Behind the Telephone Debates — 5
Integrated Services Digital Networks (ISDN): Concepts and Issues in the U.S. and in Japan

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EXECUTIVE SUMMARY

- Integrated Services Digital Networks (ISDNs) are herein considered as networks that

  -- combine various existing networks into a single network directly (where protocol is compatible) or through interfaces (where protocol is not compatible),

  -- provide voice and nonvoice services through the same line,

  -- use digital technology, and

  -- can accommodate intelligent functions.

- In Japan the Information Network System (INS), which concept corresponds to ISDN, is advocated by NTT. INS is now widely understood to refer to the highly developed telecommunications system of an information-intensive society.

- The effect of prevailing telecommunications policies on ISDN may differ substantially in the U.S. and Japan.

  -- U.S.: The basic-enhanced dichotomy delineated by the Computer Inquiry II, which might promote competition in the long run, could result in the sacrifice of short-run economy and efficiency, since AT&T and the BOCs are required to establish separate subsidiaries for providing enhanced services.

  -- Japan: Functional allocation between the INS network and the terminals has received the most attention since INS was made public in 1981. According to the new laws, however, regulation is based on the ownership of lines, not on the types of services. Therefore, the likelihood of conflict over provision of services has been reduced.

- Since the concept of ISDN originated with carriers, whether and how users will benefit from ISDN are matters of controversy; carriers also face several uncertainties.

- A fundamental problem underlies ISDN issues and debate: Who is to provide specific services in the partially regulated telecommunications and in the unregulated computer industries? Conflict among the many players has raised questions about protocol conversion, international and domestic standardization processes, availability of private-line service, user-network interface, and others.

- The integrated nature of many ISDN services (voice and nonvoice) has given rise to various tariff issues: Overall tariff level (cost advantages and disadvantages of ISDN), bit-based tariff principle,

distance-insensitive tariff, and all other tariff issues merit further discussion, particularly regarding their effects on users.

- In realization of ISDN, coordination among all players is necessary for ensuring compatibility and connectability in the competitive environments where public and private networks face severe challenges.

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INTRODUCTION

The potential for Integrated Services Digital Networks (ISDNs) during the 1990s around the world is among the most significant recent technological developments affecting society's use of telecommunications and computers today. As presently envisioned, ISDNs would combine various existing networks and provide almost all telecommunications services -- voice and nonvoice -- using digital technology. However, the assimilative character of ISDNs, while providing significant cost reductions and operating efficiencies, also raises significant political issues in both domestic and international arenas.

The very notion of ISDN engenders fear and confusion for some observers, in part because of its apparent technical complexity, and in part because the concept of integrated networks implies a considerable degree of centralization, control, and rigidity. Moreover, because the ISDNs are still speculative, rather than operative, systems, forecasting implies a great deal of uncertainty. This uncertainty poses a variety of questions: Will individuals have to pay more for access to ISDNs? Who will establish and enforce operating standards for ISDNs? Will the ISDNs promote, retard, or suffer from market competition? These are but the more obvious of the questions raised by the discovery of the potential for integrated services digital networks.

This paper consists of two parts:

Part I, The ISDN Concept, examines the conceptual basis of the ISDN, with emphasis on nontechnical and application matters.

Part II, ISDN: Facing the Issues, examines the social and political implications of ISDNs in the United States and in Japan. At the heart of any discussion of ISDN is a series of related questions: Who will control ISDN? Who will provide the services? and, Who will pay for the services? Such crucial concerns as functional allocation between the network and the terminal (CPE), protocol conversion, and bit-based tariffs are explored in detail.

Telecommunications is changing so rapidly that it is terribly difficult to evaluate its current status and to keep abreast of developments. The specific illustrations and scenarios throughout this paper are drawn from issues raised in the Computer II environment, in which period the research was conducted. The FCC began the Third Computer Inquiry (Computer III) in July 1985. Computer III proposes drastic changes in the Computer II decisions, including the basic-enhanced dichotomy. Most of these proposed changes are considered among the questions and problems presented in this paper. However, it will likely be several years before the final decisions of the Computer III are achieved, as was true for those of the First (three years) and Second (four years) Computer Inquiries. Understanding the long-term trends in technology and regulations and their effect on telecommunications and computers is paramount. I hope that this paper will contribute to the future policy decisions, including those of Computer III, and prove useful to all parties involved with, and affected by, ISDN.

The paper's recurring focus on U.S.-Japan interaction is meant to elucidate the competition between these interdependent nations in the international computer and communications markets, which continues to be

a formative issue in international trade and in the future of telecommunications systems around the world. ISDNs naturally reflect each nation's technology and particular trade advantages. But, while the U.S. ISDNs and the Japanese INS seem quite different at first glance, the two nations' technologial progress and regulatory policies have many similarities. The differences and similarities highlight useful lessons, applicable to these nations, to the European technological community, and to the world's developing countries.

I. THE ISDN CONCEPT

1

DRIVING FORCES OF ISDN

The theoretical and technological development of ISDN is being driven by forces associated with both the demand for and -- more important -- the supply of telecommunications services. Presently, the information industry is the international economy's fastest growing sector, and it will soon be the largest sector. Forecasts indicate that information industries will account for approximately 40 percent of the gross national product (GNP) of the world's combined industrialized sectors by the end of this century.[1] In the United States, an estimated one-half of the total workforce is employed in the information sector.[2] Inevitably, the demand for telecommunications and computer services will be increasingly diversified. In addition to demand attributable to end-users, information-processing companies and enhanced-service providers have stimulated demand with the variety of newly developed services that require improved switching and transmission techniques and enhanced flexibility of existing networks. The enhanced-service providers are demanding networks that are both more reliable and more user-friendly to accommodate the diversified demands of end-users.

Despite these demand pressures, it is clear that the principal motivation for development of ISDNs can be traced to the supply side. The recent advances in digital technology allowed carriers to combine many new services with existing services and networks. In order for telephone companies to satisfy demand for diversified services that may even be international in scale -- for voice and nonvoice communications -- economy and efficiency suggest that the companies integrate services into one network. (Estimates of demand for services that are not yet in

place are inexact, at best, and the installation of a separate network for each service, as is done today, is needlessly inefficient and expensive.) Telephone companies have responded to the drop in cost of digital technology by using it as an integration technique. It is worth noting that digital transmission facilities and switching techniques have existed for more than 20 years and that the quality of these is superior to that of analog counterparts. The deciding factor has been cost; only recently have digital capabilities become less expensive.

By integrating various networks into one, telephone companies expect, first, that the planning costs associated with each existing network will be incurred only once, and that the network integration will reduce maintenance costs, and, second, that the new network will accommodate peak-load traffic more efficiently since a single common network can intelligently orchestrate the variable traffic patterns for the different services provided to system users.

The creation of ISDNs, in the very simplest of terms, can be seen as merely the replacement of existing facilities and equipment with "digital pipes." Telephone companies might seize this relatively simple concept and adapt it for provision of information-processing services, since the technology now used in telephone-exchange systems is essentially the same as is used for providing computer services.[3] Telephone companies can integrate existing facilities and equipment and provide both voice and nonvoice services; they can also provide data-processing-type services through this computer-controlled digital network.

These intelligent characteristics of ISDNs are likely to incite conflicts among network providers, service providers, information-

processing companies, and equipment manufacturers, since information processing or value-adding companies have considered the intelligent functions to be their exclusive domains. These conflicts, inherent in the proposals of intelligent networks, might account for the criticism of the telephone companies for having discussed ISDNs without any explicit demand, and without users' participation.[4] Telephone companies, as a matter of course, are opposed to these views, as detailed in succeeding chapters.[5] This is the basis for conflicts.

2

DEFINITION OF ISDN AT THE CCITT

The International Telegraph and Telephone Consultative Committee (CCITT), a permanent organ of the International Telecommunication Union (ITU), provides a central forum for ISDN planning and discussion.[6] The first ISDN conference was a 1972 Joint Meeting at which the ISDN concept was defined in Recommendation G.702 at the Fifth Plenary Assembly of the CCITT as "an integrated digital network in which the same digital switches and digital paths are used to establish connections for different services."[7]

It can be said that the CCITT process is shaped as much by the compromises struck among participating countries as by progress in research. Study Group (SG) XVIII, which has been studying ISDN, after long debate adopted the currently accepted definition at the Eighth Plenary Assembly in 1984.[8] The evolution of the standardized concept, and the accepted definition, are given in Figure 1.

1972	ISDN was defined as an "Integrated Digital Network (IDN) in which the same digital switches and digital paths are used to establish connections for different services." IDN is a network in which connections established by digital switching are used for the transmission of digital signals. In the definition of the IDN, the integration is that of transmission and switching technologies, whereas in the ISDN the integration is that of services which so far are only partially defined.
1982	ISDN was defined as "a network evolved from the telephony IDN that provides end-to-end digital connections to support a wide range of services, including voice and non-voice services to which users have access by a limited set of standard multipurpose customer interfaces."
1984	ISDN was defined as a "network, in general evolving from a telephony IDN, that provides end-to-end digital connectivity to support a wide range of services, including voice and non-voice services, to which users have access by a limited set of standard multi-purpose user-network interfaces."

CCITT's 1972 and 1982 definitions of ISDN as quoted in Theodor Irmer, "Worldwide Trends towards the ISDN -- Facts and Trends," in Nippon Telephone and Telegraph Public Corp., Proceedings of the NTT International Symposium. Tokyo: NTT, February 1983, p. 41.

1984 definition from International Telecommunication Union, International Telegraph and Telephone Consultative Committee, VIIIth Plenary Assembly of the CCITT, Study Group XVIII, Report R 29, Part V, p. 2, in AP VIII 97 E, distributed at Malaga-Torremolinos, 1984.

Figure 1

Evolution of ISDN Definition at the CCITT

3

U.S. ISDNs

The Federal Communications Commission (FCC) defines ISDN as "a network which is designed and constructed to provide a wide range of telecommunication and information services and to transport electrical signals in digital, rather than analog, form."[9] Similarly, the National Telecommunications and Information Administration (NTIA) concluded that "ISDN represents the ongoing evolution of communications networks throughout the United States and the world, taking advantage of technical advances in digital communications and switching, fiber optics, satellite transmission, and more."[10]

The definitions adopted by these government organizations are similar to the CCITT terms. However, the concept of ISDN in the United States is not consistent from one person to the next; despite agreement on basic elements, the diverse U.S. telecommunications environments give rise to a variety of interpretations. Consider the comments of industry leaders:

- D. F. Hudson of Northern Telecom Inc. claims that "everyone's idea of ISDN is different. While each of us thinks he knows what ISDN is, we don't share a common understanding of what it is we are all striving for."[11]
- Philip Black, President of Teletec, Inc., went on record to explain that "the ISDN is not a network, but a set of recommendations that takes existing networks and adds to them and makes them work together to provide answers."[12]

- The emphasis on potential is foremost in the Bell Operating Companies' (BOCs') understanding of ISDN as "a network architecture that can support a wide range of voice, data, and video services in an economical fashion," and that "the ISDN concept is that networks should be open. In other words, networks should be interconnected to permit anybody-to-anybody communications."[13]
- Irwin Dorros, Executive Vice President for Technical Services at Bell Communications Research, Inc., claims that ISDN is "a telephone engineer's target architecture for building efficient access lines. That is all it is."[14]

The report of the NTIA addresses the lack of consensus apparent in the United States:

> For many people, ISDN evolution from the public telephone network implied that the term ISDN inherently defined a physically complete, real network. In certain national environments, e.g., the U.S., this in turn led to the concept of multiple ISDNs, and to discussions of the interconnection of multiple national ISDNs, and of ISDNs to, for example, specialized data networks.[15]

Several factors account for the disparity between the concept of ISDN in the United States and that current in other countries. (Each of the factors introduced below is treated more fully in a later chapter.)

- There are multiple privately owned domestic and international common carriers;
- The government promotes competition in telecommunications;
- Regulation is based on the distinction between basic and enhanced services;
- There are multiple private networks that need to be connected to public network(s); and

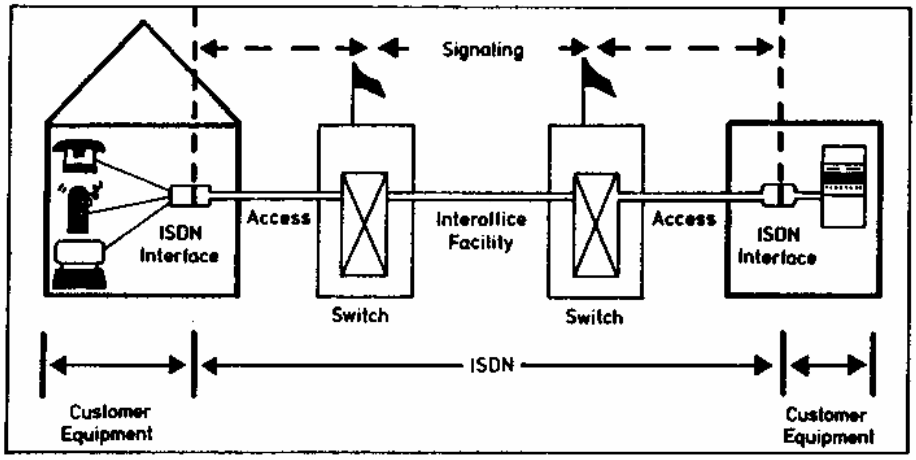
- De facto standards prevail (there is a lack of national standards).

In contrast with the U.S., according to the NTIA,

> most overseas telecommunications administrations tend to prefer: monopoly network ownership, restraint on resale activities, prohibition or limitation of foreign ownership, restrictive interconnection policies, information processing restrictions, rates based on factors other than cost, and restrictive type approval of customer premises equipment.[16]

The variety of conditions in the United States and the multiplicity of opinions expressed have caused many observers to suggest a permanent distinction between the concept of ISDN as standardized in the European and, perhaps, in the Japanese models, and the U.S. ISDN concept which reflects the U.S. telecommunications environment. There is general agreement that there are multiple ISDNs in the U.S., but given the lack of a unified vision as to what ISDNs will become in the U.S., the future is difficult to predict. Figure 2 provides one projection.

U.S. ISDN Schematic



Source: Frank Gratzer, "ISDN: The Countdown to Plug-in," Computerworld on Communications, January 18, 1984, p. 55. Copyright c 1984 by CW Communications/Inc., Framingham, MA 01701. Reprinted with permission.

U.S. ISDN Evolution Phases

Transition (1983-1986) - Pre-ISDN Services - Separate Access Facilities - Alternate Voice and Data - Expanded Digital Capability in Local Loops and Switching Exchanges - Increased Use of Common Channel Signaling - 64-Kbit/s Clear Channel Transmission - CCITT ISDN Standards
First Generation (1986-1990) - Integrated Access - CCITT Standard Equipment, Interfaces - Simultaneous Voice and Data at 64 Kbit/s - Expanded Customer Control - D Channel Signaling
Second Generation (1990 and Beyond) - High Speed Data and Video Capability - Integration of Circuit and Packet Switching - New Services

Source: As adapted by Marc H. Rudov in "Marketing ISDNs: Reach Out and Touch Someone's Pocketbook," Data Communications, June 1984, p. 241. Copyright © 1984 by McGraw-Hill, Inc. All rights reserved. Reprinted with permission.

Figure 2

U.S. ISDN Schematic and Evolution Phases

4

JAPAN'S INS

In Japan, the term "Information Network System" (INS) is far more popular than is "ISDN." INS was coined in the late 1970s by Yasusada Kitahara, of Nippon Telegraph & Telephone Public Corporation (NTT), as part of NTT's plans for the next two decades after having achieved two pre-existing goals: elimination of the backlog of unfulfilled telephone-service orders and completion of a nationwide long-distance direct dialing system. Kitahara called on INS to ensure "fair and equal provision of more economic, more convenient, and more diversified telecommunication services at any time and to any place regardless of where one lives."[17] In 1981 NTT made public its plans for the new system. Specifically, NTT intends to combine digital communications networks and computers to provide diversified communications and information services to the public, using bits as the unit for tariff-setting.

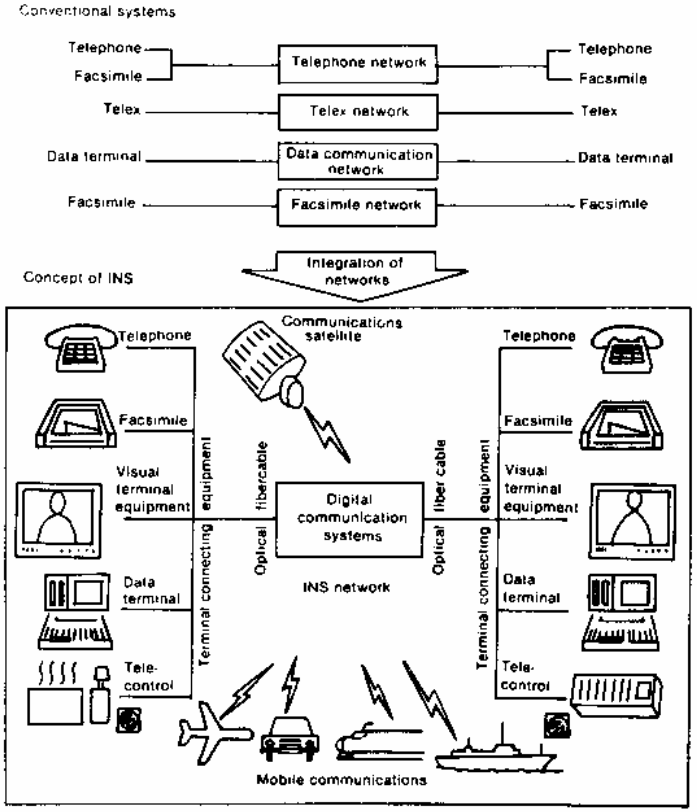
According to NTT, INS features include: 1) digitization of networks; 2) integration of networks; 3) advanced network functions; 4) intelligent processing; and 5) bit-based tariff structure.[18] The purposes, means, and expected effects of INS are reviewed in Figure 3.

Kitahara says INS is not merely a semantic distinction:

> INS is a broader concept than ISDN in the sense that INS is a social infrastructure that includes the establishment of a new tariff system in which distances are overcome, whereas the ISDN is a concept of a network that provides various telecommunications services to the public.[19]

NTT also announced a plan for the development of INS, outlined in Figure 4. In Japan, there are six public telecommunications networks:

telephone, telex, data communications (DDX), telegraph, facsimile, and video; all six of these will be integrated into a single network, according to NTT's plan.[20]



A

Purpose of INS	Actual Means	Expected Effects
Network Digitization	Digitizing information Digital transmission and switching	Economize, upgrade transmission quality, upgrade transmission efficiency, upgrade reliability
Network Integration	Common use of transmission paths and switching systems Common use of various functions	Offer numerous services via one network Further economize
Network Upgrading	Communications processing (conversions of speed, size, media) Establishment of network architecture	Provide versatile additional services Possibility of communication between different types of terminals
Unification of Tariff Systems	Bit-based rate structure according to information quantity	Tariff system that is integrated and agreeable to the economy principle
Mixing with Information Processing	Full-grown databases and their on-line use Standardization of network architecture	Full-grown data communications Expand the center-to-end type services

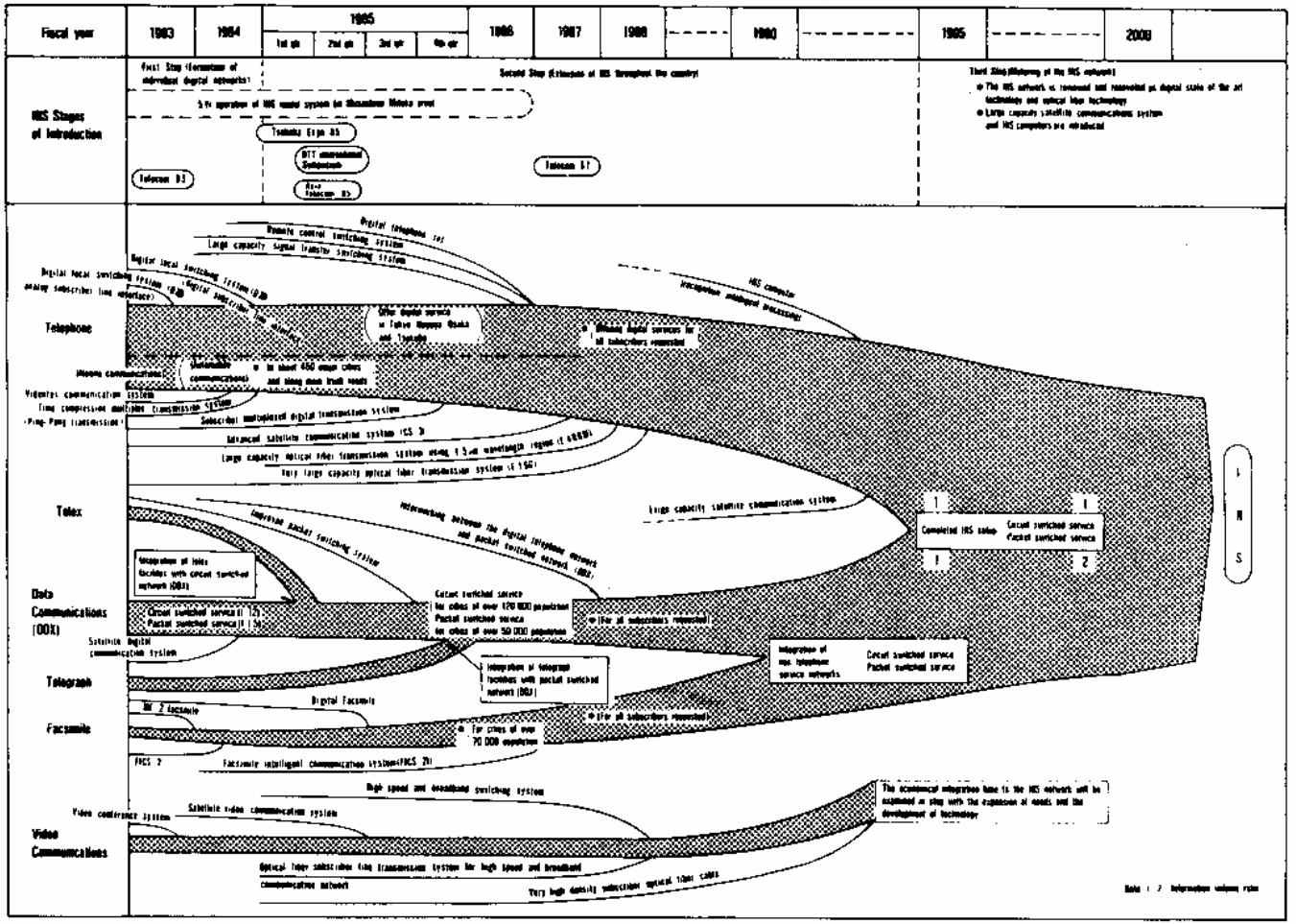
B

Source A: Nippon Telegraph and Telephone Public Corp., Ministry of Posts and Telecommuncations, Report on Present State of Communications in Japan, Fiscal 1984. Tokyo: Japan Times, Ltd., 1984, p. 28.

