Technology and Cities

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Abstract

This article explores the ways in which communications technologies influence the shape and form of cities and large metropolitan regions. After reviewing the scholarly literature, the author suggests that there is a need to consider the ways in which telecommunications can lead to both the centralization and decentralization of economic activity. The article analyzes the limits and opportunities for telecommuting as well as the emerging pattern of Internet development in the United States. Although local governments have traditionally taken a passive role with regard to telecommunications systems, there is a growing awareness that telecommunications can affect local economic development. Furthermore, the widespread deployment of antennas for cellular telephones is stimulating public involvement in land use regulations. Finally, the article considers the impact of new telecommunications on inner-city communities and the delivery of public services in cities.

Technological advances have shaped and continue to shape the economic and physical development of cities in the United States. During the 19th century, industrialization gave rise to manufacturing plants and factory towns, while the steam engine led to the growth of seaport cities and a system of railroads that linked cities and towns across North America. During the 20th century, advances in transportation technology—notably the internal combustion engine and the jet airplane—contributed to the dispersion of the Nation's population to suburban areas and to urban growth in southern and western States. Federal policies that financed the construction of airports and the development of an interstate highway system have reinforced these technological trends as well. And, of course, air-conditioning has contributed to the growth of year-round populations in what were once seasonal communities.

Today, new and emerging telecommunications technologies are transforming the economic role of cities and their pattern of physical development. Many cities have lost their roles as corporate headquarters and manufacturing centers, while others have attracted information-intensive activities, such as back offices, customer service centers, and research and development laboratories. Furthermore, rapid advances in information technology pose a major challenge to city-based financial, healthcare, and educational institutions and to cities' roles as centers for commerce and culture.

This article examines the ways in which information and telecommunications technologies are influencing the economic development of cities in the United States. It consists of:

- A brief review of the scholarly research on telecommunications and urban development.
- A discussion of how communications technologies affect face-to-face activities and the location of economic activities.
- An analysis of the role of urban concentration in an era of advanced telecommunications technology.
- An evaluation of telecommuting and its implications for urban development.
- A summary of research on the Internet and its impact on cities and metropolitan regions.
- An assessment of the potential of electronic commerce and new media on urban economic growth.
- A survey of efforts by local units of government and nonprofit organizations to use telecommunications systems to strengthen local communities.
- Consideration of municipal regulatory, planning, and public policy strategies for telecommunications.
- Conclusions regarding the role of telecommunications in the economic and physical development of cities.

Cities and Communications—A Review of the Research

Although cities are centers for culture, trade, and commerce—activities that rely on both face-to-face and electronic communication—remarkably little research has been done on the ways in which communications technologies affect the function of cities in an information-based economy. Deregulation of the telecommunications industry has caused State and local governments to become increasingly concerned about the effects of new technologies on economic development in rural and urban areas (Bonnett, 1996; Miller, 1996). However, as Stephen Graham and Simon Marvin (1996) state, "Telecommunications remain far from being a central focus in urban studies or urban policy-making. The subject of telecommunications and cities is a curiously neglected and extremely immature field of policy and research." This lack of systematic knowledge is particularly striking since Daniel Bell (1979) noted almost two decades ago that "communications infrastructure is the central infrastructure tying together a society." Unlike the Nation's transportation infrastructure—the system of highways, airports, and seaports that has generally been designed and financed by the public sector—the Nation's information infrastructure has been built by the private sector, albeit under Federal and State regulations. It has emerged only recently as the subject of community debate and discussion. In addition much of the Nation's information infrastructure, such as telephone switching offices, fiber-optics, copper cables, and satellite dishes, has traditionally been invisible to most citizens and local government agencies. But the proliferation of antennas for cellular telephone systems is generating conflict in many communities over the size and location of the new communications infrastructure.

The Nation's cities are at the forefront of the latest advances in communications infrastructure because they house large information producers, such as banks, law firms, and

insurance companies, that rely on communications systems to move information by messenger, telephone, facsimile, e-mail, or express mail. Businesses, such as financial service firms, manufacturers, and retailers, depend on telecommunications systems to coordinate activities around the world. This dependence has led to the demand that modern office buildings be equipped with high-speed communications systems that link satellites, fiber-optics, and computers to move information instantly across the Nation and around the globe.

The reform of telecommunications policies at State and Federal levels is leading to increased reliance on market criteria to guide investments in communications infrastructure. Large cities and regions with dense concentrations of communications users are typically the first places to get the benefits of the new telecommunications services. As Ilan Salomon (1996) has stated:

> The increasing trend towards deregulation and privatization of telecommunications providers encourages the development of high-end services on the basis of demand rather than social objectives which have motivated the universal service requirement. Consequently, the advanced services enter the advanced markets and slowly diffuse into the secondary, more dispersed markets.

Thus cities are bound to be affected by emerging changes in the regulatory approaches and public policies stemming from telecommunications reform at the State and Federal levels. A report issued by the Benton Foundation (1996) points out the Telecommunications Act of 1996, signed into law by President Bill Clinton on February 8, 1996, will "affect almost every aspect of communications" including local, long distance, and wireless telephone services; cable and broadcast television; and the content of television and computer networks.

Communications Technology and the Location of Economic Activities

There are two distinct schools of thought about the effect of telecommunications on urban centers. Some social theorists argue that new information technologies will inevitably lead to the economic decline of cities as electronic communications make it possible to replace the face-to-face activities that occur in central locations. For example, George Gilder (1995) states that "we are headed for the death of cities" due to the continued growth of personal computing and distributed organizations advances. Gilder further claims that "cities are leftover baggage from the industrial era."

