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The status of ISDN in the USA

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Implementation of ISDN in the USA has been slow. This article describes the present rate of ISDN uptake and reviews the regulatory and other factors which have hitherto impeded more rapid adoption of the technology. ISDN will be widely deployed in the near future, the author believes, but exactly how this comes about, and how quickly, will have major economic, political and social consequences.

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Because of economic, regulatory, technical and social factors specific to the USA, implementation of ISDN there has been slow. Changes in these factors will determine how quickly the new technology is to be produced and consumed in the future; failure to change could affect the US telecommunications infrastructure and permit foreign competitors to take the lead in equipment sales. The purpose of this article is to clarify the current status of ISDN in the USA, as well as to investigate this technology's future outlook. We will first take a brief look at the history of telecommunications in the USA, after which we will concentrate on the current ISDN market, first from the supply side and then from the demand side. Finally, in considering both the economic and sociological ramifications of ISDN implementation in the USA, we will have a better idea of its future potential.

Historical background

US government intervention in the telecommunications industry has, in the past, had a strong influence on technological innovation and implementation. The tendency in telecommunications policy has been to accept monopoly structure in varying degrees; even in 1787, during the time of the drafting of the Constitution, politicians directed Congress 'to establish post-offices and post-roads'. Later the US Post Office was to become an official part of the government.

Telegraph development also followed the belief in telecommunication's 'natural monopoly'. In the 1850s, as the telegraph industry grew, Western Union Telegraph Co used lobbying tactics to receive federal and state assistance in the form of subsidies. With these funds the company was able to complete its network and gain market dominance.

The telephone industry, likewise, was a domain where competition was viewed as economically impossible. With the exception of a brief period from 1894 until 1910 in which independent companies entered the market and subsequently created confusion in the telephone system with the introduction of incompatible equipment, the industry has recognized and encouraged monopoly structure. In 1910 and 1921 Congress passed laws permitting monopoly positions for both local and long-distance companies;[1] their aim was to have a national telephone policy that would make service as equitably and widely available as possible. The Communications Act of 1934 sought to keep communications services rapid, efficient and reasonably priced, and resulted in

[1]The Mann-Elkins Act of 1910 and the Graham Willis Act of 1921

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AT&T's monopoly. In time the public network was physically and financially implemented: firstly by Bell Laboratory's technological innovations, and secondly by cross-subsidization (where long-distance service supported local service, and commercial use subsidized residential use). As a result AT&T provided most of the local service through its 26 local companies and exclusively controlled long-distance service. In addition, the USA had one of the best telephone systems in the world (taking 100 years to build, and worth $100 billion) and provided universal service at affordable prices. During the 1970s a trend towards liberalization and deregulation began, as large telecommunications users discovered that the regulated system did not allow them to benefit from new technologies and restricted their international business. Their political pressure was effective, and in 1984 AT&T was separated from its 26 local companies by a US court decree calling for divestiture; the resulting structure was a freely competitive long-distance network and a regulated local network divided among seven regional companies.

Today policy trends are directed towards deregulation, as well as towards a competitive environment. Despite these efforts the US telecommunications industry remains highly concentrated, and the government continues to support large firms' research. The Bell companies, in fact, are primarily responsible for ISDN trials in the USA, beginning as early as 1986.[2] Currently, however, foreign competition is the industry's biggest threat.

Although US telecommunications' supply side has been limited by government policies, the demand side of the telecommunications market has been more positively influenced. One reason is that policy decisions led to price reductions and encouraged consumer adoption of technology. This pattern was experienced in the postal, telegraph and telephone industries. In all cases, as prices dropped, usage grew. Thus the history of US telecommunications shows the importance of pricing and regulation as factors influential to innovation and implementation.

ISDN: supply

The suppliers

In pursuing a study on the status of ISDN in the USA it is important to first ask who the suppliers are. In the telephone network these suppliers are divided into three principal groups: local and long-distance network operators, equipment vendors, and information service providers. Of the operators, the first and foremost are AT&T and the seven regional Bell operating companies (RBOCs or 'Baby Bells'): Ameritech, Bell Atlantic, BellSouth, Nynex, Pacific Telesis, Southwestern Bell and US West. Of these, Ameritech, Southwestern Bell and US West have most aggressively pursued basic rate interface (BRI) ISDN implementation, each having contracts for about 20 000 lines.[3] Firms have also been active internationally: AT&T has exported its digital technologies to Japan, Indonesia, Italy, Jamaica and the UK, and is working on entering the French and German markets. The regional Bells, for their part, have gone abroad with cellular communications (as US West has done in Hungary) as well as with cable television. Current federal and state legislation does not limit the Bells' overseas sales.

The Bell companies' primary switch suppliers are AT&T and Northern Telecom (Canadian–American) who together lead public switch sales in the USA. In 1990 they delivered 300 000 BRI lines, and

[2]Examples are given in the section entitled 'Current applications of ISDN', below.

[3]Basic rate interface = two B channels of 64 kbps and one D channel of 16 kbps for each telephone line; also referred to as '2B+D': D. Bushaus, 'In the United States, the Bells are betting on ISDN's future', *CommunicationsWeek International*, 21 May 1990, pp C8–9.

estimates predict 450 000 lines will be delivered in 1991.[4] The two companies supply 85% of the central office switching equipment that directs telephone traffic.