Source B: NTT

Figure 3

Concept of INS: Actual Means and Expected Efforts



Source: Nippon Telegraph and Telephone Corp., NTT International Symposium. Tokyo: NTT, May 1985.

Figure 4

INS Network Development

The term "INS" has become so popular in Japan that in some cases it is used to refer to the range of telecommunications services offered in enhanced value-added networks (VANs).[21]

The definition of INS has been changed as a result both of public debate and of the proposed restructuring of NTT and the entire Japanese telecommunications industry. Presently, INS (or INS network) is generally considered the "NTT version" of the ISDN, and it might be more appropriate to conclude that INS is a concept that includes not only networks but terminals and the establishment of a new tariff system, as well. (However, "INS" has entered the language as a generic term referring to the highly developed information society.) In preparation for construction of this long-term and expanded INS, NTT initiated the Model Integrated-System Test (MIST) in the Musashino-Mitaka area, a suburb of Tokyo, on September 28, 1984.

Figure 5 summarizes some common characteristics of ISDN and INS suggested by the general usage discussed above.

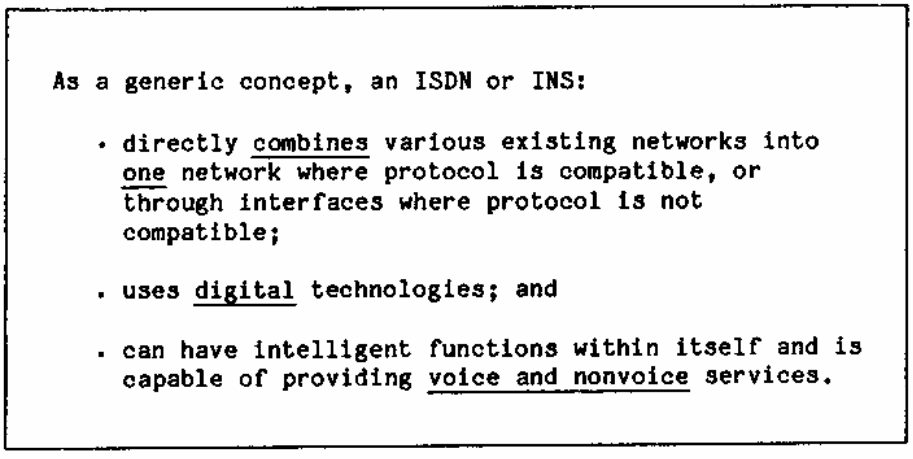


Figure 5

Common Characteristics of ISDN and INS

5

THE ISDN AND OTHER MEDIA

The rapid development of technology and the accompanying rush for social and economic applications have produced a number of so-called "new media" in Japan, including two-way CATV, videotex, and video-response systems (VRSs).[22] CATV originated as a television service for remote areas where television-image quality was substandard. Today, cable is considered an ideal medium for low-cost, high-speed, reliable data transmission, since its large bandwidth accommodates large quantities of data. Local area networks (LAN) are intended to interconnect computers (and any otherwise incompatible peripherals without separate, wired circuits) in a restricted area, and represent a potential replacement for the local loop network.

LAN provides services in a centralized and/or decentralized mode, whereas local private branch exchanges (PBXs) and mainframe computers provide service via centralized switching modes. Ultimately, these peripherals will be incorporated into ISDNs, or they will replace the integrated network; they are the potential competitors and/or complements of the future system.

One recent study introduced the idea of considering any information service as a bundle composed of content, process, and format.[23] Accordingly, it may be appropriate to speak of an ISDN as a processing component that uses computers and such transmission conduits as satellites and optical fibers. Conversely, a report from the Japanese Ministry of International Trade and Industry (MITI) divides the information industry into four groups -- information providers, system operators who process information, information carriers, and information

users.[24] In these terms an ISDN would be defined as an entity provided by system operators and/or information carriers.

These two classification models are integrated in Figure 6 to provide a coherent profile of the principal actors in the information industry. (Since an ISDN can be seen as an information process generally provided by telecommunications carriers and/or system operators, it is best classified as part of the C/II block on the chart.) System operators and information carriers share common interests in each bundle of information, differing only in terms of process -- the former provide information processing; the latter, transmitting -- which fact has increased the number of players and heightened competition in the information industry.

Group \ Bundle	I. Content or Substance (information)	II. Process (handling and transmitting information)	III. Format (hard copy, record, display, etc.)
A. Information Providers	○	X	△
B. Systems Operators (Information Processing)	X	○	△
C. Information Carriers (Information Transmission)	X	○	△
D. Information Users	○	X	○

○ Primary interest of the group

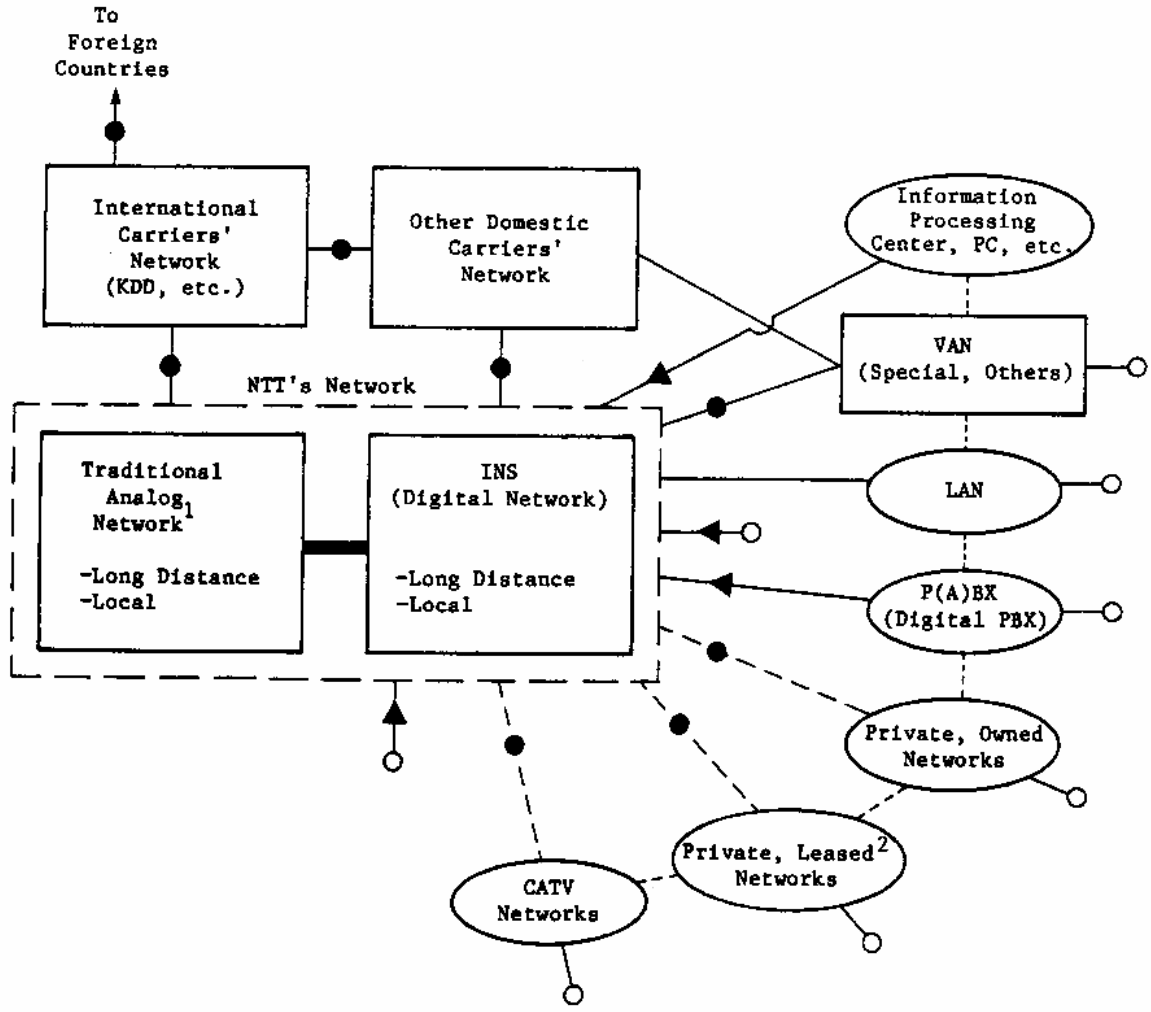
△ Partial interest of the group

X Slight interest of the group

Figure 6

Information Group and Information Bundle

An ISDN can serve as either an alternative or a complement, in economic terms, to other public and private networks. Figure 7 graphically interprets the relationships among other networks in Japan. Figure 8 provides similar data for a U.S. ISDN, with consideration given to market and regulatory conditions.

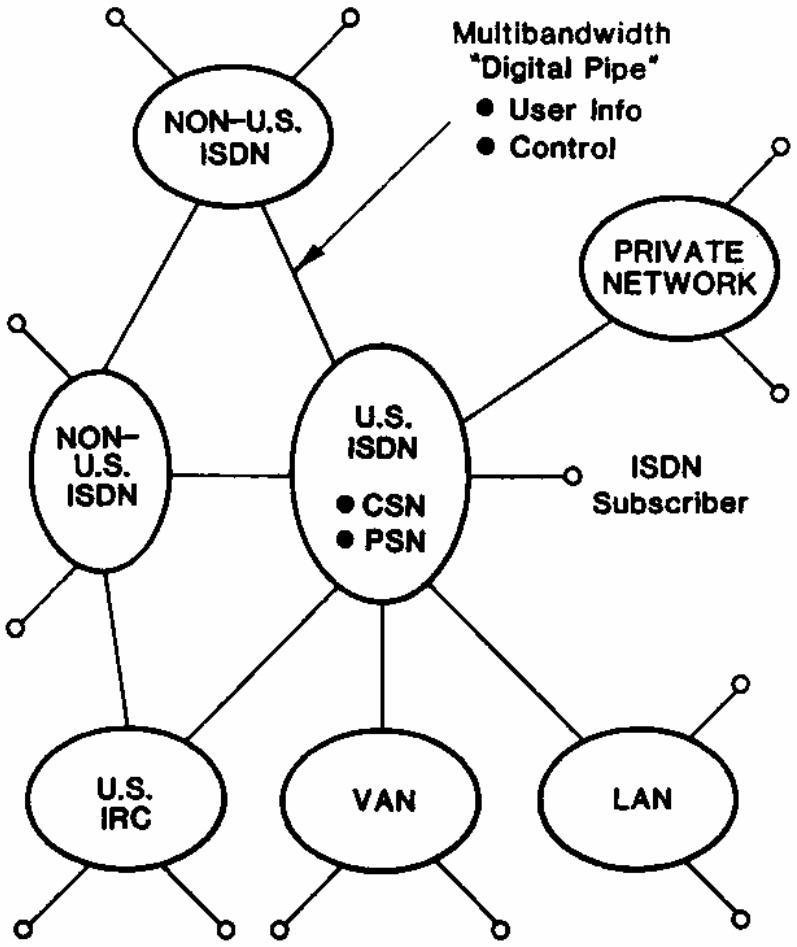


[1] At the final stage, digital networks will replace traditional analog networks.

[2] Leased from common carriers.

Figure 7

INS and Other Networks: Japan



Source: D. V. Glen, Integrated Services, Digital Networks, Standards, and Related Technology. Washington, D.C.: U.S. Dept. of Commerce, 1982 (NTIA Report 82-103), p. 6.

Figure 8

An ISDN Topology

6

MAJOR PLAYERS IN ISDN

The implementation of ISDNs would affect all information-related industries and users, domestically and internationally. The number of players has increased as a result of the convergence of telecommunications and computers and the policies recently adopted to provoke competition in telecommunications. (Recall Figure 4: Information carriers and system operators have some common interests but also conflicts.) Figure 9 identifies the major players in the ISDN arena.[25]

Figure 9

Major Players in ISDN

(1) International Organizations

ITU (International Telecommunications Union)
- CCITT (International Telegraph and Telephone Consultative Committee)
- CCIR (International Consultative Committee for Radio)

ISO (International Organization for Standardization)
OECD (Organization for Economic Cooperation and Development)
GATT (General Agreement on Tariffs and Trade)
ICA (International Communications Association)
IEC (International Electrotechnical Commission)
INTUG (International Telecommunications Users Group)
ICC (International Federation for Information Processing)
CEPT (Conference of European Postal and Telecommunications Administration)

(2) Government

U.S.

Congress
-- Communications Subcommitee of the Senate Committee on Commerce, Science and Transportation
-- House Subcommittee on Telecommunications, Consumer Protection and Finance

DOC (Department of Commerce)
-- NTIA (National Telecommunications and Information Agency)

FCC (Federal Communications Commission)
OTP (Office of Telecommunications Policy)
DOJ (Department of Justice)
DOS (Department of State)
- U.S. Organization for CCITT
- U.S. Organization for CCIR

Defense Communications Agency, DOD
Federal-State Joint Board
NARUC (National Association of Regulatory Utility Commissioners)
PUCs (Public Utility Commissions of each state)
NCS (National Communications Systems)

Japan

Diet -- Communications Committee
Political Parties
- LDP (Liberal Democratic Party)
- JSP (Japan Socialist Party)

Figure 9 (continued)

MPT (Ministry of Posts and Telecommunications)
MITI (Ministry of International Trade and Industry)
Ministry of Construction
  - Japan Highway Public Corporation
Ministry of Transportation
  - Japan National Railways
Fair Trade Commission

(3) Common Carriers

U.S.

AT&T, RHCs (Regional Holding Companies), BOCs (Bell Operating Companies), GTE, WU (Western Union), MCI, SBS, UTS, the independent telephone companies, etc.

Japan

NTT, Second NTTs -- Daini Denden Kikaku (Kyocera), Nihon Kosoku Tsushin (Ministry of Construction, Japan Highway Public Corporation), Nihon Telecom (Japan National Railways), Keidanren, etc.

(4) International Carriers

INTELSAT, INMARSAT, COMSAT, ITT, RCA, KDD, etc.

(5) Value-Added Carriers

Tymshare/Tymnet, GTE Telenet, IBM, AT&T Information Systems, etc.

(6) Information Processing Companies

IBM, Fujitsu, Hitachi, etc.

(7) End-users

Large-small, urban-rural, business-residential, rich-poor

Figure 9 (continued)

(8) Information and Service Providers

Advertisers, newspaper companies, banks, retailers, travel agencies, transportation companies, etc.

(9) Manufacturers

AT&T (Western Electric), Northern Telecom, IBM (Rolm), Motorola, Siemens, Sumitomo Electric Industries, Furukawa Electric, NEC, Fujitsu, Hitachi, ITT, etc.

(10) Organizations and Trade Associations

U.S.

EIA (Electronic Industries Association)
IEEE (Institute of Electrical and Electronic Engineers)
NBS/ICST (National Bureau of Standards/Institute for Computers, Sciences and Technology)
ANSI (American National Standards Institute)
API (American Petroleum Institute)
AAR (Association of American Railroads)
ADCU (Association of Data Communication Users)
ADAPSO (Association of Data Processing Service Organizations, Inc.)
CBEMA (Computer and Communications Industry Association)
CCIA (Cellular Communications Industry Association)
Community Antenna Television Association
COMPELTEL (Competitive Telecommunications Association)
ECSA (Exchange Carriers Standards Association, Inc.)
International Association of Satellite Users and Suppliers
IDCMA (Independent Data Communications Manufacturers Association, Inc.)
ICA (International Communications Association)
ICIA (International Communications Industries Association)
NATA (North American Telecommunications Association)
NCTA (National Cable Television Association)
NECA (National Exchange Carriers Association)
NTCA (National Telephone Cooperative Association)
OPASTCO (Organization for the Protection and Advancement of Small Telephone Companies)
USTSA (United States Telecommunications Suppliers of America)
USTA (United States Telephone Association, formerly U.S. Independent Telephone Association)

Figure 9 (continued)

Japan

Keidanren (Federation of Economic Organizations)
Communications Industry Association of Japan
Electronic Industries Association of Japan
NAB (National Association of Commercial Broadcasters in Japan)
Communication Line Products Association of Japan
Japan Cable Television Association
Japan Data Communications Association
JIPCA (Japan Information Processing Center Association)
JIPDEC (Japan Information Processing Development Center)
NSK (Japan Newspaper Publishers and Editors Association)
Japan Printers Associations
Federation of Bankers Associations of Japan

Europe

ECMA (European Computer Manufacturing Association)

(11) Labor Unions

U.S.

CWA (Communications Workers of America)
United Telegraph Workers
Utility Workers Union of America

Japan

Zendentsu (All Telecommunications Workers Union)

(12) Others

Cable operators, developed-developing countries

II. ISDN: FACING THE ISSUES

1

PRESENT TELECOMMUNICATIONS POLICIES AND ISDN

a. Present Policy Overview

U.S. The history of telecommunications in the United States is replete with interactions among AT&T, the Public Utility Commissions of each state (PUCs), the Federal Communications Commission (FCC), and the courts. Since the Hush-A-Phone settlement in 1957, United States telecommunications policy has tended to favor competition. Historically, the telecommunications industry has been regulated by the FCC and PUCs. The FCC's powers are defined in the Communications Act of 1934: The FCC holds jurisdiction over interstate and foreign telecommunications while the PUCs control telecommunications within the states.[1] The computer industry, on the other hand, has not been regulated.[2]

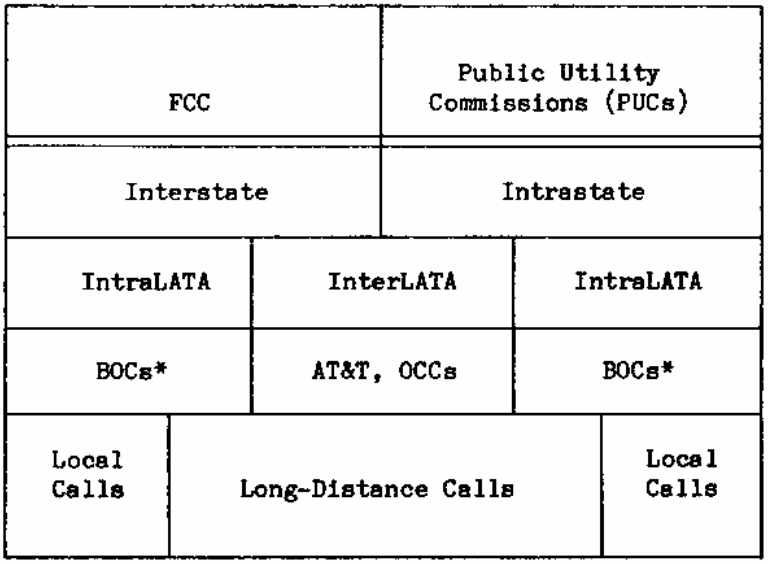
The development of such technologies as very-large-scale integration (VLSI) and fiber optics challenged the boundaries of both industries. The FCC launched its first Computer Inquiry (Computer Inquiry I) in 1966. By 1971, the FCC had designated three categories of services: communications, data processing, and "hybrid" services. This decision survived for only a short period because the "hybrid" category gave rise to a great many borderline cases that could not be satisfactorily resolved.

In 1976, the FCC initiated the second Computer Inquiry (Computer Inquiry II), and in a 1980 decision divided telecommunications services into two categories: "basic" services, which involve the carriage of information from one point to another without any transformation, and

are regulated; and "enhanced" services, which involve code and protocol conversion, storage, and various types of value-added processing, and are not regulated, although the FCC retains the right to impose regulations.[3] AT&T was allowed to provide "enhanced" services, but because of its dominance in the market, only through separate subsidiaries to ensure fair competition with other vendors.[4] At the same time, it was mandated that all customer premises equipment (CPE) be provided on an unregulated basis.

In January 1982, AT&T and the Department of Justice (DOJ) announced their agreement to an Antitrust Consent Decree. This divested AT&T of its 22 operating companies, led to the creation of seven parent Regional Holding Companies (RHCs) in January 1984 and allowed AT&T to enter freely into all telecommunications and non-telecommunications businesses.[5] It is noteworthy that on the same day the government dropped the antitrust case it had opened against IBM.

After the divestiture a new service-area category -- Local Access and Transport Area (LATA) -- was established. AT&T Communications and Other Common Carriers provide services between LATAs (interLATA service),[6] while the BOCs provide services within LATAs (intraLATA service). This new category, LATA, complicated the jurisdiction process for the FCC and the PUCs since some LATAs extend beyond state borders, and some states have several LATAs, in which case the PUCs handle both inter- and intraLATA services, as illustrated in Figure 10. Only operating areas distinguish AT&T from the BOCs in long-distance services; there is no fundamental difference in hierarchy or network technology. The functions of each in the network are the same, but they are regulated by state or federal authorities, as appropriate.



* In the states where competitors exist, BOCs are not the sole providers of intraLATA services.

Figure 10

Regulatory Authorities After AT&T Divestiture

Japan. Japanese telecommunications have been operated by the government or by quasi-government monopolies since the inception of telegraph service in 1869. Since 1952, public telecommunications services have been solely operated domestically by Nippon Telegraph & Telephone Public Corporation (NTT) and by Kokusai Denshin Denwa Co., Ltd. (KDD) internationally, established in 1952 and 1953, respectively. The Ministry of Posts and Telecommunications (MPT) has administrative responsibility for telecommunications, as well as postal services and broadcastings.

As is true in the United States and Britain, however, the telecommunications industry in Japan is on the verge of drastic change. Two telecommunications reform laws in force as of April 1985 are the Telecommunications Business Law and the Nippon Denshin Denwa Kabushiki-kaisha Law (the new NTT Law).[7]

The Telecommunications Business Law is essentially a tripartite law.

1) Competition is introduced in all areas of telecommunications, domestically and internationally,[8] including local loops and CPE. No monopolistic power is sustained.

2) Telecommunications carriers are divided between two classes: Type I telecommunication carriers (Type I carriers) establish circuit facilities and are subject to the regulation of the MPT for most of their business activities; Type II telecommunications carriers (Type II carriers) lease lines from Type I carriers and operate freely, subject to few procedural regulations. Type II carriers are further classified as either "special" (large scale) or "general," and the degree of their regulation is a function of this size differentiation.

3) While there is a one-third limitation on foreign ownership of Type I carriers, no foreign-ownership limitation is set for Type II carriers.[9]

There are four essential components of the new NTT Law.

1) NTT is made a private entity, Nippon Telegraph and Telephone Corporation, but unlike AT&T, it is not divested; The new NTT is allowed to provide both long-distance and local services.[10] The new NTT also may provide data-communications services and enhanced services within the same entity, using the common facilities that are used for telephone services, although strict accounting methods, distinct from those for the dominant telephone services, will be required for competitive services to ensure fair and equitable competition.