In this context, cities are no longer needed to access a wide range of cultural activities and information sources because telecommunications can bring the library, concert hall, or business meeting into any home or office. Telephones linked by modems to computers, television sets connected to direct broadcast satellites, and mobile telephones in cars or carried by individuals make it possible to enjoy many of the benefits of urban life without cities' problems, such as crime, congestion, commuting, and air pollution.

Twenty-eight years ago, Ronald Abler (1970) noted:

> [A]dvances in information transmission may soon permit us to disperse information-gathering and decision-making activities away from metropolitan centers, and electronic communications media will make all kinds of information equally abundant everywhere in the nation, if not everywhere in the world.

Recently, Peter Gordon and Harry W. Richardson (1997) of the University of Southern California, have suggested that communications technologies are reinforcing the movement out of cities that the automobile had initiated: "Rapid advances in telecommunications are now accelerating the decentralization trends set in motion by the advent of the automobile." They contend that, "Proximity is becoming redundant…. Entertainment already is, and instruction is more likely to be, transmitted over broad-band radio frequencies rather than seen in traditional theaters or lecture halls. Today's cities continue to become less compact; the city of the future will be anything but compact."

The widespread belief that telecommunications will lead to the inevitable decline of the city as a site for the exchange of ideas and information is based on three untested theories of communication:

- All information activities are conducted more efficiently electronically than in person.
- Human beings place little or no value on the social and psychological attributes of the workplace.
- The physical setting in which work occurs is irrelevant, if not counterproductive, to the performance of individuals and organizations.

However, the relationship between telecommunications and face-to-face activities is far more complex than most futurists would imagine. Jess Gaspar and Edward L. Glaeser (1996) suggest that "it is also possible that telecommunications are not a substitute for face-to-face interactions, but in fact these two forms of information transmission are complements. If they are complements, then we should expect cities and [selected urban] space to get more important as information technology improves…." They argue that telecommunications can make it easier for people to initiate relationships that may lead to face-to-face meetings. They also point out that relationships involving both electronic and face-to-face meetings produce increased interaction—both electronic and face-to-face. The implications of increased interaction reinforce the role of cities as meeting places, "since a common urban location drives down the costs of face-to-face meetings. If face-to-face meetings rise in importance, then more people will try to group together in areas that are easily accessible to their many contacts, and cities will still have an economic role to play in the informational economy."

Clearly, the growth of professional meetings and conventions demonstrates the value that people still place on face-to-face transactions. Recent estimates indicate that even as the use of informational technology increases, the number of conventions is actually rising: Between 1992 and 1995, the number of these events in the United States rose 11 percent, and further increases are expected in the next few years (Goldberg, 1997). (Ironically, the rise is partially attributable to the number of meetings *about* informational technology.) Gaspar and Glaeser (1996) point to the rise in business travel over the past 15 years as an indication that the demand for face-to-face contact has not diminished, even with the widespread deployment of information technology. A case can certainly be made for cities to serve as centers for meetings and face-to-face activities, but the infrastructure needed to support that function now includes direct access by airplane, adequate hotel accommodations, and amenities to attract business travelers. As the demand for interaction increases, cities capable of supporting dense concentrations of face-to-face activity will become even more economically competitive. This situation has led many cities to encourage hotel construction and invest in sophisticated convention centers and airport modernization and expansion. Cities such as Orlando and Las Vegas, once principally concerned with attracting tourists, are increasingly targeting business travelers and

professional meetings, a reflection of the importance of face-to-face activities in an age of advanced telecommunications.

It is important to note that there is still an unquestioned belief in technology's capacity to eliminate the need for cities as centers of interaction. In *The Informational City* (1989), Manuel Castells contends that technological change is leading to "[t]he supersession of places by a network of information flows…. The emergence of the space of flows [communities linked by communications rather than by geographic proximity] actually expresses the disarticulation of place-based societies and cultures from the organizations of power and production that continue to dominate society without submitting to its control." This perspective is stated even more strongly by Nicholas Negroponte (1995), "[T]he post-information age will remove the limitations of geography. Digital living will include less and less dependence upon being in a specific place at a specific time, and the transmission of place itself will start to become possible."

Negroponte's vision is shared by many futurists who argue that the "electronic cottage" will eventually replace the office. The emergence of the *edge city*, a label that Joel Garreau (1991) applied to the rise of population clusters surrounding suburban office parks, is a reflection of how both transportation and communication technologies have fostered the outmigration of work and housing from central city locations. Information technology has made it possible for many firms to move their headquarters and support functions to suburban campuses; others have simply moved their routine data-processing activities to low-cost settings, in medium-size cities, suburban areas, or overseas. A report prepared for the Office of Technology Assessment (1995) points out that information and telecommunications technologies "are making more economic functions footloose," but only in regions that provide an advanced telecommunications infrastructure, skilled labor, and good airport access.

Despite this evidence, individuals and firms that specialize in developing computer systems and software are remarkably concentrated in specific cities and regions of the United States, such as Austin; Boston; New York City; Orange County and Silicon Valley, California; Salt Lake City; and Seattle. Jonathan Weber (1997) has pointed out that "even the companies that are at the forefront of the digital revolution are placing a premium on human contact. At Microsoft, everyone is fully wired and everyone is expected to show up, every day, in person, at the company campus if they're not traveling." The value that firms place on face-to-face activities as a means to generate new products and develop new services is reflected in such corporate policies and in the intense concentration of skilled information workers in the cities and regions discussed in the following section.

Telecommunications and Urban Concentration

An alternative to the idea that telecommunications technology fosters the spatial dispersion of economic life has been put forth by geographers such as John Goddard, Jean Gottmann, and Allen Scott. Gottmann (1997) proposes that communications technologies work in two directions by making it possible both to concentrate and to disperse economic activities. He writes that the telephone had a "dual impact" on office location: "First, it has freed the office from the previous necessity of locating next to the operations it directed; second, it has helped to gather offices in large concentrations in special areas."

