

## SIGNIFICANT POINTS

- Telecommunications includes voice, video, and Internet communications services.
- Employment will decline because of technological advances and consolidation.
- With rapid technological changes in telecommunications, those with up-to-date technical skills will have the best job opportunities.
- Average earnings in telecommunications greatly exceed average earnings throughout private industry.

### Nature of the Industry

The telecommunications industry is at the forefront of the information age—delivering voice, data, graphics and video at ever increasing speeds and in an increasing number of ways. Whereas wireline telephone communication was once the primary service of the industry, wireless communication services and cable and satellite program distribution make up an increasing share of the industry.

During the late 1990s, the telecommunications industry, experienced very rapid growth and massive investment in transmission capacity. Eventually this caused supply to significantly exceed demand, resulting in much lower prices for transmission capacity. The excess capacity and additional competition led to either declining revenues or slowing revenue growth, which has led to consolidation within the industry, as many companies merged or left the industry.

The largest sector of the telecommunications industry continues to be made up of wired telecommunications carriers. Establishments in this sector mainly provide telephone service via wires and cables that connect customers' premises to central offices maintained by telecommunications companies. The central offices contain switching equipment that routes content to its final destination or to another switching center that determines the most efficient route for the content to take. While voice used to be the main type of data transmitted over the wires, wired telecommunications service now includes the transmission of all types of graphic, video, and electronic data mainly over the Internet.

These new services have been made possible through the use of digital technologies that provide much more efficient use of the telecommunications networks. One major technology breaks digital signals into packets during transmission. Networks of computerized switching equipment, called packet switched networks, route the packets. Packets may take separate paths to their destination and may share the paths with packets from other users. At the destination, the packets are reassembled, and the transmission is complete. Because packet switching considers alternate routes, and allows multiple transmissions to share the same route, it results in a more efficient use of telecommunications capacity as packets are routed along less congested routes.

The transmission of voice signals requires relatively small amounts of capacity on telecommunications networks. By contrast, the transmission of data, video, and graphics requires much higher capacity. This transmission capacity is referred to as

bandwidth. As the demand increases for high-capacity transmissions—especially with the rising volume of Internet data—telecommunications companies have been expanding and upgrading their networks to increase the amount of available bandwidth.

One way wired carriers are expanding their bandwidth is by replacing copper wires with fiber optic cable. Fiber optic cable, which transmits light signals along glass strands, permits faster, higher capacity transmissions than traditional copper wirelines. In some areas, carriers are extending fiber optic cable to residential customers, enabling them to offer cable television, video-on-demand, high-speed Internet, and conventional telephone communications over a single line. However, the high cost of extending fiber to homes has slowed deployment. In most areas, wired carriers are instead leveraging existing copper lines that connect most residential customers with a central office, to provide digital subscriber lines (DSL) Internet service. Technologies in development will further boost the speeds available through a DSL connection.

Wireless telecommunications carriers, many of which are subsidiaries of the wired carriers, transmit voice, graphics, data, and Internet access through the transmission of signals over networks of radio towers. The signal is transmitted through an antenna into the wireline network. Other wireless services include beeper and paging services. Because wireless devices require no wireline connection, they are popular with customers who need to communicate as they travel, residents of areas with inadequate wireline service, and those who simply desire the convenience of portable communications. Increasing numbers of consumers are choosing to replace their home landlines with wireless phones.

Wireless telecommunications carriers are deploying several new technologies to allow faster data transmission and better Internet access that should make them competitive with wireline carriers. One technology is called third generation (3G) wireless access. With this technology, wireless carriers plan to sell music, videos, and other exclusive content that can be downloaded and played on phones designed for 3G technology. Wireless carriers are developing the next generation of technologies that will surpass 3G with even faster data transmission. Another technology is called “fixed wireless service,” which involves connecting the telephone and/or Internet wiring system in a home or business to an antenna, instead of a telephone line. The replacement of landlines with cellular service should become increasingly common because advances in wireless systems will

provide data transmission speeds comparable to broadband land-line systems.