2) Initially the new NTT will be owned outright by the government; up to one-third ownership will eventually be ceded.[11]

3) The new NTT will be granted freedom of investment.

4) The new NTT will be reviewed within five years of private incorporation in order to evaluate its operation under the new law.

Comparison of U.S. and Japanese regulations. The major difference between U.S. and Japanese telecommunications policies is that in the United States no new act or law defines the actual substance of regulation -- telecommunications policies are being made on an ad-hoc basis; in Japan, basic regulation policies are described in the Telecommunications Business Law and the new NTT Law, though much flexibility is left for the MPT. The U.S. policies in some cases might be inconsistent, proving hazardous to carriers, service providers, and users. At the same time the various U.S. policies may be very flexible, and more able to incorporate rapid changes in technology and society. In the Japanese system, on the other hand, the telecommunications industry appears to be well organized; carriers, service providers, and users are assured of a measure of continuity in the system. However, there would be less flexibility of response in the Japanese system since it is difficult to change a law that has been passed. Figure 11 compares telecommunications regulations in the United States and Japan.

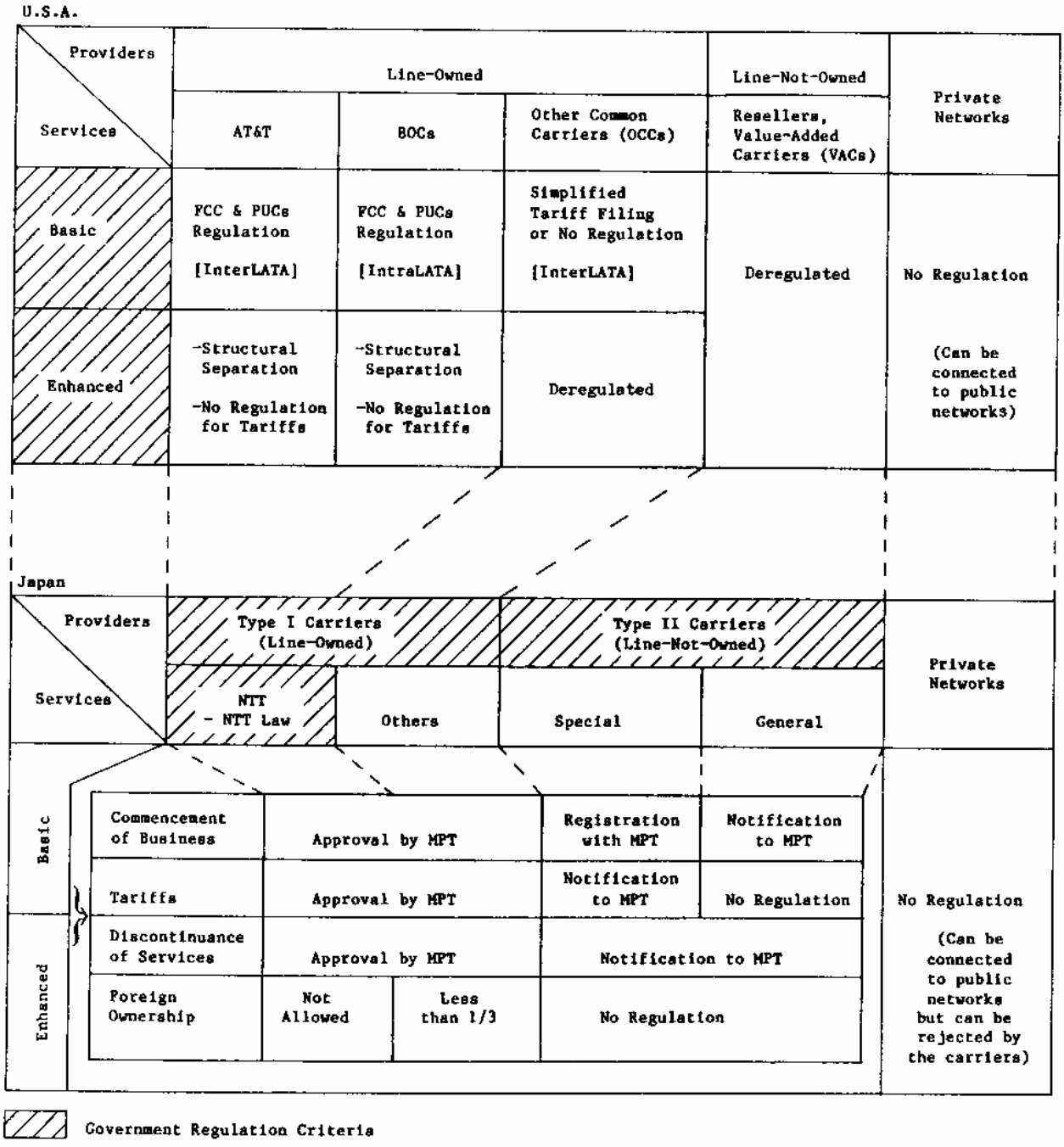


Figure 11

Comparison of Regulations in the U.S. and Japan*

* Customer Premises Equipment (CPE) is liberalized in both countries. AT&T and the BOCs must establish separate corporations for offering CPE, although recently the FCC proposed removing the structural separation requirement of AT&T for providing CPE.[12]

Telecommunications are regulated according to service categories -- basic and enhanced -- in the United States, whereas in Japan, regulation is imposed according to ownership of circuit facilities. In the United States, AT&T and the BOCs are permitted to provide enhanced services[13] only through separate subsidiaries because of their dominance in the market, but the enhanced services provided by the subsidiaries of AT&T and the BOCs are not regulated. Other companies, including IBM and other computer companies, are free to provide both basic and enhanced services with little regulation of their basic services (relative to those of the dominant companies), and the provision of enhanced services by these companies is unregulated.

In Japan, both NTT and other Type I carriers are permitted to provide enhanced services using the same facilities, but their provision of enhanced services is subject to stricter MPT regulation than is provision of those services by Type II carriers, who can also provide basic services. To remedy this apparent incongruity the president of NTT suggested the possibility of providing value-added services through separate subsidiaries of NTT.[14]

In the United States, private networks and lines can be interconnected with public networks if they meet existing standards. In Japan, according to the new law, a Type I carrier can reject interconnection with a private network that does not meet the technical standard set by the MPT, or if the Type I carrier receives MPT certification of its inability to maintain and adequately manage its facilities and equipment with connection of the private network.[15]

b. ISDN Policies

To date, most of the activity related to ISDNs in the United States has been generated by the private sector, especially carriers, with the

important exception of those government organizations that participated in the CCITT activities and continue in a research capacity. In August 1983 the FCC opened a Notice of Inquiry (NOI)[16] and sought comments on a variety of issues from interested parties.[17] Two of the major questions taken up by the NOI are: How can U.S. policies that impel competition be reconciled in an ISDN environment? and, How can the FCC best assist in the U.S. efforts to formulate a coordinated ISDN policy and at the same time represent U.S. interests? This NOI was the first inquiry by the FCC focused specifically on a future telecommunications issue. In April 1984 the FCC issued a First Report[18] on ISDN based in part on the solicited comments, the substance of which is considered in the following chapters.

In Japan, INS was first proposed to the public in 1981 and was widely publicized by NTT as a means of realizing new, diversified services — voice and nonvoice — that incorporate computers into communications. INS itself appeared as an all-encompassing alternative that could provide basic, enhanced, and even computer services.

This image of INS was roundly criticized by the private industries, which maintained that NTT was going to monopolize the fruit of the information revolution (at the time NTT was a public corporation). The Ministry of Posts and Telecommunications (MPT) began a public hearing, organizing a study group on INS to compile the comments and opinions of the 16 related organizations from August through December 1982.[19] The criticism of INS from the private sector was one of the forces that brought forth the total liberalization of small and medium-size enterprises, value-added network (VAN) services in the Second Liberalization of Data Communications Circuits in October 1982.[20]

Figure 12 illustrates the chronological development of the major ISDN-related policies and early implementation efforts.

UNITED STATES	JAPAN	CCITT
1968-March 1971: Computer Inquiry I 1976-May 1980: Computer Inquiry II 1981: Record Carrier Competition Act of 1981	1971: First Liberalization of Data Communications Circuits 1981: NTT proposed INS	1972: Fifth Plenary Assembly 1976: Sixth Plenary Assembly (formally began study on ISDN) 1980: Seventh Plenary Assembly (gave SG XVIII responsibility for ISDN) 1981: Innisbrook M., Geneva M., Montreal M.
1982: Consent Decree (AT&T, IBM) (1/82) Modification of the 1956 Final Judgment (MFJ) (8/82)	1982: Ad Hoc Committee recommended privatization of NTT (7/82) INS Forum (8/82) Second Liberalization of Data Communications Circuits (10/82) MPT formed "Study Group on INS" (8/82-12/82)	1982: Darmstadt M., Munich M., Geneva M., Florence M.
1983: International Telecommunications Act of 1983 NCTE decision (6/83) Notice of Inquiry on ISDN (8/83) Protocol Order (11/83)	1983: NTT International Symposium (2/83)	1983: Kyoto M., Geneva M., Geneva M.
1984: AT&T's Breakup (1/84) First Report on ISDN (4/84) FCC admitted some protocol conversions to some BOCs. (11/84) Cable Telecommunications Act of 1984	1984: INS Model System began (Musashino-Mitaka)(9/84) Telecommunications Business Bill and NTT Bill passed (12/84) 1985: NTT's privatization (4/85)	1984: Brasilia M. Geneva M. Eighth Plenary Assembly (10/84) (approved several ISDN Recommendations)

(M = Meeting)

Figure 12

Chronology of ISDN and Related Issues

c. Pro-Competitive Computer Inquiry II and ISDN

In the United States there are many service providers, and in Japan a number of private companies are planning to enter the telecommunications market.[21] How does this competitive market structure with multiple providers affect ISDN? The FCC, in the NOI, reported that "competition among service providers and unrestricted user access to their basic service offerings are the cornerstone of our pro-competitive policies and goals."[22] The FCC therefore concludes that "U.S. ISDNs must evolve under a structure which accommodates our multiple-vendor telecommunications market and our pro-competitive policies."[23] The fundamental issue uncovered by the FCC in the NOI is the problem of securing and sustaining a policy in an ISDN environment in light of the conclusion of many analysts that the very concept of ISDN, involving as it does the integration of existing networks and services, at first glance appears to pose barriers to competition. The universal recognition of this paradox does not mitigate the importance of competition in an ISDN environment; dissent arises over how competition ought to be ensured.

In its First Report the FCC concluded that

> our pro-competitive Computer II policies, when applied to the ISDN concept, lead to the conclusion that both basic and enhanced ISDNs will evolve in the United States. We tentatively concluded that it is important that the overall ISDN concepts which evolve appropriately accommodate the Computer II policies, that a multiple-vendor environment in the United States not be foreclosed through technical recommendations or concepts directed towards a single-vendor environment, and more generally, that sufficient flexibility be built into the ISDN concepts to accommodate the broad range of different market structures which exists in various nations.[24]

Computer Inquiry II, as we have seen, mandated a separation of services provided -- basic and enhanced -- for the purpose of regulation, and required of AT&T and the BOCs the separation of entities and facilities for providing enhanced services. This ruling, in effect, proscribes against economies of scale and, perhaps more important for the individual companies, economies of scope that could be expected to develop as the result of increased utilization of those facilities providing basic services. ISDNs, on the other hand, are networks through which all types of information could be handled indiscriminately, making less clear the distinction between basic and enhanced services. The FCC attempts to confront this confusion in the NOI:

> All facilities-owning carriers must continue to offer such transmission facilities pursuant to tariff and must take basic facilities to support their own offerings of enhanced services on the same tariffed basis as other competing enhanced service providers. Thus, carriers owning underlying transmission facilities and providing enhanced services must "unbundle" their basic and enhanced service offerings.[25]

Some carriers insisted in their comments to the NOI that the basic/enhanced dichotomy be abandoned or modified, arguing that an ISDN would require provision of code and protocol conversions -- defined as enhanced services under Computer Inquiry II -- as part of the basic service provision.[26]

Conversely, it may serve the interests of other common carriers (OCCs) to sustain the present regulatory structure as it applies to dominant carriers since the OCCs are not required to separate their enhanced and basic facilities. In addition, information-processing companies, resale companies, and value-added carriers (VACs) also might support the Computer Inquiry II decisions, since these concerns want to lease telecommunications lines from carriers -- that is, the lines

themselves without additional functions or capabilities. In fact, the companies that lease lines consider the addition of functions to leased lines -- a major source of profit -- to be their role; in many cases it is the essence of a company's existence.[27]

The basic political problem of establishing a coherent telecommunications policy involves resolution of distinct, often conflicting interests: short-term and long-term goals; big and small users; business and residential customer-services; urban and rural services. There also is a tradeoff to be considered between the realization of scale and/or scope economy and antimonopoly policies. For example, BOCs could be permitted to utilize existing facilities to provide such enhanced services as protocol conversion and storage. In this case, the cost and possibly the price of these services might be substantially less than those provided via separate facilities, reducing costs for the users. This circumstance, on the other hand, might foster a monopoly in provision of certain enhanced services, the management of which (according to many economists) would tend to be inefficient and, if basic textbooks of economics are right, would result in price increases.[28]

Bearer service/teleservice. The CCITT model of ISDN provides two service classifications: bearer services and teleservices.[29]

According to the CCITT definitions, telecommunications service is "that which is offered by an administration or Recognized Private Operating Agencies (RPOA) to its customers in order to satisfy a specific telecommunication requirement." Bearer service is "a type of telecommunication service that provides the capacity for the transmission of signals between user-network interfaces." Teleservice is a

"type of telecommunications service that provides the complete capacity including terminal equipment functions, for communication between users according to protocols established by agreement between administrations and/or RPOAs."[30]

Although the bearer and teleservice categories appear to mirror the basic/enhanced distinction, some observers have pointed out that CCITT categories are inconsistent with Computer Inquiry II, since MTS telephone and telex services are construed to be part of the teleservices category which otherwise involves only enhanced services.[31]

NTIA finds nothing contradictory in the overlap, explaining that

> the purpose of the FCC definition is to separate regulated services from unregulated services, whereas the CCITT definitions are "based on what elements are required to support the service." In other words, the FCC definitions are based on regulatory considerations, while the CCITT definitions are oriented towards technical considerations.[32]

AT&T, which generally is involved in CCITT activities, foresees no procedural problems arising from the incongruity:

> Present CCITT recommendations do not appear to be in conflict with the basic/enhanced service dichotomy of Computer II. Basic services are . . . analogous to bearer services . . . . It is recognized that within the constraints of an international standards setting process, complete uniformity between the CCITT and Commission service dichotomies may not be possible. Should that occur, however, there may well be sufficient flexibility in the CCITT ISDN model to permit U.S. service carriers to provide basic services in conformity with Computer Inquiry II and the CCITT ISDN model.[33]

The original classification was modified at the 1984 Brasilia Meeting of the CCITT; as a result, bearer services include MTS, telex, and private services.

There was a potential for confusion and controversy, but the FCC, in its First Report, observed only that

> the telephone companies in essence used their ISDN comments as a vehicle to argue that a change in the current Computer II rules may be warranted in an ISDN environment. In its comments, IBM argued that the Computer II policies are appropriate, and that ISDN planning should include sufficient flexibility to accommodate the Computer II policies. While some flexibility in the application of our Computer II policies may be warranted, and while we believe . . . . these policies include flexibility in the protocol areas . . . . this inquiry is not a rulemaking proceeding and it cannot result in a change in the Computer II rules. Our Computer II rules and policies are established, and properly should be accommodated in the ISDN planning efforts.[34]

The FCC attempted to evaluate and anticipate the ongoing convergence of computers and communications in its development of a regulatory boundary between the two areas. In Computer Inquiry I, the FCC adopted technical criteria: telecommunications, computer, and hybrid. Later, in Computer Inquiry II, it adopted service criteria: basic and enhanced. Even with the new criteria, the FCC does not seem to have succeeded in establishing a clear boundary, evidenced by the waivers granted in Computer Inquiry II. In July 1985, the FCC began a Third Computer Inquiry to address the significant changes in telecommunications and problems that have emerged since the Second Computer Inquiry. In the Notice of Proposed Rulemaking,[35] three endeavors are proposed as replacements for the "basic" and "enhanced" distinction: communications, ancillary-to-communications, and non-communications. Also proposed is "the elimination of strict structural separation in favor of lesser separation techniques, and the inclusion of a carrier's dominant or non-dominant status as a factor in decisionmaking."[36]

d. Line-owned/Line-not-owned Regulation and ISDN

In Japan, where telecommunications regulation will be based on the ownership of the lines rather than on functions, dissent seems less

likely, since any entity with or without lines could provide both basic and enhanced services. Moreover, no service will be provided under monopolistic conditions, at least as far as legal frameworks are concerned. According to Moriya Koyama, deputy minister of the MPT, "Judging from the worldwide trends toward ISDN, basic and enhanced services will be integrated sooner or later. Therefore, we decided to take the classification of 'line-owned' and 'line-not-owned.'"[37] Future regulation debates will likely focus on the dominance of NTT, considered here in a later chapter.

e. Breakup of AT&T and Privatization of NTT

The effects of the divestiture of AT&T on ISDNs in the United States are significant and permanent. First, since the United States has opted for market competition instead of a regulated monopoly as the agent for creating and controlling the system, large-capacity users of information will dictate necessary adaptations of the existing telecommunications infrastructure. Therefore, the goal of regulation -- universal service -- may prove to be elusive; service may be quite fragmented. AT&T no longer sustains "universal service," at least for enhanced communications services in the information-intensive society.[38]

Second, as a result of the lack of close cooperation between AT&T and the BOCs (since they are in competition in some areas), the lack of AT&T's coordination power, and the loss of de facto AT&T standards, the realization of such ISDN-related services as national call-forwarding might be delayed by divestiture. The provision of those services that depend on the network but are not as deeply integrated into it, however, might be accelerated.[39]

Finally, over time AT&T and the BOCs might grow even further apart, especially if it is profitable for them to construct their own separate networks.[40]

No study of long-distance/local interface has been undertaken by CCITT because it is only in the U.S. that long-distance and local services are provided separately (user-network/network-network interfaces have been studied). The mandated distinction between AT&T and the BOCs are the LATAs, which are not limited to local exchanges. The BOCs also provide interexchange services, though only within a LATA. Competition might occur, especially among those companies with additional communications capabilities such as PABX and LAN. AT&T, in turn, might seize an opportunity to connect directly these private networks, bypassing the BOCs. Despite this possibility, the BOCs gained an advantage with the divestiture, and they know the strength of their position, as some have indicated in their Reply Comments:

> While there was arguably some incentive for AT&T to design specifically tailored protocols to benefit equipment manufactured by Western Electric in the pre-divestiture marketplace, any such incentive has now disappeared because of the BOCs' total lack of manufacturing capacity. Thus, it is to the advantage of the BOCs to structure their own ISDN networks to accommodate the widest possible range of terminals.[41]

In the aftermath of the privatization of NTT in April 1985 and the intention of such companies as Kyocera or Japan National Railway to enter the telecommunications market, the future of a Japanese INS might face the same variety of problems as raised by ISDN in the United States: an uneasy alliance between competition and universal service, and the prospect of interconnecting several ISDNs. William F. Finan has described INS as "a system designed under the premise that NTT would maintain its monopoly position in almost all aspects of Japan's

telecommunications market. A policy of introducing competition . . . . would likely make INS unlikely to be fully realized.[42]

Conversely, it is possible that new entries into the network business will not disturb the realization of INS (depending on the definition of INS), although NTT's contribution to INS (or ISDNs) might be reduced.

NTT President Shinto's assesment reinforces this view:

> INS is not special at all. It involves changing the analog facilities into digital ones, which must be done whether or not NTT becomes a private company. The second-NTTs will naturally have their networks digitized . . . The weight of INS will be heavier in the new NTT.[43]

As a result of privatization and competition, in fact, the pace of nationwide digitization might be accelerated.

2

ISSUES IN ISDN SERVICES

a. Benefits for Users and Uncertainties for Suppliers

Service menu. Generally speaking the services outlined in Figure 13 can be realistically anticipated in an ISDN environment. (Figure 14 details the services being offered by the Japanese INS Model System.) It is worth noting that there are no known services themselves unique to an ISDN and that any service that can be offered via an ISDN can be provided by networks now in place or networks and capabilities that will evolve from existing systems.

- Digitized voice
- Data transport (circuit switched and packet switched)
- Video (Whether digital TV will be provided by ISDN is uncertain because of the large bandwidth required; other video services are planned in many countries.)
- Other services, including telemetry, videotex, software transfer, electronic mail, and database access

Figure 13

Services Menu in ISDN

Services	Main Features
Digital Facsimile Communications Service	- High function communications by the storage and conversion function of the network. - High speed transmission (e.g., 12 sec/A4 size).
Digital Interactive Videotex Communications Service	- Information service from CAPTAIN center, incorporating voice. - Reduced picture renewal time.
Integrated Centralized Extension System Service	- Integrated services with telephones and non-telephones. - Voice storage and document communications processing by the communications processing function in the system.
Message Communications Service	- End-to-end transmission of Japanese-language document. - Media conversion from teletex to facsimile by the storage and conversion function of the network.
Multi-media Communications Service	- Simultaneous and alternate communications with various kinds of customer equipment. - Center-to-end communications through various communications media (e.g., voice, characters, figure).
Digital Subscriber Telephone Service	- Indication of caller's number (or dialed number) and charge by out-channel subscriber line signaling. - Multi address communications and delayed delivery by voice storage function of the network.
Digital Public Telephone Service	- Indication of dialed number, charge, and remaining time by out-channel subscriber line signaling.
Digital Telewriting Service	- Simultaneous communication of voice and hand-written figures and characters.
DDX Service	- DDX circuit switching and packet switching services. - DDX terminals are accommodated to the digital local switching system.
TV Conference Service	- Teleconferencing with color monitors and high quality human voice transmission. - Multipoints (up to four) connection and automatic reservation.
Moving Image Transmission and Information Services	- Moving image transmission for entertainment, surveillance, and information retrieval.
Broadband Highspeed Facsimile/Color Facsimile Communications Services	- Ultra high speed, high definition facsimile transmission (2 sec/A4 size: 0.77 Mb/s). - High-speed color facsimile transmission (30 sec/A4 size: 1.5 Mb/s).

CAPTAIN = Character and Pattern Telephone Access Information Network (Japanese Videotex)
DDX = Digital Data Exchange

Figure 14

Services in the INS Model System

Benefits for users. The problem of benefits for network users is likely to be the most closely scrutinized of concerns raised by an ISDN. In fact, those user benefits are already a source of controversy.[44]*

According to an NTIA report, the user generally is concerned with "what the network can do, how well it can do it, and how much the user will be charged . . . ." The report lists some of the functions of concern to the user: range of services, access and control, quality, transparency, physical attributes, efficiency, and cost.[45] The potential user benefits of an ISDN include: easy access to a wide range of existing and new services through a single interface, including long-distance and local calls, teleconferencing, packet-switched data service, electronic mail, call forwarding, or videotex; increased cost-effectiveness of transmission plant and dramatically improved performance; and reduced maintenance needs.