The shift from the factory to the office and the concomitant growth in white-collar work during the 20th century has had profound consequences for cities as the headquarters for global businesses that operate on a 24-hour basis. Advanced telecommunications systems have allowed firms based in one city to be directly linked to branches and subsidiary offices in other cities. Cities that were once the centers for the production of goods are

now centers for the production of information that is distributed around the world. By extending the global reach of cities that are centers for information-intensive activities, communications technology has led to the rise of a set of global cities that are linked to one another by telecommunications networks. As a result, cities such as Hong Kong, London, Los Angeles, New York, and Tokyo are linked through a complex network of computers, undersea fiber trunks, local telephone lines and microwave links, and communication satellites. The transactions, functions, and meetings in these cities are not confined to one place but are connected by advanced telecommunications systems to other cities around the world.

Rather than consider telecommunications as a substitute for human interaction, Nigel Thrift (1996) suggests that "the rise of electronic telecommunications networks may well have produced more, not less, socialization, much of it face-to-face." According to Thrift, the principal function of major financial centers is interpreting in real time the massive amounts of information that are generated each day: "Since the international financial system generates such a massive load of information, power goes to those who are able to offer the most convincing interpretations of the moment." Interpreting information depends as much on face-to-face interaction as on electronic technologies, and this is most efficiently done in a handful of world financial centers.

Scholars such as Annalee Saxenian (1994) have highlighted the different ways in which a high concentration of research and development activities in suburban regions such as the Silicon Valley in California and Route 128 in Massachusetts can generate significant economic growth. The emergence of new economic clusters, whether in central cities, near university campuses, or in suburban settings, demonstrates the continued importance of human interaction in generating ideas, products and innovation, and the heightened role of telecommunications in enhancing the productivity of innovative individuals and firms.

Considered in this context, computers and telecommunications systems have made the modern office building even more prominent as the organizational node for generating and processing information. Today banks and financial service firms require buildings equipped with high-capacity telephone lines; backup power; large, clear floors for trading rooms; and redundant telecommunications links in the event of system breakdowns. These requirements have led to the technological retrofitting of obsolete commercial structures, the growth of new office districts in central cities, and the concentration of office parks in edge cities.

Charlotte, North Carolina, the third-largest banking center in the United States (after New York and San Francisco), is an example of a city that has thrived as its major commercial banks have expanded their operations and geographic scope of activities. Charlotte is thriving precisely because technological innovations have expanded the geographical reach and role of interstate banking. NationsBank is explicitly expanding its use of technologically intensive ways of providing banking services while reducing the need for the traditional branch bank. According to NationsBank's 1996 annual report, "We are selectively reducing our investment in bricks and mortar (we closed or sold more than 200 banking centers in 1996) and expanding lower-cost and more efficient ways to do business with us." While NationsBank is undoubtedly driven by corporate strategy, telecommunications technologies have allowed its plans to go forward. As a result, the telephone line has replaced the branch bank as the primary instrument for serving customers. The ornate edifices built to store money in downtown areas have been superseded by the automated teller machine (ATM).

One important factor that has contributed to the need for concentrating information-intensive activities and that has assumed importance in recent years is the need for high-capacity bandwidth to gain rapid access to the Internet. William Mitchell (1995) points out that a "low baud-rate connection puts you out in the boonies, where the flow of information reduces to a trickle, where you cannot make so many connections, and where interactions are less intense…. Since the cost of high bandwidth cable connection grows with distance, information hotspots often develop around high-capacity data sources. Much as oases grow up around wells."

It should be noted that a study of the distribution of information technology infrastructure in the United States found that "access to advanced information infrastructure has become more equally distributed" over time. Greenstein, Lizardo, and Spiller (1997) point out that "the highest levels of information infrastructure" are located in the Nation's big urban centers, but added that "only a small number of areas, in particular small and less densely populated regions, may not have direct access to advanced information technology capital." Many new technologies are being implemented to increase bandwidth and capacity of the existing information transportation infrastructure, particularly the Internet. Fiber-based national high-capacity backbone networks are being rapidly deployed by telecommunications firms. An analysis of data provided by *Boardwatch* magazine on the major backbone providers finds that the hubs or major "points of presence" of most backbones are located in cities. Major information-intensive cities, such as Atlanta, Boston, Chicago, Dallas-Fort Worth, Los Angeles, New York, Philadelphia, San Francisco, and Washington, D.C., turn out to be locations of the most hubs.[1] Furthermore, a report by Goldman Sachs Global Research (1996) affirms that "phone companies in general will continue to put fiber in the ground, build out broadband where it makes the most economic sense, and focus their efforts on those areas that are attractive from the standpoint of consumer demographics."

High-speed telecommunications access, however, does not depend only on access to the fastest backbone, because the transfer of information packets is only as fast as the slowest point in their journey. Bringing high-speed access to users in the so-called *local loop* is expensive (Blau, 1996). Some of the most promising technologies in the short- to mid-term (20 to 40 years) rely not on deploying fiber but on the existing copper infrastructure. These technologies (called DSL for digital subscriber line) have an inverse distance-to-speed ratio; that is, the greater the distance the signal has to travel, the slower the speed. In fact, the greatest benefit is achieved in an area approximately 2 miles or less from the service provider (Freed, 1996). This technological limitation means—test cases aside—that the first mass deployment of high-bandwidth access is likely to take place in areas of concentrated demand, such as information-intense central cities or suburban office centers.

