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LOCAL TELEPHONE SERVICE:

A Complex Dance of Technology, Regulation and Competition *

INGO VOGELSANG
Boston University

and

GLENN WOROCH
University of California, Berkeley

INTRODUCTION

Soon after the expiration of Alexander Graham Bell's basic telephone patents in 1894, competing local phone companies sprang up by the hundreds all across the U.S. Then and now, no other single market offered a more lucrative opportunity than New York City. New York Telephone, the local operating company licensed by American Telephone and Telegraph (AT&T), was the dominant local exchange company in that city. Its customers were far from happy with its service or its rates, however, and this opened up a market opportunity for competing carriers.

While several independent phone companies made deliberate attempts at breaking into the New York market, none were successful. New York Electric Lines, Peoples Telephone Company and the Atlantic Telephone Company were among the most serious contenders. Their efforts were defeated by New York Telephone, local regulators and economic conditions. To enter this market, these companies required underground conduits to string their lines. These conduits were owned by Empire City Subway Company, the subway contractor which, oddly enough, was a subsidiary of AT&T.[1] The Subway Company repeatedly claimed that there was insufficient space in subway tunnels and demanded high fees when they were made available.[2] AT&T also applied pressure to New York Telephone not to interconnect with entrants, a policy it pursued

throughout the country. Frustrated by these tactics, the entrants abandoned their attempts to enter the New York City market and either dissolved or provided service elsewhere.

If we now 'fast forward' in time, many of the same events that took place in New York City were repeated nearly a century later. In 1982, Merrill Lynch and Western Union formed a joint venture to build a "satellite park" on Staten Island, one of the five boroughs of New York City. This was a response to the explosion of telecommunications traffic, especially international financial transactions, and the severe congestion of microwave transmissions that ensued. A couple of years later, the venture became a private corporation under the name Teleport Communications and began to install optical fiber cables linking Staten Island to Manhattan. Importantly, it began to lay cables in lower Manhattan using the rights of way of none other than the Empire City Subway Company.

Teleport grew rapidly, responding to the sophisticated needs of large New York businesses by deploying advanced, highly reliable networks offering services that were often not available from New York Telephone. Their success was restricted, however, by their inability to interconnect their customers with the public switched network. This impediment was remedied partially when in 1989 the New York Public Service Commission (NYPSC) ordered New York Telephone to provide "comparably efficient interconnection" with Teleport and other alternative access providers.

While the tale of local competition in New York City is far from complete, the similarity of events a century apart is instructive. In the decades that separated these competitive episodes, AT&T went on to achieve domination of all aspects of the U.S. telephone industry. In the past 20 years or so, AT&T's dominance has been reversed by legal decisions, legislative developments and competitive forces. How technical change and regulatory initiatives govern restructuring of the local phone industry will be examined in this chapter.

Our examination of this industry will reveal how innovations in communications technology and new service offerings pressure both incumbent suppliers and industry regulators to change. This happened when Teleport deployed an all-digital, all-fiber network throughout Manhattan to offer sophisticated services to the financial community. Even in the absence of innovation, we will see how competitors are attracted to markets by distortions built into pricing

and investment behavior as a result of regulation or complacency of incumbent monopolists. Local telephone competitors like Teleport were able to undercut the incumbent's regulated rates which were highly averaged and departed from economic costs. They also were able to set up customers with service far faster, and rolled out new services more quickly.

Introduction of competition into local exchange markets is just the beginning of the story. In most cases this competition is met with aggressive responses, including price cuts and improved service offerings in threatened markets. Evidence also points to improved efficiency of incumbent providers, shown in part by the huge cuts in their employment rolls. Over the longer run, we can well expect to see increased investment in infrastructure and human capital, and the development and deployment of advanced communications technology.

With the emergence of communications competition, as with competition in other regulated industries, the politics of the regulatory process come into play. Incumbent local exchange carriers (ILECs) invariably appeal to regulators for protection from competitors. Successful entrants are not hesitant to ask regulators to close markets behind them. Regulators themselves are commonly resistant to new competition, responding to fears of impoverishing the public network, upsetting their favorite cross subsidy programs, or adapting to new technology and new industry structures. With time and with pressure from courts and lawmakers, regulators have gradually opened communications markets to competition and realized the benefits of lower prices and improved service.

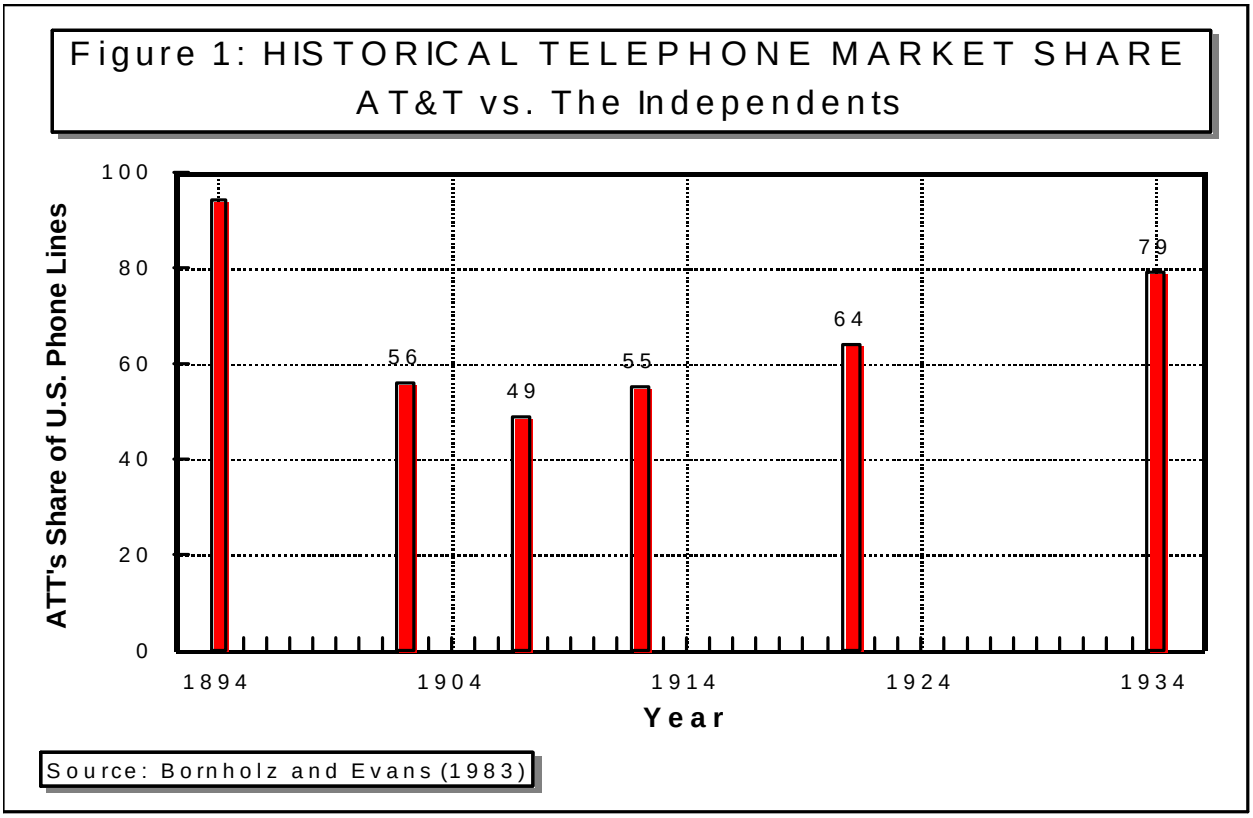
HISTORICAL BACKGROUND

FORMATION OF THE AT&T MONOPOLY

Alexander Graham Bell acquired two basic patents on telephone technology in 1876 and 1877. With the help of financial backers, he formed a company that gave local operating companies exclusive licenses to use the technology in cities and towns throughout the country. Bell charged an annual license fee for each telephone instrument leased to customers, most of whom were businesses in the early days. Bell also insisted on an equity stake in the operating

companies, a stake which eventually grew to 100 percent ownership in most cases.

During the 17 years of patent protection, Bell and his associates commanded a virtual monopoly over telephone service.[3] Upon expiration of the patents, "independent" (*i.e.*, non-Bell) telephone companies were free to offer phone service without a license from Bell. A year after expiration, 87 independents were doing business; by 1902, a mere eight years later, over 4,000 independent phone companies were in business throughout the U.S.[4] Figure 1 charts the rise and eventual fall in the market share of independent local phone companies. Their share peaked in



1907, reaching to 51 percent of all phones in the United States, mostly in areas not formerly served by AT&T.

AT&T's response to the independents was swift and devastating. The independents' market share steadily eroded as AT&T embarked on a systematic program to dominate both local and long distance telephone markets. First of all, the Bell Operating Companies cut rental rates in selected markets threatened by independent companies. Between 1893 and 1898 average rental rates fell by 75 percent (see Figure 2). In those cases where Bell companies faced head-on

competition from independents, Bell responded with especially aggressive price cuts.[5] While AT&T price cuts eroded independents' market share, the competition led to growth of phone usage. Figure 2 also shows how the pace of diffusion of telephone service, on a per capita basis, accelerated following this period.

Second, whenever possible, AT&T continued to file patent infringement suits against the independents, a practice it perfected during its original monopoly period.[6] Next, AT&T rapidly bought up independent local companies, especially those in cities where it met competition head-to-head. Finally, AT&T refused to interconnect its long distance facilities with independent companies,[7] putting independents at a disadvantage in marketing their services locally and forcing them to seek other long distance partners. Near the turn of the century, some families and businesses (especially in the Midwest) had to own two telephones, one for making local calls using the independent company and another for local and long distance calls over AT&T.[8] There were also claims that AT&T refused to provide equipment to independents through its manufacturing affiliate, Western Electric.[9]

Throughout this period, AT&T moved closer to complete ownership of its operating companies which it acquired in exchange for a reduction in its per-line license fee. With the 1891 acquisition of Western Electric and the subsequent formation of Bell Laboratories, AT&T was well on its way to achieving end-to-end dominance of the phone business.

REGULATED MONOPOLY PERIOD

As the twentieth century began, AT&T's size and breadth placed it squarely in the sights of government trust busters. The government was particularly concerned with its acquisition of competing independents, its refusals to interconnect and its alleged abuse of patents. No formal regulatory body existed at this time to examine these charges, however. A number of state laws were passed authorizing regulators or courts to force the Bell System to interconnect with the independents. This most often involved interconnection of independents with the dominant long-distance provider, AT&T Long Lines; in rare cases it involved interconnection with the local Bell Companies.[9a] Starting with the expiration of the Bell patents, dual telephone systems had

developed in many cities, culminating in 1904, when about 60 percent of cities with populations above 5,000 had dual telephone exchanges.[9b] This meant that local competition existed at that time, but largely without interconnection. This form of competition has long vanished, due to the Bell System's success with its fully interconnected network.

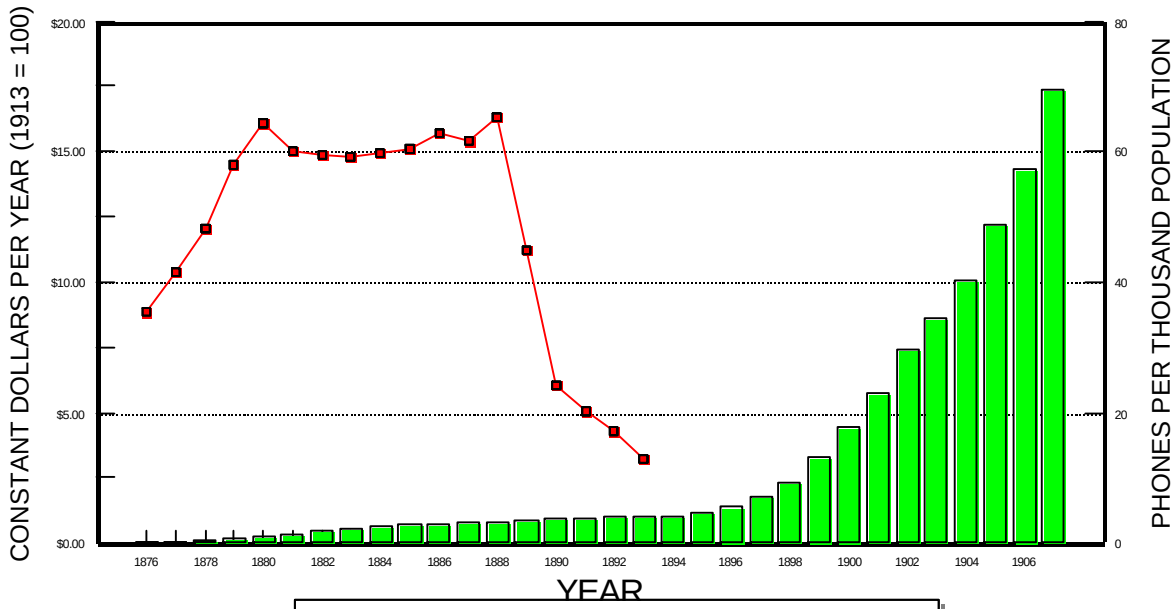
In 1910 Congress passed the Mann-Elkins Act, which assigned regulation of the telephone industry to the Interstate Commerce Commission (ICC). The ICC launched an investigation of AT&T's activities but generally was quite inactive in telephone regulation and approved most mergers.

