telecommunications services. Competition insures that prices are based on costs. In the traditional economic approach, cost-based prices become a mechanism for assuring that resources are put to their highest and best use. A new advanced service, it is argued, should be included in the basic universal package if its inclusion means little or no identifiable separate cost. This insures that additional services are provided but not in a way that "distorts" the market. One example of this is the use of touch-tone service. NTIA argues that this service can now be provided to everyone at no additional cost. More than just a luxury item, touch-tone service allows access to advanced network features and information services. Their proposal would be to expand universal service to include access to emergency services, equal access to IXCs, and opportunities for the hearing impaired.

The NTIA report argues that in some cases, subsidization of low income users, rural users and people with disabilities is necessary. If there are subsidies, they should be specifically targeted to those who need them rather than having the broad subsidies of business to residential users and urban to rural. NTIA argues that having targeted subsidies will make them more effective and reduce waste.

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[28] NTIA, *The NTIA Infrastructure Report.*

The NTIA suggestion of targeted subsidies would replace a system of rate-supported subsidies with one of tax-supported contributions. In a time of anti-tax sentiment, it is unclear whether a system which explicitly taxes all citizens to support universal service, and other social goals, would meet with much favor.

The continuation of rate-supported subsidies poses some interesting questions, as well, in a time of increasing local loop competition. The major question is, of course, which service provider pays the subsidy, or builds a subsidy into its pricing scheme? If only the LEC is required to subsidize universal service, the concept of a level playing field in the local loop arena would be unattainable. If a local service provider in competition with a LEC is required to contribute to a universal service fund, that local loop competitor may lose a significant portion of its pricing advantage.

The Impact of Private Networks

The increasing number of private networks raises additional questions about the future of universal service. Noam argues that while the change from regulated provision of services to competitively provided service attracts media attention -- it is the quiet growth of "use privatization", the creation of private networks -- that raises far more difficult and complicated questions about preserving the ability to interconnect universally.[29] Private networks are growing at a rapid rate. Crandall notes that while in 1980, nearly 100 percent of telecommunications capital investment was in the public network, by 1986, this figure had dropped to 66 percent.[30]

Noam challenges the assumption that new telecommunications technology and the deregulation of communications will automatically lead to a "global village" with increased openness. He points out that networks are not simply technical systems but reflections of interrelations among various groups, organizations and individuals. With the privatization of networks, it is entirely possible that a federation of private

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[29] Eli M. Noam, "Private Networks and Public Objectives," in *Universal Telephone Service: Ready for the 21st Century?* (Queenstown, Md.: Aspen Institute, 1991).

[30] Robert W. Crandall, *Fragmentation of the Telephone Network: Implications for the Policy Maker* (Washington, D.C.: Brookings Institution, 1988).

networks could evolve which are merely electronic neighborhoods. Although they are private, these neighborhoods, like yesterday's company town or today's shopping mall, may be the new town square in which public discourse takes place. With their political power, these private networks may be able to admit and regulate users unregulated by public law. The serious danger is that the basic "right" we now take for granted in picking up the telephone and calling anyone in the country may no longer continue to be a viable right. While this scenario clearly has a dark "1984" quality, the discussion should not be framed as to whether communications will hasten us to a world of Big Brother but to what degree we make use of communications to fully enjoy our First Amendment rights. In an age of vigorous competition, it is the marginal differences in our economic and political systems to flexibly respond that may determine our ability to compete. If companies do not have the ability to connect easily with their suppliers and their customers and if citizens and interest groups are not fully aware of political developments because the communication system is not universally accessible, there is a question of how competitive our country will be.

Should private networks significantly take the place of public networks, there are a number of potential threats to communications that would have to be overcome:

1. Private networks may limit who can join a network.[31]

2. Private networks may limit the kinds of information that are allowed to travel on the network.[32]

3. Private networks may monitor or limit electronic mail messages with their resultant threats to privacy and the resulting chilling of communications.

4. Members may have limited abilities to appeal network management decisions to regulatory agencies.

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[31] Equal protection laws do not apply; discrimination laws do apply but their reach is uncertain and subject to political vicissitudes in how they are enforced.

[32] For example, videotext services like Prodigy.

5. Private networks may force standardization on users to contain costs. If members need to tailor the network for a specialized need it may be too costly because the network does not have economies of scope and scale.

6. Differing technical standards of multiple private networks may inhibit communications between members of different networks because it is not technically possible to make an easy connection in a relatively short period of time at low cost.[33]

Noam is not sure that private networks will be able to respond to all of these concerns and argues that there ought to be a "federal" presence by creating a "federation of private networks." The federal presence could felt by requiring that any private network that desires connection to the public network be required to afford some common carriage rights of way. Although what this obligation fully implies needs development, Noam suggests that we already have precedence for this idea in the requirement that cable franchisees are required to lease a percentage of their channels as access channels to "nonaffiliated persons" on a first-come, first serve basis on a reasonable cost basis without content restrictions.[34]

While Noam envisions this federation of networks as inevitable,[35] others believe that legislative action must be undertaken. Pressler and Schieffer argue that where the Communications Act (with its emphasis on universal service) and competition (the Sherman Act) are at odds, universal service ought to win. If bypass of the public

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[33] Despite the overlap and the significance of ISDN development on ONA, the FCC has decided not to give any guidance on ISDN development. See R.M. Frieden, "The Third Computer Inquiry: A Deregulatory Dilemma," *Federal Communications Law Journal* 38 (1987): pp. 383-410.

[34] 47 USC Section 532.

[35] "Like a Greek drama unfolding, the unified, centralized system unravels because it reflects realities of a passing era. Technology and economics are tearing at its unity. The centralized system frequently still has politics on its side. It still encompasses several of the main organized constituencies in industrialized countries. But the new interests create their political constellations, too. Now another group is emerging, the alliance of large users together with the most advanced parts of the telecommunications industry, which also includes the computer, components and office equipment firms." Noam, *Private Networks,* pp. 11-12.

network is threatened, Senator Pressler argues that bypass ought to be discouraged or even actively prohibited.

The technological developments which make viable local loop competition a reality (cable, cellular, PCS, fiber) will inevitably encourage the continuing development of private networks. The development of competition in other parts of the network has certainly done this; the development of competition for the last-mile to the customer will only reinforce this trend. As more private networks emerge, the question of what their obligation may be to support universal service goals will continue to be asked. It is conceivable that these private network owners may be required to contribute to a universal service fund as part of the price for interconnecting to the public network. At the extreme, if enough private networks arise that the continued viability of the public network is threatened, regulators or legislators may actually step in and establish a right to take action to assure both a viable public network and broad access to the services various networks provide.

Price Deaveraging

One area in which competition may put pressure on universal service is in the deaveraging of geographical areas. AT&T has traditionally charged the same for calls of the same distance no matter their point of origin or their point of termination. The FCC, though never formally requiring rate averaging from AT&T, has made it clear that any move on AT&T's part to deaverage rates would result in a full investigation of the matter. MCI and Sprint also engage in averaging now but it is unclear whether they would move to deaveraging under more intense competitive pressures and whether AT&T could sustain averaging in the face of this move.[36]

One of the underlying tenets of geographical averaging of toll rates has been the concept of an average local loop cost. There is some disparity in the underlying cost of the copper, twisted pair loop. Local loops in rural areas are, for the most part, much longer than those found in urban areas. The costs of installing and

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[36] NTIA, *The NTIA Infrastructure Report,* p. 309, n. 1146.

maintaining loops vary across LECs and geographic terrain. However, the FCC has taken great pains to maintain some uniformity in the local loop costs that long distance carriers pay through the carrier common line charge. The whole concept of pooling local loop costs through the National Exchange Carrier Association and of maintaining a High Cost Fund after the depooling of the common line charge has been based on preserving an underlying cost structure which would maintain averaged toll rates.

At the local level, LECs average local loop rates as well. Local rates do not reflect specific local loop costs. Theoretically, customers with shorter loops -- notably those in urban areas close to a class 5 office -- subsidize those customers with longer loops -- those in rural areas or in sparsely populated areas. This could conceivably create a market niche for local loop competitors such as alternative fiber providers whose fiber rings are in urban areas close to many of those customers with short urban local loops.

Profitability

Competition can increase the availability and affordability of service by forcing service providers to be efficient and aggressive in improving their business. On the negative side, the benefits of competition may not extend to all segments of society. One scenario could envision new competitive providers moving into those industries with the highest expected return and sequentially turning their attention to less and less profitable markets only as competition among firms erases excess profits in the initial high profit areas. It is possible that at some point the firms will stop their move down the "ladder of profitability" stopping an unprofitable service before reaching the bottom rung of the ladder. Given the continued attention to ensuring universal service to rural and residential services (the least profitable service areas), it is really not clear how far down competitive services will travel the "profitability ladder."

In looking at local service competitors, the issue of profitability takes on great significance for various reasons. The issue of universal service and pricing to support

that policy in many ways clouds the question. If LECs continue to be able to subsidize local rates through other LEC-provided services, will there be a large enough margin for alternative local service providers to find a profitable market? Is the underlying basis for competition cost or quality and range of services? If range of services is the basis for competition, then the ability to provide fiber becomes key and the issue of whether LECs or their competitors can provide fiber more profitably is central. If portability and wireless service is desired, then cellular and PCS provide something that copper and fiber cannot, regardless of cost.

Cost and Pricing Concerns

In describing the pendular swings between competition and monopoly in the approach to telecommunications, Weinhaus and Oettinger note: "On one side lie monopoly, universal connectability, and averaging of prices; on the other side lie competition, specialized use, and deaveraging of prices."[37] It is no accident that pricing issues weigh heavily on both sides of the debate.

In many ways, cost and pricing issues are at the very heart of the monopoly/competition debates, for such issues as how far prices are allowed to diverge from cost and which services -- and therefore customers -- are expected to subsidize other services and customers are key to the argument.

The telecommunication services provided by the local telephone industry present a unique challenge to those who argue over cost and pricing issues, because a variety of products and services are provided by a common set of facilities and personnel. The investment in local loop plant, in central office switches and transmission equipment, and in inter-office facilities, as well as the expenditures associated with that investment, are used to provide local service, extended area service, intraLATA toll, and interLATA (and interstate) access. All services involve joint costs.

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[37] Carol Weinhaus and Anthony Oettinger, *Behind the Telephone Debates* (Norwood, N.J.: Ablex, 1988), p. 5.

Deciding how to price these services was much simpler in the days before the incursion of competitors for CPE and long distance services. Indeed, before the break-up of the Bell System and the entry of competitors, a fairly uniform system of regulation and pricing was followed. All services were monopoly services and an elaborate system of subsidies was deemed desirable to insure the attainment of universal service goals. That system is no longer proving tenable, as regulators struggle to strike a balance between competitive and monopoly services, all jointly provided. However, the earlier scheme did enhance affordable local rates. It also, unfortunately, created local rate structures which relied on the geographical averaging of rates and on a jurisdictional cost allocation system which allocated significant amounts of cost to interstate toll services. This may not be sustainable in today's more dynamic industry.

Central to the allocation scheme has been the treatment of local loop, or nontraffic sensitive (NTS) costs.[38] Prior to the 1930s, the telephone industry followed a "board-to-board" philosophy. In response to regulatory pressure, and to court cases like the *Smith v. Illinois Bell* case, which determined that local plant costs should be separated along state and federal lines, the industry moved to a "station-to-station" approach. Local exchange costs were allocated fully to the state jurisdiction. Interstate toll costs began and ended at the operator toll boards. In the station-to-station approach, a portion of local plant costs was allocated to the interstate jurisdiction for cost recovery and long distance pricing purposes.

The question of how much local plant costs should be allocated to the interstate jurisdiction has been a point of increasing contention. In the early separations manuals used by the long distance arm of the Bell System (AT&T Long Lines), the BOCs and the independent telephone companies during the 1940s and 1950s, the interstate allocation of local loop costs was based on a factor called "SLU," Subscriber Line Usage.[39] As time went on, a greater and greater percentage of local

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[38] Weinhaus and Oettinger offer an excellent history of the evolution from the board-to-board to the station-to-station approach.

[39] SLU was the measurement of the relative usage by jurisdiction, in minutes, of telephone company equipment.

loop costs were allocated to the interstate jurisdiction, until, with the adoption of the Ozark Plan in 1971, local loop costs -- and some associated NTS central office costs -- were allocated on the basis of "SPF" rather than "SLU." The SPF, or Subscriber Plant Factor, formula allocated increasing amounts of NTS (loop and central office costs) out of the local cost category and into intrastate and interstate toll because the SPF factor weighted a company's percentage of interstate toll usage. While a company's interstate SLU might be a small percentage, the SPF factor, because of the way it was calculated, allocated a much higher percentage to interstate toll. As the percentage of toll usage increased, the SPF factor magnified that increase. The system limited each company's total state and interstate SPF to 85 percent, a necessary safeguard since strict application of the SPF formula could in some cases result in allocations to state and interstate toll which exceeded a company's actual NTS costs, resulting in no costs being allocated to local exchange service.[40]

It is easy to see that large allocations of NTS costs to the interstate jurisdiction took a great deal of pressure off local prices. NTS costs are associated with investment which does not vary with usage. Figure 3-1 illustrates that investment. In general it encompasses the local loop, the main distribution frame in the central office, and other incidental equipment.

Large allocations of NTS costs to the interstate jurisdiction placed a great deal of pressure on interstate toll rates, a situation which the FCC regarded as a deterrent to viable long distance competition. To create an environment conducive to interstate toll competition, the FCC first froze each local telephone company's interstate SPF at 1982 levels, and then approved a plan in which each company would phase down its SPF to a uniform 25 percent.[41]

The freezing and phase-down of SPF, as well as other changes in separations rules which will be discussed later in this study, placed more rate pressure on local and state services, and on local subscribers. Only a portion of the nontraffic sensitive costs allocated to the interstate jurisdiction by the 25 percent SPF allocator are

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[40] Weinhaus and Oettinger, *Behind the Telephone Debates,* p. 96.

[41] Ibid., p. 103.

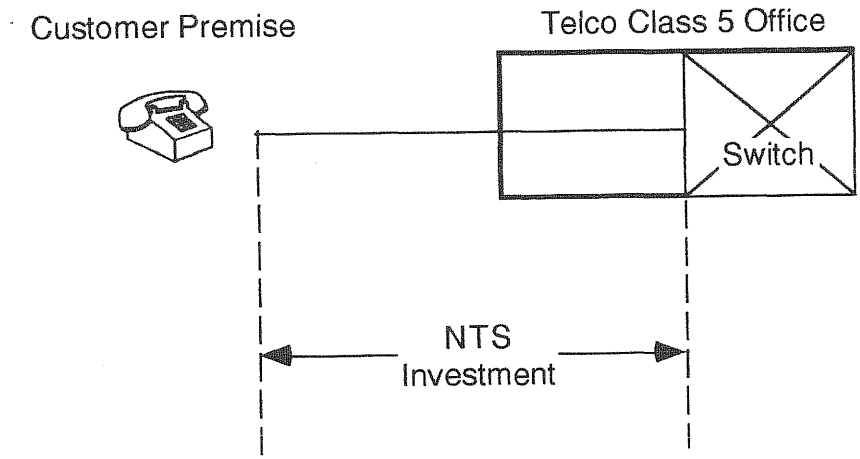

Fig. 3-1. Nontraffic sensitive investment in the LEC network.

recovered from interexchange carriers providing long distance service. Those costs are recovered in large part from Subscriber Line Charges collected from local service customers, a situation which, in effect, has raised the cost of local access to subscribers.

