

PART 1

Key Concepts

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The Telecommunications Industry

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INTRODUCTION

What exactly is the telecommunications industry? The industry, in fact, is hard to define because technological advances cause the industry to continually redefine itself. Indeed, the only constant in the telecommunications industry is that it is always changing. So it is a somewhat dubious task to write a chapter on such a dynamic market. Nevertheless, this chapter will attempt to provide an overview that segments the industry into different markets and shows where these markets are converging or overlapping.

This chapter will look at the industry through the eyes of an economist and policy maker rather than through the eyes of a technologist. Many of the other chapters in this book will focus on various technologies used in the industry, but this chapter will concentrate on the supply and demand of telecommunications services to the mass market: the consumer and small business marketplace. Although it may seem easier to write about economics because technologies change rapidly, the economics of supply and demand change rapidly, too, as the technological possibilities expand.

The telecommunications industry has been and will continue to be in the midst of convergence for some time. *Convergence* means that industry segments that were once separate and distinct are now overlapping and merging to provide similar competing services. Because of convergence, it is hard to draw lines of separation within the industry that are clear and meaningful. For the purposes of this chapter, we will define the three industry segments as voice, video, and data. From a purely technological standpoint, one could define voice and video as just different types of data; from the consumer perspective, however, these products are different in use and access, at least currently. Within each industry segment, there are wireline and wireless technologies that deliver these products. For voice communications, we have the choice of traditional landline phones or wireless phones. Cable television (wireline or coaxial cable), broadcast, and satellite (wireless) can deliver video. Data delivery can be done by dialup, broadband technologies such as *direct subscriber line* (DSL) and cable modem (wireline), and *wireless fidelity* (WiFi) as well as by satellite and data services provided by cell phone companies (wireless).

What is causing this convergence? There are several drivers. The first and primary driver is technology,

specifically the Internet. Internet protocol was once limited to data traffic such as e-mail and Web pages, but now it is being used to provide voice services such as *voice over IP* (VoIP) and video (e.g., *Internet protocol television*, or IPTV). Voice and video (television), which were once analog, have become digitized and delivered over an IP network. This transition has not always been smooth or easy. Two problems have plagued the transport of voice and video over IP networks: latency and prioritization. Voice and video communications require the information to arrive in the same order in which it was sent and without more than a split-second delay. Without this requirement, a packet of a conversation might arrive out of order and result in a jumbled and garbled mess. Likewise, delays of a second or more are especially noticeable in voice and video communication but are mere inconveniences to traditional data traffic such as e-mail. IP networks initially had problems transporting real-time voice and video, but the problems of latency and prioritization have largely been overcome.

But how and why did this technological change take place? In the United States, much of the freedom to allow this technological change came from the Telecommunications Act of 1996 (TA96) and associated rulings by the Federal Communications Commission (FCC). The FCC chose not to regulate nascent technologies out of existence and allowed them time to develop and mature. The intent of TA96 was “to provide for a pro-competitive, deregulatory national policy framework designed to accelerate rapidly private sector deployment of advanced telecommunications and information technologies and services to all Americans by opening all telecommunications markets to competition” (Duesterberg and Gordon 1997, 2). Thus, the second cause of convergence is the legislative and regulatory restructuring that allowed the technologies to adapt and change.

Underlying both the first two reasons of technology and restructuring is the basic economic incentive to reduce costs, increase revenues, and, ultimately, maximize profits. If VoIP can provide landline voice to customers at a much cheaper price than traditional landline networks, then there is a great economic incentive to develop it. If IPTV can enhance the revenue stream and leverage the investment for “fiber to the premises” (FTTP) and “fiber to the curb” (FTTC) projects, then the economic incentives will drive development and allocate resources

to overcome technological challenges. Ultimately, it is consumer demand and willingness to pay coupled with cost-effective technological innovation that is driving convergence.

Customers seem to be driven to purchase four products: (1) landline voice, (2) high-speed Internet access, (3) TV and entertainment, and (4) wireless voice and data. These four products have become known as the “quadruple play” by companies that seek to provide all of these services to customers, sometimes as bundles. Many telecommunications companies have merged in recent years either to increase their market share or market reach within one or more of these product areas or to provide a new product that they had not already offered to customers. For example, SBC merged with AT&T, and Cingular (owned by SBC and BellSouth) bought out AT&T Wireless. Verizon then merged with MCI, and the new AT&T (SBC–AT&T) plans to merge with BellSouth. These mergers and others have resulted in an industry that is dominated by large multimarket oligopolies.

After completing these mergers, the resulting companies have become the market leaders in each of the quadruple play markets except for TV and entertainment. The new AT&T is the second-largest local landline company (it will be the largest after its proposed merger with BellSouth), the largest long-distance company, the largest wireless provider (Cingular–AT&T Wireless), and the largest provider of DSL (and a nationwide IP network from the old AT&T). Verizon is the largest local landline company, the second-largest long-distance company, the second-largest wireless provider (Verizon Wireless with 45 percent owned by Vodafone), and the second-largest provider of DSL (and a nationwide IP network from MCI’s uunet). Both companies have plans to aggressively build their fiber networks to provide TV and entertainment services.

The rest of this chapter is organized as follows. First, we will explore the landline voice market with its historical segments of local and long distance. Second, the wireless voice market will be examined along with its interactions with the landline market. Third, the video and data markets will be explained along with the wireline and wireless technologies used to supply these markets. Finally, the U.S. telecommunications market will be

compared to telecommunications markets in other developed countries.

LANDLINE VOICE MARKET

Landline voice is the oldest of the telecommunications markets discussed here; historically, it was the entire telecommunications industry. Before 1970, the landline voice market was mostly served by AT&T with its affiliated local Bell operating companies. During the 1970s and 1980s, the FCC allowed increased competition for long-distance and customer-premises equipment that culminated in the divestiture of AT&T in 1984. The divestiture required the creation of a precise definition for local and long-distance calls. This somewhat arbitrary distinction between long-distance and local telecommunications had no real foundation in cost or demand considerations. Because the distinction was a creation of regulation, market forces have caused the two markets to merge. Convergence and corporate mergers are blurring any remaining distinctions between this historical separation. SBC, the largest local company, has recently merged with AT&T, the largest long-distance company; and Verizon, the second-largest local company, has merged with MCI, the second-largest long-distance company.

Long-Distance Voice Market

Historically, long-distance voice service was provided as a monopoly service by AT&T. During the 1960s and 1970s, the FCC allowed other companies—namely, Microwave Communications Inc. (MCI) and others—to provide long-distance services in direct competition with AT&T. This policy eventually led to the divestiture of AT&T from its local telephone subsidiaries and full-fledged competition in the long-distance industry. This movement from a regulated monopoly provision of services to competitive services from many companies would be repeated throughout different industry segments.