Responding to public pressure and threats of divestiture, AT&T took the offensive. Theodore Vail, long- time chairman and architect of the AT&T system, offered a deal to the government in 1913. AT&T promised to interconnect with noncompeting independents and to halt acquisition of competing independents. In exchange, Bell would submit to regulation with guarantees of protection from competition. In fact, acquisition of independents would soon resume as AT&T consolidated its ownership of franchises in large population centers and sold off its rural holdings to independents.

By 1934, with independents' share dipping to 21 percent and with virtually 100 percent of the independents connected to AT&T's long distance service,[10] Congress passed the landmark Communications Act which formed the Federal Communications Commission (FCC). The FCC was empowered to allocate rights to commercial use of the radio spectrum and to regulate interstate communications services by common carrier. States retained control over local business and residential rates and other intrastate services. Much earlier the first state-level commissions were formed in Wisconsin and New York, marking the beginning of a strained relationship of state and federal regulators. At the heart of the tension was the fact that local and long distance services had to share local facilities.

As we discuss below, how the cost of those facilities is apportioned among the services is quite arbitrary and vulnerable to political manipulation.

Figure 2: EARLY LOCAL PHONE PRICING AND PENETRATION



Sources: Historical Statistics of the U.S., 1789-1945 (1949); Stehman (1925)
Note: Snyder-Tucker General Price Index used to derive real prices, 1913=100

THE MONOPOLY BEGINS TO CRUMBLE

The second time around, competition did not come quickly, nor were the parties involved eager to promote it, including telecommunications regulators. Early steps toward competition were made by the courts. In a precedent setting 1956 decision, the courts decided against AT&T's petition to stop a company called "Hush-a-Phone" from attaching its device to the telephone network. The product consisted of an insulated metal box that fit over the telephone mouthpiece to make conversations more private in a crowded business office. In this case and many others, AT&T alleged a threat to the technical integrity of the public telephone network. The same scenario played out 12 years later in the 1968 Carterfone decision. Here the so-called "foreign attachment" was a phone coupling device that allowed phone users to communicate with

users of radio dispatch services, such as truck drivers and sales people.

A significant step toward competition in services came in 1959 with the "above 890 MHZ" decision. It had been discovered that the frequency above 890 MHZ, the microwave range, was a very effective means for line-of-sight transmission of voice and data. An FCC inquiry, initiated in 1956, sought to evaluate AT&T's petition for an exclusive franchise over the use of this frequency band. If permitted to do so, AT&T could exclude competitive carriers from long distance transmission and other uses, including local service. The FCC decided to permit limited use of this radio band by others for internal corporate communications and as a consequence it opened a door to phone competition that would never close.

In other developments, the FCC liberalized customer premise equipment and inside wiring. Quickly, the market was flooded with telephones in all colors, styles and capabilities.

The early 1980s witnessed unprecedented developments that both facilitated and hindered competition for local telephone service. Easily the most significant event was the settlement of the Justice Department's eight-year antitrust case against AT&T. The government alleged AT&T had violated Section 2 of the Sherman Antitrust Act by monopolizing local and long distance phone service, using that monopoly power to exclude entrants and to compete unfairly in nonregulated markets. On January 8, 1982, AT&T and DOJ settled their differences by signing an agreement called the "Modification of Final Judgment" (MFJ), so named because it altered the Consent Decree the parties signed much earlier, in 1956. The MFJ's principal terms called for divestiture of the Bell Operating Companies on January 1, 1984, grouping them into seven regional holding companies (RHCs).[11] The RHCs were permitted to provide local and short-haul toll service within the boundaries of 161 "local access and transport areas" (LATAs) that covered the entire country. They also had two other line-of-business restrictions: they could not manufacture equipment or provide information services (*e.g.*, voice mail). They were permitted to enter other companies' territories to provide local service.

AT&T, now consisting of the Long Lines Division, Bell Laboratories and Western Electric, was allowed to enter other markets. In particular, it won long-sought permission to enter the computer business, an opportunity which subsequently turned into a business disaster. AT&T was also permitted to reenter the local exchange business.[12] It did not pursue this option

until recently, but many opportunities for entry were not available until now.

Table 1: REGULATORY, COMPETITIVE AND TECHNOLOGICAL EVENTS IN LOCAL TELEPHONE HISTORY

Year	**Event**
1876	Alexander Graham Bell files application for patent on basic telephone technology
1878	First local exchange service begins operating in New Haven, Connecticut
1879	Leroy B. Firman invents the multiple switchboard
1885	American Telephone & Telegraph Company formed
1888	Undertaker Almon B. Strowger invents automatic step-by-step switch to eliminate switchboard operator who he suspects is forwarding business to a competitor
1907	Public utility commissions formed in Wisconsin and New York
1910	Mann-Elkins Act submits AT&T to regulation by the Interstate Commerce Commission
1913	Kingsbury Commitment promises that AT&T will refrain from acquiring independent companies and will interconnect its long distance facilities
1934	Federal Communications Act creates the FCC
1956	AT&T and the Department of Justice sign consent decree barring the company from the computer industry and requiring mandatory, royalty-free licensing of patents
1956	Hush-a-Phone decision permits attachments to phone networks which are “privately beneficial without being publicly harmful”
1968	Carterfone decision permits attachment of a coupling device
1979	Optical fiber first used to carry voice transmissions
1982	AT&T signs the Modification of Final Judgment which divests local exchange companies into seven regional holding companies and imposes line of business restrictions
1983	Cellular phone service first offered in Chicago
1983	New Customer Premise Equipment liberalized by the FCC
1984	Teleport offers competitive local business services in New York City
1990	FCC replaces rate of return regulation of large local exchange carriers with price caps
1996	Congress passes the Telecommunications Act which seeks to open local exchange to competition through facilities-based entry, sale of unbundled network elements and resale

TECHNOLOGY AND COMPETITION RESTRUCTURE THE LOCAL EXCHANGE

At the same time that the MFJ was restructuring the incumbent telephone industry, new advances were emerging from research laboratories that made possible advanced digital and wireless services and ushered in a new wave of communications providers. Transmission of voice signals over optical fiber was successfully demonstrated in the late 1970s. Soon afterwards local exchange companies began to deploy fiber in their local network, and in 1983 Teleport began providing business services in New York City over a fiber network. About this same time, phone companies began installing a new generation of electronic switches and digital transmission equipment, while businesses began purchasing switches of their own called "private branch exchanges" or PBXs. In December 1983, after two decades of regulatory deliberations, the first commercial cellular telephone services would be launched in Chicago

New technology alone could not bring competition to the local exchange, however; regulatory reform was needed to support multiple providers where the incumbents had enjoyed *de facto* franchise monopolies. Local competition initiatives, such as the NYPSC interconnection decision in New York City, exemplified the innovative experiments that were taking place at the state level. Typically, these proceedings were initiated by the entrant phone companies and facilitated by state regulators who eventually mediated an agreement among the companies.

Another good example that took place in New York State was the restructuring plan proposed by Rochester Telephone, called "The Open Market Plan."[13] Rochester proposed partitioning the company into a regulated and a competitive part, "R-Net" and "R-Com," respectively. The R-Net (now just "Rochester Telephone") would sell basic network services to competing retail carriers, including the newly formed R-Com (now called "Frontier Communications of Rochester"), at nondiscriminatory regulated rates. R-Com would be permitted to sell retail services free of regulation, but would face open competition from new entrants. The new holding company, Frontier Corporation, would also be allowed to enter long distance and cellular markets. The NYPSC eventually approved a modification of the original plan, and several companies are currently selling local exchange services using R-Net's network, including Time Warner Cable, AT&T, Teleport Communications and Citizens Telecom. The Rochester plan got off to a bad start, as far as new entrants were concerned, and for AT&T in particular. AT&T quickly gained market share as a pure reseller, but had to learn that it could not

live with the meager 5% wholesale discount it negotiated with Rochester. A disproportionate share of AT&T's new customers had been disconnected or abandoned by Rochester because of their bad payment records. AT&T initially also suffered from slow handling of new subscriptions and fault repairs that had to be handed in by fax and were dealt with by Rochester on an individual basis. AT&T could not take a customer order or complaint and directly respond to it. Rather, AT&T had to ask Rochester first for spare capacity and dates and then call back its (prospective) customers. All these problems have now be resolved, but that took time and aggravation.

About the same time, Ameritech proposed a plan which shares some features with the Rochester plan.[14] Instead of divesting itself, Ameritech proposed to interconnect with competitors and unbundle its network services, selling services at nondiscriminatory cost-based rates. In return, Ameritech sought to enter inter-LATA toll markets and to offer cable TV services in its five-state region. This plan and others have shaped the debate over deregulation of local exchange markets at the state and federal levels. They clearly have had an impact on the drafting of the Telecommunications Act of 1996 (the Telecom Act), which we discuss below.

Prior to passage of the Telecom Act (and since), communications companies have been restructuring themselves. Mergers have been announced involving local exchange companies, often in combination with cable companies, and many of these were later withdrawn. Examples include mergers between Bell Atlantic and TCI, BellSouth and Cox Cable, and US West and Time Warner. Reasons given most often for the failed unions included adverse regulatory conditions and overly optimistic forecasts regarding cost of new technology and demand for advanced services.

Two pairs of RHCs have successfully merged: first SBC and Pacific Telesis, and later NYNEX and Bell Atlantic. We can expect further consolidation of local exchange properties as well as reintegration of local and long distance services. The latter began before the Telecom Act when AT&T purchased McCaw Cellular, the country's largest cellular carrier. All the other major long distance carriers have also entered the local market, each taking different strategic approaches. MCI decided to grow internally by creating its MCImetro division.[16] The third largest interexchange carrier, Sprint, earlier was half-owned by the largest independent local phone company, GTE, who eventually sold out to its partner, United Telephone, the third largest

independent. Sprint has taken a large stake in personal communication services (PCS) along with its three cable partners. Worldcom, the fourth largest long distance company, entered the local market when it purchased Metropolitan Fiber Systems, the largest competitive access provider, who at the time owned UUNet, one of the largest internet access providers.

Local exchange companies are also reaching into nearby markets. For instance, GTE has used its freedom from the MFJ to enter the long distance market and has also acquired BBN, one of the oldest and largest internet service providers.

The vertical and horizontal integration that is occurring and will undoubtedly continue will have a profound effect on rates and offerings of local exchange carriers in years to come. In particular, the integration of local, long distance, cellular and cable services establishes the groundwork for offering innovative service packages at bundled rates.

COST OF SERVICE AND TECHNOLOGICAL ADVANCES

NETWORK PRODUCTION

It is helpful to think of local phone service as information traveling over a network composed of "links" and "nodes." The nodes of this network could be ordinary telephones, or they could be facsimile or answering machines, home computers or large electronic central office switches. The network links may be local loops connecting the customer to the exchange carrier's switch, or inter-office transmission lines connecting the switches themselves, including switches owned by long distance carriers. Links may be cables composed of wires or optical fibers, or they may be radio connections, either terrestrial or satellite.

Calls travel from one node to another. Along the way they may be switched, or there could be a dedicated line connecting the two locations. These two alternative means of making a connection give rise to a tradeoff between switching and transmission that can be illustrated by reference to simple phone networks.

