Chapter 2
Information Technology for Global Markets

Four forces have caused international securities trading to increase:

- *advances* in information technology-telecommunications and computers;
- the development of a global economy with multinational corporations needing both international communications and international sources of capital;
- the emergence of huge institutional investment funds needing cross-national diversification;
- regulatory changes, especially access deregulation that opened stock exchanges to foreign membership in many countries.

The technology for international securities trading is in place, and its capabilities will continue to increase. The emerging global communications infrastructure has evolved at three levels: 1) public and private communication networks using cable, microwave, and satellite transmission; 2) communications technology used by providers of market information services; and 3) specialized electronic securities trading systems.

THE EMERGING GLOBAL DATA COMMUNICATIONS INFRASTRUCTURE

International securities trading requires a system for efficient, rapid, and secure transmission of market data, transactions messages, and payment instructions. The infrastructure to do this has developed rapidly over the last 25 years and is continuing its turbulent development. Four technological trends contributed to this development:

- expanding computer capability and declining costs;
- digitization of data, and the resulting convergence of computer and telecommunications technologies;
- satellite communications development; and
- fiber optics development.

Improved computer performance and declining costs have resulted from improvements in basic computer technology, very large-scale integration (VLSI) technology[2] materials (e.g., use of gallium arsenide in production of chips), and computer architectures and software.[3] In 1960, it cost about $75 to do 1 million computer operations; in 1980 it cost 0.1 cent. By 1997 computer costs are expected to decrease still further. Computers make it possible to use telephone systems to transmit, store, and distribute electronically encoded information; they also control the switches that route information through a network.

"Digitizing' is the translation of information from traditional analog forms such as pictures, speech, or written/printed characters, into discrete binary-coded electronic signals for processing, storage, or transmittal. This makes possible the fusion of telecommunication and information-processing technologies. It allows man-to-machine communication not possible with a conventional telephone, and has prompted the carriers to build multi-media communications systems by combining facsimile, data, and video with voice transmittal capability.[4] Since the 1970s, AT&T, MCI, Sprint, and other communications carriers around the world have been upgrading their existing networks to high-capacity digital lines.

Fiber-optics Provides broad bandwidths that allow the transmission of high-speed video images as well as the capacity to move large volumes of data. Development of broadband integrated services digital networks (B-ISDN) can eventually provide efficient broadband interconnection for all communication services-transmitting voice, data, video, and text. ISDN is still in the early commercialization stage.

---

[1]This section draws heavily on an earlier OTA report, U.S Congress, Office of Technology Assessment, *Critical connections: Communication for the Future,* OTA-CIT-407 *(Washington* DC: U.S. Government Printing Office, January 1990), especially ch. 3, "New Technologies and Changing Interdependencies in the Communication Infrastructure."

[2]VLSI allows the placement of over 100 logical operations on a single integrated circuit chip, a capability that has been doubling about every 18 months.

[3]U.S. Congress, OTA, op. cit., footnote 1, p. 46.

[4]U.S. Congress, OTA, op. cit., footnote 1. See also, Toshio Kosuge, "Telecommunications," in Peter Robinson, Karl P. Sauvant, and Vishwas P. Govitrikar (eds.), *Electronic Highways for World Trade* (Boulder, CO: Westview Press, 1990), pp. 223-238.

These developments shape all parts of the communications infrastructure: 1) switching or networking technology; 2) transmission technology; and 3) terminal technology.[5] Switching technology consists of computer hardware and software for routing messages and establishing a communication channel, and thus provides the "intelligent" part of the network. Manual switches and electronic analog switches are being replaced with digital switches. Some superfast packet switches[6] can now transmit hundreds of thousands of packets per second; by the late 1990s, with optical switching, even greater speeds will be practical. Software development will determine the rate of further improvements in cost/performance ratios.

With more powerful microprocessors, faster computing speeds, and larger memories it is now possible to put control functions for the network not only in the central switch, but also at. nodes throughout the system. This software-driven and software-defined communication infrastructure--"the intelligent network' 'encourages the introduction of new value-added services using modular software.

Keeping pace with advances in switching technology are advances in transmission technologies: optical fiber or coaxial cable and radio or broadcast technology, which includes satellite, microwave, and for local use, cellular broadcast communications. Customers usually do not know or care how the message was transmitted, but differences in these technologies result in major differences in the type of electronic signals that can be transmitted, the quality of transmission, the range of frequencies that can be used, the speed of transmission, the confidentiality and security of the transmission, and the cost.[7]

Terminal equipment is that found at the customer end of the network, usually telephones or computer terminals. Many of these terminals now contain information-processing capability.

Advances in global communications infrastructure technologies will probably accelerate. Nevertheless, there is some danger that network interdependence may slow innovation, because once users have invested in equipment conforming to a particular standard, they will be reluctant to purchase equipment that is incompatible even if it is otherwise superior.[8]

Public and Private Global Networks

Telecommunication services are provided in many countries by state-owned monopolies, that typically use INTELSAT and regional satellite and cable facilities to transmit international communications. In the United States, telecommunications have traditionally been provided by government-regulated private-sector fins. The United Kingdom, Japan, Hong Kong, and other countries are moving toward private or private-government systems.[9] A user in one country who wants to connect with an online database in another country most often does so with a modem (a device that allows digital signals from a computer to be transmitted over analog telephone lines), through a long-distance telephone connection. Telephone companies in different countries pass calls along through interconnections across different technologies-a message often travels through microwave, satellite, and cable transmission facilities.

