Meeting Third World Needs in a Global Telecom Market 4

Information and communication technologies, operating in a newly deregulated and increasingly competitive economic climate, are rapidly reconfiguring national communication systems and linking them together into networks that span the globe. This has greatly reduced telecommunication costs and generated a wide range of new products and services.[1] As a result, telecommunications is one of the fastest growing sectors in the international market, with total sales of $400 billion in 1992 and annual growth rates averaging between 10 to 15 percent.[2]

Increases in the flow of and demand for information services across national borders are wearing away the distinction between domestic and international communication systems and markets. Whereas national monopolies once controlled the manufacturing, production, and provisioning of most communication related products and services, today international conglomerates are being formed to meet the business demand for transparent and seamless worldwide services.

In this increasingly liberalized, global telecommunications marketplace, many developing countries' communication needs can be met by the private sector. Already, many firms are eagerly competing to invest in and/or partner with developing countries to serve their rapidly growing communication markets. U.S. firms are especially well positioned in this regard. They are foremost in the development and deployment of communication and information technologies and principal players in the information and communication technology and service trade arena.

Although the global market is driving the deployment of advanced communication technologies, and channeling investments in telecommunications to developing countries, its impact will likely be uneven, with some countries and some areas remaining unserved. In many developing countries, existing infrastructure is very primitive, providing in some cases less than one

[1] For example, the price of leasing a single voice-grade channel in 1970 was between $8,000 and $9,000 per month. Today it would cost about $6,000 to lease a 64 kbps line that could provide eight times more transmission capacity. See Michael Fahey, "From Local to Global: Surveying the Fiber Landscape," *Telecommunications*, November 1993, p. 34.

[2] "Expanding Your Orbit," *Public Utilities Fortnightly*, Feb. 1, 1993, p. 27.

main telephone line per 100 persons.[3] And the cost of upgrading these networks can be astronomical—on the order of $60 billion according to some estimates.[4] Compounding the problem, many developing countries have only limited access to the foreign exchange required to purchase up-to-date equipment and services in the global market.

To meet the needs of all developing countries in a global economy, some foreign assistance and support may be required. The need for such support is typical in the case of communication technologies. Historically, for example, most national governments have found it necessary to promote universal access and the deployment of communication infrastructure, owing to the failure of the marketplace to support universal service and other related economic and social goals.

The economic incentives provided in today's international marketplace may similarly inhibit the deployment of technology to all corners of the earth, rich and poor alike. In a highly competitive, global economy, however, Third World governments can not—as did governments in the past—speed up and smooth out the technology diffusion pattern, using cross subsidies and price averaging. To the contrary, if Third World countries are to attract worldwide business and investment in telecommunications, they must dismantle their traditional regulatory regimes and veer toward greater liberalization and privatization. Otherwise, they will most likely be bypassed altogether.

In an interdependent global environment, the United States has an interest—from a trade as well as from a foreign policy perspective—to help ensure that technology deployment proceeds on a relatively even basis. Designing a telecommunications oriented foreign aid program, which carefully targets unserved areas and leverages free market, private sector developments, however, will require a clear understanding of potential market failures and barriers to deployment in a global telecommunications market.

This chapter seeks to contribute to such an understanding. To this end, 1) it characterizes the typical technology diffusion pattern associated with communication networks and the key factors likely to affect it; 2) it examines how this pattern might be influenced by the forces driving globalization of the telecommunications market; and 3) it identifies and describes the implications for Third World countries of the most probable deployment scenario.

THE DIFFUSION OF COMMUNICATION NETWORKS

Technology diffusion is typically a long-term and uneven process that depends on a number of factors, making it very difficult to access in any event.[5] The problem of predicting diffusion rates is compounded in the case of a networked communication infrastructure. Because the infrastructure as a whole is constituted by hundreds of technologies coexisting, each at different points on their diffusion curves, how quickly communication innovations are adopted is highly dependent on factors such as interconnectivity and the interdependence of content and equipment. Moreover, because communication infrastructures support both social and economic activities, network evolution will probably be determined by many social and political factors as well as by technological and economic factors. Not surprisingly, therefore, national governments have generally played a major role in determining network deployment and use.

[3] According to the International Telecommunications Union (ITU), by the end of 1992 almost 50 countries accounting for more than half the world's population had a teledensity of under one main telephone line per 100 people; at current growth rates this situation will not change until the end of the century. Denis Gilhooly, "Road to Kyoto," *CommunicationsWeek International*, Sept. 12, 1994, p. 12.

[4] According to the ITU *World Telecommunications Development Report*, it will cost $58.3 billion to provide basic infrastructure to most nations. The World Bank estimates the cost to be even greater, totaling $80 billion. Stephen Titch and John Williamson, "World Conference Pushes for Policy Changes," *Telephony*, Mar. 28, 1994, pp. 9, 7.

[5] For a crosscultural and crosssectoral analysis, see Pavio Arcageli, Giovanni Dosi, and Massimo Moddi, "Patterns of Diffusion of Electronic Technologies: An International Comparison with Special Reference to the Italian Case," *Research Policy*, vol. 20, 1991, pp. 515–529.

Major Technological/Economic Factors

As a general rule, the diffusion of new technologies takes the form of an S-shaped curve. This pattern reflects the forces of supply and demand, and the way in which users respond to new technologies. Vendors market new technologies slowly at first because investment and product development costs are high, while demand and profitability are low. As costs and prices fall and demand and profits rise sharply, vendors will greatly increase their supply.[6] Users reinforce this pattern. Their initial reaction to new technologies is generally very cautious, but their demand will eventually quicken and reach a critical mass as prices fall, knowledge of and familiarity with the technology spreads, and applications multiply and are adapted and readapted to new and different tasks.[7]

Achieving a critical mass is especially important in the case of interdependent networks.[8] Because these networks represent a large installed base, users are generally reluctant to purchase incompatible components. Instead, they may postpone the adoption of new, superior technologies until their entire network can be written off. On the other hand, once there is a critical mass, users will likely "jump on the bandwagon." This happens because network users and network services are, like network components, also interdependent. The value that users attach to a network will generally increase in proportion to the number of users it has, and the services it can support. Thus, when a critical mass of users adopts a new technology, others are quick to follow, fearing they will be left behind.[9] As has generally been the case, when teledensity approaches the range of 10 to 20 percent, communication networks will likely "take off."

Even after a critical mass has been achieved, however, diffusion will continue to be patchy, typically following a hierarchical pattern. Such a pattern was clearly evident, for example, in the case of the United States with the deployment of the telephone and telegraph. In both instances, diffusion followed a sequential pattern starting in areas with major populations. First, major trunks were linked to Northeastern cities, followed by lines to smaller towns in their immediate hinterlands. Then, connections were made to major Midwestern cities, which were later extended outward in a similar fashion. Although the telephone was patented in 1876, it did not reach Chicago until 12 years later, and transcontinental service was not inaugurated until 1915. For rural areas, the situation was even worse. As late as 1940, only 25 percent of all farm residences in the United States had telephone service. As a result, favorably situated businesses in the urban Northeast enjoyed a head start of several decades in utilizing regional and interregional telephony.[10] In the case of the telegraph, it took 17 years to link both coasts, with the small towns and rural areas again being the last to be served.[11]

---

[6] Christopher Freeman, *The Economics of Industrial Innovation* (Cambridge, MA: MIT Press, 1982); and Edwin Mansfield, "The Diffusion of Eight Major Industrial Innovations," N.E. Terleckjy (ed.) *The State of Science and Research: Some New Indicators* (Boulder, CO: Westview Press, 1977).

[7] Everett M. Rogers, *Communication Technology: The New Media in Society* (New York, NY: The Free Press, 1986); pp. 116-149; and Ronald Rice and Everett Rogers, "Reinvention in the Innovation Process," *Knowledge: Creation, Diffusion, Utilization*, vol. 1, No. 4, June 1980, pp. 499–514; See also Paul Attewell, "Technology Diffusion and Organizational Learning: The Case of Business Computing," *Organizational Science*, vol. 3, No. 1, February 1992, pp. 1–19.

[8] See Cristiano Antonnelli, "The Economic Theory of Information Networks," in Cristiano Antonnelli (ed.), *The Economics of Information Networks* (The Netherlands: North Holland, 1992), chap. 1.

[9] Joseph Farrell and Garth Saloner, "Horses, Penguins, and Lemmings," H. Landis Gabel (ed.), *Product Standardization and Competitive Strategy* (The Netherlands: North Holland, 1987); and Paul A. David, "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox," *American Economic Papers and Proceedings*, May 1990, pp. 355–361.

[10] Richard Kielbowitz, "The Role of Communication in Building Communities and Markets," contractor report prepared for the Office of Technology Assessment, 1987.

[11] Ibid. See also Richard DuBoff, "The Telegraph and the Structure of Markets in the United States, 1845–1890," *Research in Economic History*, vol. 8, 1983, pp. 269–270; and U.S. Department of Agriculture, Rural Electrification Administration, *A Brief History of Rural Electric and Telephone Programs* (Washington, DC: USDA, REA, 1989).

Recent networked communication technologies have followed a similar pattern. Included among these, for example, have been commercial television stations, cable television, competitive long distance services, AT&T data services as well as interuniversity BITNET e-mail systems.[12] Even the fax machine, which has had a very rapid rate of diffusion, exhibited this same pattern. Like the telephone, many of these technologies were initially driven by business usage.

The Role of Government in Supporting Network Diffusion

National governments have played a major role in determining the evolution of communication technologies. Viewing these technologies as a critical infrastructure that sustains all social activities—political, economic, and cultural alike—governments have, over time, consistently intervened to either promote or retard their availability.

In the United States, the Founding Fathers recognized that the widespread flow of communication was essential to developing a unified market, forging a common culture, and creating a democratic polity. To foster such communication, they incorporated three important provisions in the Constitution—the First Amendment provision for free speech; the authorization of intellectual property protection under Article 1, Sec 8; and Article 1, Sec. 8, Paragraph 7, which gives government the power to establish post offices and postal roads.[13] This goal of fostering communication has persisted throughout American history. Almost 150 years after the Constitution was written, Congress reaffirmed this commitment with the passage of the Communications Act of 1934. This act laid out the objective of providing "so far as possible, to all people of the United States, a rapid, efficient, nationwide, and worldwide wire and radio communication service with adequate facilities at reasonable charges."

To implement its objective, the U.S. Government adopted a regulatory framework that, while allowing the industry to remain in private hands, still provided some social control over the negative impacts of the single-mindedness of the market. Under this system, the telephone company was permitted to operate as a regulated monopoly, while serving the public interest as a common carrier.[14] And, when this system failed to promote adequate service in rural areas, the government took more proactive measures to encourage deployment, by channeling loans and technical assistance through the auspices of the Rural Electrification Administration (REA).[15]

As the United States became drawn into the world of international politics, communication policies were designed not only to support domestic policy goals but foreign objectives as well. Thus, for example, the U.S. government—having witnessed the military benefits of radio technology first hand during World War I—intervened to help establish the Radio Corporation of America (RCA), which subsequently bought out the British dominated American Marconi Company. In this way, the Government helped to solidify the U.S. position in international communication.[16] Similarly, to meet the defense needs of World War II, the U.S. government took the lead in providing the necessary finance and support required for the development of a number of critical communication and electronic technologies.[17] To support U.S. foreign policy throughout the Cold War, the government

---

[12] Aharon Kellerman, *Telecommunications and Geography* (London, UK: Belhaven Press, 1993).

[13] Ithiel de Sola Pool, *Technologies of Freedom,* (Cambridge, MA: Belknap Press of Harvard University, 1983), pp. 16–17.

[14] See Richard A.K. Vietor, "AT&T and the Public Good: Regulation and Competition in Telecommunications, 1910-1987," Harvard Business School, unpublished paper, April 1987, revised March 1988.

[15] Legislation permitting REA to play such a role was passed in 1949. Accordingly, REA was able to achieve high-quality, state-of-the-art service, working mainly with the "independent" telephone companies. By 1980, 90 percent of all farms in the United States were served by telephones. U.S. Department of Agriculture, op. cit., footnote 11.

[16] Daniel J. Czitrom, *Media and the American Mind,* (Chapel Hill, NC: University of North Carolina Press, 1982), p. 86.

[17] David C. Mowery and Nathan Rosenberg, *Technology and the Pursuit of Economic Growth,* (New York, NY: Cambridge University Press, 1989), p. 144.

promoted the values of democracy and a free market economy through the Voice of America Service.

Historically, some foreign governments have gone much further than the U.S. government to ensure that their telecommunication systems not only support but actually promote, national social and economic goals.[18] To this end, most foreign governments have assumed direct ownership and control over their telecommunication networks.[19]

The typical organizational pattern to emerged in Europe—and later worldwide—was that of the PTTs—the government administrations of post, telephone and telegraph. The hierarchical, government-owned monopoly model evolved in Europe over a century and a half, during which time national governments, coveting the lucrative postal revenues, finally, and after intense struggles, assumed control over their respective postal systems. Eventually, however, it was the telephone that provided revenues to subsidize the PTTs activities. The PTTs are, thus, much more than administrative agencies; they are deeply embedded in national social and political structures.[20]

Government policy will continue to play a critical role in determining technology diffusion. However, to partake of the benefits of new technologies, governments must reassess and adapt their communication policies and institutions to take into account the fundamental social and economic changes occurring in their midst. The rate-based regulatory framework that served well in the early years of telephony, when a common, universal service was required, is no longer appropriate today, given the variegated communication needs of a knowledge-based global economy.[21]

With the breakup of the Bell Telephone System in January 1984, the United States created a worldwide precedent, and set the pace for regulatory reform (see box 4-1). Under similar pressures today—made even more powerful by the threat of global competition—many countries throughout the world are reassessing, if not restructuring, their regulatory policies. Despite, in some cases, considerable resistance, a number of these countries are already dismantling their Postal and Telecommunication Administrations (PTTs) in favor of some form of privatized ownership and liberalization of entry barriers.

Describing the motivations and tensions inherent in these kinds of decisions, one observer has noted:

> Perhaps for the first time communications are being recognized as a strategic underpinning of civilization, as important perhaps as the provision of clean water. The implicit fear for many countries must be that an inadequate infrastructure will forever keep a national economy out of the world economic structure that is shaping up for the 21st century, in addition to the fear that government relinquishes an important tool. It is into this cauldron that telecom policy is being pushed.[22]

Given this radically changing international regulatory environment, developing countries will probably have less opportunity than the developed countries once had to use government policies to assure the widespread and even deployment of communication networks.

THE TREND TOWARD GLOBAL NETWORKING

Technology diffusion does not take place in isolation. It is influenced greatly by the larger technological, social, and economic context in which new technologies evolve. The single, most over-

[18] Andrew Davis, *Telecommunications and Politics: The Decentralized Alternative* (New York, NY: St. Martin's Press, 1994), pp. 62–63.

[19] Eli Noam, "The Establishment of the PTT System," in Eli Noam, *Telecommunications in Europe,* (Oxford, UK: Oxford University Press, 1991).

[20] Noam, op. cit., footnote 19.

[21] Eli M. Noam, "The Future of the Public Network: From Star to the Matrix," *Telecommunications*, March 1988, pp. 58–59, 65, and 90.

[22] Stephen McClelland, "The International Dimensions: The PTTs," *Telecommunications*, June 1992, p. 31.

BOX 4-1: The Demise of the U.S. Telecommunication Regulatory Regime

Technological developments were a major factor in the demise of the U.S. regulatory regime. The convergence of information and communication technologies blurred the distinction between what constituted a monopoly—and hence regulated—service and what constituted a competitive service to be provided in the marketplace. In addition, as new technologies both increased in capability and declined in cost, the barriers to entry into the telecommunications market were greatly reduced. Under these circumstances, many newcomers were able to make significant inroads into AT&T's traditionally protected market. Their chances for success were greatly enhanced, given the requirement that AT&T provide universal service, while its competitors could target products to the most lucrative business markets. Thus, new providers put pressure on the system of subsidy pricing, which had been so elaborately constructed over the years.[1]

Economic developments also greatly increased the incentives for others to try to enter the telecommunication/data communication market. In particular, as information came to play an enhanced and more strategic role in the realm of business, large users began to seek alternative, more efficient ways of purchasing telecommunication services.[2] Where their needs were great, or where they wanted more strategic control over their operations, users established their own internal telecommunication networks. In other cases, business users were able to make the best deal by bypassing the Bell System and purchasing services and equipment in the unregulated market.