In its comments to the NOI, GTE forwarded a scenario in which user benefits may be part of a generally improved communications environment with service providers and manufacturers profiting along with ISDN users. The GTE projections include:

- End-users will be offered new services that are more cost-effectively delivered in digital form and through the integrated networks.
- Service providers will be assured of less expensive transport of services to end-users or carriers with a fully integrated network than would be available if various networks were relied on to provide particular, limited services.

* As for the costs to users, see, in this chapter, Section e., Universal Service in an ISDN Environment and Part II, Section 4.d., Cost Advantages and Disadvantages of ISDN (Tariff Level).

- Equipment manufacturers will be able to optimize cost-reduction goals as a result of lower risks, domestically and internationally, guaranteed by the proposed standardization of interfaces.[46]

Uncertainties for suppliers. Regardless of these expected benefits for users, those participating in the development of ISDNs, face several uncertainties, as is to be expected with any potential system. R. C. Terreault of Bell Canada has identified four such areas for consideration:

1.) Market demands and economies are still unclear.

2.) Users have only a minimal awareness of ISDN.[47]

3.) Digitization of the network is capital-intensive and can be implemented only gradually, despite the fact that it is economically attractive.

4.) Progress on international-standard setting is steady but slow and, while agreement is likely on theoretical grounds, implementation by suppliers is less likely until it is demonstrated to be economically and technologically viable.[48]

Underlying these uncertainties about the projected ISDN environment are users' opinions that a clear cost-benefit analysis must be made to prove that there are definite advantages for telephone users before the implementation of ISDNs can be seriously considered.[49] The telephone companies respond that with competition, marketplace forces determine the availability of particular services and facilities and that forecasts of the conditions or costs of nonexisting demands are difficult to develop and are not necessarily reliable.[50]

b. What Bandwidth is Necessary for ISDN?

In one aspect, ISDNs are digital pipes that can provide services ranging from telemetry services, which require narrow band, to video services that call for much wider band. This variation raises fundamental questions: What bandwidths are needed in an ISDN environment? Is the requirement the same for business and residential customers? Will the bandwidth or the channel structures provided for in the initial network accommodate demands and technical progress? From the CCITT I.400 series recommendations, two main interfaces emerge: the basic interface and the primary rate interface.

The basic interface is composed of two 64 kb/s communications channels (B-channel) and one 16 kb/s channel (D-channel). A B-channel is intended to carry a wide variety of user information streams, including voice and bulk data. The D-channel is message-oriented and carries the signaling information (s-info) that controls the circuit switching of B-channels through the ISDN, tele-action (t-info) such as tele-alarm, telemetry and telecontrol, and low speed, bursty data (p-info).

The primary rate interface structures are based on the two different digital-link bit rates of 1.544 Mb/s (for North America and Japan) and 2.048 Mb/s (for Europe); these structures are primarily intended to connect large terminal clusters supported by PBXs or LANs. The access structure can be made to correspond to any suitable assembly of B- and D-channels, typically 23B+D (1.544Mb/s) and 30B+D (2.048Mb/s). Time slots not dedicated to B-channels and D-channels can be appropriated for H-channels, which may be used for facsimile, sound, or video applications.

The bandwidth or user/network interface of the digital pipe suggests two problems: First, it is important to distinguish between the needs of business and of residential customers. Business, especially big-business, customers will usually demand highly sophisticated services with huge capacities. If dissatisfied by a carrier's service, they have the option of developing their own networks. The demand for ISDN on the part of residential and, perhaps, small-business customers will likely be lower, and some customers will not need or will not be able to afford the broadband-ISDN services; of course, the degree of accessibility will depend, in part, on the tariff level of ISDN. Is the CCITT standard of 2B+D adequate for large, corporate customers and reasonable for residential customers? Are the present analog networks to remain in place in an ISDN environment to service the small-demand customers? The CCITT is studying hybrid access between digital and analog as well as more diversified channel structure, such as B+D and D in addition to 2B+D.

In the Model System of INS, NTT adopted 64 kb/s and 16 kb/s channels, each accompanied by a 4 kb/s channel for signaling. NTT claims that this structure "will permit simple, relatively inexpensive signaling in which the signals for digital terminals, such as telephone, facsimile, and videotex, all have the same durations."[51] NTT reportedly was insistent about the adequacy of the B+D structure in meetings at the CCITT though NTT later explained that it would gradually provide the 2B+D systems recommended by CCITT after 1990.[52]

Second, the choice of the 64 kb/s rates was based largely on the technology available at the time of the adoption of standards: If the ISDN network were to provide high quality of voice service, 64 kb/s was

required. But technology has advanced since, and the same quality of voice service can be achieved today with 32 kb/s or even 16 kb/s. Rates lower than 64 kb/s are now under reconsideration at CCITT for the 1984-1988 period.

Use of D-channel. There is some concern that services on the D-channel will be bundled by ISDN providers, which some observers feel would give these providers an unfair advantage over others who also provide communications or information services to end users. Several industry spokespersons have called for making D-channel services available on a nondiscriminatory basis, with priority to signaling and other network functions.[53] GTE is on record as suggesting that

> if the ISDN provider uses the D-channel in the provision of a packet-switched service, other packet-switched service providers should be permitted to use the channel on an equal-access basis similar to that being implemented for voice networks as a result of current industry restructuring due to the AT&T/DOJ MFJ.[54]

GTE further commented, "an unbundled offering of the excess D-channel capacity which is left unused by signaling and other network functions would enable the ISDN user to obtain these services competitively from many potential service providers."[55]

56 kb/s and 64 kb/s. A major concern regarding the actual implementation of ISDN is the total resources invested to date. In the United States, where digital systems are composed of the 56 kb/s channels rather than the 64 kb/s recommended by CCITT, there is significant pre-existing investment in such systems as those of T1 carriers[56] that were developed to meet the vast and diversified demands of major users.

The modification of 56 kb/s systems for a 64 kb/s system is a matter of dispute among carriers. The different positions taken by AT&T and Northern Telecom illustrate the current disagreement.[57]

AT&T maintains that initial implementation of ISDN-based devices should only support 64 kb/s, while Northern Telecom asserts that for some interim period devices should be able to support both the current 56 kb/s and 64 kb/s. AT&T rejects Northern Telecom's position on the grounds that, if accepted, ISDN interfaces and terminals would be unduly complex and, therefore, unnecessarily expensive. Northern Telecom, on the other hand, intends to have its large installed base of PBXs and central-office switches support transitional ISDN-based devices with accrual of only minimal charges.

c. Availability of Private-Line Service in ISDN

In the United States there is a general concern that in an ISDN environment users will not be free to choose services (as is currently possible) because of the very nature of integration and the process of compromise among participating countries. One of the most provocative aspects of this concern is the availability of dedicated private-line service. In the NOI, the FCC requested reactions to the notion that "permanent virtual circuits" of ISDNs might serve as adequate substitutes for dedicated private-line offerings.

The differences between these two offerings are generally defined as follows: A dedicated private line is an unswitched transmission path of specified capacity between two or more points, available 24 hours a day, under a single customer's exclusive use, wholly transparent and offered without protocols or other restrictions to the customer, and usually priced on a flat-rate monthly basis. A virtual leased circuit is a switched transmission path that exists only as long as a transmission is occurring and disappears when the transmission is terminated; it can be priced on a usage- or volume-sensitive basis.

The arguments against the ISDN virtual circuit put forward by some information-processing companies have focused on five principal issues.

First, the virtual circuit lines are not transparent and users are required to superimpose their protocols on existing network protocols. Dedicated services lines are much more transparent, users are freer to use their own protocols or transmission procedures, and the users can employ a variety of customer premises equipment (CPE), availing themselves of state-of-the-art technology.

Second, maintenance of dedicated lines is relatively easy; users can isolate technical problems through a process of elimination by separating testing equipment, software, and transmission links.

Third, since the dedicated lines are leased to users on a flat-rate monthly basis, users have predictable communications costs and, more importantly, an incentive to use these circuits as efficiently as is technologically possible. If virtual-circuit usage were priced on a usage-sensitive basis (even if it were priced on a flat-rate basis that reflects cost) the service would be more expensive than with dedicated lines, because virtual circuits require switching facilities and a variety of other network resources.

Fourth, since it does not appear that virtual circuits can provide for multiple drops, many of the currently available applications offered over multidrop private-line networks would have to be continued. (An important caveat: dependent upon the method of implementation, a virtual circuit can offer services functionally, identical to those of a leased circuit.)

Finally, virtual-circuit access penalties might well be imposed upon users, particularly those with highly interactive data-processing

requirements. Similar delays exist with respect to the time that it takes a message to travel the network.[58]

The potential merits of the virtual circuit include wider choice for users if the service is offered along with dedicated private lines, and accrual of benefits to small users, those whose usage is considerably less than full time and who would be charged only for what they used. A GTE report posited other benefits of the ISDN's virtual circuit:

> This shared use of facilities by a large segment of the market should have a positive effect on lowering residential and small business rate requirements in the future . . . . [It] could be said that, with ISDNs available, some customers would migrate away from expensive private networks to ISDNs.[59]

In their NOI comments and replies, all parties, including carriers, stressed the importance of the continued availability of dedicated private-line offerings. AT&T stated that "so long as there is a demand for private leased lines, whether analog or digital, a corresponding service will be provided."[60] The BOCs replied in the same vein, emphasizing that "in a competitive environment, the requirements of customers will determine the design of the network."[61] Although recent documents suggest the continued availability of the dedicated private lines, the ambiguities that remain merit examination.[62]

As far as the Japanese are concerned, the availability of dedicated leased line in INS has not been an issue.

d. Protocol Conversion (Inside or Outside ISDN?)

A protocol is a rule or procedure for the control of communications over a channel, and protocol conversion is necessary if terminals operating under different protocols are to exchange information. If the terminals use different codes or languages, "code" conversion is required for them to understand each other's information.

Several U.S. carriers insisted that end-to-end protocol conversions be provided through the ISDN network on the grounds that

> a basic principle of ISDN architecture is that users . . . access the network by means of a digital message-oriented signaling procedure (or protocol) which supports a wide variety of services, such as telephone, telex, videotex, and access to existing . . . and planned networks supporting dedicated services, such as packet-data transport [and that] those implementations themselves could be optimized, using unique protocols internal to the ISDN and optionally selected access protocols.[63]

The BOC's stated comments were that

> from a user's perspective, it would be more efficient to allow a variety of devices/networks to use ISDN and to have it provide for various devices/networks that may be required both during transition to and in a mature ISDN network. The latter is due to the differences in the telecommunications needs of various users who will want to exchange information with each other and due to innovations in both the connecting terminal equipment and networks.[64]

(These arguments are similar to those concerning NCTE and the use of D-channel. The problem of functional allocation is considered separately.)

Evaluating the general efficiency of the proposals, IBM submitted the following:

> [The] commission's regulatory policies are grounded on the belief, which we are convinced is correct, that in the long run, such inhibition of competition would cause harms -- the dampening of innovation and the inability to satisfy diverse user needs -- that would far outweigh any perceived short-run efficiency gain.[65]

The IBM observation effectively frames the problem of the difference in cost savings in the short run and those in the long run. Telephone companies could offer lower rates by building on the economies of the network; for example, colocating the necessary gear with the basic network equipment in their central offices and passing this on as lower

prices, since it would be more cost-efficient than services offered through separate subsidiaries or by value-added-network suppliers (economies of scope). But this short-run efficiency would have a hidden long-run cost. There might be a significant cross-subsidization of an unregulated service by the regulated network, which impedes competition; in the long run, cost savings achieved through the "fair" competition among separate subsidiaries of AT&T and the BOCs might be more substantial. Moreover, the competitors (i.e., value-added carriers), presented with the possibility of telephone companies' lower rates, might want to colocate their protocol-conversion gear in the central offices to secure fair competition. Who would gain, carriers or competitors? What of final users?[66]

e. Universal Service in an ISDN Environment

Many arguments have been forwarded about universal service[67] in the competitive environment, but little research has been dedicated to universal service in an ISDN environment, which represents a serious oversight in view of the purpose of the U.S. Communications Act of 1934 and the obligations laid out in the new NTT Law in Japan.[68]

Will ISDNs promote or hamper universal service? Will basic telephone services continue to be fundamental in an ISDN society? Would this arrangement still be desirable in terms of equity and fairness? How should we consider the special feature of the telecommunications services -- that the total utility to the users increases as the number of users increases? There seem to be at least three factors to consider regarding universal service with an ISDN, in addition to the tariff structure and the tradeoff with pro-competitive policy.

The first consideration is the functional allocation between terminals and the network. If many functions are incorporated into the network, then small businesses, residential customers, and (presumably more important in terms of the universal service) poor or small-scale customers would be more likely to have access to ISDN services. The additional cost of providing services to additional users would be significantly reduced for network providers relative to the implementation cost; the lower cost of CPE should guarantee wider distribution of ISDN services. Conversely, if very few functions are put in the network, or if market forces dictate the availability of services, the opportunity for small-scale and poor customers to enjoy the benefits will be substantially reduced.

Second, the ISDN and non-ISDN interface is a significant factor. If this interface is flexible and the ISDN network can be connected to non-ISDN networks easily, then even those who do not presently need ISDN services would retain access to an ISDN should they eventually require it. They would benefit from the ISDN services at their own discretion and would be availed of any advance in the provision of universal service.

Lastly, the method for digitization of the present network should be carefully considered.[69] Should the present access lines be transformed into digital lines at one time, residential customers would more likely gain access to new ISDN services. At the same time, they might be forced to pay higher prices for the new services because the old lines are not fully depreciated. Those who could not afford the additional expenditure would be in danger of having to surrender their fundamental telephone services.[70] On the one hand, if the traditional analog lines

(non-ISDNs) are left in place along with sophisticated digital lines (ISDNs), those who need only telephone service would get inexpensive services in the short term, but as time passed and traditional users took up the ISDN services, those relying on analog lines might have to pay higher prices for unenhanced service, since there would be fewer users sharing the common costs. On the other hand, the price of ISDN services would become lower and lower as the number of customers and volume of use increase. The problem here is one of timing: When should facilities, especially local facilities, be digitized, and how can the the externality of the telecommunications systems be equitably accounted for?

The final question here applies to the Japanese INS: Will the basic concept of INS -- the fair and equal provision of more economic, more convenient, and more diversified telecommunications services at any time and to any place regardless of where one lives -- be unchanged? In other words, will NTT continue to provide universal INS services under competitive conditions? Considering these possibilities, the redefinition of universal service in an ISDN environment seems necessary.[71]

f. Who Provides Services through ISDNs?

The last section of this chapter is devoted to the most crucial and controversial issue: Who will provide these services? Although CCITT emphasizes that its recommendations are aimed at the user-network interfaces, it does not specify who is to provide particular services.[72] It is undeniable that many parties have vested interests in these standards-setting activities. (This section is closely related to the functional allocation problem, considered in the next chapter.)

ISDN services are best characterized according to the networks-provided functions, terminal functions, and operational and commercial features associated with the service provision. Should roles be shared in provision of these ISDN service functions? If so, what organizational factors should be considered? If the services are to be provided competitively by network, terminals, and service providers, what benefits and costs will be incurred?

It is plausible that service provision or functional allocation ought to reflect the peculiar social and cultural conditions of a given nation. In the United States many petitions and decisions have thus far been passed concerning provision of, and fair competition in, telecommunications. The service providers have at least been identified by this process. Still, ISDNs might well incite new arguments and require an entirely new process of resolution.[73]

The Europeans appear to support ISDN as the most efficient, and thus most beneficial, system if these services are provided from the network.[74] In Japan, as explained in the previous section, the MPT called for a hearing based on private-sector criticism of INS. At this hearing, several organizations reportedly expressed the view that there should be appropriate cooperation and role-sharing between NTT (a public corporation at the time) and the private sector in the development of INS and, therefore, NTT should in principle retain its status as a common carrier providing low-cost, high-quality telecommunications lines (basic communication services). Enhanced services such as data communications using INS networks, it was thought, should be subject to free-market mechanisms so that private-sector concerns might compete on

fair terms. Finally, there was a general concern that NTT would initiate database business under the guise of information processing.

NTT responded by claiming that, although NTT might be reformed by the recommendation of the Second Ad-Hoc Committee, it would provide enhanced services and CPE on a fair competitive basis vis-a-vis its natural competitors in the private sector, and that this competition would result in an INS that developed efficiently and responsively. As for database business, NTT stated that it would not operate so-called "soft" businesses such as information collection, selection, arrangement, integration, editing, and filing, though it did plan to produce software for retrieval and processing, data-communications equipment at information centers, and CPE. Again, this activity would be with no advantage in its market position relative to other private enterprises, since it would rely on accounting systems distinct from those of its monopolistic telephone business. Dr. Shinto, President of NTT, posited that "it is NTT's responsibility to upgrade the quality and capacity of the network so that it can be used freely. The user's responsibility is to utilize them to the maximum extent."[75]

In sum, who provides what services is one of the most crucial issues in ISDN development. Harvard University's Program on Information Resources Policy created the Information Business Map, Figure 15, as a method of displaying the boundaries of the information business and regulation.[76] How would the map change in an ISDN environment both in the U.S. and Japan?

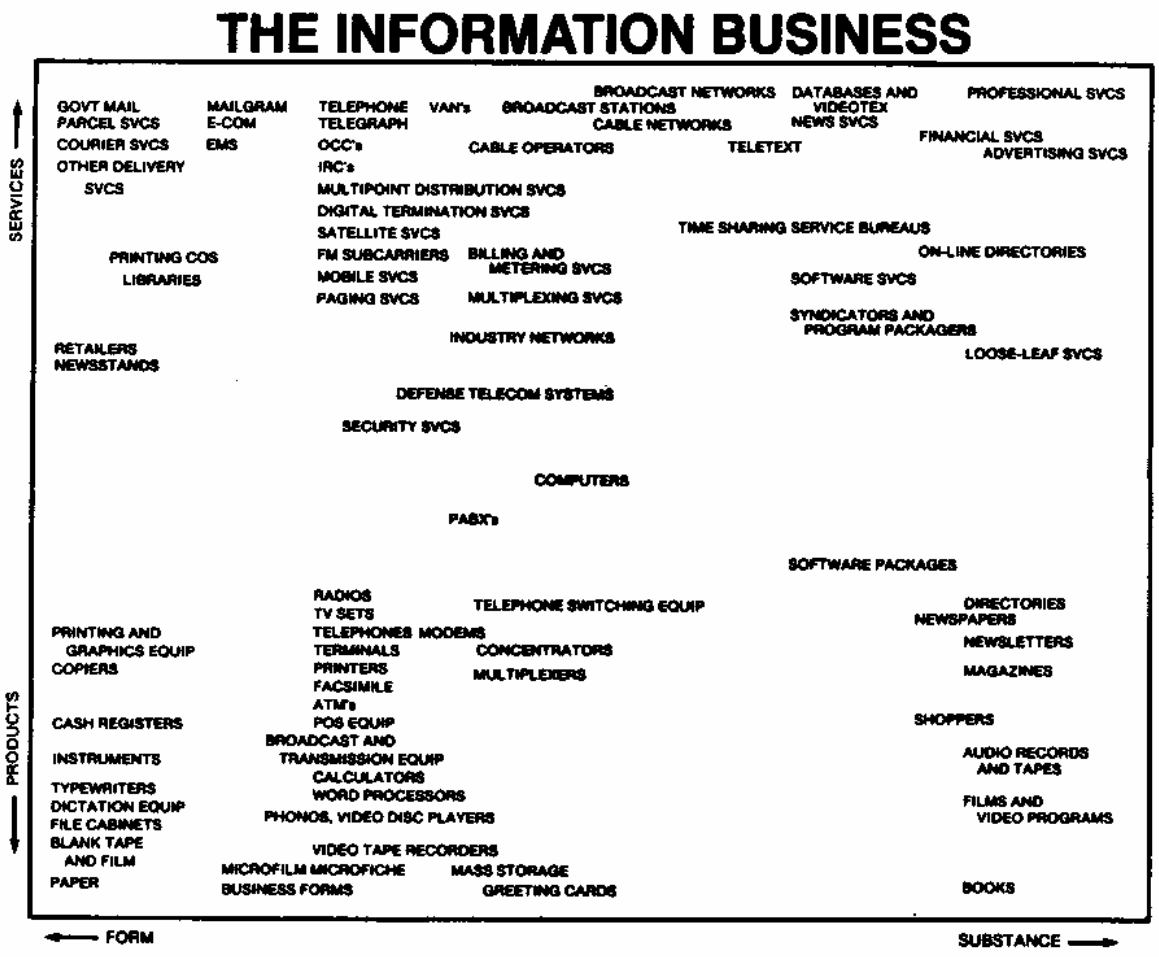


Figure 15

The Information Business Map

3

ISSUES IN STANDARDIZATION

a. Overview

Standardization is key. Standardization will impact on carriers, service providers, information-processing companies, end-users, and manufacturers. The international standards for ISDN will provide for the interconnection of all existing networks and for the interoperability of equipment, and will encourage market entry, competition, and innovation. And standardization will have its negative impacts, as well.

The ISDN standard interfaces can be expected to connect CPE to an ISDN and to facilitate the economic and efficient interconnection of domestic and international communications networks. However, the multiplicity of interests demands compromise, the effects of which particular interest groups intend to influence by various means: participating more actively in the CCITT or, ironically, not participating at all and relying on non-procedural influence.

To the extent that the ISDN market is large enough to have a substantial impact on equipment and services trade, any individual nation or corporation will be able to gain an advantage if it can influence the early rounds of decision making on standardization.

The telecommunications industry in one country, especially if its domestic market is small, depends on the creation of a large-scale world market.[77] Several countries have expressed a need for early determination of digital standards because they do not have large-plant investments in the latest analog technology and are poised literally to skip a technical generation by establishing a new digital telecommunications network. Leaders of countries that have already invested in

ISDN-type services think it is essential that standards be agreed upon before implementation reaches a point at which compromise will be too difficult -- too costly -- to achieve.[78]

General problems of standardization. Generally speaking, four points must be considered in setting a standard:[79]

- Timing. If the standard is set too late, it will likely not succeed because of the high cost of replacing or adapting a system that developed without respect to the standard. Conversely, a standard set too early hampers technological development.
- Coordination. The difficulty of this balancing of interests among companies and countries with differing services, products, shares in the market, and telecommunications policies is predictive of the ensuing maintenance and modification difficulties after the standard has been adopted and enforced.
- Sphere (degree of freedom). A standard that is excessively detailed can inhibit value-adding adaptations and product diversification. Of course, a standard that grants too much freedom does not fulfill its function as a standard.
- Actual adoption. Even if a standard is set, it will be of no use if it is not actually used, whether owing to facility restraints or to high replacement cost.[80] A dominant company might tend not to adopt a standard that threatens its market position.

