Chapter 2
Networks for Financial Services

Until recently, a state-owned postal, telegraph, and telephone agency (PTT) operated the public telecommunications network in each European country. Some of these have recently been privatized.[1] In the United States, the telecommunications network was developed by privately owned corporations and came to be dominated by the American Telephone& Telegraph Company (AT&T). AT&T functioned as a heavily regulated monopoly until it was broken up in 1984 into a long-distance carrier (AT&T) and seven regional Bell operating companies (RBOCS), each of which has a monopoly over local telephone service in its region. AT&T now must compete with MCI and Sprint in long distance and international services.

International transmission lines are generally provided by the joint investment of telephone companies or PTTs in two or more countries using the facility, with switching remaining in national hands at either end of the transmission line.[2]

Public networks by definition afford universal access to highly standardized services at regulated rates or tariffs. Private networks, which may be operated by a corporation, group of corporations, association, or services vendor, offer dedicated or discriminatory access to select and usually tailored services, at rates set by contractual agreement with the users.

U.S. banks active in overseas markets primarily serve large corporations rather than individuals. They offer "wholesale" services such as cash management,[3] financial market data, and currency and securities trading. (Citibank is an exception to this rule; it emphasizes retail as well as wholesale services overseas.) These banks have two needs for international communications:

- As intra-corporate business support: voice, voice mail, fax, E-mail, and data transmission, and
- As a means to create and deliver financial products and services: electronic funds transfer, cross-border electronic letters of credit, customer account information and cash management, financial information.

Manufacturers Hanover Trust, which merged with Chemical Bank in January 1992, was fairly typical. The bank's 'Global Wholesale Bank' used international telecommunications primarily for internal bank business, while its operating services group (GEOSERVE) delivered electronic banking products and services to corporate customers around the world. GEOSERVE customers using the network could access the bank's computers to check their account balances and to initiate funds transfers and letters of credit.

Private Networks

In the 1980s, many large U.S. commercial banks and investment banks or securities houses created private networks made up of facilities leased from public telecommunications companies. These leased facilities might include cable circuits and satellite capacity, interconnected to the public network, with some network and terminal equipment owned by the financial institution. The bank exercises full financial and managerial responsibility over network operations. While only very large financial institutions have elaborate international private data networks, many financial institutions have a few point-to-point leased circuits to tie their dispersed locations into larger operating centers. (See box 2-A.)

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1 In some cases, regulatory authority and operating responsibility have been separated, with the latter being lodged in a quasi-governmental corporation for greater independence. In some cases, partial private ownership of the operating corporation has been allowed or is contemplated for the future.

2 The transoceanic cable systems have Consortium ownership that traditionally reflected the degree of national use of the cable. Satellite transmission facilities are collectively owned and operated by the world's governments through Intelsat with shares proportional to national use of the system. A series of intergovernmental agreements effectively divided up transmission between satellites and cables. The Federal Communications Commission (FCC) has now authorized competitive international satellite systems. In May 1985, the FCC authorized the construction of a private undersea fiber-optic communications link between the United States and the United Kingdom, with no obligation to offer service to the public.

3 Cash management is a set of services that allows company treasurers to collect and manage revenues, schedule payments, and place the corporations' temporarily idle funds so as to obtain the best yield from them while maintaining necessary liquidity.

Box 2-A—The Largest U.S. Banks and Their Private Networks

Citibank, NA, of New York, is the largest U.S. bank and one of the few that offers a full range of retail and wholesale financial services around the world. During the 1980s, Citicorp developed 100 separate private **networks, covering** *92 countries. Each* Citicorp business unit independently bought, developed, or **contracted** for networks. Beginning in January 1992, these are being combined into one global information network, or GIN. The goals are seamless technology integration, with common architecture and protocols, services across national borders, and reduced costs. The GIN will include voice, video, and data capabilities, will connect local-area networks (LANs) and wide-area wideworks (WANs), and will support value-added services such as electronic data interchange (EDI). The consolidation is expected to save $100 million per year within 3 years, by bulk purchases and leases and by eliminating some of the 1,500 network professionals. GIN was made feasible, Citicorp officials say, because of the evolution of ISDN (integrated services digital networks) and advances in flame-relay technology. In time, Citicorp may turn part of GIN over to a systems integrator or may have an outside entity manage or operate its systems ("outsourcing"). This is not, however, an explicit goal.