Changes were also taking place in the way regulators thought about the regulatory structure.[3] As early as 1962, a number of regulatory economists began to question the public-utility concept. Together, their work—if it did not itself give rise to the new deregulatory climate—served at least to legitimate it.[4]

Under similar pressures today—made even more powerful by the threat of global competition—many countries throughout the world are reassessing, if not restructuring, their regulatory policies. Despite, in some cases, considerable resistance, a number of these countries are already dismantling their Postal and Telecommunication Administrations in favor of some form of privatized ownership and liberalization of entry barriers. Describing the motivations and tensions inherent in these kinds of decisions, one observer has noted:

> ...Perhaps for the first time communications are being recognized as a strategic underpinning of civilization, as important perhaps as the provision of clean water. The implicit fear for many countries must be that an inadequate communication infrastructure will forever keep a national economy out of the world economic structure that is shaping up for the 21st century, in addition to the fear that government relinquishes an important tool. It is into this cauldron that telecom policy is being pushed.[5]

---

[1] For a discussion of this pricing system, see *Separation Procedures in the Telephone Industry: The Historical Origins of a Public Policy* (Cambridge, MA: Harvard University, Center for Information Policy Research, 1981).

[2] Dan Schiller, "Business Users and the Telecommunications Network," *Journal of Communication*, vol. 32, No. 4, Autumn 1982.

[3] For one discussion, see Alfred E. Kahn, "The Passing of the Public Utility Concept: A Reprise," in Eli Noam (ed.), *Telecommunications Regulation Today and Tomorrow* (New York, NY: Harcourt Brace Jovanovich Publishers, 1983), ch. 1; For an account of these changes in attitude as seen from within the regulated industry, see Peter Temin, *The Fall of the Bell System* (New York, NY: Cambridge University Press, 1988), who argues that changes in ideology were in many ways more significant than changes in technology.

[4] As Roger Noll has described, "Economists generally entered the study of regulation with the naive view that regulatory institutions were set up for the purpose of rectifying market failures. Unfortunately, and almost without exception, the early empirical studies—those commencing in the late 1950s and continuing into the 1970s—found that the effects of regulation correlated poorly with the stated goals of regulation. By the early 1970s, the overwhelming majority of economists had reached consensus on two points. First, economic regulation did not protect consumers against monopolies, and indeed often served to create monopolies out of workably competitive industries or to protect monopolies against new firms seeking to challenge their position. Second, in the circumstances where market failures were of enduring importance (such as environmental protection) traditional standard-setting regulation was usually a far less effective remedy than the use of markets and incentives." Roger G. Noll, "Regulation After Reagan," *AEI Journal on Government and Society*, No. 3, 1988, pp. 13–20.

[5] Stephen McClelland, "The International Dimensions: The PTTs," *Telecommunications*, June 1992, p. 31.

SOURCE: Office of Technology Assessment, 1995.

riding contextual factor affecting the pattern of technology deployment in Third World countries today is the trend towards global communication networking. Thus, to anticipate the evolution of communication technologies in developing countries, it is necessary to begin by considering what such globalization might entail.

Globalization Defined

The term "globalization" suggests two related, but nevertheless distinct phenomena, which can at times work in opposition to each other. One relates to notions of comprehensives and universality.[23] Global communications, as embodied in these notions, entails the distribution of communication networks and information flows on a worldwide, and equally accessible basis. The value or goal implied by this use of the term globalization is availability and access, while the means for achieving this goal is technology advance and deployment. Thus, measures of this type of globalization might include the ubiquity of technology and technology applications, as well as the cost and connectivity of technology.

The second meaning attached to the term globalization relates not to geographic scope, but rather to territorial boundaries. In this sense, globalization can be said to occur when social interactions and transactions transcend territorial, state boundaries, and thereby supersede both national and intergovernmental decisionmaking processes.[24] From this perspective, globalization of communication entails a shift in the provisioning of communication and information from the public to the private sector in an international marketplace. The value associated with this shift is efficiency; communication resources are assumed to be more efficiently allocated if provided in response to global market signals of supply and demand. Evidence and measures of this type of globalization might take the form, for example, of the growth and development of a world market for communication and information products and services; the proliferation in the number and variety of private sector communication providers; or the emergence of new, transnational and nongovernmental centers of decisionmaking.

These two types of globalization are interrelated, often driving one another. The global deployment of communication technologies, for example, facilitates the development of transnational organizations. These organizations, in turn, through their demand for communications, help to drive the diffusion of technology and the development of a global marketplace.

The interrelationship between the two types of globalization may not always be mutually reinforcing, however. The values of universality and efficiency sometimes conflict. As the history of technology diffusion illustrates, market incentives may be insufficient to support both universal service and other, related social and economic goals. Nor is the international marketplace, on its own, likely to give rise to communication networks that are interconnected on a global basis.

Globalization as Measured by Deployment and Interconnection

Just as the birth of the telegraph, telephone, and television gave rise to communication systems and networks that stretched across the globe, so too will many of the technology advances being witnessed today facilitate worldwide access. However, whether or not these advances promote worldwide access will depend not only on technology but also on the technological and regulatory mechanisms that provide for interconnection.

[23] *Webster's Third International Dictionary*.

[24] As Ruggie describes, "Perhaps the best way to put it is that the globe itself has become a region in the international system, albeit a nonterritorial one. Thus, global does not mean universal. Instead the concept refers to a subset of social interactions that take place on the globe. This subset constitutes an inclusive level of social interaction that is distinct from the international level, in that it comprises a multiplicity of integrated functional systems, operating in real time, which span the globe." John Ruggie, "International Structure and Institutional Transformation: Space, Time, and Method," in Ernst Otto Czempiel and James N. Rosenau, *Global Changes and Theoretical Challenges: Approaches to World Politics for the 1990s* (Lexington, MA: Lexington Books, 1989), p. 31.

New Technological Capabilities

As described in chapter 3, major improvements continue to be made with respect to all aspects of communication networking. These advances are fostering both the supply and demand of communication systems and services. Cost reductions and improvements in performance support the extension of communication systems and services over wider geographical areas. Global demand is stimulated by the reductions in the cost of service provision, improvements in network capabilities, as well as by the development of new and more flexible communication systems and services.

One major step toward global service capacity has been the development of fiber optic technology. Most fiber optic lines in use today can handle a maximum of 32,000 long-distance calls simultaneously, or 2.5 billion bits per second. Researchers at AT&T's Bell Laboratories, however, have recently transmitted 300 billion bits of information per second down a single strand of fiber, a technology which may be commercially available in as little as two and a half years.[25] These gains in capacity have, moreover, been matched by a decline in price. At present, the price per unit of transmission for fiber optics has been dropping at a rate of 40 percent per year.[26]

Improvements in fiber optics have not only greatly reduced costs and increased capacity; they have also facilitated digital connectivity among nations. As a result, an unprecedented number of new transoceanic fiber cable projects have been undertaken in the past few years (see table 4-1).[27]

The undersea fiber-optic cable system AMERICAS-1—the first fiber-optic cable connecting Latin America, the Caribbean and the United States—is capable of handling anywhere from 80,000 to 320,000 simultaneous phone calls or the equivalent voice and data.[28] Other projects include the 12,000 kilometer Asia Pacific Cable Network to link eight countries in the Asia-Pacific region by 1996, and a 2,200-mile fiber-optic cable in the Black Sea region being built by a consortium of 30 telecommunications companies.[29]

Advances in wireless technology also hold great promise for the extension of global communications systems.[30] With wireless technology, service can be extended to countries and regions where the high costs of communication systems and/or unsuitable geographic terrain have historically stifled development. Equally important, developing countries can use wireless to "catch up" with the industrialized world. Having no sunk investment in outmoded systems, they can leapfrog directly to advanced telecommunication systems. Wireless technologies can also be used to upgrade existing wireline services.

---

[25] Leslie Cauley, "Scientists Search for More Room on Phone Lines," *The Wall Street Journal*, Sept. 28, 1994, p. B7.

[26] Michael J. Mandel, "This Investment Boom Gives the Economy Running Room," *Business Week*, July 25, 1994, pp. 68–70.

[27] As described by Davis, Dinn, and Falconer, "Due to technology, the costs of transport for transatlantic cable systems has been going down dramatically ever since TAT-1 was installed in 1958. In today's equivalent dollars, each circuit in TAT-1 cost about $6 million. In 35 years, the equivalent cost of a transatlantic cable circuit has been reduced by a factor of 1,500." See, for a history and overview, John H. Davis, Neil F. Dinn, and Warren E. Falconer, "Technologies for Global Communication," *IEEE Communications Magazine*, October 1992, p. 38.

[28] AMERICAS-1 cable system is the first fiber-optic cable connecting Latin America, the Caribbean and the U.S. and is the world's first undersea application of optical-amplifier technology. Optical amplifiers increase the number of transmitted calls by boosting digital signals as they travel along the system, rather than electronically regenerating them. See IDB Worldcom Inaugurates Americas-1 Undersea Cable System," *Telecom Highlights International*, Wednesday, September 1994, p. 5.

[29] See, "(AT&T Corp.) Phone Concern's Unit, KDD Win Asia-Pacific Cable Pact," *The Wall Street Journal*, Oct. 4, 1994, p. A 15. See also "U.S. Big 3 Join in European Fiber-Optic Deal," *Telecom Highlights International*, Aug. 10, 1994, p. 4.

[30] Radio waves are the basic unit of wireless communicate. By varying the characteristics of a radio wave—frequency, amplitude, or phase—these waves can be made to communicate information of many types, including audio, video and data. Although the term "radio" is most commonly associated with commercial radio broadcasting services, it encompasses the entire range of wireless communication technologies and services, including television, microwave, radar, shortwave radio, mobile, and satellite communication. For a discussion of new developments in wireless technologies, see U.S. Congress, Office of Technology Assessment, *Wireless Technologies and the National Information Infrastructure*, OTA-ITC-622 (Washington, DC: U.S. Government Printing Office, August 1995).

TABLE 4-1: Capacity and Cost per Voice Path of Selected TransOceanic Cable Systems, 1956–2000

	Year in service	Cable system	Cost ($US) per voice path	Capacity (voice paths)
Trans-Atlantic	1956	TAT-1*	557,000	89
	1965	TAT-4*	365,000	138
	1970	TAT-5*	49,000	1,440
	1983	TAT-7*	23,000	8,400
	1988	TAT-8	9,000	37,800
	1989	PTAT	6,000	85,000
	1991	TAT-9	5,500	75,600
	1993	TAT-10	4,000	75,600
	1994	CANTAT-3	1,000	302,000
	1996–97	TAT-12/13	1,000	600,000
Trans-Pacific	1957	Hawaii 1*	378,000	91
	1964	TPC-1*	406,000	167
	1974	Hawaii 2*	41,000	1,690
	1975	TPC-2*	73,000	1,690
	1988	TPC-3*	16,000	37,800
	1991	North Pacific	5,000	85,000
	1992	Cable	5,500	75,600
	1996	TPC-4	2,000	605,000
		TPC-5/6		
Japan/Saudi Arabia/U.K.	1997	FLAG	1,500	605,000

*No longer in service.

Notes: Costs are capital and construction costs only, stated in US$ to the nearest $500, unadjusted for inflation. Current technology permits approximately five virtual voice paths to be derived from a digital channel operating at 64,000 bits per second (64 kbit/s). Fiber optic cables are expected to have a useful life of at least 25 years. Table reports average cost per voice path for cables with multiple landing points. For example, the TAT-9 system connects the United States and Canada with the United Kingdom, France, and Spain. The average U.S.-U.K. cost per voice path is approximately $4,000. Reserve capacity of cables is generally excluded.

SOURCE: Telegeography, 1994.

Since the launching of the first communication satellite—Hughes Early Bird—in 1965, satellite technology has played an important role in the transmission of information over long distances and to remote areas. Early satellites transmitted telephone calls across the Atlantic and Pacific Oceans and were used domestically to distribute network television programs. The range of satellite services has increased with each technological improvement. Today, systems are being developed that transmit information directly to end users and that support broadband communication services such as multimedia.

Satellites have proved especially useful in providing service to areas such as Eastern Europe and the former Soviet Union, where demand is much greater than existing infrastructure can handle. In 1994, five outlying Russian cities received telecommunications service through a combination of five new regional satellite earth stations and existing analog connections. By 1996, 25 cities throughout Russia will have regional earth stations and an additional 125 locations will be reachable by very small aperture terminal (VSAT).[31]

Given the geography of the region, satellite communications is also a logical choice for Latin American countries, where they have been in use since the late 1960s. Most countries in Latin America currently use PanAmSat and several Intelsat satellites to provide international voice, data, and imaging services for business. With the launch of the second-generation Brasilsat and

[31] "Russian Provider Gets $100M Boost," *CommunicationsWeek International*, July 18, 1994, p.1.

Mexican 30-band spacecraft later this year, more than 10 satellites will be available to meet the region's telecommunication needs.[32]

Satellite technology has also allowed the newly industrialized nations of the Pacific Rim to provide communication services at a pace commensurate with the vigorous growth of their economies. International high-speed, digital, private-line service, provided through Intelsat Business Service, was introduced in 1989 to link Japan and the United States. Carriers from Hong Kong, Japan, Malaysia, and Singapore quickly followed suit. With growth rates exceeding 50 percent, however, demand soon exceeded Intelsat's capacity, and domestic and regional satellites were required to fill the gap.[33] Japan has already launched a second domestic satellite, while South Korea, Malaysia, Thailand, and the Philippines have either committed to or are planning their own systems. A second wave of operators is also emerging to provide services in Asia, which includes Thaicom, PanAmSat, Apstar, Koreasat, Rimsat and Measat.[34] As competition among carriers becomes more intense, users benefit from specialized service offerings and discounted prices.

In Europe, satellites (along with cable technology) have been used primarily to support commercial broadcasting. During the period from 1988 to 1990, the number of European satellites increased from nine to 17, while the number of satellite channels increased from 67 to 138.[35] The Europeans have been much less inclined, however, to foster satellite usage for data and voice services. Satellite services are themselves still somewhat restricted.[36] And the European Telecommunications Standards Institute (ETSI) has been accused of delaying the development of a VSAT market. In 1993, there were about 1,600 two-way interactive VSAT terminals operating in Europe, with approximately 3,000 more on order; in contrast, in the United States, more than 50,000 such dishes had been installed by Hughes Network Systems, Inc., alone.[37]

Looking farther into the future, global networks based on the development of low earth orbiting satellites (LEO) offer great promise, allowing communication services to be relayed anywhere throughout the world. Low-earth orbiting satellites fall into two categories, "little LEOs" and "big LEOs."

The term little "LEOs" refers to systems that will use multiple small satellites to provide nonvoice, data messaging to fixed and mobile terminals on a potentially global basis. Little LEOs operate in frequencies below 1 gigahertz (in the very high frequency/ultra high frequency bands). These satellites are each expected to cost between $6 million and $10 million.[38] There are at present eight companies in the United States that propose to offer little LEOs using similar system architectures. If these systems are to provide services on a global basis, some international spectrum licensing issues must be resolved.[39]

---

[32] Sylvia Ospina, "The Restructuring of a Region: Updating Latin American Communications," *Satellite Communications*, September 1994, p. 24.

[33] Ellen Hoff, "The Race is On: Asian Carriers Increasingly Must Adjust to Regional Competition," *CommunicationsWeek International*, Jan. 18, 1993.

[34] "Global Satellite Industry Alive and Well Says New Report," *Telecom Highlights International*, Sept. 7, 1994, pp. 16–17.

[35] Anton Lensen, *Concentration in the Media Industry: The European Community and Mass Media Regulation* (Washington, DC: Annenberg Washington Program, 1992), p. 8.

[36] Dawn Hayes, "Space Segment Still Out of Reach," *CommunicationsWeek International*, December 1991, p. 12; and Dawn Hayes, "Satcom Protest," *CommunicationsWeek International*, Dec. 16, 1991, p. 4.

[37] Andreas Evagora, "VSAT Advances Pitched in Europe," *CommunicationsWeek International*, Apr. 5, 1993, p. 23.

[38] For a more detailed discussion of this technology, see U.S. Congress, Office of Technology Assessment, *The 1992 World Administrative Radio Conference: Issues for U.S. Spectrum Policy—Background Paper*, OTA-BP-TCT-76 (Washington, DC: U.S. Government Printing Office, November 1991), p. 23.

[39] Ibid.