Long-distance rates have declined significantly since the divestiture of AT&T in 1984. Figure 1 shows the decline in rates from 1984 to 2003. In 1984, the average price of a long-distance call was almost sixty cents per

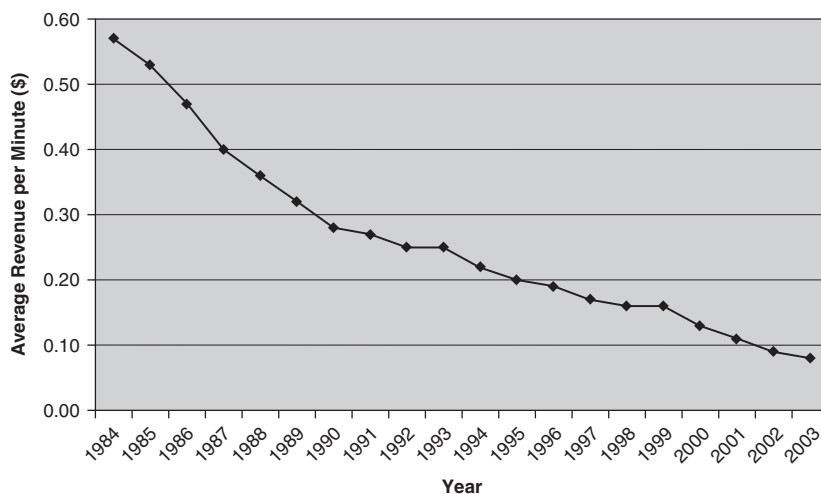


Figure 1: Average revenue per minute for interstate and international calls (in 2003 dollars), 1984–2003

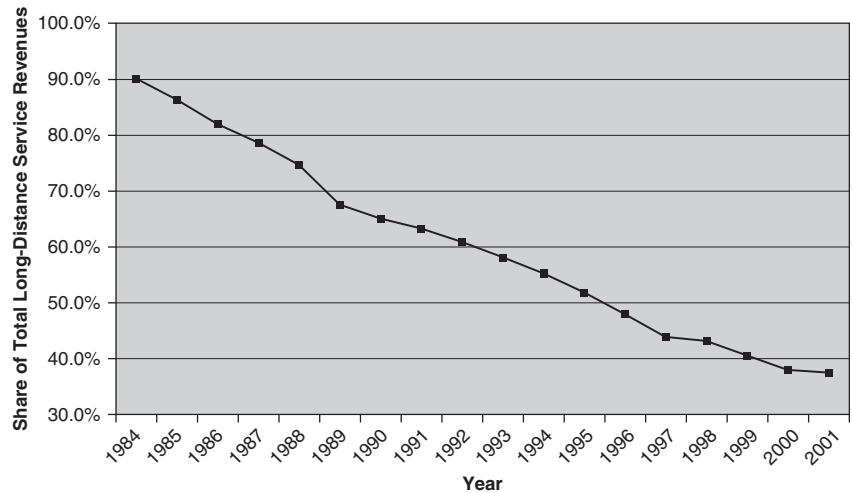


Figure 2: AT&T's share of total long-distance revenues, 1984–2001

minute (in 2003 dollars), but the average price was less than ten cents per minute by 2003. Much of the decline resulted from lower costs to connect calls to local telephone networks (Taylor and Taylor 1993). AT&T's market share declined from more than 90 percent in 1984 to less than 40 percent in 2001 (see Figure 2). MCI and Sprint were the second- and third-largest providers of long distance during this time, and their market shares grew as AT&T's declined. Table 1 shows the annual market share for the long-distance market between 1984 and 2001 (the most recent year the FCC produced these statistics). By 2001, MCI's market share had grown to 23.4 percent, and Sprint's had grown to 9.3 percent.

Overall, the traditional long-distance landline voice market is in serious decline for two reasons. First, the "death of distance" (Cairncross 2001) has been caused by a shift in long-distance traffic away from the public switched telephone network (PSTN) onto private data networks and the public Internet. This shift was first led by international traffic that could avoid voice call termination charges and high regulated prices by carrying the voice traffic over data lines. Even within the United States, regulatory policies caused prices for domestic long-distance calls to be high above their marginal cost. These high margins eroded as competitive alternatives became available. The second reason for the decline of the long-distance landline voice was the high market penetration of wireless phones with significantly different pricing. In 1998, AT&T Wireless's Digital One Rate incorporated long distance into the company's wireless plan at no additional charge above that for airtime. This pricing plan was quickly adopted by other wireless firms. Under this plan, customers had monthly bundles of minutes on their wireless phone contracts that they would lose if they were not used. Thus, the effective marginal price of a long-distance call on a wireless phone was zero as long as users did not exceed their allotted minutes. Not long after this, wireless plans included free calls during nights and weekends (e.g., airtime during night and weekends did not count against customers' monthly allotments of minutes). Thus, customers shifted much of their usage away from landline long distance and onto wireless phones.

Regulation of the long-distance market also changed substantially during this time (Sappington and Weisman

Table 1: Percentage Shares of Total Toll Service Revenues for Long-Distance Carriers, 1984–2001

Year	AT&T	MCU	Sprint	All Other Long Distance Carriers
1984	90.1	4.5	2.7	2.6
1985	86.3	5.5	2.6	5.6
1986	81.9	7.6	4.3	6.3
1987	78.6	8.8	5.8	6.8
1988	74.6	10.3	7.2	8.0
1989	67.5	12.3	8.4	11.8
1990	65.0	14.5	9.7	10.8
1991	63.2	15.6	9.9	11.3
1992	60.8	18.1	9.7	11.5
1993	58.1	19.7	10.0	12.3
1994	55.2	20.7	10.1	14.0
1995	51.8	24.6	9.8	13.8
1996	47.9	25.6	9.7	26.8
1997	43.8	25.6	9.5	21.0
1998	43.1	23.5	8.5	24.9
1999	40.5	23.7	9.8	26.0
2000	37.9	22.4	9.0	30.7
2001	37.4	23.4	9.3	23.8

Source: Federal Communications Commission (2003), Table 7.

1996). Even after divestiture, AT&T was regulated under *rate-of-return regulation* by the FCC; it is one of the heaviest forms of regulation because it limits both profits and prices. Because MCI and Sprint had much lower market shares, they were not regulated but still filed their rates

with the FCC. This asymmetric regulation allowed MCI and Sprint to know AT&T's rates with certainty and respond in a competitive manner. The FCC changed from rate-of-return regulation to price-cap regulation in 1989, but not until 1995 was AT&T declared nondominant and effectively deregulated.

Local Voice Market

The path taken by the local voice market has been similar to that of the long-distance market. Each local market was historically served by a monopoly local telephone company that was rate-of-return regulated by the state regulatory board. Most cities and heavily populated areas were served by subsidiaries of AT&T until divestiture in 1984. At divestiture, local telephone subsidiaries were separated from AT&T's long-distance and equipment pieces. The local telephone pieces of AT&T were broken into seven different companies called *regional Bell operating companies* (RBOCs): NYNEX, Bell Atlantic, BellSouth, Ameritech, Southwestern Bell, US West, and Pacific Telesis. These companies corresponded to different geographic regions of the country (see Figure 3). The companies did not serve all customers in their regions but only major population centers. Other local telephone companies known as *independents* (because they were independent of the Bell system), served customers in the other areas.

Local telephone companies did not face competition until much later than their long-distance counterparts. In fact, competition in the local market came about because of competition in long distance. Competition in local markets started in large urban areas where new start-up companies provided direct connections from the customer to the long-distance network and thereby bypassed the local telephone network. This competition arose because of artificially high regulated rates that the local telephone companies charged to long-distance companies to connect their networks to customers. Much of this bypass was uneconomic in the sense that it was caused by regulatory rules rather than underlying differences in

costs. The upstart companies became known as *competitive access providers* (CAPs) or *alternative local transport companies* (known as ALTs). These companies continued to expand the local telecommunications services they offered until full-fledged local competition was introduced by TA96. These upstart companies became known as *competitive local exchange carriers* (CLECs) after this legislation. The traditional local telephone companies then became known as *incumbent local exchange carriers* (ILECs). Several rules from TA96 sought to put CLECs on an equal footing with ILECs. One rule was *local number portability*. For many business and individuals, changing phone numbers when changing phone service presented a great barrier to switch carriers. Because the ILECs started with all the customers, this gave them an unfair advantage in a fully competitive marketplace. To combat that advantage, local number portability required that all phone companies allow their customers to take their phone number with them when they changed local companies (Black 2002, 99).

Rates for local telephone service did not decline as they did in the long-distance market. In fact, the recurring monthly charge for basic telephone service has increased from 1986 to 2004 as shown in Figure 4: The average monthly residential charge rose from \$17.70 in 1986 to \$24.31 in 2004 (in nominal dollars). Part of the increase in local residential rates has been a shift in recovering costs away from per-minute charges (*access charges*) charged to long-distance companies and toward per-line *subscriber line charges* (SLCs) charged to end users.