The Bank of America, the third-largest bank in the United States, has a packet-switched network to support its World Banking Division. The network is used to transmit data on loans and letters of credit, to supply financial information to officers and customers, to support on-line accounting, to send and receive international **payments,** and to receive customer instructions for business transactions.

Chase Manhattan, among the largest 10 banks in the United States, uses a private packet-switched network provided by Tymnet, which is owned by British Telecom.

Manufacturers Hanover Trust had a T1 (high-speed) backbone network providing transport among its U.S. locations, and a global X.25 packet-switching network based on Telenet (now Sprint hardware and software) connecting 52 cities in 27 foreign countries.

Bankers Trust offers no retail services but is a "merchant bank," i.e., a combination of investment bank and commercial (wholesale) bank. The bank's private network, created in 1982, is primarily a data network but carries some voice traffic on heavily used segments, such as between London and New York There are also some 24-hour trading circuits for direct trading between countries where the business day overlaps (these differ from regular voice circuits because traders have an open microphone on their desk that is activated by a distant trader using a 4-digit code). Satellite links are used for backup; Bankers Trust prefers terrestrial links to satellite links to avoid the several seconds delay which is disorienting for traders and may affect their ability to trade in volatile moments.

SOURCE: OTA, from interviews and materials provided by bank offices.

The chief reasons that banks developed private networks during the 1980s were:

- Their special requirements for highly reliable, secure transmission,
- The fact that many enhanced data services were not available on public networks, and
- Lower unit costs in terms of volume of use. (Circuits are leased at flat rates, i.e., not volume-sensitive rates.)

The decision whether to carry voice communications on a private network or on the public network is largely cost driven, because voice accounts for about 80 percent of all traffic and voice messaging is a largely undifferentiated product. Banks also are especially sensitive to costs when communications are "products" (e.g., in electronic funds transfer), because of the narrow profit margins on many such products.

Financial firms often use private networks with packet switches, multiplexer, and multiprotocol bridges/routers to interconnect local area networks (LANs) serving their far-flung facilities. (See box 2-B.) It is difficult for telephone operating companies to provide these connections with standard equipment because of frequent incompatibilities between computer architectures and communications architectures.[4] Alternatively, banks may find it cheaper and easier to use a third-party services provider that can interconnect LANS, perhaps with TCP/lP,[5] X.25, frame-relay, or other advanced

[4] Robert Crandall, the Brookings Institution, interview, Nov. 30, 1991.

[5] TCP/IP (Transmission Control Protocol/Internet Protocol) is a Department of Defense protocol developed to link computers across networks.

Box 2-B—Private Networks in Other Financial Industries

Not only banks but other kinds of financial institutions developed international private networks during the 1980s:

- One of the largest securities houses, Shearson Lehman, has private T1 networks between New York and London and between New York and Tokyo. These are primarily for data but some of the leased circuits are dedicated to voice. Data circuits go through three international hubs (New York London, Tokyo) that have multiplexer concentrators to route messages to about 30 other locations. In London, there is a connection to SWIFT for funds transfer.
- American Express operates a network of 37 nodes linking 10,000 automated teller machines in 16 countries and 1.6 million Point-of-sale terminals in 25 countries. Transaction authorization at these terminals is on-line and immediate.[1]
- A global money brokering firm[2] uses only point-to-point lines-i.e., dedicated open lines between the firm and its customers. For domestic communications, across state lines, it leases circuits on fiber-optic cables, provided by services vendors who house the firms' multiplexer% on the vendors' premises. These communications are voice, referred to by the firm as "shouting down the pipe." For international service, the firm leases low bit-rate voice circuits; for example, it has 49 point-to-point lines to London. Other kinds of service are deemed not necessary and too expensive. A high bit-rate circuit might cost $2,500, compared with $700 for the voice circuits. The firm used satellites in the past, but the several seconds delay was disruptive for voice trading and it now uses cable.
- Reuters Ltd., a worldwide vendor of general news and financial data services delivers information services, predominantly financial market data, to customers around the world over leased lines and satellites. It has its own earth stations on Long Island, having been granted a license by the Federal Communications Commission. (In the United Kingdom, its home country, Reuters had to buy a company that already had a license in order to operate an earth station. In most of the rest of Europe, only post telephone and telegraph agencies can operate earth stations).

SOURCE: OTA, from interviews and materials provided by corporate offices.

[1]National Telecommunication and Information Administration, *Telecom 2000,* NTIA *Special* Publication 88-21, October 1988, p. 447.