Public telephone systems have encouraged the development of computer networks. A computer network is a collection of computers-whether minicomputers, mainframes, or supercomputers—that communicate with each other using common protocols, over transmission links that can be cable, satellite, or ordinary telephone lines. The networks may be local area networks (LANs) or long-distance networks (wide area networks, or WANs). They allow any computer in the network to access and use computer programs or data stored on any other network computer.

In the United States, the unbundling of some communication services and the divestiture of AT&T have encouraged business users to assemble their own networks. Deregulatory changes encourage the

[5]Kosuge, op. cit., footnote 4.

[6]Packet-switching systems divide user messages into many short blocks or packets that can be routed independently through numerous geographically distributed switching nodes.

[7]Greza Feketekuty, *'International Network Competition in Telecommunications, " in Robinson et al., op. cit., footnote 4, pp. 257-287.

[8]U.S. Congress, O'IA, op. cit., footnote 1, p. 43.

[9]R. Brian Woodrow, "Trade in Telecommunications and Data Services: A 'Constitutional' Analysis," in Robinson et al., op. cit., footnote 4, pp. 15-42.

unbundling of services by allowing users to separately purchase communication services or functions that were formerly available only as a single unit (the kind of end-to-end service once offered by the AT&T Bell System). Unbundling has encouraged the development of value-added services, and may be carried further by the development of "open network architecture" (ONA), which allows service providers to buy elemental network functions and reconfigure them to meet their particular needs. True ONA requires further advances in software development, and it may in the end not be acceptable to all users because it transfers to them the problems of network planning and management.[10]

A striking feature of modern global telecommunications is the development of private networks to serve the needs of individual translational enterprises. Once data are digital, corporate networks allow translational corporations to perform corporate functions in any country. Many large financial institutions like Citibank, American Express, Salomon Brothers, major stock exchanges, and other kinds of multinational corporations such as IBM, Digital Equipment Corp., Unisys, General Motors, and Britain's Imperial Chemical Industries, have developed their own networks, using satellite capacity and transmission lines leased from communication companies. IBM, for example, has "a global communications network that ties together its installations in 145 countries. There are also privately owned data networks that serve many corporations, such as Telenet Communications.

Digital data and the declining costs of telecommunications have resulted in a proliferation of information services providers, and in the development of closed user-group networks—i.e., SWIFT,[11] and Reuters Limited, the international news service.

Global networks are "making previously untradable services tradable." In the past, vendors could offer such services in the foreign market only through foreign affiliates.[12] Data services, which make use of international telecommunication circuits, are offered in many countries on a competitive and unregulated basis. International data services have normally used established monopoly transmission arrangements, but alternative distribution possibilities are opening up; for example, domestic satellite providers in one country may sell cross-border capacity or specialized services in bordering countries.

These developments are strongly resisted by the government-controlled public telephone and telegraph authorities (PTTs) in European and Third World countries. In some countries there are restrictive laws governing the use of communications technologies and systems to protect the state monopoly. Such legal, regulatory, and political barriers will be serious problems for some time, although there are strong indications that these barriers are breaking down because communication is essential to competition in today's world economy. Foreign competition tempts corporations to move their activities to other countries, where business conditions are more favorable.

Systems for the Transmission of Financial News and Market Data[13]

Communications between exchanges, over-the-counter markets, and clearing organizations in different countries, as well as communications between investors and their brokers in one country and markets in other countries, are for the most part handled through the same communication modes used by other business enterprises-i.e., leased transmission lines. A portion of these communications are handled by specialized information services vendors. The rapid, broad dissemination of market data is an essential element in making securities markets both efficient and fair. It is largely accomplished today by information services vendors using a variety of public communication modes.

Advances in technology and restructuring of its costs are having a profound effect on the structure of the information services industry. They may induce vendors to move into more specialized, value-added services. It is possible that systems being developed by the vendors for their own competitive reasons

[10]U.S. Congress, OTA, op. cit., footnote 1.

[11]SWIFT stands for Society for Worldwide Interbank Financial Telecommunications; it is a system allowing banks and other financial institutions, including brokerage fins, to exchange payment instruction or clearing messages.

[12]Karl P. Sauvant, "Services and Data Services: Introduction, " in Robinson et al., op. cit., footnote 4, pp. 3-15.

[13]This section draws on a contractor report prepared fo, OTA by Monica Roman, "Financial Information Services Vendors," August 1989.

could become the real international exchanges of tomorrow, as markets become more global, and computer-based trading and telecommunications become strategic advantages. Vendors are ahead of exchanges in preparing to field global electronic trading systems. However, vendors will have to work out interfaces with clearing and settlement and other systems (see ch. 5).