The total number of switched access lines has decreased from a high of approximately 192.5 million lines in December 2000 to approximately 175.5 million in December 2005 (FCC 2006, 5). Much of the decline has been caused by people disconnecting second lines that were used for Internet connections or teenagers. These individuals have switched to broadband connections for Internet use and substituted wireless phones for teenagers. ILECs have suffered not only from the overall decline in the size of the market but also from competition with



Figure 3: RBOC regions at AT&T's divestiture, 1984

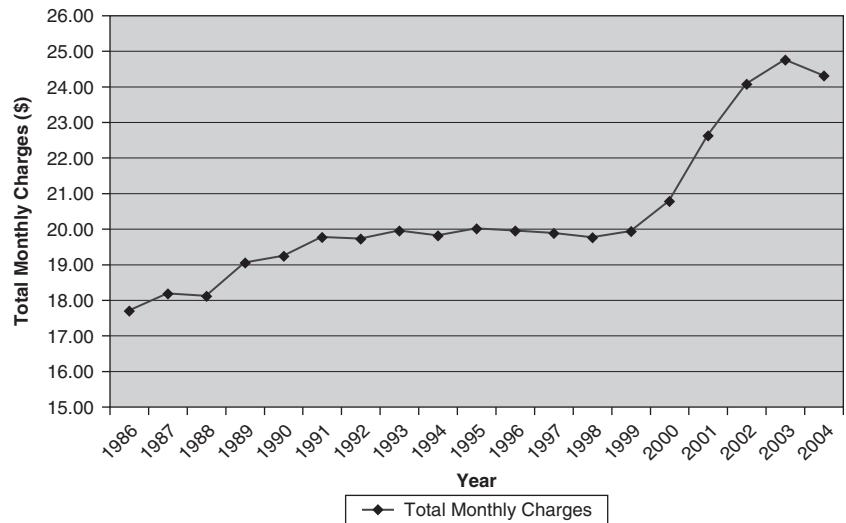


Figure 4: Total monthly charges for local services in urban areas, 1986–2004

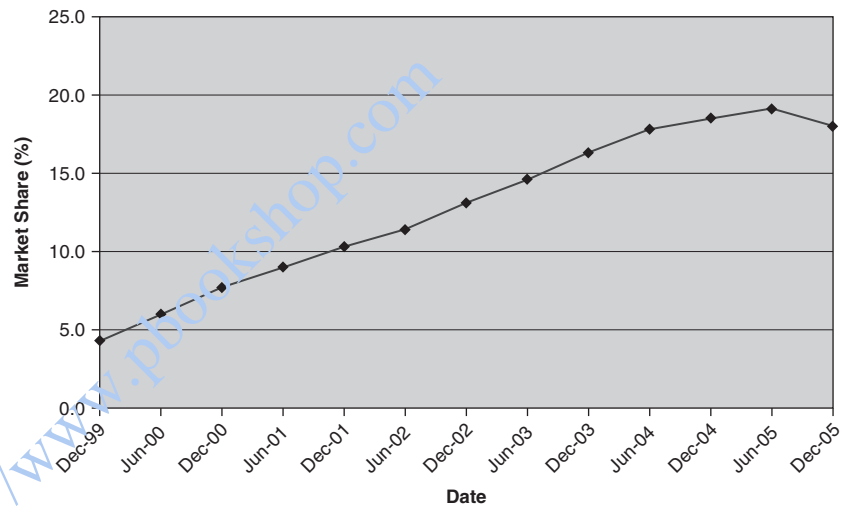


Figure 5: Growth in CLEC market share, 1999–2005

CLECs. CLEC market share has increased steadily from 4.3 percent in December 1999 to 17.8 percent in June 2004 (see Figure 5).

In addition to suffering from the decline in second lines, the local wireline market faces competitive threats from so-called intermodal forms of competition for primary lines to a household. Loomis and Swann (2005) have shown clear links among wireless, wireline, and broadband telecommunications. In the future, more and more households will go “wireless-only” and disconnect their wireline services. Others will shift their voice usage toward *voice over IP* (VoIP), using their broadband connections and disconnecting their traditional landline phones.

The local landline market has changed considerably because of mergers since AT&T’s 1984 divestiture. Figure 3 (RBOCs at divestiture) has changed to Figure 6 (RBOCs today). In 1997, Bell Atlantic merged with NYNEX to become the new Bell Atlantic. In 2000, the new Bell Atlantic merged with GTE, the largest independent telephone company, to become Verizon. Verizon merged with MCI in 2006. Southwestern Bell Corporation changed its name to SBC Communications in 1995 and acquired Pacific

Telesis in 1997, SNET in 1998, and Ameritech in 1999. SBC merged with AT&T in late 2005 and took on the AT&T name for the company. On March 5, 2006, the new AT&T announced plans to purchase BellSouth. US West was acquired by Qwest, a long-distance company in 2000. Thus, only AT&T, Verizon, and Qwest will remain from the eight companies formed from the 1984 divestiture of AT&T.

Long-Distance and Local Voice Market

Markets that are in decline often see industry consolidation through mergers as a means to decrease costs in order to survive in a shrinking market. The local and long-distance markets have seen much industry consolidation with the top local provider (SBC) merging with the top long-distance company (AT&T) and the second-largest local company (Verizon) merging with the second-largest long-distance company (MCI). With these mergers, the distinction between local and long distance is difficult to discern except as a regulatory artifact.

In spite of blurring lines between long distance and local services, two important regulatory and public policy decisions concern the interaction between these two



Figure 6: RBOC regions, 2006

industry segments. These decisions include universal service and intercarrier compensation.

Universal service is the public policy of having a telephone network that is available, integrated, and affordable to all Americans (Mueller 1997). Historically, long-distance calls were priced above their marginal costs in order to price local telephone service below its marginal cost. This cross-subsidization was approved by both federal and state regulators to ensure that local telephone service would be affordable to most people. The divestiture of AT&T broke the linkage between long-distance and local rates. As AT&T long distance faced more competition, policy makers feared that local rates would increase and that households would disconnect their local phone service. Local rates did increase following divestiture, but households did not disconnect their phones. Instead, households responded to their total bill in which local rates increased but long-distance rates decreased even more rapidly. As a result, the market penetration rate rose from 91.4 percent in 1984 to 93.3 percent in 1990 (Hausman and Belinfante 1993).

In addition to the cross-subsidy issue from long distance to local, TA96 added the e-rate program under the category of universal service. The e-rate program provides subsidies ranging from 20 percent to 90 percent for Internet access to schools and libraries, depending on how disadvantaged they are. The fund was capped at \$2.25 billion, and the amount of requests for funding quickly exceeded the funds available. This program fundamentally changed the understanding of universal service. Previously, only landline voice service was treated as needing support under universal service; the e-rate program now extends this same type of support to Internet access.

Another area of universal service is support for high-cost rural telephone companies. The RBOCs generally serve only densely populated areas of their states. These areas are generally cheaper to serve because of economies of scale and geographical considerations. Each area of a state that is not served by an RBOC is served by an independent telephone company. The independents serve

areas that are less densely populated, more rural, and therefore of higher cost. Because of the policy of geographic rate averaging, the high-cost rural telephone companies have needed subsidies to continue to maintain low rates. These funds have come from high access charges for long-distance calls as well as surcharges on bills of all telecommunications service providers.

Access charges are a large part of the second public policy decision concerning local and long distance services: intercarrier compensation. *Inter-carrier compensation* started with access-charge plans around the time of divestiture. Because AT&T was split between its long-distance and local pieces, a mechanism of prices had to be developed to charge long-distance companies for their use of the local telephone network in order to connect a long distance call. Economists had argued that these charges should only include variable traffic-sensitive costs of completing the long-distance calls; the fixed non-traffic-sensitive costs should be paid for by end users in the form of a per-line charge (later called the *subscriber line charge*, or SLC). Because of rate shock and concerns about universal service, the SLC was not set high enough to pay for all of the non-traffic-sensitive costs; the remainder was collected through increases in access charges above the traffic-sensitive cost level. This decision ultimately led to bypassing of local networks and the rise of CAPs and CLECs as discussed earlier.