Another equipment manufacturer which provides for the US ISDN market is IBM, which works in conjunction with the Bell companies to provide BRI ISDN service. Other manufacturers include Network Equipment Technologies (NET), which has introduced a Sonet-based switch that is standards-based, and modem-makers like Hayes Microcomputer Products, which has released an ISDN PC adaptor. Codex Corp is working on supplying functions such as security in an ISDN environment. Another company, Dale, Gesek, McWilliams & Sheridan, which conforms its products to Bell Communications Research (or 'Bellcore', the operating companies' research laboratory) specifications, has entered the market with a network workstation and a technology-transfer software package using common-channel Signaling System 7.

Foreign efforts to acquire and start up telecommunications manufacturing companies in the USA have resulted in new suppliers. Taiwan computer company Mitac, for example, launched Micro Integrated Communications Corp (MICC) in October 1989 in California, and plans to manufacture low-cost ISDN products. Likewise France's Matra Communicatiion has signed a letter of intent to acquire InteCom, Inc, of Dallas: it will market a low-end, ISDN-compatible private automatic branch exchange (PABX).

Impediments to supply

Regulation. Despite the seemingly adequate number of suppliers of ISDN equipment and services in the USA, several impediments have restrained growth. Perhaps the most important of these is the government regulation placed on the telephone industry.

At first, monopoly policy in the telephone industry was universally accepted, and competition was considered undesirable for the telecommunications infrastructure. Rate structures encouraged a certain amount of reinvestment of revenues to improve the national telephone system. The Federal Communications Commission's (FCC) belief in telecommunications monopoly, reflecting earlier approaches to postal and telegraph service, was successful in guaranteeing universal service, but attracted criticism for its disincentives to investment and advancement; its 'rate-of-return' rules limited companies' allowable profit margin, which in turn discouraged innovation. The generalized rejection of monopoly in public networks, as we have said, resulted in AT&T's 1984 break-up in an antitrust consent decree, which was overseen by US District Court Judge Harold H. Greene. However, the local monopoly was kept, and Judge Greene placed restrictions on the US regional Bells; they were forbidden to provide long-distance service, to provide information services and to manufacture equipment. These restrictions denied the RBOCs' development of the technology, even though their contribution (in voice storage and forwarding, videotex and electronic mail, for example) was needed. The RBOCs were limited to reselling other companies' products, which may have discouraged them from investing or innovating. Thus the telephone industry, hindered by regulatory mechanisms, is distinguished from others (like the computer industry) which prosper under free competition.

These impediments, however, are slowly being lifted. In 1989 Judge Greene modified the information services restriction to allow protocol

[4] *Ibid.*

and code conversion, voice storage and forwarding, electronic mail and electronic white pages, but still banned content generation and content manipulation. In April 1990 the US Court of Appeals asked Judge Greene to reconsider his stance on information generation, and to give the Bells more freedom to provide information services. The court nonetheless supported the judge's bans on manufacturing equipment and providing long-distance service. FCC chairman Alfred Sikes, however, told a Senate subcommittee shortly thereafter that if the RBOCs were permitted to manufacture equipment, regulation could protect ratepayers from abuses. (Earlier, in December 1989, Sikes had announced at an intelligent network conference that he expected regulation to be eased by mid-1991, by Congress and/or the FCC.)[5] In June 1990 a US court rejected the FCC's Computer Inquiry III decree, which would have permitted the RBOCs to provide enhanced services without the establishment of separate subsidiaries.

Indeed, the movement towards deregulation in the telephone industry has turned into a national debate. The Bell companies themselves are the greatest proponents of 'freeing the Bells', citing the trailing US investment in local telephone networks as well as the possibility of new information services as the primary reasons for change. According to sources at the University of Southern California, the USA invests $150 per subscriber line per year, as compared with Japan's NT&T, which invests $270–300.[6]

Critics, on the other hand, claim that deregulation is dangerous: the Bells would take advantage of their monopoly position (serving regions with 80% of the subscriber lines in the USA) and would overcharge captive customers in local service, later using the profits to enter other markets. Antitrust protection, they say, is essential to a competitive industry. Author Vincent Mosco, for example, points out that major firms have the political ability to change market structure, eliminate competition and use regulations to their advantage.[7]

The 'Free the Bells' movement, however, has Sikes's influence on its side. Named chairman of the FCC in 1989, he has become known for his pro-deregulation beliefs in which the communications industry should be directed by markets, not regulators. 'I see myself as an activist,' he says. 'I want to make sure we align our regulations to the new competitive realities of the workplace.'[8] Sikes's orientation pleases the Bells and others in the telecommunications industry who believe that too much power lies in the hands of Judge Greene. On 9 February 1990 a bill was drafted to shift much of this power to the FCC and Congress. Although this bill was not passed, it is perhaps a sign that the Bells' other restrictions may be lifted in the future.