Starting with the simplest case, consider phone service between two customers in the same city represented by points A and B in Figure 3. In that case the cheapest way to provide

service is to build a link between the two locations, either landline or wireless, without any switching needed whatsoever. Construction of this link requires a large fixed cost and has negligible marginal cost of usage (just pick up the phone and the other end rings). Since average costs are everywhere declining, strong scale economies prevail. In addition, since capacity of conduits, cables and other transmission facilities is often available in discrete "lumps" that exceed current traffic levels, idle capacity will generally persist until demand grows to fill available capacity.

<< FIGURE 3 >>

Suppose now that there is a third customer, C, and hence, three different pairs which may want to communicate. Three direct links could be built between each pair of customers. Alternatively, only two links would be needed (between A and B, and between B and C) if a switch is used (at B) as in Figure 3. If the switch is cheaper than building a third link, and if the added traffic (between A and C through B) on the two links does not significantly raise costs, then it pays to substitute switching for transmission. In general, when there are n subscribers, the number of two-way links needed for complete direct service is $1 + 2 + \cdots + (n - 1) = n(n - 1)/2$, while the number needed for a network having a single switch is merely (n - 1). Therefore, the number of links saved by installing a switch is: $1 + 2 + \cdots + (n - 2) = (n - 2)(n - 1)/2$.

The savings that comes from indirect traffic (ABC) sharing with direct links (AB and BC) is made possible with switching equipment. This savings occur when local and long distance calls share the same local loop and local transmission facilities on route to their final destinations.[16a]

The ability of a sparse network to deliver the same services as a complete network is at the source of "scope economies" in local exchange networks. Scope economies occur when a single firm can provide an entire array of services more cheaply than a collection of firms who specialize in just a few of those services. Scope economies stem from the joint use of facilities by several services without substantial congestion problems.

Microprocessors are the principal component of digital switches, and so as their performance increases and their price falls, switching costs fall and scale and scope economies

increase. As a result, local exchange carriers are induced to install more switching, reducing the length of the various links. In the other direction, as advances occur in transmission (*e.g.,* fiber optic and radio transmission) switching is rendered relatively expensive.

Network architectures adopted by telephone companies can be traced back to relative cost of switching and transmission. The typical local exchange network, depicted in Figure 4, has a "double star" form in which, in addition to large central office switches, smaller switches are placed closer to the customers. Some data networks (*e.g.,* local area networks connecting personal computers) have a "ring" architecture which does away with the need for switches: all traffic is squeezed onto the same line, entering at the source and leaving at the destination, much like a bus picks up and drops off passengers.

<< FIGURE 4 >>

As a general rule, overall cost of local exchange service is highly dependent on the density of the relevant population. In particular, dense populations are highly correlated with short average "loop lengths" (the distance from a customer to the central office switch), which greatly reduce cost of transmission equipment.

NATURAL MONOPOLY QUESTION

Properties of network production raise the possibility that supply of local exchange services will be a natural monopoly. This would be the case if the In other words, the cost of providing local exchange service is "subadditive," which requires the cost of a given level of local services when supplied by a single firm is less than when parceled out to two or more firms. Subadditivity is related to the notions of scale and scope economies, but is by no means equivalent to them taken together. In providing a single service, if production experiences scale economies, then costs are subadditive.

When there are scale economies in the relevant range of output (*i.e.,* average costs exceed marginal costs at market demand), then the first-best prescription for efficiency--setting price at

marginal cost--will fail to generate sufficient revenues to cover costs because average cost will exceed price. It is for this reason that economists often prescribe second-best pricing rules. In providing multiple services, one such rule is "Ramsey pricing," which requires the markup of price over marginal cost for each service to be inversely proportional to its price elasticity of demand (provided service demands are independent). This rule says that services that consumers demand inelastically--perhaps because they do not have access to reasonable substitutes--should make the greatest contribution to defray the fixed costs of the telephone network through high charges. This suggests why second-best pricing rules have not been popular with regulators: they call for taxing economically least-powerful consumer groups who, because of one-person, one-vote representation, may be quite powerful politically.

Early empirical studies attempted to determine whether telephone service was a natural monopoly. These studies were conducted on data from long distance services and/or from the integrated AT&T system. More recent attempts have turned attention to local exchange services, as viable competition in these markets has become a reality. One study using pre-divestiture accounting data concluded that costs for local exchange services were *not* subadditive.[17]

Just because a single firm can supply the entire market at lowest cost does not ensure that the market will result in a monopoly. Pairwise, costs could be subadditive and yet multiple firms could survive in the market. Whether the efficient industry structure will obtain depends, among other factors, on strategic behavior of firms, especially actions aimed at eliminating competitors from the market. As mentioned, local exchange service requires large fixed investment in plant and equipment, much of which is literally and economically "sunk." Investments such as underground cabling and central office switches, once in place, have much smaller value should they be deployed for other uses. Similarly the same holds for the enormous software programs needed to run the switches and the signaling system. Since an incumbent firm is unable to recover the sunk portion of its investments, it is willing to cut its prices all the way down to its avoidable cost, which can be very low for telephone services. Consequently, a new entrant who has not yet made such investments may face the specter of a devastating price war after it enters. If the threat of a price war with the incumbent is credible, a rational entrant will very likely find more profitable ventures in which to invest its money.

TECHNICAL CHANGE

A weakness of the above-mentioned cost studies is that they are based on historical costs, which employ accounting rules that do not, in general, measure economic costs. Necessarily, the results fail to incorporate new technologies such as wireless access methods. Wireless access, in particular, promises to offer significant cost reductions relative to the public switched network and even relative to traditional cellular service. That promise has not yet been realized however since these networks are not widely operational at this time.

One means to account for such technical change is to estimate costs of hypothetical networks using engineering models. Such models price out a hypothetical network, obeying basic engineering principles and using best estimates of component costs. An FCC study finds that a new wireless, digital network could provide local exchange service for $703 in initial capital cost per subscriber, and would require $546 per subscriber annually to operate. Comparable estimates of long-run incremental capital costs for traditional landline networks range from $700 to $1,200 per subscriber.[19] However, estimates of operating cost are substantially lower than those for landline networks. Of course, given the great variety in characteristics of the serving territory, an efficient network design would employ both wireless and wireless components.

Technical change has also been responsible for reduction in the overall cost of providing local telephone service. The relentless progress toward more powerful and lower cost microprocessors significantly reduces the cost and capabilities of switching and signaling needed in the modern phone network.[19a] Digital technology has reduced the cost of operating a phone network by automating nearly every aspect of doing business, including testing and repair of network equipment, customer service, billing and collection. Advances in optics and materials science have not only increased the capacity and clarity of fiber optic cables, they have also reduced the cost of installation and maintenance of these networks.

More generally, the adoption of digital technology in all aspects of the network has improved performance and lowered costs. Digital transmission, whether over copper or fiber cables or over the airwaves, is clearer and more secure. Digital compression techniques expand the number of transmissions that can occupy the same medium. One consequence of digitalization

is the growing importance of software in running a modern telecommunications network. Both switching and signaling are software intensive, as are network maintenance and repair and customer billing and service. Today, the computer code needed to run a central office switch numbers in the millions of lines. This code is very costly to produce and to change but it does give network designers the opportunity to build in sophisticated user features.

We need to remember that all components of local telephone service are not supplied by carriers, and the cost of these components often figures prominently in the diffusion of new technologies (*e.g.*, a personal computer and a modem needed to access internet services). Residential customers must provide the telephone itself and inside wiring in their homes, as well as other equipment such as fax or answering machines. Businesses are of course better able to self-supply equipment and services. A large or even medium-size business will buy its own switch, called a private branch exchange or PBX, to route internal calls within the company. Many of those internal networks have been displaced by Centrex, a comparable service provided by the local exchange carrier using their access lines and switches.

DEMAND FOR LOCAL TELEPHONE SERVICES

LOCAL EXCHANGE SERVICES

The economic good that concerns us in this chapter is a service that benefits customers who use a provider's (or their own) facilities and equipment. Compare this with transportation obtained by purchasing a car to get around. Phone service is akin to using a public bus or train for transportation, or to a lesser extent, renting or leasing a car for that purpose.

All communications services are not equal in the eyes of consumers, any more than different transportation modes are the same. Before we refer to a market we need to decide which communication services should be included, and which ones can be ignored. In other words, we must define the economic market for communications services that include local telephone services. Economists define markets in terms of power over price. We follow the conventional approach and look for the smallest collection of services and the smallest geographic

region such that a "small but significant and nontransitory increase in price" for those services and that region will be profitable for a hypothetical monopolist.[20] For instance, if raising the price of all calls made by residential customers within a city by 10 percent above cost over a one-year would result in an increase in profit, then we should consider whether the same was true for a smaller collection of services, such as all intra-city calls during business hours only. If residential customers easily shift their calling to before- or after-business hours, then raising rates for this smaller collection of services will not be profitable.

Consumer ability to turn to substitutes when prices for these services increase is an important aspect to this analysis. What choices do consumers have if the price for a service goes up? Would a service or group of services lose so much to another service (whose price is unchanged) that the price increase would be unprofitable for a hypothetical monopolist? Cross-price elasticities are designed to measure this substitutability. It is also important to know the extent to which suppliers of other services quickly can switch their production to this service, without having to build new capacities. Those suppliers would be considered very likely entrants, although they would be uncommitted because they can exit and switch back to the other markets easily. The supply elasticity measures the extent to which competitors will respond to elevated prices.

DEMAND PATTERNS

The consumer's willingness to pay for phone services depends on features of those services and of alternative means of communication. For instance, a customer could use cellular service in place of landline phone service. By doing so, the user would gain mobility by placing and receiving calls anywhere in the calling area even while walking or driving in a car. On the other hand, a call placed to a cellular phone may not reach other members of a household if the phone is away from the home since, at present, cellular service associates a phone number with a particular handset.

Approximately 85 percent of all outgoing calls by residential customers are local.[21] In 1995, households spent $19.49 per month on basic service, which amounted to 0.724 percent of

their annual expenditures.[22] Many different kinds of calls go into this average, not just calls to businesses or other residential customers, including facsimile transmissions, access to on-line services, and even 911 calls.

It is important to distinguish "access" from "usage" in regard to any phone service. Access not only permits a customer to place a local call but also is necessary to connect with a long distance provider to make intercity calls. Access to the local network is required to use "enhanced services" such as voice mail or internet services provided by the local exchange carrier or a third party. Usage can be further distinguished by the number of calls and by their duration and distance.

Invariably, local exchange service comes highly "bundled." In addition to "dialtone," which connects the user with the public switched network, local service provides a phone number, directory assistance, emergency and repair services, and white and yellow directories. Before the advent of long distance competition, long distance service was also bundled with local service. Separately, customers can order enhanced services such as voice mail, call waiting, call forwarding, and automatic number identification.

Businesses purchase many of the same services as residential customers, but on a larger scale. A single business may have hundreds of lines running into it, including some that are dedicated connections to their long distance providers, bypassing the local network.

Technical features of the connection include the clarity and reliability of the line and the bandwidth (or transmission speed) of the connection. As discussed above, mobility offered by different services is valued by users. Customers also value accurate, understandable bills, and fast and effective of customer and repair services.

The value of phone service increases with the number of other parties connected to the network. In the extreme, phone service is no more than a conversation piece, figuratively speaking, when a person is the only one in town with a phone. The relation between the value of phone service and the number of subscribers is called a "network externality." It is an externality because when a new subscriber joins the network, existing subscribers benefit since they can each place and receive calls from one more individual.[24] The belief that network externalities exist gives an economic justification for rate structures that promote universal service. So-called

"lifeline rates" provide low-income households with basic service for a low monthly fee. Besides bringing these households onto the network, other subscribers are said to benefit because they can now reach them.

Local calling is highly variable but regular usage patterns emerge over the day, over the week and even over the year. Long distance rates recognize usage patterns and seek to economize on network capacity by varying by the hour and by the day. Local rates rarely vary over time despite wide variations in usage. This is becoming a serious problem for local exchange carriers in light of the explosion in demand for on-line services such as America On Line, CompuServe and hundreds of internet access providers. In six short years, internet reached one quarter of U.S. households, compared to 14 years for cellular phones and 35 years for the telephone.[24a] The popularity of the internet imposes heavy demands on local exchange companies' lines and switches. It is predicted that the amount of data traffic will surpass voice traffic on the Pacific Bell network in California by the year 2002.[25] By one estimate, calls to these services average 22 minutes compared to 4 minutes for voice calls.[26]

Aggregate access to the phone network is often summarized by the percentage of households that have one or more active telephone lines, the so-called "penetration rate." Much public policy in this industry is devoted to achieving "universal service," which in simple terms amounts to maximizing the penetration rate.