Cable and other program distribution is another sector of the telecommunications industry. Establishments in this sector provide television and other services on a subscription or fee basis. These establishments do not include cable networks. (Information on cable networks is included in the statement on broadcasting, which appears elsewhere in the *Career Guide*.) Distributors of pay television services transmit programming through two basic types of systems. Cable systems transmit programs over fiber optic and coaxial cables. Direct broadcasting satellite (DBS) operators constitute a growing segment of the pay television industry. DBS operators transmit programming from orbiting satellites to customers' receivers, known as minidishes.

Establishments in the cable and other program distribution industry generate revenue through subscriptions, special service fees—primarily installation—and advertising sales. They also charge fees for services, such as the transmission of specialty pay-per-view or video-on-demand programs; these often are popular movies or sporting events.

Some cable and satellite systems facilitate the transmission of digital television signals. Digital signals consist of simple electronic code that can carry more information than conventional television signals. Digital transmission creates higher resolution television images and improved sound quality. It also allows the transmission of a variety of other information. Digital television also uses compression technology to expand the number of channels.

Changes in technology and regulation now allow cable television providers to compete directly with telephone companies. An important change has been the rapid increase in two-way communications capacity. Conventional pay television services provided communications only from the distributor to the customer. These services could not provide effective communications from the customer back to other points in the system, due to signal interference and the limited capacity of conventional cable systems. As cable operators implement new technologies to reduce signal interference and increase the capacity of their distribution systems by installing fiber optic cables and improved data compression, some pay television systems now offer two-way telecommunications services, such as video-on-demand and high-speed Internet access. Cable companies are also increasing their share of the telephone communications market both through their network of conventional phone lines in some areas and their growing ability to use high-speed Internet access to provide VoIP (voice over Internet protocol).

VoIP is sometimes called Internet telephony, because it uses the Internet to transmit phone calls. While conventional phone networks use packet switching to break up a call onto multiple shared lines between central offices, VoIP extends this process to the phone. A VoIP phone will break the conversation into digital packets and transmit those packets over a high-speed Internet connection. Cable companies are using the technology to offer phone services without building a conventional phone network. Wireline providers' high-speed Internet connections also can be used for VoIP and cellular phones are being developed that use VoIP to make calls using local wireless Internet connections. All of the major sectors of the telecommunications industry are or will increasingly use VoIP.

Resellers of telecommunications services are another sec-

tor of the telecommunications industry. These resellers lease transmission facilities, such as telephone lines or space on a satellite, from existing telecommunications networks, and then resell the service to other customers. Other sectors in the industry include message communications services, such as e-mail and facsimile services, satellite telecommunications, and operators of other communication services, ranging from radar stations to radio networks used by taxicab companies.

## **Working Conditions**

The telecommunications industry offers steady, year-round employment. Overtime sometimes is required, especially during emergencies such as floods or hurricanes when employees may need to report to work with little notice.

Installation, maintenance, and repair occupations account for 1 in 4 telecommunications jobs. Telecommunications line installers and repairers, one of the largest occupations, work in a variety of places, both indoors and outdoors, and in all kinds of weather. Their work involves lifting, climbing, reaching, stooping, crouching, and crawling. They must work in high places such as rooftops and telephone poles, or below ground when working with buried lines. Their jobs bring them into proximity with electrical wires and circuits, so they must take precautions to avoid shocks. These workers must wear safety equipment when entering manholes, and test for the presence of gas before going underground.

Telecommunications equipment installers and repairers, except line installers, generally work indoors—most often in a telecommunication company's central office or a customer's place of business. They may have to stand for long periods; climb ladders; and do some reaching, stooping, and light lifting. Adherence to safety precautions is essential to guard against work injuries such as minor burns and electrical shock.

Most communications equipment operators, such as telephone operators, work at video display terminals in pleasant, well-lighted, air-conditioned surroundings. If the worksite is not well designed, however, operators may experience eye strain and back discomfort. The rapid pace of the job and close supervision may cause stress. Some workplaces have introduced innovative practices among their operators to reduce job-related stress.