"Big LEOs" will operate in frequencies above 1 gigahertz. These systems can provide a wide range of global, or nearly global, mobile digital voice and data services. Applications include, for example, facsimile, paging, satellite-based news gathering, position location, search and rescue, disaster management, environmental monitoring, cargo tracking, and industrial monitoring and control services. Because these systems are larger and more complex than little LEOs, they are likely to be more expensive, costing on average $10 million to $20 million per satellite (see box 4-2 and box 4-3).[40]

On a more modest scale, microwave transmission can also be used to enhance global communication. Microwave has long been a mainstay in telecommunications network technology. Historically, its primary use was high-capacity, long-haul service, and it will continue to be important in such markets. Today microwave provides about one-third of all worldwide transmission capacity. Although there may be limited prospects for this technology in advanced industrial countries, where technology options abound, a growing market is predicted in developing countries where costs are high and alternatives few.[41]

One of microwave's advantages is its relatively low construction costs for rural applications compared to other technologies. Unlike terrestrial wireline technologies, it does not require replacement of physical cable plant, usually the highest component of development costs. Rooftops, hills, and mountains often provide an inexpensive base for microwave towers. Unit costs of microwave service are also falling, as more high-powered systems expand the usable spectrum. Very small capacity systems with only a handful of circuits are also now available. Recently, firms such as Alcatel and Northern Telecom have adapted microwave for use in high speed networks. One major disadvantage of microwave is that it requires line-of-sight of the transmission path. A second is that microwave is subject to electromagnetic interference.

The Role of Interconnection

Some technologies, such as satellite, are inherently global in scope, but other technologies can be used to provide global service if interconnected on a world-wide basis. Cellular radio is a particularly promising technology in this regard, given its rapid growth in markets throughout the world. According to the International Telecommunications Union (ITU), subscribership to global cellular systems grew by 47 percent in 1993, totaling 43 million. This growth rate far outpaced the 5 percent growth reported for fixed-line telephone subscriptions. The number of cellular subscribers in developing countries rose from just under 3.5 million in 1992 to over 5.3 million in 1993. This number is expected to increase to 26 million by the end of the decade.[42]

If cellular is to fully support global service, however, there will probably need to be greater consensus on international standards. Although Europe has settled on the GSM (Global System for Mobile Communication) standard, U.S. providers have been unable to agree on one of two competing standards.[43] The situation might improve in the future, however, given considerable momentum in support of the European standard. Europe will itself have a sizable market for cellular, increasing from $6.07 billion in 1991 to $14.44 in 1996. Countries outside Europe that have committed to GSM include Australia, Hong

[40] Andrease Evagora, op. cit., footnote 37.

[41] C. Bruce Page, "Microwave Vendors Gear Up for New Growth," *Re: Transmission*, Apr. 6, 1992, pp. 10–11.

[42] Newsletter of the ITU, July, 1994, pp. 21–23.

[43] The U.S. Cellular Telecommunications Industry Association originally came out in support of time division multiple access (TDMA). However, six of the Bell Regional Operating Companies have been conducting trials using code division multiple access (CDMA), a technology that was first developed in the military, but which is now being adapted for civilian use by Qualcomm Inc. See Andreas Evagora, "Common Mobile Components Sought," *CommunicationsWeek International*, Mar. 2, 1992, pp. 1, 6; Tom Crawford, "Why CDMA Should Be the Choice for Digital Cellular Carriers," *Telecommunications*, March 1993, pp. 49-51; and John Williamson, "Bids for Global Recognition in a Crowded Cellular World," *Telephony*, Apr. 6, 1992, pp. 37–40.

BOX 4-2: Big Low Earth-Orbiting Satellites (LEOS)

A new generation of mobile satellite service (MSS) systems called Big LEOS (low earth-orbiting satellites) is in development stages to provide mobile telephone service to nearly any point on earth. The proposed "Big LEO" MSS systems, though not yet in use, received international frequency allocations at the 1992 World Administrative Radio Conference. More recently, on January 31, 1995, the Federal Communications Commission (FCC) granted licenses to three of five U.S.-based applicants who sought approval to deploy MSS systems: 1) Motorola Satellite Communications, Inc.'s *Iridium;* 2) Loral/Qualcomm L.P.'s *Globalstar;* and 3) TRW, Inc.'s *Odyssey*. TRW's *Odyssey* system actually proposes to use 12 satellites in medium earth orbit or 10,354 km above the earth. Motorola's *Iridium* system proposes 66 satellites at 770 km and Loral/Qualcomm's *Globalstar* system proposes 48 satellites at 1,401 km. A fourth organization, the London-based International Maritime Satellite Organization (INMARSAT), also plans to deploy a medium earth-orbiting MSS system through a separate affiliate called ICO Global Communications, Ltd.[1] These system developers are hoping to initiate services as early as 1998 to a market that could reach 5 million to 10 million users worldwide by early in the next century.

Services

All three MSS systems licensed by the FCC in January 1995 seek to provide global, or nearly global, mobile digital voice and data services, including cellular-like telephone services and data transmission for applications such as facsimile, paging, satellite-based news gathering, position location, search and rescue, disaster management, environmental monitoring, cargo tracking and industrial monitoring and control services. Systems under development would provide service to and from mobile and hand-held terminals in addition to fixed locations. The market for such anytime anywhere services is expected to include international tourists and business travelers, emergency relief organizations and government officials. If deployed, these systems will have a relatively low incremental cost per call, and so system operators may be in a position to make a limited amount of capacity available at low prices for use in underserved regions of the world. Fixed terminals could also be deployed for shared use in developing countries where mail line telephone density is sometimes less than one for every 100 people. Handset costs are expected to range from $500 to $3,000 with service costing anywhere from $.40 to $3.00 per minute in addition to monthly service charges.

Technology

Big LEO systems operate in frequencies above 1 GHz and employ orbital locations between 500 and 1,400 km. By employing satellites in low earth orbit, these systems have the potential to alleviate the delay in conversations characterized by voice transmitted over geosynchronous satellites which are up to 60 times higher in the sky. The LEOs are also expected to be less costly to manufacture and easier to deploy.

The proposed systems differ both in the number and arrangement of satellites but employ similar strategies for call completion. All four systems use "dual mode" handsets, which facilitate transmission via both terrestrial cellular networks and the satellite constellation. A call initiated from a handset would first seek transmission over the local cellular network for connection to the wireline network. Calls originated in areas outside the reach of cellular would be transmitted up to the satellite and relayed back to a ground station from which the call would be routed over the public switched network. Motorola's *Iridium* system is unique in its plans to incorporate intra-satellite transmission links which would make possible direct transmission from one *Iridium* handset to another. Satellite-to-satellite transmission requires more sophisticated, and thus more costly, satellites than the "bent-pipe" style satellites employed by *Globalstar, Odyssey* and *Inmarsat-P.* These satellites relay traffic from ground terminals directly to the nearest gateway.

(continued)

BOX 4-2: Big Low Earth-Orbiting Satellites (LEOS (Cont'd.))

A key characteristic of all three systems licensed by the FCC is the method chosen to ensure that multiple users may simultaneously access the same satellite. TRW's *Odyssey* system and Loral Qualcomm's *Globalstar* system both use code division multiple access (CDMA) to achieve this goal. CDMA allocates each user the same band in its entirety on a continuous basis. Interference is avoided by assigning each user a unique spreading code for spreading his/her signal to fill the band. The *Iridium* system uses time division multiple access (TDMA), which allocates to each user a different *time* to transmit. Digital techniques have refined this technique so that turns can be taken so quickly that it appears to each user that he has a full-time channel. Finally, all Big LEO systems employ at least two satellite-tracking stations to monitor satellite functioning and orbital location.

[1] For a description of each of these four MSS systems, see box 4-3. The FCC did not grant licenses for the MSS systems proposed by Mobile Communications Holdings, Inc. and Constellation Communications. Two entities, Personal Communications Satellite Corporation and Celsat, Inc., have applied to construct geostationary MSS systems in the 2 GHz MSS allocations.

SOURCE: Office of Technology Assessment, 1995.

Kong, Hungary, India, Russia, Singapore, and the United Arab Emirates. Also favoring the European standard are Brazil, Columbia, Iran and New Zealand.[44]

With the evolution of more advanced terrestrial based services such as personal communication systems (PCS) and future public land mobile telecommunications systems (FPLMTS), care will be needed to assure that the interoperability problems that have been associated with GSM are not replayed.[45] Interoperability is still possible, but by no means certain.[46]

Standard setting has suffered from the slow and arduous process of consensus building, which has typically failed to keep pace with rapid advances in communication technologies. To encourage agreement, make allowances for technology change, and facilitate interoperability among an increasing number of interdependent parties, networking standards are often incorporated in elaborate reference models and defined in overly broad and generic terms.[47] Thus, even after standards have been formally set, users still have had to specify the particular uses to which these standards will be applied; vendors have to implement compatible technologies that meet standards and specifications; and products need to be certified as to their compatibility with one another.[48] The process can be so complex and time consuming that the window of opportunity

[44] Karen Lynch, "U.S. Seen Losing Cellular Advantage," *TelecommumnicationsWeek International*, Mar. 22, 1993, p. 44; See also Mark Newman, "GSM Takes on the World," *TelecommunicationsWeek International*, Oct. 2, 1994, pp. 1, 60.

[45] Still in the concept phase, future public land mobile telecommunication systems is seen by the Europeans to be the successor to GSM. As presently conceived, it would consist of a terrestrially based system (perhaps supplemented by satellite technology) using large towers located throughout a region to provide an array of voice, data, and video services to mobile users. The United States has remained somewhat skeptical of this technology, on the grounds that clear service definitions and specifications have yet to be developed. Instead, the United States has concentrated on the development of personal communication systems (PCS). OTA, *The 1992 World Administrative Conference*, op. cit., footnote 39, p. 77.

[46] Although the United States and the Europeans disagreed at the World Administrative Radio Conference (WARC)-92 about bandwidth allocation for FPLMTS, the (Federal Communications Commission) FCC has recently proposed to allocate PCS bandwidth that falls, to a considerable degree, in the same range of spectrum as that allocated at World Administrative Radio Conference (WARC) to FPLMTS. Thus, even if the U.S. and Europe pursue different technologies, a FCC decision such as this would still allow for a viable, worldwide mobile communication system. Ibid.

[47] These standards are referred to as anticipatory standards because the process of setting standards anticipates the creation of the product. For a discussion, see Carl F. Cargill, *Information Technology Standardization: Theory, Process and Organizations* (Cambridge, MA: Digital Press, 1989).

[48] Ibid.

BOX 4-3: Four Proposed "Big LEO" Satellite Systems

***Iridium:* Motorola Satellite Communications, Inc.**

The *Iridium* system plans a constellation of 66 low earth-orbit satellites (LEOS) arranged in six different planes and 15 to 20 earth-based gateways. *Iridium* is unique in its plans to employ satellite-to-satellite crosslinks at 25 Mbps which would circumvent the need to downlink voice and data to intervening hubs. The satellites will travel longitudinally, ringing the planet from pole to pole, at an altitude of 770 km. System capacity is 3,840 full duplex circuits/satellite which would support transmission rates for voice and data of 4.8 kbps and 2.4 kbps respectively. Three tracking stations will track *Iridium* satellites and monitor battery life, temperature and transponder status.

The cost to construct, launch and operate *Iridium* for one year after the launch of the first satellite is expected to be $3.759 billion. As of February 1995, investments in *Iridium* totaled $1.57 billion. Motorola, Inc., is the largest investor with 27 percent of Iridium Inc.'s stock. *Iridium's* second largest investor is a consortium of 17 Japanese companies that invested about $235 million led by DDI Corporation, Japan's second-largest telecommunications company. Other investors include: Vebacom GmbH, the German energy conglomerate Veba AG's telecommunications arm; Korea Mobile; Sprint; STET, Italy's PTT; Bell Canada; Raytheon; Lockheed; and other participants from North and South America, Europe, and Asia.

Iridium handsets are expected to cost as much as $3,000 with calls costing approximately $3 per minute. Motorola approved the project in June of 1990 and in August 1992, Iridium received an experimental license to construct and launch an initial network of five satellites. The license granted to *Iridium* on January 31, like those granted to *Globalstar* and *Odyssey,* gives Motorola the authority to construct, at its own risk, a system capable of operating in the feeder link frequency bands they requested, but not the authority to operate in those bands.[1] Satellite construction is already under way and *Iridium, Inc.* has said it intends to begin satellite launch by January, 1997. Commercial service is expected to become available in 1998.

***Globalstar:* Loral Qualcomm Satellite Services, Inc.**

The *Globalstar* system would have a network of 48 satellites equally divided into eight orbital planes that would orbit the earth at an altitude of 1,401 km. Satellites would be "bent pipe" style and possess a 1,500-mile-wide footprint to provide "global" coverage between 70 degrees latitude north and south. System capacity would be 2,800 full duplex circuits/satellite, which would support transmission rates for voice and data of between 1.2 kbps and 9.6 kbps depending upon channel conditions.

The cost to construct, launch, and operate *Globalstar* for one year is expected to be $1.554 billion. Globalstar, L.P., an international partnership founded by Loral Corp. and Qualcomm, Inc., invested $275 million in an initial financing round in March 1994. An initial public offering in February 1995 raised an additional $188 million, bringing total funds to $492 million. Investors include AirTouch Communications, Inc.; Alcatel N.V. and France Telecom of France; Vodafond plc of the United Kingdom; DACOM Corp. and Hyundai Electronics Industries Co. Ltd. of South Korea; Daimler Benz Aerospace AG of Germany; Finmeccanica of Italy; and the international Space Systems/Loral aerospace consortium.

Globalstar handsets are expected to cost $700 with calls costing approximately 40 cents per minute plus a monthly service charge of between $8 and $10. Globalstar plans to begin launching satellites in the second half of 1997 with service to begin in 1998.

(continued)

BOX 4-3: Four Proposed "Big LEO" Satellite Systems (Cont'd.)

Odyssey: **TRW, Inc. and Teleglobe**

The *Odyssey* system proposes 12 medium earth-orbit satellites, equally divided into three orbital planes at an altitude of 10,354 kilometers and 10 to 11 earth stations. Like *Globalstar* and *Inmarsat-P, Odyssey*'s satellites would be "bent-pipe" style and so would not utilize inter-satellite transmission. System capacity is 2,300 full duplex circuits/satellite which would support transmission rates of 4.8 kbps for voice and between 1.2 kps and 9.6 kbps for data. Satellite lifetime is projected at 10 years.

TRW, Inc. estimates the cost to construct, launch, and operate the system for one year at $1.8 billion. Teleglobe and TRW will provide 5 percent and 10 percent of the equity, respectively. They are seeking financing for the remaining eighty-five percent, most of which is expected to be in equity and the balance a combination of debt and vendor financing. TRW said it has sufficient current assets and operating income to finance the project and submitted a declaration from its CFO during the licensing process committing TRW to expend the funds necessary to construct, launch, and operate the *Odyssey* system.

Odyssey handsets are expected to cost less than $500 with calls costing 75 cents per minute plus a monthly service charge of $24. Satellite launch is scheduled to begin in the third quarter of 1998. TRW expects the system to become operational by the end of 1998 with six satellites giving single-satellite service to selected regions. Full constellation deployment is envisioned by the end of 1999.

Inmarsat-P: **ICO Global Communications Limited (consortium including Inmarsat and 38 Inmarsat signatories)**

Inmarsat-P, sometimes referred to as *Project-21,* would employ 10 or 12 satellites in intermediate circular orbits (10,355 km). Each satellite would have the capacity for 4,000 circuits and an expected lifetime of 10 years.

The cost to construct, launch, and operate the system for one year is expected to be $2.8 billion. About $1.4 billion in initial financing was committed by 39 signatories to Inmarsat including a commitment of $150 million by Inmarsat as an organization. The Inmarsat Council has indicated that Inmarsat and its affiliates will maintain at least 70 percent ownership. Additional pledges of $900 million were turned away and the remaining $1.4 billion will be financed through equity and debt. The U.S. investor is Comsat Corp., the U.S. government's representative in international satellite treaties. In Europe, the biggest investors are Deutsche Telekom AG's mobile-phone unit and the Swiss, Spanish and Dutch state phone companies. Other major investors are: the Beijing Maritime & Shipping Co., an arm of the Chinese Ministry of Transport; Japan's main international phone carrier, KDD, Ltd.; India's international phone company; and Singapore Telecom Pty.

Inmarsat handsets are expected to cost between $1,000 to $1,500 with calls costing $2 per minute. *Inmarsat* has started the licensing process in the United Kingdom and hopes to begin offering service in 1999 with the system fully operational by the year 2000.

---

[1] The Federal Communications Commission (FCC) *did not* award unconditional authorization to any of the three systems licensed on January 31 for specific feeder link frequencies, that is frequencies for transmission links between the satellites and gateway earth stations. Some of the feeder link frequencies are currently allocated to other services and require allocation action at an International Telecommunications Union World Radio Conference, or are being considered for uses other than satellite services domestically, in other Commission proceedings. "International Bureau Grants Three Licenses for 'Big LEO' Satellite systems." Jan. 31, 1995, FCC News Release.