As early as 1850 there was a market for international financial information services; Paul Julius Reuter began using carrier pigeons to fly stock market quotations between Brussels and Aachen, Germany. The opening of the first underwater telegraph cable in 1851, connecting Dover and Calais, allowed Reuter to start delivering market data and financial news from London to Continental Europe. Because of high start-up and low marginal costs, vendors could be more efficient than user firms in information gathering (as is still true today, for the most part). The company Reuter founded, Reuters Holdings PLC, is now one of five companies that dominate the market for securities and futures market data (prices and quotations). The other four are Quotron Systems Inc., Automatic Data Processing Inc. (ADP), Telerate Inc., and Knight-Ridder Inc.[14] These five companies have approximately 400,000 terminals worldwide.[15]

The market for financial information can be divided into three broad categories: 1) general financial news,2) quotes and sale prices for exchange-traded instruments, and 3) quotes and prices for over-the-counter instruments. (The latter two are different markets because the sources of data are different, and because of differences in trading practices and trading technology.) Financial information vendors either gather general financial news themselves or select and carry reports from leading news organizations. Quotes (bids and offers), last-sale prices, and volume information-including those for most stocks, all commodity and financial futures, and all options-are generated by markets and sold to vendors. In foreign exchange (forex) and fixed-income (bond) markets, where there are no centralized marketplaces, price information is contributed by banks and securities firms to vendors.

Dow Jones & Co., Inc., is the leading provider of financial news in the United States, but Reuters has an edge over Dow Jones in financial news that affects forex and freed-income prices because of Reuters' vast international communications network. Other providers of on-line financial news include Knight-Ridder, Associated Press, McGraw-Hill Inc., Financial News Network, and Market News Service.

Quotron Systems has long dominated the market for U.S. stock market data, but ADP is a strong competitor. Outside the United States, the leader is Reuters (based in the United Kingdom), which recently entered the U.S. market for stock prices. In the past, Reuters supplied market data and news for foreign exchange, money market instruments and commodities in the United States, but not for equities. The internationalization of the securities markets has prompted foreign vendors such as Reuters and Telekurs of Switzerland to enter the U.S. market. The relative ease of acquiring and distributing price information for exchange-traded instruments has also attracted new competitors, including PC Quote Inc., and ILX Systems, a new venture backed by International Thomson Organization.

At the same time, U.S. companies such as Quotron and ADP have been expanding their operations overseas. The growing interrelationship among the equities, futures, freed-income, and foreign exchange markets has also led to diversification among vendors who traditionally specialized in one market. Telerate Inc., which holds a near monopoly in the market for U.S. Government securities prices, has entered the equities market through its recent acquisition of CMQ Communications Inc., the leading provider of stock quotes in Canada.

The relative ease with which any vendor can obtain data from the leading North American stock markets and many of their foreign counterparts has changed the market for centralized market trade data into a commodity market, in the sense of relatively undifferentiated bulk goods, competing in terms of price. It has increased the competition among vendors so much that in order to maintain their profit

[14]Quotron is now owned by Citicorp; Telerate is now owned by Dow Jones & Co., Inc., long Telerate's majority shareholder.

[15]In early 1989, 426,000 were reported, according to Eric Philo and Kenneth Ng, *Reuters Holdings PLC* (New York, NY: Goldman, Sachs & Co., February 1989), p. 5. There maybe some double counting here due to screens displaying more than one vendor's data, and there has probably been some contraction due to securities firms reducing their labor force.

margins and to generate as much revenue per terminal as possible, vendors are trying to add value to the product through new technology or some special feature. Third-party suppliers are now encouraged to offer historical information, research, analytics, and tailored news services through the terminals of financial information vendors such as Quotron, Reuters, and Bridge. The vendors typically keep for themselves 30 to 40 percent of the revenue generated by third-party products.[16]

The commodity or bulk nature of equities trade data has no parallel in the fried income and foreign exchange markets, which depend on data contributed by dealers, banks or other organizations. But the largest securities firms have announced plans (at the end of April 1990) for a joint venture to distribute government bond data 24 hours a day. This network would include all 844 primary bond dealers and four major interbroker dealers, who execute trades for all dealers,

Reuters created the market for real-time foreign exchange data in 1973, when it first put computer terminals on the desks of banks' traders and persuaded them to enter their rates into the system. Reuters does not pay banks for contributing their quotes to the service, but charges subscribers a flat monthly fee. While Reuters is the strongest in the forex market, Telerate is a competitive alternate service. This benefits forex traders by providing a back-up quotation system and by assuring competition for Reuters. It was difficult for Telerate to gain a place in forex until Reuters agreed to permit its subscribers to install "binco boxes" —bank in-house computers—that let them simultaneously update their rates on Reuters and Telerate. Without the binco boxes, Telerate's forex market coverage was often slightly behind because dealers posted their rates on Reuters first.[17]

The financial information business is still growing, and continues to attract aggressive competitors. This may eventually bring down prices for information services. In the meantime, both the integration of markets and technological change are creating upheaval and uncertainty among financial information vendors. As recently as 5 years ago, a dealer's desk would typically hold a Reuters terminal and perhaps one from Telerate. Because markets did not greatly affect one another, there was no need for most traders in one market to be watching other markets .18 The technology generally used was a dumb terminal connected to a vendor's host computer by dedicated telephone circuits. But as a number of niche services sprung up, traders ended up with more and more dedicated terminals on their desks. Many of these were later replaced with personal computers, to allow local storage and manipulation of price information. The video switch eliminated the clutter of terminals on traders' desks by allowing several screens to be controlled by a single keyboard, and became an important part of trading rooms in many countries.