Empirical studies have been conducted to estimate the elasticity of demand for access. Typically, these studies find that demand for access is quite insensitive to the flat rate charges for local service and to household income. A classic study has estimated the price elasticity of access demand to be in the range of -0.0175 to -0.0492 depending on the availability of measured service.[28] This means that if all prices for local service increase by ten percent, then the penetration rate will decrease by approximately 3 ⅓ percent. This same study found income elasticity to be 0.1296.

Evidence regarding local usage demand is much more scarce because measured local service has been a recent and limited phenomenon. Today, only the cities of Chicago and New York have *mandatory* measured local service.[29] Information is not routinely collected on the number of calls made per month.

There has been one experiment which examined household response to measured rate service. In 1977 GTE conducted a 2-year experiment with mandatory measured service in three small cities in central Illinois. Residential subscribers had to pay varying rates for each call and for each minute of a call.[31] Monthly data were gathered on both the number of calls and the total minutes of use of each household. This made it possible to estimate elasticities for both per-call charges and per-minute charges on the demand for calls and minutes of use with great precision. The per-call price elasticity of number of calls was -0.076 and the per-minute price elasticity of minutes of use was -0.055.[31a] This indicates that a ten percent increase in either the per-call or per-minute charge would result in substantially less than a one percent reduction in the number of calls and minutes of calling. This highly inelastic usage could imply that departures from marginal cost pricing—such as that caused by flat rate local service—do not result in large dead-weight losses.[31b] In a follow-up study, it was determined that the cost of metering usage required for local measured service would outweigh the social benefits of getting prices equal to marginal costs.[32]

Studies of telephone access (as well as connection to other utility services) conclude that users exaggerate the importance of one-time connection charges in their decisions to subscribe.[33] A typical access demand elasticity with respect to installation charge is -0.0034,[33a] implying that an increase from $100 to $110 in this one-time fee would induce 0.34 percent of customers to drop off the network. For this reason universal service programs have focused on reducing connection charges.

PRICING OF LOCAL PHONE SERVICE

Typically, local phone service in the U.S. is sold at a flat rate. Customers subscribe to the service for a fixed monthly fee which allows them to make an unlimited number of phone calls within a local calling area.[34] Calls outside this area are charged on a usage basis--either per call, per minute or per message unit--and vary with distance to the caller. Enhanced services such as voice mail and call waiting are offered on an *a la carte* basis with monthly charges for each service. There is a recent trend toward metered local service with optional plans for local areas.

Overall, provision of residential local service has been criticized as being subsidized by other services. This issue will be taken up below.

Business customers face monthly subscription charges that are significantly higher than residential access in most areas. This occurs despite the fact that these lines are typically less expensive to install and operate. While there is flat-rate service available for single-line businesses, most business customers face usage charges for outgoing calls. Since businesses typically have more peak usage than households, these (higher) usage charges are justified.

Phone calls of all types, including local calls, have the property that they often benefit both the calling and the called parties. Nevertheless, the calling party is usually charged for the call and so we say the called party enjoys a "call externality" (provided, of course, that the call is not a nuisance). While most local calls have no usage charge at all, pricing does not reflect how benefits of a call are distributed between the two parties. In contrast, in the U.S. most cellular users are charged for both incoming and outgoing local calls. This explains why some cell phones have integrated pagers to screen in-coming calls. In another example, businesses (and some households) arrange for an 800/888 number for which they accept incoming calls at their expense.

STRUCTURE OF THE LOCAL EXCHANGE INDUSTRY

SERVICE MARKET CONCENTRATION

Under the current structure of the local exchange industry, the dominant ILECs face a competitive fringe of new entrants that include some giant firms, such as the large long-distance carriers (AT&T, MCI and Sprint) and cable TV companies (Time-Warner and TCI). Depending on the market definition, the average market share of the ILECs in 1996 ranged from about 88 percent to about 98 percent in terms of revenue**.** The low figure comes from including mobile services, because non-wireline carriers have average shares approaching 50 percent in this part of the local market. The high figure is for switched services in the landline network. Thus, market structure depends crucially on market definition. To illustrate the role of market definition dramatically, the above figures imply market shares for entrants of between two percent and 12

percent.

To delineate the local exchange industry, we might begin with local retail telephone service (access and use) in the landline network ("plain old telephone service" or POTS) and ask which other services are close substitutes that should be included in the market.

Local mobile services, for instance, both partially complement and partially substitute for POTS. They are complements to the extent that calls between customers of landline and mobile networks permit additional calls that would not have been made without the availability of mobile phones. The complementarity is basically a network externality effect (except to the extent that the user only makes mobile calls to his home line). Mobile and landline services are substitutes to the extent that calls to and from mobile phones replace calls between stationary phones and that mobile phones replace additional lines. At equal prices, substitutability would probably increase substantially. On the supply side, mobile service providers could offer local exchange services in competition with landline networks, but not without building new capacity in wireless local loops.

Unswitched (private line) services for businesses are substitutes in demand to local telephone services in the conveyance of data and telephone calls within large organizations. Part of this substitutability is probably due only to the price difference between "special" (*i.e.*, unswitched) access and switched access used by IXCs. Integrated Services Digital Network (ISDN) and broadband services clearly are close substitutes to local telephone services for business users.

Intra-LATA long-distance services--sometimes called "local toll"—have been supplied by ILECs since the MFJ. They are not substitutes in demand for local telephone services. Also, suppliers of these services cannot easily switch to supplying local telephone services. However, ILECs have started to offer intra-LATA toll services at a flat rate along with genuine local telephone services (*e.g.*, NYNEX in Massachusetts). Nevertheless, we conclude that, at this time, they are not in the same market.

Telephone companies increasingly offer bundles of services. This blurs market boundaries to the extent that customers feel that they benefit from one-stop shopping. Digital convergence--the combining of different voice, data and video services on the same physical network--also blurs

boundaries. On the demand side, consumers can use the same medium and the same CPE for different purposes. This potentially increases the market for telephone services to include computers (internet) and cable TV, all of which would be supplied over the same line.[36] In principle, cable TV companies can deliver telephone calls. At the time the Telecom Act passed, convergence of telephony and cable TV appeared to be around the corner. This looks more remote now, so we exclude multichannel video services from the local telephone market but treat cable TV companies as potential entrants to the telephone market.

Table 2 reports the incumbent market shares depending on which services we include in addition to plain old telephone service. Throughout enhanced services (consisting of CLASS services, voice mail and internet access) and multichannel video, are excluded.

Table 2: INCUMBENT MARKET SHARES GIVEN DIFFERENT DEFINITIONS OF THE LOCAL EXCHANGE MARKET

Service Market Definition	**ILEC Revenue**	**CLEC Revenue**	**Total Revenue**	**Submarket ILEC Share**	**Cumulative ILEC Share**
Plain old telephone service	$54 billion	$1 billion	$55 billion	98%	98%
+ IXC access, private line, ISDN, Centrex	$34 billion	$1 billion	$35 billion	97%	98%
+ Local mobile services	$12 billion	$12 billion*	$24 billion	50%	88%

Source: authors' estimates compiled from multiple sources.

* - includes all nonwireline (Block A) cellular carrier revenues.

Historically, residential customers have had no choice between different suppliers except in the cellular market, where they could choose between two suppliers. In contrast, business customers have had several options besides the ILECs. They could self-supply by building transmission facilities or installing switching equipment, and they could turn to many competitive suppliers of business services. Under any of our market definitions, however, the ILECs have continued to be the dominant suppliers.

Geographically, local exchange markets are not easily delineated, and the distinction from long-distance markets may become blurred over time. The usual geographic market definition by demand substitution must be carefully applied in the case of telecommunications because calls of different distances are not substitutes for each other, and neither are access lines at different locations. If the dominant ILEC raises the flat rate for residential subscribers along a single street, leaving it unchanged in the surrounding neighborhood, the subscribers affected by the higher rates likely would not move to other locations. Thus, the geographic size of a local exchange market may be more meaningfully determined by supply considerations.[38] The area covered by a single local exchange would be the smallest meaningful market size. Broadening it to include several local and tandem exchanges makes sense because ILECs offer services in these local calling areas at one price (or flat rate). Since the importance of distance as a cost factor has been diminishing over time and since local calling areas seem to be growing, the size of local exchange markets would be growing, too. At this time, the largest possible market size for the assessment of market power would be the territory of an ILEC.

The multimarket dominance of the seven RBOCs in the U.S. supply of business and residential switched access lines has been 85 percent and 81 percent, respectively. GTE and Sprint respectively account for more than half of the rest, out of about 1,500 small and mid-size local exchange companies.[39]

Entry Barriers

Sunk Capital Investment

Estimates of current asset book value of U.S. local telephone networks falls in the range of $150 billion which translates into roughly $1,000 per line. Clearly, market entry may require substantial amounts of capital. It is well recognized, however, that capital requirements represent entry barriers only if they are largely sunk and accompanied by significant economies of scale (and, in the multiproduct setting, by economies of scope).

In order to offer local telephone services, a firm has to provide customer access to the

local network. Such access can be quite costly, but the cost varies significantly with customer density. Adding a customer in downtown Chicago may cost only $150, while it may cost $10,000 in remote rural areas. Thus, there are strong economies of density (which are a type of scale economy). In addition to economies of density, there are economies of scale from the construction of common ducts, laying of fiber-optic cable and use of digital switching equipment. While the capital investments required may pose entry barriers if facilities-based entry is attempted on a large scale, they would not in and of themselves prevent localized or non-facilities-based entry. Thus, in order to argue that capital investment is a barrier, one would have to make a case for both facilities-based entry and for entry over large geographic areas.

In the past, capital entry barriers appear to have been significantly lower for wireless mobile services, but higher installation and maintenance expenses have resulted in higher total costs for these services. For such services, economies of density are much less pronounced. On the contrary, because of capacity limits of the spectrum allocation, there may be some *dis*economies of density in areas that require more cells (for a given spectrum). At the same time, there may be subadditivity properties because a single carrier may be able to use a given spectrum to meet a given demand more efficiently than multiple carriers could. For example, with two suppliers, one carrier may have idle capacity while the other has to block calls. If all users were sharing the same spectrum, however, less curtailment in service would be necessary.

Spectrum auctions may now have raised capital requirements for wireless services because of high prices bid for licenses. An entry barrier will ensue if imperfect capital markets prevent an efficient entrant from acquiring the necessary spectrum. However, the effect is mitigated by a second-hand market for spectrum that reduces the sunken nature of bids paid in the auctions. Also, these new barriers are certainly less formidable than the legal entry barriers they replaced.

Bottlenecks

Some local network investments stand out as entry barriers because they are a *bottleneck* (or *essential facility*). A bottleneck has three main characteristics: it is controlled by the dominant firm; competitors are unable to duplicate the facility at reasonable cost; and denial of access to the

facility would harm competitors and competition.

Under the essential facility doctrine in U.S. antitrust law, a dominant firm must have a valid business reason to deny access to a bottleneck. This doctrine was established in 1912 in a Supreme Court case[40] involving railroad access to bridges and a ferry over the Mississippi river in the St. Louis area. However, this doctrine is not easily enforced so that, in spite of antitrust policy, bottlenecks tend to persist as barriers to entry.

Bottlenecks in the local network controlled by ILECs potentially include access to small end-users, end-office switching, numbering, intelligent network services and databases. Among these, access to small end-users stands out. In particular, having the same small customer supplied through two parallel lines is very costly. Also, the access to call completion is absolutely vital for new entrants. Consider an ILEC that currently has all households in its area as subscribers and an entrant that takes away some of those. These few subscribers will still want to make local calls to all the subscribers of the ILEC. While the same also holds in the other direction, the reciprocal interest for subscribers of the ILEC is likely to be much smaller because so few people are on the entrant's network. For example, if one percent of the population were on one network and the remainder were on the other and everybody had the same probability of calling and being called, then incoming and outgoing calls between the two networks would be statistically balanced. However, with each call people in the smaller network would individually have a 99 percent probability of wanting to reach someone in the other network. The reciprocal probability would be only one percent. Thus, while the network externality has the same absolute size in both directions, in terms of the benefit per subscriber it is relatively much higher in the smaller network.