[2]A brokering firm is an intermediary, bringing buyers and sellers together; in this case, the money brokering firm handles trades Of foreign *currency,* overnight Federal funds, Eurodollars, etc. Its customers are dealers located in banks or other large financial institutions. An official of the firm provided OTA with information in extended discussions but asked that the firm not be identified.

packet-switching technologies. In Europe, most of these services providers are U.S. firms.

Public Networks

Having global private networks does not preclude the use of the public switched network. It is most often used for voice, but it is also necessary to deliver products and services (account balance reporting, initiation of funds transfers and letters of credit) directly to customers' terminals and personal computers. Public switched networks may be used more for data transmission as switched multi-megabit data service (SMDS) becomes more widely deployed in the future.

Large investment banks and brokerage houses usually have arrangements with AT&T, MCI, and/or Sprint for discounted pricing for high-volume international carriage. AT&T's bulk sale contract, for example, is known as Tariff 12. The discount can be as much as 40 percent off regular business rates for large users willing to sign a long-term contract (usually 5 years) at a pre-stipulated volume of traffic. Competitive prices usually determine the allocation of traffic among the three major international carriers, but there are also considerations of redundancy and back-up capacity.

Data transmission is increasingly important for financial institutions. Public data networks, where available, are said to have a poor record of support of vendor-specific protocols. European PTTs want to force all vendors to use X.25. This is an international three-level standard protocol for interfacing terminals or computers to public packet-

switching networks,[6] but X.25 services are not always available and there is no standard interface. The inability to get needed services across national borders drove the development of private networks in the 1980s.

These conditions changed significantly in 1990, when carriers began offering "virtual private networks" (VPNs). Normally, specific leased circuits are reserved for the customer, irrespective of the volume of traffic on those dedicated lines. To make more efficient use of the total network facilities, virtual networks allocate lines dynamically upon need and there will not necessarily be the same links every time (a "virtual" network). This capability results from the development of sophisticated ''intelligent" software in the network switches. Many financial institutions worried at frost that there might be less quality control and predictability with virtual private networks than with leased line networks, because they could not monitor the lines. In fact, VPNs are now said to have added reliability compared with leased circuits since they are dynamically switched if line failures occur. All major U.S. carriers now offer virtual private network service internationally, generally through arrangements with in-country carriers and PTTs. These arrangements are not always easy to make, but in general the experience with virtual networks appears to be satisfactory for major users.

Shared and Value-Added Networks

In addition to their own private networks, most banks use a number of shared and third-party private networks such as SWIFT, MasterCard International, VISA International, and ATM networks. These are ''value-added' networks because they do more than transmit data; they also gather, select, format, or process data, perform other operations, or facilitate the sending and receiving of various kinds of messages. These networks are used, for example, for credit authorization and validation and for payments and settlements. The most widely used is SWIFT' (the Society for Worldwide Interbank Financial Telecommunications), which by 1990 had 1,812 member banks and linked 3,049 financial institutions in 84 countries.[7]

SWIFT is technically a message system and not an electronic funds transfer (EFT) system. SWIFT messages instruct a bank to make payment, and the bank then transfers funds from one account to another on its books. (The ability of banks to make "final payment' sets them apart from other financial institutions.) However, for many purposes SWIFT is considered an EFT system because its messages are accepted by banks as authentic and authoritative.[8]

In 1990 a replacement network, SWIFT II, was introduced, and will be fully completed by the end of 1992. It will eventually offer an electronic data interchange (EDI) service for network users, a netting service for banks trading in ECUs (the uniform European currency unit), and the automatic matching of foreign exchange and money market transactions.

Very large financial institutions, with their own international networks, still depend on SWIFT for communications to regions that their private networks do not reach. Many financial institutions other than banks want access to SWIFT'. SWIFT has in recent years allowed new categories of institutions to participate, e.g., securities exchanges and brokers and dealers. Broader access has become a highly charged issue.[9] SWIFT would be a benefit, for example, to a mutual fund whose payment orders must now go through a broker to a bank to another bank to another broker to a customer, with additional costs and counterpart risks at each step. But some members have objected that access to SWIFT

6 It was developed by the Consultative Committee for International Telephone and Telegraphy (CCITT) with the participation of the United States, Canada, Great Britain, France, and Japan, among other countries.

7 Small and mid-sized banks usually funnel their international traffic through the SWIFT facilities of larger, correspondent banks. Although SWIFT is used by banks of all sizes, only about 100 of the approximately 12,000 U.S. banks are actually members of SWIFT and only about 60 of these routinely generate more than 200 messages a day. Information supplied by the American Bankers Association.