Current FCC communications policy's three major objectives give witness to the trend towards deregulation.[9] The first objective, according to Sikes, is to sustain and strengthen the competitive system. This is possible through the removal of institutional barriers, but also requires regulatory steps to maintain fairness in the marketplace.The second is to encourage the maximum investment in the US telecommunication system. The third FCC goal is to coordinate and streamline the overall regulatory process. Sikes explains that the general consensus believes some level of economic regulation is nonetheless necessary, and US regulators must impose penalties, disincentives and sanctions on private actions which society views as undesirable. Meanwhile, desirable acts of investment, consumption and planning should be encouraged. With

[5]M. Rockwell and B. Schultz, 'US IN feared falling behind', *CommunicationsWeek International*, 15 January 1990, p 11.
[6]P. Coy, 'Should the US free the Baby Bells?', special report in *Business Week*, 12 March 1990, p 120.
[7]V. Mosco, 'Deja vu all over again?'. *Society*, July/August 1989, pp 36–37.
[8]M. Lewyn, 'The smooth operator making connections at the FCC', *Business Week*, 23 April 1990, p 45.
[9]A. Sikes, 'The objective of the FCC: strengthening and facilitating full and fair competition', speech delivered before the *Financial Times* World Communications Conference, London, UK, 4 December 1989; reported in *Vital Speeches*, 1 March 1990, pp 317–320.

these goals in mind, the FCC is slowly adapting its policies to the evolved telecommunications environment.

Standardization. Past experience has shown that in order to have an efficient, successful telecommunication systems there is need for coordination in both the technological and regulatory domains. Sociologist James E. Katz, who specializes in telecommunications and computers, confirms that before different information processing systems can be interconnected, standardization questions must be resolved.[10] He specifies that, currently, electronic mail messages cannot easily be sent from one commercial network to another. Ideally, he says, standards would permit interconnection of personal computers, fax machines, printers, telexes, electronic mail services and telephones; such standards would promote economic efficiency and social progress.

Nonetheless, the Bell companies have been working with several groups in order to coordinate ISDN standards. These groups include the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE) and the International Telegraph and Telephone Consultative Committee (CCITT). In addition, the FCC supports the proposal forwarded by US state regulators who would like to organize a formal group to set standards for public network connectivity. These coordinated efforts are working towards common ISDN standards.

Widespread availability of ISDN, however, will take many years, depending on how quickly standards are implemented. Analysts say that US implementation of ISDN has moved along too slowly, partially because of the long standardization process needed for packet switching and manufacturer compatibility.[11] In addition, the standards are interpreted differently by each local telephone company, and some, like Bell Atlantic, are served by several switch vendors, and have separate software needs. Until such compatibility problems are resolved, Bell tells the manufacturers that it will offer, but not actively market, the ISDN network. Nevertheless reports say that the Bells are already expecting to see a better selection of compatible equipment in 1991.[12]

Costs. Another impediment to ISDN development equally debated in the US telecommunications industry is cost. Because ISDN is a network favouring wide-scale service introduction, it is economically difficult to launch. Operators must change many components of their networks, such as switching and software, and manufacturers must produce the necessary equipment. These changes require time and money.

Some companies have decided that it is not worth the risk. GTE, for example, cancelled its plan for the development of ISDN software. It had scheduled to deploy ISDN for 1992, but claimed that the high costs forced the project's cancellation. The company notes, in any case, that Northern Telecom and AT&T are coming out with similar products; GTE will explore other ways to provide its customers with services.

Other companies, such as PictureTel Corp of Massachusetts, are experiencing similar difficulties due to the high costs of videoconferencing equipment such as Codecs, used for the conversion of analog signals to digital ones and for the compression of pictures for video transmission. This videoconference equipment manufacturer is six years old, and still unprofitable, a sign of the industry's high entry costs for suppliers.

[10]J. Katz, 'Pivotal Issues', *Society*, July/August 1989, p 9.
[11]Bushaus, *op cit*, Ref 3, p 9.
[12]*Ibid*, p 9.

Nonetheless, in comparison with fibre optics narrowband ISDN operations emerge as affordable. Fibre-to-the-home installation costs in the USA have been estimated at more than $250 billion, including fees for trenching, terminal electronics and installation labour.[13] Narrowband ISDN's use of existing copper cables, thus avoiding the need to start anew, has helped the technology move from the trial stage to actual delivery in 1988 by several US telephone operating companies.[14]

The question still remaining, however, is how the nation will fund the future telecommunications infrastructure. According to critics of the old system, it has become obvious that a regulatory reform is needed.[15] Because costs are high, regulation must permit flexibility in earnings to encourage investment and introduction of new services. At the same time, traditional regulatory goals such as universal service should be retained so that all members of society may benefit from the Information Age. One of these critics, Bailey M. Geeslin, says that what is needed is a regulatory reform package that will further a market-based approach.[16] He discourages rate-of-return regulation (which prices above market) and direct government support (politically intolerable in the USA due to the huge budget deficit and the belief in a competitive environment). New regulatory policies, he says, should consider not only cost savings and revenues from known services but also those resulting from network use by other services. In this sense the 'integrated and incremental nature of network investment' is taken into consideration, with basic service redefined from plain old telephone service (POTS) to an infrastructure of information services.

Current applications of ISDN

While it is true that the USA has not seen a rapid development of ISDN capabilities in its domestic network, it is also true that ISDN implementation does currently exist. At the local level, as we have seen, the regional Bells have of course been most active in ISDN implementation. The resulting network consists of an 'island-type' structure, with ISDN use concentrated in large cities. At the national level AT&T and MCI, as well as specialized carriers, have been most involved in ISDN. AT&T's main applications aimed for international ISDN service include videoconferencing, local area network interconnections and facsimile transmission.