TA96 recognized that the system of access charges was flawed and needed to be overhauled. The law charged the FCC with developing a solution, and the FCC devoted the third of its trilogy of orders from TA96 to *access-charge reform*. The FCC reform plan, however, has a large failure. Instead of raising the SLC, the FCC created a brand new charge—a *presubscribed interexchange carrier charge* (PICC)—that the local companies charged to the long-distance companies based on the number of customers who had that company as their default long-distance carrier. Revenue raised from this new charge was used to lower access charges. The FCC also distinguished between primary and other lines coming into a residence and allowed the SLC and PICC to be higher for nonprimary lines. The

FCC wanted the long-distance companies to absorb the PICC charges as their per-minute access charges declined. Instead, the companies passed on the new PICC charges to consumers as a new fee and, in some cases, charged more than the PICC charge. The end result was worse than if the FCC had simply raised the SLC directly. After two years, the FCC admitted its mistake and eliminated the PICC charge and began raising the SLC.

Intercarrier compensation includes more than just access charges for long-distance service. Because TA96 formalized rules for full-blown local competition between ILECs and CLECs, intercarrier compensation has also included payments, called *reciprocal compensation*, between ILECs and CLECs for terminating local traffic between subscribers. Reciprocal compensation rates were set at a fraction of the price of access charges even though the physical act of terminating a phone call is the same whether it originates across the country or across the street. Charging different prices for the same service is referred to as *price discrimination* by economists and invites *arbitrage* (buying in the low market and selling in the high market) unless there is an easy way to prevent it. In the case of reciprocal compensation, CLECs could accept long-distance traffic from the long-distance company and pass it on to the ILEC as local traffic. The CLEC would only pay the low per-minute reciprocal compensation rate, and the long-distance company would avoid the much higher access-charge rate. This act would be even easier if the CLEC and the long-distance company were part of the same holding company. Thus, there was pressure to lower access charges and make reciprocal compensation rates higher than their marginal cost.

One byproduct of having reciprocal compensation rates higher than their marginal costs was that CLECs could make a profit from terminating local traffic. One type of customer with the highest amount of terminating traffic is the Internet service provider (ISP). ISPs with dialup access have large modem banks that allow individuals to connect to the Internet by placing local calls. If the ISP is a customer of the CLEC and the individual connecting to the Internet is a customer of the ILEC, then the ILEC must pay the CLEC per-minute reciprocal compensation for the duration of the Internet connection. In this way, some CLECs received 40 percent to 70 percent of their total revenue from reciprocal compensation from the ILECs. The FCC eventually ruled that a call to an ISP was not a local call and therefore should not be subject to reciprocal compensation rules. This ruling placed some CLECs into bankruptcy.

The rules for intercarrier compensation get even more difficult when VoIP providers and wireless carriers are added to the mix. Efforts to reform intercarrier compensation and the universal service fund in order to provide a consistent plan that addresses many of the concerns already raised have been led by coalitions of industry players and regulators. One plan, known as the Missoula Plan (named for the town in which the group met at one point), was filed with the FCC in August 2006 and will be the subject of comments and debate in the coming years. The Missoula Plan task force has worked under the auspices of the National Association of Regulatory Utility Commissioners (NARUC) and is sponsored by AT&T,

BellSouth, and Cingular, as well as by approximately one-quarter of the small rural companies. Qwest, Verizon, and most wireless providers have reserved judgment on the plan.

WIRELESS VOICE MARKET

The wireless voice segment of the telecommunications industry has been one of its fastest-growing segments. This segment started in 1985 when two cellular providers were awarded licenses in each geographic territory by the FCC. One license was given to the landline company, and the other was awarded by a combination of merit hearings and lottery. This duopoly structure did not make for a competitive environment, but the industry grew at a rapid clip because of the high demand for mobility in communications. This robust demand led to calls for the FCC to allocate more radio spectrum to wireless telephony. As a result, an additional 120 megahertz (MHz) of radio spectrum was sold by the FCC in its broadband personal communication system (PCS) auctions from December 1994 to January 1997 (compared to 50 MHz for cellular at that time). In all, 2074 licenses were awarded, and more than \$20 billion was bid.

To ensure more competition than under the former duopoly structure, the FCC imposed a spectrum cap such that no single company could have a license for more than 45 MHz in any single market. In November 2001, the FCC raised that limit to 55 MHz; in January 2003, the commission eliminated the spectrum cap altogether. The elimination has led to mergers and industry consolidation. In 2004, Cingular bought AT&T Wireless (at that time, a company independent of AT&T Long Distance); in 2005, Alltel bought Western Wireless and Sprint merged with Nextel. These mergers helped solidify the dominance of four nationwide wireless carriers—Cingular, Verizon Wireless, Sprint-Nextel, and T-Mobile—with several smaller regional carriers. The firms' market shares are shown in Table 2.

In August 2006, the FCC began an auction of an additional 90 MHz of wireless spectrum. The bidders with the largest upfront deposit include a consortium of satellite TV providers, including DirecTV and EchoStar; and a group of cable TV companies, including Comcast, Time Warner Cable, and Cox Communications. Wireless providers T-Mobile, Cingular, and Verizon Wireless have also registered at the auction to acquire additional spectrum.

Table 2: Market Share by Subscriber for the Top Four Mobile Telephone Operators

Mobile Telephone Operator	Market Share (%)
Cingular Wireless	27.1
Verizon Wireless	24.2
Sprint PCS	11.9
T-Mobile	9.6

Source: Federal Communications Commission. 2005. Tables 2 and 4.

In 2008, the FCC will auction off additional spectrum that is now occupied by local television stations.

Before the creation of these nationwide carriers, the wireless industry was served by smaller regional carriers. Because customers wanted to use their wireless phones outside of their carriers' regions, each company developed roaming agreements so its customers could utilize another company's network while in its territory. The charges for using this roaming feature were passed along to the customer. Because roaming charges were much higher than the standard home rate for calls, customers complained frequently and loudly to their carriers. The development of nationwide carriers allowed consumers to use their own companies' networks and choose pricing plans that would avoid all roaming charges.

Wireless subscribers and revenues have increased rapidly over time. Figure 7 shows the rapid increase in the number of wireless subscribers, and Figure 8 shows the increase in minutes of use over wireless networks. As of December 2003, nationwide wireless penetration was 54 percent. The average minutes used per month increased from 255 minutes in 2000 to 599 minutes in 2003. Figure 9 shows that the average total bill for wireless has

declined greatly with the slight increase in recent years because of increased usage.

The wireless industry has experienced several pricing innovations that have spurred its growth. The first innovation was AT&T's Digital One Rate, which was introduced in May 1998. This plan combined wireless airtime and long-distance charges into a single rate, effectively absorbing the long-distance surcharge for long-distance calls made on wireless phones. This pricing plan was quickly copied by the other wireless companies. As mentioned earlier, this type of pricing plan cut landline long-distance usage significantly. On the flip side, it spurred wireless growth because of the "savings" in long distance that was introduced in this plan. In January 2004, AT&T Wireless also introduced mobile-to-mobile calling whereby calls to another AT&T Wireless subscriber would be free. These free calls did not count against a customer's monthly allotment of minutes; the plan helped spur customers to get their friends and family to switch to the same carrier. Similar "in-network" plans were introduced later by many other wireless companies.