Product Differentiation

Even if the quality provided by an entrant turns out to be the same as or better than that provided by the incumbent, consumers are hesitant to switch to other suppliers and therefore have to be compensated by lower introductory prices. When MCI entered the long-distance market in the 1970s, it could not offer the same quality of service to its customers as AT&T. AT&T

customers only had to dial 1 + telephone number, while MCI customers had to dial long access codes before the telephone number and had to use touchtone service. Thus, AT&T commanded a price premium, and MCI had a hard time getting customers.[41] Also, AT&T took advantage of the brand loyalty to the Bell System, from which it continued to benefit after the breakup because it was still identified with the Bell System—although AT&T forfeited use of the Bell name and Bell logo to the RHCs.

In recent years, due to digitalization and improved network intelligence, local telephone companies offer many more services in addition to POTS, including 3-way calling, call forwarding, call waiting, caller identification, voice mail and internet access. In doing so, they differentiate their offerings in terms of variety and quality. This enables them to differentiate pricing as well. At the same time, consumers can get most of these services from other sources. Since buying from several sources involves transaction costs, suppliers in telecommunications markets increasingly offer one-stop shopping. Suppliers now compete with bundles of services, and by doing so both increase and decrease transaction costs for consumers. Bundling raises transaction costs because consumers have to evaluate all services at the same time. It lowers transaction costs because, for all services taken together, the number of options to be evaluated is reduced to just one. Overall savings need not materialize if the composition of bundles differs between suppliers.

Because competitive local exchange carriers (CLECs) never start out with a full-service network, the amount and type of product differentiation a CLEC can offer depends on network services available to them from the ILEC. Thus, the ability of entrants to offer better quality than incumbents depends crucially on the network elements that entrants can provide themselves. Most obviously, resellers can hardly improve on the incumbent's quality of service and may even suffer from poorer services, due to technical difficulties or discrimination.

THE EMERGENCE OF COMPETITION

MARKET ENTRY

A feature that makes the emerging competition in the local exchange fascinating is the diversity of entry. *De novo* entry by new firms or firms from unrelated industries now occurs almost exclusively through resale made possible under the Telecom Act. However, starting in 1983 with Teleport, competitive access providers (CAPs) have become *de novo* facilities-based entrants in the local exchange markets as they have started to offer bypass services to IXCs. The CAPs have now diversified and entered the market for switched services. MFS and Teleport already generate close to 50 percent of their revenues from this market segment. Most facilities-based entry is diversification by firms that already operate in related markets. Examples include geographic extension (*e.g.*, *a* long-distance company entering local service) and market extension (*e.g.*, a cable company entering telephony).

If one had to point to the single most important reason for the new competition in local telephone markets, it is the advance of technology. Digitalization permits a carrier specializing in one service to enter another service without building or acquiring a second network. Thus, digitalization has reduced barriers between voice telephone, data and media services. Digital compression expands capacity, making it possible to use existing lines for new and enhanced services and reinforcing advantages possessed by incumbent providers. Optical fiber has reduced the importance of distance as a cost factor, blurring the difference between long-distance and local services. Multiple access methods[42] have created new ways for competitors can gain access to customers, specifically over the radio spectrum. Moreover, the emergence of new services, the diffusion of microelectronics and computers, and the overall reduction in costs have increased the size and extent of the telecommunications markets and the ability of the market to accommodate competitors.

THE COMPETITORS

What competition has already materialized or is likely to materialize soon? In particular, which companies can we expect to begin providing some or all local exchange services in the near future and what technologies and entry strategies might they use?

Self Supply

Competition has developed in the form of self-supply of telecommunications services through private switching equipment, private networks and computer networks, and voice mail. Clearly, such bypass has been one of the first modern attempts at competition in local telephone networks. While data on self-supply are scarce, it appears that this form of competition has been retreating more recently because of the appearance of CAPs and more competitive offerings by the ILECs.

Competitive Access Providers

Competitive access providers have developed from two sources. One is the access of IXCs to large customers. This service was made particularly lucrative through the high access charges by the ILECs. The second is the high-speed data flow between large office buildings in inner-city areas. This service was helped by the CAPs' innovative double-fiber ring architecture that offers redundancy in case of breakdowns. CAPs now serve all large US cities and have begun offering switched services as well. While most of them still specialize in serving large business customers, some are offering telephone services to households. They do so by providing their own switches and transport network, but rely on ILECs for unbundled local loops (mostly for small business and residential customers). In early 1997, Teleport Communications Group, for example, owned 26 switches, was getting over 40 percent of its total revenues from switched services (mostly from business) and had 170,000 access lines.[44] Brooks Fiber, a CAP that specializes in serving medium-sized cities, has been quite actively pursuing residential telephone customers.[44a]

Although CAPs have yet to show profits, they are valued highly in the stock market. In

1996 MFS (including UUNet) was acquired by WorldCom for $14 billion. As of mid-1997, equity in Teleport Communications, the second largest CAP, was valued at about $5 billion.

Wireless Service Providers

If one includes cellular mobile services in the local exchange market, competitors have already made substantial inroads. By the end of 1996, cellular subscribership had grown to about 28 percent of stationary access lines. Since cellular services are supplied by a duopoly, one owned by the incumbent landline carrier (the local ILEC) and the other by an independent company, roughly 11 percent of the total local market (including mobile) in terms of access is already supplied by competitors. In terms of usage, the number would be lower while in terms of local revenues it would be slightly higher.

We do not feel that mobile services are part of the same market as POTS yet. This may change quickly, however, as cellular services grow in penetration (*i.e.*, scale) and scope (*e.g.*, PCS and wireless local loops). Penetration will increase in terms of subscriber numbers and in terms of new entrants. Entry goes along with a change in technology from analog to digital systems. Sometime after spectrum auctions held by the FCC between 1994 and 1996, up to 5 new entrants will appear in metro areas. This will reduce market shares of incumbent landline carriers in wireless markets from an average of about 50 percent now to values as low as 20 percent. The question here is whether the roughly equal spectrum capacity of the entrants and incumbents and their similar technology will lead to approximately equal market shares or whether there will be pricing and product differentiation that will make the resulting oligopoly asymmetric. Some of these wireless systems will compete nationwide, including services provided by AT&T/McCaw, Bell Atlantic/NYNEX and Sprint Spectrum.

Nextel Communications has a system that is built on paging licenses and therefore has less spectrum than cellular and PCS providers. This system has emerged from dispatch services and, through use of digital technology, now tries to compete with paging and telephone services. Until now it has not made any major inroads into telephony, although Nextel has spectrum licenses to operate nationwide.

A final mobile wireless service does not yet provide service--the mobile satellite phone service. Users are connected via a radio link that bounces off a satellite. The oldest systems have used satellites in geostationary orbit about 22,300 miles above the earth. In such a system the satellite was positioned permanently over the country to receive and re-transmit signals. Newer systems use either low earth orbit (LEO) or medium earth orbit (MEO) technology which has the satellite closer to earth and constantly traveling across the area. There are advantages and disadvantages to the different systems.[45]

These are premium services, offering users both global and cellular phone service, paging, fax, data, and sometimes global positioning service. An example of a LEO system is "Teledesic" which is a joint venture between McCaw Communications and Microsoft. The planned service will specialize in data transmission, bouncing signals off as many as 840 satellites orbiting the earth at an altitude of about 500 miles.

Costs and prices are commensurate with satellite mobile's premium service. When they do become available, estimates of usage rates range from $1 to $3 per minute, with hand-held devices costing up to $3,000 apiece. Current estimates of the various systems range from $550 million to $6.3 billion. "Learning by doing" and competition are bound to drive costs down. And while these principally-fixed costs can be spread as penetration increases, this technology runs into capacity limitations in high density areas because they cannot reuse frequencies as cellular systems can.

Cable Television Networks

Cable television networks in their current form have emerged only because regulators had insisted on a separation of telephony and multichannel video services, and because the Bell System had agreed early on not to enter the TV market.[47] Consequently, synergies and potential natural monopoly properties of combining the two markets were foregone. Cable TV companies developed separate networks. Although cable TV networks pass 95 percent of US homes and actually are connected to over 60 percent,[48] for three reasons, all of which quickly lose importance, they cannot easily offer telephone services. First, two-way traffic on their networks

suffers from major quality problems because of cable TV's specific hierarchical architecture and predominant use of coaxial cables. At some cost coaxial networks could be retrofitted to carry two-way voice, and fiber-optic cables are now replacing the longer-distance parts of cable TV networks. This increases two-way capacity and reduces the need for amplifiers that tend to create noise and reduce the quality of telephone calls. Second, cable TV networks have no switches, but these could be installed fairly quickly at the headend. Third, coaxial cable is unsuitable for the telephone drop into homes if only because it does not carry low voltage electric power as does the local exchange company's copper wires. Consequently customer premise equipment must depend on the electric system for power. Although it can be done gradually, as penetration increases, replacing drop lines may be the most expensive part of making cable TV networks usable for telephony. Potential solutions to this problem include a combination of adapters at the curb and in the house, new copper drop lines, wireless local loops or subloops, and unbundled local loops or subloops purchased from the ILEC.

Overall, cable TV companies may have the lowest incremental cost among facilities-based entrants into the local telephone market. However, they suffer from sometimes small and/or isolated service areas that would make achieving economies of scale in switching quite difficult. They also suffer from a reputation for poor services due to lax technical standards, and from a history of price increases. Thus, after much speculation, the cable TV companies are moving only very gradually into local telephone markets. At this time, TCI is offering full-fledged telephone services in Connecticut.

Electric Power Companies

Electric utilities have two assets that make them potential entrants in telecommunications markets. They own telecommunications networks deployed for power management. Those networks consist of optical fibers whose transmissions are not vulnerable to electromagnetic interference. Such networks could be converted to sell telephone services to others. Moreover, they own ducts, poles, rights of way and access to virtually every business and household.

Even with these advantages they have not yet become very forceful entrants in local

telephone markets. One reason is regulatory. In the past, under the Public Utility Holding Company Act, they were prevented from offering telecommunications services. This hurdle has now been abolished by the Telecom Act. At the same time, electric utilities and state commissions have their hands full coping with regulatory changes that have opened electricity markets to competitive entry. A second reason is the nature of the utilities' telecommunications networks, which are largely trunk networks over longer distances outside the cities. As a result, electric utilities in the past have mostly leased their lines to businesses and telecommunications companies rather than entering telecommunications retail markets. This is now changing. Boston Edison, as one of many examples, has entered a partnership with a small cable TV entrant to offer telephone services in the Boston Edison service territory.

Resellers

Under resale, entrants buy a retail service from an ILEC and sell it to end-users. Thus, the ILEC provides all aspects of the service except for marketing and billing. Reselling the ILECs' local retail telephone services has emerged as a potentially important form of market entry. This became apparent in 1995 when Rochester Telephone implemented its *Open Market Plan*. There was surprisingly large demand for reselling, but the wholesale discounts and service quality became major problems. Consequently, the Telecom Act and the FCC's *Local Competition Order* have put strong emphasis on reselling.[49] Ordinarily, reselling can only have limited competitive effects because it only contributes to the last stage of the value-added chain. Resellers can only affect prices, not service offerings. Even the effect on prices is limited because ILECs control the resellers' principal costs. According to the Telecom Act, resellers can either buy at wholesale discounts equal to the ILECs' avoided costs from reducing their own resale business,[50] or they can buy in bulk at quantity discounts. In the first case, to undercut the ILEC profitably, the reseller must have lower retail costs than the retail costs avoided by the ILEC. In the second case, the reseller makes use of the ILECs' nonlinear pricing structure, and volume discounts in particular. This could induce the ILECs to linearize their pricing structure. More likely, the ILECs will see this as an opportunity for additional indirect business with price-

conscious small end-users that otherwise might switch to facilities-based entrants.

Both of these cases would not greatly increase competition in the local telephone markets. However, resale has another more important function. It complements and accelerates market entry in facilities-based forms. Facilities-based entry is time consuming, expensive and risky. Starting with resale allows an entrant to capture market share while or before it is building its own facilities. This way, when the new facilities come on stream, the entrant already has enough of a customer base to generate an acceptable capacity utilization (needed because, as mentioned above, switching and transmission facilities are "lumpy"). In addition, the entrant can concentrate on building new facilities in areas with high business and population densities and resell in less dense areas. This strategy would work for a firm that wants to advertise its entry in broad geographic areas. The problem with this competitive strategy is that the ILEC is bearing a major part of the market risk of the entrant and is receiving a low return for that service. In addition, the ILEC will not be able to maintain geographic tariff averaging. A more efficient distribution of risks between network service providers and resellers could be achieved through a schedule of prices based on the length of purchase commitment, with the highest expected price for spot purchases.