The comparative advantages of dense urban areas are not limited to high-bandwidth access. They extend to the deployment of new information technologies in general, since most cities that have a high concentration of information industries such as finance, insurance, and real estate are also high-use telecommunications customers (Guldman, 1994). A technological alternative to Internet access through telephone lines is already being marketed but in only a few U.S. cities with a concentrated number of users. This alternative provides wireless Internet access through a system of radios mounted on utility poles that are accessed by radio modems. Metricom, an Internet service provider based in Los Gatos, California, has already wired the San Francisco Bay Area and intends to wire the largest cities where there is substantial online activity ("The Net, Via Thin Air," 1996).

Furthermore, the recent announcement that Teledesic Corporation plans to develop a new communications system based on low-Earth-orbit satellites that can provide Internet connections around the world means that remote areas will have access to high-speed Internet service without relying on terrestrial fiber-optic or copper cable systems. With such satellites, users would need to rent or purchase antennas and signal decoders that would plug into telephones or computers. This technology would make it possible to conduct video conferencing and advanced telecommunications activities almost anywhere in the world. Seen in the context of telecommunications increasing interaction, it would intensify the global demand for both face-to-face and electronic communications in the next century.

The comparative advantage of large metropolitan regions as the sites for new capital investment in telecommunications should allow information-intensive cities to maintain their economic strength as places where both face-to-face and electronic communications are affordable and accessible. Far from proving the unmitigated decentralizing force of technology, current events bear out Thomas Mandeville's conclusion (1983) that technology facilitates both centralization and decentralization of tasks and jobs.

Telecommuting, Small Business, and the City

Almost every technological forecast of the urban future emphasizes the enormous potential of telecommuting, the capacity to do work at home or remote locations, rather than commute to an office or work environment. Changes in the organization of work, in the composition of the work force, and in the cost and capability of personal computers are contributing to the rise of telecommuting in the United States. Advanced information systems make it possible for workers to be electronically accessible without being physically confined to an assigned office. In addition, the increased need for flexible hours to retain and attract employees has reinforced the appeal of telecommuting for both individuals and managers. According to at least one management consulting firm, approximately 9 million people regularly telecommute, and approximately 25 million will telecommute by 2000. However, most telecommuters work at home only 2 or 3 days a week—the balance of their work is conducted in an office (McQuay, 1995).

Despite the popular rhetoric that telecommuting will replace the need for offices, most workers do not have jobs that allow them to have substantial freedom from their work sites. Most of the largest growing occupations in the United States involve jobs that are location dependent—they require the onsite presence of the worker. The well-publicized growth of the service sector involves many location-dependent jobs (Salomon, 1996). Thus while many entrepreneurial jobs offer the potential for working at home, work will not be totally dispersed to the "cottage" or countryside in the next decade.

It is useful to remember that long before e-mail and the Internet were developed, teleworkers conducted all or part of their work from home. Operating a business from home, full- or part-time, is increasingly feasible with advanced telecommunications systems. Many people have traditionally worked at home on an informal basis: reading reports, preparing for meetings, or grading papers. The home telephone line linked to a computer and modem has expanded that informal mode of work into a far broader set of activities. Telecommuting is also being used by businesses and public agencies as a way to reduce air pollution from automobiles and as a technique for reducing highway congestion at peak periods. Several studies have suggested that telecommuting can increase productivity in an organization, improve employee morale, reduce the stress associated with commuting, and help companies recruit highly skilled employees.

However, telecommuting presents several obstacles. Serious concerns have been expressed about the social isolation of people who work at home alone. Even some studies recommending telecommuting add that the problem of social isolation should be dealt with by limiting the number of days an employee can do so (Lewis, 1996). Resentment by fellow workers has occurred in some cases, and unions have opposed telework for fear that it would diminish the opportunity to organize workers (Argyle, 1990). One study reports:

> [I]t is not self-evident to us that home-based teleworking is likely to be sustainable on any appreciable scale. The reasons for reaching this view include the problems of social isolation for individual teleworkers, the difficulties of managing large-scale telework schemes, the risk of losing both creativity and team spirit within organizations with substantial numbers of home-based teleworkers, and the economic precariousness of much freelance work. (Gillespie et al., 1995)

The experiences of public organizations and private firms indicate that remote work has distinctive limits. Despite the massive investment in information technology by individuals and businesses over the past two decades, the office environment—typically in a central city, but often in the suburbs—remains the fundamental organizing element of the information economy. Trends in office design also shed light on the importance of central offices as places where ideas are exchanged. Offices (even those engaged in computer software development) are increasingly turning to cubicles as opposed to individual rooms to foster "teamwork, cooperation, and shared knowledge" (Lohr, 1997).

At the same time, technological innovations and the reduced costs of computers and long-distance telecommunications are now making it possible for entrepreneurs and small businesses to take advantage of telecommunications technologies and to compete in national and international markets. James E. Katz (1996) suggests that cellular telephones are especially important to small firms: "Wireless communication can help small and medium-sized businesses, and especially the one-person shop." In contrast with technological innovations that were initially used by large organizations and subsequently adopted by small firms, mobile telephony has been most heavily used by the self-employed and by small businesses. A study by a British telecommunications firm found that a majority of its mobile telephony users were self-employed and one-fourth were in firms with fewer than 100 employees.

The Internet, Cities, and Regions—A Summary of the Research

The Internet is transforming the ways in which individuals and firms obtain information, market services and products, and communicate within and between organizations. Access to and use of the Internet is an essential requirement for obtaining timely information and for distributing information that was once available only in libraries or through books, newspapers, magazines, and other publications. In March 1997, the Federal Communications Commission (FCC) issued a report stating:

> The Internet is substitutable for all existing media. In other words, the Internet potentially poses a competitive threat for every provider of telephony, broadcasting, and data communications services…. The Internet creates alternate distribution channels of pre-existing content, but more importantly, it permits delivery of new and hybrid forms of content. (Werbach, 1997)

Even in this arena, however, the influence of technology is selective. While the Internet will undoubtedly have a competitive effect on other forms of content distribution, the content being distributed continues to emanate largely from cities where media have traditionally been concentrated. The Internet provides a powerful vehicle for delivery of old content while stimulating new content production because of the ease of startup and distribution.