De facto standards are those that are decided in the marketplace and tend to be favored by powerful companies, since market dominance often grants the company the right to establish de facto standards. De jure standards, set by the government or by an appointed organization, are

generally preferred by small companies whose position in the open market is not powerful enough to create adequate demand for their products without objective standards. Clearly, the smaller companies risk losing their market share if subjected to the de facto standards set by dominant companies. In some cases, dominant companies might choose to disturb or delay de jure standard-setting activities, in order to introduce more flexibility into the standard or attempt to establish their own de facto standard as the national and/or international standard.

b. Who Sets ISDN Standards?

Official organizations. In the United States, private companies have the right in most cases to choose not to adopt a standard. In Japan, however, most standards are government-mandated (before the NTT privatization, NTT-mandated) and some technical standards must be met in providing services. The variety of organizations empowered to set standards is outlined in Figure 16.

In Japan it was reported that a conflict might arise between MPT and MITI with regard to the standards for the restructured telecommunications industry. MITI, which is taking charge of the computer industry, is going to set the Japan Industrial Standard (JIS) based on open-system interconnection (OSI) of the International Standards Organization (ISO) and CCITT. MPT will adopt OSI independently of MITI. MPT is calling for a new standard, distinct from JIS, for telecommunications.[81] In addition, a Liberal Democratic Party (LDP) report is recommending strengthening the coordination functions of the Cabinet so that conflicts among ministries do not interrupt the transition into an information-intensive society.[82]

International	CCITT (International Consultative Committee for Telephones and Telegraphs) ISO (International Organization for Standardization) IFIP (International Federation for Information Processing)
U.S.A.	ANSI (American National Standards Institute) -- T1 Committee EIA (Electronic Industries Association) IEEE (Institute of Electrical and Electronics Engineers) NBS (National Bureau of Standards) DCA (Defense Communications Agency) FCC (Federal Communications Commission) NCS (National Communications System)
Japan	JISC (Japanese Industrial Standards Committee) Committee for Development of CCNP (Computer Communication Network Protocol) Telecommunication Advisory Council

Figure 16

Formal Standards-Setting Organizations

De facto standards. In the United States, AT&T played an important role[83] in the standardization of telecommunications before its divestiture: In most cases, other carriers followed AT&T. After divestiture, however, other telephone companies began their own technologies and, as a result, AT&T has lost some of its standards-setting power. Even AT&T and the BOCs -- formerly related -- are using different and, more importantly, incompatible ISDN-type data-communications networks. AT&T has Circuit-Switched Digital Capability (CSDC) in four states, while two Regional Holding Companies (RHCs) -- NYNEX and Pacific Telesis -- recently introduced Circuit-Switched Digital Service (CSDS) using Northern Telecom's Datapath. Although both services use 56 kb/s, they

are not compatible. AT&T's CSDC provides both data and voice services, while CSDS Northern Telecom Datapath cannot provide voice services, and the terminal interfaces are different.[84]

In Japan, NTT has played the major role in setting standards for telecommunications as a public corporation (both as a quasi-government agency and through its research and development activities with major Japanese companies). Before the privatization, NTT set the standards for its facilities with the exception of some CPE standards. After privatization, however, this administrative power reverted to the MPT. Technical standards for carrier facilities will be stipulated by ordinance, and those for CPE by ordinance or required approval of the MPT. In addition to no longer setting standards for carriers' facilities, NTT also surrenders its responsibility for examining and approving CPE.

c. CCITT versus Domestic Standards

Policy alternatives. The standards set by the CCITT are not always satisfactory to a participating country. Since CCITT Recommendations are not binding for member countries but "form a desirable basis for bilateral and multilateral agreements"[85] of these countries, the participating countries are likely to insist on accommodating their own domestic telecommunications conditions so that they might assume a leadership position in the world or at least not be placed at a disadvantage.

In the United States, there are two particular concerns about standardization at the CCITT.

The first focuses on differences between service providers in the U.S. and those in other countries. An NTIA report suggests that

> compromises in the CCITT arena are always being reached with PTTs (Post, Telegraph, and Telephone authorities) who, although they represent a variety of approaches, normally cluster toward provision of services on a monopoly basis. The CCITT documents must be reviewed with a concern for regulatory aspects as well as technical aspects.[86]

Second is the dominance of carriers in CCITT activities. The Independent Data Communications Manufacturing Association, Inc. (IDCMA), in its comments to the NOI, expressed the concern:

> U.S. contributions to international ISDN planning are heavily influenced by AT&T and its subsidiaries. AT&T and the other carriers which participate in ISDN planning share, at least to some extent, the PTTs' interest in sweeping additional functions into the telephone network.[87]

In general, there are three alternatives for a country when it is clear that the CCITT recommendations are going to differ from existing domestic policies or standards:

- to follow the CCITT recommendations and change domestic policies/standards;
- not to follow the CCITT recommendations and allow the domestic policies or standards to remain in effect; or,
- to try to change or modify the CCITT recommendations to accommodate domestic policies or standards.

AT&T and the BOCs support the first alternative, although they insist upon flexibility in the CCITT standards; AT&T and IDCMA support the second alternative; and IBM and ADAPSO, the third. It could be said that AT&T is wavering between alternatives 1 and 2, since it is involved in the CCITT activities as a recognized private operating agency (RPOA),[88] and the parties that have not been active participants and are not RPOAs or Scientific or Industrial Organizations (SIO) naturally

Zysman's analysis of the development of telecommunications is relevant here:

> It now becomes a choice of how much power and memory to put on the desk, how much to put off the desk, i.e., in a mainframe or mini, and how to link several computers together. The choice depends on the purpose of the system, the tasks of the various participations, their needs for common data and common applications. The computers are linked by telecommunications networking products like local area networks (LAN) or PBXs, and are linked into the public phone network as well. The convergence between the industries is real, not metaphorical. AT&T and IBM, NEC and Fujitsu are dominant in different parts of the same business, and would like to capture part of the others' markets.[96]

Scale economy and equal provision of services might call for inclusion of as many functions as possible in the network, if there is sufficient and ubiquitous demand.[97] However, network-installation costs are higher than are those of CPE when demand is inadequate, and costs -- pecuniary and nonpecuniary -- might be higher after facilities are in place, especially in an era of rapid technological change. More significantly, in the face of a national emergency, the effect on society could be tremendously costly.

The arguments for functional allocation are best represented by public statements made by interested parties:

> ISDN should serve as a transparent pipeline for the transmission of user information. Users should be able to select their own protocols and codes to meet their own individual system and applications with a certainty that changes in the ISDN will not cause any adverse impact . . . . Users should have the right to exercise management control over their telecommunications systems. Today, there are many ways for users to improve their system performance and correct system faults. Users must retain the ability and responsibility to tailor their systems to meet their own particular needs.[98]

According to IBM, including many functions within the carrier's monopoly "could lead to the restriction of innovation and to less efficient use of telecommunications networks, to the detriment of all

IDCMA's official opinion is that

> unfortunately, U.S. representation in CCITT has not mirrored the domestic commitment to competition because the predominant role is played by carriers that have historically resisted the Commission's pro-competitive policies . . . AT&T sends larger delegations to ISDN working party meetings than any other non-governmental entity . . . and, AT&T may also view the CCITT environment as an opportunity to create a competitive advantage for itself in domestic markets. After all, ISDN is being designed as an extremely intelligent network, and the evolutionary process being planned will progressively incorporate additional functions and features into the network.[89]

M/A-COM INC. addressed this concern directly:

> The standards process is voluntary, hence if representation is unequal, it is because many organizations have chosen not to participate at this time. If they have chosen to develop products that do not use the standards, then they must be prepared to let the marketplace decide which product it wants . . . . Waiting silently until standards are developed and then opposing their adoption is not legitimate, assuming the standards are developed by recognized standards bodies that are not dominated by special interest groups. If the standards development activities are open, then this problem should not occur.[90]

It is worth noting here that, to date, IBM and the other computer companies have supported the FCC's Computer Inquiry II decision, whereas AT&T and the BOCs have not supported Computer Inquiry II and have filed numerous petitions.

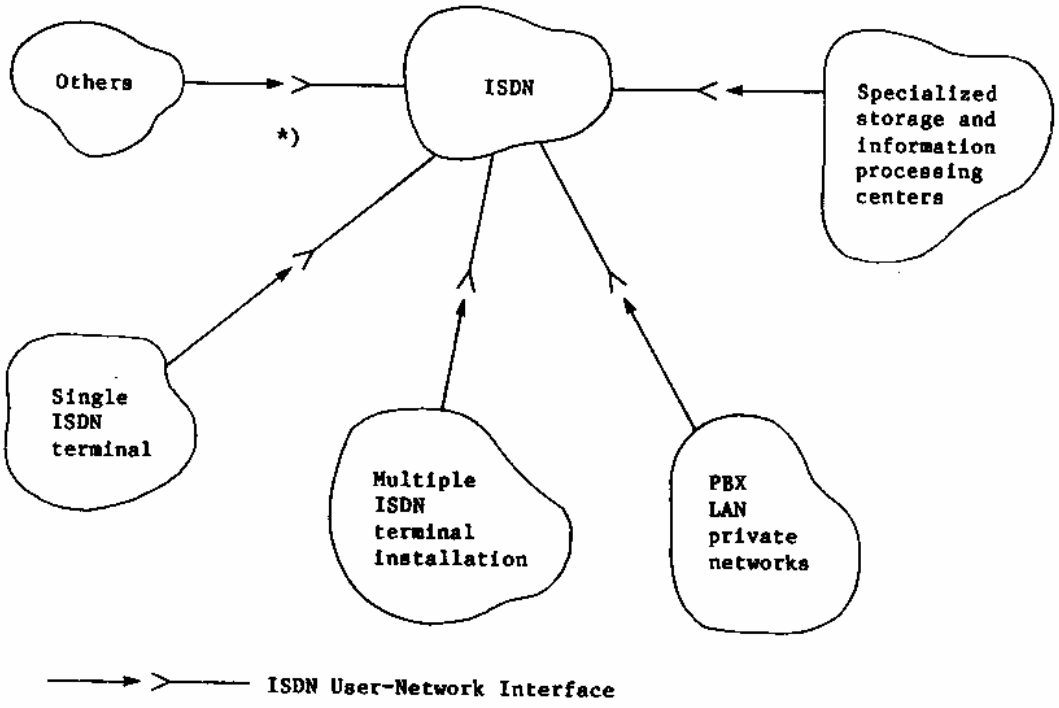
Naturally, each alternative has particular advantages and disadvantages. If domestic and international standards differ, domestic manufacturers would have difficulty entering foreign markets since foreign users of U.S. equipment would demand modifications -- the costs of which would have to be borne by the manufacturers. U.S. manufacturers would not realize economy of scale if the market share garnered by their products in foreign markets were not large enough to compensate for the separate research and development facilities required

by the inconsitent standards. Likely, foreign manufacturers would suffer in terms of their performance in the United States.

The major difference between the United States and Japan is size of domestic market: The United States can afford to establish standards regardless of world standards because its domestic market is big enough to ensure that domestic manufacturers can achieve economies of scale. Japan, and most other nations, generally follow international standards to be able to export products worldwide. The United States has 37.4 percent, Japan 12.4 percent, Europe 35.4 percent (communist countries included except U.S.S.R.) and the rest of the world 14.8 percent of the world's telephones.[91] The decisive factors are size of the domestic and foreign markets and strength of domestic manufacturers.[92]

d. User-Network Interface Issues (Functional Allocation)

Overview. Now, we arrive at one of the most controversial issues -- user-network interface or functional allocation. The importance of this issue stems from three characteristics: First, ISDNs could provide vital intelligent functions such as storage, conversion, and processing; second, "from the user's perspective, the ISDN is completely described by the characteristics which can be observed at the ISDN user/network interface, including physical, electrical, protocol, service, and performance characteristics";[93] and, third, the user-network interface is a regulatory boundary in both the United States and Japan. Figure 18 gives examples of ISDN user-network interfaces.



Source: CCITT XVIIIth Plenary Assembly, AP VIII-97-E, 1984, p. 134.

Figure 18

ISDN User/Network Interface Examples

Generally, network providers would favor placing most of the intelligence, or processing functions, in the centralized network, while enhanced-service providers or information-processing companies favor reliance on CPE (or on their own networks, when they lease lines from the carriers). Much effort has been expended at the CCITT on determining the appropriate demarcation point. However, the choice is based on political and economic as well as technical factors. The different political and market conditions in countries participating in the CCITT make the choice difficult, especially for the United States,

whose market conditions are unique by virtue of size, multiplicity of private service providers, and pro-competition policies in effect.

Who are the users? A user of ISDN receives full or partial services from an ISDN provider. This includes both those who receive full ISDN services and those who provide another user with services that are competitive with services provided by the carrier. CCITT Recommendations have done little to clarify confusion; it is not clear that service resellers and value-added carriers are to be considered users.[94] It might be appropriate to classify users as "end-users" (who desire complete ISDN services) and "service providers" (who need partial ISDN services in order to provide their own telecommunications or information-processing services to end-users and to other users). Service providers compete with carriers and, interestingly, carriers distinguish between end-users and service providers but information-processing companies do not.

Functional allocation of intelligence. According to the current director of the CCITT, T. Irmer, technical matters

> are rational and in principle they can be solved. But another problem which to my mind is much more serious -- since it is unfortunately closely related to non-technical matters -- and which will soon cause us a lot of headaches is the LOCATION of the "intelligence" for the service features, the maintenance and the network management of the ISDN. Is it to be placed in the network, in the terminals, or in both, and if so in which proportion? And WHO owns and handles this "intelligence" (separately or jointly): Administrations, recognized private operating agencies, private companies, the users? The more it becomes possible to realize the idea of the ISDN through modern technology, the more these non-technical aspects will raise problems of vital concern to all parties and groups whose business and legal interests will be affected by the ISDN.[95]

Zysman's analysis of the development of telecommunications is relevant here:

> It now becomes a choice of how much power and memory to put on the desk, how much to put off the desk, i.e., in a mainframe or mini, and how to link several computers together. The choice depends on the purpose of the system, the tasks of the various participations, their needs for common data and common applications. The computers are linked by telecommunications networking products like local area networks (LAN) or PBXs, and are linked into the public phone network as well. The convergence between the industries is real, not metaphorical. AT&T and IBM, NEC and Fujitsu are dominant in different parts of the same business, and would like to capture part of the others' markets.[96]

Scale economy and equal provision of services might call for inclusion of as many functions as possible in the network, if there is sufficient and ubiquitous demand.[97] However, network-installation costs are higher than are those of CPE when demand is inadequate, and costs -- pecuniary and nonpecuniary -- might be higher after facilities are in place, especially in an era of rapid technological change. More significantly, in the face of a national emergency, the effect on society could be tremendously costly.

The arguments for functional allocation are best represented by public statements made by interested parties:

> ISDN should serve as a transparent pipeline for the transmission of user information. Users should be able to select their own protocols and codes to meet their own individual system and applications with a certainty that changes in the ISDN will not cause any adverse impact . . . . Users should have the right to exercise management control over their telecommunications systems. Today, there are many ways for users to improve their system performance and correct system faults. Users must retain the ability and responsibility to tailor their systems to meet their own particular needs.[98]

According to IBM, including many functions within the carrier's monopoly "could lead to the restriction of innovation and to less efficient use of telecommunications networks, to the detriment of all

who benefit from efficient telecommunications and international trade in the telecommunications-related products and services."*[99]

The AT&T position is that "providers of basic services will need to perform the same or similar 'networking' conversions to efficiently and economically interconnect to such an interface, if it differs from that employed by end users connecting to the network."[100]

Y. Kitahara of NTT believes that

> whether communication and information-processing functions are included in the network and share the processing functions of the exchange facilities or are in stand-alone computers should be arbitrated case by case on technological and economic grounds. Generally speaking, however, information processing, which converts and changes the meanings and content of information, bears little relation to exchange functions and, therefore, would benefit by separation.[101]

A hearing conducted by the MPT in Japan in 1983 (162 business-sector and 94 academic representatives) addressed the future of telecommunications. Many people insisted that the network be granted only fundamental transmission functions without intelligence or, at most, be allowed such intelligent functions that become more efficient and more economical if put into the network. Other functions, it was recommended, should be allocated to terminals and/or VANs, since terminals and VANs can flexibly meet the diversified customers' demands; users pay for what they use if such functions are put in terminals and/or VANs, which is thought to be fair; and terminal prices can be expected to decline in the future. Opposing factions argued that many functions should be given to the network in order to secure public interest and compatibility (universality), to make services more accessible by means of less expensive terminals, and to improve cost performance through the joint use of equipment.[102]

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* See also the comments by IBM in Part II, Section 2.d., Protocol Conversion (Inside or Outside ISDN).

Dr. Shinto says:

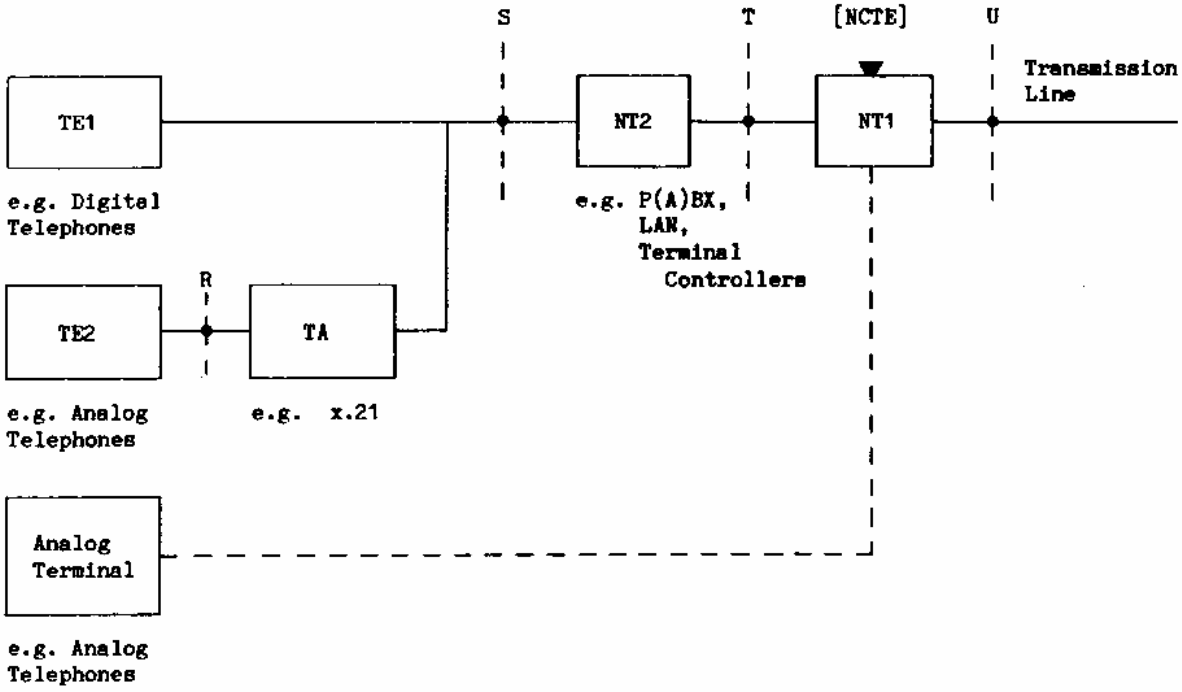
> in short, we cannot run the business unless the customers can use INS conveniently. We will put interfaces into the network if it is inexpensive and more convenient, but if it is better to put these functions into CPE than in the network, that will be done. This is competition: convenience and cost. This is not decided as in the monopoly days. Nobody will use our network with interfaces if it is not easy to use and is expensive. This is the merit of competition.[103]

The official stance of the Telecommunications Advisory Council (Denkitsushin Shingi-kai) is that

> it is considered appropriate to make the basic telecommunications system as transparent as possible. That is, of the communications-processing functions, functions that are closely related or inseparable (e.g., speed conversion) should at least be endowed in the transmission-exchange facilities, and other enhanced-communication and data-processing functions, which must be separate from the transmission exchange, should be chosen freely by users either through the Type I carrier, the Type II carrier or CPE.[104]

This all seems quite plausible at first glance, but how do we judge "closely connected and inseparable," and who adjudicates? Cannot Type I carriers use the same equipment for enhanced services and basic services to attain the economy of scale? Thus Japan might face the same problems of attaining efficiency and equity as does the United States.

NCTE in the United States -- U or T/S? Figure 19 shows the configuration and reference points for ISDN user-network interfaces. NT1 includes functions that may be regarded as belonging to Layer 1 (physical) functions of the Open Systems Interconnection (OSI) Reference Model, and includes maintenance functions (e.g., test loops), power feedings, and timing and line transmissions. NT2 may be regarded as Layer 2 (data link) and Layer 3 (network) functions such as protocol handling, switching, and multiplexing. Private automatic branch exchanges (PABXs), local area networks (LANs) and terminal controllers



TE2 = Terminal Type 2
TE1 = Terminal Type 1 (needs TA)
TA = Terminal Adapter for existing terminals
(not necessary for digital telephones, etc.)
NT2 = Network Termination Equipment to include protocol handling, switching, statistical multiplexing, physical contribution/concentration.
NT1 = Network Termination Equipment to include maintenance functions (e.g. test loops, performance monitoring), power feedings, timing.
R,S,T,U = Reference Points
NCTE = Network Channel Terminating Equipment
x.21 = DCE (Data Circuit Terminating Equipment)/DTE (Data Terminal Equipment) interface for synchronous terminals

Source: Adapted from Figure 1/1.411 and Figure 5/I.411 CCITT XVIIIth Plenary Assembly, AP VIII-97-E, 1984, pp. 128, 132.

Figure 19

Reference Configuration and Reference Points for the ISDN User-Network Interfaces

are examples of equipment or combinations of equipment that provide NT2 functions. Between these are the reference points. The difference between the U and T points is that the T point incorporates the NT1 interface into the network.

T interface was created by the CCITT at the urging of the U.S. delegation. According to an NTIA report published in 1982, "In the United States, T is expected to be the demarcation between regulated and unregulated domains. In some other countries, T will not exist; the PTT may choose to provide both NT1 and NT2 functions in a single box NT with no visible interface."[105]

In June 1983, however, the FCC decided not to regulate network channel-terminating equipment (NCTE) and to group it with CPE within the meaning of Computer Inquiry II, finding "no technical, legal or policy justification for restricting independent manufacturers from providing CSUs[106] or digital NCTE to digital-service subscribers."[107]

The functions of NCTE, which the FCC has declared is a part of CPE, are included in the NT1 of the CCITT model. The FCC's response to this problem is simple: "The NT1 equipment, if located at the customer's premise, is NCTE."[108] European countries, in which CPE tends to be provided and controlled by the PTTs, are leaning toward the S and T points, so that most functions will be provided by the network, and the discussion at the CCITT now is directed only to the S and T points. In the recent Recommendations of the CCITT only S and T points appear.