Interexchange Carriers (IXCs)

The IXCs are probably the most formidable new competitors in the local exchange. They have a strong incentive to enter this market, if only because 40 percent of their costs for long-distance services currently are for the local exchange. To the extent that IXCs are able to sell their own local services, their costs are likely to decrease substantially provided local customer and carrier access charges continue to be over priced. ILEC charges are likely to decrease substantially in the near future, however.

The large IXCs have well-known brand names and excellent reputations. This enables them to gain new customers for local services and, in particular, for one-stop shopping. The advantage of the IXCs over ILECs is that their brand-name recognition is nation-wide, while the ILECs only command regional brand-name recognition.

IXCs have some head-start in terms of facilities-based competition over *de novo* entrants with their points-of-presence (POPs) already located in local networks. This is especially true for AT&T which originally had tandem switches located near its operating companies' central offices and so today has POPs close to ILEC central offices. In any case, IXCs currently only have direct access to very large business customers. To gain other customers, they would have to add local transport and loop facilities in order to own a full local network. They would also have to add switching capacity, although that could probably be done gradually. Their current base is much smaller than that of the ILECs.

In 1994 MCI decided on a strategy to build its own local networks in selected cities for selected customers. Although these networks would not reach most households, this strategy proved to be very expensive and MCI quietly scaled back its plans. It appears now that the major IXCs pursue entry strategies that combine the use of different tactics. They use CAPs to access large business customers, they own cellular companies to cover the mobile market segment and eventually to build wireless local loops, and they use resale and unbundled network elements to cover most residential customers.

Even though the IXCs are potentially strong competitors in the local markets, it appears to be harder for them to enter local markets than it is for ILECs to enter long-distance markets, once the regulatory hurdle has been cleared. In those cases where the regulatory hurdle has been removed, the ILECs have been successful long-distance entrants in their territories. Within a year, GTE has gained more than one million long-distance customers, and SNET already has about 30 percent of the long-distance customers in Connecticut, but only about 10 percent of long-distance traffic.

ILECs Outside Their Territories

The recent mergers between SBC and PacTel and between Bell Atlantic and NYNEX have not been challenged by the Justice Department. In part, the Justice Department did not believe the mergers posed anticompetitive problems because the firms were not viewed as likely entrants in each others' territories. This is particularly surprising for Bell Atlantic and NYNEX

which are direct neighbors in the highly contested New York City area.[53] Out-of-region ILECs may not be seen as likely entrants because their network does not extend beyond their current boundaries. However, they have switches and network intelligence close by, so their incremental costs of entry in the adjacent areas should be substantially lower than the stand-alone costs of *de novo* entrants. GTE in particular, with its checkered territory, could fairly easily enter other ILECs' service areas but may also be most vulnerable to entry by others into its 28 states. In California, GTE and PacBell have entered into interconnection agreements for the completion of calls. This hints at the fact that competition between adjacent ILECs is developing, but primarily for toll calls. Also, Ameritech is offering some local service in the St. Louis area, in SBC service territory, and US West is entering the Atlanta metropolitan area, which is in BellSouth territory.

ASSESSMENT OF THE ENTRANTS

Two factors are most important for the relative advantages of the various new competitors--the incremental costs of building local telephone networks and the pre-existing goodwill with potential subscribers. The costs of building local telephone networks vary significantly by type of entrant. One estimate of the costs of different distribution technologies found capital expense per subscriber for cellular radio, PCS, cable telephony and CAP to be $2,860, $1,100, $835 and $1,210, respectively.[54]

Cable TV companies have the lowest cost of building local loops but have to upgrade their networks (which they have already been doing to prepare to offer expanded channel capacity and digital services). Cellular phone companies that want to supply landline services incur somewhat higher costs. Wireless local loops are, on average, as costly or more costly than fixed loops but have less economies of density and are sunk to a lesser degree.[55] Thus, they have advantages in some remote areas or for entrants with low penetration levels (which mimic a remote area) or in cases of high churn rates, where subscribers have to be turned on/off on short notice. Analog wireless loops are particularly costly because of their low capacity. Because of the current price structure, usage for local loops is, on average, substantially higher than mobile usage. CAPs often have low costs of supplying business customers and large apartment buildings in downtown areas,

but high costs of supplying residential customers and businesses elsewhere.

Pre-existing goodwill should have a large influence on the costs of gaining subscribers and on the prices that a new competitor can charge. Goodwill is also decisive for the success of one-stop shopping and product integration. Survey results conclude that IXCs have a clear goodwill advantage over the ILECs, while cable TV companies are clearly at the bottom among the three.[56] While we have no goodwill data on the other entrants, it is clear that CAPs are only known to potential business customers. Thus they have to start from scratch but, compared to the cable TV companies, that may not be so bad. Cellular providers and electric utilities are likely to occupy ranks in the middle, probably behind the ILECs.[56a]

We have tabulated conjectured advantages of ILECs and pure types of entrants in Table 3. This table does not include potential advantages from resale and unbundled network elements, which will partially compensate for some disadvantages. It also does not include potent combinations of entrants, such as IXC and cable TV (bundled service) or PCS and CAP (wireless access and fiber transport). Table 3 makes clear that there are diverse tradeoffs such that no market participant dominates on all counts, not even the ILECs in their home markets.

REGULATION BRINGS COMPETITION TO THE LOCAL EXCHANGE

REGULATION VERSUS COMPETITION

Regulation can both encourage and discourage competitors and competition. Between 1910 and the early 1970s, both federal and state regulation discouraged competition in local telecommunications markets. Then, initially forced by court decisions, the FCC started to favor competition in the long-distance area. However, local competition was not on the FCC's agenda, and the state regulators only gradually became interested in it. Nevertheless, long-distance competition put competitive pressure on the ILECs, as IXCs bypassed local networks to access large long-distance users on more favorable terms. The interest in local competition really began in the late 1980s, through proceedings on "open network architecture" (ONA), which were

intended to give service providers access to unbundled parts of the ILEC networks. At that time, a few state commissions, New York and Illinois in particular, took the initiative to remove barriers to competition and actively facilitate entry by new competitors. Inadvertently, regulation has also been conducive to local competition through imbalances it created in the local rate structure. The efforts of regulators to hold certain politically sensitive rates down led to high rates in other areas, creating opportunities for entrants. In order to keep local residential rates low, regulators allowed business and long-distance access rates to increase. This clearly encouraged access bypass and private networks.

Technological advances in computer technology, fiber optics and wireless transmission have paved the way for competition in the local exchange. Regulatory policy tends to lag technical change because it protects current stakeholders against new interest groups. Current interest groups have large, well defined stakes and low costs of organization. In contrast, entrants tend to have ill-defined stakes (only options on future gains) and are heterogeneous, as are consumers who could benefit from entry. Thus regulation generally protects incumbents against entrants. Only after the entrants have established themselves can they gain influence similar to the incumbents. It is thus fortunate for the development of competition in the local exchange (and quite different from the earlier development of long-distance competition) that powerful incumbents in other markets, who are under the same regulatory jurisdiction as the ILECs (IXCs and cable TV companies), are among the most aggressive and potent entrants.

Table 3: RELATIVE ADVANTAGES OF PURE ENTRY STRATEGIES INTO THE LOCAL EXCHANGE

Competitor	Required Investment	Consumer Goodwill	Competitive Advantage	Competitive Disadvantage	Preferred Market Segment	Speed of Facilities-based Entry
in-region ILEC	low	high	existing networks, diverse customer base, known brand name	regulation especially duties imposed by 1996 Act	households, medium density, full provider	infinite
out-of-region ILEC	medium to high	medium	low costs in adjacent areas	lack of network facilities	adjacent areas	medium
IXC	medium	very high	nationwide brand names, switching and transport capacities	lack of local loops, insufficient switching capacity	large business customers with direct links, households	medium to high
wireless/ cellular	medium to high	medium	mobility, existing customer base	spectrum scarcity especially in high density areas	low density, high income	high
cable TV	low to medium	low	existing networks, bandwidth	one-way networks, lack of switching and poor reputation	broadband, medium to high density, transport network for other CLECs	low to medium
CAP	low to medium (for large users)	low	existing networks, bandwidth	lack a presence outside central business district	high density, large business subscribers, access for other CLECs	high
electric utility	medium	medium	transport capacity, rights of way, own demand for load management	no local loops or switching, lack of expertise	transport for other CLECs	low

THE LEGACY OF REGULATION

Regulatory Jurisdiction

Although the services we consider in this chapter are local, the LECs are regulated both by state regulators and by the FCC, but not by municipalities.[59] Local exchange rates are under state control except for access provided for interstate services. Scope economies dictate that local and long distance share the same local loops and switching. As a result, the assignment of LECs to local and national markets becomes somewhat difficult. Regulatory division of labor would have been simple, had it not been for the 1930 *Smith v. Illinois Bell Telephone Co.*[60] decision that favored the *station-to-station* over the *board-to-board* method of assigning assets to services. Under the board-to-board method, a long-distance phone call begins at a long-distance carrier's POP in the originating exchange and ends at the POP in the destination exchange. It therefore excludes the use of the local network. The philosophy behind this method is that subscribers who make and receive long-distance calls have already paid for the use of the local network (through flat-rate services). Under the station-to-station method, a long-distance phone call begins at the originating telephone set and ends at the destination set, including use of the local network at both ends.

Based on the court decision favoring the station-to-station method, allocation of local network costs between local and long-distance services was made to determine their respective rates. As it happened, politics governed the allocations of joint and common costs which were designed to subsidize local basic services. This scheme led to relative prices bearing no relation to costs, sometimes above standalone costs and thereby inviting entry into selected services. Regulators often responded to the possibilities that entrants were engaged in "cream skimming" by erecting barriers to local exchange markets. They feared that these entrants would serve only the high-margin, "creamy" markets and ignore the low-margin, "skim" markets.

Rate Regulation

Traditional rate regulation prescribed a fair return on fair value. This was based on the Constitutional ban on the seizure of property without due process.[61] Thus rates were based on cost, including a fair rate of return on the firm's assets. This was deemed fair to both telecommunications investors and rate-payers. However, by neglecting efficiency effects, rate-of-return rate making created neither good profit opportunities for investors nor low prices for consumers. While an early theoretical paper claimed that rate-of-return regulation would lead to inefficient investment behavior (too much capital relative to other inputs), there was never strong empirical evidence for this phenomenon.[62] Nevertheless, economists continue to believe that rate-of-return regulation, as it is practiced, provides weak incentives for cost minimization and for investment in risky new technologies and services.

Since rate-of-return regulation was based on the regulated firm's costs, it was natural for regulators to think that they could allocate costs to individual services, leading to *fully-allocated-cost* pricing. This meant that costs not caused by an individual service, but common to several or all services, were to be fully assigned to the services according to some formula determined by convention or regulatory decision. Fully- allocated-cost pricing turned out to be quite inefficient and incompatible with competition. Such cost allocation tends to be arbitrary and therefore opens the door for regulatory policies favoring interest groups. In particular, it allows regulators to defer rate increases affecting their main constituencies. Between 1950 and 1980, as costs of local access rose and costs of long-distance services fell, regulators shifted costs from residential local access to long-distance services, thereby preventing the local rates from increasing and the long-distance rates from declining as much as they otherwise would have. This was achieved by assigning more than proportional costs of non-traffic-sensitive plant and equipment to the federal (*inter*state) jurisdiction and less to the state (*intra*state). This did not affect profits very much because most of the shift was internal to the Bell System.

The state regulators' pricing strategy developed into residual pricing, by which residential local rates were kept low and other services were priced according to market conditions. However, local telephone rates increased substantially after the AT&T divestiture, because

regulators feared for the financial viability of the newly created RHCs in absence of internal subsidies.

The cross-subsidy flows from residual pricing have apparently been substantial. There have been subsidies from toll to local, business to residential, urban to rural, and high-density to low-density usage. A service can be said to receive a cross-subsidy if it sells for less than its average incremental cost, i.e., the increase in cost from adding that service to the firm's existing product line, averaged over the amount of that service provided. A service can be said to cross-subsidize other services if it sells for more than its average stand-alone cost, *i.e.*, the cost to produce only the service in question. The extent of cross-subsidization in favor of residential local services has never been fully clarified. As the FCC recently put it, "we simply do not have the tools to identify the existing subsidies precisely at this time."[63] We have most clearly subsidized residential access in remote areas where costs are particularly high and rates are relatively low (because only few subscribers can be reached by local calls).