Wireless companies have also provided customers with discounted or sometimes even free phones with a one- or

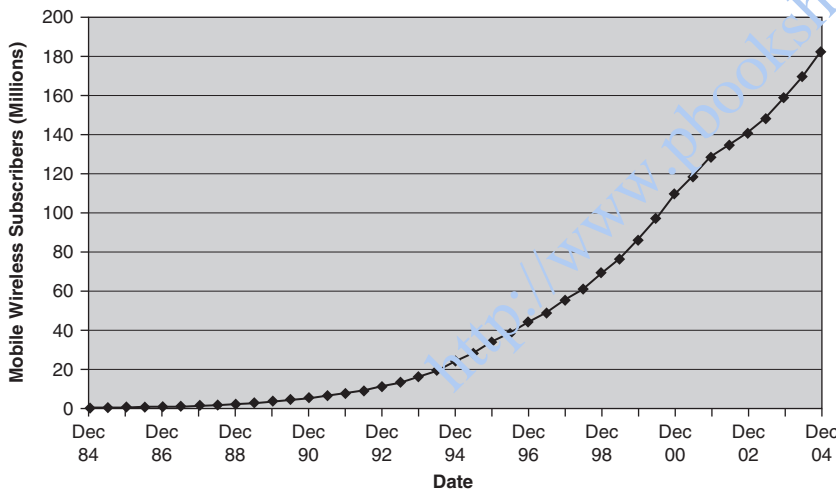


Figure 7: Number of mobile wireless subscribers, 1984–2004

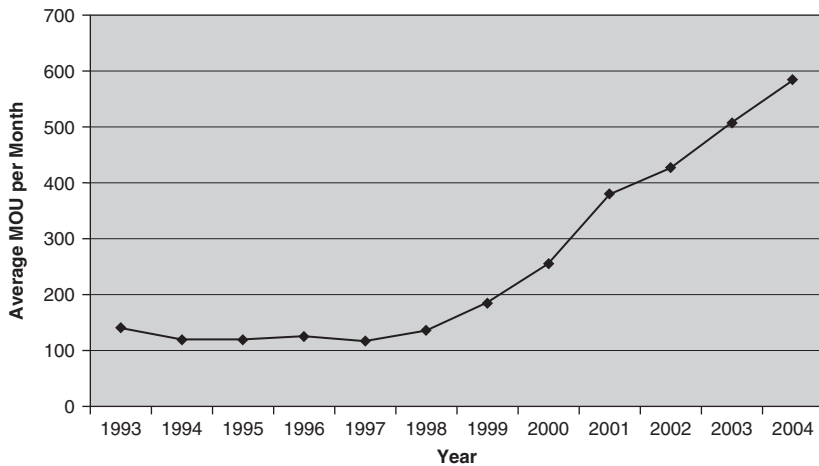


Figure 8: Average minutes of mobile wireless telephone use (MOU) per month, 1993–2003

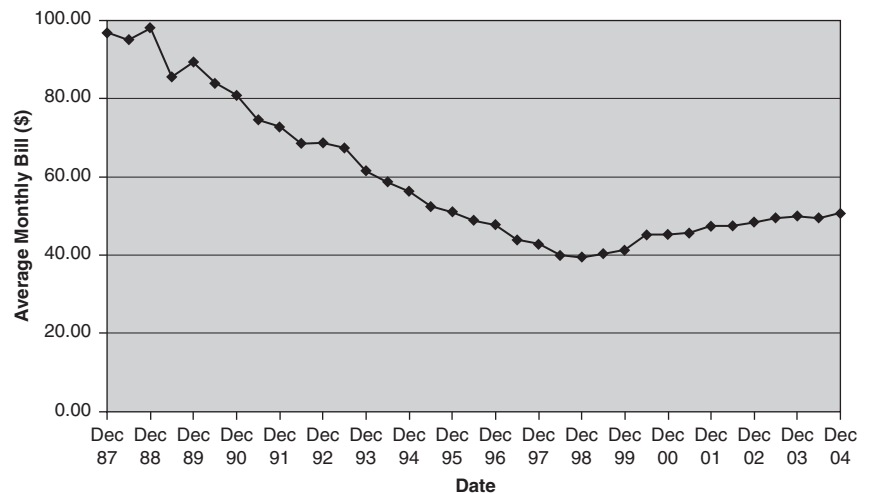


Figure 9: Average monthly bill for mobile wireless telephone service, 1987–2004

two-year contract. Providing a discount for the cost of buying a phone in order to use the wireless service lessened the upfront financial burden of getting service even if the monthly charge was higher as a result. Wireless companies have also signed exclusive deals with phone manufacturers to capture consumer interest in the latest technology. One example is Cingular's exclusive limited-time contract with Motorola to sell its RAZR line of phones.

As wireless phones increasingly became a substitute for landline usage, many customers started to see their wireless phones as substitutes for their landline phones. Surveys have shown that 10 percent to 15 percent of households have “cut the cord” and gone wireless only. This percentage has been highest among younger people and new households. One problem that the wireless industry faced in this substitution was that one landline phone could serve many individuals in the household. If the household consisted of a family of four, this would mean four separate wireless plans to substitute for one landline phone. To effectively lower the price of this substitution and spur growth elsewhere, the wireless companies introduced family plans in which family members could join another family member's plan for as low as \$10 per month and share their bundled minutes. These family plans lowered the price for a household to substitute wireless phones for its landline phone.

As discussed earlier, local number portability required local landline companies to allow their customers to keep their local telephone numbers when they switched carriers. This rule applied only to landline companies, so a wireless customer who changed carriers would have to change phone number and notify all of his or her contacts of the new number. This hassle gave customers a great incentive to stay with their current providers and hindered free and equal competition in the market. In November 2003, the FCC required companies in the top one hundred markets to implement local number portability and roll it out nationwide by May 2004.

Unlike landline telecommunications, the FCC and state regulatory commissions do not regulate and never have regulated wireless firms' prices or profits. However,

the FCC does hold power over the wireless spectrum licenses that the wireless companies use and can impose rules on how the firms operate; one example is the ruling on local number portability.

As the cellular industry began, the FCC required all U.S. providers to use a single analog standard called *advanced mobile phone service* (AMPS). In the mid-1990s, the wireless providers began building second-generation (2G) networks that used digital technology. These 2G networks were better than the AMPS network because they had better signal quality and used the radio spectrum more efficiently. The FCC did not mandate a 2G standard, and two different types of standards developed. The first set of standards takes samples by time and is similar to time division multiplexing of landline networks. The time-slicing techniques include *time division multiple access* (TDMA), *global system for mobile* (GSM), and *integrated digital enhanced network* (iDEN). GSM was the standard used in Europe, and most U.S. companies that started using TDMA, like Cingular, have since switched to GSM. Nextel uses the iDEN standard. The second set of standards used complex algorithms to compress digital signals. This standard is called *code division multiple access* (CDMA), and it is used by Verizon Wireless and Sprint PCS. TDMA was proven to work on a large scale sooner and enjoyed a “first-mover” advantage. CDMA is more sophisticated and expensive but ultimately was able to use radio spectrum more efficiently than TDMA. However, once a company has chosen a standard, switching technologies becomes expensive. Third-generation wireless services (3G) have been developed in Europe and Asia. Two competing standards are available: universal mobile telephone service (UMTS) (also called WCDMA), which was mandated in Europe; and CDMA2000, which is used in parts of Asia.

Of the five nationwide mobile telephone operators, Cingular and T-Mobile use TDMA or GSM as their 2G digital technology, Sprint PCS and Verizon Wireless use CDMA, and Nextel uses iDEN. Verizon Wireless has deployed $1 \times$ RTT technology throughout its network. Discussion of the wireless carriers upgrade plans to 3G networks will be delayed until the section on data and Internet access.