8 Another U.S. system, CHIPS (Clearinghouse Interbank Payments System) is owned and operated by major New York banks and links 140 financial institutions. CHIPS messages do create legal obligations to deliver money, and according to the Federal Reserve System Board of Governors, CHIPS can be considered an electronic funds transfer system. Final payment-i. e., legal transfer of funds from one bank to another and one account to another-is done by FEDWIRE, operated by the U.S. Federal Reserve System.

9 Discussion with Charles Taylor, Executive Director of the Group of Thirty, Washington, DC, Nov. 18, 1991. The Group Of Thirty is an association of 30 internationally respected financial experts from Central Banks, investment houses, and academia, who meet to discuss and seek cooperative solutions to global financial issues.

Box 2-C—Example of the Use of International Telecommunications Networks by Foreign hanks

Banca d'Italia uses public networks for two-way data transfer services from personal computers through the public network outside databases such as the Organization for Economic Cooperation and Development, and for message switching to access CEBAMAIL. The public ITAPAC packet-switching network has been found to provide a good quality service at relatively low cost, with pricing based on volume, The public telex system is used for incoming wire service dispatches. There are private lines for message switching and file transfer services, using protocols not offered by the public facility. SWIFT is used for the exchange of payment orders and other financial operations. IBM's International Network links computer terminals in the bank with the Bank for International Settlements (in Basle) and with IBM's DIAL service. The European Academic Research Network is used to exchange messages and texts among the international scientific community. The Bank also gets information services from Reuters and Telerate.

Danmarks ***Nationalbank*** uses CEBAMAIL to communicate with European correspondent banks, and SWIFT for international transfer of payment orders. These two shared networks are used to **exchange information** foreign exchange markets and to discuss common decisions. The bank uses a number of value-added networks including Dow Jones, Telerate, and Bloomberg for international news.

Bank of Israel uses SWIFT for currency transfer and related purposes, and relies on Reuters and Bloomberg for financial market data and news. It subscribes to a number of information services, including BITNET, EARN, LEXIS, and DIALOGUE. The public network serves for other international communications.

Bank of Tokyo, ***Ltd.,*** completed linking its worldwide offices in the late 1970s; a combination of private networks and the public network provides message switching, data transmission, voice communications, fax and E-mail. Key considerations were cost, quality, and security. There are four major nodes: Tokyo, Hong Kong, London, New York The bank uses CHIPS, FEDWIRE, SWIFT, and other shared and value-added networks.

The Industrial Bank *of Japan, Ltd.* has two primary private telecommunications networks. IBJ Net was implemented in 1989 for reasons of security, privacy, and cost-reduction. It originally carried voice and facsimile communications between the bank's international offices, and now transmits data by packet-switching, using AT&T leased circuits, with Tokyo, New York and London as the primary hubs. IBJ Net also transmits data between LANS in IBJ international offices. The International Banking On-line System (IB0S) is the bank's proprietary computer system, used in the offices outside of Japan, to support loans, foreign exchange, and treasury and accounting operations. Data resident in **host** computers at each office are transmitted using the GE Mark III telecommunications system, but managed by the IBJ's proprietary software. The bank also participates in CHIPS, SWIFT, and other international shared networks.

SOURCES: Information provided by the Telecommunications Department of Banca d'Italia courtesy of Tommaso Padoa-Schioppa Vice Director General communication of Jan. 27, 1992; Ejner Petersen Head of Foreign Exchange, Danmarks Nationalbank, in a letter of Jan. 6, 1992; Abraham Jacoby, Director, Computer Services Department, Bank of Israel, letter of Jan. 5, 1992; Toyoo Gyohten Advisor to the Board of Directors, Bank of Tokyo, Ltd., letter of Dec. 26, 1991; and Masatoshi Tamaru, Senior Vice President (New York), Industrial Bank of Japan Ltd., letter of Jan. 2,1992.

encourages nonbanks to compete with banks and undermines the payment settlement role of banks.

CEBAMAIL is another shared network, established by European Community central banks and later expanded to serve other banks (the Federal Reserve Bank of New York is a member). It began as a voice network but later became a data network, and is used to exchange information on foreign exchange markets and to discuss common decisions.[10] (See box 2-C.)

Shared financial networks entail some serious payment risks, to be discussed later.