The shifting of NTS costs in excess of 25 percent out of the interstate arena and into the state and local cost categories puts more pressure on local rates as well. Because of the pressure for intraLATA toll competition, this shift in NTS costs may affect local rates more strongly than would have been the case in earlier years. Previously, shifts out of the interstate arena into the state jurisdiction could have been, and often were, absorbed through increased state toll rates. With the advent of intraLATA toll competition, LECs are averse to increasing those toll rates to a non-competitive level.

At the state level, regulators have traditionally priced services on a "value-of-service" basis and on a residual basis. Rather than pricing to reflect underlying costs, regulators have targeted rates based on perceived value of the service, or on ability to pay. For this reason, business rates tend to be two to three times residential rates. Regulators have tended to respond to telephone company rate cases by allowing companies to first increase rates on state toll and on vertical services, and to increase local rates almost as a last resort.

While this residual approach to pricing local service has promoted affordable rates, and so encouraged universal service, it has, many economists have argued, distorted local pricing, with local prices being priced well below the underlying cost of providing service. Indeed some economists have argued that the structure of local service rates, that is, their flat-rate nature, makes this situation even worse.[42]

Residual pricing has been possible because state and local services have all been monopolies. With one provider of these jointly provided services it has been possible to enact policy through pricing. Cross-subsidies are possible, and perhaps even desirable. With the advent of competition in various portions of the network, however, former pricing approaches may no longer be effective.

A basic tenet of competition is that price should be set at marginal cost. A basic approach of monopoly service is that some services bear their fully distributed costs, and perhaps more. It is obvious that tension is inevitable when monopoly and competitive services are offered side by side. As Alfred Kahn has noted:

> It is precisely the wedding of the provision of POTS with all the other attributes of modern telecommunications service from common facilities and our consequent attempt to retain the two together within one framework of traditional public utility regulation that has given rise to all our present problems.[43]

As competitors emerge for various segments of the public switched network (PSN) and its services, there is pressure to price those services competitively. If PSN services are priced too high and alternative providers exist, those customers with the ability to avail themselves of alternative services will leave the network. The result is

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[42] John T. Wenders, *The Economics of Telecommunications: Theory and Policy* (Cambridge, Mass.: Ballinger Publishing Company, 1987), for example, argues that local rates are set too low and that an optimal local service structure includes measured service.

[43] Alfred E. Kahn, "Thoughts on the Past, Present, and Future of Telecommunications Regulation," in *Telecommunications Deregulation: Market Power and Cost Allocation Issues,* John R. Allison and Dennis L. Thomas, eds. (Westport, Conn.: Quorum Books, 1990), p. 263.

bypass, or cream-skimming. As bypassers leave the network, the remaining network costs have to be borne by those remaining on it; the result is higher prices for those still using PSN services. The result is also encouragement of further bypass. This difficult cycle results not only in higher prices for these competitive PSN services, but also in higher prices for those PSN services which have relied on a subsidy from those now bypassed services.[44]

If prices well in excess of underlying costs entice potential competitors, it is important to the PSN provider to lower its prices for competitive services closer to marginal cost. This means that prices for competitive PSN services can no longer subsidize other PSN service prices. The resulting implications for local service rates are clear. If it is indeed true that local rates do not bear their full cost burden and that local rates have been subsidized by other services, as those services face competitive pressures and the need to lower prices, local rates may have to bear a greater amount of cost. As an example, if intraLATA toll rates have been subsidizing local service, as toll rates decrease in response to competition, so too does the subsidy.

While prices for competitive services can be too high, they can also be too low. As the provider of a range of services, a local telephone company may be in a position to underprice competitive services and so drive competitors out of the market. Because it generates revenue from so many sources, a telephone company may be able to absorb significant short-run losses on some services. The telephone company may also be able to shift costs from competitive services over to monopoly services and so unfairly keep competitive prices down. While no blind advocate for the perpetuation of traditional regulation, Kahn cites the need for regulators to prevent such price discrimination and anti-competitive behaviors.[45]

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[44] John R. McNamara, in *The Economics of Innovation in the Telecommunications Industry* (New York: Quorum Books, 1991), p. 98, points out some of the difficulties inherent in the concept of marginal cost. He makes the points that marginal-cost pricing may not recover sufficient revenues; that such costs are difficult to measure, and that marginal-cost based prices may appear unfair or counter to social objectives "such as providing subsidies to some classes of customers."

[45] Kahn, *Thoughts on the Past,* p. 268.

The total PSN encompasses a range of services, and specific direct and overhead costs created by them. Each service, through its pricing, absorbs direct and overhead costs. How much each service absorbs is the real issue. Through a value-of-service approach, regulators have priced services based on the perceived benefit to the customer. In pursuit of specific public policy goals, regulators have allocated a greater percentage of overhead costs to some services, to the benefit of others. With interstate access charges, more overhead -- and perhaps, as some would argue more direct costs -- have been pushed into the state jurisdiction. With increased competitive pressures on intraLATA toll services, private line services, and other non-local services, more overhead costs will be forced to the local arena.

If regulators wish to continue pricing local rates according to policy objectives, they may have to seek subsidies from competitive service providers. In the interstate toll market, all interexchange carriers pay for the High Cost Fund and for Lifeline service, for example.

Local loop competition, however, presents some interesting questions. If local rates are currently subsidized, is there any margin for a local loop competitor? A heavily subsidized local loop is conceivably being offered below cost. Can a competitor therefore provide alternative local loop service at a lower price and still cover costs and generate a profit? If not, then viable local loop competition based on price alone may not be feasible.

If local loop competition is driven by technology or convenience rather than price, then, despite the below-cost pricing of the loop, viable competition may emerge. As more competitors emerge, the remaining LEC-provided loops will increase in price as they bear the increasing burden of stranded LEC local loop investment. As more pressure is put on local rates, and they increase, will local rates eventually be high enough to attract broader-based competition, competition that is indeed price-driven?

If local competition is inevitable, is local measured service an appropriate rate structure to accommodate competitors? Flat local rates encompass both the provision of the loop, the connection to the central office, the telephone number, and local usage. If LECs prepare for local loop competition by unbundling the loop, how will that unbundling take place? In New York, the loop is unbundled into a link and a

port. The link represents the physical connection all the way to the switch; the port represents the connection to the switch and the telephone number. The port could also represent the local usage component. In local measured service tariffs, the flat rate component can be perceived as capturing the physical facilities costs, while the usage component captures usage costs. Such a model could very well accommodate the unbundling of the local loop. LECs, through the port charge, are providing a service analogous to the local switching component included in access charges. The local switching component represents the use of the LEC switch to route a call. This same procedure could be followed to unbundle local rates.

The Impact of Separations Rule Changes on Local Pricing

Because of jurisdictional issues and the traditional practice of residual pricing, issues surrounding local loop competition cannot be totally divorced from separations issues.

The FCC's Part 36 Rules specify the method for allocating telephone company costs between state and federal jurisdictions. The Part 36 Rules detail a complicated method of separating telephone investment and expense into various categories and then allocating the dollars in those categories to the state and federal jurisdictions on the basis of specific allocation factors. While direct assignment is desired, in most instances investment and expense are allocated according to certain factors.

For example, the Part 36 category of investment having to do with local switching equipment, Category 3, is comprised of most of a company's central office switches. This category of investment is allocated between state and interstate use based on Dial Equipment Minutes (DEM). The DEM factor is based on the minutes of holding time of originating and terminating local switching equipment.[46] Any change in the relative percentage of interstate holding time minutes to the total affects the costs allocated to the interstate jurisdiction.

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[46] Jurisdictional Separations Procedures for Telecommunications Companies, Section 36.125.

The DEM factor, like the SPF factor dealt with earlier in this study, allocates a relatively lesser percentage of cost to the interstate jurisdiction than had been the case in prior years. When SPF was frozen and then phased down to 25 percent, any amount in excess of 25 percent accrued to the state arena. Prior to the rewrite of separations rules in 1988 which resulted in the transition from the FCC's former Part 67 Rules to the current Part 36 Separations rules, the interstate portion of the DEM factor was weighted for the type of switching equipment used. Electromechanical equipment was accorded a higher interstate weighting than digital equipment, based on the assumption that more set-up time was required by the electromechanical switch for interstate calls. With the advent of digital switches, and the rewrite of the separations rules, beginning in 1993, no weighting of the interstate component of DEM will be made for companies with more than 50,000 lines. The net effect of this change in DEM is to allocate relatively more dollars to the state jurisdiction, placing more pressure on the LEC to recover costs from state and local services.

This process of phasing down the interstate allocation of various factors will continue because of several interstate proceedings. Some interstate proceedings which at first glance appear to have little bearing on the issue may, indeed, shift costs to the state jurisdiction. A current example is the FCC's proceeding having to do with transport rate restructure.[47] In this proceeding, the FCC is trying to determine the best approach to take to end the equal charge per unit of traffic rule. That rule, which was established by the Modification of Final Judgement, specified that LECs would charge all interexchange carriers (IXCs) the same price per unit of traffic (per minute) for carrying IXC traffic from the LEC central office to the IXC point of presence. Unfortunately, LECs do not carry all IXC's traffic over the same type of facilities. For some IXCs, the LEC hauls the traffic from the central office to an access tandem and then to the POP. For carriers with a good deal of traffic (like AT&T), the LEC hauls the IXC's traffic over dedicated facilities from the central office to the POP. Figure 3-2 illustrates this situation.

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[47] Transport Rate Structure and Pricing, CC Docket No. 91-213, *Order and Further Notice of Proposed Rulemaking* (1991).

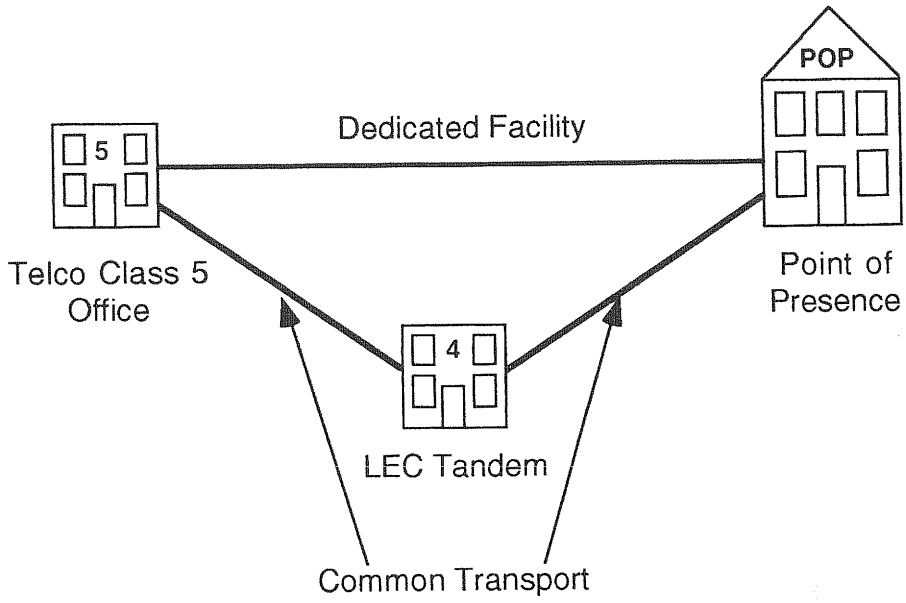

Fig. 3-2. Routing of long-distance calls by the LEC.

The MFJ provision regarding equal units of traffic expired on Sept. 1, 1991; however, the FCC has extended the provision pending further consideration.[48] The FCC is concerned for several reasons. One reason is that it is mostly AT&T which has sufficient traffic to justify dedicated facilities and, thus, lower charges from the LEC. This could undermine the level playing field upon which long distance competition is based.

Of greater concern, and perhaps of more relevance to this study, is the potential treatment of LEC facilities. If most IXCs decide to order dedicated facilities, rather than paying to be routed through an access tandem, the LEC's access tandem investment could be stranded. Concerned about that possible outcome, LECs are proposing, among other solutions, a change in the way access tandem equipment is allocated in the separations process.

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[48] Interestingly, these provisions of the MFJ and the FCC continued concurrence on policies that for a time resulted in one carrier (AT&T) making substantial contributions to its own competitors.

Current separations rules specify the direct assignment of tandem switching investment (Category 2) wherever possible, with the remainder of the investment allocated on the basis of relative minutes of use.[49] Because such a large number of tandem switches are used to provide access services, a significant portion of Category 2 equipment is allocated to the interstate arena. In its comments during the FCC's proceeding in this matter, USTA suggested that Category 2 investment be allocated on the DEM factor. USTA estimated that the result of such a change would reduce interstate transport rates by 6.1 percent.[50] A portion of that decrease would go to a higher intrastate allocation.

It is important to remember that separations allocation procedures are based on relative usage. Any change in relative units will result in cost shifts, especially since each dollar of investment pulls with it significant dollars of allocated overhead. For this reason, the whole question of expanded interconnection and of replacing LEC services is an important one. If expanded interconnection takes place in the interstate arena, and more LEC interstate circuits are replaced by competitive offerings, a relatively larger number of state circuits will remain, thus pulling more cost toward the state jurisdiction. The alternative is also possible if expanded interconnection becomes more of a state phenomenon and more state circuits are removed; a relatively larger percentage of interstate circuits would remain and pull more dollars into the interstate "bucket." In either event, the relative amount of cost to be recovered by state and local services is affected.

Another issue of concern regarding jurisdictional separations must be the ability to measure the jurisdiction of calls. As is discussed later in this study, with number portability the ability to determine the jurisdiction of a call may be greatly impeded, or even destroyed. There is already some indication that efforts to determine the jurisdiction of some calls are estimates at best. In a recent portion of the ONA proceeding, enhanced service providers (ESPs) argued that "neither ESP customers nor

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[49] Section 36.124 (b).

[50] Comments of the United States Telephone Association in CC Docket No. 91-213, November 22, 1991.

ESPs are able to ascertain accurately which calls are intrastate and which are interstate."[51] The ESPs noted that this inability to determine jurisdiction would make it difficult for them to order the appropriate ONA services.

The ESP's concerns may be a portent of future difficulties. As more and more varied service providers connect to the network in the central office, or some other location, will the LEC be able to determine the true jurisdictional use of its equipment by these various providers? If some semblance of accurate jurisdictional measurement is not possible, can the LEC continue to perform meaningful jurisdictional separations? Unlike the past, a LEC may not be able to determine the ultimate destination of a line or a trunk connected to its central office. Line-side technologies and the emergence of competition may further erode jurisdictional distinctions.

Introduction to Preemption

The earlier discussion of the "Video Dialtone" docket makes clear that the FCC has a vision for the future of telecommunications. While the picture does not have many details, competition is the dominant theme. As we know, the FCC is not the only regulatory body with jurisdiction over communications policy. The Communications Act of 1934 (the "Act") talks about a dual system which includes both the FCC and the States. Section 151 of the Act grants the FCC the authority to regulate:

> interstate and foreign commerce in communication by wire and radio so as to make available....a rapid, efficient, nationwide, and world-wide wire and radio communication service with adequate facilities at reasonable charges....

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[51] Part 69/ONA Order, para. 67.