Manufacturers, for their part, have introduced equipment to be used in these networks. Mitac, for example, has focused on the development of products such as ISDN terminal adaptors. Future developments will deal with PABX switch designs, and integrated voice, data and image ISDN workstations. Dale, Gesek, McWilliams & Sheridan Inc has developed an intelligent network workstation and a software package with common-channel Signaling System 7 capabilities. By using basic rate ISDN, these tools provide functions such as data and voice encryption, facsimile, answering machine applications, videoconferencing, speaker phones and digital speech.

Companies specializing in videoconferencing brought their products to the market in the mid-1980s, and some corporate studios decided to locate in the USA because of the comparative price and quality of networks. One such company is PictureTel. Together with chip maker Intel it has developed microprocessors for PC manufacturers, making possible videoconferencing from the desktop. Another US company,

[13]D. Wilde, 'Fibre winding its way to the home', *CommunicationsWeek International*, 23 April 1990, p 16.
[14]S. Weinstein and P. Shumate, 'Beyond the telephone', *The Futurist*, November/December 1989, p 9.
[15]Such critics include Bailey M. Geeslin (Vice President of Marketing and Technology, Nynex), G.A. Keyworth (Director of Research, Hudson Institute) and Gary Ames (President of US West).
[16]B. Geeslin, 'Funding the future infrastructure', *Society*, July/August 1989, p 22.

Video Telecom, has developed Conference System, which it says is the only videoconferencing product already carrying graphics and data. Modem suppliers aim for more immediate ISDN uses, such as high-speed data transmission.

At the regional level, the seven RBOCs have started various trials. One of the first was Project Victoria, begun in 1986 by Pacific Bell in Danville, California, for 200 customers. Another early trial was conducted by Illinois Bell for McDonald's, also in 1986.

Nynex's New York telephone company began a statewide ISDN trial in March 1990. The trial is composed of two phases: first, the interconnection of local and long-distance carriers, and second, the integration of equipment produced by various suppliers.

At about the same time US West began conducting a trial combining its ISDN service with IBM's Information Network, the result permitting users access to BRI. Users of the US West–IBM trial had access to electronic mail, marketing programmes and other business applications. IBM eventually hopes to have connectivity with the Bells in 20 major US cities.

Although the regional Bells have been active in setting up trials, current regulation has been a disincentive for product manufacturing. Bellcore has been testing several prototype services that would satisfy market demand. One of these is the Videowindow, an advanced video teleconferencing system. However, because Judge Greene's restrictions do not permit Bellcore researchers to market the product, and no other company has adopted it, Videowindow remains unsold. The President of US West, Richard D. McCormick, believes that allowing the RBOCs to enter the market could have a positive influence on the US telecommunications equipment trade deficit, which came to $1.9 billion in 1989.[17]

Whether or not the trade deficit is entirely due to government regulation, the fact remains that US telecommunications companies have lagged behind their foreign competitors in investment for the last five years.[18] Furthermore, new technologies such as digital signalling systems, permitting caller-ID and other telephone services, are often first created in the USA but afterwards sent to other countries, such as the UK, France, Japan and Singapore.

Current US telecommunications research also centres on broadband fibre-optic networks. In recent years dozens of fibre trials have taken place. One began in 1988 in Dakota Dunes, South Dakota: in a joint effort with US West, real estate developer Dakota Dunes Development Co began a project for a self-contained city which would appeal to communication-intensive businesses such as credit card, insurance and computer companies. The 2000-acre community employs a $1.8 million fibre network, and should be completed within 12 years. It is foreseen that the fibre network will be used for high-speed data services (such as ISDN) and videoconferencing.[19]

ISDN: demand

The users

Despite barriers to entry restricting supply in the US telecommunications market, there is nevertheless an ever-growing demand for data transmission services. This demand is a boost for the US telecommunications industry, which has a compound annual growth rate of 6%

[17]Coy, *op cit*, Ref 6, p 124.
[18]C. Work, 'Wiring the global village', *US News and World Report*, 26 February 1990, p 46.
[19]D. Bushaus, 'Developer lures business with fibre', *CommunicationsWeek International*, 15 October 1990, p 26.

and potential revenues of around $15.1–26.5 billion by the year 2000.[20]

Large communications companies constitute a major portion of ISDN users. IBM, for example, uses BRI ISDN for various business applications including electronic mail and marketing programmes. Other corporate users include Chevron and General Motors (GM). GM reports that it makes use of digital facilities where they are available; its US network is digital and its global conversion to digital is still in progress. As more and more countries convert to digital infrastructures, ISDN is seen as having great potential for companies such as GM.

Tenneco, of Houston, Texas, is one of the USA's largest ISDN users: it has over 2400 lines installed. The company uses ISDN's integration of voice and data to bring together offices in remote locations, with Southwestern Bell support. Other users of Southwestern Bell include Shell Oil, 3M and AT&T technologies.