Origination and termination charges for inter-LATA calls are usage sensitive and higher than incremental cost. In 1995 IXCs paid ILECs $34 billion in direct subsidies (Universal Service Fund, Lifeline, Link-up America, *etc.*) and access fees for origination and termination. The incremental costs of access services received (which consists of transport and switching) were in the neighborhood of $10 billion. Thus, for access minutes costing less than 1 cent, the IXCs were paying on average about 3 cents. However, that does not mean that IXCs pay more than the stand-alone costs of access (which consist of transport, switching *and the local loop*).

On average in 1995, the residential rates per line for measured service and flat-rate service were $12.50 and $17.16 per month (including the FCC's Subscriber Line Charge of $3.50 but excluding 911 charges and taxes). This compares with $37.00 for flat-rate single-line business services and somewhat more per line for multiple-line business service.[64] The rates charged businesses are clearly above the incremental costs of providing lines and other monthly costs of subscription, but are they above stand-alone costs? Recent incremental cost studies used for the FCC's August 1996 *Local Competition Order* indicate that residential access in many states is not subsidized on average. Has the $12.50 monthly charge for measured service been below the incremental cost of providing residential service? On average across the United States, it has been

below the incremental cost of providing unbundled local loops (without any retail costs). Thus, it must be below the incremental cost of residential subscriptions including loop cost (by an amount of $2 to $5 per month), and substantially below incremental cost when only local switching and transport are included.[65]

The alleged subsidies from urban to rural areas and from high-density to low-density areas are difficult to separate because rural areas are predominantly low density and urban areas are predominantly high density. Quite clearly, some low-density/rural customers pay substantially less than their average incremental costs. Thus, these subscribers are subsidized. The amount of subsidy is currently debated. Proxy-cost models estimate that the amount of subsidy is between $5 billion and $15 billion per year.[66]

As indicated above, local subscription rates are on average below average incremental costs. In most states, basic local service includes subscription and unlimited local usage on a flat-rate basis. That combination is often priced below average incremental cost, but somewhat less so because usage costs less than 1 cent per minute.

In contrast, enhanced services are priced well above their average incremental costs. Examples include "custom local access signaling system" services, or "CLASS services," such as call waiting, caller identification, voice messaging, and voice dialing. Typically, these services are individually sold for flat monthly charges ranging from $3.00 to $6.50 per month, which are believed to be many times higher than average incremental cost.[67] Even if local residential rates are not greatly subsidized, they certainly seem to be distorted relative to other rates.

REGULATORY REFORM

Rate regulation reforms began in the late 1980s. At that time, all states and the FCC regulated telephone rates to ensure the firm did not earn more than its allowed rate of return on invested capital. In 1990 the FCC adopted the new regulatory scheme of "price caps" with profit sharing for the LECs. A price cap scheme places a ceiling on the average revenue a firm can charge on all services, with appropriate adjustments over time for inflation and the rate of productivity improvement that comes from technical change. State incentive regulation schemes

started earlier and vary substantially. They have in common that they give regulated firms some pricing flexibility not enjoyed under rate-of-return regulation and that, within limits, they reward superior performance with higher profits.

All these schemes should induce regulated firms to become more efficient and should prepare them for increased competition. Price caps in theory are particularly strong in both respects. By setting price ceilings that automatically adjust over time, they allow the firms to reap profits from improved efficiency while simultaneously providing reduced prices to consumers. By partitioning a firm's services into baskets, price caps allow firms to rebalance their price structures in anticipation of competition. In practice, the cost-cutting incentives of price caps have been curtailed by the short duration of automatic adjustment parameters, and price rebalancing has been limited through percentage bounds by which individual rates could be increased or decreased. Also, a number of states established rate moratoria on basic residential rates, thus leading to a decline of those rates in *real* terms. Partly because of these developments (in the case of price caps) and partly in spite of them (in the case of rate moratoria), cost coverage for basic local residential services has actually increased in recent years, mostly because costs in the local network declined in nominal terms over time (due largely to technical progress in cables and switching and due partly to lower interest rates).[67a]

At the federal level, price cap regulation and reform of the access charge structure have gradually reduced access charges, although they are still far above costs and in part unrelated to costs. As indicated below, this is about to change substantially, both through tightening of price caps and through market forces coming from new substitutes for conventional ILEC access. Lower access charges will make entry of IXCs in local exchange markets somewhat less attractive because the potential for cost savings on long-distance calls will be reduced.

Pre-1996 Entry Barriers

Until passage of the 1996 Telecommunications Act, many states had prevented entry into switched local telephone services. The experience with wasteful competition through dual local telephone systems at the beginning of the century makes that posture seem reasonable. It is more

likely, though, that competition would make it difficult to maintain subsidized rate structures and public service obligations.

Between the AT&T divestiture in 1984 and passage of the Telecom Act, more and more states started to allow and even encourage competition in local exchange markets. The experience of these forerunners has been incorporated in the Telecom Act, which attempts to abolish all regulatory barriers to entry and, in addition, tries to eliminate other entry barriers, such as bottlenecks and sunk capital requirements.

For the last 15 years, cellular mobile services have been offered by at most two providers in each local area. One of these providers originally was a subsidiary of the ILEC, while the other was an independent carrier (who could be a subsidiary of an ILEC with a different service area). The FCC viewed this duopoly situation as sufficiently competitive and did not to regulate it. About half of states engaged in some form of rate regulation and other restrictions on cellular carriers. This regulation appears to have had no price-reducing effects, or possibly may have led to higher rates .[68] It was abolished through the Omnibus Budget Reconciliation Act of 1993.

While duopolies have some competitive properties, they do not provide full-fledged competition, particularly when each duopolist controls a scarce input (spectrum) that limits the available capacity. Spectrum auctions held by the FCC from 1994 through 1996 not only brought in over $20 billion and added new competitors to wireless telecommunications, but they also increased the available capacity. It will take a few years and an additional $20-40 billion to bring all this capacity on stream. However, in several urban areas new PCS entrants have started to capture market share and helped to lower prices. As a result, competition for wireless telecommunications services has started to increase substantially, and this is sure to spread to nonmobile services.

Intercarrier Relations

Telecommunications services differ from many other sectors of the economy in that competing firms have to collaborate intensively on an ongoing basis. Calls that originate on one network have to be completed on the network to which the called party has subscribed. Also, it is

often most economical to share the use of network parts rather than have competitors duplicate them. Although advantages from such collaboration accrue to all parties, the size of the advantages is often sufficiently asymmetric to make collaboration difficult. In particular, as explained above, dominant ILECs tend to gain less than entrants. In fact, by denying collaboration the ILECs may be able to erect entry barriers and thereby increase their profits.[69]

Interconnection between ILECs has been going on for decades, but that was between neighboring monopolies that were barred from entering each others' territories. Interconnection between ILECs and cellular carriers, which started in 1983, was also not between competitors because cellular and landline telephone services were seen as complementary to each other. Procompetitive collaboration between carriers was initiated by FCC decisions on interstate access by information service providers and IXCs.[69a]

Information services fell under the line-of-business restrictions of the MFJ, so that Bell operating companies could only offer these services through a separate subsidiary, thereby eliminating any scope economies achievable between these and other network services. The FCC considered the loss of economies of scope severe and therefore, in its ONA proceedings, forced dominant LECs to make available to other service providers some unbundled basic services and comparably efficient interconnection to their networks. In return, the Bell operating companies were relieved from the line-of- business restriction on information services.

Regarding interstate access of IXCs, the FCC helped CAPs by not regulating them and by allowing them to be under federal jurisdiction if more than 10 percent of their traffic was interstate. Nearly all CAPs thereby avoided regulatory entry barriers or rate regulation that state regulators might have imposed on their leased line services. The FCC also paved the way for interconnection of CAPs, enhanced service providers, and private networks with the ILEC networks. Thus, entrants no longer had to duplicate all ILEC facilities to bypass ILEC networks, but could selectively do so using ILEC local loops and switches combined with their own transport facilities. These developments, which culminated in the FCC's 1992 and 1993 *expanded interconnection* orders, were bold (and therefore challenged by the ILECs), but they opened local competition only at the wholesale level because, without legislation, control over local switched services remained largely outside the federal jurisdiction.

The expanded interconnection decision originally called for *physical collocation* of facilities. That means that new competitors would have been able to install their own facilities in ILEC central offices or other feasible network nodes. This would have given entrants the ability to use ILEC networks almost as if they were their own. The ILECs successfully brought suit against this obligation as a regulatory confiscation, in violation of the Constitution. Retreating, the FCC required *virtual collocation*, under which the physical interconnection with entrants would take place in a manhole outside an ILEC's central office.[70] The ILEC would then install interconnection facilities in the central office that would either be leased by the ILEC from the entrant or built according to specifications provided by the entrant. Thus, virtual collocation tries to mimic the outcome of physical collocation without giving the entrants physical access. The FCC's decisions on collocation were immensely helped by practical state experience gained with both forms of collocation, especially in New York and Illinois. The New York State Public Service Commission had, in its 1989 interconnection decision, established such a stringent standard for virtual collocation that NYNEX instead opted for physical collocation with Teleport. Once again, while many state commissions continued to impose barriers to local competition, some states took the lead in lowering barriers and facilitating entry.

TELECOMMUNICATIONS ACT OF 1996

The Telecommunications Act of 1996 is the first major reform of federal telecommunications regulation in over sixty years. Unlike the Communications Act of 1934, the Telecom Act takes competition (rather than regulation) to be the principal mode of governance for telecommunications markets. The main objective of the new Act is to further open telecommunications markets and to protect competition against the market power of incumbent dominant carriers.

A number of the Act's provisions are designed to create opportunities for new local exchange competitors. First, state and local regulations restricting entry into telecommunications markets are to be abolished or declared invalid. Federal preemption facilitates entry of facility-based exchange service providers and resellers.

Second, all ILECs must allow others to interconnect at all feasible points of their networks. Physical collocation is the rule. ILECs and CLECs must transport and terminate calls from each others' subscribers and compensate each other for this service. Third, ILECs must offer number portability, allowing a new competitor to take an existing subscriber with her/his telephone number, and dialing parity, allowing subscribers of new competitors to dial without special access codes and without delays. Fourth, ILECs must offer unbundled network elements that allow entrants to pick and choose, but also to rebundle elements to offer full network services without building a network. The elements have to be priced to approximate economic costs with allowance for a reasonable return. Fifth, ILECs must offer resale of all their retail services at wholesale prices with a discount equal to their cost savings from not selling at retail themselves. Finally, new entrants must be given access to network infrastructure such as rights of way, ducts and poles, as well as telephone numbers, databases, directories, etc.

In order to make these things happen, the telecommunications companies must negotiate in good faith. If agreements are not reached quickly, state regulatory commissions can be asked to mediate or arbitrate. If this doesn't occur in a timely manner, the FCC becomes the arbiter of last resort. During the first year after passage of the Telecom Act, the experience has been that reaching agreements between ILECs and new competitors has been contentious and has involved many complicated arbitrations. For example, the Massachusetts Department of Public Utilities issued an order in the arbitration between NYNEX and several new competitors on December 4, 1996, but even six months later none of the interconnection agreements under arbitration had been signed.

In addition to the provisions cited, the Telecom Act relaxes the cable-telco cross-ownership ban. It also dismisses the MFJ consent decree as well as consent decrees signed when GTE acquired Sprint and when AT&T merged with McCaw Cellular. Importantly, the line-of-business restriction barring RBOCs from long-distance services is lifted. As a "carrot" to induce the RBOCs to open their local markets to competition, they must first convince their state regulatory commissions, the Department of Justice and the FCC that local competition is developing in its territory.

CONCLUSION

Our survey of the local telephone services industry reveals the ceaseless interplay between communications technology, regulatory policy and competitive forces. The latest round of this complex dance is destined to be one of the most dramatic that the industry has ever seen. However, after passage of the Telecom Act, it has become abundantly clear that local telephone markets will not quickly become competitive. Rather, it will take years until ILECs will no longer be dominant.

In order for competition to succeed in local telephone markets, any implicit cross-subsidization has to vanish. The stage for this has been set through the universal service reform required by the Telecom Act. This proceeding is going to make cross-subsidies explicit and available to CLECs and through the access charge reform that will eliminate interstate access charges as potential sources of subsidies. In addition, ILECs and state regulators will have to change rate structures to reflect costs of incumbents and entrants.