At the same time, Section 152(b) of the Act commands that:

> [N]othing in this chapter shall be construed to apply or to give the Commission jurisdiction with respect to (1) charges, classifications, practices, services, facilities of regulation for or in connection with intrastate communications services by wire or radio of any carrier.

These two sections are an attempt to balance the interests of the states and the national government. But in the recent case of *Louisiana* v. *FCC,* the Court confessed that:

> [W]hile the Act would seem to divide the world of domestic telephone service neatly into two hemispheres -- one comprised of interstate service, over which the FCC would have plenary authority, and the other made up of intrastate service, over which the State would retain exclusive jurisdiction -- in practice, the realities of technology and economics belie such a clean parceling of responsibility. This is so because virtually all telephone plant that is used to provide intrastate service is also used to provide interstate service, and is thus conceivably within the jurisdiction of both state and federal authorities. Moreover, because the same carriers provide both interstate and intrastate service, actions taken by federal and state regulators within their respective domains necessarily affect the general financial health of those carriers, and hence their ability to provide service, in the other "hemisphere."[52]

Drawing a bright, clear line between state and federal jurisdiction over communications in an era of rapid technological change is, of course, a difficult task. To date, the effort has not been successful, with so much ambiguity as to stymie federal and state regulators as well as service providers because of their inability to precisely predict what the courts will do next. The following section offers a summary

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[52] *Virginia State Corporation Commission* v. *FCC,* 737 F.2d 388 (4th Cir. 1984), *rev'd and remanded sub nom. Louisiana Public Service Commission* v. *FCC,* 106 S.Ct. 1890 (1986).

of the federal preemption of state jurisdiction and its potential effect on local loop competition to the extent that that is possible.[53]

The Importance of Preemption in Telecommunications Policy

Where federal law and state law conflict, the federal law may "preempt" or foreclose the operation of state law. Preemption is not a new issue to telecommunications. During the creation of the Communications Act, the balance between federal and state power to regulate communications was a significant point of discussion. For the next thirty years, however, most of the disputes about jurisdiction were relatively minor because:

> (i) the philosophies of federal and state regulators were generally in harmony; and (ii) the technology of communications, as then applied to the telephone network, tended to reinforce the essentially non-competitive environment prevailing at that time.[54]

In the 1960s, however, as new technologies made competition possible, preemption became an important concern of regulators. The FCC used preemption in two areas. In the first, the FCC preempted state law so that it could regulate cable television. In the second, it did just the opposite -- it preempted state law to deregulate common carrier services.

Preemption is only an issue when telephone plant provides both interstate and intrastate service. It is only when both the FCC and the state(s) have jurisdiction, that there is the possibility for a conflict in policy between the FCC and the state. The Constitution has made provision for this eventuality. If there is a legitimate

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[53] For a good introduction to preemption in telecommunications policy, see Richard McKenna, "Preemption Under the Communications Act," *Federal Communications Law Journal* 37, January 1985; and Walter Saparanov, "Federal-State Jurisdiction Conflict in the Information Services Industry," Outline of Remarks for the American Bar Association Annual Meeting, Atlanta, Georgia, August 31, 1991.

[54] Richard McKenna, "Preemption."

conflict between the federal and state law, the supremacy clause of the U.S. Constitution, Article VI, Section 2, says that the federal law will prevail.

There are many ways that federal and state laws can come into conflict. The easiest way to identify a conflict is when enactment by Congress expressed clear intent to preempt state law (see *Jones* v. *Rath Packing Co.*, 430 US 519, 525 [1977]. In other cases, however, it is not so clear that there is a conflict. Congress may decide that its policy is not to regulate in a field. This decision could really mean that: (1) a Federal law is not needed but it is still up to the states to decide if they want to regulate, or (2) the official policy is no regulation, state or federal. A second test, therefore, is whether Congress has legislated comprehensively so as to occupy an entire field of regulation and thereby "left no room for the state to supplement federal law" (see *Rice* v. *Santa Fe Elevator Corp.*, 331 US 218, 230 [1947]). State law could also stand as an obstruction to the accomplishment and execution of the full purpose and objective of Congress" (see *Hines* v. *Davidowitz,* 312 U.S. 52, 67 (1971)). In every case, the court will look for congressional intent. This intent could be expressed either directly through statute or indirectly through the activities delegated to an administrative agency.

When there is a conflict between state law and federal regulation, the court will not overturn the preemptive federal regulation if the state regulation is a reasonable accommodation of conflicting policies within the federal agency's domain. Again, the only exception to this rule is that in reading the statute or its legislative history that the accommodation is not one that Congress would have sanctioned.

In almost every one of the major cases involving preemption in telecommunications, the Supreme Court had decided in favor of the FCC. Prior to the Supreme Court's *Louisiana* decision, the Section 2(b) exception to federal preemption was limited in its application to local services, facilities and disputes that are "separable from and do not substantially affect the conduct or development of interstate communications" (*North Carolina Utilities Commission* v. *FCC* 537 F.2d 787 [4th Cir. 1976]). If the local services and regulation were separable, then it was beyond the reach of federal preemption. Otherwise, the FCC could preempt the state

regulation when it "stands as an obstruction to the accomplishment and execution of the full purpose and objective of Congress."[55]

The Louisiana Case

When the Supreme Court released its opinion in *Louisiana* and overturned a FCC preemption order many greeted the opinion as a turning point in the law on preemption. Up until *Louisiana*, the case law had been clear: if the FCC wanted to preempt it could do so and win in the courts. In *Louisiana*, however, the court held that the Section 2(b) exception precludes the FCC from preempting state regulation over depreciation of telephone company property falling under joint federal and state jurisdictions for intrastate ratemaking purposes. The Supreme Court in its reasoning noted the following limits on FCC authority under the Communications Act: (1) the Act is properly interpreted as enacting a "dual regulatory system," both federal and state; (2) the FCC may not preempt state law merely to effect federal policy. The FCC is an agency that has no power to "act, let alone preempt the validly enacted legislation of a sovereign state" unless authorized by Congress; thus, the FCC may not limit the application of the Section 2(b) exception without express statutory authority; (3) legislative intent is evidenced by Joint Board's[56] power to allocate federal and state jurisdictions for ratemaking purposes.

Since *Louisiana* was a significant departure from previous case law, the fundamental question is what has actually changed with the *Louisiana* case? Is the case a significant departure in law? Or, should the case be limited to the facts so that it is not so much a question of law but that the FCC had just gone too far in its preemption? To answer these questions, it is necessary to look at *Louisiana* and subsequent cases interpreting it.

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[55] Telerent Leasing Corp., 45 FCC 2d 204, 29 R.R. 553 (1974), *aff'd sub nom. North Carolina Utility Commission* v. *FCC,* 537 787, 792 (4th Cir. 1976). ("North Carolina I.")

[56] 47 U.S.C. 410(c) (1976).

Louisiana does represent a shift in the state law on preemption. Whereas previously the FCC would only lose if the preemption was over something intrinsically the authority of the state, now the courts are willing to examine the merits of a preemption order if the case is mixed. In addition, the standards have also changed when the matter is mixed.

> *Louisiana* has restruck the balance of power between state and federal regulators of telecommunications by restoring state commissions' authority to regulate service which is "local in nature" even if the policies they adopt might substantially and adversely affect the development or conduct of interstate communications....In other words, that a given policy would adversely affect either incentives or abilities to offer or subscribe to an economically efficient interstate service offering is not a factor to be weighted in determining whether the FCC may preempt that state policy.[57]

As a result of the *Louisiana* decision a string of cases appeared challenging the FCC's power to preempt. These reinforce the court's focus upon separability and *dual* responsibility and the harder test that the FCC must meet in order to have its preemption orders stand.

Inside Wiring: The court did not allow preemption of state regulation of inside wiring. The FCC can preempt "only if it negates a valid federal policy." The court disagreed with the FCC's attempt to limit Section 2(b) to common carrier services.[58]

State Franchise Boundaries: Preemption of a Texas order prohibiting the connection of a local exchange from interconnecting with a customer was upheld on grounds that there is a federal policy of protecting the customer's rights to

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[57] John P. Haring and Kathleen B. Levitz, "The Law and Economics of Federalism in Telecommunications," *Federal Communications Law Journal* 41 (July 1989), p. 261.

[58] *Detariffing the Installation and Maintenance of Inside Wiring* (CC Docket No. 79-105), 51 Fed. Reg. 8498 (1986), *on reconsideration*, 1 FCC Rcd. 1190 (1986), *on further reconsideration*, 3 FCC Rcd. 1719 (1988), *remanded sub nom., Nat'l Ass'n of Regulatory Commissioners* v. *FCC,* 880 F.2d 422 (D.C. Cir. 1989) [hereafter NARUC III].

interconnect to the public interstate network. The state PSC ruling was found to be extraordinarily broad.[59]

Marketing of Centrex and CPE: The court upheld the FCC's jurisdiction over marketing where interstate and intrastate elements of Centrex or similar services cannot be separated.[60]

Disconnection of Subscriber Service for Nonpayment: Preemption of disconnection service by local exchange companies for IXCs was upheld because the disconnection involved interstate service and there was no showing of inseparability of the interstate and intrastate aspects.[61]

Carrier Provision of Enhanced Services: Preemption was disallowed of state rules covering enhanced services not necessary to achieve federal policy goals (*Computer III*).[62] In this case, the court held that the FCC had failed to provide support in the record for its conclusion that accounting safeguards alone could, in the absence of structural separation, adequately constrain the BOC's ability to engage in cross-subsidization. The court also found that Section 2(b) limits the FCC's power to preempt state regulation of services provided "in connection with intrastate communications services by wire or radio of any carrier." The preemption was declared to be overly broad in the absence of a showing that any such state requirements would "thwart or impede" valid federal policies and that the FCC had not justified that all state regulations could feasibly coexist with the FCC's regulatory scheme.

In looking at the reasoning in *Louisiana* and its progeny it appears that the present law on preemption requires that the FCC make three showings before the courts will allow the preemption order to stand: (1) the federal and the state

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[59] *In Re Atlantic Richfield Co.*, 3 FCC rcd 3089 (1988), *aff'd sub nom., Public Utility Commission of Texas* v. *FCC,* 866 F.2d 1325, 1335 (D.C. Cir. 1989).

[60] *Furnishing of CPE by the Bell Operating Companies*, 2 FCC Rcd. 143, 156 (1987) ("BOC CPE Relief Order"), *aff'd sub nom. Illinois Bell Telephone Co.* v. *FCC,* 883 F.2d 104 (D.C. Cir. 1989).

[61] *Public Service Commission of Maryland* v. *FCC,* 909 F.2d 1510 (D.C. Cir. 1990).

[62] *California* v. *FCC,* 905 F.2d 1217 (9th Cir. 1990).

commissions both have jurisdiction over the matter; (2) the FCC preemption order is designed to accomplish a valid federal regulatory objective; and (3) state regulation would "thwart or impede" federal policy because the interstate and intrastate components cannot be separated.[63]

Potential Impact of Preemption on Local Loop Competition

If there is a conflict between the FCC and state governments over policy in introducing competition into the local loop, how far the FCC can impose its will on state utility commissions is, in part, already determined by some of the above preemption cases.

If the FCC is concerned about low depreciation rates affecting the rate at which BOCs can move towards providing broadband fiber services, the court is likely to deny a preemption order and expect the FCC to separate out depreciation rates for that part of equipment devoted to interstate and intrastate service.

Another important component of introducing competition into the local loop is the conditions under which interconnection might take place. If past law is any indication, the FCC will be able to preempt local regulation of services when those rules "thwart or impede" the FCC's policy on competitive interstate service. The court also allowed federal preemption of state regulation on marketing and disconnection services where it was shown that the services had an affect on interstate service and were not separable.

In addition to making sure that the common carriers have nondiscriminatory access, the FCC is concerned that the enhanced service providers will experience state regulation in a way that impedes interstate communications. Under the *California* case, however, the court will require a much more closely argued rationale for preemption. In this case, the same rules enunciated in *Louisiana* and its progeny were cited but because the FCC had failed to accumulate enough evidence to support its order, it is still unclear how those rules would affect regulation of enhanced service

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[63] *Public Service Commission of Maryland* v. *FCC,* 909 F.2d 1510 (D.C. Cir. 1990).

providers. This may take some time to find out because, as the court mentioned, it is not interested in a blanket preemption but instead, a well-justified position as to why a particular state policy would "thwart or impede" valid federal objectives.

Open Network Architecture (ONA)

In its *Computer Inquiry III* proceeding, the FCC sought ways to accomplish two goals: allowing the RBOCs into information services without requiring them to do so through a separate subsidiary and creating enough safeguards to assure that the RBOCs did not discriminate against their information services competitors, especially since those competitors had to purchase services from the RBOCs in order to do business.

Among the remedies which the FCC crafted was the requirement that RBOCs file and implement a new set of tariffs and services which would facilitate a concept referred to as "Open Network Architecture" or ONA.[64] ONA requires the RBOCs to unbundle their network. After numerous meetings with their potential information services competitors--and network services customers--each RBOC was required by the FCC to prepare and implement a plan that indicates how they would meet the needs of their customers for unbundled services.

The ONA structure basically consists of four types of services. Enhanced service providers (ESPs) come to the RBOCs to order a basic serving arrangement or BSA. That BSA represents the linkage between the ESP and the RBOC central office. The ESP then orders basic service elements or BSEs. These BSEs are software-driven services available at the central office and needed by the ESP to provide service to the ESP customer.

Figure 3-3 shows the linkage between the ESP and the central office (the BSA) and also the location of the BSEs ordered by the ESP from the RBOC. The ESP

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[64] Robert J. Graniere, *Implementation of Open Network Architecture: Development, Tensions, and Strategies* (Columbus, O.: The National Regulatory Research Institute, September 1989); and John D. Borrows and Robert J. Graniere, *An Open Network Architecture Primer for State Regulators* (Columbus, Ohio: The National Regulatory Research Institute, November 1991).

can also order ancillary services from the RBOC. These ancillary services are non-network in nature, such as billing.

Of great interest here is the fourth type of ONA element -- complementary network services (CNS). These are ordered by the ESP and the RBOC customer. The individual ordering telephone answering from an ESP also orders call forwarding (a CNS) from the RBOC. More importantly, the individual orders a telephone line from the RBOC. The ESP's customer meets the ESP at the RBOC, and gets there by ordering from the RBOC, not from the ESP. This is illustrated in figure 3-4.

The reason that this is of interest to a local loop competition study is that the ONA plan seemingly did not envision local loop unbundling. Its vision of the "local bottleneck" was the class 5 office, and all of its software-driven capabilities, and the linkage between the ESP and the RBOC. The local loop, per se, the link between the ultimate customer shared by both the ESP and the RBOC, was left out of the ONA structure.[65]

However, once unbundling is seen as a possibility in one area of service, it inevitably will be regarded as both possible and desirable for other services. The concept underlying unbundling is maximum customer choice. The customer orders only what is needed or wanted. In the ONA lexicon, "ONA was designed to unbundle basic services provided by the BOCs to promote efficient and innovative use of the network by ESPs and prevent BOCs from discriminating against independent ESPs in favor of BOC ESP operations."[66]

Such a concept of choice is in keeping with the continuing trend toward competition. If it is possible to provide choice in the linkage between the ESP and

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[65] Robert J. Graniere and Roger Musgrave, *Interstate Basic Service Elements: Effects on the Prices of Message Toll Service and Plain Old Telephone Service* (Columbus, Ohio: The National Regulatory Research Institute, December 1991), makes the point that with unbundling of feature groups, the local loop now must be included. It is interesting to note, however, that no BSEs are envisioned for common line.