Other ISDN customers include several US medical schools. Stanford University, Duke University, Harvard University and Johns Hopkins Health Systems use a primary-rate interface to link the medical schools of each campus. The network allows the institutions to transmit data, images and video. They report that transmission of radiographic images is one of the network's most useful applications.[21]

In addition to large firms, many small firms use ISDN for data and voice transmission. The firms consist of a wide range of business areas, from finance to health care.[22]

Thus the demand side of the telecommunications equipment market has been highly fragmented, for the most part in the private sector. According to Peter W. Huber of the Manhattan Institute for Policy Research, private buyers make up 40% of the purchasers of the telephone switching market and 20% of fibre-optic cable and electronics.[23] However, as far as ISDN is concerned, this demand centres mostly on large and medium-sized companies rather than on residential use.

User needs. In February 1990 Kanupke Associates of New Jersey conducted a survey of 111 data communication and information services managers of large US companies to find out which services were of interest to potential ISDN users. The managers' responses showed that 2% already used the service, 10% had definite plans to use it and 50% would probably use it.[24]

Moreover, 92% of the managers wanted ISDN for terminal-to-host connectivity, 90% wanted personal computer-to-host connectivity and 82% wanted PC-to-PC connectivity. Currently, the service is used for its voice features, like call conferencing, as well as its information displays, like caller identification. In addition, the managers reported that they would use ISDN for customer service purposes.

Other sources also see an open market for data services. William Ferguson, chairman of Nynex, says that wide-scale use of facsimile machines, voice mail and credit card transactions by telephone prove that the public is eager for telecommunications advancements.

Different companies choose ISDN services for different reasons. Some companies use it for specific applications. Allied-Signal uses ISDN for videoconferencing, network access and facsimile, and may use it for future applications in disaster recovery and international communications. McDonald's likewise has plans to use ISDN for mainframe access, facsimile, packet switching and public network access.

[20]Geeslin, *op cit*, Ref 16, p 18.
[21]'Stanford to join med net', *CommunicationsWeek International*, 15 October 1990, p 23.
[22]Examples include First Chicago Corp, which provides financial services, and CardioCare, a health services company.
[23]P. Huber, 'The new competitive environment', *Society*, July/August 1989, p 28.
[24]D. Bushaus, 'Users voice their interest in data', *CommunicationsWeek International*, 21 May 1990, p C10.

Impediments to demand

As in the supply side, numerous impediments exist which have restricted market demand. Price, standardization and consumer awareness and education are a few of these. According to the Kanupke Associates survey, pricing and connectivity are end users' top concerns for ISDN service.

Pricing. Until now users have hesitated to adopt ISDN, waiting for the point at which ISDN is more cost effective than analog-based networks. Until it is, users will hang on to modem technology, which is less expensive and in which they have already made substantial investments. High ISDN terminal equipment costs are a disincentive; however, consultants forecast price reductions as user demand increases. In the meantime companies such as Hayes Microcomputer Products offer users hybrid products, using both analog and ISDN digital technologies. It is predicted that customers will move towards a gradual adoption of ISDN, and these products are intended to aid the transition.

Likewise, Soren Neilson of EDS sees a migration from analog to digital technology. He hopes that as ISDN is introduced, cost will be reduced. He adds: 'When service costs come down, you see people's minds become creative and they will come up with inventive uses of this technology.'[25]

Paul-Henry Ferrand of AT&T sees price as a prime factor in international acceptance: as international ISDN is globalized and prices drop, 'the service may ultimately herald a return to the public switched network', he says, explaining that the availability of modern services on the public network at affordable prices will put an end to the need for leased lines.[26]

Consultants such as Chuck Kanupke say that users are not convinced of ISDN benefits; he suggests that it is up to the telephone companies to market their services for their data network, not voice, capacities.[27] The Bell companies, however, do see customers moving towards switched data service. According to Pacific Bell, it is now economically possible for ISDN to reach the public switched network.[28]

Suggestions for regulatory reform specify the replacement of profit caps by price caps, a change which would affect consumers' pocketbooks. The first term refers to the practice of placing a maximum figure on the rate of return the company can earn, based on its assets. The second, on the other hand, refers to a method in which a ceiling is placed on prices, allowing the company to keep its earnings within those rates. AT&T, the Bells and GTE are now instructed by the FCC to use price caps. The old system, it was argued, encouraged inefficiency because only profits resulting from new equipment purchases could be kept by the company; all other profits had to be returned to the customers in the form of rate cuts. Proponents of price caps view the new method as a step towards deregulation.[29] Companies are rewarded for their efficiency, and services already experiencing competition are not affected. In addition, customers are treated fairly: price caps are determined using the consumer price index minus a productivity figure.

In order to offer BRI ISDN services, some telephone companies, such as Illinois Bell, Pacific Bell and Southwestern Bell, impose increased tariffs. Under these tariffs ISDN lines now cost approximately twice as much as POTS lines. The CCITT is attempting to convince customers that ISDN is nonetheless an economical choice: although it

[25]T. Sweeney, 'Users choose net options', *CommunicationsWeek International*, 21 May 1990, p C19.
[26]A.-M. Roussel, 'AT&T: ISDN link is key', *CommunicationsWeek International*, 7 May 1990, p 6.
[27]Bushaus, *op cit*, Ref 24, p 8.
[28]*Ibid*, p 8.
[29]H. Geller, 'Looking not far into the future', *Society*, July/August 1989, p 22.

costs twice as much, the basic ISDN standard handles the service of several POTS lines. Analysts say that prices are still too high, and that tariff structures must bring prices closer to, or even lower than, POTS prices.[30] Videoconferencing products suppliers, for example, are hoping that advances in connectivity and widespread use of ISDN will eventually allow users to make video calls for the price of a normal telephone call. The current price of AT&T videoconferencing on international ISDN from France to the USA, for example, is $1.90 or FF11 per minute.[31]

Although tariffs are lower (in real terms) than in the past, they are surveyed by state regulators, and thus vary widely. Available services also vary: what is offered in one geographic area may not be offered in the next. As a result consumers are still not clear what ISDN will cost, and are forced to be flexible in their telecommunications choices.