Several other technological advances in the early and mid- 1980s also irrevocably changed the delivery of financial information. In addition to using dedicated telephone lines, vendors began exploring other alternatives, such as broadcasting data by FM sideband and satellite. In the United States, commodity market data vendors began in 1981 to use small, low-cost, receive-only satellite dishes which were particularly effective for one-way broadcast communications such as financial quotations. They are now used by vendors such as ADP, Dow Jones, Knight-Ridder, PC Quote, Reuters, and Telerate. Although dedicated interactive networks remain the primary delivery mechanism of financial information vendors, financial data accounts for about 63 percent of the approximately 114,000 data broadcasting satellite receiving sites in operation in 1989.[19]

It is often cheaper for securities firms to buy hardware off the shelf than it is for them to lease equipment from vendors. In addition, the securities firms want to be able to choose whether to use a dumb terminal, a PC, or a UNIX-based workstation, and they would like industry-standard hardware that can be integrated with the fins's other systems. In recognition of this, Reuters recently stopped manufacturing terminals and Quotron plans to sell off-the-

[16]Roman, op. cit., footnote 13.

[17]Other major reasons for Telerate's success in penetrating the foreign exchange market are said to include two foreign exchange brokers arranging for Telerate to carry their quotes, the availability of AP-Dow Jones foreign exchange news on Telerate, and the need for U.S. Merest rate data.

[18]However, fixed-income traders always have needed to follow the f$_{ore}$@ exchange markets since currency prices and interest rates are closely linked.

[19]Waters Information Services, "DataBroadcasting Marketplace," New York, NY, 1989.

shelf equipment. ADP is also moving to industry-standard hardware.

Vendors have begun to offer their data in digital, as well as analog form, to satisfy the demand for analytical tools. Receiving a stream of digital data (rather than a pictorial image on screen) gives users more flexibility in viewing, analyzing, and using data--e.g., the ability to create customized composite pages. This has created a dilemma for financial information vendors because neither exchanges or vendors are sure how best to price digital information.

This has become a highly controversial issue: who owns the data, who has access rights to it, who can reformat and resell it, and when does reformatting constitute value-added service? The fees paid by customers have in the past been based on the number of terminals or display devices authorized to receive information in analog form. Resolving the data-pricing issue will become more complicated and more difficult as international data services become even more fiercely competitive.

Electronic Trading Systems

The commodity nature of data and the diminished role of information vendors as systems providers are causing vendors to move toward offering transactional services, using automated execution systems, Citicorp and McGraw-Hill failed with the GEMCO electronic commodity trading system a few years ago. The World Energy Exchange and the International Futures Exchange of Bermuda (INTEX) both failed to convert open outcry traders to screen-based trading in the futures market. But these and other failed ventures in automated trading have not deterred Reuters, which in 1987 bought Instinct Corp., a registered broker/dealer offering an electronic securities trading system that began in the 1970s. Instinct is now executing trades of an average of 13 million shares a day (including both NYSE-listed and over-the-counter stocks), a volume still tiny by comparison with the approximately 273 million shares traded by the New York Stock Exchange and NASDAQ together on an average day. Reuters hopes, however, that exchanges will begin using Instinct or another Reuters-developed system during the hours when their trading floors are closed.

Reuters launched the Monitor Dealing Service in 1981 to allow forex traders to negotiate transactions over their terminals instead of telephones. This system has been successful, perhaps in part because of its built-in audit trail. In 1989, between 30 and 40 percent of the $640 billion traded each day in the interbank foreign exchange market took place on the Monitor Dealing Service.[20]

Telerate did not until recently offer forex dealers a transactional system such as Reuters' Monitor Dealing Service, but it has now launched a conversational, or on-line, dealing system through a joint venture with AT&T, known as The Trading Service. This service allows dealers to have multiple "conversations, " that is, talk to several dealers at once, unlike the Monitor Dealing Service.

Reuters is taking another step forward in automated trading with an enhanced version of the Monitor Dealing Service and a centralized order database facility. While the original Dealing Service facilitates one-on-one negotiation between two traders, Dealing 2000 will emulate an auction market where bids and offers from multiple parties are exposed. This is designed to replace "blind" brokers, who act as middlemen in foreign exchange trading. The system will display the aggregate size of all bids and offers at each price, but will not disclose the identities of the dealers participating.

Quotron has not moved as rapidly as Reuters, but reportedly has electronic execution facilities in development for both foreign exchange and fixed-income markets. It has been aggressively marketing Currency Trader, which allows corporate customers of Citicorp to automatically execute foreign exchange trades of $500,000 or less.

Whether the foreign exchange market will accept the automated trading Reuters is offering through Dealing 2000 is still uncertain, but the technology used in that system was adapted for GLOBEX, a futures trading system being jointly developed by the Chicago Mercantile Exchange (CME) and Reuters.

CME is one of two Chicago futures exchanges trying to develop systems for ' '24-hour trading,' or the execution of transactions at a geographical distance or outside of trading hours of local markets, CME and the Chicago Board of Trade (CBOT) first

[20]Bank of International Settlement's statistics.

separately and now jointly, are taking the calculated risk that their own automated system--if successful--may eventually put out of business their traditional form of market, the "open outcry" or pit auction system. They may recognize the likelihood that international markets will eventually be fully automated and free of the constraints of time and distance, and know that if they do not take the lead, others outside the industry will do so.

This has come about because foreign futures exchanges began to compete directly with U.S. futures exchanges. There are financial centers in Auckland, London, Paris, Frankfurt, Zurich, Hong Kong, Tokyo, Singapore, and Sydney which now operate futures and options exchanges as well as stock exchanges. Because they began to offer their own local versions of U.S. contracts, investment firms were able to offer these products to customers without regard to trading hours in the United States. This trend drove the threatened exchanges to consider accommodating 24-hour trading.[21]

The first attempts to meet this competition took the form of mutual offset agreements. such as the one between The Chicago Mercantile Exchange (CME) and the Singapore International Monetary Exchange (SIMEX) for Eurodollar and foreign currency contracts. "Offset' (in this context) means that one can open a position in one country and close it in another, and pay only one brokerage fee. CME/SIMEX was for a time one of the most successful of the many offset agreements attempted by exchanges, although only marginally so.