[66] "Amendments of Part 69 of the Commission's Rules Relating to the Creation of Access Charge Subelements for Open Network Architecture" and "Policy and Rules Concerning Rates for Dominant Carriers," CC Docket No. 89-79 and CC Docket No. 87-313, Report and Order & Order on Further Reconsideration & Supplemental Notice of Proposed Rulemaking, released July 11, 1991.

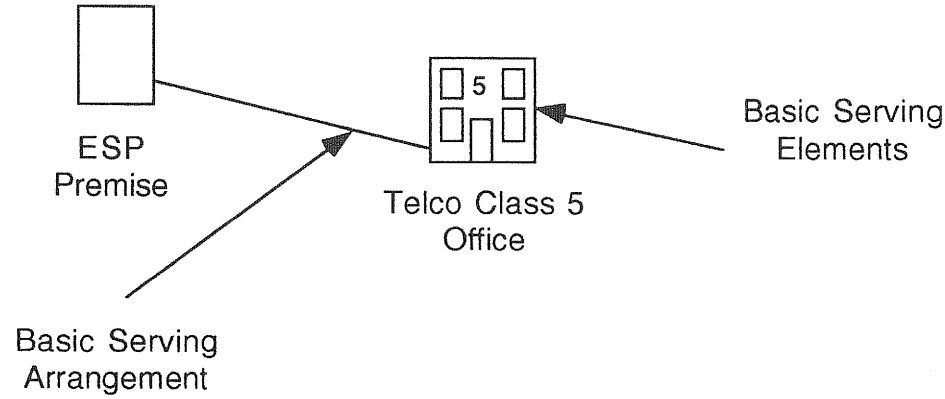

Fig. 3-3. ONA linkage for information service providers.

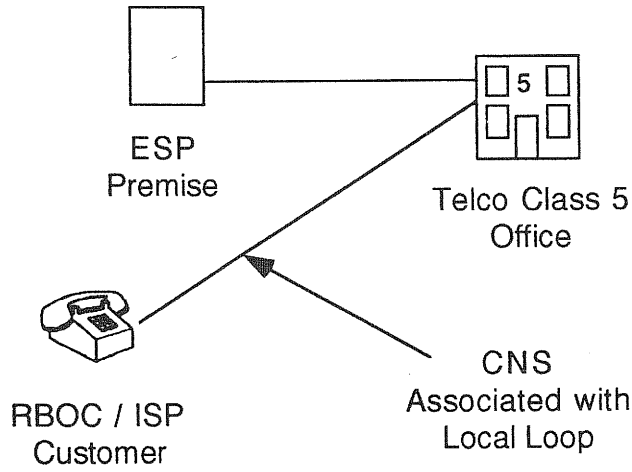

Fig. 3-4. ONA linkage to a subscriber.

the BOC, why not between the ultimate customer and the BOC? Indeed one of the commenters in the ONA proceeding made just such a leap, suggesting that the loop itself should be unbundled.[67] While this suggestion was not acted upon in the ONA proceeding, it has been embraced in others, as will be discussed later in this study.

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[67] In the Hatfield Report and Model which was filed as part of the ONA proceeding, Dale Hatfield "actually suggested, but did not push, the idea that the loop portion of the network could, itself, be divided into two parts: the feeder portion and the distribution portion. . . . an additional point of access could be provided into the monopoly local network." Remarks by Dale Hatfield at the Information Industry Liaison Committee, Long Term Unbundling and Network Evolution Forum, Phoenix, Arizona, February 12, 1992.

The concept of unbundling for purposes of controlling discriminatory practices is also of interest here. The information services market is unique in some ways. When the FCC established access charges, the focus was on assuring that the other interexchange carriers would be treated on a par with AT&T. The emphasis was on the BOC not discriminating among its IXC customers. The BOC itself could not, with a few exceptions, provide interstate toll and so compete with its access customers.

In information services, the BOC is both service provider and competitor to the ESP. ONA plans were devised to assure that the BOC would not discriminate against its competition. This model is much more like that which the local telephone company will face with local loop competition. The telephone company will be both service provider and competitor. Regulators will need to look for ways of inhibiting discriminatory practices.

A basic component of ONA plans is that the BOC charge its own information service operation the same rates for the same services it provides to its competitor. Such safeguards have to be addressed for local loop competition as well. Indeed, the situation may be even more crucial, since information services are part of an emerging market. In local loop competition, competitors would be replacing the telephone company provider for existing services.

Expanded Interconnection/Colocation

The unbundling of services represents only a portion of the process which leads to competition. Customers must not only be given a wide choice of services through unbundling, they must also be given the ability to interconnect with the public switched network in a manner which maximizes choice.

A discussion of local loop competition, and of interconnection, must address the status of the class 5 office through which the loop is connected to the rest of the world.

The combination of local loop and class 5 office constitutes what has been termed the "local bottleneck" monopoly. To get to long distance customers,

interexchange carriers have to purchase access to both loop and office. It can be argued, however, that the true bottleneck is the class 5 office. Alternative local loop providers may arise, but to provide effective service, they will have to be able to connect into the public network. That connection point is the class 5 office. The possibilities for local loop competition will depend, in many regards, on the regulators' approach regarding interconnection.

Activities have begun, at both the federal and the state level, to explore possibilities for expanding interconnection options into the office. At the federal level, discussions of interconnection center on interstate access services, especially special access services. The FCC has opened a notice of proposed rulemaking to explore the introduction of expanded interconnection for interstate special access services and issued a notice of inquiry regarding extension of such interconnection to switched services.[68]

The FCC follows a familiar course in this proceeding. The FCC begins with special access, and then, in a Notice of Inquiry, begins to address the possibility of extending expanded interconnection into the switched arena. This movement follows the course of prior competitive entry. Long distance competition began with competition for private line services and then expanded to switched services. Because of issues such as toll averaging and the continued flow of some subsidy to the local jurisdiction through High Cost Fund payments, such caution is understandable.

In the proceeding the FCC discusses two colocation options: virtual or physical. The FCC also proposes two different approaches to unbundling the channel termination portion of the special access rate structure. Figure 3-5 illustrates the current special access structure.

The FCC's focus in this proceeding is on the channel termination component. In its initial discussion of unbundling that component, the FCC looked at the linkage to the POP. Currently, the facility to the POP is owned by the LEC. Under a virtual colocation proposal, a customer (an interexchange carrier, a competitive access

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[68] Expanded Interconnection with Local Telephone Company Facilities, Notice of Proposed Rulemaking and Notice of Inquiry, CC Docket No. 91-141, 6 FCC Rcd, 3259.

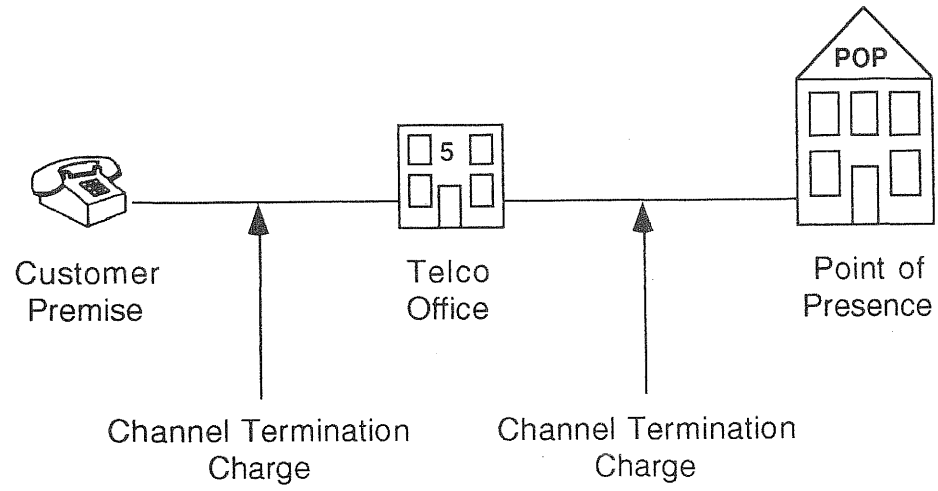

Fig. 3-5. Current special access rate structure.

provider, and so forth) could connect with the LEC network at some point outside of the central office. A manhole would be a likely location. This structure is illustrated in figure 3-6.

The customer would replace LEC facilities with its own facilities up to one-eighth of a mile from the central office. The LEC would own all of the equipment in the central office and the outside plant facility to the interconnection point.

In the physical colocation scenario (figure 3-7), the customer would actually lease space within the central office, would provide its own equipment, and would connect to the network at some agreed upon location within the office. The colocation point in the earlier figure would merely move inside of the office.

In either scenario, the customer would pay a connection charge. The connection charges would differ between the virtual and physical colocation scenarios to reflect underlying cost differences. Under a physical colocation approach, a customer would also pay rental charges for central office space.

Whether virtually or physically collocated, in this scenario the facilities at issue are more "trunk-like" in nature than "loop-like." While the current special access structure levies the same channel termination charge for the connection between the end-user's customer premises and the central office as it does for the connection between the central office and the POP, there are differences between the facilities

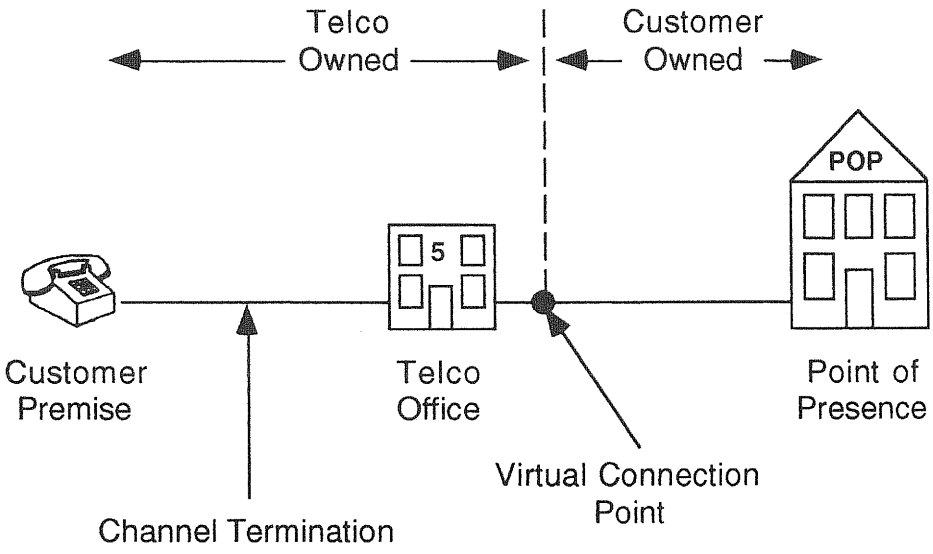

Fig. 3-6. Structure of the FCC's virtual colocation proposal.

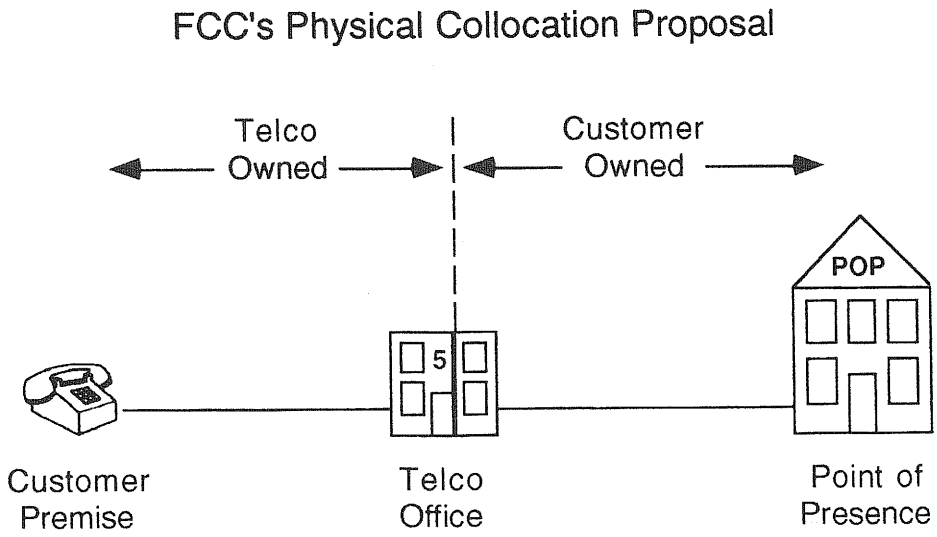

Fig. 3-7. Structure of the FCC's physical colocation proposal.

provided in each case. In creating the special access rate structure, the FCC chose to ignore those differences and opted for a symmetrical rate structure. Under this scenario proposed in the proceeding, only the connection between the central office and the POP would be affected. Customers not opting for this unbundled feature would continue to pay under the existing rate structures.

In an alternative scenario, however, the FCC solicits comments regarding the unbundling of channel termination charges in general. The option discussed for this alternative scenario is virtual colocation, with all customers paying a connection charge to cover central office facilities and outside plant facilities up to one-eighth mile from the central office. Customers could then pay an optional transmission charge for facilities from the connection point to their premise. Figure 3-8 illustrates this approach:

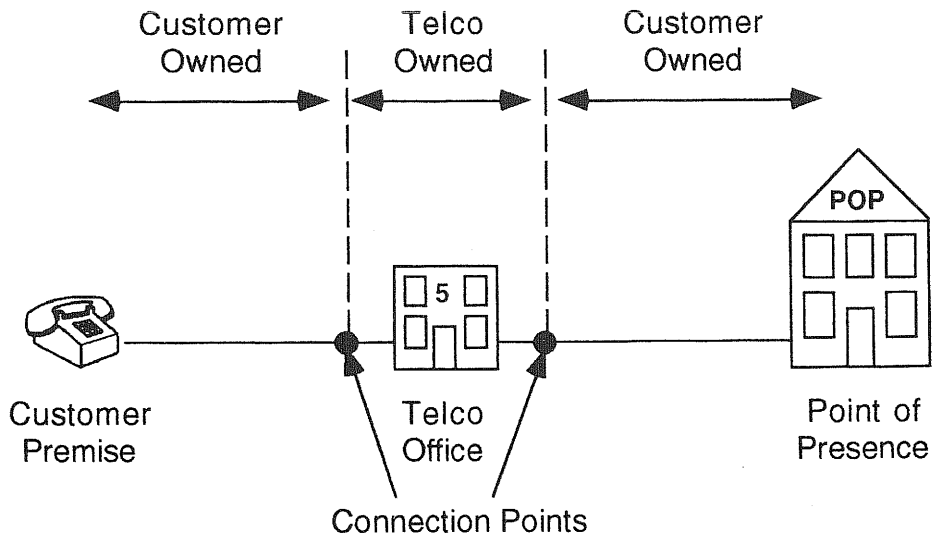

Fig. 3-8. The FCC's alternative scenario for access: the unbundled local loop.

Of interest to a consideration of local loop competition is the FCC's move from a limited, trunk-side unbundling to a total unbundling of facilities between the central office and all premises. In effect, this alternative suggests the possibility of the unbundling of all channel termination facilities, including the "loop-side" terminations. This is a clear step toward unbundling facilities between customers and the LEC. The final step would appear to be unbundling of loop facilities in general, a move that is being seriously contemplated in some states and acted upon in others.