The United States might experience particular problems. T interface would permit only carriers to provide NCTE and might frustrate rather than promote the FCC's policy of encouraging competition.[109] However, if the U.S. standard is different (if U point is adopted) from that of

the rest of the world, equipment manufacturers would incur disadvantages and the portability of CPE would be threatened.[110] The BOCs also argued that this NCTE decision could slow or possibly prevent deployment of ISDN technology in the United States, which could erode the leadership position the United States has enjoyed in the telecommunications field. Figure 20 summarizes advantages and disadvantages that have been argued regarding these reference points.

(1) U Point

Advantages

- Users and manufacturers will benefit from the greater flexibility for satisfying requirements.
- This demarcation point is consistent with NCTE and related decisions since 1956 Hush-A-Phone decision. It meets present pro-competitive policy.
- There is no technical reason preventing the integration of NCTE into the network. (AT&T did not show NCTE would be detrimental to the public network.)

Disadvantages

- U interface needs more difficult engineering, administration, and operations of the network.
- It needs a more complicated interface and might inhibit introduction of new services, and hence reduce the competitive opportunities.
- It does not allow for independent evolution of terminal and networks; evolutionary network changes will require the service user to modify the CPE under its control, and the network service providers might have difficulty in improving obsolete access technology.
- It might harm the clear transmission lines.
- Carriers may well delay implementation of ISDN network modifications that require modifications to equipment under control.

(2) T/S Points

Advantages

- Worldwide portability will be guaranteed because T/S-point demarcation meets the international standard.
- Manufacturers benefit because they can sell overseas without changing models.
- This demarcation is technically simpler and easier than the U interface.

Figure 20

Advantages and Disadvantages of U and T/S Points

Several BOCs filed a petition with the FCC for reconsideration of this NCTE decision, but their petition was denied in April 1984.[111]

In November 1984 the FCC amended Part 68 of its rules to create technical interconnection standards for connection of NCTE to digital services, to ensure that terminal equipment attached to digital services will not cause harm to the network.[112]

Clearly, the problem has not been solved with respect to CCITT standards. Which alternative of the three would the United States take in this matter? Perhaps the most plausible scenario involves see the United States' trying to change the CCITT recommendations, attempting to make them conform to U.S. policies, or at least broadening CCITT standards to accommodate U.S. policies.

In the NOI the FCC explains its view "that the public interest would best be served by assuring that U.S. policy is understood by all participants in the ISDN specification process, to the end that it will be accommodated in this process."[113] Furthermore,

> no showing has been made that we should depart from our view that the public interest will be best served by seeking to make United States domestic and international telecommunications policies fully understood by ISDN participants with the objective of fostering the Commission's domestic and international telecommunications policies. Accordingly, this issue does not warrant reconsideration.[114]

There appears to be some hope that the CCITT could accommodate U.S. policies; the T interface was originally set by the opinion of the U.S. delegation -- and by virtue of the dominance of the United States[115] in the CCITT and international political and economic arenas.[116]

U or T or S -- Japan today. U.S. policy requires competitive provision of CPE but basically monopolized[117] local services, in addition to the dichotomy between basic and enhanced services, which is

the source of the problems discussed above. In Europe, most services -- including CPE -- are provided by the PTTs, and the demarcation point does not seem to cause any problems.

Japan is in a unique position, since its local network services and CPE are competitive (according to the new telecommunications laws): It matters less whether a service is provided by the network or by CPE, and the government maintains a rather strong influence in standards-setting activities. As of early 1985, however, only NTT intends to provide local services in Japan.

e. Network-Network Interface Issues

Relative to the user-network interface, the network-network interface received little attention at the CCITT, since the ISDN model of the CCITT was meant to define the final shape of ISDNs, and telecommunications services were being provided under monopolistic conditions in most countries. As the ISDN study progressed, the importance of this network-network interface became evident.

The ISDN obviously will not evolve instantaneously and all extant networks might not be converted in a reasonable time span. During the transition period, and even in the final stage, the appropriate interface between existing/traditional and ISDN networks must be defined. In addition, with multiple services providers it might be necessary to make allowance for interconnection of multiple networks with dissimilar characteristics and capabilities. This would provide an opportunity for individual networks to participate in an ISDN, though there would remain the problem of how or under what conditions these connections would be made. These and related interconnection problems associated with ISDNs, service-specific networks, and enhanced-service

providers' networks, are among the major topics for the CCITT's 1984-1988 study period.

f. Other Issues of ISDN Standardization

Numbering. GTE concluded in its comments that "if the numbering and routing plan for ISDN fails to include adequate mechanisms by which users can specify service providers, then the users' ability to select them will be adversely affected."[118] Although it was reported that the numbering plan adopted by the CCITT is appropriate for a multiple-provider environment, it remains a source of confusion that there are multiple service providers, multiple ISDN providers, etc.

Role of satellites. Controversy has arisen over the degree of satellite usage created by some attributes of satellite circuits -- transmission delay and error rate.[119] Some parties worry that the CCITT Recommendations would discriminate against satellite systems (reliable emergency systems) because they are dominated by entities that "rely heavily on terrestrial systems and work under the assumption that ISDN will evolve out of the existing telephony networks."[120]

Use of ISO/OSI model. The International Organization for Standardization Open Systems Interconnection (ISO/OSI) model is a description of a preferred architecture for data-communications networks which was adopted by the International Organization for Standardization (ISO) as a guideline for standards development.

Some parties argue about the appropriateness of this model. ADAPSO considers it

> a poor tool for drawing distinctions between services, particularly basic and enhanced services . . . and should not be used . . . to draw a distinction between the services which must be performed as part of the network and those which can be offered separately by third parties.[121]

Power feeding. This issue raises national security and emergency concerns. Sophisticated terminals require more power than the telephone company provides.

Compatibility and flexibility. Compatibility or interoperability can be accomplished in one of two ways: via hard means (standardization) or soft means. If ISDN standardization does not succeed, the soft companies could move into the business of connecting existing networks. IDCMA claims,

> It is important to understand that ISDN can be implemented differently here than it is in foreign countries without impairing the compatibility and interoperability of U.S. and non-U.S. ISDNs . . . . Indeed, domestic standards for data communications equipment routinely differ from CCITT Recommendations, and it is not at all unusual for an international private line to have a customer-provided modem at the U.S. end and a PTT-provided modem at the other. Thus, technical compatibility and interoperability can be achieved without requiring consistency among nations as to the demarcation point between user and network.[122]

4

ISSUES IN ISDN TARIFFS

The tariff principle dramatically demonstrates the changes likely to be brought about with an ISDN environment. There have been few discussions of tariffs associated with an ISDN and, indeed, they are difficult to assess. In fact, "asking people to develop tariffs applicable to ISDN now is like asking for the duplication of today's tariffs based on Alexander Graham Bell's first demonstration of telephony."[123] The CCITT Study Group III is reviewing tariff principles in an ISDN environment and is expected to make some recommendations during the 1984-1988 period.

a. Tariff Setting (Who Sets What?)

In the United States, the tariffs of AT&T and of the BOCs are regulated by the FCC and the PUCs, with the principle of rate-of-return pricing and rate averaging widely applied throughout their service areas. Other common carriers (OCCs) are less regulated; they simply file their tariffs with the FCC or the PUCs. In the matter of price-setting, it is generally true that the OCCs set their prices somewhat below those of AT&T. AT&T plays the role of price leader. Providers of enhanced and computer services decide their prices freely (this includes AT&T Information Systems and Regional Holding Companies (RHCs)) and, accordingly, their prices would be quite competitive.

In Japan regulation is made on the basis of line ownership. Type I carriers must submit their tariffs to the MPT for approval (for both basic and enhanced services), while the special Type II carriers are required to notify the MPT. General Type II carriers are not regulated and neither are computer services providers. (See Figure 11.)

This regulatory condition, based on the ownership of lines, might raise problems for Type I carriers, including regulatory lag. If the MPT does not approve a tariff for a new VAN-type service of a Type I carrier, or if the MPT's decision is not pronounced within a reasonable time span, the Type I carrier can lose its competitive edge, since Type I and Type II carriers provide similar services. The Type II carriers' resultant gain might be significant, and should the regulatory lag be extended, Type II carriers could meantime provide new services at lower prices and enhanced quality.[124]

b. Tariff Problems To Be Considered In ISDN

Telephone rates have a long history in both the United States and Japan, and many economic and social activities are coordinated with the present tariffs. Whether or not ISDNs gain societal acceptance depends heavily on their rate structure. Determination of pricing for the telecommunications services has taken into consideration, at least for the monopolistic environment, the factors outlined below:

- Costs: The rates charged must produce sufficient revenues to cover at least total operating costs, regardless of the service mix.
- Value: There is a hierarchy of services. Business customers are characterized as receiving greater values for the same initial cost (equipment cost) compared to residential customers, which is reflected in the higher rates for businesses. This argues for system-wide price averaging -- customers' paying equally for similar services.
- Policy: Public interest and equity must be considered, even if the prices are separated from costs.[125]

Figure 21 notes several characteristics of ISDN that affect tariff-setting.

- A single facility can be used to provide many services with similar transmission characteristics. The subtle differences that separate facsimile and telephone and data service would be hard to recognize.
- Distinctions between services are unclear and transmission characteristics are indistinguishable.
- With total liberalization of CPE and interconnections with non-ISDN and private networks, the telephone company may never know what service is provided.

Figure 21

Factors Affecting ISDN Tariffs

The following are among the questions raised by members of the CCITT Study Group III:

- How can tariffs for voice and nonvoice services be reconciled?
- How should the tariffs on services similar to traditional analog services be established?
- What is the efficient means of accommodating the fact that costs are the same for every user but benefits differ among user classes?
- Can the effect of the local-area network (LAN) be accounted for in tariffs?
- Can the services provided by satellites be subjected to standard tariffs?

- What should determine optional access fees for interconnection of ISDN and non-ISDN networks?
- Should the fact that, according to national policy, ISDN service is available only in particular regions affect the tariff-setting policy?
- Can the fluctuation of costs, dependent on the degree of expansion of service areas, be represented in the tariff structure?[126]

Although no definitive characterization of tariffs in an ISDN environment can be made, NTIA comments[127] to the NOI imply that an ISDN tariff policy will probably consist of these three major components:

- Network-access component.
- Network-utilization component. This will be based on how and to what degree the network is used and will probably include a combination of information (number of bits transmitted), bandwidth (or bit rate), duration, distance, and type of call.
- Network-processing component. This will be charged for functions performed within the network and might include such features as code and protocol conversion, customer-information storage in the network, signal enhancement (e.g., error correction), and access to network-information resources. Charges for these features may be made on an individual basis or bundled into various services, depending on technical and eocnomic factors and the regulatory environment in the country of interest.

NTT is studying the tariff principle relative to INS, and classifies the tariff structure in a similar way:

- Basic charges based on the interfaces (bandwidth) of an INS network.
- Communication rates that accommodate voice and nonvoice services, either according to the amount of information transmitted or by reflecting the cost structure.
- Charge for information processing based on cost (and reflecting the market mechanism), since information processing can be provided either in the network or at the CPE.[128]

c. Cost-Based Principle in ISDN Tariff Setting

In a competitive environment, prices generally reflect costs. In the telecommunications industry, in which a state-owned monopoly or a dominant private entity coexists with competitors, there are bound to be disagreements about fair competition. In reality, arguments have been voiced by both sides: "cross-subsidization" from the monopoly to competitive services, and "cream-skimming" of small competitors who provide services only in the profitable urban areas.

In discussions about ISDNs, the effect of tariffs on competition are paramount to all concerned operators. In the United States service providers demanded cost-based pricing be adopted for basic transmission services, to avoid cross-subsidization and market distortion.[129] Allied carriers further speculated that

> over-recovery . . . could be prevented . . . by the incorporation of a cap . . . and, in a competitive environment, any entity which deviates from cost-based pricing is subject to bypass -- both from other ISDN providers as well as other service providers using conventional architectures.[130]

In Japan, the situation is similar. Competitors, especially information-processing companies, warn of the likelihood of cross-subsidization of NTT's monopolistic telephone revenues to the avowedly

competitive data-communications service arena. "Equal-footing" is now a key phrase at NTT. The Fair Trade Commission reportedly is reviewing competitive policy in the aftermath of the privatization of NTT since the company will likely maintain monopolistic power as the direct successor to the unregulated NTT and inheritor of its services and assets.[131]

d. Cost Advantages and Disadvantages of ISDN (Tariff Level)

Will expenditures by users increase or decrease with ISDNs? ISDN tariff levels will be a function of technology, depreciation, functional allocation between the network and CPE, and the policies dictating the rate of fair return and cross-subsidization between urban and rural areas.

There is some feeling that expenditures will increase with the availability of an ISDN because more diversified and sophisticated services will be introduced. Some have commented that "ISDN will not represent much of an achievement if its sole accomplishment is to provide -- at higher cost and in a single network -- services which are currently provided at lower cost by existing networks."[132] Perhaps there is a more elemental question to be addressed: Is digital technology, which is a basis of ISDN, really less expensive than analog technologies?

Cost advantages and disadvantages of ISDN. Four distinct cost advantages of ISDN merit review:

1.) Cost savings (space, real estate, and resource savings) due to multiple-service provision via a single switching/transmission facility.

2.) Cost savings realized in systems electronics, maintenance, and labor costs because fewer amplifiers or repeaters are needed.

3.) Savings in planning costs associated with increased flexibility that is not restricted to the requirements of a single service.

4.) Cost savings owing to full utilization of bandwidth not fully utilized by telephone services alone.[133] (Costs might increase if new services are not used to the extent assumed in ISDN projections.)

Few parties doubt the probability of cost reduction via digitization of trunk lines. However, projected cost reductions based on a variety of other factors are widely debated.

First, implementation of ISDN technology will require users to replace all existing services with a network that, while it is more sophisticated, may be considerably more expensive, since this new network provides access to intelligent functions that the average user did not explicitly demand and may not need to utilize.[134] Essentially, this problem is related to functional allocation between the network and CPE, as well as the cost of "intelligence."

Second, although digital technology itself is increasingly inexpensive, savings are ultimately realized when all equipment is digitized.[135] Though ISDN presupposes, by definition, implementation of end-to-end, all-digital networks in the final stage, during the process of digitization, or in those areas in which only analog technologies are needed, a coder or converter will have to be installed between digital and analog coding as an interface, which is expensive.[136]

Third, while it is relatively inexpensive to replace trunk lines, it is expensive to replace local loops (were they to be replaced) that

connect the local exchange to customers' telephones or terminals.[137] In addition, the cost of local lines might increase because installation and maintenance of local lines is labor intensive even though the lines generally continue to be physical pairs.[138] However, this problem is not unique to ISDNs; wage hikes would cause cost increases even in existing systems.

If carriers invest more heavily in digital technologies, accelerating their depreciation of existing equipment -- whether to compete with other carriers or with private networks that own fewer analog assets -- the tariff level is likely to increase in the short run, although this is not predictive. In the midst of rapid technological progress, new investment usually is directed toward new, sophisticated, low-cost developments. A comparison of the cost increase due to the accelerated depreciation and the cost decrease due to the new, investment-attractive technology must be made.

In Japan, NTT is planning an annual investment to its internal fund capacity; that is, depreciation cost without additional investment. If matters go as scheduled, rates at least would not increase, despite the fact that nearly 15 years will be required for completion of the INS. However, NTT could veer from its original course as competition becomes more severe, even if NTT continues to dominate the telecommunications market. According to the new laws, the MPT has the right to control "excess" supply. But how would the MPT manage the problem? The practicalities have not been addressed.

e. Pros and Cons of Bit-Based Tariff

The tariff structure for telecommunications services is based on a variety of factors, including call duration and time of day, amount of

information transmitted (characters on bits), distance, and user class (business or residential). Different services adopt different combina tions of these cost factors. In the Japanese case, for example, telephone tariff combines time and distance; telegraph considers only the amount of information (characters-bits); telex uses the time and distance; digital-data exchange (DDX) packet-switched service relies on distance and bits; and DDX circuit-switched service is based on time and distance.

The establishment of an entirely new tariff structure, one that appropriately uses the bit as a guideline, was advocated by Yasusada Kitahara for the INS environment. His aim was to conquer the INS-related difficulty distinguishing among voice, data, and other traffic resulting from the traffic's uniform integrated digital nature, especially with the liberalized CPE of the United States and Japan.

Kitahara's recommendation is cogently derived:

> As the telephone service is primarily used for transmission of conversations, a transmission efficiency [i.e., the speed of speech] of around 50 b/s in any language is consistently observed. Therefore, in every country, tariff structure is based on two factors -- "distance" and "circuit holding time" -- and is not directly dependent on the amount of information transmitted.
>
> On the other hand, in nontelephone services, which primarily provide for machine-to-machine communication, transmission speeds differ and can be freely changed during transmission. Therefore, for these services, the "amount of transmitted information," instead of "circuit holding time," is the important factor . . . . Where a network is changed from analog basis to a digital basis, the amount of exchanged information can be measured accurately in bits . . . . In the ISDN, therefore, the signals for different kinds of telephone and nontelephone services can be unified, permitting the amount of exchanged information to be consistently represented in terms of bits. Thus, it can be foreseen that different kinds of telecommunication services, which have previously been provided separately under

> independent tariff structures, will be combined in the ISDN by the use of "bits" as a basic unit of information quantity, enabling the development of a new tariff structure.[139]

Since INS was presented to the Japanese public, attention has focused on the bit-based rate structure. Despite general agreement,[140] it is now clear that research into desirability of the bit-based tariff system, and optimal methods for change, and the timing of that change, are required. Reportedly, the Minister of the Posts and Telecommunications ordered the Telecommunications Advisory Council to study future telecommunications tariff systems.[141]

In the United States little discussion has focused on the bit-based tariff. There seems to be a sizeable opposition to the bit-based tariff based on its precluding the application of creativity to economize communications costs and on the high expense of voice transmission.[142] Figure 22 outlines the arguments associated with bit-based tariffs.

Pros:

- The tariff structure is simple.
- The tariff reflects the nature of non-telephone services. (They primarily provide for machine-to-machine communications, whose transmission speeds differ and can be freely changed during transmission.)
- The signals for different telephone and non-telephone services can be combined easily.
- Resellers cannot "cream-skim." (This may be an advantage only for carriers that own networks.)
- Since users pay for the bits transmitted, bit-based tariff might win support on grounds of fairness, uniformity, rationality and simplicity.
- The accounting and billing difficulties among networks, terminals, and services would be eased.

Cons:

- This tariff might preclude creativity or will to economize, especially those of CPE.
- Although digital streams are all alike for a mechanical switch, subscribers see differences among services.
- Adoption of the bit-based tariff will affect distribution among people at least for a short period.
- Users with old, low-speed CPE pay the same rates as those with new, high-speed CPE.
- This tariff might prevent integration of voice communications -- which requires more bits than does data communications -- into the ISDN, because voice transmission would be relatively expensive. In addition, integration of video communications may prove less likely since it requires far more bits (500 times more than telephone requires).

Figure 22

Bit-Based Tariff: The Arguments

f. Realization of Distance-Insensitive Tariff (Japan)

Distance-insensitive tariff[143] has attracted much attention in Japan.[144] First, price differences between local and long-distance calls are extremely high in Japanese telephone services. NTT has long been criticized for this difference. And although NTT has decreased the difference by decreasing the long-distance rates from 600 yen ($2.40) per 3 minutes to 400 yen ($1.60) in recent years without increasing the local rates -- 10 yen (4 cents) per 3 minutes -- the rate difference is still a factor of 40. The Japanese government intends to eliminate this price difference (as does NTT) with installation of INS.[145] Telecommunications progress is expected to eliminate the information disparity between Tokyo and outlying regions and to diversify the location of firms and factories.[146] In fact, there is another reason that telecommunications is expected to play an important role in Japan's future; it does not consume -- and even may conserve -- energy, which Japan cannot produce domestically.

Second, NTT has to prepare now for competition with long-distance services, which will impel NTT to desensitize rates relative to distance. Local calls are subsidized by long-distance calls in Japan. However, NTT will not (and will not be allowed to) increase the local rates from the mid- to late '80s. INS is clearly very useful to NTT for keeping and attracting customers. NTT has gradually introduced less distance-sensitive rates for the new services (DDX circuit-switched service, 1:12; DDX packet-switched service, 1:1.5).[147] There is still cross-subsidization between long-distance and local rates of traditional services, and further investigation of distance-insensitive tariffs must consider the accurate reflection of costs in the competitive environment.

5

COMPETITION AND COORDINATION

a. ISDN in Competitive Environments

ISDN and monopoly. The potential incompatibility of ISDN and competition is definitional: Network integration (by either hard or soft means) may not be reconcilable with an environment that stimulates diversification. Integration of services, facilities, and equipment may promote economies of scale that induce service providers to lower prices (typically this increases general welfare by stimulating economic development). Multi-service, high-capacity ISDNs could strengthen monopolies,[148] allowing them in some cases to restrict interconnection and to cross-subsidize. The possibility of the unfolding of this series might stimulate stronger government regulation, in order to uphold pro-competitive policies.