Another response was to lengthen trading hours; for example, CBOT began both an earlier opening (7:20 a.m.) and an evening session,

In September of 1987, the CME announced that it would develop-together with Reuters-an electronic futures and futures-options trading network, the Post (Pre) Market Trade System, later renamed GLOBEX for "global exchange. " CME members accepted the idea, with the assurance that GLOBEX was strictly an off-hours system, and in return for receiving a portion of the revenues generated by GLOBEX.[22] On June 20, 1988 in London, England. the CME and Reuters Holdings PLC reached an agreement to adapt the new Dealing 2000 transaction system for the purpose. The network will operate only after normal CME hours of trading and will link investors in North America, Asia and Europe.

GLOBEX, when it opens in mid-1990, will be an interactive data communications network linking individual user terminals with a central computer at Reuters. For entry of orders, trader terminals consisting of keyboard, monitor. and printer will be located in the offices clearing members and individual members (including overseas members) who are qualified and backed by a clearing member. (See ch. 5 for an explanation of the responsibility of clearing members.) Administrative terminals, in the offices of clearing members only. would also receive confirmations of all trades resulting from orders entered into associated trader terminals. The terminals will display the 10 best bid and 10 best offer prices, along with the quantity bid or offered; the last sale price, and other data.

Reuters will provide the computer hardware and software and also make available other Reuters services (e.g., news and cash market quotations) through GLOBEX terminals. The exchange will determine the instruments. and the rules and procedures for trading, and will provide clearing facilities. auditing, compliance, and market surveillance, Despite Reuters being a British company. the joint effort is largely seen as a globally strategic move for the preservation and enlargement of the U.S. position in commodities and financial futures trading, It may also be a harbinger of global .● floor-less* . trading in the future. It is significant, however. that Reuters has recognized the value of partnership with an organized and regulated marketplace, the futures exchange.

MATIF (the French financial futures exchange) has already agreed to use GLOBEX for after-hours trading, and exchanges in other countries are also

[21]Karen Pierog, "How Technology Is Tackling 24-hour Global Markets,'' *Futures*, June 1989, p. 68.

[22]The rights conferred by membership in CME, or "a seat,'' are to be divided into access to pit trading and access to trading through GLOBEX. Members will have the right to "lease" one of these rights; e.g., a pit trader can lease to someone else, presumably overseas. his access to GLOBEX, thus generating additional income. If GLOBEX (or other electronic trading systems) comes to dominate futures trading, the increase in value of their access to it will presumably compensate the pit members for this competition.

expected to participate, when various regulatory issues are worked out.[23]

In 1989 the CBOT unveiled plans for another off-hours global system, "AURORA." While the GLOBEX system is an automatic order matching system, AURORA attempts to emulate the traders in the pit with icons (symbols) that allow traders to select the counterparts to their trade. The CBOT claimed that AURORA will capture "all of the economic advantages of the auction market combined with the advantage of the ability to conduct trading from any location in the world."[24] One interesting feature of both AURORA and GLOBEX is that they adjust the timing of all bids and offers to equalize for distance; i.e., the speed with which they are posted depends on the transmission time for the most distant trader active at that time.

AURORA also tabulates bids and offers by contract month, reports who traded how much with whom, and keeps a running tabulation of his positions for the trader. It automatically sends matched trades through for clearing by the Board of Trade Clearing Corp. The system uses Tandem mainframe computers, Texas Instrument artificial intelligence components, and Apple computer graphics.

There were complaints from the financial futures community about the need to install two terminals, and in May 1990, immediately after the Japanese Ministry of Finance announced that it would permit Japanese firms to subscribe to GLOBEX, CME and CBOT announced they would merge the GLOBEX and AURORA development efforts. The details of this agreement are not yet negotiated. AURORA may survive as an optional user interface. The operation of GLOBEX may be delayed until mid-1991.

The London International Financial Futures Exchange developed an electronic trading system, Automated Pit Trading System or AFT, which like the AURORA system, emulates open-outcry trading. APT is now trading about 4,000 orders a day, but is growing, and LIFFE may soon list thinly traded contracts only on APTS. The system is used now to extend trading hours to cover the European trading day, but it is not a 24-hour system and will not be available outside the United Kingdom. LIFFE says that the cost of high-speed communications links for worldwide trading is prohibitively high.[25] However, this could change if the LIFFE system proves popular.

There are also automated trading systems at the Irish Futures and Options Exchange, the London Futures and Options Exchange, the New Zealand Futures and Options Exchange, the Sydney Futures Exchange, the Tokyo Grain Exchange, and the Tokyo International Financial Futures Exchange. These trading systems, like those in stock markets, were not designed for 24-hour trading, but possibly could be adapted. Some of them were specifically designed for trading after exchange-hours.

Reuters' success in recruiting exchanges to use its automated trading facilities is not limited to the futures market. The Chicago Board Options Exchange and the Cincinnati Stock Exchange have agreed to form a joint venture with Reuters and Instinct to create a worldwide system for entering, routing, and executing options listed on the CBOE and equities traded by the Cincinnati Stock Exchange, the only fully automated securities exchange in the United States.