Standardization. In addition to pricing, lack of common standards also makes users apprehensive. In the Kanupke survey 43% of the managers responded that they did not believe that standards were yet stabilized. Both users and equipment manufacturers agree that standards will aid ISDN acceptance; for example, William C. Garraty, of Hitachi America, says 'the promise of connecting equipment from different vendors will become a major advantage for ISDN users'.[32] According to him, with standardization users will eventually be able to purchase customer premises equipment (CPE) from various manufacturers without problems of incompatibility.

Presently networking systems are limiting: users of one product may not be able to transmit to end users of a different product. Eventual international ISDN standards will be open and non-proprietary. However, Nielsen notes that two standards have emerged: one European and the other American. 'It's unfortunate,' he says, 'because it delays the business community on an otherwise excellent idea.'[33] He sees ISDN service as having great potential, as long as telephone companies solve the geographical difficulties. Others, like consultant Larry Oliver, agree, pointing out that lack of common international standards could lessen the benefits of added end-to-end services like caller line identification. He doubts, however, that lack of international standards will affect users' simple transmissions.[34]

Widespread ISDN, made possible by common standards, would also have a positive influence on connectivity. While ISDN is available in the USA for the long-distance network, local ISDN networks are described as having an 'island' structure, as they are located in large urban areas. AT&T Bell Laboratories is in fact still working on interconnections with some local Bells.[35] Connectivity was a major concern cited by managers taking part in the Kanupke survey, who specified connectivity problems between these ISDN 'islands'. Nonetheless, promoters of ISDN assert that customers in areas not served by local switches need not have connectivity problems. Options such as digital adjunct switches, remote access techniques and digital PABXs can give rural users, for example, access to ISDN networks.

Consumer awareness. ISDN has often been criticized as a 'technology looking for an application'.[36] Researcher G.A. Keyworth describes how companies are taking a 'wait-and-see' attitude towards consumer-oriented digital technologies. It seems that the inability to predict the market's future keeps them from making the necessary investments

[30]Bushaus, *op cit*, Ref 24, p 9.
[31]Roussel, *op cit*, Ref 26.
[32]K. Smalheiser and J. Karp, 'ISDN: the new telephone network', *Fortune*, 24 October 1988, Special Advertising Section.
[33]Sweeney, *op cit*, Ref 25, p C19.
[34]M. Laws, 'BT sets basic rate ISDN', *CommunicationsWeek International*, 23 April 1990, p 8.
[35]Roussel, *op cit*, Ref 26.
[36]T. Sweeney, 'IBM-Northern link', *CommunicationsWeek International*, 12 November 1990, p 4.

now; they are not going to develop new equipment without knowing when the customers will be ready to buy it.[37]

Steven Kropper, of International Data, reports that the telephone companies have hesitated to invest in new ISDN software because they want first to be assured of adequate consumer demand. Managers at Nynex agree that these technologies' unpredictable effects on the marketplace make planning difficult. Walter Johnson, of Nynex's Science and Technology Center, emphasizes that while it is possible to predict what a technology will produce in five years, no one can predict market needs for the next 10 years.[38]

Thus manufacturers have a sceptical attitude towards user interest. As Bob Jones, of the UK-based Dowty Informations Systems, says, 'Some in the datacoms industry have been flagwaving about ISDN for years. It may be good for publicity but it doesn't do much for users.'[39]

The problem, analysts explain, is that users are not convinced they can benefit from ISDN services. Steve Sazegari, of Dataquest, notes that user interest is still unfocused; potential users do not have a clear concept of ISDN's eventual role.[40] Moreover, users who do learn of ISDN's capabilities still have many questions regarding the service. Tim Conners, of AT&T, reports that users often ask vendors how ISDN works, how it can be used effectively and what changes it requires.[41]

In order to convince users of ISDN's benefits, many manufacturers have adopted the tactics of 'technology push': they attempt to get the user 'interested'. In fact, some companies are using classic marketing techniques to promote ISDN. One advertisement targets US businesspeople, explaining that ISDN will permit 'exciting new telecommunication capabilities to hundreds of millions of telephone users worldwide'.[42] It stresses lower costs for users, greater revenues for exchange facilities and added revenue sources for equipment vendors.

McDonald's explains that it found current technologies inadequate, and in offering itself as a 'technology test bed' received AT&T's and Illinois Bell's recommendations for a new network based on ISDN.[43] By December 1987 McDonald's became the first major US business to incorporate ISDN-based services into its daily operations. Now it has between 1000 and 2000 basic rate lines, and by 1992 hopes to have most domestic McDonald's restaurants participating in the network. Like Tenneco, McDonald's asserts that it is already realizing the savings it had projected with the new network service.