The development of Internet-related technologies is also having a profound effect on the headquarters of major financial firms by allowing a corporation's headquarters office to exert a new form of control over their satellite offices. For instance, BankBoston is using Java, an Internet programming language, to deploy "complex programs across a smorgasbord of operating systems across the world." (Stirland, 1997.) Java programs are developed at the center (where such activity remains) and deployed to branch offices. The final effect is to concentrate decisionmaking and control in the city of Boston where BankBoston is headquartered. All indications are that such enabling technologies will soon be widely deployed.

According to data compiled by FCC, there are approximately 47 million Internet subscribers in the United States and more than 175 countries are now connected to the Internet. Originally created by the U.S. Department of Defense as ARPANET, the Internet was transformed in 1984 when the National Science Foundation (NSF) took control of it, renamed it NSFNET, and linked five supercomputers across the United States. The Internet has grown rapidly in recent years through connections to conventional telephone systems. According to Barney Warf (1995), "The Internet is the largest electronic network on the planet … and has become the single most important mechanism for the transmission of scientific and academic knowledge."

The Internet has evolved into a medium that serves many more purposes than anyone anticipated. With Internet use growing at approximately 40 percent a year nationally, new technologies—high-speed microwave and wireless communications and enhanced cable television systems—will compete with local telephone companies as direct access providers to the Internet. Investment in the Nation's telecommunications systems to accommodate Internet traffic will have its most obvious effects on those cities and metropolitan regions with the largest concentrations of Internet users. Rather than undermining cities and major metropolitan regions, the Internet may reinforce their comparative advantage as centers for information production and transmission.[2]

According to a recent study, 50 percent of all U.S. Internet hosts are located in just five States: California, Massachusetts, New York, Texas, and Virginia.[3] Within these States, Internet hosts are densely concentrated in a small number of metropolitan regions. Furthermore, 90 percent of all Internet hosts are in 21 States, primarily on the East and West coasts of the Nation; in the Midwestern States of Michigan, Minnesota, and Ohio; and in a cluster of Western States, including Colorado, New Mexico, Texas, Utah, and Washington. This concentration may represent a natural process of technological diffusion, a technological gap that will close in the future. Nevertheless, Internet activity in the United States is clearly associated with large cities and metropolitan regions.

Within and among cities and regions, the Internet is creating a new set of leaders and losers. Five large metropolitan regions in the United States account for approximately one-third of the Nation's Internet hosts. The largest single concentration of Internet hosts is based in Silicon Valley, California (encompassing Alameda, San Francisco, San Mateo, and Santa Clara counties).[4] This region, with major universities, high-technology firms, and computer software companies, has almost twice as many Internet hosts as southern

California's Los Angeles, Orange, and San Diego counties combined. Middlesex County, Massachusetts, the home of many of the high-technology firms along Route 128, has 4.3 percent of the Internet hosts in the United States, the second-largest concentration of Internet hosts of any county in the Nation. Los Angeles County has the third-largest concentration of Internet hosts—2.8 percent of the Nation's total.

A hierarchy of Internet host concentrations can be found in major metropolitan regions in the United States. The top five have 40,000 Internet hosts or more, and a second tier of regions includes cities such as Atlanta, Austin, Boulder, Charlotte, Chicago, Dallas, Minneapolis-St. Paul, Pittsburgh, Salt Lake City, and Seattle. Cities such as Detroit, Houston, Miami, and New Orleans have yet to develop as centers for Internet host computers. This pattern confirms Robert Warren's observation (1989) that "the uneven distribution of benefits from telematics exists among, as well as within, urban regions."[5]

Given the heightened role of information in a knowledge-based economy and the great value placed on high-speed communications, the location of Internet hosts suggests that urban and metropolitan regions may avoid decline because of telecommunications technology. In the 19th century, access to a deep-water port was essential for the growth of cities; at the end of the 20th century, high-speed, reliable access to the Internet may be the critical factor in regional development. Despite the rhetoric surrounding the Internet, high-capacity bandwidth is not yet available in most households, and downloading information from the Internet can take a substantial amount of time. But universities, corporations, government facilities, and commercial office buildings with high-capacity links to the Internet offer users substantial advantages for obtaining and sending information.

Municipal governments are also actively involved in developing their own World Wide Web sites to disseminate information about local government activities and to provide a way for citizens to contact local officials. Samuel Nunn and Joseph R. Rubleske (1997) found from their content analysis of 39 municipal Web sites that the typical site provided information on government operations and services, government and citizen interaction, legislation, and elected officials. Cities, however, were not found to be taking advantage of the more advanced technological characteristics of the Internet, such as electronic filing of forms and other transaction-based features.