SOURCE: Office of Technology Assessment, 1995.

sometimes closes and those standards are overtaken by new technologies and events (see box 4-4).

Discouraged by the lagging process, many vendors and users have begun to circumvent the traditional standards-setting process by developing standards consortia.[49] Operating in a relatively closed environment, these groups have greatly simplified the standards process. Membership is generally restricted, and fees can reach as high as $650,000 per year.[50] Given such exclusivity, consortia often replicate the dynamics of the market. Instead of consensus, they can lead to competing vendor alliances, each supporting a different standards. In such cases, consortia may serve to reduce the total number of technology alternatives, but they offer little in terms of developing open systems.

Nowhere have the benefits of interconnection been more vividly illustrated than in the case of the Internet, which, as described in chapter 3, has been growing globally and at a phenomenal rate. The Internet is a global computer network that provides technical compatibility and transparent connectivity based on a widely used suite of protocols, TCP/IP. Like the Internet itself, Internet standards evolved in a very informal way as part of the efforts of the Defense Advanced Research Projects Agency (DARPA) in 1969, with funds from both the Department of Defense and the National Science Foundation, to establish computer networks linking researchers across the country. The original participants were few, and they were bound together by a common research purpose. Thus, despite rapid network growth, the Internet standards setting body—the Internet Engineering Task Force (IETF)—has been able to hold to its tradition of openness and inclusively. Conducted for the most part online, this open process has not occurred at the expense of timeliness. Today, the Internet is the forerunner of a truly global information network with over five million host computers providing full TCP/IP connectivity to more than 90 countries around the world.

Its success notwithstanding, in terms of global connectivity, the Internet should be viewed as the exception rather than the rule. Other technologies and applications have been slow to take off on a global basis because of inconsistencies in standards and technology deployment. Thus, for example, although the demand for electronic data interchange (EDI) is rapidly growing, the international EDI market barely exists at present.[51] This delay is due in part to the fact that, while the United States has adopted the ANSI x.12 standard for EDI, most of the rest of the world is using EDIFACT.[52] In Asia, the biggest standards barrier to the use of EDI is one of language.[53]

The Need for a Consistent Technology Base

For networks to interconnect, they must also be comparable in terms of quality, and the types of service offered. Thus, one finds, for example, that the worldwide deployment of integrated services digital networks (ISDN) has suffered not only from a lack of interoperablity but also from the lack of a ubiquitous and consistent technology base. To understand the problem, one need only consider the situation in Europe where, despite a common communication policy set out

[49] Vendor consortia have been established, for example, to set standards for switched multimegabit data service (SMDA), fiber distributed data interface (FDDI) over twisted pair, asynchronous transfer mode (ATM), and frame relay technologies. For a discussion, see Martin Weiss and Carl Cargill, "Consortia in the Standards Development Process," *Journal of the American Society for Information Science*, September 1992, vol. 43, No. 8, pp. 559–565.

[50] Ibid.

[51] The European EDI service market generated $100 million in revenue in 1991, and is predicted to reach $500 million in 1996. The North American EDI market, which suffers from less fragmentation, is expected to reach $1.5 billion by 1998. See Donne Pinsky, "AT&T, BT, and IBM Connect Euro Edi," *CommunicationsWeek International*, Oct. 19, 1992, p. 48.

[52] Alice LaPlante, "Handling Standards That Aren't Standard," *Computer World*, Apr. 13, 1990, p. 80.

[53] Paul Kimberley, "EDI: Status in the Asia-Pacific Region," *Telecommunications [International Edition]*, vol. 1, n. 28, January, 1994, pp. 39–48.

BOX 4-4: Integrated Services Digital Network (ISDN)

ISDN is a public switched service that allows the digital transport of voice, data, and image communication over a single network. Although originally lauded for its ability to provide advanced services on a ubiquitous basis over the public network, its prospects seem much less promising today. After 10 years of development, ISDN has yet to be widely deployed.

ISDN's poor showing is the result, in part, of ineffective marketing, regulatory barriers, and poor pricing. However, these problems might have been more easily overcome had it not been for the problem of interoperability. Like all networking technologies, ISDN required a critical mass for the market to take off, but such a market could only develop if vendors' systems could interconnect. Given the competitive environment, however, the momentum to create the requisite standards for interconnection was lacking.

Notwithstanding years of considerable effort to develop ISDN standards, vendors continued to create products that, although they were said to conform to these standards, were incompatible. Even when AT&T, Northern Telecom Inc., and Siemens Stromberg-Carlson agreed to modify their switches to conform to a single standard, the Regional Bell Operating Companies (RBOCs) continued to deploy ISDN at varying rates. Even Bellcore's effort, ISDN1—which sought to produce a standard basic rate interface protocol—was a disappointment. Within a week of Transcontinental ISDN Project Trip 92, a major industry-sponsored event designed to demonstrate coast-to-coast interoperability, two RBOCs—Southwestern Bell and U.S. West—announced that they would not, in fact, adhere to the new standard.

SOURCE: Office of Technology Assessment, 1995.

by the European Union (EU), which calls for harmonization, ISDN deployment varies greatly. Whereas in France, deployment has reached almost 100 percent, in countries such as Greece, it is virtually nonexistent.[54] Spotty interconnection discourages usage, and hence further deployment.

Frame relay technology has experienced a similar fate. Many multinational corporations would use frame relay as a networking technology if it were available in more than a few major cities. In February 1993, Finland was the only country in Europe where a public frame relay-service was available. Although customized services are available from public network providers, the costs are prohibitive for most companies. Frame relay also suffers from interoperability problems, since unlike x.25 packet switching, frame-relay networks use different trunking protocols.[55]

Institutional Barriers to Global Deployment

Interconnection problems are not just technical in nature; more often than not they involve institutional arrangements. Institutional arrangements are critical because, if global communication systems are to be truly seamless, they require not only common standards and interfaces but also common rules of access and pricing. Achieving such commonality can be very difficult, however, given that rules of interconnection reflect both national social and economic goals as well as communication policies.

[54] As described by the European telecom manager for Westinghouse Communication Systems, "It is not always easy to match up ISDN in the United States with ISDN in Europe... And in countries where we need it most like Spain, ISDN is just not available." Cited in Terry Sweeney, "Mix and Match Networks," *CommunicationsWeek International*, Apr. 5, 1993.

[55] David Yuen and Bob Reinhold, "Frame Relay Faces National Boundary," *Network World*, Apr. 13, 1992, pp. 17–18; and Donne Pinsky, "So Close Yet So Far," *CommunicationsWeek International*, Jan. 18, 1993, p. 3.

Rules of interconnection establish the basis on which public network operators allow other providers to access the public network and determine the prices that are charged for such access. If communication systems are to be truly global, comparable rules of interconnection need to be consistently, and transparently, applied. Interconnection rules are required, moreover, not only for providers from different countries, but also for different kinds of providers within each country. For example, there need to be rules governing the relationship between public and private networks, between value-added data services and public networks, and between providers of public voice telephone services whether they are fixed or mobile.[56]

Establishing interconnection procedures was relatively easy in the past, when there were fewer types of services, and when providers were modeled after one another, assuming for the most part the form of the classic PTT. Such uniformity no longer exists today.[57] National communication systems now differ significantly, depending on the extent to which they are government owned or operated, monopoly based or liberalized, and/or regulated or not regulated.[58] At one end of the scale are countries such as the United States, New Zealand, Great Britain, Japan, Singapore, Malaysia, and Mexico, which are striving to minimize government involvement. At the other end are countries such as China, Brazil, Venezuela, and Uruguay, where the legacy of the traditional PTT is very strong.[59] Discrepancies in rules for interconnection reflect these basic organizational and, at bottom, philosophical differences.

Globalization Measured in Terms of Worldwide Trade and Provisioning of Services

Viewing global networking from the perspective of ubiquity and universality, globalization still appears a long way off, with many barriers yet to be overcome. On the other hand, if instead the term global communication is used to refer to the transcending of national boundaries, then the evidence points much further in the other direction. Moreover, there are a number of developments driving this trend toward globalization, including among them an increase in the demand for worldwide service; the growth in world-wide trade and the development of a worldwide market; the privatization and commercialization of the telecommunications sector; and the emergence of global service providers.

The Growing Demand for Worldwide Services

The provisioning of communication products and services on a world-wide basis both mirrors and serves to drive the broader trend toward the development of a global economy. This global economy is characterized by the emergence of economic actors who buy and sell their products and provide services world-wide. Equally, if not more important, they establish their base of operations on a transnational basis, allocating all their activities among a number of countries to gain the optimum advantage.[60] When not fully integrated into multinational corporations, these firms are networking their activities across global boundaries through a variety of alliances and arrangements such as cross licensing of technology, joint ventures, orderly marketing agreements, offshore production of components,

[56] Grahm Finnie, "Interconnect: New Operators Plug In," *CommunicationsWeek International*, Mar. 16, 1992, p. 18.

[57] See Mehreroo Jussawalla (ed.), *Global Communication Policies: The Challenge of Change* (Boulder, CO: Westview Press, 1992), p. 4.

[58] Colin D. Long, "Interconnection in Europe: The Legal and Regulatory Dimension," *Telecommunications Policy*, July 1991, pp. 95–98.

[59] Stephen McClelland, "The International Dimension: PTTs," *Telecommunications Policy*, June 1992, pp. 31–37.

[60] Thus depending on the particular case, it might be best for a firm to disperse many of its production facilities—such as design modification, fabrication and assembly—to foreign countries, and to focus its own domestic production on the fabrication of key components. Or, alternatively, a firm might decide to manufacture a product domestically, but transfer abroad such downstream activities as distribution, sales, marketing, and service. See Michael Porter (ed.), *Competition in Global Industries* (Boston, MA: Harvard Business School Press, 1986).

secondary sourcing, and crosscutting equity ownership.[61]

As companies spread their corporate boundaries, they must have access to advanced telecommunication products and services that can span the globe. Transnational corporations, for example, must operate on a real time basis in response to their rapidly changing environment. Moreover, they must be able to balance their global operations with the requirements of local markets—such as the need to establish special marketing channels, service contracts, and work relationships. To function as a single unit, they must be able to apply information and knowledge to an ever growing number of complex business problems, as well as to share and leverage these resources both within and across organizational and national boundaries. For these purposes, seamless worldwide networking technologies, which can support applications such as electronic data interchange, computer integrated manufacturing, databases for information management, videoconferencing as well as other kinds of groupware, will be critical.

In developing such global strategies, businesses have benefited from major reductions in the cost of buying international communication services. In 1970, for example, a firm had to pay approximately $8,000 to $9,000 per month to lease a single voice-grade channel. Today, it is possible to lease a 64kbps line, which provides eight times the transmission capacity for approximately $6,000 per month. Declining prices stem not only from technology advances such as fiber optics; equally, if not more, important has been the growth of international competition. With the pressures toward liberalization and the privatization of many telecommunication regimes (as described below), this competition will become even more intense in the future, continuing to force prices down and demand up.[62]

Increased competition and growth in worldwide demand is also due to the emergence of new suppliers and the development of new kinds of products and services that are based on the convergence of communication technologies. Included among these, for example, are systems integration; 24-hour commodity trading, payments, and settlements; credit authorization; and computerized reservation systems.[63] Greater competition and many more such services can be expected in the future, because the barriers to entry are relatively low. Often, all that is required is software and a computer-network link.

Consider, for instance, telecommunication discount companies, such as International Discount Telecommunications (IDT). Capitalizing on the gap between U.S. telecommunication prices and prices in other, less deregulated, countries, IDT uses computerized switches in the United States to reroute calls from foreign subscribers. These companies undercut their competitors' rates by as much as one-third.[64] Similarly, the small but rapidly growing telecommunication services company Viatel sells software-based value-added services to small and

---

[61] See Peter Cowhey and John Aronson, *Managing the World Economy: The Consequences of Corporate Alliances* (New York, NY: Council on Foreign Relations, 1993); See also, David Lei and John W. Slocum, Jr., "Global Strategy, Competence Building and Strategic Alliances," *California Management Review,* fall, 1922, pp. 81–97. Once generally associated with U.S. industries, multinationals are, themselves, increasingly becoming global in nature. For example, globally networked Japanese and European firms, while differing somewhat in style from U.S. firms, have significantly grown in number in the course of the past decade. See Bruce Kogut, Weijian Shan, and Gordon Waler, "Knowledge in the Network and the Network as Knowledge," in Gernot Grabher, *The Embedded Firm: On the Socioeconomics of Industrial Networks* (London, UK: Routeledge, 1993), p. 90.

[62] Karen Lynch, "Global Services Showdown: Communications and Computer Companies Jockey to Redefine Themselves as International Service Providers," *CommunicationsWeek International*, May 11, 1992, p. 22.

[63] Bruno Lanvin, "Information Technology and International Trade," in Bruno Lanvin (ed.), *Trading in a New World Order: The Impact of Telecommunications and Data Services on International Trade in Services* (Boulder, CO: Westview Press, 1992, p. 4; see also Office of Technology Assessment, *U.S. Telecommunication Services in European Markets* (Washington, DC: U.S. Government Printing Office, August 1993).

[64] Meheroo Jussawalla, "Introduction," in Meheroo Jussawalla (ed.) footnote 57, op. cit., p. 4.

medium-sized businesses in Latin America and Western Europe.[65]

The demand for global networking services has also been spurred on by the growing complexity of the worldwide marketplace. Given a multitude of available services and service providers, divergent standards and levels of technology deployment, as well as differing national languages, rules, and regulations, many businesses are finding that it is more cost-effective to "outsource" the management of their international networks on a contract basis.[66] Thus, for example, J.P. Morgan & Co. has contracted with BT North America to handle all of its overseas, terminal-to-host networks, at a cost of $20 million. Similarly, BT North America has contracted with Gillette Co. to manage its telecommunications operations in 180 countries. AT&T also provides virtual private network services on a global basis. For example, AT&T is currently providing the network linkages for GE in 16 different countries.[67]

The Growth in Worldwide Trade

The growth in worldwide trade in telecommunications and information-based networking services attests to the demand for more versatile products and seamless worldwide services.[68] Communications is, today, one of the fastest growing sectors in the international market, with expansion over the past decade outstripping growth in GNP.[69] In 1990, the market for international calls totaled $50 billion.[70] In 1990, the world market in telecommunication equipment and services was estimated at $370 billion, growing to $400 billion in 1991 and 1992, despite the world recession. Estimated annual growth rates in the telecommunications market ranged between 10 to 15 percent.[71]

Spending on information technologies has remained closely aligned with spending on communication technologies—a fact that bears witness to the growing convergence of these technologies. Excluding telecommunication hardware and services as well as information services, world-wide spending on information technology totaled $305 billion in 1990. Growth in this sector was approximately 12 percent between 1989 and 1990, with software contributing the greatest proportion with a growth rate of 17 percent.[72]

Globalization is also evidenced by the growing percentage of national revenue that is derived from international offerings. According to one account, for example, 16.3 percent of worldwide value-added services revenue stemmed from international offerings in 1990. Estimates are that this figure will increase to 28 percent by 1996.[73]

This international growth potential is especially important for countries such as the United States, where the domestic market for many products and services is rapidly becoming saturated (see tables 4-2 and 4-3). The European market for value-added services, for example, is

---

[65] See, "Soros Makes Investment in Viatel," *Telecom Highlights International*, vol. 15, No. 41, Oct. 13, 1993, p. 5.

[66] Rita Das, Kenneth E. Ferrere, and Douglas P. Macbeth, "Global Networks—The Easy Way," *AT&T Technology: Products, Systems and Services*, No. 4, 1993, p. 10.

[67] Ibid.

[68] OTA, U.S. *Telecommunication Services in European Markets*, op. cit., footnote 65.

[69] "Telecommunications Is the Measure of Economic Growth," *Telecommunications Highlights International*, vol. 15, No. 49, Oct. 6, 1992, p. 2.

[70] Gary C. Staple (ed.), *Telegeography 1992: Global Telecommunications Traffic Statistics and Commentary* (Washington, DC: International Institute of Communications, 1992).

[71] An FCC report, *Preliminary 1993 Section 43.61 International Telecommunication Data*, reported that U.S. customers spent about $12.0 billion for international services in 1993, an increase over the previous year of $1.2 billion. In 1993, U.S. customers made a total number of calls equaling 1.9 billion, while those received were 1.2 billion. According to the FCC report, U.S. carriers supplied 14,172 private line circuits between the United States and international points in 1993. See, "FCC Released International Traffic Data," *Telecom Highlights International*, Oct. 12, 1994, p. 8.

[72] *Information Technology Outlook 1992* (Paris, France: OECD, 1992), pp. 6–7.