VIDEO AND CABLE TELEVISION

Before the advent of cable TV, video programming was delivered by over-the-air broadcasts. The FCC licensed television channels to broadcast over *very high frequency* (VHF) from channels 2 to 13 and *ultrahigh frequency* (UHF) for channels above 13. In a typical local market, the FCC would license three to four VHF channels and several more UHF channels. A VHF station is often affiliated with one of the major commercial television net-works: ABC, CBS, NBC, and, later, FOX. Some of these stations are owned by the network, and some are independently owned but have the right to carry the network programming in their particular markets. Although a small percentage of homes receive their video programming from over-the-air broadcasts, the local network affiliated stations are usually carried to homes over cable TV and satellite (Nuechterlein and Weiser 2005, 360).

Cable TV started as noncommercial community antenna TV and was not originally seen as a competitive threat to broadcast TV over the airwaves. However, as more and more cable-only channels became available and more and more homes were passed by cable TV, cable TV became increasingly popular. As of June 2004, 98.8 percent of homes in the United States are passed by cable TV and 61 percent of homes passed subscribed to cable TV (FCC 2005, 14). Cable TV firms use coaxial cable to deliver cable content, and their networks were traditionally one-way networks that delivered video content from the cable headend to end users. To provide cable modem service (discussed in the next section), cable firms had to upgrade their networks to become two-way networks so that users could send as well as received information.

Although local broadcast stations were being seen by fewer and fewer people over the airwaves, they were still seen by many people on their cable systems as cable TV companies retransmitted local over-the-air stations on their cable systems. At first, this seemed to “save” the local broadcast channels from a slow death as the over-the-air market shrank, but station owners soon became jealous as other content channels received payment from the cable firms for their channels while the broadcast channels were essentially free. To change this situation, the Cable Act of 1992 gave broadcasters the right to forbid retransmission without their consent. This property right gave broadcasters the ability to negotiate a fee from a cable company for retransmission of its station. The broadcaster could waive this right and require the cable TV operator to carry its station under “must carry” rules. In most cases, broadcasters did not receive high monetary compensation but were able to negotiate additional channel “slots” on a cable firm’s lineup in exchange for the right to use its local network channel.

In addition to broadcast TV, cable operators faced competition from another “wireless” provider. By the mid-1990s, *direct broadcast satellite* (DBS) providers such as DirecTV and Dish Network entered the video-delivery market. The DBS market share of the video market has increased steadily, reaching 25 percent by 2004, as shown in Table 3. Among cable TV firms, Comcast is the largest with more than 21 million customers (see Table 4). Taking the video market as a whole, Comcast has the largest market share with 23 percent, and DirecTV has a

Table 3: Direct Broadcast Satellite Market Share as Percentage of Multichannel Video Programming Distribution

Date	Market Share (%)
June 2000	15.65
June 2001	18.67
June 2002	20.83
June 2003	22.68
June 2004	25.09
June 2005	27.72

Source: Federal Communications Commission. 2006a. Table B-1.

Table 4: Number of Subscribers for Top Cable TV Firms, 2004

Company	Number of Subscribers
Comcast	21,569,521
Time Warner	10,955,507
Cox	6,386,867
Charter	6,211,505
Adelphia	5,426,991
Cablevision	2,944,235
Bright House	2,187,410
Mediacom	1,532,110

Source: Federal Communications Commission. 2005. *Eleventh annual report on the status of competition in the market for delivery of video programming, February 2005*, Tables B-1 and B-3.

Table 5: Top Ten Firms by Market Share in the Video Market as a Whole, 2005

Rank	Company	Market Share (% of Subscribers)
1	Comcast	22.99
2	DirecTV	15.72
3	EchoStar	12.27
4	Time Warner	11.69
5	Cox	6.73
6	Charter	6.37
7	Adelphia	5.50
8	Cablevision	3.22
9	Bright House	2.34
10	Mediacom	1.55

Source: Federal Communications Commission. 2006. *Twelfth annual report on the status of competition in the market for delivery of video programming, February 2006*, Table B-3.

market share of 16 percent. The top ten firms are shown in Table 5.

Within the cable TV industry, firms are organized as *multiple system operators* (MSOs). There has been significant consolidation in the cable TV industry and across the landline telecommunications industry and cable TV. In 1998, AT&T, the largest long-distance company at the time, bought TCI, then the largest cable TV operator. Then, in 1999, AT&T bought Media One, the fifth-largest cable TV operator. TCI and Media One became AT&T Broadband, which was sold in 2001 to Comcast, the second-largest MSO. It seems that the convergence between cable TV and landline voice communications took longer than AT&T anticipated, and the cable TV properties were more valuable to another MSO than they were to a long-distance landline voice company.

Prices for cable TV have risen steadily over the past several years. Figure 10 shows the average price for basic service, while Figure 11 shows the average total cable bill for customers overall. Basic cable service has risen from \$11.57 in 1997 to \$13.80 in 2004, but the average total monthly bill has almost doubled from \$24.34 in 1995 to \$45.32 in 2004.

Cable TV has been regulated and deregulated several times. Before 1984, some municipalities regulated cable TV rates in addition to awarding local franchises.

However, the Cable Act of 1984 removed cable systems from municipal rate regulation where it existed. Because of this deregulation and other causes, cable rates rose 43 percent from 1986 to 1989. This sudden rise in rates led to calls for federal rate regulation. Thus, the Cable Act of 1992 required the FCC to regulate cable TV rates. This lasted until the Telecommunications Act of 1996 removed rate regulation for all cable services except basic-tier cable service.

In addition to high prices and both the regulation and deregulation of prices, the industry has also faced controversy surrounding so-called *à la carte* pricing. *À la carte* pricing refers to a pricing scheme in which consumers would only pay for channels they wanted and would not be required to buy packages or tiers of programming. Cable TV firms have consistently claimed that such a pricing scheme would raise the costs to all consumers because programming and advertising is based on the number of subscribers and this number would be reduced under such a scheme. The FCC originally agreed with the industry's analysis but has changed its mind recently. To head off a requirement to offer *à la carte* pricing, several firms have begun to offer "family-friendly" packages to placate the most vocal advocates of *à la carte* pricing.

Cable TV providers not only face current competition from DBS but also now face future competition from