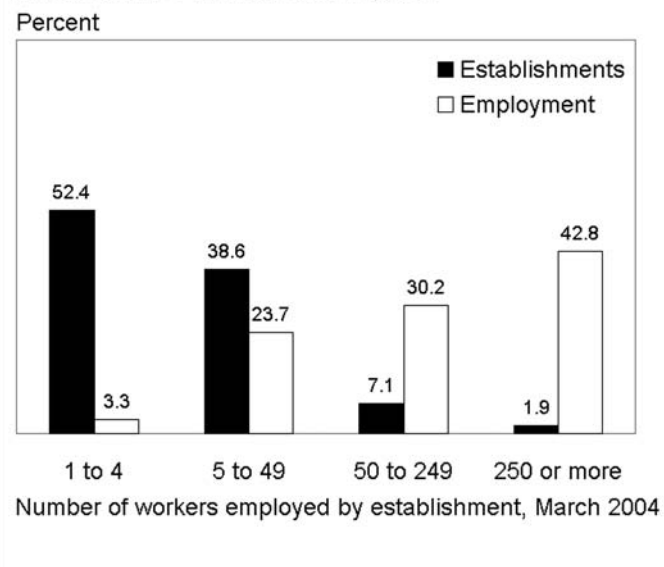
Most other telecommunications managers, administrative workers, and professionals work 40-hour weeks in comfortable offices. Customer service representatives may work in call centers where they answer customer service calls—many during evening and weekend hours.

The number of disabling injuries in telephone communications, the principal sector of the telecommunications industry, has been well below the average for all industries in past years.

## **Employment**

The telecommunications industry provided 1 million wage and salary jobs in 2004. Most telecommunications employees work in large establishments. Seventy-three percent of employment is in establishments with 50 or more employees (chart 1). With continuing deregulation, however, the number of small contractors has been increasing. Telecommunications jobs are found in almost every community, but most employees work in cities that have large concentrations of industrial and business establishments.

**Nearly three-fourths of workers in the telecommunications industry are employed by establishments with 50 or more jobs.**



**Occupations in the Industry**

Although the telecommunications industry employs workers in many different occupations, 55 percent of all workers are employed in either office and administrative support occupations or installation, maintenance, and repair occupations (table 1).

Telecommunications craftworkers install, repair, and maintain telephone equipment, cables and access lines, and telecommunications systems. These workers can be grouped by the type of work they perform. *Line installers and repairers* connect central offices to customers' buildings. They install poles and terminals, and place wires and cables that lead to a consumer's premises. Some may install lines or equipment inside a customer's business or residence. They use power-driven equipment to dig holes and set telephone poles. Line installers climb the poles or use truck-mounted buckets (aerial work platforms) and attach the cables using various handtools. After line installers place cables on poles or towers or in underground conduits and trenches, they complete the line connections. Some line installers, called *cable splicers*, specialize in splicing together two telecommunication lines.

*Telecommunications equipment installers and repairers, except line installers*, install, repair, and maintain the array of increasingly complex and sophisticated communications equipment and cables. Their work includes setting up, rearranging, and removing the complex switching and dialing equipment used in central offices. They may also solve network-related problems and program equipment to provide special features.

Some telecommunications equipment installers are referred to as telephone station installers and repairers. They install, service, and repair telephone systems and other communications equipment on customers' property. When customers move or request new types of service, such as a high-speed Internet connection, a fax, or an additional line, installers relocate telephones or make changes in existing equipment. They assemble equipment and install wiring. They also connect telephones to outside service wires and sometimes must climb poles or ladders to make these connections.

**Table 1. Employment of wage and salary workers in telecommunications by occupation, 2004 and projected change, 2004-14.**

(Employment in thousands)