[73] Karen Lynch, "Global Service Showdown: Communications and Computer Companies Jockey To Redefine Themselves as International Service Providers," *CommunicationsWeek International*, May 11, 1992, p. 22.

Rank	Company	International communications revenue ($m 1993)	Total revenue ($m 1993)	Income before taxes ($m 1993)	Employees (1993)	Employment change (1992–93)	Outgoing MITT (m 1993)[1]	State ownership
1	AT&T (U.S)	8,976[Y]	39,863[2]	6,204	308,700[3]	-1%	7,235[T]	0%
2	DBP Telekom (Germany)	5,534[Y]	35,679	1,934	231,000	0%	4,880[T]	100%
3	Cable & Wireless (U.K.)	3,425	7,058	1,634	41,348	+4%	NA	0%
4	France Telecom (France)	3,364	22,426	3,527	154,548	-1%	2,751	100%
5	BT (U.K.)	2,944	20,540	4,140	156,000	-9%	2,301	0%
6	MCI (U.S.)	2,772[Y]	11,921	1,045	36,235	+17%	2,839 [T]	0%
7	KDD (Japan)	2,159	2,159	299	5,772	-2%	952 [T]	0%
8	Telmex (Mexico)	1,557	7,898	3,301	48,771	0%	625 [T]	0%
9	Stentor (Canada)[4]	1,525	10,852	NA	88,500	-9%	1,669	3%
10	PTT Telecom (Netherlands)	1,464[Y]	6,370	1,441	34,359	-2%	1,236	100%
11	Telstra (Australia)	1,190[Y]	9,089	1,719	65,200	-5%	640[T]	100%
12	Sprint (U.S.)	1,188Y	11,368	776	50,000	0%	1,181	0%
13	Swiss PTT (Switzerland)	1,184Y	6,392	519	20,521	-2%	1,572	100%
14	Telefonica (Spain)	1,043	9,587	844	74,340	0%	802	32%
15	Teleglobe (Canada)	975	1,110	89	2,128	+2%	808	0%
16	Singapore Telecom (Singapore)	968	1,975	937	10,937	+1%	480	89%
17	Iritel (Italy)5	935	1,436	NA	NA	NA	1,190	100%
18	Embratel (Brazil)	899	4,736	388	12,083	+2%	164	100%
19	DGT (Taiwan)	824	4,496	799	NA	NA	441T	100%
20	Telia (Sweden)	705	4,541	508	34,090	-18%	685	100%

(continued)

TABLE 4-2: Top 25 International Telecommunications Carriers (Cont'd.)

21	OPT (Austria)6	688Y	4,824	250	55,194	0%	767	100%
22	VSNL (India)	665	665	81	NA	NA	284T	85%
23	Belgacom (Belgium)	641	3,207	353	25,643	-6%	979	100%
24	Bezeq (Israel)	623	1,769	172	9,878	-1%	176T	76%
25	Korea Telecom (South Korea)	598Y	6,205	1,095	NA	NA	265T	98%

Notes: Figures for 1993 fiscal year. Figures for Japanese, U.K., Australian carriers aare for year ended 31 March 1994. Figures for KDD are for year ended 31 March 1993. Figures converted to U.S. dollars at 1993 average exchange rates. Domestic operators excluded from ranking. NA=not available.

[Y] Yankee Group estimates.

[T] Estimates by TeleGeography Inc., Washington.

[1] Minutes of international telecommunications traffic.

[2] Excludes product revenues.

[3] T&T employee figures include equipment manufacturing.

[4] International services to U.S. only.

[5] International services to European countries.

[6] OPT Austria figures include postal and bus services.

SOURCE: The Yankee Group Europe, Watford, England.

TABLE 4-3: Top 15 Communications Equipment Manufacturers

Rank 93	Rank 92	Company	Communications equipment revenue ($m 1993)[1]	Total revenue ($m 1993)	Change in total revenue (1992–93)	Income before taxes ($m 1993)	Change in income (1992–93)	Employees (1993)	Total revenue per employee	Main communications products
1	1	Alcatel Alsthom (France)	14,544	27,605	-3.3%	1,582	-7.4%	196,500	140,485	Public, private network systems
2	2	Siemens (Germany)	11,986	49,385	+4.0%	1,761	-8.9%	391,000	126,304	Public, private network systems
3	3	AT&T (U.S.)	11,783	67,156	+3.5%	6,202	+4.1%	308,700	217,545	Public, private network systems
4	4	Motorola (U.S.)	10,105	16,963	+28%	1,525	+91%	120,000	141,358	Mobile, data communications products
5	7	NEC (Japan)	8,714	32,192	+1.8%	226	NR	147,910	217,648	Public, private network systems
6	5	Northern Telecom (Canada)	7,861	8,148	-3.1%	(1,070)	NR	60,293	135,140	Public, private network systems
7	6	Ericsson (Sweden)	7,703	8,088	+34%	399	+150%	69,597	116,215	Public, mobile network system
8	8	IBM (U.S.)	5,300	62,716	-2.8%	8,797	NR	256,207	244,786	Computer networking products & systems
9	9	Fujitsu (Japan)	4,388	28,231	-9.3%	236	NR	163,990	1172,153	Publiic, private network systems
10	10	Bosch Group (Germany)	2,655	19,655	-5.6%	433	-42%	156,615	125,501	Public, private network systems
11	17	Nokia (Finland)	2,161	4,418	+30%	1,146	NR	25,800	1160,785	Mobile, public network system
12	18	Matsushita Electric (Japan)	2,046	59,565	-6.1%	1,153	-21%	254,059	234,452	Private network equipment
13	11	GEC (U.K.)[2]	1,917	14,571	+3.1%	1,301	+0.1%	86,121	169,191	Public, private network systems
14	13	Philips (Netherlands)	1,831	31,672	+0.5%	822	NR	238,500	132,798	Mobile, public network systems
15	26	Samsung Electronics (South Korea)	1,788	10,159	+34%	262	+122%	44,733	227,119	Public, private network systems

Notes: Figures are for 1993 fiscal year. Figures for Japanese and U.K. companies are for year ended 31 March 1994. All figures converted to U.S. dollars at 1993 average exchange rates.
[1]Communications equipment revenue estimates by Sirius.
[2]GPT revenue included in GEC figures, not Siemens.

SOURCE: CommunicationsWeek International; Sirius, Montpellier, France.

projected to grow much faster than the U.S. market.[74] Moreover, the export of services to Europe is expected to foster the sale of U.S. telecommunications equipment and strengthen the competitiveness of the U.S. services industries—such as airlines, hotels, and banks.[75]

Third World markets are also very promising, because penetration levels are so low, and many of these countries are now opening their markets to foreign competition. For example, with a penetration rate of 0.98, and a population totaling more than one billion, China provides a major opportunity for U.S. equipment suppliers. In the case of Latin America, the potential for American companies is equally great. In Mexico alone, the market for wireline equipment now exceeds $2 billion annually.[76] As developing countries press to modernize their networks, the market for advanced technologies will also experience considerable growth. In 1992, more than $4.6 billion was spent on digital switching in the developing countries, and it is estimated that the market will total more than $7 billion by the turn of the century.[77]

The Convergence of Prices and Product Offerings

The development of a global market depends not only on a greater exchange of communication and information-related products and services across national boundaries. For a unified market to exist, there must also be widespread access to market information and a convergence of prices and product offerings. The expansion of trade—such as we are witnessing today in telecommunications—will help to drive this convergence. For, as markets become more global, so will competition and the availability of market-related information. At the same time, however, to the extent that price differentials are artificially maintained, the cost and complexity of doing business will be increased—and global trade will be inhibited, and global trading patterns distorted, as a result.

Telecommunications pricing is reflected in public tariffs, which lay out all of the telecommunication options, together with price and conditions of service.[78] These tariffs have always been subject to political as well as economic factors, because governments have traditionally been the providers of services, for the most part. Thus, rates have been set not only to reflect costs but also to promote universal services through cross subsidization or—as is happening in many developing countries today—to generate revenues for unrelated government operations. Not surprisingly, under these circumstances, prices and services have varied significantly from country to country.[79]

Significant price distortions were tenable in a national regulatory environment, in which most of the trade that took place was internal to the firm. Some services could be used to subsidize others, so long as costs were covered overall. When transactions occurred across national boundaries, as in the case of international telephone calls, pricing arrangements were negotiated through the appropriate state authorities.

In today's global economy, such pricing strategies will have much greater consequences, serving to inhibit and distort international trade. Without standardized services and a relatively common scheme of pricing, businesses will find it extremely difficult to manage global networks.

---

[74] OTA, *Telecommunication Services in European Markets,* op. cit., footnote 65.

[75] Ibid.

[76] Ibid.

[77] Robin Bromby, "Digital Switching Markets in Developing Countries Report," *Telecommunications (International Edition)*, Vol-27, October 1993, pp. 16–18.

[78] A tariff describes the services available, the conditions under which they will be provided, the cost structure, and the price of service. For a discussion of tariffing and the general factors on which it is based, see Phyllis Bernt and Martin Weiss, *International Telecommunications* (Carmel, IN: Sams Publishing, 1993), pp. 37–53.

[79] Ibid. See also Robin Mansell, "Tariffs: Who Should Pay for the Telecommunication Network?" *Telecommunications*, July 1993, pp. 41–45.

Special efforts will be required to identify and negotiate the appropriate services and terms. Where there are major price and service disparities, traffic will likely be routed in round about ways through countries such as the United Kingdom or Singapore.[80] In other cases, however, the search costs entailed in setting up a network may simply be so high as to outweigh any benefits from their use.[81]

The impact pricing disparities can have on trade is particularly apparent when reconciling international accounts. International calls entail the use of facilities in two countries, so revenues and costs must be shared between them. To settle accounts, providers in the countries where a call originates pays facility owners in the countries where it is completed a sum based on a bilaterally negotiated "accounting rate" (the agreed upon cost of the call) and "settlement rate" (the agreed upon percentage split of the revenues, which customarily is 50 percent).

If there is a large gap in the prices charged in each country, problems are likely to arise, as is the case in the United States today. When possible, users initiate calls in the United States because the rates, which are subject to competitive pressures, are lowest there. This is not necessarily beneficial, however. Because American providers initiate more calls than they receive, they must pay out an excess of funds, which take the form of a trade deficit.[82] Moreover, because international accounting rates do not match true costs, American service providers may not cover their total costs. In fact, depending on the accounting and settlement rates, they may actually subsidize a foreign vendor's service.[83]

Nonetheless, the pressures for liberalization continue to swell. These include, for example, the incorporation of telecommunication services within the framework of the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA); competition from multinational providers and advances in networking technology that permit bypass of the public switched network; the European Community Open Network Directive; as well as the persistent demand of large, multinational business users (see box 4-5).[84] Given these forces for change, it is not surprising that, even in the case of such traditional state-oriented stalwarts as Ireland, Spain, Portugal, and Italy, steps are being taken to move towards more international cost-based tariffs.[85]

Privatization and the Shift of Networking Activities to the Marketplace

Globalization is also being furthered through the movement to privatize the provisioning of communication products and services.[86] This trend towards privatization reflects the growing economic value of communication and information in society. Although communication has always served a critical function, its economic value looms even larger today in a global knowledge-based society. To capitalize on this development, PTTs throughout the world are selling off either all or part of their telecommunications facilities to global private sector providers and investors, with expertise and capital to spare. According to

[80] Singapore is now connected to three international cable systems and plans to be a partner in six by 1996. See "Singapore Telcom Announces SEA-ME-WE Inauguration," *Telecommunication Highlights International*, Nov. 2, 1994, p. 3.

[81] Bernt and Weiss, op. cit., footnote 80.

[82] Mansell, op. cit., footnote 81, p. 41.

[83] Bernt and Weiss, op. cit., footnote 80, pp. 83–97.

[84] Ibid. See also "Study Says EC Firms Favor Opening Telecommunications," *Telecom Highlight International*, Sept. 29, 1993, vol. 15, No. 39, p. 7.

[85] "The Countries of Europe React to Spur of Global Competition," *INTUG News*, October 1993, p. 4.

[86] See, for a general discussion, G. John Ikenberry, "The International Spread of Privatization Policies: Inducement, Learning and 'Policy Bandwagoning,'" in Ezra N. Suleiman and John Waterbury, *The Political Economy of Public Sector Reform and Privatization* (Boulder, CO: Westview Press, 1990), pp. 99–106. For a discussion of privatization in telecom, see Bjorn Wellenius and Peter A. Stern (eds.), *Implementing Reforms in the Telecommunications Sector: Lessons From Experience* (Washington, DC: World Bank, 1994).

BOX 4-5: Telecommunications and Trade

The Uruguay Round of the General Agreement on Tariffs and Trade (GATT) was the first in the GATT's 50 year history to cover trade and investment in the service sector. The General Agreement on Trade in Services (GATS) contains three interrelated sections. The first establishes the rights of users and service providers in foreign countries in such areas as most-favored-nation treatment (nondiscrimination among foreign service providers), national treatment (equal treatment for domestic and foreign service providers), transparency (publicly available information), market access, and the free flow of transfers and payments.[1] The second section provides a timetable by which each country commits to applying the specified rules. The final section sets forth guidelines for continued negotiations in telecommunications, financial services, air transport, and labor mobility.

The telecommunications component of the GATS—the telecommunications annex—covers only "enhanced" or "value-added" services (i.e., services in which signals require some form of manipulation). Examples of such services include electronic data interchange, electronic mail, credit-card verification and database access. The annex ensures that national telecommunications regulations be transparent and that foreign firms and individuals have access to basic telecommunication services as well as intracorporate communications across national borders. The annex also includes a commitment by developing nations to raise the percentage of telecommunications equipment on which tariffs would not be raised above a certain bound rate.[2]

The United States sought unsuccessfully to include the provision of basic long-distance and local telecommunications services within the scope of the telecommunications annex. The practice of subsidizing local telephone service with higher rates on long-distance service was also left unaddressed by the annex. However, the signatories did agree in April 1994 to initiate a Negotiating Group on Basic Telecommunications to pursue further market liberalization through voluntary negotiations to be completed by April 1996. Negotiators from 24 nations and a representative from the European Union met four times in 1994 to discuss differences among national regulatory regimes and strategies for greater market liberalization. The group has since grown to include India, which privatized its basic and cellular telephone services at the end of 1994, and an additional 31 nations that are participating as observers.[3] The group will continue to meet every other month during 1995 to explore possible bilateral agreements, and a full plenary session was scheduled for July 10, 1995.[4]

The provisions for telecommunications trade liberalization in the North American Free Trade Agreement (NAFTA) mirror very closely those achieved in the Uruguay Round of the GATT. The greatest market-opening achieved by NAFTA is the Mexican market for enhanced services previously off limits to companies with majority foreign ownership. The Mexican long distance market will become open to private investment in 1997 creating further opportunities for U.S. companies.

(continued)

BOX 4-5: Telecommunications and Trade (Cont'd.)

The first World Telecommunications Development Conference (in Buenos Aires, Argentina, in March 1994) and the vision of a "Global Information Infrastructure" (GII) articulated by Vice President Al Gore, have further energized the drive toward telecom deregulation and market liberalization. Vice President Gore outlined the five principles guiding the U.S. plan for the National Information Infrastructure (NII)—private investment, competition, flexible regulatory framework, open access and universal service—and suggested that they be incorporated into the Buenos Aires Action Plan, the blueprint for the next four years of telecommunications development. The same five principles plus a sixth regarding diversity of content including cultural and linguistic diversity were endorsed by representatives of the 34 democracies in the Western Hemisphere at the recently completed Summit of the Americas. The GII was also a topic for discussion at the Asia Pacific Economic Cooperation forum in November 1994, and the Republic of Korea is considering a Ministerial Meeting on telecommunications for 1995. Finally, members of the Group of 7 Industrialized Nations held a Ministerial Conference on the Global Information Society in February of 1995 to discuss further market opening.[5]

[1] See M. Angeles Villarreal, "*Telecommunications Services: Provisions in the Uruguay Round and in NAFTA*," Congressional Research Service, Aug. 11, 1994.

[2] The percentage of telecommunications equipment covered by bound tariffs increased from 35 to 95 percent. U.S. Department of Commerce.

[3] Nations participating as observers include: Brazil, Indonesia, Singapore, Venezuela and South Africa. "WTO Telecom Talks Pick Up Momentum," *Telcom Highlights International*, Mar. 15, 1995, p. 4.

[4] Ibid.

[5] Raphael Cung and Susan Gates, "Secretary Brown Leads Mission to Asia, Represents U.S. at APEC Meetings," *Business America*, November, 1994, pp. 6–9.