While SWIFT and CEBAMAIL are shared networks owned by banks, most banks also use third-party networks. For example, Chemical Bank has a private international network for intrabank messages, but outsources all telecommunications related to its customer cash management services to the General Electric Information System (GEIS). Many European banks use IBM's International Network and DIAL service to communicate with

[10] Letter to OTA from Danmarks National Bank, Jan. 6, 1992.

Box 2-D-Citicorp Moves Into Electronic Services

Citibank is unusual among U.S. banks in emphasizing retail services overseas-i.e., services to individuals and households. Citibank has a retail presence in 11 countries in Europe, with 700 branches and 11,300 people; it serves 3 percent of all European households.

In the 1960s electronic communications allowed nonbanks to create financial instruments, such as money-market mutual funds invested in short-term government securities, that paid higher interest rates than banks could offer under existing regulations. Money flowed out of bank into these new kinds of investments. Corporations began to sell commercial paper directly to investors or to borrow from industry-owned finance companies. Banks were less often the intermediary between borrowers and lenders ("disintermediation").

Citicorp decided to shift its assets away from prime wholesale lending to computer based services. Citicorp created a time-sharing computer subsidiary, "Citishare," which developed the first comprehensive automated teller machine network in New York and later extended it across the country. It issued 20 million credit cards and purehased two other credit card companies. In the late 1970s Citicorp worked toward becoming a global, diversified company offering retail banking, commercial banking, investment, insurance, and information services. It entered joint ventures with NYNEX, RCA, and McGraw Hill to offer electronic services to the home and to develop 24-hour trading systems. In 1985 Citicorp passed Bank of America to become the largest U.S. bank in terms of domestic deposits. The next year it bought a controlling interest in Quotron, an information services vendor specializing in financial market data.

SOURCES: David Lascelles, "Networking Without Frontiers," ***Financial Times, special*** **section on international banking, May** ***9,1990,*** p. ***6;*** ***Citibank World,*** vol. 1, No. ***2,*** April 1992; and interviews.

each other and with the Bank of International Settlements in Basel, Switzerland.

Although value-added networks rely on the basic telecommunications infrastructure, they are not subject to regulation as is the primary basic service supplier. Value-added networks maybe operated by:

- Telecommunications companies that manage connections between users' computers and terminals (e.g., AT&T[11]),
- Hardware suppliers that tend to specialize in interconnection of their own computers (e.g.,IBM), and
- Services providers with no particular allegiance to a telecommunications provider or to computer hardware (GEIS, Reuters).

Many value-added processing services such as treasury management, dealing and trading, settlement services, and transaction or credit authorization, were developed to meet the needs of financial institutions. (See box 2-D.) There is now a strong movement of financial institutions to become suppliers, as well as users, of such value-added services. The ability to develop value-added services is a valuable competitive advantage of U.S. banks. In France, following deregulation of financial markets, there has been rapid development of such services by banks in alliances with information suppliers. The French Government is backing the development of a nationwide payments and credit card authorization network.

The Changing Balance

Financial institutions appear to be going back to reliance on the public switched network. The comparative costs of public and private networks are changing, and technology is allowing public networks to provide better control and reliability and to offer value-added services if they choose to do so. As private networks become less effective as product differentiators, costs and reliability become the primary selection criteria. One bank official says that the importance of the price of services "cannot be overestimated.' '[12] When volume discounts such as Tariff 12 made the public switched network cheaper for basic voice services, there was an immediate and almost total migration back to the public network.

11 Under the Modified Final Judgement, AT&T at first had to provide value-added services and networks through fully separate subsidiaries. The FCC removed the separate-subsidiary requirement and since August 1991, AT&T has been free to offer network-based value-added services directly.

12 Edward J. Regan, Vice President, Chemical Bank, New York, interviewed by OTA in March 1992.

This could also happen with data services. A few years ago, data traffic came from large computer terminals and tended to be steady, predictable, and consistent. With LAN-to-LAN communications and more diverse applications, traffic has become "bursty." Financial institutions, in particular, tend to sporadically transmit large numbers of short messages with little traffic between bursts. Some leased circuits are "empty" much of the time. If there is a great deal of excess capacity on a bank's leased lines, much of their cost advantage disappears, particularly as public network international tariffs are reduced. Banks are also increasingly eager to reduce the high costs of managers for private networks.[13]

Banks and brokerage houses spend about 4.5 percent of their revenues on information systems—more than utilities, heavy industry, or retailers.[14] A survey by Ernst & Young for ***The American Banker*** found that the U.S. banking industry spent over $11 billion on information technology in 1990, and expected this to rise modestly from 1991 through 1993.15

Most of this goes for computer hardware, software, and services; financial institutions have been a major impetus for development of advanced computer applications. Nevertheless, one source estimates that financial institutions worldwide spent $243 billion in 1990 to operate communications networks (domestic and international), including staff, line charges, equipment leases, and depreciation; possibly about $40 billion of this went to private networks.[16] The magnitude of these expenditures clearly makes the tradeoffs between public and private international networks important to financial institutions.[17]

Photo credit: Citibank

A Citibank telecommunications operation center for its global network.