State Activities Regarding Unbundling, Expanded Interconnection and Colocation

The New York and Illinois regulatory commissions have been the leading commissions in unbundling and interconnection. In a decision regarding the unbundling of PBX and Centrex lines, the New York Commission notes: "Experience in telephony has shown time and again that monopoly prospers and competition flounders unless segragable services are unbundled and offered in their elemental forms, accompanied by reasonable and fair interconnection terms."[69] Activity at the state level regarding expanded interconnection has actually been more robust than at the federal level.

At the state level, alternative fiber providers like Teleport and MFS have sought, and attained, interconnection with the local telephone company office. In Chicago, a competitive access provider (CAP) may connect to the public network through a virtual colocation arrangement very much like that proposed by the FCC in its expanded interconnection proceeding. At this point, interconnection appears to be limited to the trunk side of the class 5 office and to private line services. That may change in the near future.

In a monograph entitled *Telecommunications Free Trade Zones: Crafting a Model for Local Exchange Competition*, Commissioner Barnich and his staff propose a whole new vision for the city of Chicago.[70] That vision includes the provision of any telecommunications service by any provider, number portability, and total

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[69] Opinion and Order Concerning Comparably Efficient Interconnection Arrangements, and Instituting Proceeding, Opinion No. 91-24, p. 22. This opinion is part of three proceedings: Case 88-C-004 (Proceeding on Motion of the Commission to Review Telecommunications Industry Interconnection Arrangements, Open Network Architecture, and Comparably Efficient Interconnection); Case 88-C-063 (Proceeding on Motion of the Commission to Review Intellipath II Digital Centrex Service Pricing and Rate Design); and Case 91-C-1174 (Proceeding on Motion of the Commission Regarding Comparably Efficient Interconnection Arrangements for Residential and Business Links).

[70] Terrence Barnich, Craig Clausen, and Calvin Monson, "Telecommunications Free Trade Zones: Crafting a Model for Local Exchange Competition," *ICC Monograph,* January 1992.

interconnection. To demonstrate the viability of this vision, the monograph cites the various forms of competition already prevalent in the Chicago area: cellular service, competing fiber optic systems providers, and smart buildings.

In New York, the Public Service Commission (PSC) has begun to implement some of the same elements suggested in the Illinois monograph. The New York PSC, in the late 1980s, allowed New York Telephone to provide virtual colocation, in a plan very similar to that proposed by the FCC's expanded interconnection docket and currently in effect in Illinois.

Finding virtual colocation to be less efficient than physical colocation, the Commission approved an Optical Transport Interconnection Service (OTIS) tariff, effective May 10, 1991, which allowed physical colocation by New York Telephone's private line and special access service competitors.[71] As the name implies, OTIS involves the interconnection of fiber optic facilities. According to the OTIS tariff, alternative service providers pay New York Telephone rent for use of the central office, in return for which the alternative provider is given a specified amount of floor space, the ability to locate their equipment in the central office, and constant access to their equipment. The OTIS tariff also requires that alternative service providers pay Universal Service Elements. These are charges meant to provide New York Telephone with some of the contribution they ordinarily get from state private line and special access services. In other words, these services are priced above their marginal costs and contribute toward the company's overall cost of service. When these services are replaced by competitors, that contribution is no longer available, placing more of a burden on local service rates. The Universal Service Elements defray some of that loss.

Building on the success of this undertaking, the New York PSC has moved from allowing trunk-side interconnection to the class 5 office, to allowing loop-side interconnection as well. PBX and Centrex loops have been unbundled and steps are being taken to extend unbundling to residential and business lines. PBX and Centrex

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[71] Gail Garfield Schwartz, "Infrastructure, Competition and Policy," a paper presented at the Conference on Telecommunications Free Trade Zones: A Model for Local Exchange Competition, Evanston, Ill., March 30, 1992.

lines have been unbundled into port and link charges. According to the New York PSC order,

> A link is a pair of wires, or a virtual circuit path, to the LEC switch. The port embodies the function of providing dial tone to the Public Switched Network and possesses a unique network address (e.g., a telephone number).[72]

It is interesting to note that the New York Commission recognizes the addressing function as an integral component of the port charge.

In this arrangement, alternative Centrex and PBX line providers will purchase ports; those using telephone company lines will pay link and port charges. This is in recognition of the idea that

> the only portion of the subscriber loop that is a monopoly is the point of entry to the switch--the port. We intend that all subscriber loops be separated into links and ports, so that all links will be open to competition.[73]

In determining where to establish the demarcation point between the port and the link, the NYPSC has chosen the main distribution frame (MDF) as the proper location because

> this is the point where outside plant facilities (links) terminate, and access to the central office switch originates (ports)."[74]

Note that in both the Illinois and the New York models, access to the class 5 office is essential for viable intrastate private line and viable local loop competition to take place. For these services, the class 5 office is both the means of connecting to a

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[72] NYPSC, Opinion No. 91-24, p. 4.

[73] Schwartz, "Infrastructure," p. 6.

[74] Opinion No. 91-24, p. 25.

customer (for intrastate private line) and to the rest of the world (PBX and Centrex providers).

The process by which expanded interconnection moves from private line to local service is an understandable one. Once alternative carriers hook on to the class 5 office at the trunk side, with no technical problems, the prospect of hooking up at the loop side becomes a much stronger possibility. The movement to unbundle local services, encouraged by the ONA proceedings, makes it easier to regard the loop and the class 5 office as separable entities. Once the loop and the office are separable, local loop competition becomes a more likely proposition.

The drive toward local competition is actually moving with great speed at the state level. A recent survey of the status of local competition in 27 eastern states yielded some interesting results.[75] Eleven of the states surveyed allowed some form of local competition by competitive access providers. In most of those states, the competitive providers are currently allowed to provide only non-switched local services. Four of the states allow some form of switched local service. Most of the states surveyed stop short of allowing competitive providers to provide subscriber-to-subscriber local service; limiting competitive access providers to, for the most part, offering connections between LEC offices and long distance carrier points of presence. New York has been the most aggressive in allowing competitive access providers to provide loop-equivalent services, while the Illinois commission is now considering a generic docket covering a broad range of issues regarding local competition. Only two of the eastern states, New York and Massachusetts, have explicit policies covering colocation and interconnection.[76]

Expanded interconnection and local competition raise some issues of concern. Stranded loop investment and the impact on universal service if alternative carriers "skim the cream" from LEC provided services are familiar issues. Other problems that arise may not be so familiar: how to handle floor space in the event of physical colocation, how to provide number portability for alternate service providers, how to

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[75] *State Telephone Regulation Report* 10 (June 4, 1992).

[76] Ibid.

interconnect a variety of service providers, and how to determine compensation arrangements.

With cable companies adding fiber to their networks, and with alternative service providers like Teleport and Metropolitan Fiber Systems accelerating the availability of fiber to large volume users, there will be no shortage of service providers seeking to complete their offerings through interconnection at the class 5 office. Indeed, those state regulators who are proponents of local loop competition look forward to such an outcome. Terrence Barnich, in describing the workings of the Telecommunications Free Trade Zones, notes that universal service from all providers will be required, and that "the potential linkage of the switched telephone network to cable television systems makes this all the more plausible." Former New York Commissioner Schwartz envisions radio-based subscriber access in the near future.[77] It is interesting to speculate about the mechanism for requiring a universal service obligation of all service providers in a Telecommunications Free Trade Zone. Such an approach would require specific legislative or regulatory action.

Radio-based subscriber access requires less speculation. As this study has shown in earlier chapters, wireless technologies like cellular service and PCS/PCN can, and in the case of cellular already do, provide customers with an alternative to a wire-line local loop. Alternative access providers like Teleport and MFS stand ready to offer fiber optic connections to the LEC class 5 switch at the trunk side of the switch and, eventually, at the line side as well. Cable companies are also preparing to provide fiber optic pathways to a customer's home. Indeed LECs themselves are exploring the provision of fiber optic connections as close as the curb, or even into the subscriber's residence.

The basic technologies required to fulfill the vision of a Telecommunications Free Trade Zone are well on the way to being developed. The regulatory and economic issues underlying this vision of the future still need to be addressed.

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[77] Barnich and others, "Telecommunications Free Trade Zones," p. 16; and Schwartz, "Infrastructure," p. 6.

The Numbering Plan and Number Portability

A major strength of the PSN has been its numbering scheme. The NANP has provided a means by which everyone connected to the PSN has a unique address which can be reached by everyone else on the network through a relatively simple, uniform dialing scheme.

The ten-digit NANP scheme is an integral part of the call routing process. The first three digits of the ten-digit number, the NPA, signify the geographic location of the called party; the next three digits (the NXX code) signify the central office. The final four digits signify the specific line being called. This simple dialing scheme allows customers to place calls without operator intervention (Direct Distance Dialing). Despite divestiture, and the resulting emergence of hundreds of new interexchange carriers, the common acceptance of the NANP by all parties prevented major disruptions in the long distance market for customer, LEC and carrier.

Indeed, in the long distance market, the provision of equal access demands dialing parity. Non-AT&T carriers do not receive equal access services as long as their customers have to dial additional digits to reach their carrier of choice. The importance of addressing is not lost on regulators at the local level, as is evident in New York and in Illinois, two states which are actively pursuing local loop competition. In their proposal for a Telecommunications Free Trade Zone, the Illinois Commission includes total number portability. In describing the unbundling of centrex and PBX loops into "links" and "ports," the New York PSC specifies that the port includes an address, or telephone number.

Any analysis of potential local loop competition should include some consideration of the impact on the current numbering plan. Three potential impacts, in particular, should be addressed: (1) number exhaustion; (2) cost of interconnection and translation; and (3) impact on separations.

Number exhaustion is already a problem because of growth in traditional access lines. Because of this growth, the initial scheme of limiting central office codes to an "NNX" format, in which N can only be a digit between 2 and 9, while X can equal any digit, has been changed to an "NXX" format. This change provides an additional

152 central office codes per NPA. The exhaustion of NXX codes has been exacerbated by cellular service. The FCC, in determining that cellular providers should be deemed equal to independent telephone companies, specified that the BOC administering the NANP scheme in each NPA assign each Type 2 cellular provider its own full 10,000 number NXX.

Exhaustion of NXX codes is not the only potential problem; NPA codes are slated to run out in mid-1995. There have been many suggestions for expanding the available pool of NPA codes, from collapsing NPAs to changing the current N 0/1 X format to an NXX pattern. No matter what is done to deal with the number exhaustion problem, the solution will be costly. All network switches will have to be updated. If substantial changes are made, like adding digits to the current 10-digit format, billing and record systems will have to be revamped. The question of how these costs will be recovered by the local telephone companies and what the impact on affordable telephone service may be as a result, will be matters that regulators will have to consider.

A third point of concern is the impact on jurisdictional separation as a result of changes in the numbering scheme. One of the views of what is to come is number portability. Up until now telephone numbers have been associated with a specific location. As a result the jurisdiction of a call has been fairly easy to determine, at least at the originating end. The jurisdiction of a call is now defined by reference to the location of the calling party and the location of the called party. If a call originates in one state and terminates in another, the call is an interstate call. Conversely, if the call both originates and terminates in the same state, the jurisdiction is intrastate. The actual routing of the call is not at issue, only the originating and terminating locations. And the locations of the terminating and originating locations are evident from the telephone number itself because the telephone number has been perceived as stationary.

It has never been easy to determine the jurisdiction of a call at the terminating point. Terminating call traffic does not bring with it information about originating location. As a result, telephone companies have had to, for all practical purposes, estimate the jurisdiction of terminating traffic. Before divestiture, companies did some

sampling through the Central Message Distribution System (CMDS) and imputed that sample result to total traffic. The advent of divestiture broke up the CMDS system, and telephone companies have been trying to develop alternative methods for determining the jurisdiction of terminating traffic and of 800 and 900 calls. One such method is the STARS program.

The importance of jurisdiction has been evident in the access arena. LECs bill IXCs for terminating as well as originating traffic. Since the LEC cannot determine the jurisdiction of terminating traffic, the LEC bills the IXC on the basis of estimates the IXC provides on what the split between interstate and state terminating traffic may be. Because there is seldom exact parity between state and interstate access charges, jurisdiction has a significant impact on LEC revenues and IXC costs. It is sobering to realize how much of that revenue impact is based on estimates of jurisdiction.

The implications of jurisdiction go deeper than access charges and access revenues; they go to the very heart of the separations process. The costs of telephone company joint plant and associated expenses are jurisdictionally separated based on usage factors. Equipment which can be shown to be solely dedicated to one jurisdiction is directly assigned to it. The vast majority of telephone plant and expense, however, is used jointly to deliver local, state, and interstate service. Outside plant and circuit equipment used in the provision of state and interstate traffic are allocated on SPF or on conversation minutes and conversation minute miles. Switching equipment is allocated on dial equipment minutes.

The measurement and development of all of these factors (SLU, SPF, DEM, CM, and CMM) are based on the premise that jurisdiction can be determined. Changes in these factors can have profound effects, shifting large dollar amounts between jurisdictions.

As new services emerge, and seek to interconnect with the telephone network, and as telephone numbers move from being location-specific to being person-specific, the ability to measure with any degree of certainty the jurisdiction of the services provided may be adversely affected. The result may be a need to change current separations practices significantly. Indeed, it appears that a comprehensive

examination and reassessment of the separations process is about to be jointly undertaken by state and federal commissions.

Changes in separations practices may be dependent on profound changes to the whole area of call routing and signalling. Signalling Systems 7 (SS7), an enhanced signalling system which is currently being deployed throughout the LEC and IXC networks, may provide the mechanism for carrying call information sufficient for tracking jurisdiction for separations purposes. Accommodating these modifications to the separations process and the multitudinous systems which feed that process, will be expensive.

Signalling System 7

A signaling system has been described as something "analogous to the central nervous system of a living organism, something to coordinate the functions while remaining completely separate from the organism's other parts and not actually performing their function."[78]

Traditionally, the perceived need for signaling in the PSN was limited to providing status information (a station is on-hook or off-hook, signaled by DC current or a single-frequency tone) and call destination information (that is, the dialed number, signaled by dial pulses or multi-frequency tones). The main characteristics of these signaling functions are that they travel over the same facilities as those used by the actual calls, and that their capacity and flexibility is limited.

The wide-spread introduction of electronic (program-store) switches, which execute sophisticated computer programs, allowed the concept of signaling to be revisited.[79] Currently LECs and several IXCs are installing a separate signaling data network to connect all switches, network databases, and network management stations. Signaling information such as messages needed to set up or terminate a call will no

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[78] W.C. Roehr, Jr., "Inside SS 7," *Data Communications*, October 1985, p. 120.

[79] A good historical and technical overview may be found in Abdi R. Modarressi and Ronald A. Skoog, "Signaling System No. 7: A Tutorial," *IEEE Communication Magazine,* July 1990, p. 19, and references herein.

longer be exchanged over the actual public network, but will instead be transmitted between the network elements involved via the separate network.

SS7 is described in a series of standards published by the International Consultative Committee for Telephone and Telegraph (CCITT). These standards have been adopted by the American National Standards Institute (ANSI).