SOURCE: Office of Technology Assessment, 1995.

one estimate, 45 percent of the world's access lines are privately managed today.[87]

In Europe, privatization aims to enhance the competitiveness of national telecommunication providers.[88] One by one, European governments are recognizing that state owned PTTs will be greatly disadvantaged in an intensely competitive and rapidly expanding global market. In fact, they may be unable to join the fray, without the freedom and flexibility required to enter new markets and establish new alliances.[89] Most striking in this regard is, perhaps, the recent conversion of the French and German governments. Long a proponent of centralized state control, the French government decided to transform France Telecom into a joint stock company with the state retaining monopoly control. Similarly, the German parliament has agreed to a plan for privatizing Deutsche Telekom.[90]

Similar motives are driving privatization in Asia—at least among the most economically advanced countries—with Japan, Australia and New Zealand leading the way. Change is also taking place in the less well-off regions of Southeast Asia. Singapore Telecom, for example, has established a joint public-private telecom venture, which many view as a first step toward total

[87] See, "What Are the Implications for Your Business in the Global Telecom Revolution?" *Management Accounting*, June 1992, p. 46; See also Stephen McClelland, "The International Dimensions: PTTs," op. cit., footnote 22, June 1992, p. 31.

[88] In its green paper on telecommunications, the Commission of the European Community called for a competitive community-wide telecommunications market by 1998.

[89] As described by McClelland, "Internationalization has become the order of the day, with a first strike at someone else's territory as the preferred method of defense." op. cit., footnote 87, p. 31.

[90] "The Countries of Europe React to Spur of Global Competition," *INTUG News*, October 1993, p. 305; and "Deutsche Telkom Plan Approved," *Telecom Highlights International*, July 7, 1993, vol. 15, p. 27.

privatization.[91] Indonesia already has such a corporate arrangement. In Malaysia, the PTT is privatized, with its stock now floated in the marketplace.[92]

Fully aware of the growing importance of communication for economic growth, many developing countries hope privatization will facilitate access to the foreign capital and expertise needed to develop their national communication infrastructures. In Latin America, Mexico serves as a model of industry restructuring, having privatized its state PTT, TELEMEX, with record speed.[93] The government plans to sell its remaining stake in TELMEX for approximately $600 million. Foreign capital has also been invested in Telefonos de Venezuela and Telefonica de Argentina.

Similar modernization strategies are being pursued in other parts of the world. India, for example, is developing a plan to open up its telecommunication sector to private investment, as are countries in Eastern Europe.[94] Even China, which has long opposed foreign investment, is now considering foreign bids to support its goal of providing 40 million new lines by the year 2000. Such privatization strategies have also gotten a boost from the World Bank, which has made financial aid for infrastructure development contingent on competitive reforms.[95]

Investors to fund such national privatization efforts have not been hard to find. To the contrary, global telecommunication investors view emerging economies as a bargain, if not a potential gold mine.[96] Purchasing prices and interest rates are low, and the cost of the technology is declining. At the same time, dividends are rising and the annual per-share earning growth rates of telecom range between 15 to 20 percent.[97] Investors also benefit from preferred access to a new and rapidly expanding market sector.[98] Regulatory restrictions in the United States provide the Bell Operating Companies with an additional incentive for foreign investment, and indeed they have been among the most active in this regard.[99]

Privatization efforts are not limited to nation states. There is a move underway to privatize Inmarsat, an international treaty organization established in 1979 to provide communication services to ships—especially those from poor countries. As Inmarsat has expanded into more and more lucrative activities, the pressure has grown to transform it into a private sector organization. Thus, a proposal has been made to allow its members to trade their holdings. The stakes are considerable. Providing services such as portable satellite communication for emergency services, the media, and the airlines, Inmarsat has grown at an annual rate of 20 percent over the

---

[91] "Singapore Starts Telecom Sell-off," *Telecom Highlights International*, vol. 15, No. 34, Aug. 25, 1993, p. 5.

[92] "World Bank Paper Urges Telecom Liberalization," *Telecom Highlights International*, vol. 16, No. 8, Feb. 23, 1994; and "More Notes on the S.E. Asia Market Potential," *Telecom Highlights International*, Mar. 16, 1994, vol. 16, No. 11, p. 3. Taking advantage of Western capital and expertise, Malaysia aims to increase phone subscribers from 2.3 million today to 7.8 million by the year 2000.

[93] Restructuring usually takes place by selling companies privately. In some cases, however, they are first sold to a consortium, the stock of which is later sold publicly. Sometimes the U.S. portion of the consortium and the stock are later sold to institutional investors. See Margaret Price and Marlene Givant Star, "Privatization Brings Global Opportunities," *Pensions and Investments*, July 26, 1993, p. 3. For a comparison of the approaches being followed in Latin America, see Randa Zadra, "The Telecommunication Revolution in Latin America," *Telecommunications*, July 1993, pp. 33–36.

[94] For example, Matav, the state telephone company of Hungary, recently sold 30 percent of its holding to an American-German consortium made up of Ameritec Corporation and Deutsche Bundespost Telekom, for $850 million. This deal is the largest to date in Eastern Europe. The consortium will have exclusive rights to provide local service in 29 out of 56 regions for the next eight years. See "Western Ventures Helping Eastern Europe," *Telecom Highlights International*, vol. 16, No. 2, Jan. 12, 1994, p. 1.

[95] "World Bank Sets Telecom Aid Rules," *Telecom Highlights International*, vol. 16, No. 11, Mar. 16, 1994, p. 4.

[96] Ibid.

[97] Patricia Kranz and William Glasgall, "Bells Are Ringing All Over the World," *Business Week*, December 27, 1993, pp. 96–97.

[98] Margaret Price and Marlene Givan Star, op. cit., footnote 95, p. 3.

[99] OTA, *Telecommunication Services*, op. cit., footnote 65.

past decade and now has accumulated assets totaling $400 million.[100] Not surprisingly, its competitors—including among them state-owned, nonprofit organizations and private sector companies—want to limit its activities. They argue that Inmarsat has an unfair advantage, given its intergovernmental treaty status.[101]

Worldwide Provisioning of Services

Global providers of telecommunication and information-based products and services are emerging to meet worldwide demand. Less hampered by domestic constraints, a rash of telecommunication providers has appeared on the global scene.[102] To stake out new markets, share the high risks and costs of technology development, and better provision their services on a worldwide basis, these carriers are aggressively setting up global partnerships, consortia, and joint ventures.[103]

However, despite the rapid growth in worldwide demand and the present high rates of investment, many suspect that—over the long term—there will not be sufficient money or markets to go around.[104] Estimates are, for example, that when the inevitable shake out occurs, only five to seven global conglomerates can survive.[105] So the time is short, and the competition for partners fierce. As aptly described by one participant observer, "We're at the stage of [the game of] Monopoly where you buy everything that is available. The next stage is to form consortia with other players as the initial opportunities become limited. The last phase, yet to come, could be some form of cash-flow race for the finishing line."[106]

The top contenders are focusing on the lucrative "outsourcing" market. They are striving to be the major provider of seamless global communication to the world's largest 500 multinationals. This market is estimated at $10 billion, and rapidly growing.[107]

AT&T, for example, has established WorldPartners, a one-stop-shopping consortium and joint venture, in conjunction with Japan's largest international provider, KDD, and Singapore Telecom. The WorldPartners Association also includes members of Unisource, the network services company formed by PTT Telecom Netherlands, Spain's Telefonica, Sweden's Telia, and Swiss Telecom PTT. Unisource has most recently been exploring an equity partnership with AT&T to cement their global services agreement.[108]

Soon after the announcement of WorldPartners, British Telecommunications (BT) and MCI struck a $4.3 billion deal, which has received the approval of both the U.S. Justice Department and the European Commission. The partnership calls for both a new outsourcing venture to provide global voice and data services, and for BT's purchase of a 20 percent stake in MCI. BT will own 75 percent of the joint venture, NewCo., with MCI holding the remaining share. The Norwegian, Dutch, and Finish phone companies have also joined the BT-MCI alliance.[109]

Alarmed at the prospect of competition from global outsourcers, France Telecom and Deutsche Telekom have also established a joint venture called Eunetcom. This group has had some difficulty getting off the ground, and especially in finding partners.[110] Its first choice, MCI,

[100] "Notes on the Possible Privatization of Inmarsat," *Telecom Highlights International*, Dec. 8, 1993, vol. 15, No. 49, p. 15.
[101] Ibid.
[102] Peter Heywood, "Fresh Air for Cross Border Networking," *Data Communications International*, April 1993, p. 93.
[103] Klaus Grewlich, "Agenda for the 1990s," in Meheroo Jussawalla (ed.), op. cit., footnote 62, pp. 233–234.
[104] Paul Strauss, "The Struggle for Global Networks," *Datamation*, Sept. 15, 1993, vol. 39, No. 8, p. 26.
[105] Stephen McClelland, "Global Chess," *Telecommunications International*, vol. 27, No. 7, July 1993.
[106] Richard House, "A Global Mating Game," *Institutional Investor*, September 1993, pp. 65.
[107] "Global Telephone Networks Expand," *Corporate Growth Report*, June 14, 1993, p. 6685.
[108] Peter Olsthoorn and Jennifer L. Schenker, *CommunicationsWeek International*, Sept. 12, 1994, p. 2.
[109] Richard L. Hudson and Charles Goldsmith, "Phone-Industry Alliances in Europe Face Tough Scrutiny, Regulator Warns," *The Wall Street Journal*, Sept. 20, 1994, p. A7C.
[110] Jonathan Levine, "A Counter Coup in Telecom," *Business Week*, Nov. 15, 1993, pp. 51–52.

defected to establish a joint venture with British Telecom, and it is awaiting approval of an alliance with U.S. long-distance carrier Sprint.[111]

NETWORKING PROSPECTS IN THE THIRD WORLD

The forces for globalization are, today, converging in the Third World. How this trend will affect the prospects for networking in developing countries is difficult to predict. The outcome will depend not only on the rate of technology diffusion, the quality and sophistication of the network, and network architecture. Equally important will be the financial and human resources available in Third World countries, the functioning of their markets, the quality of their legal and regulatory frameworks, as well as their levels of government competence.

Third World Networks: An Overview

There is a tremendous gap between the developed countries and the Third World in terms of the number, variety, and quality of communication and information networking technologies. In the average U.S. home, for example, there is likely to be at least one, if not two or more, telephones, televisions, as well as subscriptions to cable services. And, an ever growing number of American families now have computers that can be linked up to access global information services. In stark contrast, more than half of the population of the developing world has never made a simple phone call. In some regions, such as Rwanda and Niger, there is only one main telephone line per 1,000 persons.[112]

Even more alarming, the gap between the telecommunications "haves" and "have nots" shows little signs of receding. In the 10 years since the Maitland Commission issued its report *The Missing Link*—which first noted the telecommunications gap and called on developed countries to take steps to reduce it—very little progress has been made.[113] There are today 50 countries, which together comprise more than half of the world's population, that still have under one main telephone line for every 100 persons. Given their present rates of technology deployment, many of these countries will fail to reach this level of teledensity by the year 2000.[114]

One factor accounting for this disparity in network diffusion has been insufficient investment. Investment is especially important in highly capital intensive sectors such as telecommunications. Although developing countries have increased the amount that they invest annually—from $3 billion in the 1970s to $12 billion in the late 1980s—they have been unable to keep up with the unmet demand for telephone services. (in 1988 U.S. dollars.)[115] To achieve such a goal, estimates are that Third World countries must invest approximately $25 billion on an annual basis throughout the 1990s.[116] The pay-off for such investments will likely be high in terms of both financial returns and network diffusion. As is depicted in figure 4-1, countries that reinvested a higher proportion of their telecommunications revenues (with the exception of SubSahara Africa) experienced the most rapid rates of network growth. Financial returns are similarly high. According to the World Bank, the economic return on World Bank supported telecommunications projects averages 19 percent (see table 4-4).

Inadequate investment in network infrastructure can be explained in part by the paucity of financial and technical resources to be found in

---

111 Hudson and Goldsmith, op. cit., footnote 111.

112 All told there are 23 countries that have five or fewer lines per 1000 persons. See *World Development Report 94*, op. cit., footnote 4. p, 224.

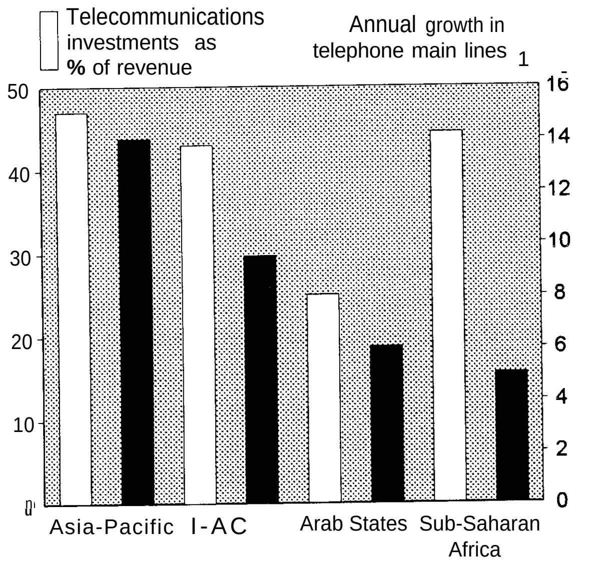
113 ITU, *World Telecommunications Development Report:World Telecommunication Indicators* (Geneva, Switzerland, 1994), p. 73.

114 Ibid.

115 Robert J. Saunders, Jeremy J. Warford, and Bjjorn Wellenius, *Telecommunications and Economic Development* (Baltimore, MD; Johns Hopkins University Press, 1994), p.74.

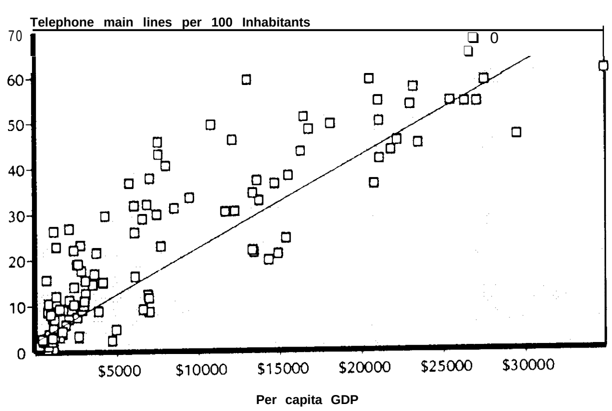
116 ITU, *World Telecommunication Development Report,* op. cit., footnote 115.

FIGURE 4-1: Telecommunications Investment and Growth in Main Lines



SOURCE: ITU, World Telecommunications Development Report, 1994.

FIGURE 4-2: National Wealth and Telephone Density



SOURCE: ITU, UN, World Bank, OECD

TABLE 4-4: Average Percentage Rates of Return on World Bank-Supported Projects, 1974–1992

sector	1974-82	1983-92
Irrigation and drainage	17	13
Telecommunications	20	19
Transport	18	21
Airports	17	13
Highways	20	29
Ports	19	20
Railways	16	12
Power	12	11
Urban development	..	23
Water and sanitation	7	9
Water supply[a]	12	8
Infrastructure projects	18	16
All Bank operations	17	15

.. Not available.

[a] Rates are financial, not economic, rates of return.

SOURCE: World Bank data.

the Third World. The relationships between teledensity and financial resources (as measured by GDP) is depicted in figure 4-2.