The argument for implementation of ISDN according to market-forces -- assuming there is no natural monopoly in a rapidly changing technological age -- presumes unpredictable future developments that cannot be accounted for in the short term.[149] An OECD report credits open-market competition as having

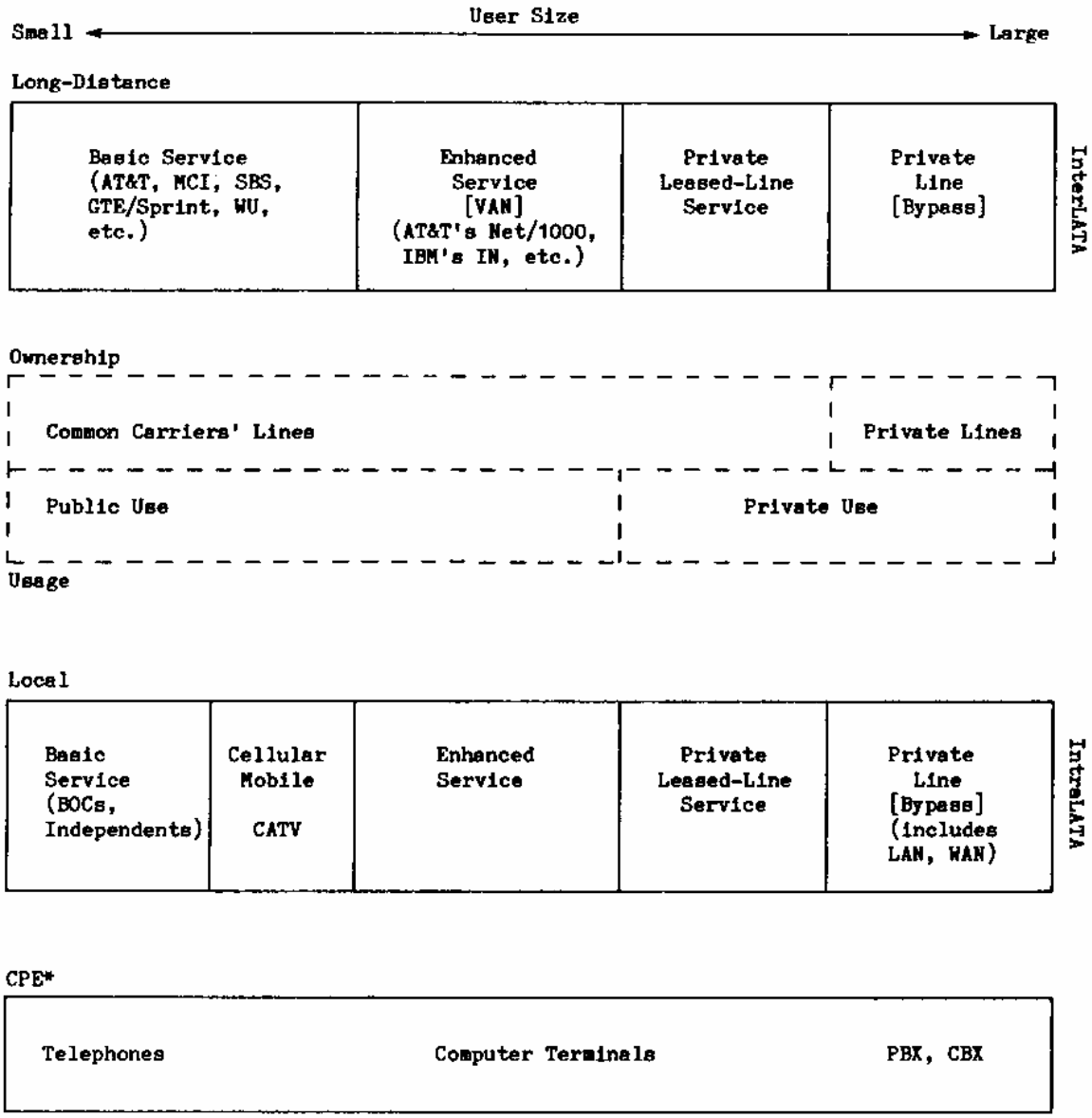
> encouraged innovation, increased consumer choice, and it has moderated equipment price increases. Competition has not led to the collapse of the regulated common carriers, but it has forced them to adopt more rapidly to emerging market needs.[150]

Competition between public and private networks. The very long-term returns on investments made to date in ISDN/INS are perhaps too distant. W. F. Finan has commented, "The technology is moving too quickly; private service providers can deliver today some of the services that INS contemplates providing five or more years forward."[151] According to

David Hanson, "Most users today . . . are not waiting for the ISDN to become a reality . . . . They are proceeding with their own private networks, hopefully confident that the ISDN will not make them obsolete until they are fully depreciated."[152] These private networks threaten public networks, since the private networks are used by large companies to bypass public telephone networks[153] -- the very customers who generate the greater share of the telephone companies' revenues. (Approximately eight percent of business customers generate 62 percent of revenue for long-distance business traffic in the U.S.) The motivation for a user to construct a private network is twofold:

- Volume is large enough to ensure cost-savings or at least sufficient to eliminate or minimize the impact of monopoly cross-subsidies between urban and local areas.
- Company-specific information-transmission needs are met by a private network. In both cases, the importance of capacity for connection[154] to the public networks cannot be overrated.

The role of private networks will be expanded; they will encroach on the territory of public networks, and the boundary between them will be blurred.[155] Simultaneously, the end-user's network options will increase, as shown in Figure 23. End-users can decide which public services they will use and which services they will internalize both for local and long-distance services, according to their communication needs. Competition prevails among these networks, and service providers have to be efficient and meet the demand adequately especially in order not to lose big customers. If existing telephone operating companies are to maintain their competitive position as they attempt to realize ISDN operation, they will have to provide some interim digital service over the local loop.



*CPE is detariffed and separated from a carrier's basic transmission service, and is available through carriers, enchanced service providers, or retail sources.

LAN = Local Area Network
WAN = Wide Area Network
CPE = Customer Premises Equipment
VAN = Value Added Network
CATV = Cable Television
LATA = Local Access and Transport Area

Figure 23

End-Users' Choices Among Network Services

Consideration must be given to the absence of monopoly in provision of this short-haul technology. Short-haul technology for high-speed data communications over relatively short distances such as Local-Area Data Transports (LADT), data-over-voice multiplexing devices, Digital-Data Service (DDS) in the U.S. meet customers' demands for ISDN-type services without conversion of present local loops into digital ones.[156]

NTT's response to the demand of large-scale users was its digital-circuit services and satellite digital communications services in the autumn of 1984. Both services offer six speeds, ranging from 64 kb/s to 6 Mb/s. NTT also initiated "Business INS" and "Regional INS" through its Business & Regional Area INS (BRAINS) Service Bureau, both of which are designed to provide interim INS-type service including digital PBXs and LANs.

b. ISDN Coordination for Compatibility and Connectability

Overview. Competition, which provides incentives to minimize costs, promotes innovation, and provides a wide range of services at prices based on costs, does not guarantee the interconnectabilities and compatibilities among networks. Theoretically, if the standards are set in an "appropriate" way, all the networks can be interconnected. But the real world does not easily permit this. Therefore, the realization of ISDN -- if end-to-end digital connections are ever to be realized -- requires coordination among operating companies (local and long-distance), enhanced-service providers and manufacturers.[157] At the same time, however, it should be kept in mind that coordination impedes competition at least to some extent.

The United States. The FCC maintains exclusive power over inter-state and foreign common carrier communications services; the federal

courts arbitrate on challenged FCC decisions and antitrust cases; the National Telecommunications and Information Administration (NTIA) acts as an advisor to the president on telecommunications; and in each state a Public Utility Commission (PUC) holds powers of jurisdiction for intrastate telecommunications. At the very least, coordination will be difficult and uneasy; the likelihood of constraints on efficiency is indubitably high. A recent report from the NTIA assesses the potential hazards of existing fragmentation:

> The line between state and federal jurisdiction is not always clear because the same facilities may often be used for both types of service. The transition to an ISDN may be delayed in the United States unless these jurisdictional disputes are resolved. New firms may be reluctant to enter the integrated services market unless they know if, by whom, and how they will be regulated.[158]

Finally, the call for a more definitive organizational hierarchy is being heard; Janet Cameron and Steve Moore have written in Computerworld on Communication: "Jurisdictional battles among the multiplicity of agencies jointly responsible for U.S. telecommunications policy periodically lead to suggestions that a Department of Telecommunications be formed."[159]

The divestiture of AT&T raised the problem of coordinating long-distance and local communications; this may be a result that was not sufficiently understood at the outset. Irwin Dorros said in his testimony on the divestiture of AT&T:

> The government does not appear to understand the importance of strong central business decisions and orchestration to make new and sometimes speculative services successful, nor the importance of access by the BOCs to vertically integrated technology for the conception, planning and implementation of nationwide services.[160]

However, the aftermath has seen initiative from several fronts. The seven regional holding companies (RHCs) cofounded Bell Communications Research (Bellcore) to address national-security and emergency-preparedness requirements of the MFJ (Modification of Final Judgment) and to provide predominantly technical support. Bellcore does not coordinate interests among the BOCs, independent telephone companies, AT&T, and the other common carriers (OCCs).[161]

The Exchange Carriers Standards Association (ECSA) was established as "a not-for-profit corporation, voluntarily established by the exchange carrier industry to address technical interconnection and other standards issues in the post-AT&T divestiture telecommunications environment."[162]

The ECSA-sponsored T1 Committee, accredited by the American National Standards Institute (ANSI), has taken a leadership position in the development of compatibility standards. Most of the interested parties agreed[163] with the importance of this T1 Committee, since

> all parties with a direct and material interest in the standards-setting process -- exchange carriers, interexchange carriers, enhanced services providers, equipment manufacturers and vendors, user groups, professional associations, and federal and state governmental agencies -- will have the opportunity to participate fully in that process and to contribute their expertise and views in a coordinated and effective fashion.[164]

Finally, there is increasing pressure from the information-processing companies for the FCC to be more active in the CCITT standards-setting process. Conversely, AT&T and the BOCs are on record as being satisfied with existing planning mechanisms. AT&T also opposes FCC rulemaking in anticipation of an ISDN as redundant.[165]

For its part, the FCC concluded in the First Report that:

- It is not the proper role of the FCC to design ISDNs; monitoring of international deliberations on ISDN will continue.
- FCC rulemaking on ISDN is impractical at this time; the FCC will continue in its informal capacity in USCCITT, JWP, and the ECSA/T1 ISDN subcommittee.[166]

An industry observer has commented, "With ISDN, the FCC appears to be moving towards a hands-off policy, although the inquiry is continuing."[167] Staffed primarily by attorneys, economists, and engineers with radio training, the FCC and its traditional role of arbiter is being compromised by heightened political regard for policies limiting regulation and favoring competition. Critics also allege that "It is widely rumored that the Federal Communications Commission does not have the technical expertise necessary to understand all the ramifications of the information technology industry."[168]

Japan. Presently, the primary concern in Japan is simply that "excessive" coordination may result from the efficient matrix of policy and standards-setting agencies. Julian Gresser has analyzed:

> In sum, planning in Japan is a device to enlighten government, industry, and the public on where the country is tending. It is a tool of prediction, an aid to structural change, a guide to government policy, and a means of overcoming bottlenecks. Plans are benchmarks for industry and industrial firms to set their own targets and standards, and for this reason compliance with government plans is often voluntary, planning is a means of binding a broad social consensus.[169]

Tetsuro Tomita, former deputy director general of the Telecommunications Bureau, MPT, capsulized the purpose of telecommunications reform bills as that of

> establish[ing] a market of harmonious competition. The goal of lowest-achievable-level regulation is to establish a market not so liberal as to incite bankruptcy but one to which numerous enterprises are

attracted and sustained by open competition.[170] This is elemental in all telecommunications reform.

6

OTHER PROBLEMS

a. Vulnerability of the System and Centralization of Industries

The most pertinent disadvantages associated with operative ISDNs are the relative vulnerability of the system to crises, and the likelihood of the network's encouraging industrial concentration.

The integration of networks and services is definitionally tantamount to a weaker system for emergency conditions, natural or military; there are no alternative networks, whereas with the present network there are, though satellite and mobile systems can be expected to play important roles in emergencies. Faults arising in one part of the network will likely be channeled through and multiplied across the whole network. More and better alternatives -- functional and systemic -- should constitute an immediate development priority.

The greater quantity of data transmitted through the integrated networks is also likely to incite purposeful centralization and coalition of industries among operators whose technical interdependence will be established. The propensity for exclusionary behavior in this environment may require precautionary antitrust legislation.[171]

b. International Issues

The general harmony of interests that exists in discussions of international ISDN implementation is often disrupted by simple, detailed discussion of the demands of the technology. More and in-depth discussion of the worldwide potential of ISDN is needed to promote understanding of its practical impact.

Interconnections for the networks of different countries for interoperability are crucial: physical gateway; common numbering schemes that allow for carrier selections via multiple networks; and code,

address, and signal conversions.[172] Routing and accounting for calls require more sophisticated methodologies, especially where multiple networks exist, since route will directly affect carrier revenues.

The repository of "intelligence" will be contested internationally as it will be domestically. The designation of a single country in one region to handle service (data), maintenance, and management would force other nations into extreme dependency: The quality and accuracy of data will determine the ability of receiver nations to provide their citizens with high-quality, reliable communications. The possibility of a loss of access or analysis capability in such a circumstance would literally render the receiver nation dependent on the provider nation, unable to exercise its national sovereignty.

Perhaps least well-explored are the potential effects on developing countries. At the very least, these nations will be compelled to follow the standards set by the technologically advanced nations. In fact, the developing nations may be unable to maintain and operate worldwide ISDN networks, which could constitute a threat to their national sovereignty. These problems are characteristic of the history of telecommunications development. The unprecedented aspect is the magnitude of the potential effects and of their consequences.

GLOSSARY*

A/D	- Analog/Digital
ANSI	- American National Standards Institute (This voluntary U.S. organization develops and publishes standards for codes, alphabets, and signaling schemes.)
AT&T	- American Telephone and Telegraph Company
BOCs	- Bell Operating Companies
CAPTAIN System	- Character And Pattern Telephone Access Information Network System (Japan)
CATV	- Community Antenna Television (Cable Television)
CBX	- Computerized Branch Exchange
CCIS	- Common Channel Interoffice Signaling
CCITT	- International Telegraph and Telephone Consultative Committee
CCNP	- Computer Communication Network Protocol (Japan)
CCS	- Common Channel Signaling
CEPT	- Conference of European Postal and Telecommunications Administrations
CPE	- Customer Premises Equipment
CSDC	- Circuit Switched Digital Capability (AT&T)
CSDS	- Circuit Switched Digital Service (Service by some BOCs using Northern Telecom's Datapath)
CSN	- Circuit Switched Network
CSU	- Channel Service Unit (CSU performs certain line-conditioning functions such as equalization and signal reshaping. It also has line loopback test capability, used in troubleshooting procedures to isolate network problems.)
DDD	- Direct-Distance-Dialed Services
DDS	- Dataphone Digital Service (A private line service of AT&T, wherein digital signals are transmitted directly in digital form, rather

* Japanese terms are indicated. All other terms are U.S. or international terms.

than being translated into tones of varied frequencies, as in analog transmission.)

DDX - Digital Data Exchange (Japan)

DOD - Department of Defense

DOJ - Department of Justice

DSL - Digital Subscriber Line

DSU - Data Service Unit

DTE - Data Terminating Equipment

DTS - Digital Termination Services

ECSA - Exchange Carriers Standards Association (This non-profit corporation was voluntarily established by the exchange carrier industry to address technical interconnection and other issues in the post-AT&T divestiture telecommunications environment.)

EPBX - Electronic Private Branch Exchange

ESS - Electronic Switching Systems

FCC - Federal Communications Commission

FDM - Frequency-Division Multiplexing

HDTV - High-Definition Television

ICOT - Institute for New Generation Computer Technology (Japan)

INMARSAT - International Maritime Satellite Organization

IDN - Integrated Digital Network

INS - Information Network System (Japan)

INTELSAT - International Telecommunications Satellite Organization

IP - Information Provider

IRC - International Record Carrier

ISDN - Integrated Services Digital Network

ISO/OSI - International Organization for Standardization/ Open System Interconnection

ITU	- International Telecommunication Union
JISC	- Japanese Industrial Standards Committee (Japan)
KDD	- Kokusai Denshin Denwa Co., Ltd. (Japan)
LADT	- Local Area Data Transport
LAN	- Local Area Network (a computer communication system which usually covers relatively small or "local" areas)
LATA	- Local Access and Transport Area
LSI	- Large-Scale Integration
MDS	- Multipoint Distribution Service
MFJ	- Modification of Final Judgment
MITI	- Ministry of International Trade and Industry (Japan)
MTS	- Message Telephone Service (ordinary long-distance calling)
MPT	- Ministry of Posts and Telecommunications (Japan)
NCTE	- Network Channel Terminating Equipment
NOI	- Notice of Inquiry
NT	- Network Termination
NTIA	- National Telecommunications and Information Administration
NTT	- Nippon Telegraph and Telephone Co., Ltd. (Japan)
OCCs	- Other Common Carriers
OECD	- Organization for Economic Co-operation and Development
OSI	- Open System Interconnection
PAX	- Private Automatic Exchange
P(A)BX	- Private (Automatic) Branch Exchange
PCM	- Pulse Code Modulation
PSN	- Packet Switched Network

PSTN	- Public Switched Telephone Network
PTTs	- European Postal, Telephone, and Telegraph authorities
PUC	- Public Utility Commission
RAM	- Random Access Memory
RHCs	- Regional Holding Companies
RPOAs	- Recognized Private Operating Agencies (at the CCITT)
SCC	- Specialized Common Carrier
SDM	- Space-Division Multiplexing
SPC	- Stored Program Control
T1 Carrier	- Short-haul transmission system (transmits over distances of up to 50 miles) This carrier uses wire pairs with digital repeaters spaced 6000 feet apart to carry 1.544 mb/s. Into this bit stream 24 speech channels are encoded, using PCM and TDM.
TCM	- Time Compression Multiplexing
TDM	- Time-Division Multiplexing
VAC	- Value Added Carrier
VAN	- Value Added Network (a data network operated by a firm that obtains basic transmission facilities from a common carrier, adds "value" such as error detection and sharing, and resells the service to users)
WAN	- Wide Area Network
WATS	- Wide Area Telephone Service (long-distance zoned rate calling)

NOTES

Part I

I.1. See, William H. Davidson, The Amazing Race: Winning the Technorivalry with Japan. New York: John Wiley & Sons, 1984, p. vii. The author assumes in this estimation that the information sector continues to grow at its current average annual rate of 15 percent.

I.2. See, Charles Jonscher, "Information Resources and Economic Productivity," Information Economics and Policy, Vol. 1, No. 1, 1983, pp. 13-36.

I.3. Zysman says, "Today, the telecommunications industry must be broadly understood to encompass the provision . . . for information networking . . . of terminal, transmission, and switching equipment, and voice, data, video, and facsimile services." John Zysman, "The New Media in American Perspective," presented at the Berkeley Roundtable on the International Economy, Berkeley, Cal., August 1984, p. 5.

I.4. See, F. T. Andrews, "ISDN '83," IEEE Communications Magazine, January 1984, Vol. 22, No. 1, p. 7.

I.5. A report of the National Telecommunications and Information Administration (NTIA) points out three factors favoring ISDN: new or expanded services which can be offered, the economy or lower cost of offering the services because of digital network characteristics, and new technology permitting the new services to be offered at reasonable cost. Combining these factors, it says, results in economic benefits through service integration. See, D. V. Glen, Integrated Services Digital Networks, Standards, and Related Technology. Washington, D.C.: U.S. Dept. of Commerce, 1982 (NTIA Report 82-103), p. 2.

I.6. For the details of CCITT/ITU and ISDN, see, D. M. Cerni. The CCITT: Organization, U.S. Participation, and Studies towards the ISDN. Washington, D.C.: U.S. Dept. of Commerce, 1982 (NTIA Report 82-101), and D. M. Cerni, "The CCITT: Organization Recommendation Development, and U.S.A. Participation," Telecommunications, Vol. 16, No. 11, October 1982, pp. 62-67.

I.7. Theodor Irmer, "Worldwide Trends towards the ISDN -- Facts and Trends," in NTT, Proceedings of the NTT International Symposium. Tokyo: NTT, February 1983, p. 41. (See Figure 1.)

I.8. The Study Groups of the CCITT provide the working place for the development of the recommendations and make the real decisions, with voluntary participants from administrations, recognized private operating agencies (RPOAs), and scientific or industrial organizations (SIDs).

I.9. In the Matter of Integrated Services Digital Networks (ISDN), FCC GEN Docket No. 83-841, (hereinafter cited as ISDN), Notice of Inquiry, August 10, 1983, 94 FCC 2d 1289, para. 1.

I.10. Ibid., Comments filed by NTIA, October 24, 1983, p. 1.

I.11. Desmond F. Hudson, "Plato, Aristotle, and the Integrated Services Digital Network," presented at the ISDN 83 Conference in Monterey, Cal., October 10, 1983, p. 8.

I.12. David Hanson, "Building up Value-Added Networks," Computerworld on Communications, June 6, 1984, p. 16.

I.13. The BOCs' Comments to the NOI, Appendix, pp. 9-10.

I.14. "Technologist Irwin Dorros Looks Ahead," Computerworld on Communications, September 5, 1984, p. 27.

I.15. ISDN, (see note I.9), Comments filed by NTIA, October 24, 1983, pp. 1-2.

I.16. Ibid., p. 16.

I.17. Yasusada Kitahara, Information Network System: Telecommunications in the Twenty-First Century. Tokyo: The Telecommunications Association, 1982, p. 20.

I.18. Moriji Kuwabara, "NTT's Technological Endeavors Toward Constructing INS," paper delivered at NTT International Symposium 85, May 20-21, 1985, Tokyo.

I.19. Yasusada Kitahara, Sekai no Denkitsushin no Doko (Worldwide Trend in Telecommunications). Tokyo: Telecommunications Association, 1984, p. 49.

I.20. NTT has yet to decide when, if ever, video networks can be integrated because of the anticipated high cost.

I.21. It is helpful to bear in mind the two classes of INS: narrow INS includes the integrated digital network system offered by NTT with the "reformed" rates structure; broad INS encompasses narrow INS and all value-added services.

I.22. See, Benjamin M. Compaine, ed., Understanding New Media: Trends and Issues in Electronic Distribution of Information. Cambridge, Ma.: Ballinger Pub. Co., 1984, and Japan Communications and Information Association, New Media Hakusho (New Media White Paper). Tokyo: Nihon Keizai Shimbunsha, 1984.

I.23. Anthony G. Oettinger, The Information Evolution: Building Blocks and Bursting Bundles. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., May 1984 (Research Draft).

I.24. Japan, MITI, Machinery and Information Industries Bureau, Hiyakusuru Johoka (Jumping Information). Tokyo: Computer Age Co., 1984, p. 13.

I.25. For more on the formal standards-setting organizations, see, Part II, Section 3 of this paper, Issues in Standardization.

Part II

II.1. It should be noted that the FCC rulings significantly affect PUCs' regulation of the intrastate services as per the definition of interstate service and other preemptions of state authority.

II.2. For further background, see, Carol L. Weinhaus and Anthony G. Oettinger, At the Heart of the Debates: Costs, Control, and Ownership of the Existing Network. Behind the Telephone Debates - 1. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., May 1985, Section I.

II.3. The authority of the FCC to regulate enhanced services is disputed, depending on the nature of the service and whether the provider is a common carrier.

II.4. GTE managed to overturn this requirement after initially having been required to maintain separate subsidiaries; only AT&T and the divested BOCs are now governed by this separation settlement. For further background, see, Carol L. Weinhaus and Anthony G. Oettinger, Concepts: Understanding Debates Over Competition and Divestiture. Behind the Telephone Debates - 2. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., June 1985, Section IV.

II.5. AT&T can provide enhanced services through fully separated subsidiaries as per a Computer Inquiry II decision.

II.6. For details, see C. L. Weinhaus and A. G. Oettinger, Concepts: Understanding Debates Over Competition and Divestiture, June 1985. Program on Information Resources Policy, Harvard University.

II.7. The designation "new" is to distinguish this from the present NTT law (the Nippon Telegraph and Telephone Public Corporation Law).