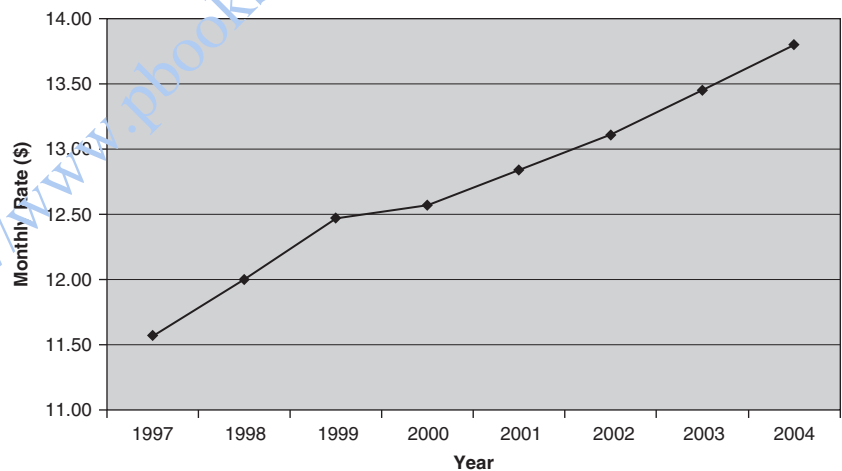


Figure 10: Average monthly rates for basic services, 1997–2004

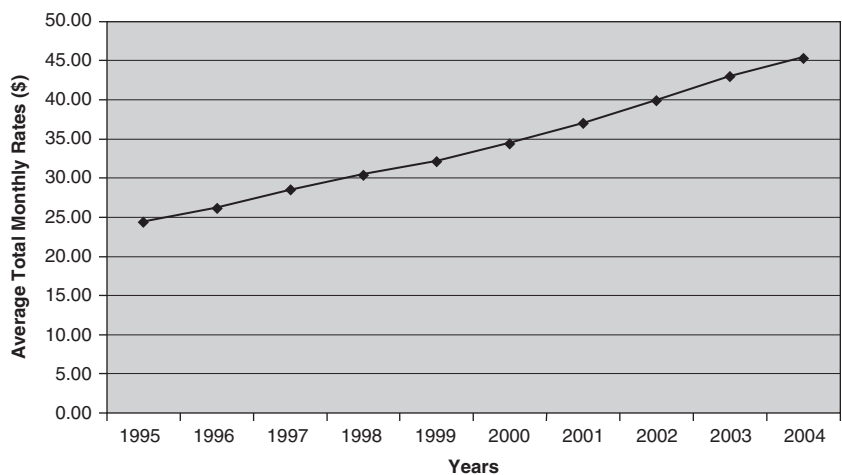


Figure 11: Average monthly rates, 1995–2004

the RBOCs that are rolling out fiber networks to provide IPTV in addition to high-speed Internet access. IPTV is projected to offer several enhancements over traditional cable TV, including greater interactivity, easier guides and channel changing, and even more channels. RBOCs have been hindered in their efforts to roll out video services because of local franchise agreements. Cable TV companies usually have franchise agreements with local municipalities, and the RBOCs argue that it would be too expensive and onerous to negotiate city-by-city franchise agreements in order for them to provide service. They have asked Congress to issue a national franchise license for them to provide video programming nationwide and have already obtained statewide franchise authority in several states.

If one takes a larger definition of the relevant market, cable TV also faces competition from videotape and DVDs and Internet video downloads such as iTunes and video iPod. With convergence comes another emerging distribution channel for video programming: the Internet. Web sites such as YouTube, Google Video, MSN video, and Yahoo Video are increasing the amount of free and paid content for viewers. In addition, TV networks are distributing their content over their own Web sites and partnering with others to sell online versions of their TV content.

The video programming and distribution industry is also somewhat vertically integrated. Several cable TV systems own parts of many of the programming channels that they and others carry on their systems. For example, Cablevision has a 60 percent ownership of American Movie Classics, Cox owns 24.6 percent of Discovery Channel, and Time Warner completely owns HBO. TV networks are owned by larger corporations that also own video content and programming. CBS is owned by Viacom, NBC is owned by General Electric and Vivendi, ABC is owned by Disney, and FOX is owned by News Corporation. Vertical integration could make it difficult for new firms to enter in competition with the cable TV firms. The Cable Act of 1992 required cable firms to make their own programming available on reasonable terms to rivals. This requirement was renewed by the FCC in 2002.

Some cable TV firms are offering voice communications (local and long distance) over their broadband cable modem systems in direct competition with the RBOCs and the long-distance companies. Most of the firms are using VoIP to provide these services over their broadband cable-modem networks. Several cable companies have also partnered with Sprint-Nextel to offer wireless phones. Convergence is taking place as RBOCs enter the video market and cable TV firms offer voice services. Both types of firms are gearing up to provide the quadruple play of voice, video, data, and wireless.

DATA AND INTERNET ACCESS

Although there was talk of alternative “information super-highways” in the 1980s, the Internet has taken over as the data network for the consumer market. The Internet is a network of networks that use the TCP/IP protocols. The Internet evolved from ARPANet, which was developed in the 1960s by the Department of Defense; and NSFNET, which linked universities and supercomputers in the 1980s.

Despite having these roots in government funding, the Internet was privatized on April 30, 1995. There were then five major backbone providers: uunet, ANS, SprintLink, BBN, and MCI. By 2000, uunet and ANS were brought by MCI WorldCom, BBN was part of Genuity, MCI's old network was owned by Cable and Wireless, and AT&T had created its own IP network using its own fiber and purchasing IBM's Global Network. These backbone providers had peering arrangements to exchange traffic and provide links to regional networks and ISPs.

The exponential growth of the Internet would not have occurred without the development of easy-to-use end-user applications. The first applications were e-mail systems that could exchange messages between systems. End-user e-mail interfaces became easier to use with more and more features. Netscape and its World Wide Web browser popularized the use of the Internet beyond simply e-mail, and customer demand grew rapidly. The explosive growth of Web sites and extensions of basic browser functions drove consumers to demand access to the Internet and, eventually, higher speed access.

Starting in the mid-1990s, the number of residential second lines soared, driven by demand for dialup Internet access (Cassel 1999). It was not long before the attraction of always-on connectivity, faster speeds, and declining prices spurred a switch from second lines to broadband technologies. *Broadband* is defined by the FCC as speeds 200k or faster in one direction, which is low by some standards. The current technologies that offer broadband speeds are cable modems, DSL, satellite, and WiFi. The broadband market shows the greatest evidence of convergence, with cable TV firms offering cable modem service and landline voice companies offering DSL. As shown in Figure 12, cable modems have the highest percentage market share of the broadband market with 59 percent; ADSL follows with 37.2 percent. Cable modems were first to the marketplace, but ADSL has tried to close the gap in recent years with lower pricing that has led to increased market share. Table 6 shows the number of lines served by various companies that provide cable modems, with Comcast being the largest provider. Table 7 shows the

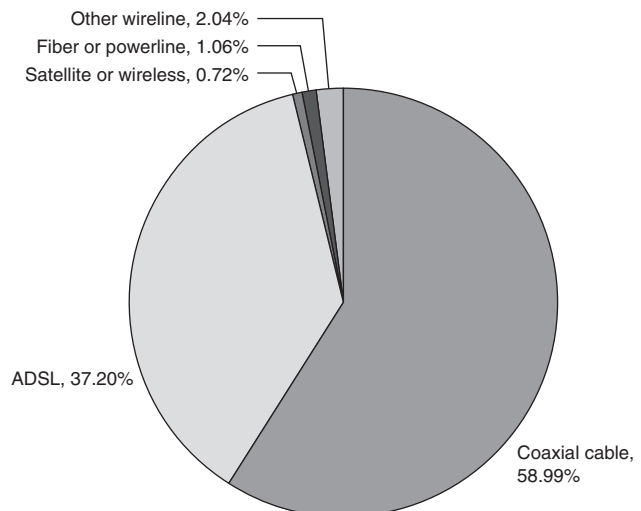


Figure 12: Broadband technologies' market share

Table 6: Major Cable Modem Providers, Ranked by Subscribership, First Quarter 2005

Company	Number of Subscribers
Comcast	7,410,000
Time Warner	4,120,000
Cox	2,750,000
Charter	1,980,000
Adelphia	1,490,000
Cablevision	1,440,000
Total North America	21,150,000

Source: Leichtman Research Group, cited in *The digital fact book*. 2005. 7th ed.

Table 7: Major DSL Providers by Subscribership, First Quarter 2005

Company	DSL Subscribers
SBC	5,610,000
Verizon	3,940,000
BellSouth	2,350,000
Qwest	1,120,000
Sprint	550,000
Covad	550,000
Total North America	14,700,000

Source: Leichtman Research Group, cited in *The digital fact book*. 2005. 7th ed.

various companies that provide ADSL, with SBC being the largest.

Landline broadband faces increasing competition from wireless technologies. The wireless technology with the most users is WiFi, which is used in home wireless networks and coffee shops. WiFi is also used by *wireless Internet service providers* (WISPs) to provide Internet services in rural communities. WiMAX is an emerging wireless technology that promises wider ranges and faster speeds than WiFi; thus, it may be a better competitor to wireline broadband. Sprint-Nextel recently announced its intention to build a “4G” wireless broadband network using WiMAX technology.