Occupation	Employment, 2004		Percent change, 2004-14
	Number	Percent	
<b>Total, all occupations</b> .....	1,043	100.0	-6.5
<b>Management, business, and financial occupations</b> .....	116	11.1	-5.5
Top executives .....	12	1.2	-2.6
Marketing and sales managers .....	9	0.8	1.1
Computer and information systems managers .....	7	0.6	4.1
Human resources, training, and labor relations specialists .....	11	1.0	-3.6
Management analysts .....	10	1.0	-19.9
Accountants and auditors .....	8	0.8	-1.9
<b>Professional and related occupations</b> .....	181	17.4	-1.1
Computer software engineers .....	39	3.8	-2.8
Computer support specialists .....	12	1.2	-1.7
Computer systems analysts .....	14	1.4	1.3
Network and computer systems administrators .....	14	1.3	-0.5
Network systems and data communications analysts .....	14	1.3	24.3
Engineers .....	39	3.7	-1.9
Electrical and electronic engineering technicians .....	13	1.2	-4.5
<b>Sales and related occupations</b> .....	162	15.5	-7.0
Supervisors, sales workers .....	15	1.4	-1.9
Retail salespersons .....	24	2.3	12.6
Sales representatives, services, all other .....	53	5.1	-7.5
Sales representatives, wholesale and manufacturing .....	26	2.5	0.3
Telemarketers .....	25	2.4	-34.7
<b>Office and administrative support occupations</b> .....	307	29.5	-7.2
First-line supervisors/managers of office and administrative support workers .....	24	2.3	-12.3
Telephone operators .....	27	2.6	-42.3
Bill and account collectors .....	12	1.1	-5.9
Bookkeeping, accounting, and auditing clerks .....	12	1.1	-14.0
Customer service representatives .....	133	12.7	11.3
Production, planning, and expediting clerks .....	13	1.2	-18.9
Secretaries and administrative assistants .....	16	1.6	-12.9
Office clerks, general .....	21	2.1	-18.8
<b>Installation, maintenance, and repair occupations</b> .....	269	25.8	-9.4
First-line supervisors/managers of mechanics, installers, and repairers .....	22	2.1	-11.7
Telecommunications equipment installers and repairers .....	140	13.5	-17.2
Line installers and repairers .....	89	8.6	-0.5

Note: May not add to totals due to omission of occupations with small employment

*Cable installers* travel to customers' premises to set up pay television service so that customers can receive programming. Cable service installers connect a customer's television set to the cable serving the entire neighborhood. Wireless and satellite service installers attach antennas or satellite dishes to the sides of customers' houses. These devices must be positioned to provide clear lines of sight to satellite locations. (Satellite installation may be handled by employees of retail stores that sell satellite dishes. Such workers are not employed by cable and other pay television services.)

Installers check the strength and clarity of the television signal before completing the installation. They may need to explain to the subscriber how pay television services operate. As these services expand to include telephone and high-speed Internet access, an understanding of the basic technology, computer software, and an ability to communicate that knowledge are increasingly important.

*Telephone operators* make telephone connections, assist customers with specialized services such as reverse-charge calls, provide telephone numbers, and may provide emergency assistance.

*Customer service representatives* help customers understand the new and varied types of services offered by telecommunications providers. Some customer service representatives also are expected to sell services and may work on a commission basis. Other administrative support workers include *financial, information, and records clerks; secretaries and administrative assistants; and first-line supervisors/managers of office and administrative support workers*. These workers keep service records, compile and send bills to customers, and prepare statistical and other company reports, among other duties.

Seventeen percent of the industry's employees are professional workers. Many of these are scientific and technical personnel such as engineers and computer specialists. *Engineers* plan cable and microwave routes, central office and PBX equipment installations, and the expansion of existing structures, and solve other engineering problems. Some engineers also engage in research and development of new equipment. Many specialize in telecommunications design or voice, video, or data communications systems, and integrate communications equipment with computer networks. Others research, design, and develop gas lasers and related equipment needed to send messages through fiber optic cables. They study the limitations and uses of lasers and fiber optics; find new applications for them; and oversee the building, testing, and operations of the new applications. They work closely with clients, who may not understand sophisticated communications systems, and design systems that meet their customers' needs.

*Computer software engineers and network systems and data communications analysts* design, develop, test, and debug software products. These include computer-assisted engineering programs for schematic cabling projects; modeling programs for cellular and satellite systems; and programs for telephone options, such as voice mail, e-mail, and call waiting. Telecommunications specialists coordinate the installation of these systems and may provide follow-up maintenance and training. In addition, the industry employs many other managerial, business and financial, professional, and technical workers, such as *accountants and auditors; human resources, training, and labor relations managers; engineering technicians; and computer programmers*.