The New York Stock Exchange recently announced its intention to study the feasibility of off-board 24-hour trading systems. The over-the-counter dealers represented by the National Association of Securities Dealers (NASD), plan to extend their automated quotation system, NASDAQ, to the United Kingdom, allowing NASD members both in the United Kingdom and in the United States to make markets in several hundred issues during normal U.K. trading hours, and to use NASDAQ services during the-se hours. If approved by the Securities and Exchange Commission, the system will be open from 4 a.m. to 4 p.m. eastern time *(9*

[23] At one point, it was thought that the Sydney Futures Exchange and the London International Financial Futures Exchange (LIFFE) had already signed agreements or were ready to do so. The agreements with LIFFE were reported to have broken down because of a demand by CME for "exclusivity," i.e., that LIFFE not join other systems and not list contracts that would compete with CME products. David Burton, Chairman of LIFFE, as quoted in "Unraveling a Technology Tangle," *Futures adoptions, special* supplement to *Euromoney*, July 1, 1989.

[24] "AURORA—EOS," promotional literature distributed by CBOT.

[25] "Europe Forges Ahead in the Technology Race," *Futures adoptions, Special* Supplement to *Euromoney*, July 1, 1989, p. 2.

a.m. to 9 p.m. London time).[26] NASD dealers will have a choice, on a security-by-security basis, of being a U.S. market-maker, a European market-maker, or an international market-maker, and their workstation capability will be defined accordingly. All NASDAQ market services except for its automated small order execution system (SOES) will be available internationally. NASDAQ already shares quotes with both the London and Singapore stock exchanges, for 700 and 35 cross-listed securities, respectively. Automatic intercontinental execution and trade confirmation will now be possible over the link.

NASD will also introduce, in 1990, an electronic system for global trading of unregistered (privately issued) foreign and domestic debt and equity securities. The PORTAL[27] system will allow users to dial up a special NASD host computer for both primary and secondary market trading; participants will also be able to use their NASDAQ workstation for secondary trading. All sales will be negotiated (investors will get quotations, last-sale price, and volume details on screen, in major currencies but will work with a dealer). PORTAL will lock in transactions and allow settlement by electronic book entry through the International Securities Clearing Corp. [See figure 2-l.]

TECHNOLOGICAL BARRIERS TO 24-HOUR TRADING

Technology risks, such as communications outages, are an important factor in 24-hour trading. Line outage and other contingency plans must be coordinated over several countries, different languages, staggered time zones and varying numbers of telephone companies. For example, to maintain a dedicated circuit from New York to Tokyo can involve from five to seven telecommunications companies. This makes contingency plans difficult to formulate. Global operations require competent and experienced management at all levels around the clock.

Although technology costs are declining relative to capabilities and services offered, at the same time development costs, operational costs, and maintenance costs of automation have risen. Automated systems rapidly become obsolete as new technologies develop; they require sophisticated management information systems and technical infrastructures, with high re-engineering costs. Regulatory rules often influence or even dictate technologies that must be used. These rules in many cases have had a positive impact on the industry. For example, The New York Stock Exchange's rule number 387 requires all member firms to confirm their trades with institutional clients through the Depository Trust Co.'s automated Institutional Delivery system or its equivalent to be eligible for the delivery v. payment function--i.e., to pay for securities only when actually received (by book entry) and not before. But other regulatory, legislative, and political processes inhibit automation, including disputes over regulatory jurisdiction and foreign legislation prohibiting dissemination of some data. Resistance to change, respect for tradition, and social customs—which may reflect deeply rooted institutional relationships, strong economic interests, or cherished values-also significantly impede automation in some foreign countries.