In addition to private companies building wireless broadband networks, cities and local governments have taken the initiative to build new networks. WiFi networks are being deployed across much larger geographies such as the cities of Philadelphia and San Francisco. In these cases, city governments are taking the initiative to have the technology deployed by partnering with private firms to build and manage the networks. These cities already have wireline broadband services available to most city residents. In other cases, smaller rural municipalities

are looking to build broadband networks where private companies have not deployed any broadband technologies. Other cities have opted for a landline fiber solution similar to the Utah Telecommunication Open Infrastructure Agency (UTOPIA) project. Municipal broadband has been a politically controversial topic, with private firms looking to bar municipalities from providing broadband services out of fear that subsidies from taxpayers will provide an unequal playing field and potentially delay or stop private investment.

Another politically sensitive issue concerning the Internet has been called “net neutrality.” *Net neutrality* does not have a precise definition but usually refers to a policy that broadband providers cannot charge content providers to send information over their broadband lines to end users. This policy debate began when broadband providers such as Verizon, AT&T, and Comcast proposed charging content providers such as Google and Yahoo to send data over their lines. The providers would create “fast lanes” for high-bandwidth applications such as movie downloads or streaming video. The providers claim that this would ensure these applications have the bandwidth available when they need it and would support enhanced infrastructure. Critics claim that users will end up paying twice for access to content.

Aside from Sprint’s announcement concerning WiMAX, wireless companies are already upgrading their networks to provide wireless data that surpass minimum broadband speeds. Until the major carriers upgraded their networks, less than 2 percent of their mobile traffic was data. Their second-generation networks—using GSM, CDMA, and TDMA—yielded data speeds of 9.6 to 19.2 kilobytes per second (kbps). Recently, however, several networks have been upgrading to third-generation network technologies such as *evolution data optimized* (or *only*) (EvDO) in major cities across the United States. These third-generation networks allow broadband speeds for laptops, personal digital assistants (PDAs), and cell phones from anywhere the signal reaches. Verizon Wireless launched its CDMA2000 1 × EVDO network in late 2003 and now offers it in several major U.S. cities. Sprint began to deploy this same technology in July 2005. Cingular Wireless is planning to deploy WCDMA with *high-speed data packet access* (HSDPA) technology in many major U.S. markets. This technology will allow average download speeds of 400 kbps to 700 kbps with burst rates of up to several megabytes per second (Mbps); CDMA2000 1 × EV-DO, on the other hand, delivers average user speeds of 400 kbps to 700 kbps and allows maximum data-throughput speeds of 2.4 Mbps.

INTERNATIONAL TELECOMMUNICATIONS

Although much of this chapter has focused on the U.S. telecommunications market, similar convergence of industry markets has occurred elsewhere in the world. In some cases, the United States has been in the forefront of these changes; in other cases, notably wireless and broadband data, the United States has lagged behind. The movement of landline voice services from monopoly

to competition in both local and long distance has followed the U.S. pattern with some delay. In many cases, countries first had to transition from state-owned telecommunications monopolies to private, regulated firms. In Canada, several telephone companies were owned by provincial governments. In the United Kingdom, British Telecom was privatized in 1985. In other parts of Europe, France Telecom and Deutsche Telecom moved from state-owned telephone and telegraph monopolies to private companies. In Japan, Nippon Telephone and Telegraph Corporation started the process in 1985, but in 1996 it was restructured into a holding company with a separate long-distance division and two local telephone companies, NTT East and NTT West.

After privatization, all of these countries opened their landline markets to competition. In 1985, the United Kingdom opened entry into telecom services and Japan allowed long distance and international calling competition. Canada allowed competition in long distance in 1992 and local competition in 1997. The European Union opened all telecommunications markets to competition in 1998 (Crandall 2005).

On the wireless telecommunications front, the move toward competition took a similar but delayed path in mimicking the U.S. experience. Most of the developed countries only had one or two wireless carriers as late as 1991. Even today, many countries only have two to four wireless carriers competing. In spite of being in the forefront in wireline and wireless competition, the United States has lagged behind in its auction of 3G radio spectra and deployment of 3G services. In addition, the United States ranked tenth in broadband penetration at the end of 2003 (Organisation for Economic Co-operation and Development 2005, 129).

CONCLUSION

Having looked at each of the telecommunications industry segments separately, we clearly see that each segment faces competitive inroads by other industry segments. The landline voice market (both local and long-distance) faces competition from wireless voice and cable TV companies. Cable TV firms are facing increasing competition from DBS firms and local telephone companies using IPTV. Local voice companies, cable TV firms, and wireless firms are competing for the broadband data market. Large multimarket firms will continue to increase their market shares or market reach in each of the quadruple play markets of landline voice, high-speed Internet access, TV and entertainment, and wireless voice and data.

GLOSSARY

Advanced mobile phone service (AMPS): Wireless analog standard used in the United States.

Alternative local transport carrier (ALT): Smaller local landline company that provided bypass of the ILEC network. These companies later became known as CLECs.

Code division multiple access (CDMA): A 2G wireless standard that uses complex algorithms to compress the digital signal.

Competitive access provider (CAP): Smaller local landline company that provided bypass of the ILEC network. These companies later became known as CLECs.

Competitive local exchange carrier (CLEC): Smaller, upstart company that competes with ILECs for local landline voice customers.

Digital subscriber line (DSL): A broadband Internet access service provided by LECs.

Direct broadcast satellite (DBS): Wireless video providers such as DirecTV and Dish Network that compete with cable TV companies.

Evolution data optimized (or only) (EvDO): A third-generation wireless standard that enables broadband data speeds on wireless networks.

Federal Communications Commission (FCC): The federal agency created by the Communication Act of 1934, which regulates interstate telecommunications.

Fiber to the curb (FTTC): The use of fiber optic cable to the pedestal or neighborhood and copper or coaxial cable from that point to the home.

Fiber to the premises (FTTP): The use of fiber optic cable directly to the home that replaces copper or coaxial cable.

Global system for mobile (GSM): A 2G wireless network standard that uses time-slicing techniques.

High-speed data packet access (HSDPA): A 3G wireless data standard.

Incumbent local exchange carrier (ILEC): Traditionally regulated monopoly providers of local voice landline services.

Integrated digital enhanced network (iDEN): A 2G wireless network standard that uses time-slicing techniques.

Internet protocol television (IPTV): Delivers video (television) programming to homes using Internet protocols.

Internet service provider (ISP): Company that provides Internet access to end users.

Multiple system operators (MSO): Cable TV companies that provide video programming via many different local systems.

National Association of Regulatory Utility Commissioners (NARUC): Umbrella organization representing state and federal regulatory commissions.

Presubscribed interexchange carrier charge (PICC): New charge as a result of TA96 instituted by the FCC to lower switched access fees. Charged by local companies to long-distance companies.

Public switched telephone network (PSTN): The traditional voice network operated by ILECs and long-distance voice companies.

Regional Bell operating company (RBOC): Any of seven local telephone companies created from the divestiture of AT&T in 1984.

Second generation (2G): Wireless network standards that use digital technology, including TDMA and CDMA.

Subscriber line charge (SLC): Per-line prices charged to end users that started around the time of divestiture.

Telecommunications Act of 1996 (TA96): The most recent, wide-ranging telecommunication law; technically, a rewrite of the Communications Act of 1934.

Third generation (3G): Wireless network standards that provide faster data transmission and include UMTS and WCDMA.

Time division multiple access (TDMA): A 2G wireless network standard that uses time-slicing techniques.

Universal mobile telephone service (UMTS): A 3G wireless standard also known as WCDMA.

Voice over Internet protocol (VoIP): Using Internet protocols to transmit voice conversations over data networks.

Wireless fidelity (WiFi): The popular name given to 802.11 standards for transmitting data wirelessly.

Wireless Internet service provider (WISP): Company that provides Internet access to end users using wireless technology, usually over an unlicensed spectrum.

Worldwide interoperability for microwave access (WiMAX): A newer wireless standard that allows higher speed and longer ranges than WiFi.

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See *Cable Modems; Data Communications Basics; DSL (Digital Subscriber Line); Voice Communications Systems: KTS, PBX, Centrex, and ACD; Voice over IP (VoIP)*.

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