Sixteen percent of the industry's employees are in sales and related occupations. In addition to selling telecommunications and related services to businesses and residential customers, the industry employs a large number of advertising sales workers that sell advertising on their cable or satellite systems or for their telephone directories.

## **Training and Advancement**

The telecommunications industry offers employment in jobs requiring a variety of skills and training. Many jobs require at least

a high school diploma or an associate degree in addition to on-the-job training. Other jobs require particular skills that may take several years of experience to learn completely. For some managerial and professional jobs, employers require a college education.

Telecommunications line installers and repairers often are hired initially as helpers, grounds workers, or tree trimmers who clear branches from lines. Because the work entails a lot of climbing, applicants should have physical stamina and be unafraid of heights. The ability to distinguish colors is important because wires and cables are coded by color. Although many line installers and repairers do not complete a formal apprenticeship, they generally receive several years of on-the-job training, which may also include some classroom or online training. Line installers may transfer to other highly skilled jobs, such as telecommunications equipment installer and repairer, or may move into other kinds of work, such as sales. Promotion to crew supervisor, technical staff, or instructor of new employees also is possible.

Most companies prefer to hire telecommunications equipment installers and repairers with postsecondary training in electronics; some choose to hire persons with experience as line installers. Training sources include 2-year and 4-year college programs in electronics or communications, trade schools, and training provided by telecommunications companies and/or equipment and software manufacturers. Telecommunications equipment installers and repairers may advance to jobs maintaining more sophisticated equipment or to engineering technician positions.

For sales jobs, individuals with sales ability enhanced by interpersonal skills and knowledge of telecommunications terminology also are sought.

Communications equipment operators should have clear speech and good hearing; computer literacy and keyboarding skills also are important. New operators learn equipment operation and procedures for maximizing efficiency. Instructors monitor both the time and quality of trainees' responses to customer requests. Formal classroom instruction and on-the-job training may last several weeks.

A bachelor's degree in engineering usually is required for entry-level jobs as electrical and electronics engineers. Continuing education is important for these engineers; those who fail to keep up with the rapid changes in technology risk technological obsolescence, which makes them more susceptible to layoffs or, at a minimum, more likely to be passed over for advancement.

While there is no universally accepted way to prepare for a job as a computer professional, most employers place a premium on some formal college education. Computer software engineers usually hold a degree in computer science or in software engineering. For systems analyst, computer scientist, or database administrator positions, many employers seek applicants who have a bachelor's degree in computer science, information science, or management information systems.

Due to the rapid introduction of new technologies and services, the telecommunications industry is among the most rapidly changing in the economy. This means workers must keep their job skills up to date. From managers to communications equipment operators, increased knowledge of both computer hardware and software is of paramount importance. Several major companies and the telecommunications unions have created a

Web site that provides free training for employees, enabling them to keep their knowledge current and helping them to advance. Telecommunications industry employers now look for workers with knowledge of and skills in computer programming and software design; voice telephone technology, known as telephony; laser and fiber optic technology; wireless technology; and data compression.

## Outlook

Employment in the telecommunications industry is expected to decline 7 percent over the 2004-14 period, compared with 14 percent growth for all industries combined. Industry consolidation and strong price competition among telecommunications firms will decrease employment as companies try to reduce their costs. Additionally, technological improvements, such as high-speed wireless data transmission, fiber optic lines, and advanced switching equipment, have massively increased the data transmission capacity of telecommunications networks, and resulted in much higher productivity that will further reduce employment. Telecommunications equipment also is more reliable and requires less monitoring. In spite of the declining employment, a growing number of retirements and need for skilled workers will create good job opportunities for individuals with up-to-date technical skills.

The industry will continue to grow despite the lower employment as people and businesses will demand ever wider ranges of telecommunications services. The growth of high-speed Internet and video services will lead to continued upgrades of telecommunications networks. Residential customers will use an increasing range of services as technology and competition lower the price of high-speed Internet access, video-on-demand, and wireless and Internet-based telephone services. Cable companies and telephone companies will both offer cable television, high-speed Internet, and phone services. Wireless carriers will compete directly with the residential wired services, providing increasingly reliable cellular communications and increasingly faster Internet service. Therefore, the lines between cable and satellite TV, wireless, and wireline telephone systems will become blurred.