THE PROBLEM OF STANDARDS

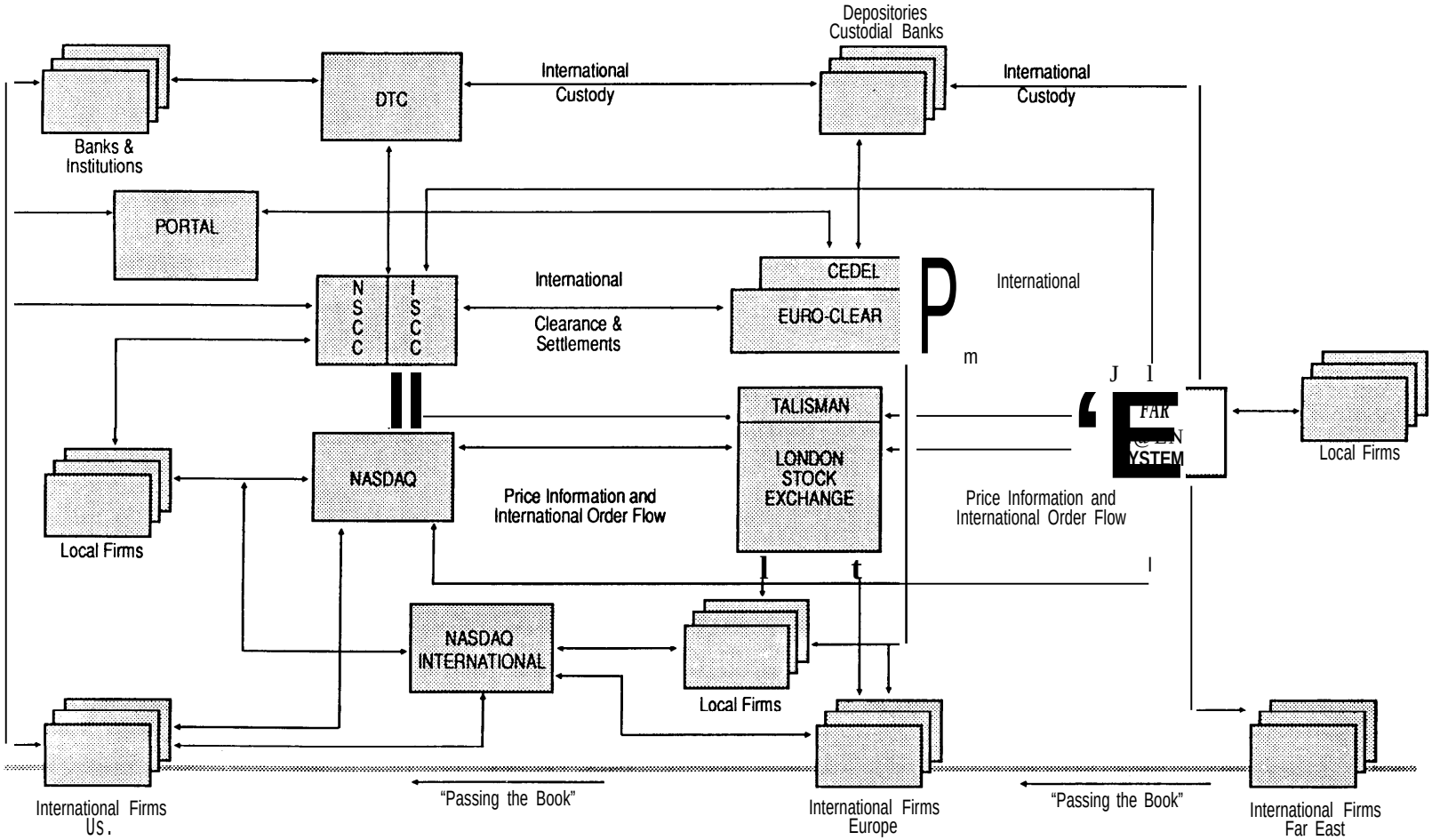
Electronic 24-hour/global trading has several problems yet to be solved. One is the issue of international regulation to control global market and credit risk and to coordinate post-trade procedures. Another is the lack of global data standards.[28] Two levels of standards are important, those that affect communication of data in general, and those that particularly affect securities trading. The needs for

[26] There will be two new kinds of market-makers on NASDAQ after this system opens—European-only market-makers from 4 a.m. to noon eastern time and international market-makers from 4 a.m. to 4 p.m., in addition to existing U. S.-only market-makers. Market-makers will make the choice on a security-by-security and terminal-by-ter——l basis. *NASD Executive Digest,* June 1989.

[27] PORTAL stands for Private Offerings, Resales, and Trading through Automated Linkages.

[28] Standards are general models, specifications or criteria for technology, designed to allow technological applications coming from different producers to be interoperable. Interoperability allows users to mix and match components of, for example, communication systems and also makes it easier for them to migrate to a new system, phasing out older equipment gradually. Standards may be set by custom or general consent, by market forces, or more formally by authority. In the United States, standards—when they exist-are set by industry, often through professional associations. Standards-setting in the United States is becoming more politicized, especially in communications standards, since the Bell System no longer sets standards de facto. See U.S. Congress, OTA, op. cit., footnote 1, pp. 297-299.

Figure 2-1--Overview of International Trading Through NASD



SOURCE: National Association of Securities Dealers.

global standards range from technical standards and common languages to bank holidays.[29]

International standards are becoming increasingly important for 24-hour trading; these problems are not new to the general demands of international commerce. The need for standards has arisen in many other fields, from railroad and air transportation to early telegraph, telephone, and most recently, computer-to-computer, facsimile, and digital voice communications. In each of these cases, countries developed their own systems, often independently of one another, often with little concern for future international standardization or harmonization with other countries' systems.

As needs for international commerce emerged, countries typically moved to develop a set of compatible international standards. This often led to establishing an international organization to facilitate or coordinate worldwide standards-making. Some of these, like the International Organization for Standards (ISO), became permanent. The same pattern of evolution is happening today in the financial securities field. A half dozen international bodies are currently studying some aspect of standards-setting for international trading or regulation of these markets.

Standards that affect the financial trading industry, including markets, clearinghouses, brokerage and banking industries, information service industry, etc., are established in many different forums. The U.S. subgroup of ISO and the American National Standards Institute set industrial standards for information processing and other technical subjects. The principal international bodies include ISO, which is the most influential; the Comite Consultatif International Telegraphique et Telephon (CCITT); and recently several new international bodies, composed of representatives of the private sector and governments, have also been formed. Standards developed by these organizations are formulated by consensus (75 percent of the IS0 body must approve a proposed standard prior to acceptance and promulgation). After a standard is formulated, its adoption by member firms is still voluntary.

Technology standards are critical in terms of "the weakest link. ' That is, if the technical performance or capacity of a market participant, or clearing member, is below those of the market or clearinghouse, then the benefit of the market's or clearinghouse's technology is compromised. There is no minimum standard required today for the technology a broker or futures commission merchant must have, either internationally or domestically, in order to offer its clients the best access to price information or to clearing services.