Related to the subject of user awareness is that of user education. Reports state that there is a new demand for managers capable of running ISDN technology, but unfortunately few people understand it or have hands-on experience.[44] The concern is not only for hiring people who are familiar with ISDN, but also for those who can think in terms of an integrated network.

Harvard University has found its own solution: for its 20 000-line network using New England Telephone's digital centrex service it has contracted for Harvard employees to work directly in telephone company facilities so they may continue learning about ISDN technology.

The future

Economic ramifications

The telephone network has been said to be as important to the Information Age as the transportation system was to the Industrial Age.

[37]G.A. Keyworth, 'Goodbye, Central: telecommunications and computing in the 1990s', speech delivered before the Economic Club of Indianapolis, Indianapolis, IN, 15 February 1990; reported in *Vital Speeches*, 1 April 1990, pp 358–361.
[38]B. Page, 'Integrating the technology', *CommunicationsWeek International*, 21 May 1990, p C15.
[39]A. Evagora, 'Modem makers eye ISDN', *CommunicationsWeek International*, 23 April 1990, p 34.
[40]Bushaus, *op cit*, Ref 24, p 9.
[41]M. Semilof, 'Wanted: ISDN-literate managers', *CommunicationsWeek International*, 21 May 1990, p C11.
[42]Smalheiser and Karp, *op cit*, Ref 32.
[43]*Ibid.*
[44]Semilof, *op cit*, Ref 41.

Many authors currently express concern over the USA's participation in the Information Age: if the country does not make the necessary investments in the telecommunications infrastructure it could face serious economic consequences.

Current opinion and studies. Keyworth foresees a digital network as essential to the USA's future: it will be the way goods and services will be delivered, used and produced. Infrastructures, he says, create economic opportunities. Thus if the USA does not invest in telecommunications now, it may become the world's greatest customer, not the greatest supplier.[45] Neil Gross writes: 'The first countries to install it [ISDN], or the even faster broadband ISDN superhighways, can expect to gain a competitive edge over other nations.'[46] Right now, Japanese competition is especially feared; NTT is spending $1.4 billion a year to digitize its major-city networks, and expects to begin broadband service by 1995.[47] In addition, Bell Atlantic acknowledges that these Japanese investments are made with expectation of future revenues in technology exports to the USA.

Other researchers agree that the telecommunications infrastructure is essential to US economic security, especially in the present context of foreign competition. Huber writes, 'If competition is coming, as I believe it is, and as the history of the last three decades surely indicates it is, fundamental change in regulatory policy is essential.'[48]

Gary Ames, President of US West, stresses the need for national policy. 'We need a national policy that will promote modernization of the public network,' he said, 'a national policy that will encourage America's telephone companies to open the public network to private uses, without technical or regulatory barriers.'[49]

Henry Geller, Director of the Washington Center for Public Policy Research, calls for a policy allowing the telecommunications industry to work freely with technology and the marketplace. Thus he suggests maximum use of competition, where products and services may be introduced without first requiring administrative permission.[50] Huber is also a proponent of competition; he writes, 'We will see steadily growing competition in the local exchange as elsewhere. The principal force is not regulatory but technical. The regulators' main challenge is to keep pace with changes driven from the outside – and, above all, not to stand in the way.'

The need for regulatory reform was emphasized in a 1988 study on technology's role in economic change, conducted by the US Office of Technology Assessment (OTA). It describes the US economy as being influenced by three major forces: new technologies, foreign trade, and changing tastes and values. The report states that information technology has, over the past decade, had a profound impact on economic growth. While 20% of all new plant and equipment went towards information technologies 10 years ago, today 40% does. The size of the enterprise has also changed, now that new technologies make competitiveness and efficiency possible in smaller scales. Thus, the study says, the telecommunications industry has changed, along with the need for regulated monopolies. What is more, technological changes 'may increase the need for regulations to protect the health, safety, and privacy of individuals'.[51] In general, the OTA calls for a re-evaluation of current rules, regulations and incentives.

Unfortunately, as Geeslin points out, public policy change is a slow

[45]Keyworth, *op cit*, Ref 37, p 361.
[46]N. Gross, 'The rush to pave a digital superhighway overseas', *Business Week*, 12 March 1990, p 130.
[47]*Ibid.*
[48]Huber, *op cit*, Ref 23, p 29.
[49]G. Ames, 'America's telecommunications', speech delivered before the 'Beyond Decline' symposium, Colorado Springs, CO, 22 January 1990; reported in *Vital Speeches*, 1 May 1990, pp 446–448.
[50]Geller, *op cit*, Ref 29, p 27.
[51]C. Norman, 'Rethinking technology's role in economic change', *Science*, 20 May 1988, p 977.

process, and forces such as technology, the marketplace, economics and international competition will not wait. Nonetheless, he explains, the USA, recognizing that the information industry is the 'backbone of future economic growth', should create regulation which permits earnings flexibility and encourages introduction of services and investment in the network.[52]

Sociological ramifications

In addition to economic concerns, researchers and operators alike are looking into ISDN's social implications. US West, for example, in conducting its Denver ISDN trial, takes into consideration the long-term economic and social ramifications. Authors stress US regulatory policy's influence on the common citizen.