Business demand will rise as companies increasingly rely on their telecommunications systems to conduct electronic commerce, ordering, record keeping, and video conferencing. In order to remain competitive, businesses will require higher speed access to the Internet.

Technology is continuing to transform the industry and will continue to bring on line a wider array of services to homes and businesses. The installation and upgrading of fiber optic networks will bring ever-faster communications to residential customers' homes. Internet telephony will blur the boundaries between telecommunications providers and Internet service providers. Wireless providers will continue to increase the capacity of their radio networks and introduce improved portable, lightweight devices capable of transmitting voice, data, email, Internet access, and video. New phones will blur boundaries between phones and computers. Some wireless phones will not only function on traditional wireless networks, but also will use VoIP technology to make phone calls through local wireless Internet networks. Undersea cables and orbiting satellites are integrating wireline and wireless customers into a global system of high-speed communications.

Employment growth will differ among the various occupations in the telecommunications industry, largely as a result of technological change. Employment of communications equipment operators is expected to decline due to increasing automation. Computer voice recognition technology lessens the need for central office operators, as customers can obtain help with long-distance calls from automated systems. This technology, which also enables callers to request numbers from a computer instead of a person, is expected to reduce the number of directory assistance operators. The numbers of these workers will drop further as more customers use automated directory assistance resources on the Internet.

Employment of line installers and repairers is expected to decrease due to more reliable equipment and expanding applications of wireless technology. Employment of telecommunications equipment installers and repairers is expected to decline because newer, more reliable technologies will reduce the need for equipment maintenance. Employment of these workers also will be limited by the tendency of many companies to contract out maintenance and installation work to specialized contractors that are part of the construction or retail industries. However, there still will be many openings available for individuals with the necessary technical skills.

Employment of electrical and electronics engineers and computer professionals is expected to change only slightly. The expansion of communications networks, and the need for telecommunications providers to invest in research and development, will create some job opportunities for these workers. However, the increasing standardization of telecommunications technology will limit their employment.

## Earnings

Average weekly earnings of nonsupervisory workers in the telecommunications industry were \$853 in 2004, significantly higher than average earnings of \$529 in private industry. Table 2 presents earnings in selected occupations in telecommunications in 2004.

**Table 2. Median hourly earnings of the largest occupations in telecommunications, May 2004**

Occupation	Telecommunications	All industries
Computer software engineers, systems software .....	\$35.46	\$38.34
Electronics engineers, except computer .....	32.84	36.43
First-line supervisors/managers of office and administrative support workers .....	25.08	19.72
Telecommunications equipment installers and repairers, except line installers .....	24.65	23.96
Sales representatives, services, all other .....	24.18	22.60
Telecommunications line installers and repairers .....	22.78	19.39
Telephone operators .....	16.01	13.65
Customer service representatives .....	15.34	12.99
Telemarketers .....	14.63	9.82
Retail salespersons .....	12.05	8.98

Twenty-four percent of employees in the industry are union members or covered by union contracts, compared with about 14 percent for all industries. Most telecommunications employees belong to the Communications Workers of America or the International Brotherhood of Electrical Workers.

### Sources of Additional Information

For information about employment opportunities, contact your local telecommunications company, or:

- International Brotherhood of Electrical Workers, Telecommunications Department, 900 Seventh St. NW., Washington, DC 20001.
- Communications Workers of America, 501 3rd St. NW., Washington, DC 20001.

For information about certifications and courses on cable and telecommunications technology, contact:

- Society of Cable and Telecommunications Engineers (SCTE), 140 Phillips Rd., Exton, PA 19341-1318.  
Internet: <http://www.scte.org>

More information about the following occupations in the telecommunications industry appears in the 2006-07 edition of the *Occupational Outlook Handbook*.

- Communications equipment operators
- Customer service representatives
- Electrical and electronics engineers, except computer
- Line installers and repairers
- Office clerks, general
- Radio and telecommunications equipment installers and repairers