Developing compatible standards for trading financial instruments is as important to international commerce as having the same gauge railroad tracks in neighboring countries. The standards now being focused on by national and international bodies eventually will provide the infrastructure for large-scale global trading. Until then, obstacles, risks, and inefficiencies will remain in international trading.

Two types of standards[30] are important for both domestic and international trading of securities, and particularly for clearing, settlement, and payments systems. The first type is technical standards, the second includes standards governing details of the process by which trading takes place and the infrastructure that supports trading.

Technical standards would include those that apply to international communications in general—e.g., international digital network standards for worldwide voice, data, and graphics services. Historically, there have generally been two sets of communications standards, the CCITT standards of the International Telecommunications Union followed in most of the world, and U.S. standards that evolved more or less de facto through the dominance of the Bell System in the United States.[31] U.S.

[29] Differing bank holidays is a serious problem; because, when banks are closed securities transactions cannot be settled, and more importantly credit cannot be provided for market participants, to assure continued liquidity. Consider the consequences if the October 1987 market crash had occurred 1 week earlier, on Columbus Day. U.S. exchanges were open but U.S. banks were closed, and critically important credit would not have been available to bolster market liquidity.

[30] Although only two categories of standards are used here, other treatments might use four categories: process, risk assessment, infrastructure, and procedures. Some of the examples cited in this section do not lend themselves to the adoption of uniform standards, but rather needed improvements can be affected through harmonization. In some countries, for example, it is illegal to disclose or transmit overseas information concerning a person's financial position. As another example, there are also problems in assessing risks that stem from different accounting practices in various countries.

[31] Ithiel de Sola Pool, "Competition and Universal Service," in Harry Shooshan (cd.), *Disconnecting Bell, The Impact of the AT&T Divestiture (New York, NY:* Pergamon Press, 1984), p. 119.

equipment suppliers have increasingly had to adopt standards set internationally, in order to compete in world markets.[32] Two major sets of standards, for ISDN and for open systems interconnection, are currently being debated in various international meetings and consultations. With the planned integration of the European Community (EC) market in 1992 (ch. 4) there are even stronger reasons for U.S. industry to coordinate its standards with those of the rest of the world. The EC established a European Telecommunications Standards Institute in 1988 for standards development.[33] A continuing industry-wide effort is needed to coordinate U.S. standards with evolving global standards.

Some basic technical standards are essential for financial communications. One example is a universal standard for international communications message formats that facilitates instantaneous identification of the exact details of a trading., the nation and firm originating the trade, the number of shares or contracts being traded, the price, and the identity of the transactors.[34] Other examples include technical details of how screen-based trading should occur globally and the minimum level of technology to be used by all participants.

Procedural standards are even more important. They apply to operational aspects of trading, clearing, and settlement; e.g., such as the method for trade matching, number of days to settle a trade, use of a depository for holding equities, use of a recognized numbering system for identifying financial instruments and transactions, formats for data transmission, the method of payment, etc. Infrastructure standards refer to the method of regulation, mechanisms to protect the clearinghouse against the financial failure of a clearing member, existence of funds to protect customers of a failing broker or futures commission merchant, bankruptcy laws to adjudicate the disposition of customer assets if a broker fails, credit processes at banks, clearinghouse guarantees, etc.

These standards govern the specific dimensions of investor-protection regulation and fiscal responsibility. Prospectus standards (disclosure of information about a new issue), accounting standards, and ownership standards[35] are especially important in international trading.

Neither technical standardization nor harmonization of regulations will come easily, cheaply, or swiftly. Some markets will have to make costly changes, while others will need more modest changes. Even modest changes can prove very difficult and time-consuming to implement because of the complexity of effecting change in established procedures, and because any change can challenge vested interests.[36] Some changes may be implemented by the private sector alone, but others will require government assistance, in the form of changes to regulation or legislation.

Government involvement in standards-setting, in the United States, is controversial. There is a long history of resistance to it from within the government as well as by industry. But business firms have little experience, and in many cases little interest, in protracted international negotiations. At a minimum, encouragement, facilitation, and leadership from government will be needed. More active government participation in developing international standards related to securities trading will probably be critical, because other governments are deeply involved in the standards-making process.

---

[32] U.S. Congress, OTA, op. cit., footnote 1, pp. 295-300. For example, computer vendors and telecommunication carriers had to adopt tie CCITT X.400 standard for electronic mail. Also, the Federal Communications Commission has tried to speed up the U.S. standards-setting process for high definition television because standards are being developed and adopted in other countries.

[33] This institute is financed by all of the European PTTs and major telecommunications suppliers.

[34] Today, each country has its own system for identifying trade data information, so there is little compatibility among these systems internationally. Recommendations have been made by the Group of Thirty to adoptISO standard 6166, which provides a uniform structure for the International Securities Identification Number, and standard 7775, which deals with the uniform structure of securities messages, i.e., the message types. However, no country has to date implemented either standard. Additional inter-depository/clearing system message standards are being developed.

[35] Countries differ as to the definition of a "share" and what rights are included—e.g., shareholder voting rights.

[36] This has been the experience of the U.S. Task Force of the Group of Thirty, attempting to b@ about change in clearing and settlement processes, as discussed inch. 5, according to OTA staff discussions with Gerard Lynch, a Managing Director at Morgan Stanley, Inc. and head of the U.S. Working Group of the Group of Thirty, December 1989.