Part of the slow start of competition is due to legal tactics and regulatory procedures that delay application of the procompetitive provisions of the Telecom Act. However, real logistic and technological obstacles such as provision of number portability and operations support systems postpone the supply of unbundled network elements by ILECs. There are also real delays by CLECs in getting their networks and organizations going and in convincing subscribers to switch to their services. Thus, market penetration by new competitors will take its time. Nevertheless, we are confident that competition will ultimately succeed, especially as new local communications technologies will certainly be discovered and overtake the existing alternatives.

ENDNOTES

* The authors are grateful to Joseph Farrell and Bridger Mitchell for many insightful comments on an earlier draft of this chapter.

1. Wilcox, Delos, *Municipal Franchises*, Vol. 1 (Rochester: Gervaise Press, 1910), p. 260.

2. Gabel, David, "Competition in a Network Industry: The Telephone Industry, 1894-1910," *The Journal of Economic History*, 54 (September 1994), p. 562.

3. In fact, Bell did face competition from Western Union in the first few years after his patent was granted. Western Union also claimed ownership of telephone technology which was developed by Elisha Gray and Thomas Edison. Bell sued Western Union for patent infringement and won. In a 1879 settlement Western Union sold off its exchanges to Bell and agreed not to enter the telephone business, and Bell agreed to stay out of telegraph.

4. Bornholz, Robert and David Evans, "The Early History of Competition in the Telephone Industry," in *Breaking up Bell: Essays on Industrial Organization and Regulation*, William Brock and David Evans, eds., (New York: 1983), p. 11.

5. See, for example, Weiman, David and Richard Levin, "Preying for Monopoly: The Case of Southern Bell Telephone Company, 1984-1911," *Journal of Political Economy*, 102 (February 1994), 103-26.

6. Mueller, Milton, *Universal Service: Competition, Interconnection and Monopoly in the Making of the American Telephone System* (Cambridge: MIT Press and AEI Press, 1997).

7. Stehman, J. Warren, *The Financial History of the AT&T Company* (Boston: Houghton-Mifflin 1995), p. 25.

8. Mueller, *"Universal Service,"* p.81-86.

9. Bornholz and Evans, "Early History," p. 13.

9a. Mueller, *"Universal Service,"* p. 120.

9b. *Ibid*., p. 81.

10. Ibid., p. 14.

11. These were Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell and US West.

12. Judge Harold Greene, who oversaw the AT&T divestiture, made this decision to ensure parity between AT&T and other long distance carriers who were permitted to enter the local exchange. *U.S. v. AT&T*, 552 F. Supp. at 175, 176.

13. Rochester Telephone Co., "Petition for Approval of Proposed Restructuring Plan," filed with the New York Public Service Commission, March 3, 1993.

14. Ameritech Corporation, "Customers First: Ameritech's Advanced Universal Access Plan," filing before the FCC, March 1, 1993.

16. British Telecom's purchase of MCI was intended to help finance this venture. Earlier, MCI had acquired local rights of way and facilities in 200 cities from Western Union.

16a. This same kind of economy also occurs when airlines create hub airports and then route flights through the hub on their way to their final destination.

17. Shin , Richard and John Ying, "Unnatural Monopoly in Local Telephone," *Rand Journal of Economics*, 23 (Summer 1992), pp. 171-83.

19. See Hatfield Associates, *The Cost of Basic Universal Service*, Boulder, CO, July 1994 and Benchmark Cost Model in "A Joint Submission by MCI Communications Inc., NYNEX Corporation, Sprint Corporation, and US West, Inc.," FCC Docket No. 80-286, December 1, 1995.

19a. Signaling is the transmission carrying information about the nature of the call and the provision of value added services such as number identification or call waiting.

20. Federal Trade Commission and U.S. Department of Justice, *Horizontal Merger Guidelines*, (Washington, DC: Government Printing Office, 1992).

21. Short haul toll calls account for about 5 percent while long distance and international calls make up the remaining 10 percent. Vogelsang, Ingo and Bridger Mitchell, *Local Telephone Competition: The Last Ten Miles* (Cambridge: MIT Press and AEI Press, 1997), p. 4.

22. FCC, "Trends in Telephone Service," Industry Analysis Division, Common Carrier, Bureau, March 1997, Table 11, p. 16.

24. The value of additional subscribers is felt to be very small since phone service is nearly universal in the United States and most developed countries. The U.S. residential penetration rate for telephone service was 93.9 percent in 1995. FCC, "Monitoring Report," May 1996, pp. 80-

286.

24a. 1997 Annual Report of the Federal Reserve Bank of Dallas (reporting on research by W. Michael Cox). Also covered in Peter Brimelow, "The Silent Boom," *Forbes*, July 7, 1997, pp. 170-171.

25. See Pacific Bell, "Surfing the 'Second Wave:' Sustainable Internet Growth and Public Policy," 1997, http://www.pactel.com.

26 *Ibid*. Also, household usage of data services runs about 45 minutes per day compared to about 22 minutes per day for voice calls. Demand for online access is greatest in the early evening hours, happily at a time when other local calling is not at its peak.

28. Perl, Lewis, "Residential Demand for Telephone Service, 1983," prepared for the Central Service Organization of the Bell Operating Companies by National Economic Research Associates, Inc., White Plains, NY, December 1983.

29. In 1983, only 54 percent of households even had the option of some kind of measured service.

31. In some cases there were no minute charges; in all cases subscribers could opt for a flat rate *multiparty* service.

31a. Park, Rolla Edward, Bruce Wetzel and Bridger Mitchell, "Price elasticities for local telephone calls," *Econometrica*, 51:6, 1983, pp. 1699-1730.

31b. Provided there is not excess capacity—as would happen if peak load pricing was not employed—so that short-run marginal cost would be negligible.

32. Park, Rolla Edward, and Bridger Mitchell, "Optimal Peak-load Pricing for Local Telephone Calls," Technical Report R-3404-1-RC, Rand Corporation, March 1987.

33. Hausman, Jerry "Individual Discount Rates and the Purchase and Utilization of Energy-using Durables," *Rand Journal of Economics*, 10:1, Spring 1979, pp. 39-54.

33a. Perl (1983), op. cit.

34. Part of the fixed monthly fee is a charge of $3.50 mandated by the FCC to defray the cost of providing local customers with access to their long distance providers.

36. This would automatically mean that services like multichannel video and telephone services would belong to the same market even if cable TV companies could not deliver telephone calls.

37. See Telecommunications Industries Analysis Project, "1995 Calculated Interstate and Intrastate Revenues for the Proposed Universal Service Fund and Formats for Comparisons of Different Benchmarks," December 4, 1996; revised December 13, 1996.

38. A telecommunications-intensive business may, however, relocate based on rate levels.

39. The two trade associations for service providers, USTA and OPASTCO, have about 1,200 and 450 members, respectively.

40. *U.S. vs. Terminal Railroad Association of St. Louis*, 224 U.S. 383 (1912), and 236 U.S. 194 (1915).

41. However, for some time MCI did receive a substantial discount on access charges to compensate for the lack of equal access.

42. These are technologies that encode and decode information in different ways so as to share the same medium without interference.

44. Teleport Communications' web site: http://www.tcg.com/

44a. As of June 1997, Brooks Fiber had 21,786 access lines in service in Grand Rapids, Michigan, of which 15,876 were business lines and 5,910 were residential. Of these, 6,192 were business lines served exclusively over Brooks facilities, along with 591 residential lines. See FCC Memorandum Opinion and Order in CC Docket 97-137, Ameritech Applications for In-Region InterLATA Authority, August 19, 1997.

45. The higher the satellite, the longer it stays in orbit, the greater the time delay of transmissions, the more power required to connect, the fewer satellites needed to cover a given area and the lower the software control requirements. The LEO projects include Iridium, Globalstar, Teledesic, Ellipso and Celestri. Odyssey and ICO Global are the leading MEO projects.

47. The first was the 1926 cross-licensing agreement with GE, RCA and Westinghouse. See Faulhaber, Gerald R., *Telecommunications in Turmoil*, (Cambridge, MA: Ballinger, 1987), pp. 11-14.

48. *Television & Cable Factbook*, Cable Vol. 63 (Washington, DC: Warren Publishing, 1995)

49. FCC, "Implementation of the Local Competition Provisions in the Telecommunications Act of 1996," First Report and Order, CC Docket 96-98, FCC 96-325, Released: August 8, 1996.

50. *Ibid*. The FCC Order also contains a range of default discounts that could be used if no cost

studies were available. The pricing part of the Order, however, was thrown out by the courts. Many state commissions have, nevertheless, adopted the FCC's recommendations.

53. The Justice Department could have believed that taking away one potential entrant would still leave the New York area with enough other potential and actual entrants.

54. Economics & Technology, Inc./Hatfield Associates, *The Enduring Bottleneck* (1994), Table 3.2. Study sponsored by MCI.

55. For cost comparisons, see Economics & Technology, Inc./Hatfield Associates, *Bottleneck*.

56. Hill, G. Christian, "It's War!", *Wall Street Journal*, 16.9, 1996, S. R1.

56a. A wireless customer survey found that 67% of cellular and 73% of PCS users reported to be either "extremely satisfied" or "very satisfied" with their service. Peter D. Hart Research Associates, March 1997.

59. In contrast, cable TV companies have always been regulated by municipalities and, with the passage of the Cable Act of 1992, are also regulated by the FCC. Cities do wield considerable power over local telephone entry conditions though their control of public rights of way, rights to siting antennas and towers, and so forth. In the first decades of the phone industry, cities had the power to grant local phone franchises. Bornholz and Evans, op. cit. p. 22.

60. 282 U.S. 13, 152-153 (1930).

61. The Fifth Amendment states: "No person shall ... be deprived of life, liberty or property, without due process of law, nor shall private property be taken for public use, without just compensation."

62. See also the theoretical arguments by Greenwald, Bruce C., "Rate Base Selection and the Structure of Regulation, *The Rand Journal of Economics* 15 (1984), pp. 85-95.

63. FCC, First Report and Order, FCC 97-158, In the Matter of Access Charge Reform (CC Docket No. 96-262), Price Cap Review for Local Exchange Carriers (CC Docket No. 94-1), Transport Rate Structure and Pricing (CC Docket No. 91-213), End-User Common Line Charges (CC Docket No. 95-72); Adopted: May 7, 1997; Released: May 16, 1997, para 9.

64. FCC, "Trends in Telephone Service," Industry Analysis Division, Common Carrier Bureau, March 1997, Table 8, p. 12.

65. This is in line with the finding that on an incremental-cost basis residential local exchange

service was subsidized by nearly $4 billion in 1992 and 1993. Hatfield Associates, *The Cost of Basic Universal Service*, Boulder, CO, July 1994.

66. See Telecommunications Industries Analysis Project, "1995 Calculated Revenues." The lower amount corresponds to the Hatfield Model and the higher amount to the Benchmark Cost Model.

67. Kaneshige, Thomas, "The Regional Bells Go to the Top of the CLASS," *Communications International*, 22 (September 1995), pp. 24-27.

67a. Gabel, David, "Pricing Voice Telephony Services: Who Is Subsidizing Whom?" *Telecommunications Policy*, 19:6, 1995, pp. 453-464.

68. See Ruiz, Keta L., "Pricing Strategies and Regulatory Effects in the U.S. Cellular Telecommunications Duopolies," Ph.D. Dissertation, Boston University, 1994; and Shew, William B., "Regulation, Competition, and Prices in Cellular Technology," Working Paper prepared for the American Enterprise Institute, Washington, DC, June 2, 1994. In contrast, Hausman, Jerry (1995), "The Cost of Cellular Telephone Regulation," working paper, MIT, January finds that rates were actually higher by 17% in states that regulate cellular services.

69. For an analysis of how pricing of interconnection services can eliminate competing networks and how certain pricing rules counteract these tendencies, see Economides, Nicholas, Giuseppe Lopomo and Glenn Woroch (1996), "Regulatory Pricing Rules to Neutralize Network Dominance," *Industrial & Corporate Change*, 6:4, 1996, pp. 1013-1028.

69a. For an extensive discussion of these decisions see Vogelsang and Mitchell (1997), Chapter 6.

70. Some ILECs had already implemented physical collocation and could continue this practice if they wished to do so.

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