New Media, Electronic Commerce, and Urban Growth

The Internet is emerging as a new source of jobs and economic development for firms based in large cities. Businesses increasingly rely on the Internet to sell their products and services. One computer manufacturer sells more than $2 million in computers and related equipment each day on the Internet, and corporate demand for the design and construction of Web sites is expected to be a $10 billion industry by the end of the century. Entertainment companies, advertising agencies, and financial service firms are developing new products and services to be distributed electronically to the home and office. Electronic commerce is expected to be a huge industry in the very near future. According to some media analysts, "ecommerce" will be an $11.7 billion industry by 2007.[6]

The potential for commerce and other forms of revenue from the Internet is having a positive effect on job growth in cities, where most companies poised to reap its advantages are located. A significant amount of effort is being directed toward production for the new medium. Startups and subsidiaries of large companies have been established to design Web sites and create electronic information services in a handful of cities, such as Austin, Los Angeles, New York, San Francisco, and Seattle. The new multimedia industry needs a broad array of talent harnessed to the latest computer and graphics

technologies. Large cities and metropolitan regions are best equipped to supply this skilled labor. They already have the writers to produce copy, artists to design graphics, musicians to deploy sound, and skilled technicians to integrate the various components.

The recently deployed multimedia industry is not geographically dispersed across the country but based in urban centers where such talent is accessible and an advanced telecommunications infrastructure is available. Allen J. Scott (1995) has found that two regions in California—the San Francisco Bay Area and the southern California region, including Los Angeles and the immediate surrounding counties—account for approximately 90 percent of multimedia producers in the entire State. In the San Francisco Bay Area, the multimedia industry consists primarily of technology-intensive firms, whereas in the southern California region, the multimedia firms are generally involved in entertainment and communications activities.

New York City, the Nation's financial and cultural capital, is also home to an impressive amount of activity, stemming from the growth of the Internet and the deregulation of the telecommunications industry. The economic importance of new media to New York City has been analyzed in a 1996 study by Coopers & Lybrand. The report stated that new media businesses were concentrated in Manhattan, south of 41st Street, in an area known as *Silicon Alley*. The study found that firms in Silicon Alley generated more than $1.04 billion in gross revenues and provided more than 18,000 full-time-equivalent jobs. Coopers & Lybrand also found that multimedia firms considered access to a high-quality telecommunications infrastructure to be more important in future locational decisions than the quality of life in New York—a fact that is spurring "recycling" of old urban real estate.

In lower Manhattan, several office buildings have been rewired to accommodate firms that require high-capacity telephone lines, and in downtown Los Angeles, where there is a surplus of vacant commercial space, new telecommunications infrastructure has been used to attract tenants to vacant office buildings. One of the most successful examples of using new telecommunications systems to revive old real estate is a 400,000-square-foot office building at 55 Broad Street in lower Manhattan—now the New York Information Technology Center—which serves as a magnet for high-technology firms seeking access to state-of-the-art telecommunications systems (Trachtenberg, 1996).

Using Telecommunications to Strengthen Urban Communities

Numerous efforts are under way to use communications technology to increase citizen awareness and involvement in local activities in towns, cities, and neighborhoods. Douglas Schuler (1996), author of *New Community Networks: Wired for Change*, states:

> [C]ommunity networks (sometimes, called civic networks, Free-Nets, community computing-centers, or public access networks), some with user populations in the tens of thousands, are generally intended to advance social goals, such as building community awareness, encouraging involvement in local decision making, or developing economic opportunities in disadvantaged communities.

An example of such a local community network is the Liberty Net in Philadelphia, which contains information on economic opportunities and business organizations. In East Palo Alto, California, a city with 26,000 residents, a 65-percent high school dropout rate, no branch banks, and only one ATM, a successful nonprofit organization—Plugged In—teaches young people how to use computers, design Web pages, and create desktop

publications. Plugged In also operates a chat service that will soon be carried on the Web (Richtel, 1997).

A variety of public and nonprofit organizations are involved in efforts to develop computer centers in public housing projects, community centers, and libraries, thereby providing low-income individuals access to the Internet, whether or not they have a telephone at home. In Berkeley, California, workstations accessible to the public have been placed in laundromats and at gathering places for the homeless (Mitchell, 1995). Most important, the U.S. Department of Housing and Urban Development (HUD) has established the Neighborhood Networks program to provide computer hardware and software to residents of HUD-insured and HUD-assisted housing. In East Harlem, Manhattan, HUD has established a Neighborhood Networks computer learning center at Taino Towers, a 676-unit, federally insured and assisted apartment complex. The computer laboratory has 18 Pentium-chip-powered computers and offers employment assistance, plus computer literacy training and general equivalency diploma courses.

In Charlotte, North Carolina, a project supported by IBM has been placed in a public housing complex and in the public library to allow parents to learn about their children's performance in school. The San Francisco Unified School District is working closely with the San Francisco Housing Authority to provide computer access and training in public housing projects, homeless shelters, and family service centers.

It is important to remember, however, that even as Internet laboratories proliferate, a considerable portion of the Nation's population does not have basic telephone service. Large sections of central cities often include low-income households that cannot afford such basic services (Organisation for Economic Co-Operation and Development, 1992; National Telecommunications and Information Administration, 1995). As a recent report noted, "Americans most prone to phonelessness are not rural and elderly as is often assumed. They are urban, young, lower income, and within the lower income and age brackets, disproportionately black and Hispanic" (Mueller and Schement, 1996). According to the Bureau of the Census, U.S. Department of Commerce, 94.2 percent of all households in the Nation have a telephone. Approximately 5.6 million households are without telephones in the United States, affecting approximately 15 million individuals. A report prepared for the National Telecommunications and Information Administration (1995) states: "The lowest telephone penetration rates exist in central cities.… The Northeast central cities ranked as the region with the largest proportion of telephone and computer 'have nots,' followed by Southern cities and rural areas." These households are concentrated in large cities and consist predominantly of young, minority, and poorly educated persons.[7]

The absence of telephone service in such a large number of households limits those citizens' ability to obtain information about jobs, to be in contact with healthcare providers, and to participate in telephone-based educational tutoring, as well as prevents their access to the Internet. However, several alternative technologies may reduce the burden of being without a telephone. The growth of storefront pay telephone centers, typically for international calling customers, also provides local telephone service in low-income neighborhoods. In addition, new forms of wireless technologies, including two-way paging, may be an alternative to conventional telephone service in certain communities. Beepers and paging services are used extensively in inner-city neighborhoods, yet little is known about who uses them, what purposes they are used for, and what their relationship is to existing telephone networks. Mueller and Schement (1996) believe that "narrowband, two-way paging services have enormous potential to replace POTS [plain old telephone service] as the building block of universal service. Simple paging services could limit telcos'

[telecommunications companies] exposure to bill nonpayment while enhancing the communication access of otherwise phoneless people."