Constrained by the need to restructure their economies and pay off their foreign debts, many Third World countries have lacked the funds to invest in infrastructure development. Foreign exchange for advanced telecommunication equipment has been especially in short supply.[117] While domestic currency can be used to finance the technology for the local portion of a telecommunication network, more sophisticated technology —which can only be purchased in the global market—will be required for the major backbone portions of Third World networks. The foreign exchange problem is particularly acute for countries-such as many of those in Africa—that have no indigenous telecommunications sec-

[117] As noted by the ITU ;'The terms of trade for developing countries deteriorated during the 1980s so that many countries are now spending an increasing amount of their foreign exchange earnings on debt servicing. Total external debt as a percentage of exports rose from 125 percent in 1980 to 177 percent in 1991 for low- and middle-income countries. Some developing countries are also faced with ongoing currency devaluations which make imports more expensive.” Ibid., p. 88.

tor and/or that have major outstanding foreign debts.[118]

In some countries, government-owned PTTs have consciously made telecommunication investment a second order priority. Instead of reinvesting their operational surplus, telephone administrations siphon it off for other government purposes. In Syria, for example, the government imposed an 80 percent tax on the state owned telephone company from 1985 to 1991.[119] Such practices may diminish in the future, given greater appreciation of the economic benefits associated with network deployment. Already, by 1990, 40 Third World countries had either begun or were preparing to revamp their telecommunication administrations so as to achieve greater network modernization.[120]

In the poorest areas, resources for network deployment are also limited by the lack of a sizable middle class with disposable income to buy the services and equipment required to effectively drive sales and investment. Even when demand is high—as is often the case in urban areas—it may be dampened by artificially high prices, which are based on tariff structures designed not only to cover costs but also to generate general revenues.[121]

Uneven network deployment occurs not only between countries but also within the developing countries themselves. As depicted in table 4-5, when Third World countries have had resources for investment, they generally use them to build up telephone infrastructure in large cities instead of rural areas. Of course, this focus makes sense, because cities are home to most businesses, middle class consumers, and politically active citizens alike.[122]

The prospects for the poorest countries and poorest regions within countries thus seem bleak, even given major technology advances. Consider, for instance, the case of low earth orbiting satellites (LEOs), which have been touted for their promise for developing countries. Although LEOs can greatly extend the geographic scope of communications, they will not necessarily improve access. Given the high costs of developing these systems, services will likely be prohibitively expensive for many, at least in the near term.[123] For example, even when mass produced, Motorola's Iridium phone will cost an estimated $1,500. At this price, a person living in the Central African Republic, earning on average $376 per year, would have to work four years to buy a telephone. With service estimated to cost about $3.00 per minute, he or she would have to work 17 hours to pay for a one-minute phone call.[124]

A lack of education and technical expertise will also make it difficult for developing countries to take advantage of many new technologies. For example, although the Internet provides developing countries with an inexpensive way of gaining access to networking services such as e-mail and remote file transfer, its usage requires a level of technical understanding and comfort not likely to be found in poorer areas. Not surprisingly, therefore, Internet growth has been the strongest in countries such as India and Malaysia where a "computer culture" already exists.[125] In contrast, growth has been slowest in the Middle East, where communication is restricted and information is generally thought of as a source of

---

[118] See chap. 2, for a general discussion of the debt problem.

[119] ITU, op. cit., footnote 115, p. 119; see also Norm Wingrove, "Telecommunications Spur Technology Advance in Vietnam and Other 'Little Dragons,'" *Research Technology Management*, January/February 1994, p. 2.

[120] Saunders, Warford, and Bjorn Wellenius, op.cit., footnote 115. p. 19.

[121] As described by the ITU, "Telephone subscription charges as a percentage of average per capita income are over 5 in many developing countries; in the low-income countries they are often over 10. In contrast, in most developed countries, subscription charges amount to less than 1 percent of per capita income. op. cit., footnote 115, p. 77.

[122] Ibid.

[123] See Joseph Pelton, "Will Smart Sat Markets Be Large?" *Satellite Communications*, February 1993, pp. 39–42. See also, Richard L. Hudson, "Inmarsat Begins Fund-Raising Drive for $2.6 Billion Satellite Phone System," *The Wall Street Journal*, Sept. 12, 1994, p. B8.

[124] OTA, *The 1992 World Administrative Conference*, op. cit., footnote 39, p. 124.

TABLE 4-5: Number of Main Telephone Lines Per 100 Persons in Selected Countries as of January 1, 1988

Region and country	National	Main cities[a]	Other areas
Industrial countries			
Austria	38.38	54.20	31.32
Canada	44.49	59.20	43.45
Denmark	55.13	59.58	52.36
France	44.68	47.98	29.27
Germany[b]	39.27	50.20	35.98
Italy	33.28	41.48	30.65
Japan	40.81	56.13	37.48
Norway	46.41	55.81	41.89
Spain	26.18	31.84	21.02
Switzerland	52.87	65.54	46.73
Developing Countries			
Africa			
Algeria	2.70	7.13	1.58
Ethiopia	.24	3.39	.04
Kenya	.66	4.95	.19
Malawi	.28	2.20	.07
Morocco	1.14	3.17	.42
Sudan	.24	1.32	.04
Togo	.28	1.27	.00
Tunisia	3.01	7.00	.79
Zambia	.73	1.36	.17
Zimbabwe	1.45	6.39	.41
Asia			
Iran	3.15	6.31	1.10
Malaysia	7.21	22.65	5.17
Pakistan	.61	2.69	.19
Papua New Guinea	.91	5.91	.22
Sri Lanka	.54	1.12	.29
Thailand	1.67	6.94	.45
Turkey	7.01	7.46	6.56
Latin America			
Brazil	5.59	10.17	4.14
Colombia	7.20	13.26	1.83
Costa Rica	8.62	15.28	2.57
Ecuador	4.41	8.27	1.91
Peru	2.30	4.90	.52
Uruguay	10.61	16.05	5.24
Venezuela	9.19	16.20	5.08

[a] Defined by the national administration; population thresholds, and consequently the number of cities included, vary widely among countries

[b] Estimated from combined Federal Republic of Germany (January 1987) and German Democratic Republic (January 1988) data.

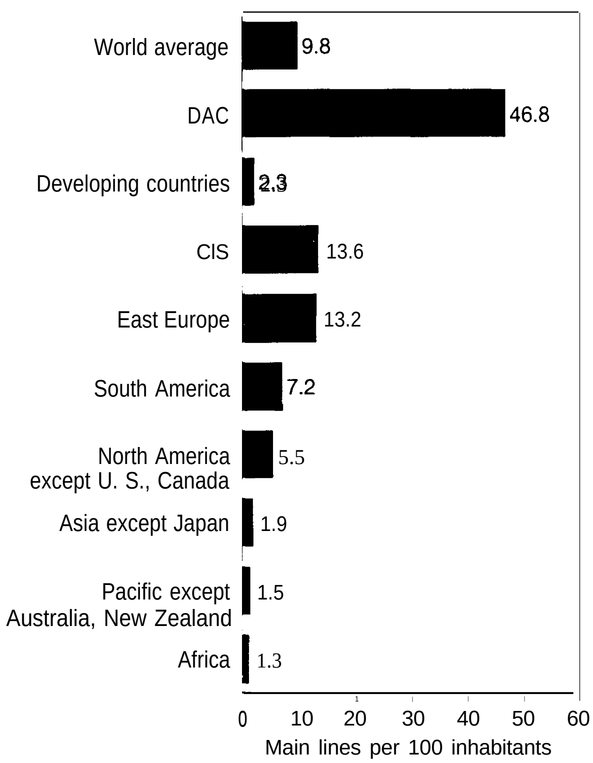
SOURCE: World Bank

power. In 1994, Muslim countries accounted for a mere 42 of the 15,000 nets on the global Internet; and as many as 29 of these nodes were located in Tunisia. [126]

As in the case of all networking technologies, the acceleration of network deployment in the Third World requires a critical mass of users. Based on experiences in other countries, this "take-off" stage will occur when teledensity approximates 10 to 20 percent. As can be seen in figure 4-3, many regions in the world have far to go before they reach this point. Thus, if countries are to have access to even the most basic form of communication services, a greater priority must be given to infrastructure investment. According to the ITU, developing countries must invest at least 3.5 percent of their gross domestic investment.

Even after a critical mass has been achieved, significant national disparities in technology deployment will likely persist due to the rapid pace of technology change, the money required for investment, as well as major national discrepancies standards of living and the ability of countries to generate both the capital and the human resources required to develop and deploy advanced communication/information systems. Even as some countries race to keep up, others are deploying yet more advanced technology. [127] For example, it is estimated that it will cost $120 billion between now and early 2005 just to upgrade the Central and Eastern European communication networks. During the same period, the European Community will spend approximately $18.6 billion per year to develop a broadband telecommunication infrastructure. 128

FIGURE 4-3: Teledensity by Region



KEY: DAC=Development America Assistance Committee of the OECD; CIS=Commonwealth of Independent States

SOURCE: NTT America.

Alternative Sources of Funding

Third World countries must provide the bulk of investment required to develop their own communication and information infrastructures. However, in many cases, access to additional funding may be critical to success. Given the growing number of lucrative businesses opportunities to be found in the developing world, foreign investment can be expected to provide most of this funding. Such investment has already reached an all time high, last year tripling the amount received from governments as foreign assistance. [129]

126 Ibid.

127 As noted by the ITU, "The majority of telecommunications capital spending is in developed countries. Of the $125 billion spent on telecommunications in 1992, 80 percent was in high-income economies. Of that figure, over 60 percent was in just three countries: Germany, Japan, and the United States, ITU, op. cit., footnote 115, p. 87.

128 Jennifer L Schenker, "No Turning Back," *CommunicationsWeek International*, Sept. 26, 1994, p. 12-15.

129 According to the World Bank, private investment increased 50 percent in 1993, and another 9 percent the following year to total $179.9 billion in 1994. In contrast, governmental aid remained unchanged during this period, totaling $54.5 billion in 1994. See "Private Investment to Poor Nations Hits a Record High at World Bank," The *Washington Post*, Jan. 23, 1995, p. A14.

Despite the growth of private financial flows to developing countries, foreign assistance can still play a critical role. Circumventing the poorest countries, most private funding has been channeled to those Third World countries that are already experiencing rapid growth. Foreign assistance, if targeted carefully, can be used to leverage this private investment and to fill in the funding gaps.[130]

The Growth in, and Distribution of, Private Foreign Investments

Private capital flows to the Third World totaled $165.6 in 1992, an increase of $32 billion—or 23 percent—from the previous year.[131] This strong growth in private financial flows is being driven by high competitive rates of return, growing confidence in Third World political and economic stability, as well as by the developing countries' concerted efforts to reform their economies and open them up to trade and foreign investment. Two types of investment merit special attention—equity and foreign direct investment. A fair portion of these funds will find their way into the telecommunication and information technology and services sectors.

Equity investments

Equity investments can provide an increasingly important source of funding for telecommunication infrastructure, given many developing countries' efforts to upgrade, and revitalize, their stock exchanges. Third World stock markets already constitute approximately 7 percent of world market capitalization and 10 percent of the total value of the worldwide stock market.[132] As developing countries take further steps to privatize portions of their national telephone administrations, their telecom stock issues are becoming more and more prevalent.[133] These telecom stocks are generally rated very highly, especially in the fastest growing regions such as Asia's Pacific Rim.[134]

Equity investments, however, are far from being equally distributed throughout the developing world. The countries that are the most developed are the ones to be targeted for this kind of investment, with the poorest countries receiving but an insignificant amount (see table 4-6).[135] This distribution pattern reflects the tendency of equity markets to develop after countries have adopted market oriented reforms, and when they can boast of reasonable levels of political stability. Poorer countries have also been more reluctant than those with dynamic economies to encourage this type of investment. Not having a strong indigenous economy of their own, they are more vulnerable to the potential instability of foreign equity investment. These countries are concerned, moreover, lest foreign investors come to dominate key sectors such as telecommunications.[136]

Foreign direct investment (FDI)

The trend towards privatization in the developing countries has also opened the door to greater

[130] The Revival of Private Flows to Developing Countries," *Financial Market Trends,* Oct. 9, 1993, pp. 21–40.

[131] Ibid.

[132] Peter Cornelium, "The Internationalization of Emerging Stock Markets," *Intereconomics,* May/June 1994, pp. 131–138.

[133] Dean Lewis points out five different ways of privatizing: 1) negotiated sale of 100 percent of the company to a single buyer; 2) sale of a minority stake to a single buyer or group of buyers; 3) public offerings in the domestic market or international markets or both; 4) sale of a minority stake to a single purchaser combined with a public offering; and 5) break up and sale of components. As he notes, "How the enterprise is sold will be determined largely by the government's objectives for the privatization program and by the commercial and policy constraints surrounding the transaction." Dean Lewis, "Options for Selling a Telecommunications Company," in Bjorn Wellenius and Peter A. Stern, *Implementing Reforms in the Telecommunications Sector: Lessons From Experience* (Washington, DC: World Bank, 1994), chap. 28, p. 431.

[134] See "Asian Telecoms Ringing Off the Hook," *Barron's,* Oct. 12, 1993, p. 50; see also Lilia Clemente, *Columbia Journal of World Business,* vol. 29, summer 1994, pp. 92–121.

[135] As described by Clemente, "In 1993... new purchases of foreign equities reached $170 billion. The most common destination was Europe, largely from other European markets, but almost $40 billion flowed into Latin America and Asia's Pacific Rim. U.S. investors accounted for 40 percent of the flows into the Asia/Pacific region and 75 percent into Latin America." Clemente, op. cit., footnote 136, p. 94.

[136] Cornelium, op. cit., footnote 132.

TABLE 4-6: Emerging Stock Markets—Overview

	Market Capitalization (US$ millions)		Value Traded (US$ millions)	Number of Domestic Companies at end	Market Concentration[1]
	1983	1992	1992	1992	
Africa					-
Cote d'Ivoire	248	331	4	24,000	-
Egypt[2]	1,106	2,594	293	656	-
Kenya	-	607	12	57	-
Mauritius	-	377	10	22	-
Morocco	253	1,876	70	62	-
Nigeria	2,970	1,243	23	153	53.6
Tunisia	-	46	2	17	-
Zimbabwe	265	628	20	62	47.7
Asia					
Bangladesh	48	315	11	145	-
China	-	18,314	13,363	53	-
India[3]	7,178	65,119	20,597	6,700	32.2
Indonesia	101	12,038	3,903	155	61.4
Korea	4,387	107,448	116,101	688	22.4
Malaysia	22,798	94,004	21,730	366	14.0
Pakistan	1,126	8,028	980	628	19.1
Philippines	1,389	13,794	3,104	170	30.6
Sri Lanka	-	1,439	114	190	-
Taiwan	7,599	101,124	240,667	256	15.4
Thailand	1,488	58,259	72,060	305	36.3
Europe					
Greece	964	9,489	1,605	129	50.4
Portugal	84	9,213	3,455	191	22.1
Turkey	968	9,931	8,191	145	11.4
Middle East					
Iran	-	1,157	225	118	-
Jordan	2,713	3,365	1,317	103	31.6

(continued)

TABLE 4-6: Emerging Stock Markets—Overview (Cont'd.)

Western Hemisphere					
Argentina	1,386	18,633	15,679	175	72.5
Barbados	-	258	2	15	-
Brazil[4]	15,102	45,261	20,525	565	51.2
Chile	2,599	29,644	2,029	245	57.9
Colombia	857	5,681	554	80	62.9
Costa Rica	118	477	11	93	-
Jamaica	113	3,227	386	48	-
Mexico	3,004	139,061	44,582	195	39.4
Peru	546	2,630	398	287	-
Trinidad & Tobago	1,011	514	22	27	-
Uruguay	9	368	9	26	-
Venezuela	2,792	7,600	2,631	66	80.0
Total	83,222	774,093	594,685	13,217	-

[1]Share of value traded held by ten most active stocks.
[2]Cairo.
[3]Bombay.
[4]Sao Paulo.

SOURCE: International Finance Corporation: Emerging Stock Markets Factbook 1993, Washington, DC, 1993.

(FDI), which—despite the global economic recession—has continued to grow at an amazingly rapid pace.[137] Between 1991 and 1993, FDI to the developing countries increased by 100 percent—from $40 billion to $80 billion—constituting more than one-half of all private flows to the Third World.[138]

FDI in the telecommunications sector has been particularly popular, generally taking the form of either joint ventures or corporatization and sale of a major or controlling equity stake in the telecom provider.[139] These kinds of arrangements offer a number of advantages to developing and developed countries alike.

Developing countries can benefit in a number of ways from the foreign purchase of either all, or a portion of, their telecommunication operations.[140] Such arrangements allow these countries to reduce their foreign debt while upgrading their national infrastructure.[141] At the same time, they can gain greater access to advanced technology, the markets in developed countries, as well as hard currency.[142] FDI are also more secure than other types of foreign investment, being less volatile and subject to interest rate fluctuations.

[137] UNCTAD, *World Investment Report: Transnational Corporations, Employment, and the Workplace* (New York, NY: The United Nations, 1994), p. xix; See also, David D. Hale, "Stock Market: New World" *Columbia Journal of World Business*, vol. 29, summer 1994, pp. 14–28.

[138] Ibid.

[139] Robert R. Bruce, Jeffery P. Cunard, and Lothar A. Kneifel, "Exploring New Ways To Attract Capital for Privatization," in Wellenius and Stern, op. cit., footnote 135, pp. 463–469.

[140] For a discussion of the arguments for and against, see T.H. Chowdary, "Telecommunications Restructuring in Development Countries," *Telecommunications Policy,* September/October. 1982, pp. 591–611.

[141] Often, investors are obligated to expend a considerable amount of money to extend and upgrade service in exchange for control over the enterprise and certain guaranteed exclusive rights. See Aileen A. Pisciotta, "Telecommunications Reforms: Options, Models, and Global Challenges," *IEEE Communications Magazine*, November 1994, p. 29.