New technologies are reducing the cost of private networks. European PTTs are cutting the price of international leased lines, although their costs are still much higher than those from the United States to Europe.[18] In some counties, the costs of leased lines have decreased 50 percent since 1987. Compression technologies, which allow more information to be squeezed into a given capacity, could reduce prices even further.

But while private networks are becoming cheaper, public switched facilities are beginning to offer low-cost virtual network services. *Network World* developed a model that shows that the amount of switched traffic necessary to cost-justify a transatlantic private line dropped from 18,765 minutes per

13 Financial services institutions have the highest percentage of total employees categorized as information systems employees, 7.6 percent of all employees for nonbanks and 6.2 percent for banks, compared with 6.1 percent for telecommunications companies, 3.4 percent in high-tech manufacturing, 0.9 percent in retail industries, and 3.4 percent for all industries, according to a survey of 500 largest American users of information technology reported by *Information Week*, Sept. 16, 1991.

14 National Telecommunication and Information Agency (NTIA), *Telecom 2000*, NTIA Special Publication 88-21, October 1988.

15 "Technology Spending Evades Cost Cutting," *American Banker*, Aug. 21, 1991, p. 1.

16 Alan Cane, "~ormation Technology in Finance,' *Financial Times*, Nov. 7, 1990, p. III-1.

17 Manufacturers Hanover probably invested $55 million for its proprietary telecommunications network. Marjorie Greene reports this estimate from a study by a competitive analysis group at First Chicago in 1985, based on interviews. ("Public Policy and International Telecommunications Technology in Financial Markets-An Overview," OTA contractor report, February 1992). It is possible that the true costs were higher even at that time. Citicorp says it spends from $1 to $2 billion per year on information technology, including telecommunications equipment and services (Discussion with Michael Nugent, Association General Counsel of Citibank, N.A., New York City, Dec. 4, 1991.) *The Financial Times* estimates Citicorp expenditures at $1.5 billion yearly (Alan Cane, "Information Technology in Finance," *Financial Times*, Nov. 7, 1990, p. III-l). A large securities firm estimated, in OTA discussions with officials who asked that the firm not be identified, that it spends about about $50 million for international telecommunications, and about $10 million of this is for leased circuits.

18 The monthly rental for half circuit at 64 kbps to the United States ranges from $3,863 (UK Mercury) and $4,115 (France Telecom) to $7,124 (Austria). From the United States to Europe, the average price is about $3,400.

month (mpm) in 1987 to 11,493 mpm in 1989, but rose again to 15,352 mpm in 1991, because the cost of AT&T's best international business services dropped by 32 percent from 1989 to 1991.

A migration of financial institutions back to public networks may also be greatly encouraged because there is a growing need for financial institutions to be linked electronically directly with customers' computers. The scope of internetworking among corporations is growing, and banks may have to participate in electronic payments and electronic data interchange in order to retain their traditional customer relationships and avoid being bypassed. Private networks cannot always provide direct connections to customers as can public networks.

Paul Glaser, formerly head of Citicorp's Corporate Technology Committee (now retired), says that "...except for higher bandwidth on the dedicated circuits, it is best to go public" for domestic communications.[19] The evidence suggests the likelihood of a decline in the use of private networks by financial institutions, or at least that banks will increasingly handle traffic growth by routing it over public networks. Edward Regan, of Chemical Bank, concurs: "The concept of dedicated corporate networks must be re-examined as public carriers build more intelligence, flexibility and reliability into their networks. The trade-offs . . will change."[20] For international communications, however, this will require that PTTs become more customer-oriented and innovative.

[19] Correspondence with OTA staff, May 24, 1992.

[20] Edward J. Regan, then Vice President, Manufacturers Hanover Trust, in a talk given at Communications Networks'91, Washington DC, Jan. 29, 1991.