In this context it is important to note that the SS7 standards are closely tied to the Integrated Services Digital Network (ISDN)[80] Access Signaling (referred to as Signaling System No. 1). In fact one attraction of ISDN is its ability to give the end-user, via the local loop, access to the signaling system of the carrier(s) handling the actual call. This capability allows the user stations involved in a call to exchange end-to-end messages during the voice or data call, or to affect the characteristics of the call while it is in progress. This concept and its related benefits rely on all network elements, and therefore all network service providers, utilizing interconnected, compatible signaling system.

The SS7 standards use a layered approach based on the OSI reference model to describe the methods by which messages of various types may be transmitted over the network. Once fully integrated into a carrier network, SS7 will appear as two distinct components. On the one hand, the SS7 standards describe a highly reliable data network for the transport and delivery of messages, using a structure similar to an X.25 packet network. It should be noted that the reliability of the entire carrier network depends on the signaling system, since no call setup can occur without it.

The second aspect of SS7 is in the higher-level functionalities built upon the signaling network. The existence of the signaling network allows the administration of

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[80] ISDN is a CCITT standard which describes a universal transmission and signaling architecture for a future, all-digital network. In the United States, carriers are in the process of implementing two ISDN access methods, the basic rate interface (BRI), and the primary rate interface (PRI). Under the BRI method, an existing local loop is reconfigured for the digital transmission of two voice or 64kbps data channels, plus a separate 16kbps signaling channel, over a single two-wire loop. The PRI is based on a 4-wire local loop configured in the same way as a traditional 1.5Mbps DS1 (or T1) channel. The PRI provides 23 voice or 64kbps data channels, plus one 64kbps signaling channel. Widespread adoption of ISDN as an alternative to the current analog utilization of the local loop will depend on the availability of affordable equipment and ubiquitous ISDN service across the country.

very complex databases in a centralized manner. Applications like the Virtual Private Network, which require an extensive database to implement (and in some cases a database which the end-user can modify in near real-time), cannot be implemented in a distributed architecture where each switch requires a complete copy of the user database. Using SS7, the database remains in one place, and is queried by each switch as needed, using standard messages over the signaling system.

SS7 is currently deployed by each IXC for signaling among its own switches. Similarly, LECs are deploying intraLATA implementations of SS7. The ultimate goal, of course, is to interconnect all SS7 subnetworks into a national signaling network, which could be accessed directly by ISDN users and utilized by all service providers for call setup as well as enhanced services.

Some examples of these enhanced services are 800, and especially enhanced 800 services. During the call setup, SS7 is used to query network databases for call restrictions (that is, some 800 customer may accept calls only from a specific geographic area) and call routing (enhanced services allow an 800 call to be routed to different destinations based on the time of day).

Other examples of SS7 utilization include calling card calls (the calling card and Personal Identification Number are authenticated using an SS7 query), as well as a number of services commonly referred to as Advanced Intelligent Network, such as call forwarding, caller ID, and blocking of caller ID information.

The new technologies described in this report will for various reasons only increase the need for an integrated signaling system. PCN, for example, relies on signaling to locate subscribers. High-bandwidth, fiber-optic transmission of multimedia (voice, data, image, and video) calls will require access to the signaling system to adjust and manage the bandwidth utilization during the call.

At the same time, it is likely that the access to the network will no longer be exclusively "channeled" through a common local loop. Indeed, no single body may exist to enforce adherence to standards in the way Bellcore performs this function today.

The likely impact on the user may be that of confusing and potentially expensive incompatibilities between the access methods to the signaling system(s) of

different local loop providers. The availability and quality of access to the signaling systems may well become so fundamental an issue as to fall under the umbrella of universal service. For this reason, the issue of access to the signaling system will increasingly become a potential object of regulatory action.

CHAPTER 4

AN ANALYSIS OF POSSIBLE COMPETITIVE SCENARIOS

This report has presented an overview of the capabilities, current regulatory treatment, and the deployment mode of five technologies: the copper loop, fiber optic facilities, coaxial cable, cellular service, and PCN/PCS. It has also discussed some of the salient policy considerations surrounding the issue of local loop competition occasioned by the operating features and economic characteristics of the new technologies.

The purpose of this chapter is to examine, in the context of the information provided in the earlier chapters, potential competitive situations which may develop in the next five years. It is hoped that by doing so, the reader's understanding of the regulatory policy consequences will be strengthened. Equally important, this chapter evaluates the outcome of different approaches to those situations.

Impact on Loop Competition of Converging Technologies

The telephone company local loop faces potential competition from a variety of technologies and industry groups. The portability of wireless communication and the large amount of bandwidth available on fiber optic facilities owned by cable companies or alternative transport providers like Teleport will present significant competition for the copper twisted-pair local loop. The synergies available should these various alternative technologies converge could present a substantial threat to traditional telephone company local loop services.

This study will address the potential forces at work from two perspectives: the services offered through the various technologies, and the generic strategies of the current providers in the industry.

Referring back to table 2-6, we can discern a number of trends. The LECs have a majority of their local loop investment in copper twisted pair technology. This provides them with the ability to serve effectively the needs of low to medium volume

voice transmissions. Table 2-6, however, shows two areas of service (and demand) which the LECs are not well positioned to address due to their copper local loops. One of these areas is the need for mobility of the user's terminal equipment, even if this forces the user to accept lower available bandwidth. The second area is the provisioning of high-bandwidth services for high-speed data, image, and video transmission. The need for both services is unknown, but thought by some to be sufficient to support the requisite investment in these technologies.

Mobile services are best provided by wireless technologies (cellular now and PCN in the future), which absent a net significant increase in demand creates an inevitable loss of traffic on the LEC local loop. While LECs can enter the wireless market themselves, the likelihood remains that the current local loop facilities will become less utilized, putting an upward pressure on the cost of traditional residential and business lines.

High-bandwidth services will most certainly be delivered over fiber optic distribution architectures. The LECs have the opportunity to exploit this trend during the natural depreciation and replacement cycle of the local loop facilities (hence the current interest in fiber-to-the-curb and fiber-to-the-home projects). However, alternate access providers and cable TV providers are at least equally well positioned to install and operate competing fiber optic cable plant.

From the demand side we see that the move to increasingly mobile voice and low-speed data communications pushes the LEC local loop towards providing primarily high-bandwidth services most suited to transmission over fiber-optic cable. As the LECs are pushed in this direction, they will then find themselves heading straight into competition with the cable TV and alternate access providers. In fact, we may be headed for a virtual reversal of existing information distribution methods.

Today, low-bandwidth data are primarily distributed over landlines, and high-bandwidth information has been assigned to large (analog) portions of the wireless spectrum in the form of broadcast TV and microwave facilities. The information infrastructure of tomorrow may well see low-bandwidth voice and data occupy the airwaves, with high-speed data, image, and video traveling over fiber optic

landlines. The resolution of various policy options -- such as spectrum allocation -- will influence whether this outcome occurs.

From the point of view of the existing providers, a recent industry study explains how and why these various technologies may converge.[1] Of real concern to LECs will be the ability of these various technologies to permit nonLECs to form alliances which, for all purposes, bypass the LEC almost completely. In actuality, however, the LECs have also been very active in seeking strategic alliances (and acquisitions) with all kinds of firms.

According to the Donaldson, Lufkin, and Jenrette study, there appears to be a natural alliance between cable companies and alternative access providers like Teleport.[2] Indeed a real alliance is being formed by the purchase of Teleport by TCI and Cox enterprises, two of the largest cable companies. While cable companies have mainly served suburban areas; metropolitan fiber providers like Teleport have built facilities in urban areas and have (or shortly will have) switching capabilities. Cable companies, unaccustomed to providing a full array of switching services or to providing crucial business functions for large corporations, can gain both of those capabilities through a partnership with companies such as Teleport. Meanwhile, metropolitan fiber providers, by teaming with cable companies, broaden their reach beyond urban areas. Cable companies' recent plans to replace their coaxial facilities with fiber optics add yet another dimension to what these alliances could offer -- an almost totally broadband network, complete with switching capability, reaching urban and suburban areas, and serving both businesses and residences.

In short, this convergence of fiber providers and cable companies can create a network parallel to the public network. This alternative network would require interconnection to the public network at times, but much of the traffic may never need to touch it.

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[1] Joel D. Gross and Suzanne Becker, "Local Telephone Competition Intensifies as Strategic Competitors Converge. Could This Become the Telephone Company's Worst Nightmare?," *Industry Viewpoint,* Donaldson, Lufkin & Jenrette, May 18, 1992.

[2] Ibid., p. 4.

The implications for the telephone companies of this convergence can be even greater than they seem at first glance if the long distance carriers find that such a network provides a cheaper means of accessing customers. If the cable-fiber provider network offers access that is priced below the access charges which LECs now charge through their state and interstate access tariffs, long distance carriers will be quick to take advantage of the situation, and will, in the process, bypass the local exchange telephone companies.

As has been shown earlier in this study, alternative fiber providers are becoming more significant competitors to local telephone company services. While limited to providing special access services at first, they are moving quickly into the provision of switched services. With actions like those recently taken by the New York commission, alternative fiber providers will be able to offer PBX and Centrex connections as well. As regulatory barriers fall, these alternative providers will be able to offer services on a par with those available from the telephone company, and may be able to offer them at lower rates and with added functionality because of the fiber medium.

The Donaldson, Lufkin, and Jenrette study suggests that wireless competitors like PCN and cellular will become a substitute for the copper landline networks for a significant percentage of the population.[3] Portability is a feature which the landline networks cannot provide and a feature which many users may find increasingly convenient and attractive. Wireless services by themselves could represent a significant competitor to landline loops. When combined with other alternative service providers, wireless services could represent even greater competition to the traditional telephone company. The impact here is mixed as LECs own wireless companies in their own territories.

Wireless technologies like cellular service have required connection to the public switched network to complete calls to landline customers. If these wireless technologies are linked to networks provided by cable companies or cable companies in tandem with alternative fiber providers, calls among a variety of wireless and wired

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[3] Ibid., p. 11.

customers can be completed without any connection to the public network. PCN services will be provided through microcells covering a relatively small area. These microcells have to be connected to switching facilities. A topology which might prove attractive for PCN service would be to use the cable company's suburban infrastructure and the alternative fiber provider's urban infrastructure to haul signals from PCN antennae to the alternative fiber provider's switch. In this scenario, the telephone company is not involved at all. Alternatively the LEC-owned wireless company could enter into alliances with all these same providers and preempt the nonLEC wireless companies.

Even with such a self-enclosed topology, the alternative network would eventually require interconnection to the public network in order to complete some calls. However, this topology suggests a host of subscribers able to meet many of their communication needs without the public switched network and without a local loop connection purchased from the local telephone company.

Possible Local Loop Competition Scenarios

The following are discussions of three possible scenarios in which significant competitors to the local loop emerge. While the scenarios are based on different technologies or industry players, all three ultimately address common themes and concerns.

At the base of any discussion of local loop competition is the assumption that significant numbers of telephone company local copper twisted-pair loops will be replaced by alternative technologies. This replacement of telephone company facilities has been a common theme in all discussions of competition to the public switched network; it is the theme of bypass.

If the telephone company local loop is bypassed, or replaced by alternative providers, the results which may occur include stranded telephone company investment, higher rates for those left using telephone company facilities, an erosion of the financial viability of the telephone company, and a threat to the affordable

rates which have been perceived to be at the heart of universal service in this country.

Indeed any discussion of bypass comes back to the issue of universal service. A discussion of these various scenarios must extend the discussion of universal service to ask whether these new local loop alternatives, with their technologically advanced features, should not broaden the very definition of universal service beyond POTS to include video dialtone or number portability.

Discussions of these various scenarios must also address the tension between competition and monopoly. Local loop monopoly assumes averaged rates and averaged services for all. Competition assumes a market-driven approach to pricing, to enhanced service, and to service availability. If a basic underpinning of telecommunications policy is the continued provision of universal service, it is possible that competition, despite all of its benefits, will irreparably harm that public policy goal. To maintain universal service in the face of rising competition, competitive providers may have to bear some of the costs of maintaining basic, affordable service for all.

The prospect of strong competitors to the current local loop also raises questions about their status. Whether they should be considered common carriers and whether they should have the obligation to serve -- perhaps even as a carrier of last resort -- are relevant questions. Another question may be whether the creation of a number of viable alternatives to the local loop may not make any form of regulation superfluous. Perhaps the marketplace, given enough competitors, would automatically provide affordable and desirable service to all requesting it.

All of these issues are addressed to some extent in each of the following three scenarios. These scenarios are similar in that they each address a situation in which significant competition develops for current local loop services. The basis for that competition, and the emphasis placed on specific policy concerns, are a bit different for each situation presented, however. PCN/PCS, which offers a feature wireline loops cannot (that is, portability), raises concerns about interconnection, numbering plans, preemption, and jurisdiction. Alterative fiber-optic cable providers (ALTs), who are positioning themselves to offer more bandwidth at lower prices than LECs have

been able to do, raise questions about interconnection and "cream skimming." The cable television scenario exemplifies concerns about jurisdictional issues, about the tension between legislative and regulatory approaches, and about the continued viability, indeed the very definition, of universal service.

These are only a few possible scenarios. Other combinations of industry players and technologies are possible, and indeed should be analyzed. A consideration of all such combinations, however, will almost inevitably focus on the questions and issues addressed here.

Scenario #1: PCN/PCS Becomes a Significant Competitor to the Local Loop

PCN/PCS services offer a feature that the current twisted-pair based local loop cannot practically offer: portability. Indeed, even if the copper loop were replaced with fiber optic cable (and all the broadband services fiber optic could provide), the loop would still not be able to provide this feature. There is the possibility that portability will prove so attractive to customers that PCN/PCS services may actually replace significant numbers of LEC provided local loops. The impact on the local loop and on universal service could be grave. The likelihood of such a development is one that regulators should at least consider.

Some industry analysts foresee a bright future for PCN/PCS services. An Arthur D. Little market study estimated that 15 percent of all households would subscribe to the service if it were offered within the next three to five years, and that 60 million people (about 24 percent of current population levels) would subscribe within the next 10 years.[4] It is of course impossible to gauge the accuracy of such estimates; however, these estimates suggest that a significant migration from wireline loops to PCN/PCS loops may take place as these new wireless services are deployed in the next three to ten years.

It is, of course, possible that PCN/PCS services will merely be an extension of the local loop, or a parallel service to current wireline loop connectivity. Since PCN

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[4] As quoted by Monheim, "Personal Communications Services," p. 344.

services appear to offer most of the features now offered by a voice-grade physical loop, plus offering the added bonus of portability, it is safe to assume that a certain number of physical loops will come to be regarded as redundant. If it is assumed that a significant percentage of local loop customers will replace their service with PCN service, it is also safe to assume that such a development would have serious implications for local service as it now exists.

It is important to note that the stage for PCN/PCS is being set at the federal level, as was the case with cellular services. The FCC is considering, among other items, how PCN/PCS providers will be licensed, how many will be licensed in any given area, what that given area will encompass, how licenses will be deployed, and what qualifications potential licensees will have to demonstrate. Since the FCC has stated a preference to regulate these new services lightly in order to facilitate innovation, it is likely that PCN/PCS providers will not face much, if any, service or rate oversight at the federal level. The cellular example is significant here.[5] The FCC did not make state certification a requirement for applying for a cellular license. Since, as is the case with cellular, only the FCC can grant frequency licenses, the ability of the states to determine how many PCN/PCS providers there will be and who they are will be severely constrained.