Current opinion. Geeslin poses the following question about the telecommunications network: 'Will this resource be developed in a way that promotes the greatest social good, or will current regulatory policy, more suited to the technological environment of the past, serve to impede the evolution of the public network and deployment of innovative services?'[53]

Mosco points out that deregulatory policy has had negative impacts on US society in the past. He explains that the deregulation process which began in the 1970s reflected the political influence of large businesses, and resulted in lower prices for long-distance and other services which best suited their telecommunications needs. The rate cuts in long-distance service, however, were absorbed by residential, small business and local organizations in their local service fees. Mosco therefore believes that deregulation has not helped those who could most benefit from telephone service, such as the poor. Universal service, he says, is not true to its name: 25% of US citizens below the poverty line do not have telephone service.[54] In addition to the tendency for cross-subsidization, deregulation tends to eliminate jobs and lower real labour costs.

The Bell companies themselves are aware of existing inequalities. Ames, of US West, explains that in order to remain competitive the telephone companies must concentrate their investments in high-demand urban areas. The result is a lack of modern facilities in rural areas. What is feared is a future 'two-tier' society of 'information-haves' and 'information-have-nots'.[55] Pro-Bell congressman Al Smith shares this concern, warning that we are developing a divided system of 'information-rich' and 'information-poor'.[56]

These themes are part of proposals for a socially oriented telecommunications policy. Such proposals consider the public networks' contribution to the US quality of life; they call for a social policy which would not only satisfy citizens' communication needs but also promote information literacy. Such a policy would have positive effects on education, medical services, banking services and the like. As Ames says, 'advanced telecommunication can be the key to a better standard of living, to a better quality of life, to economic development, to community betterment, to business competitiveness, and to national competitiveness'.[57] What is needed, authors seem to agree, is a national policy which will promote these goals.

Statistical background and social trends. Statistics may lead us to believe

[52]Geeslin, *op cit*, Ref 16, p 17.
[53]*Ibid*, p 17.
[54]Mosco, *op cit*, Ref 7, pp 33–34.
[55]Ames, *op cit*, Ref 49, p 448.
[56]Coy, *op cit*, Ref 6, p 119.
[57]Ames, *op cit*, Ref 49, p 447.

that technological advancements such as ISDN could have a strong influence on the US public. Traditionally US households have had a high penetration of communication technology. In 1989, for example, 98% of households had television, 61% had a VCR, 54% had cable television service, 24% had a telephone answering machine and 21% had a computer.[58] Computer penetration, in particular, has boomed: it grew from 340 000 units in 1981 to some 12 million in 1985.[59] In addition, research on changing usage patterns shows that the average household has multiple units of electronic technologies, even as household size is diminishing. One explanation cites a growing social trend towards individualism, in which multiple televisions, radios, Walkmans and so forth provide personal access to the media. This individualism has also resulted in a broader functionality of telecommunications, which some researchers predict will provide future opportunities for new services.[60]

There is current research dedicated specifically to telephone systems that provide services directed to individuals rather than to their telephones. Two Bellcore managers describe experimental systems which direct messages to the person, wherever he or she may be, rather than to a particular telephone. In one system messages may be gathered at public telephones by dialling a code number, and in another system calls are received on portable digital transmitter-receivers. These technologies are now feasible, and the authors predict that they may be made available within the next decade.[61]

Despite this positive image of the USA's telecommunications future, some doubts do remain. John Carey, director of Greystone Communications, asserts that it is only because of lower prices that consumers have quickly adopted new technologies in recent years. In spending the same proportion of their income, they have been able to purchase more goods and services. Carey warns that this fact could make new service introduction difficult; manufacturers must find consumers who, at the beginning, are willing to pay higher prices until efficiencies and large-scale production can bring prices down for mass consumption.[62] That is why Sazegari claims that user interest depends on ISDN's ability to be as economical as existing services. He warns that 'somebody has got to sacrifice in the beginning'.[63]

With regard to other barriers to mass adoption, Carey adds that of income distribution changes. The trend shows that the US middle class is shrinking: the population is now concentrated in the upper-class and lower-class categories. Although the wealthy are able to afford new technologies, the poor are not, and the society is faced with the possibility of the information division discussed earlier.

Conclusion

There is no question that ISDN will be deployed in the USA, because it already has been, for IBM, McDonald's, Harvard and others. The current ISDN Critical Mass Index, according to International Data, stands at 36%.[64] That means that more than one-third of the infrastructure needed for ISDN is already in place. Predictions optimistically place this figure at 95% by the year 1994, when sending messages by an ISDN network could prove to be as common as today's facsimile use. Thus industry forecasters predict a bright future for AT&T and international integrated services networks. Nevertheless many questions re-

[58]J. Carey, 'Adopting new technologies', *Society*, July/August 1989, pp 13–14.
[59]Huber, *op cit*, Ref 23, p 28.
[60]Carey, *op cit*, Ref 58, p 14.
[61]Weinstein and Shumate, *op cit*, Ref 14, p 12.
[62]Carey, *op cit*, Ref 58, p 11.
[63]Bushaus, *op cit*, Ref 24, p 9.
[64]'Is the electronic superhighway of tomorrow on schedule?', *Business Week*, 26 March 1990, p 92.

garding ISDN in the USA (pertaining to regulatory policy, standards, manufacturing, consumer adoption and social equality) remain. Although answers proposed by researchers, managers, manufacturers and government agents vary, the one point they all agree on is that the outcome will carry profound economic, social and political implications for the country as a whole.