[142] Clive Crook, "Third World Finance: New Ways to Grow," *The Economist*, Sept. 25, 1993.

FDI agreements can, moreover, be customized to meet a developing country's specific needs and concerns.[143]

For investors and businesses in developed countries, there are likewise gains to be made. Above all, these partnering arrangements allow foreign vendors to obtain a foothold—and often a major competitive advantage—in some of the most profitable and rapidly growing telecommunications markets. Given the tremendous backlog of demand in developing countries, these investments can be made with minimal risk. By accelerating technology deployment in the Third World, FDI in telecommunications also paves the way for related service industries—such as banking, insurance, and tourism—as well as for multinational corporations, which depend on networking technologies for their survival and growth. In the long run, investments linked to telecom privatization may also enhance the overall economic climate in developing countries in favor of open markets and greater economic reforms.

As in the case of the global equity market, foreign direct investment is somewhat skewed in its distribution. Faced in the 1980s with enormous debt problems, the countries of Latin America were among the first to privatize their telecom operators to attract foreign investment.[144] More recently, many other developing countries are following suit. Today, there are ongoing privatization efforts in the Philippines, Malaysia, Indonesia, and Thailand, to name a few. Countries in sub-Sahara Africa, however, have been noticeably absent from these developments (see box 4-6).

Foreign Assistance for Telecommunications

Aid for telecommunication infrastructure development in the Third World is available from a variety of sources. Because networking is characterized by positive economic externalities, these sources of support will likely be mutually reinforcing. To make the most of this, this aid should be nonduplicative and well coordinated.

Multilateral assistance

Multilateral aid for telecommunications accounted for approximately 3 percent of all global telecommunications investment in 1992.[145] For countries that have very limited foreign exchange and minimal foreign investment, this aid constitutes a primary source of infrastructure investment.[146] In 1992, for example, total capital spending on telecommunications in all of Africa was less than that provided by multilateral lenders.

Telecommunications-related foreign assistance is not a priority for most multinational development banks, accounting for 6 percent of their loans in 1992.[147] This limited funding appears, moreover, to lack a basic, or shared, rationale. As a result, there are few agreed upon measures with which to evaluate its impact, or to justify its future support. Not suprisingly, therefore, the uses of telecom related aid programs has fluctuated up and down, varying considerably by donor, agency and region.

---

[143] Flexibility and appropriate timing are critical for success. As pointed out by Smith and Stable, "A large body of international experience with the divestiture of state-owned telecommunications operators indicates the importance of several common procedural and substantive issues. These include the need to state clearly the objectives for divestiture at the outset; allow sufficient time to prepare a carrier for sale, typically two to three years; and secure the legal conditions for sale, which usually involve adopting a legislative reform package and organizing a regulator independent of the incumbent operator. Experience also suggests that the success of a divestiture will be decisively affected by the economic incentive reflected in the price-control rule and the network performance targets, both quantitative (e.g., in the number and location of access lines to be added) and qualitative (e.g., in the number of permissible faults and response to outages)." Peter L. Smith and Gregory C. Staple, "Telecommunications Sector Reform," *IEEE Communications Magazine*, November 1994, p. 51. See also Robert R. Bruce, Jeffrey P. Cunnard, and Lothar A. Kneifel, "Exploring New Ways To Attract Capital for Privatization," in Wellenius and Stern, op. cit., footnote 135, chap. 28, pp. 463–469.

[144] See Stephen J. Dalla Betta, "Telecom Privatization in Latin America," *Telecommunications*, March 1994, pp. 61–64; see also Randy Zadra, "The Telecommunication Revolution in Latin America," *Telecommunications*, July 1993, pp. 33–36.

[145] ITU, op. cit., footnote 115, p. 90.

[146] Ibid.

[147] Ibid.

BOX 4-6: The Africa ONE Project

The African continent is home to 12 percent of the world's population but has only 2 percent of the world's main telephone lines. As of 1993, Africa's measure of teledensity—the number of main telephone lines per 100 people—was 1.6. The comparable teledensity figures for the Americas, Europe and Oceania are 27, 31 and 38 respectively.

A number of African network operators, notably the Pan-African Telecommunications Network (PANAFTEL) and the Regional African Satellite Communications System (RASCOM), are using satellite, radio and other technologies to expand the reach of communications throughout the African continent. But the task of improving telecommunications availability in Africa and connecting the continent more fully to global communications networks remains enormous. Recognizing the magnitude of the challenge and the importance of telecommunications to Africa's social and economic development, the International Telecommunications Union approached AT&T Submarine Systems, Inc. (AT&T SSI) in October 1993 with the challenge of devising a regional telecommunications system that would contribute to the above stated goals.

The result is the Africa ONE Project—a proposed 35,000 kilometer undersea fiber optic ring around the continent with landing points in 41 African countries and in Saudi Arabia and Italy. The cable would utilize the latest optical amplifier technology to provide maximum flexibility and capacity for growth and be capable of transmitting data at the rate of 2.5 billion bits per second. A planned three tier approach would, first, concentrate on linking Africa's populous coastal centers via the undersea cable. Second, inland areas would be interconnected with Africa ONE by satellite or some other means. Finally, Africa ONE would be integrated into existing undersea fiber optic networks and likely spur new transoceanic cables to South America and Australia.

A Regional Authority comprised of representatives from participating National Telecommunications Authorities, RASCOM, international telecommunication carriers and other network investors will govern the operation of Africa ONE. Investment in the expected $1.9 billion network is open to anyone and the Regional Authority that owns and manages the network will operate on a for-profit basis. AT&T SSI, the world leader in the installation of undersea fiber optic cables, hopes that financing for Africa ONE will be in place by the end of 1995 and that the cable will be completed by the end of 1999.

SOURCE: Testimony of William B. Carter, President of AT&T Submarine Systems, Inc. AT&T Corporation before the U.S. House of Representatives Committee on International Relations Subcommittee on Africa and Subcommittee on International Economic Policy and Trade, "Joint Hearing on Trade and Investment in Africa," Mar. 8, 1995. And "AT&T Has Plans for Africa," *Telcom Highlights International*, Apr. 12, 1995, p. 5.

In 1992, the European Investment Bank (EIB) was the largest contributor to such programs, providing close to $3 billion. The bulk of this funding, however, remained in Europe where it was used to help European operators finance overseas operations and acquisitions.[148] Nonetheless, on balance, the EIB provided more telecommunication funding to non-European countries—especially those in Central and Eastern Europe—than most other development agencies (see table 4-7).

The InterAmerican Development Bank ranked at the opposite extreme. Throughout the entire period between 1983 and 1992, the number of telecom-related loans distributed by the IDB totaled 3. In 1992, the IDB provided virtually no telecommunication funding.[149]

[148] Ibid.
[149] Ibid.

TABLE 4-7: Telecommunication Loan Approvals

Lender	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AsDB	0	72.6	69.0	0	0	135.0	125.4	160.9	0	185.5
AfDB	44.4	28.9	50.9	9.1	0	0	0	73.9	10.5	60.2
IDB	0	25.9	0	0	0	0	0	300.0	0	0
IBRD	32.0	150.0	67.0	50.4	682.3	36.0	161.0	616.7	349.8	430.0
EIB	22.3	0	21.4	22.6	13.9	3.8	54.4	101.8	86.8	219.2
EBRD	—	—	—	—	—	—	—	—	210.9	321.8
Total	98.7	277.4	208.3	82.1	696.2	174.8	340.8	1253.3	658.0	1216.7

Note: Not including telecommunication loans by EIB to Western Europe.

Key: AsDB: African Development Bank; AfDB: Asian Development Bank; IDB: Inter-American Development Bank; IBRD: International Bank for Reconstruction and Development—The World Bank; EIB: European Investment Bank; EBRD: European Bank for Reconstruction and Development.

SOURCE: ITU/DDT Telecommunication Project Database.

Bilateral governmental assistance

Bilateral assistance for telecommunications is similarly diverse in terms of its amount, location, and rationale. The Japanese, for example, provide more telecommunication funding than some multilateral lenders. Most of this funding, which is often bound by trade contingencies, is targeted for countries in Asia. In contrast, the Swedish International Development Authority—in keeping with its long tradition of providing aid for basic needs—has been a major supporter of telecommunications for economic development. Thus, in the decade between 1982 and 1983, Sweden provided approximately $70 million to sub-Sahara Africa, an amount equal to one-third of that provided by the African Development Bank during the same period.[150]

Other sources of telecommunication support

A number of regional and international agencies, which provide social and economic services, have developed networks as part of their operations. The United Nations Development Program, for example, is linked up to nodes in over 100 nations.[151] Similarly, the World Health Organization and the UN Disaster Relief Organization have developed their own specialized networks to support their ongoing activities. In addition, the Organization of American States (OAS) sponsors a number of low-budget projects that aim to foster networking in Latin America. International nonprofit organizations, such as ECOnet, have likewise contributed to the development of global networking.

U.S. Aid for Telecommunications

Finding precise figures for U.S. expenditures on telecommunication-related aid projects is very difficult (see appendix B for an overview). Funding is generally dispersed through different agencies, geographic bureaus, and applied aid projects—such as energy or health care—where the telecommunication component may be hidden.[152] Moreover, because the rationale for funding varies according to the goals of specific projects, it is difficult to generalize from one project, or region, to the next.

Funding by region runs almost in parallel with that of the multilateral banks. Over the last few

[150] Ibid., p. 91.
[151] *Communication of the ACM*, August 1994, op. cit., footnote 28.
[152] Ibid.

years, the Eastern European bureau within the U.S. Agency for International Development (USAID) has spent approximately $2 million per year on telecommunication related projects.[153] On the other hand, USAID does not formally designate any telecommunication related aid for Latin American.

United States telecom-related aid projects also reflect the general shift in the direction of U.S. aid policy, which occurred in the mid-1980s, from a "basic needs approach" to one focusing on structural economic adjustments.[154] As can be seen in box 4-7, of the six telecom projects being sponsored by USAID in Eastern Europe and the Newly Independent States, only one involves technology deployment. Five programs aim to promote and facilitate structural changes in the telecommunication regulatory environment, while the remaining program is designed to help defray the high cost to U.S. companies of developing telecommunications projects in this area. The State Department's telecommunications program similarly focuses on structural telecommunication reforms.

Implications for Developing Country Networking

Communication and information technologies can have far-reaching consequences. They not only affect relationships of time and space; they also help to structure social and economic organization, as well as values.[155] If information networking technologies are to serve Third World development needs, they must be made available in a timely fashion; equally important, however, they must be deployed in a manner that is consistent with economic development goals.

In a networked-based global economy, communication needs are relative, and timing is everything. Where networks are involved, "first movers" generally have a major advantage, and technology laggards are often left behind. It is, in fact, precisely for this reason that those developing countries aspiring to use information technology to "leap frog" beyond the industrial era to prominence in the information age are in a heated race with one another to deploy networking technologies.

Patterns of network diffusion are likewise critical. If diffusion is uneven, and network quality unequal, networking technologies will likely serve to reinforce, instead of diminish, social and economic disparities within and among countries throughout the world. In places where network modernization trails too far behind, community residents will be unable to link up to critical communication facilities such as educational and healthcare centers or networked business enterprises. To interconnect efficiently, communication networks must be comparable.

Network architecture must also be supportive of economic development goals and strategies. Technology choices and the way in which they are arranged, distributed, and interconnected will determine who is able to communicate, under what conditions, and how effectively. Thus, for example, if future development strategies place greater priority on promoting productivity in agriculture—as is the case today in China—networks must be designed to ensure rural access.

In the past, governments played a key role in shaping their national infrastructures to serve economic and political goals. In a highly competitive, global economy, this option is no longer tenable. As described above, national telecommunication rules and regulations are easily bypassed. And in many cases, developing countries are rapidly dismantling them, in an effort to compete for global business.

In a global economy, which is highly dependent on networking, multinational businesses will necessarily be the major drivers of technology. As already noted, these businesses and financial interests are competing intensely with one another to finance and build facilities in the most lucrative, developing country markets. In this open, market-driven environment, technology diffusion can be expected to follow the same

[153] More precise figures were unavailable.
[154] See chap. 2 for detailed description of this shift in aid policy.
[155] See chap. 3 for a discussion of the relationship between communication technology and social and economic outcomes.

BOX 4-7: U.S. Agency for International Development (USAID) Telecommunications Projects in Central and Eastern Europe and the Newly Independent States

USAID telecommunications-related assistance to countries in Central and Eastern Europe and the Newly Independent States (NIS) has averaged approximately $2 million per year in recent years. Some of the programs described below were conducted in conjunction with the U.S. Department of State. Program descriptions adapted from USAID documents are provided below.

Newly Independent States Regional, FY 1993–1994

State Department/cip Telecom Assistance Program—Program organized telecommunications seminars on basic telecommunications legislation, tariff regime, mobile communications, packet switching, and regulatory issues.

Central and Eastern Europe Regional, FY 1992–1995

Joint State/aid Telecommunications Policy, Law, and Regulations Program—Program organized seminars on telecommunications regulations and spectrum management. Also provided funding through the U.S. Trade and Development Agency for major policy/legal framework studies in Hungary.

Capital Development Initiative Telecom—Through an intensive program of policy interventions, this program aims at fostering the development of telecommunications infrastructure in Central and Eastern European countries through creation of a business environment conducive to private investment in telecommunications and promotion of U.S. private investment in developmental telecommunications projects.

Central and Eastern Europe Regional, FY 1993–1994

Development Cost Support Grants—Program awarded grants competitively to U.S. companies to help defray on a cost sharing basis the high expenses of telecommunications project development in Central and Eastern Europe.

Rural Telephone Cooperative Development—Program supports the U.S. National Telephone Cooperative Association (NTCA) rural telephone development activities in Poland under grants from USAID. Two telephone cooperatives assisted by NTCA are in operation. NTCA contributed significantly to the acceptance of private ownership of telephone operations in Poland.

Grant For U.S. Telecommunications Training Institute, Telecommunications Training Program—Grant brought dozens of telecommunications managers to the United States for telecommunications training donated by U.S. telecommunications companies through the U.S. Telecommunications Training Institute.

SOURCE: Information provided by U.S. Agency for International Development, January 1995.

hierarchical pattern that characterized the evolution of communication networking in the past.

THE NEED FOR TELECOMMUNICATION-RELATED AID POLICIES THAT SUPPORT U.S. TRADE GOALS

The shift toward a liberalized, global communication environment affords a number of opportunities for the United States. The prospects for increased trade in equipment and services are particularly great, given technology convergence and the development of a wide array of new products and services, the growth in worldwide demand, the provisions for telecom services within the GATT, and the liberalization and privatization of many telecommunication regimes. Foreign manufacturing and investment opportunities will also abound, as developing countries adopt new technologies to modernize and upgrade their communication networks. Global communication networks may also serve to promote worldwide economic growth and development, by allowing businesses to reconfigure and redistribute their research and development, production, and marketing activities to their best advantage regardless of their geographic location.

In this interdependent global environment, the United States has an interest—both from an economic as well as a foreign policy perspective—to help ensure that Third World countries are not left behind. When networks are extended and linked together, in the early stages of their development, everyone gains. A network's value increases with the number of users, as does the demand for equipment and services. Moreover, in an information, networked economy, electronic networks serve to channel the flows of trade and investment, much as railroads, telephones, and highways influenced the course of business in the industrial age. If U.S. businesses can not interconnect with Third World networks, they will have less opportunity to compete in these rapidly growing markets. Moreover, they will be unable to globally reconfigure their businesses to take advantage of low-cost labor and resources.

In the past, there was only one way to build a network—hierarchically and all of one piece. Today, this is no longer the case. Taking advantage of the higher performance and enhanced variety of new communication technologies, as well as the much greater flexibility that they afford, new small scale "bottom up" networking solutions can be developed to extend services to people and places that—in an increasingly liberalized regulatory environment—might otherwise go unserved.

The United States can promote both its foreign aid and trade goals by helping Third World countries to develop grassroots networking in remote areas. Infrastructure related aid projects have generally had a high pay off. At the same time, experience has shown that it is this type of aid project that is most likely to stimulate trade. Bottom-up networking can also support the kind of comprehensive, "holistic" development strategies that have proven essential for sustainable growth. For example, if grassroots networks are set up by local people, using their own labor and resources, they can serve to promote entrepreneurship, stimulate local activity, and reinforce community ties. Given the wide range of technologies now available, local networks can also be customized to match the needs and resources of specific areas. Equally important, these networks will not compete with, but instead will complement and add value to, the information networks that are presently being deployed in high density areas. As an added benefit, given network growth in unserved areas, Third World governments will likely be under less pressure to use subsidies to promote universal access, and hence more willing to promote regulatory reforms and open their markets to U.S. equipment and service providers.