In establishing cellular service, the FCC did note that the states would retain oversight over intrastate uses. Any state traffic traversing a cellular system is subject to state commission regulation. This same dichotomy will probably pertain to PCN/PCS as well. As a result, any actions which state commissions may wish to take regarding PCN providers may be fairly limited in scope.

A basic concern for regulators should PCN connections significantly replace physical loops would be the continued existence of affordable universal service. A significant decrease in number of subscribers for local loop services would result in

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[5] The regulatory approach to cellular, and the FCC's decisions in deploying that service, are discussed at some length in chapter 2.

stranded investment, revenue shortfalls, and pressure on the local telephone company to increase rates for those still on the network.[6]

Increases in rates for those remaining on the network could have a spiraling affect, with even more users leaving the network. As rates increase, the question of universal service and affordability must be considered.

There are different approaches to this scenario. Those regulators mainly concerned with the preservation of universal service through affordable local rates might decide to levy a universal service charge on PCN providers. This charge could be built into the cost of interconnection to the public network, or could be built into PCN providers' rates. If the charges were paid by PCN providers to the LEC, the price of the LEC-provided local loop would remain low as a consequence. Subsidies could be paid into a central fund for dispersion directly to customers in need of support. In either case, LEC local loops would not be disproportionately higher than PCN connections merely because the LEC bore the full cost of supporting universal service while the PCN providers did not. "Too much" of a contribution would hurt the ability of wireless companies to compete.

Regulators primarily concerned with the deployment of innovative services and the enhancement of competition would avoid the levying of any universal service charge on PCN providers, leaving the market and the customer to decide the relative merits and usefulness of the competing services. Indeed, at an extreme, a regulatory body could decide that PCN represented a significant enough competitor to the local loop to justify the end of local loop regulation, leaving the whole issue of service and pricing to the market.

Regulators may find that pricing will be the key to maintaining both viable telephone companies and strong PCN competitors. If PCN providers price on a usage basis, LEC flat-rated pricing, even at a slightly increased level, could still prove attractive enough to avoid a large migration to PCN services, despite the attractions offered by portability. Also, local measured service pricing, targeted below PCN rates,

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[6] This issue is relevant for all possible scenarios in which any competitor replaces a significant number of local loops, whether that competitor is a wireless service provider, a cable television company, or an ALT.

could be a feasible way of providing LEC revenue, preserving a low flat-rate basic rate, and keeping LEC services an attractive alternative.

Regulators primarily concerned with maintaining low local loop rates may continue a residual pricing approach, raising rates on other LEC services before increasing local rates. This process may prove more difficult than has been the case in the past. Because these other LEC services (intraLATA toll or access charges for example) are facing competition, raising rates for these services may create other problems.

Regulators primarily concerned with encouraging competition will favor more cost-based local rates and will be concerned that LECs not be able to take advantage of market dominance and so underprice their services to the detriment of their competitors.

The question of the PCN provider's status will also be of interest to the regulator. Should the PCN provider be regarded as a common carrier, and, as such, should there be an obligation to serve? Will there be any indication that PCN service could become so widespread that that service can be defined as "universal service," and so should the regulator become concerned with the affordable pricing of PCN service as well? Should PCN services be tariffed and overseen by regulators? If there are several PCN service providers licensed in each location, competition may be sufficient to regulate pricing and service quality. If only two PCN providers are licensed, should regulators step in to assure fair pricing and good service?

PCN service providers will need interconnection to the public network, just as cellular providers do today. The status and cost of that interconnection should be of concern to regulators. If the cost is high and the interconnection provided is inferior, PCN services will not flourish. Conversely, if interconnection is provided too cheaply (that is, significantly below the cost of provision), to the detriment of the LEC, local loop service will be damaged and PCN services will receive an unfair competitive advantage.

The manner in which interconnection is provided should be of concern to regulators as well. Cellular connections are negotiated. If PCN services are deployed more widely than cellular services, especially if a large number of PCN providers are

licensed in each locality rather than just two providers as is the case with cellular service, negotiated agreements may be too onerous. In those circumstances, interconnection could be regarded as a tariffable service, especially if regulators are concerned about nondiscriminatory provision of interconnection.

As mentioned earlier, the deployment of cellular service has begun to place a strain on the NANP. If a significant number of PCN service providers are approved, the North American Numbering Plan may have to be significantly revised. A result will be the need to reprogram all switches by all service providers. A question that should be faced by regulators will be assignment of responsibility for implementing the new plan. If PCN services, which caused this need, do not bear some of the financial burden, they will have an unfair competitive advantage vis a vis standard local services. And if they pay too much, their ability to attract new customers will suffer.

An additional question related to interconnection deals with intelligent networks. PCN services will be dependent upon an intelligent network, a network similar to the SS7 networks being developed by LECs and long distance companies. Should interconnection entail access to SS7-type services?

PCN deployment would have far reaching effects on more than local service. Because the Subscriber Line Charge (which end users pay) and the Carrier Common Line Charge (which long distance carriers pay) that help to defray interstate costs of the local loop are based on number of lines, rates for long distance services would be affected, as well as local rates.

The lower the number of Subscriber Line Charges (SLCs) to be levied, the higher the amount of revenue to be generated through Carrier Common Line Charges (CCLs). As CCL charges increase, the incentive for long distance carriers to bypass the LEC increases as well, placing another LEC revenue stream in jeopardy. Since affordable local rates have depended upon a revenue stream from long distance and access services, this lost revenue stream would put pressure on local rates as well. The increased CCL rates could also have a tendency to increase long distance rates, since interexchange carriers pass along CCL charges to long distance customers.

Scenario #2: Alternate Access Providers Become Significant Competitors to the LECs.

At the present time, alternate access providers, also referred to as Alternate Local Telephone providers (ALTs), have gained a small market share in a number of large metropolitan areas. Their revenue is derived from the sale of special access services. As we have described in this report, the ALTs are currently pursuing an aggressive strategy of gaining interconnection with the LEC network. Regulators seem poised to grant these requests, and it is likely that the ALTs will request authority to provide switched services soon.

This scenario assumes that the ALTs are permitted to provide a full range of services in a large number of geographic areas, and that they are successful in their initial entry into these markets. As a first step it is illustrative to review the reaction of the LECs to the services that are already being provided by the ALTs.

Where ALTs have introduced service into the major urban centers, the LECs have cut their prices and improved their service response time. While this is certainly good for the business users, the foregone revenues hurt the LEC. Even where the LEC makes a small percentage cut in its price, when this percentage is taken across a very large revenue base, the total amount of lost revenue can be significant. But, in fact, the prices cuts have been significant; in most markets, the LEC has reduced DS1 prices about 50 percent with the entrance of an ALT. This means a loss of about $800 million. With the arrival of ALTs, the LECs have also cut their interstate switched access rates from $.081 per minute in 1988 to $.047 per minute in 1992. Here, the revenue loss amounts to about $200 million. While the price cuts are one response to the entrance of a competitive ALT, the response may be more painful to the LEC than the ALT especially where the ALT can still make a profit at these lower prices because it has a lower cost structure.[7]

A second response by the LECs to ALT competition has been to upgrade their networks by deploying fiber optics, installing more advanced digital switching or increasing the "intelligence of the network". According to the FCC's 1992 Fiber

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[7] Gross and Becker, "Local Telephone Competition Intensifies," p. 27.

Update Report, the LECs have installed 160,000 sheath miles of fiber while all the ALTs have installed 2,071. Clearly the LECs have installed a large amount of fiber, but it must be remembered that the LECs have a far greater territory to cover while the ALTs have focused on the high density business routes. Some have suggested that the telephone industry would have to spend between $100 billion and $1 trillion[8] to fully deploy fiber to the home. It is unclear whether the LEC's installation of fiber in high-density routes will be sufficient to oust the ALTs from this lucrative market. As mentioned earlier, the ALTs not only provide services at a much lower cost than do the LECs but also provide "alternative service" (for reliability, security and insuring competition). If users are interested in obtaining reliability of service by obtaining a second provider, even though the LECs are providing redundant networks, then the ALTs will have a market no matter how low the LEC prices become.

It is important to note that any conclusion drawn about ALTs so far has been based on competition for a small number of services. It is illustrative to look at New York City, where the ALTs have made notable advances into the LEC market. The city has an enormously high concentration of large business users in a very small geographic area (Manhattan). In addition, a large portion of the voice and data traffic originating in the financial section is destined for points outside the New York LATA. This configuration provides an ideal market for an ALT which offers DS1 (T1) level service between a large user premise and one or more IXC POPs. By providing this service, the ALT completely bypasses the LEC network.

On the other hand, once interconnection is made available at attractive rates, and the ALT is permitted to provide switched services, two other avenues for the ALT to compete with the LEC open up.

First, the ALT may approach the large business user and offer PBX or Centrex lines between the user premise and the LEC class 5 office, in fact bypassing only the local loop. This approach will directly impact the local loop revenue flowing to the LEC, leading to the consequences discussed in the introduction to this section.

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[8] Anthony Ramirez, "Phone Link: Long Way to Go," *New York Times,* November 2, 1991, Sec. 1, p. 37.

Second, the ALT can in fact use the LEC local loop as a device to aggregate traffic. This is done by using the interconnection at the LEC class 5 office to take traffic from the LEC local loop and place it on the ALT network for delivery to the IXC POPs. In fact the ALT provides bypass for the LEC intraLATA network with the exception of the local loop. However, any significant market penetration by the ALT into the intraLATA access services will reduce LEC revenues and ultimately the local loop pricing through the loss of cross-subsidies built into the present rate structures.

As this scenario develops, regulators will be faced with difficult choices. On the one hand, one may wish to pursue competition aggressively by setting attractively low rates for interconnection, and by placing little or no limits on the services the ALTs may provide. This approach is almost certain to stimulate strong competition, availability of services at low rates, and the introduction of new technologies into the network. At the same time, increasing upward pressure will build in the local loop rates, leading to the potential problems with the LECs' financial viability and the loss of universal service discussed earlier.

On the other hand, a different approach would focus on maintaining the current local loop at affordable rates. Universal service contributions may be added to the interconnection rates, and significant restrictions related to their designation as a common carrier could be placed on ALTs which achieve a certain market share. Competition under this approach will develop more slowly, and the danger is that competition may indeed never develop except for a few selected markets. Without this competition, the introduction of innovations and new technologies into the local loop may be severely delayed.

As the third scenario will point out, the situation may be further complicated by the fact that the ALTs and the cable TV providers together may be able to take advantage of the competitive climate by combining the strengths inherent in their infrastructures.

Scenario #3: Cable/Telephone Separation is Lifted and Telcos Can Provide Video Service and Cable TV Companies Can Provide Telephone Service.

The characteristics of the local loop will surely be affected by whether the cable companies and the LECs are permitted to compete. The increasing use of fiber optic technology by both the LECs and cable companies is partly responsible for the potential for competition. Another factor is that most of communications, whether voice traffic, video or data, are now moving to technologies which are digital and integrated. This means that no matter what the information, it all can be digitized and sent through a digital pathway. One of the consequences of this is that if a company is going to lay fiber optic cable, which has an extraordinary capacity to transmit a large volume of information, there is the possibility of taking advantage of this capacity to fulfill all the customer's needs. In practical terms, if the phone company is already laying fiber and has a connection to the home, why not transmit video and data as well as the traditional voice traffic? At the same time, cable will need to pay off its investment in fiber. In addition to using fiber optics to broadcast video programming, why not use the same fiber connection to service the home's voice and data needs? Whereas cable and telephone companies were limited to specific information services in the past, the changes in digital and fiber optic technologies, is now making it possible for each of these industries to provide the services of the other.

Attitude changes towards the effectiveness of competition in regulating the telecommunications market are also making telephone/cable competition a possibility. The proliferation and convergence of technologies now allows competition among technologies. Rather than "picking a winning technology" by regulation, so that the phone company or the cable company is "selected" to deliver particular services, competition in the market would pick which of these technologies or combinations of technologies would best serve the consumer. This rationale underlies the video dialtone policy effort of the FCC.[9]

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[9] FCC, Further Notice of Proposed Rulemaking, First Report and Order and Second Further Notice of Inquiry on Telephone Company-Cable Cross Ownership Rules, Sections 63.54-6358, CC Docket No. 87-266 (November 22, 1991).

If the regulatory barriers were removed between the telephone companies and cable companies, what would the telecommunications industry look like? There are two components to this question. The first question is what would the new laws and rules governing the two industries look like? Second, what is the range of responses that the cable companies and LECs could take in response to the introduction of competition?

If political consensus to removing these ownership restrictions occurs, one of the more difficult questions in drafting regulation will be how much of the existing legislative and regulatory framework would have to change? If a "level playing field" is desired so that neither the LECs nor the cable companies would be encumbered by rules that affect their ability to compete, dramatic changes would be necessary since cable and telephone are regulated very differently and by different jurisdictions.

The Cable Act of 1984 preempts state regulation and gives cities the power to give franchises or permits to local cable operators. LECs, meanwhile, are subject to a federal/state regulatory partnership which itself is under continuing redefinition. To have a level playing field, the policies of these three entities would have to be coordinated so that their regulations do not unfairly handicap the ability of either cable companies or telephone companies to compete.

These dual regulatory structures pose problems in a number of ways. For example, before telephone companies can invest in fiber for regulated services, they must gain the approval of PSCs. Either the phone companies accelerate their depreciation schedules which increase costs to pay back their investment in copper wire or they can enter into social contracts with commissions to install fiber optics in return for pricing and service flexibility. If the LECs need to enter the video programming market in order to speed up the deployment of fiber to the home or to the curb, they would still have to convince legislators to make the necessary legislative changes to free them from this regulatory constraint. The question then becomes whether the LEC activities in the voice, data and video programming areas should be regulated, and, if so, by whom. Cable companies, meanwhile, should they desire to provide common carrier voice and data service may come under the additional regulatory supervision of state public service commissions and the FCC.

Cable companies face additional regulatory hurdles. Under the Cable Act, cable companies are required to obtain franchises from cities in the areas in which they operate. Frequently, there are service obligations and franchise fees attached to this franchise. Cable companies might argue that they are subject to this regulation when delivering video programming but that telephone companies are not. One legislative option would be to free the cable companies from the obligations under the Cable Act, but this seems unlikely. A second option would be to require LECs to obtain local cable franchises. One question that should be pursued under this scenario is how much of a competitive burden the franchise obligations are. Clearly, the options as they are proffered by the cable companies and the LECs involve dramatic changes in legislation. Changes to the Communications Act do not come easily. The legislative changes proposed by the cable companies and the LECs are equal to, if not greater, than those proposed following divestiture of AT&T.

If policy makers sought to craft this new legislation, one of the major obstacles to cable/telephone competition would be the familiar problem of cross-subsidization. Under the video dialtone proposal, LECs would provide common carrier services for traditional voice services as well as video programming. In addition, the video dialtone NPRM also asks comment on whether LECs should be allowed to produce their own video programming (currently prohibited by law but no longer prohibited as an "information service" under the MFJ). Cable companies fear that telephone companies would use the revenue flows from their regulated businesses to subsidize the LEC's entry into competitive production of videoprogramming or other information services. Ways to not only detect the flows but also prevent the use of cross-subsidies would need to be found. The assumption that fear of detection is sufficient to prevent cross-subsidization may no longer be valid.