One strategy that addresses the phoneless population is to provide voice mail to low-income individuals. This is the principal activity of the Community Voice Mail Project (CVM), which was initiated in Seattle but has spread to approximately 20 cities in the United States. CVM provides people without telephone service with a seven-digit telephone number and access code to retrieve messages from any public or private touch-tone phone. In Seattle, a toll-free number donated by Frontier Communications of New England, Inc., permits CVM users to retrieve messages from pay phones at no cost. In addition, many communities are providing e-mail and voice mail to their users.

The wiring of public schools has become a goal at the State and Federal levels as part of their efforts to improve education with new technologies. According to the National Center for Educational Statistics (1996), 50 percent of public schools indicated that they had access to the Internet, but "only 31 percent of schools with a large proportion of students from poor families had access to the Internet, compared to 62 percent of schools with relatively few students from poor families." It is important to note that more than wires are needed to build a modern telecommunications infrastructure in a school. Wiring the public schools is "only a small part (4–15 percent) of the total cost for technology infrastructure in a school. High powered workstations, local area networking and staff development are three of the largest cost components for implementation." (NYSERNet, 1996.) Network infrastructure is one of the most rapidly changing and volatile fields in the communications industry, so there is considerable uncertainty about the lifespan of such "wiring."

Schools should enforce public policies for wiring that recognize the need for adequate funds to acquire, operate, and maintain related computers and equipment. This need poses a special challenge to urban school districts that are typically less affluent than many suburban districts. Ironically, it is less expensive to link public schools in central cities to the Internet through high-capacity T–1 telephone lines than in rural areas. The cost of installing high-capacity telephone lines is distance sensitive and, therefore, it costs 4.5 times more per month to be connected to the Internet using a T–1 line in the 518 area code in upstate New York than in Manhattan's 212 area code (NYSERNet, 1996).

Municipal Planning and Policymaking Strategies for Telecommunications

With a few exceptions, local governments in the United States have traditionally limited their policymaking role in telecommunications to the granting of municipal franchises for cable television systems. The Telecommunications Act of 1996 altered the cities' role in regulating telecommunications facilities and providing their services. Nunn and Rubleske (1997) argue that "federal policy makers expect local governments to devise their own local approaches to the use of advanced infomatics to take advantage of whatever benefits the local community believes the NII [National Information Infrastructure] can provide for citizens." They report that the "closest thing to a federal policy of local information highways is the Telecommunications and Information Infrastructure Program of the National Telecommunications and Information Administration," which provides grants to local governments, educational institutions, and nonprofit groups to use telecommunications to improve access to and quality of public services.

According to a legal interpretation of the Telecommunications Act of 1996, cities still have the ability "to manage rights-of-way and to receive compensation for the use of

these rights-of-way." However, they must do so on a "nondiscriminatory and competitively neutral basis" (Bonnett, 1996). The Act also maintains local zoning authority over cellular towers and other wireless telecommunications facilities, and it allows municipalities to provide telecommunications services "in connection with a municipal electric utility, municipal water utility or on a stand-alone basis" (Thomas, 1996).

Many communities are using their authority over rights-of-way and land use to develop new regulatory approaches to telecommunications facilities that are located in residential or commercial zones. The San Francisco Planning Commission has adopted guidelines designed to ensure that rooftop wireless telephone antennas are as inconspicuous as possible. To maintain an aesthetic standard, cellular towers in Jefferson Parish, Louisiana, are required to be disguised as trees; the tower is "required to resemble a woody tree with a single trunk and branches on its upper part." (National League of Cities, 1996.) Plano, Texas, has imposed height restrictions on cellular telephone towers, and towers that are on building facades must be painted to match the structure.

Other cities have formulated policies for telecommunications that are based on broader social and economic objectives. Birmingham, Alabama, will receive $500,000 in cash and benefits by providing to a cellular telephone company a 25-year lease for two antenna sites on city-owned golf courses. Birmingham obtains rental fees, cellular telephone service to the city's emergency and public safety personnel, and improvements on the municipal golf courses. Huntsville, Alabama, has formulated a public-private partnership with six personal communication service providers to control the placement of towers in the community. The city, in conjunction with a third party, has developed a plan to have a single network of tower sites, and will receive both long-term revenue from use of the towers and access to the towers for municipal services.

Several communities are also involved in developing telecommunications systems to strengthen their economic competitiveness. In part because of dissatisfaction with its cable provider, Tacoma, Washington, is proceeding with an ambitious plan to build a fiber-optic network in every neighborhood and bring coaxial cable into every household and business. The city will build the network through City Light, the publicly owned utility company.

Clearly, cities are pursuing a variety of proactive strategies to make certain that they have adequate telecommunications systems and to ensure that privately built telecommunications systems do not disrupt neighborhoods or the physical amenities of residential communities. This is not, however, an easy task. Over the next few years, armies of powerful lobbyists from cable companies, long distance providers, regional operating corporations, utilities, and other interested parties will descend on city halls and State capitols to promote their agendas.