While in theory the idea of competition selecting the winning and losing technologies and insuring cost and service discipline in the marketplace has significant merit, a fundamental question is how this competition would actually play out. For example, in order to have competition, there cannot be barriers to entry and exit for cable or telephone companies. The logic is simple: if someone can offer a better service at a lower price, then that business should be allowed to compete and enter

the market. By the same token, if a business is not able to provide a competitive service, they ought to be able to exit the market and enter other markets where they are more competitive. If competition is to prevail, this freedom to enter and exit the market ought to be given to both cable and telephone companies. Yet, should public policy allow telephone companies to abandon a particular market because it is not profitable enough? Regulators could insist that these areas continue to be served, but to do so would mean that the telephone companies can no longer compete on a level playing field. With a penetration rate of 60 percent, it is hard to imagine that cable companies can and would be able, or have the financial incentive, to reach the remaining population. Frequently, the advocates of competition would argue that competition would insure that affordable wireless communications would reach this rural, underserved market. It may be difficult for regulators to trust that these high cost service areas would be served without some clear evidence that this approach would work. Another possibility is that rural users who are not served under a competitive market could be subsidized by something similar to the universal service fund. This might be difficult to implement where, for example, competitors concentrate their attention and energies on highly profitable segments of the communications network and do not apply energies and focus on providing innovative services to the less profitable rural areas.

With free entry and exit conditions it is also unclear whether head-to-head competition will occur. If telephone companies were able to move into the video business, it is possible, as one study has pointed out,[10] for the telephone companies to provide a separate and voice and video/data network. One implication of this economic/technology study is that all the touted benefits of providing information across an integrated network are not at all practical and that the current system of separate networks, in fact, is the most efficient approach to delivering information services. The current effort, by U.S. RBOCs in the United Kingdom to build voice, data and video networks using twisted pair and coaxial technologies lends credence to

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[10] Leland Johnson and David P. Reed, *Residential Broadband by Telephone Companies? Technology, Economics, and Public Policy* (Santa Monica, Calif.: Rand Corporation, 1990).

this possibility. Under this scenario, eliminating the cable/telco cross-ownership ban may only mean that both cable and LECs can be monopolies with no competition between them.

The next question is what the responses of the cable and telephone companies would be should there be open competition between the two. In part, the answer depends on the specific legislation that is adopted, but the LECs and cable companies are already taking steps to prepare for competition. With these early steps we can extrapolate to the time when telephone/cable ownership restrictions are removed.

In this context it is worthwhile, and indeed necessary, to draw a parallel to the situation found currently in the competition between LECs and ALTs, as described in scenario #2. As we discussed, the entry of an ALT into a LEC market has often forced the LEC to upgrade their network, improve performance, and lower prices. It appears that the ALTs will be successful in maintaining a market presence in the large urban market regardless of a LEC's efforts. Meanwhile, the LECs are the sole providers of fiber to the suburbs and rural areas, leaving the ALTs behind. But here is where the cable companies come in.

As mentioned earlier, there is a natural symbiosis between the cable companies and the ALTs. The cable companies provide connection to the suburbs with miles of fiber optic cables and experience with entertainment programming while the ALTs possess technical expertise in switching and a reputation for delivering reliable telecommunications services. In order to respond, the LECs would have to work closely with the state commission and the company would be forced to make difficult choices. The pressure would be intense and the financial and political stakes high. The pressures are further exacerbated because communications will be central to our nation's competitiveness. Internationally, for example, the Japanese have plans to spend $60 billion to complete a national fiber optic system by 2015.[11]

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[11] Anthony Ramirez, "Fiber Optics at Home: Wrong Number?", *New York Times,* November 17, 1991, Sec 4, p. 18. Apparently, however, Nippon Telephone and Telegraph has backed down from this goal and has reframed it as an "ideal" because of the high costs involved. Anthony Ramirez, "Doubts on Japan Rewiring," *New York Times,* November 9, 1991, Sec 1, p. 40.

It is clear that the cable/ALT partnership could prove to be a formidable competitor to the LECs. Does this mean that we could see two fiber connections to the home? Given the incredible capacity of fiber optics, technically it does not make sense to have two cables going to the home where one fiber optic cable has sufficient capacity. This technical fact, at least true for today's information needs for the indefinite future implies it does not make financial sense to have two cables into the home except for the benefits of competition in keeping prices for a given technology (in this case, two fiber optic networks) as close to costs as possible. Although some regulators and economists may not entertain the possibility, it may be that integrated fiber optic networks may be a natural monopoly, one requiring a much larger volume of information in order to achieve scale economies. With a natural monopoly, the larger the network becomes, the lower the long run average costs. If this is the cost characteristic of fiber optic networks, it means that once a competitor gains enough of a size advantage over its competitor, its fixed costs can be averaged over a larger installed base resulting in total lower costs to the consumer. Looking at the deployment of fiber optics in this way, success may be determined by being the first to enter the business and having a head start in building a sufficiently large fiber optic network. This means that competition now would turn on the legislative and regulatory decisions on the timing and identity of individual actors' entrance into the market.

The final response taken by the LECs to the introduction of competition is to cut their costs to become more competitive. The difficulty is that while the LECs have made great strides in increasing productivity, they still do not have the productivity of the ALTs who are building new networks which have low-labor costs, have low overhead and can be placed within high-density lucrative markets. Another way that the LECs hope to cut costs is by obtaining pricing and service flexibility from state commissions. There are however, limits to the tactical utility of using pricing flexibility in meeting the threat competition. Assuming open, unbundled service offerings,[12] the LECs may not be able to raise prices substantially above costs

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[12] Efforts are still underway in fully realizing a working implementation of the goals and objectives of ONA.

to subsidize their efforts in contested markets because to do so would invite competition into the subsidizing markets. Presumably, the only place that the LECs would be able to enjoy these subsidies without contest is in markets where no one chooses to enter because the costs are too high. But even if LECs are given pricing flexibility, -- say through price caps -- presumably there will still need to be some regulation of the LECs to ensure universal service or that there is a "carrier of last resort." The existence of these regulations may be an impediment to how well the LECs can respond to the ALT threat. The LECs may have to completely revamp their organizations in order to become more competitive. Where regulatory commissions retain regulatory authority, the decisions may go slower and be less dramatic than is necessary to respond to the cable/ALT threat.[13] The alternative, no regulation of LECs and the allowance of complete pricing flexibility would invite cross-subsidization by captive customers of customers of LEC activities in contested markets.

If the installation of two fiber optics lines to the home does not make sense, how do we politically justify having only one? The fundamental theme has been one of competition and yet the telecommunications network to the home may, in fact, be one network because of fiber's transmission capacity. Will the public be happy with having one supplier of services? Who should it be? Should it be the cable companies who are already the subject of public debate and legislative concern on price increases and service disruptions? Would the public support a policy where cable TV companies were also given the voice and data traffic? At the same time, should the LECs now be given a monopoly in videoprogramming and data traffic as well as their traditional voice traffic? If the high costs of installing fiber optics do not fall through technical innovation and the revenues of videoprogramming are necessary to underwrite these costs, it may well force the public to choose between the cable companies and the telephone companies in providing the telecommunication services of the future.

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[13] Witness the painful reorganization that many companies like GM and IBM are now experiencing.

One way out of this difficult choice would be a compromise that allows cable and telephone companies to enter into joint enterprises. This is in fact what many of the RBOCs are now experimenting with in the United Kingdom. According to Gross (1992), US West, Pacific Telesis, NYNEX and Southwestern Bell "collectively own all of the cable systems in the United Kingdom where they are ardently building hybrid cable telephone networks with cable partners."[14] Interestingly, these hybrid networks are not integrated networks but telephone and cable networks sharing a common conduit, a common backbone network, and administrative and overhead costs.[15] There are also questions of whether the public would or should accept two monopolies working together.

Conclusion

Over the last fifty years, regulatory efforts have fashioned a rather simple but workable telecommunications infrastructure and regulatory approach. For the most part, particular services have been provided by particular businesses through particular technologies. If there were changes to this neat assignment of responsibilities, it was gradual and was not allowed to threaten the logic and stability of this simple approach. Until recently, the overlapping jurisdictions of the federal, state and local governments worked together because their interests and outlooks were in harmony.

This tidy categorization of service and regulatory responsibilities, however, is severely threatened by dramatic changes in technology along with changes in attitudes towards regulation. The future calls for dynamic changes to take place: the entrance of competitors into markets which were formerly regulated. There is even competition among the providers of satellite, fiber optics and wireless technologies. Since the regulatory edifice built up over the last fifty years is based, in part, on the technologies providing service, the existing regulatory structure is subject to stress. Complicating this dynamic process are questions about the efficacy, legitimacy,

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[14] Gross and Becker, "Local Competition Intensifies," p. 37.

[15] Ibid., p. 36.

adaptability and divergent views of the FCC, the State PSCs and local governments in regulating telecommunications.

CHAPTER 5

CONCLUSION

This report has emphasized a basic theme in telecommunications: the tension between universal service and the continuing introduction of competition into the public network. The impetus of competition is perhaps unstoppable. Once successful incursions were made into the CPE and long distance markets with no disastrous effects, the eventual introduction of competition into the last foothold of telephone company monopoly -- the local loop and the class 5 office -- became a certainty.

There are lessons to be learned from the CPE and long distance experiences. Competition brings with it discernible benefits. Customers have much greater choice in selecting feature-rich CPE and can reap the benefits of substantially lower long distance rates. Local loop competition will offer customers enhanced features like portability and greater bandwidth and will have a downward effect on pricing.

But competition isn't introduced without disruption and efforts to ease the effects of that disruption. CPE competition required the creation of new FCC rules (Part 68) and the replacement of hard-wired connections with modular jacks in every premises in America. Long distance competition entailed changes in dialing patterns and a good deal of customer confusion, as evidenced when you try to reach the long distance carrier of your choice from a pay telephone. Billing systems and switches all had to be changed significantly to accommodate IXC competition. A formerly seamless system cannot be broken up without some cost in effort and resources on the part of all involved, including regulators and policy makers.

The introduction of competition in local loop services made possible through the newer techniques will undoubtedly cause disruption and confusion as well. Indeed, competition in this "last mile" of the once-seamless public network may be more unsettling than developments in CPE and long distance services have been. CPE and long distance services are "separable" services, that is, separable from what has been the heart of the public switched network: the loop and the class 5 office. CPE and inside wire connect on at one end; IXCs at the other. Long distance

carriers may vary; the type of CPE in the customer's premises may vary. But the loop and the class 5 office have remained stable and constant.

Once there are competitive providers of loops (and perhaps of class 5-type switching) there is no longer one network. What develops is a conglomeration of networks which may or may not wish to interconnect with one another. This conglomeration of networks calls in question the continued viability of a public network, of what that network has to offer, and of how that network is supported.

A basic tenet underlying the concept of a public network has been affordable, ubiquitous universal service. The introduction of local loop competition has the potential to affect universal service much more than CPE and long distance competition have done so far.

The pricing scheme for the seamless network which existed before competitive inroads were made was based on a complex system of cross-subsidies and geographical averaging designed to make sure that residential, small business, and rural customers were provided with affordable service. Competition in the long distance and CPE markets have eroded those cross-subsidies. Efforts like Lifeline service and the Universal Service Fund are designed to maintain some subsidies to assure affordable service to all takers. However, it is undeniable that competition in the long distance market has put greater pressure on local rates. The SLC is an example of the shifting of costs out of long distance rates onto the local subscriber. Changes in the separations rules are increasingly shifting costs out of the long distance arena into the local jurisdiction. Telephone companies, facing declining revenues from one source, look for other means of making a profit.

As competition has eroded revenue sources at the peripheries of the telephone company network, (that is, CPE and long distance), greater pressure has been put on local rates. When competition erodes local service revenues, there are serious implications for local service pricing. If competitors make significant inroads, customers continuing to subscribe to LEC local services may face higher and higher prices. Regulators whose major concern is the continuation of universal service, and the ubiquitously available affordable rates on which that policy is based, may have to consider creating new Universal Service Funds or other subsidization mechanisms.

Local service competition may have the effect of accelerating the disparity between technological "haves" and technological "have-nots." If local service competitors are able to offer feature-rich networks not available through the public network, those on the public network will be at a disadvantage. Since competitive providers, who have no obligation to serve, will naturally gravitate toward the high-profit urban areas and the high-profit large business user, residential customers, small business users, and rural area residents may be left with no option but a feature-poorer network.

There are important implications for universal service in this scenario. The basic question becomes: "What is universal service?" If it is plain old telephone service, then the public network, as a carrier of last resort, need only deliver dialtone. Regulators are then left to oversee prices and conditions for what may become a declining percentage of traffic and subscribers increasingly found in residential and rural areas.

If policy makers decide to broaden the definition of universal service to encompass the technological strides made in the last decades, as the NTIA suggests in its Infrastructure Study, a whole new set of questions arises. If the public network must be upgraded to deliver these services, who will pay for that upgrade at a time when traditional revenue sources and subsidies are declining? If a host of local service providers emerge, should they face any form of regulation, including the obligation to serve? What are the responsibilities, if any, of these competitors toward the maintenance of universal service?

Policy makers and regulators will be addressing these questions in a new environment. Instead of one regulated local telephone company, there may be a host of new players offering services which customers have been accustomed to receiving from a regulated entity. What the relationship of regulators should be to these new players will in itself be an interesting question. As the new players seek connection to the public network and to each other regulators will undoubtedly be called upon to facilitate the process. Balancing the needs of the public network, of these new competitive entrants in the local services market, and of universal service goals will present a challenging dilemma for regulators.

In addition to dealing with new players, regulators and policy makers may also be facing a whole new regulatory paradigm. The current system of dual regulation is based on the ability to determine, or at least estimate, the geographic jurisdiction of network usage. The major focus has been on identifying any geographical boundaries that happen to exist between the originating point of a call and the terminating point. The introduction of long distance competition hasn't changed that dependence on geography to determine jurisdiction. The creation of networks parallel to, and often interconnecting with, the public network may change that dependence.

With traffic traversing various networks before and after it hits the public network, it may not practically be possible to determine where traffic ultimately originates or terminates. Efforts to allocate public network costs on geographical usage may prove futile in this new environment. As a result the current basis for determining jurisdictional boundaries may be substantially eroded and a new paradigm may have to be developed.

In the interim, regulatory and policy responses to the new environment of local services competition will be very much influenced by jurisdictional issues. While ALTs interconnection seems to be progressing very quickly at the state level, competitive developments in the other technologies discussed in this report have been, and will continue to be, strongly dependent upon federal decisions. The deployment of cellular services and PCN/PCS has been guided by the FCC. Issues regarding the entry of telephone companies into the cable market and cable companies into the telephone business will also be decided at the federal level. As a result, state regulators and policy makers will be constrained in what they can do in responding to local service competition.

Within these constraints, state regulators will have to make some basic decisions regarding their ultimate role in an environment that includes local service competition. Regulators who believe that the free play of the market should be an overriding consideration will see their role as primarily being one of removing barriers to competition and the innovations that competition brings. Those regulators will be concerned with issues of market entry, nondiscriminatory interconnection, and predatory pricing. Regulators whose guiding principle is the preservation of universal

service will concentrate on tactics to assure affordable rates and the continued viability of a public network. For those regulators issues of primary importance will be the continuation of subsidies and the creation of universal service funds.

Most regulators will no doubt take a middle ground, seeking to protect the "average" subscriber while at the same time fostering the benefits of competition. Striking a workable balance at the middle ground will be a major regulatory challenge.