Cities also face another direct threat: the potential loss of billions of dollars of revenue as online commerce grows. With consumers expected to increasingly use retailers that set up shop on the Internet, many cities with thriving retail districts stand to lose sales tax revenue because of the change in consumer purchasing behavior. Furthermore, the health of businesses in the retail districts is itself in question. This matter is not trivial for major urban areas, in which manufacturing-oriented employment has been replaced by retail jobs over the past three decades. Even in New York City, which has a diversified economy, approximately 17 percent of its overall tax revenue is generated by sales taxes (Citizens Budget Commission, 1997). States may try to make up for some of the lost revenue by imposing a telecommunications sales tax on access providers, but the odds are against its success. The governors of California, Massachusetts, and New York have

voiced opposition to targeting access providers. Massachusetts has already passed a law prohibiting taxes on access providers. Federal legislation seeking to prevent localities from imposing new taxes on the Internet—through access providers or other means—has been introduced in Congress. The legislation, introduced by Senator Ron Wyden (D–Oregon) and Representative Chris Cox (R–California), was criticized as an intrusion in local affairs at the U.S. Conference of Mayors' June 1997 meeting.

Cities must also deal with the inherent biases in Federal policy that favors rural areas over urban. In the wake of the Telecommunications Act of 1996, FCC is changing its rules to fund services in rural areas. A proposal likely to emerge is a surcharge on revenue, which will amount to a massive subsidy from urban to rural areas. While providing services in remote areas is a worthwhile goal, it will impose significant costs on urban areas. In addition, large subsidies to rural areas may inadvertently discourage investment in innovative local-loop technologies in cities.

Conclusions

For the past half-century, futurists and urban planners have predicted that advances in telecommunications would bring about the economic demise of urban centers. While many cities in the United States have experienced population loss and economic decline, a large number of cities and metropolitan regions can benefit from the development of advanced telecommunications networks and, particularly, the Internet. In general, technology has had mixed results with regard to centralizing and decentralizing forces. Forecasts that teleconferencing would make air travel unnecessary have proven to be wildly exaggerated, as have forecasts about telework and the electronic cottage replacing the office environment. Contrary to the conventional wisdom, new telecommunications technologies can strengthen cities with a high concentration of information-intensive activities and firms that depend on both face-to-face activities and electronic communications.

Many cities have distinct advantages in an information-based economy: They have large concentrations of media, advertising, entertainment, educational, healthcare, and financial services. Telecommunications technologies can extend the reach of these services far beyond their traditional physical boundaries. As these services prosper, so can the cities that house them.

Many cities also have technological advantages. The private sector is making new investments in technologies to improve bandwidth for the flow of information through national backbone networks. Their reach into localities is likely to occur first in cities that have dense concentrations of businesses and population. The availability of high-speed access is, in turn, likely to spur economic activity and telecommunications innovation.

Local governments face several telecommunications-related challenges: They need to attract and retain technology-intensive firms, develop high-speed telecommunications access in their city, and try to guarantee access to information to low-income residents in an era of deregulation. Without access to the Internet, individuals and community groups face serious obstacles to obtaining programs and reports from government agencies and private sources.

Although cities have a vast array of public institutions that should provide the natural access points for low-income individuals, many of these institutions are plagued with problems. For example, public school systems in large cities often have inadequate funding, crowded classrooms, and aging buildings. Any school modernization and building program should include the provision of classroom computers linked to the Internet. Given the private sector's role in the production of computers and the development of

new telecommunications systems, a collaborative enterprise between the public and private sectors is necessary to achieve the goal of linking every public classroom to the Internet. School programs must also include training for the new multimedia industries that are burgeoning in many central cities.

In some communities, the public library can serve as the community's information resource; in other communities, housing projects, religious organizations, and recreation centers can be used for facilitating access to electronic information. Providing access to the Internet must be part of the planning of any new construction or rehabilitation of the existing built environment. And, as new technologies move to the mass market, policies must address the need for universal service in all households, including those of the urban poor.

Cities can capitalize on their role as major users of information and telecommunications systems. Local public services, such as libraries, tax and finance administrations, and criminal justice systems are information intensive; they depend on computers, telephones, and sophisticated information retrieval and imaging systems. Public-sector organizations constitute a significant market for advanced telecommunications equipment, yet they rarely use their purchasing power to achieve economic and community development objectives. Local governments play a vital role in the telecommunications infrastructure through their purchasing power, authority over municipal franchises, and control over land use.

Municipalities can also use information technology to reform their own internal structures and set up feedback loops on the effectiveness of municipal services. Currently most municipal Web sites provide information about public services. Few take the next step to allow the citizenry to make queries about specific situations or monitor delivery of services.

A city's future as an information center depends on information-producing activities that occur through both face-to-face and electronic communications. Public policies that foster investment and competition in the telecommunications industry are necessary to allow cities to retain information-intensive industries and the residential populations necessary to support stable neighborhoods and economic activity.

Author

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Notes

1. Based on Anthony Townsend's analysis of data from *Boardwatch* magazine March/April 1997 as posted on the publication's Web site.

2. Researchers use data from Matrix Information and Directory Services, Inc., (http://www.mids.org) and the Netwizards Internet Domain Surveys (http://www.nw.com) to analyze the location of Internet hosts in the United States. The data reflect all uniquely named computers connected to the Internet on a full- or part-time basis, thus measuring the number of computers engaged in frequent or continuous Internet access and service provision.

3. For more detailed information, see Moss and Townsend, 1996.

4. The high concentration of computer software and information technology companies in the San Francisco Bay Area has generated competition for office space on the San Francisco Peninsula (McCloud, 1996).

5. Also see Nunn and Warren, 1996.

6. Paul Kagan and Associates, July 1997.

7. National Telecommunications and Information Administration.

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