II.8. In terms of international services, however, new entry might not occur in the short term because of the international agreements with the International Telecommunication Union (ITU).

II.9. A dispute arose between MPT and MITI with regard to this foreign ownership of Type II carriers. MPT wanted to establish a higher percentage limitation from the viewpoint of national

sovereignty, while MITI argued for no limitation. The United States government became involved in this issue and supported the MITI position. Finally, MPT ceded their original proposal. This event illustrates the struggle between MPT and MITI; with the merging of computers (MITI) and telecommunications (MPT), they are engaged in a battle for territory.

II.10. The Second Ad-Hoc Committee on the Administrative Reforms of Japan originally recommended a breakup of NTT similar to that of AT&T. Considering this and other factors, the new NTT Law requires government review of the law within five years of its enactment.

II.11. The government owns 50 percent of the shares until a review, to be made within five years.

II.12. See, Policy and Rules Concerning the Furnishing of Customer Premises Equipment and Enhanced Services by American Telephone and Telegraph Company, and Related Waiver Requests, FCC CC Docket No. 85-26, Memorandum, Opinion and Order and Notice of Proposed Rulemaking, February 22, 1985, 50 FR 9060.

II.13. The Modified Final Judgment (MFJ) restricts AT&T and the BOCs from offering such enhanced services as electronic publishing (AT&T) and information services (BOCs).

II.14. Nikkankogyo Shimbunsha Tokubetsu Shuzaihan, Ugokidasu Shindenden (New NTT Beginning to Move), Kyodaina Shikake no Hajimari (Beginning of a Huge Device). Tokyo: Nikkankogyo Shimbunsha, 1984, p. 174.

II.15. Japanese Legislation of Telecommunications, Vol. 1, Telecommunications Business Law, Article 52. Tokyo: Communications Study Group, 1984 (unofficial translation), p. 29.

II.16. ISDN, (see note I.9).

II.17. In the ISDN proceeding (see note I.8), the Commission received comments from the following parties: Aeronautical Radio, Incorporated (ARINC); American Petroleum Institute (API); American Satellite Company (ASC); American Telephone and Telegraph Company (AT&T); Association of American Railroads (AAR); Association of Data Communications Users (ADCU); Association of Data Processing Service Organizations (ADAPSO); Bell Operating Companies (BOCs); Communications Satellite Corporation (COMSAT); Computer and Business Equipment Manufacturers Association (CBEMA); Continental Telecom Incorporated (CONTEL); Ericsson Communications (Ericsson); Exchange Carriers Standards Association, Incorporated (ECSA); GTE Service Corporation (GTE); Harris Corporation, Farinon Division (Harris); ITT World Communications (ITT Worldcom); Independent Data Communications Manufacturers Association, Inc. (IDCMA); International Business Machines Corporation (IBM); International Communi-

cations Association (ICA); M/A-COM, Incorporated (MA-COM); MCI Communications Corporation (MCI); MarTech Strategies Incorporated (MarTech); Motorola, Incorporated (Motorola); Mountain States Telephone and Telegraph Company, Northwestern Bell Telephone Company, Pacific Northwest Bell Telephone Company; National Telecommunications and Information Administration (NTIA); Northern Telecom Incorporated (Northern Telecom); RCA Communications, Incorporated (RCA); Satellite Business Systems (SBS); Secretary of Defense: Dept. of Defense, National Communications System, Defense Communications Agency (DOD); United Telephone System, Incorporated (UTS).
Reply comments were filed by the following parties: ADAPSO; ARINC, AT&T, Aerospace Industries Association of America, Incorporated*; BOCs; CBEMA; ECSA; Ericsson; GTE; IBM; ICA; IDCMA; MA-COM; MCI; MN&P; MarTech; NTIA; Northern Telecom; RCA; Tymnet Incorporated*. (Note: An asterisk indicates that the party did not file comments until the reply period.)

II.18. ISDN, (see note I.9), First Report, FCC 84-131, released April 2, 1984.

II.19. Member organizations of the study group are: NTT, KDD, Communications Industry Association of Japan, Electronic Industries Association of Japan, Nihon Hoso Kyokai (NHK), The National Association of Commercial Broadcasters in Japan (NAB), Communication Line Products Association of Japan, Japan Cable Television Association, Japan Data Communications Association, Japan Information Processing Center Association (JIPCA), Japan Information Processing Center Association (JIPDEC), The Japan Newspaper Publishers and Editors Association (NSK), Dentsu Inc., Captain System Research and Development Center, Federation of Economic Organizations (Keidanren), Japan Printers' Association, The Federation of Bankers Association of Japan, Japan Federation of Employers Association.

II.20. H. Shimoda, "INS Sengokujidai e Dendenkosha no Sabaibaru Senryaku" (NTT's Survival Strategy toward the War Age of INS), Computopia, Vol. 18, No. 22, March 1984, p. 14.

II.21. Among these companies are Daini-Denden Kikaku (a subsidiary of Kyocera), Japan National Railway (JNR), Japan Highway Public Corporation, and Keidanren. They are now called "Daini-Denden" (second NTTs) in Japan.

II.22. ISDN, (see note I.9), para. 45.

II.23. Ibid., para. 49.

II.24. ISDN, (see note II.18), para. 3.

II.25. ISDN, (see note I.9), para. 28.

II.26. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, pp. 21-23; Comments filed by AT&T, October 24, 1983,

Appendix, pp. 13-14; Comments filed by Northern Telecom, October 24, 1983, pp. 10-11.

II.27. Ibid., Reply Comments filed by IBM, December 5, 1983, pp. 14-19.

II.28. See, the discussions in Part II, Section 2.d. of this paper, Protocol Conversion.

II.29. "Teleservices" is CCITT's recently coined term, resulting from the redefining of "telecommunications services." According to the recent I-Recommendations of the CCITT, telecommunications services comprise bearer services and teleservices.

II.30. CCITT Document AP VIII-97-E, June 1984, pp. 11-12.

II.31. ISDN, (see note I.9), Comments filed by ADAPSO, October 23, 1983, pp. 25-26; Comments filed by IBM, October 23, 1983, pp. 12-14; Comments filed by CBEMA, October 23, 1983, pp. 16-17.

II.32. ISDN, (see note I.9), Comments filed by NTIA, October 24, 1983, p. 12.

II.33. ISDN, (see note I.9), Comments filed by AT&T, October 24, 1983, pp. 9-10.

II.34. ISDN, (see note II.18), para. 37.

II.35. In the Matter of: Amendment of Sections 64.702 of the Commission's Rules and Regulations (Third Computer Inquiry); and Policy and Rules Concerning Rates for Competitive Common Carrier Services and Facilities Authorizations Thereof/Communications Protocols Under Section 64.702 of the Commission's Rules and Regulations, CC Docket No. 85-229, Notice of Proposed Rulemaking, Adopted July 25, 1985, Released August 16, 1985.

II.36. FCC, "Action in Docket Case, FCC Initiates Third Computer Inquiry ('Computer III') (CC Docket 85-229)," News, FCC, Report No. DC-166, July 25, 1985.

II.37. M. Koyama, et. al., Nippon no Joho -- Tsushin Bencha (Japanese Information and Communication Venture). Tokyo: Diamond, 1984, p. 2.

II.38. J. Zysman, (see note I.3), p. 15.

II.39. See, Ithiel de Sola Pool, "Competition and Universal Service: Can we get there from here?" in Harry M. Shooshan, ed., Disconnecting Bell: Impact of the AT&T Divestiture. New York: Pergamon Press, Inc., 1984, p. 124.

II.40. A MarTech Strategy study concludes that "ISDN evolution in conjunction with the settlement will tend to move away from BOC end delivery. If they can't get away with narrowly defining exchange access and/or keeping the basic service restriction on the BOCs, then an incentive may exist to bypass the BOCs." MarTech Strategies, Inc., ISDN Integrated Services Digital Networks: Impacts & Industry Strategy. Indiatlantic, Fla.: MarTech Strategies, Inc., 1982, p. 33.

II.41. ISDN, (see note I.9), Reply Comments by Mountain States Telephone and Telegraph Company, Northwestern Bell Telephone Company, and Pacific Northwest Bell Telephone Company, December 5, 1983, p. 5.

II.42. William F. Finan, "Comparing the Restructuring of the U.S. and Japanese Telecommunications Markets," presented at the 5th International Conference, Future Analysis, Forecasting and Planning for Telecommunications, Vancouver, B.C. Canada, July 1-4, 1984, p. 14.

II.43. Nikkankogyo Shimbun, (see note II.14), p. 181.

II.44. ISDN, (see note I.9), Comments filed by ADAPSO, October 24, 1983, p. 15. "The source of ADAPSO's concern lies in the fact that it has never been demonstrated that ISDN will promote user options and flexibility or replace existing networks with an equally or more cost-effective alternative."

II.45. D. M. Cerni and E. M. Dray, International Telecommunication Standards: Issues and Implications for the '80's. A Summary Record of a July 1982 Workshop. Washington, D.C.: U.S. Dept. of Commerce, 1983 (NTIA SP-83-15), pp. 113-116.

II.46. ISDN, (see note I.9), Comments filed by GTE, October 24, 1983, p. 41.

II.47. A survey by Telematics Resource Group shows relatively low user awareness; see, Mark H. Rudov, "The ISDN Market," presented at the ISDN Broadband Communications Conference, Crystal City, Va., November 13-14, 1984.

II.48. R. C. Terrealt, "What do ISDN users need?" Telephony, Vol. 207, No. 11, September 3, 1984, pp. 44ff.

II.49. See, H. E. Marks, "ISDN: Issue for the Future, Global Communications System," presented at the Twelfth Annual Telecommunications Policy Research Conference, Airlie, Va., April 23-26, 1984.

II.50. ISDN, (see note I.9), Comments filed by the BOCs, GTE, and Northern Telecom, October 23, 1983.

II.51. Gadi Caplan, "Japan's Information Network System," IEEE Spectrum, Vol. 21, No. 5, May, 1984, p. 52.

II.52. Ekonomisuto (Economist), September 25, 1984, p. 11.

II.53. ISDN, (see note I.9), Reply Comments filed by GTE, December 5, 1983, p. 18; Comments filed by IBM, October 24, 1983, p. 16; Comments filed by CBEMA, October 24, 1983, p. 13; and Comments filed by ADAPSO, October 24, 1983, p. 30.

II.54. ISDN, (see note I.9), Reply Comments filed by GTE, December 5, 1983, pp. 18-19.

II.55. Ibid., p. 19.

II.56. T1 Carrier is a short-haul transmission system to carry 1.544 Mb/s, in which 24 speech channels are encoded.

II.57. "Northern Telecom, AT&T square off over ISDN issue," Data Communications, November 1984, pp. 50-52.

II.58. ISDN, (see note I.9), Comments filed by ADAPSO and CBEMA, October 24, 1983.

II.59. ISDN, (see note I.9), Comments filed by GTE, October 24, 1983, p. 49.

II.60. ISDN, (see note I-9), Reply Comments filed by AT&T, December 5, 1983, p. 16.

II.61. ISDN, (see note I.9), Reply Comments filed by the BOCs, December 5, 1983, p. 6.

II.62. ISDN, (see note I.9), Reply Comments filed by AT&T, December 5, 1983, p. 17. AT&T noted there was uncertainty as to the continued availability of dedicated private lines in other countries.

II.63. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, p. 21; Comments filed by AT&T, October 24, 1983, Appendix, p. 13; Comments filed by Northern Telecom, October 24, 1983, p. 11.

II.64. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, pp. 21-22.

II.65. ISDN, (see note I.9), Comments filed by IBM, October 24, 1983, p. 17.

II.66. Gartner Group says: "IBM's opposition is based, in a large part, on a concern that the telcos will subsequently offer ubiquitous advanced protocol conversions via their packet networks, seriously challenging the position of Systems Network Architecture (SNA) as de facto standards for data transmission." Gartner Group, Strategies in Telecommunications Services, November 28, 1984, (Products, P-435-364.1).

II.67. There is no standard definition for universal service, but the concept suggests that nearly every household should be able to afford a telephone. John McGarrity, Implementing Access Charges: Stakeholders and Options, Program on Information Resources Policy, Harvard Univ., March 1983, p. 70.

II.68. The purpose of the Communications Act is to "make available . . . to all the people of the United States a rapid, efficient . . . communications service with adequate facilities at reasonable charges." (Section 1 of the Communications Act, 47 U.S.C. 151). One of the obligations of NTT is to "contribute to the provision of reliable telephone services throughout the country." Japanese Legislation of Telecommunications, Vol. 2, New NTT Law, Article 2.

II.69. T. Irmer, director of CCITT, advises that "service integration . . . at each stage of the process, be based on the requirements and the economic conditions prevailing at that stage." In "The International Approach to the ISDN," Telecommunications Journal, Vol. 49, No. 7, July 1982, p. 412.

II.70. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, Appendix, p. 7. "In fact, by combining data with voice through the use of digital technology, ISDN will permit the Commission to encourage extension of the universal-service goal to services which previously have been available only to a small segment of users."

II.71. In February 1985, AT&T Network Systems announced a new vision named "Universal Information Services," "so that network providers everywhere can give any customer any kind of voice, data or image service in any place, at any time, in any combination, with maximum convenience and economy."

II.72. The Study Group XVIII of the CCITT reports that "The service classification and descriptions . . . are independent of different possible arrangements for ownership and provision to the customer of the means required to support a service. . . ." Document AP VIII-97-E, June 1984, p. 39.

II.73. Some of the burning issues center on D-channel, CCIS, NCTE, and protocol and code conversions.

II.74. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, p. 19.

II.75. M. Koyama, et. al., Nippon no Joho-Tsushin Beucha (Japanese Information Communication Venture). Tokyo: Diamond, 1984, p. 80.

II.76. See, J. F. McLaughlin and A. E. Birinyi, Mapping the Information Business. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., 1980.

II.77. See, Helmut Schön, "Die Deutsche Bundespost auf ihrem Weg zum ISDN," Zeitschrift fuer das Post-und Fernmeldewesen, June 1984.

II.78. See, U.S. Congress, Senate, Committee on Commerce, Science and Transportation, Long Range Goals in International Telecommunications and Information: An Outline for United States Policy, Committee Print. 98th Congress, First Session, March 11, 1983, p. 128.

II.79. As for the standardizations of network architectures, see, Sogo Deita Tsushin Nettowakuka Koso Kondankai, Nettowaku Shakai o Mezashite (Aiming at Network Society). Tokyo: Computer Age Co., 1984, pp. 128-169.

II.80. Marvin A. Sirbu of MIT explains that "standardization is the process of developing the consensus among firms and the patterns of behavior which will achieve the ultimate goals of a standard, not just production of a document." M. A. Sirbu and L. Zwimpfer, Standards Setting for Computer Communication: The case of X.25. Cambridge, Ma.: MIT Research Program on Communications Policy, 1984, p. 5.

II.81. Nihon Keizai Shimbun, October 29, 1984.

II.82. Ibid., October 20, 1984.

II.83. It is said that 90 percent of telecommunications standards can trace their origin to AT&T's Bell Laboratories. See, Baynard, "The Nature of the Voluntary Industrial Standards Concept," Computers & Standards, Vol. 1, No. 1, 1982, p. 151.

II.84. AT&T recently announced an option within CSDC which will enable it to connect with Datapath on similar equipment of other manufacturers, although the voice capability is disabled when this option is used.

II.85. D. M. Cerni, "The CCITT: Organization, Recommendation, Development, and USA Participation," Telecommunications, Vol. 16, No. 10, October 1982, p. 65.

II.86. D. M. Cerni and E. M. Dray, (see note II.45), p. 110.

II.87. ISDN, (see note I.9), Comments filed by IDCMA, October 24, 1983, p. 3.

II.88. According to an NTIA report, of the first 47 documents to SG XVIII during the 1981-1984 study period, the United States contributed 13 documents; Japan, nine; Canada, five; CCIR, five; China, three; France, three; UK, three; Austria, two; Sweden, two; and Switzerland, one. Of the 13 U.S. documents, nine originated with AT&T, three with ITT, and two with COMSAT. See, D. M. Cerni, The CCITT: Organization, U.S. Participation, and Studies Towards the ISDN. Washington D.C.: U.S. Dept. of Commerce, 1982 (NTIA Report 82-101), p. 106.

II.89. ISDN, (see note I.9), Comments filed by IDCMA, October 24, 1983, p. 8.

II.90. ISDN, (see note I.9), Comments filed by M/A-COM, Incorporated (MA-COM), October 24, 1983, pp. 4-5.

II.91. Calculations based on AT&T Communications, The World's Telephones: A Statistical Compilation as of January 1982.

II.92. This is based on the closed-market assumption. In the real, open-market world, all nations will have to adopt a global view to be successful. The disequilibrium that hampers the fact that the U.S. can operate self-sufficiently even in the closed economy.

II.93. D. V. Glen, (see note I.5), p. 117.

II.94. See, Anthony M. Rutkowski, "ISDN: Designing the World's Telecommunications Networks," Intermedia, March, 1983, Vol. 11, No. 2, p. 19.

II.95. T. Irmer, (see note II.69).

II.96. J. Zysman, (see note I.3).

II.97. MarTech Strategies points out five reasons for providing centralized intelligence shared among various services rather than distributed intelligence: 1) Common use of network features -- call processing and much software can be common among services; 2) Costs -- costs should be lower due to shared facilities and possible load averaging; 3) Speed of introducing services -- the introduction of new services is faster if there are only a few locations for the supporting databases/features; 4) Evolution -- it is easier to evolve if only a few locations require changes; and 5) Flexibility -- the ISDN can be conveniently rearranged and reconfigured for technical, market or political reasons. MarTech Strategies, Inc., ISDN Integrated Services Digital Networks: Impacts and Industry Strategy. Indiatlantic, Fla.: MarTech Strategies, Inc., 1982, pp. I-22/23.

II.98. ISDN, (see note I.9), Comments filed by CBEMA, October 24, 1983, pp. 17-19.

II.99. ISDN, (see note I.9), Comments filed by IBM, October 24, 1983, p. 10.

II.100. ISDN, (see note I.9), Comments filed by AT&T, October 24, 1983, p. 13.

II.101. Y. Kitahara, INS Gijutsu (INS Technology). Tokyo: Kikaku Center, 1983, p. 37.

II.102. Denki-Tsushin no Shoraizo ni Kansuru Chosa Kenkyukai (Research and Study Group on the Future Image of Telecommunications), 21-Seiki no Denki-Tsushin (Telecommunications in the 21st Century). Tokyo: Nihon Keizai Shimbunsha, 1983, p. 241. As we have seen in the previous section, in response to the hearing on INS, several organizations such as the Japan Information Processing Center Association, Keidanren, the Japan Newspaper Publishers and Editors Association, the Japan Information Processing Development Center (JIPDEC) and the Federation of Bankers Associations of Japan expressed their view that enhanced services should be left to the market mechanism. See, Ministry of Posts and Telecommunications, Japan, and Tsushingyosei Mondai Kenkukai, Denki-Tsushin Gyosei '83 (Telecommunications Policy '83). Tokyo: Gyosei, 1983, p. 162.

II.103. Nikkankogyo Shimbunsha, (see note II.14), p. 182.

II.104. Telecommunications Advisory Council, "21 Seiki ni Itaru Denkitsushin no Choki Koso" (A Long-term Plan of Telecommunications for the 21st Century). Tokyo: 1984, p. 9.

II.105. D. V. Glen, (see note I.5), p. 60.

II.106. CSU (channel-service unit) is a terminal that performs signal shaping and loop-back testing for AT&T's Dataphone Digital Service (DDS) lines. NCTE is a generic term for the same type of equipment used on any digital-data lines and provides the NT1 interface to the local loop.

II.107. As for the network connection criterion, the FCC concluded that "in determining whether carriers may restrict the connection by the customer of a particular piece of equipment or class of equipment to telephone company transmission facilities, the fundamental test is whether such interconnection would constitute use of the network in a way that is privately beneficial without being publicly detrimental . . . . The burden of proof rests on the carrier seeking to restrict interconnection to demonstrate that the customer-provided equipment would cause harm to the telephone network." In the Matters of Petitions Seeking Amendment of Part 68 of the Commission's Rules Concerning Connection of Telephone Equipment, Systems and Connective Apparatus to the Telephone Network; and Notice of Inquiry into Standards for Inclusion of One and Two-Line Business and Residential Premises Wiring and Party Line Service in Part 68 of the Commission's Rules, FCC CC Docket 81-216, (hereinafter cited as Interconnection), Third Notice of Proposed Rulemaking, June 2, 1983, 94 FCC 2d 5; Reconsideration denied, FCC 84-145, released April 27, 1984, note 5.

II.108. ISDN, (see note II.18), para. 22.

II.109. ISDN, (see note I.9), Reply Comments filed by IBM, December 5, 1983, p. 9.

II.110. Conversely, it is held by some that "U" interface does not threaten the portability, since 1) CCITT Recommendations prescribe two disparate reference points (S and T), and 2) CPE is often specifically designed for a given country with consideration given to its power sources, etc.

II.111. Interconnection, (see note II.107). It should be noted that AT&T did not request the reconsideration.

II.112. Interconnection, (see note II.107), Second Report and Order, November 26, 1984, 49 FR 48714.

II.113. ISDN, (see note I.9), para. 54.

II.114. Interconnection, (see note II.107), Reconsideration denied, FCC 84-145, released April 27, 1984, para. 18.

II.115. See note II.88.

II.116. At the Eighth Plenary Assembly of CCITT, a question for study of SGXVIII was prescribed: "Definition of the parameteres at the network site of NT equipment" (No. 16, Question P).

II.117. Many exceptions for the local monopolies have appeared recently.

II.118. ISDN, (see note I.9), Comments filed by GTE, October 24, 1983, p. 48.

II.119. ISDN, (see note I.9), Comments filed by NTIA, October 24, 1983, pp. 20-22.

II.120. ISDN, (see note I.9), Comments filed by American Satellite Company (ASC), October 24, 1983, p. 3.

II.121. ISDN, (see note I.9), Comments filed by ADAPSO, October 24, 1983, pp. 27-28.

II.122. ISDN, (see note I.9), Comments filed by IDCMA, October 24, 1983, p. 12.

II.123. E. J. Exton, "ISDN - Tariff Implications," Telecommunication Journal, Vol. 50, No. 5, 1983, pp. 244-248.

II.124. This may be one of the most convincing reasons for Type 1 carriers to separate their enhanced services from other services they provide.

II.125. According to Meyer, there are at least eight identifiable goals associated with regulatory ratemaking: 1) universal service, 2) static efficiency in resource allocation, 3) equity for different kinds of users and services, 4) financial self-sufficiency (total revenues equal to total cost), 5)

prevention of uneconomic entry, 6) consistency with expected technological change, 7) administrative simplicity, and 8) historical continuity. See, John R. Meyer, et. al., The Economics of Competition in the Telecommunications Industry. Cambridge, Ma.: Oelgeschlager, Gunn & Hain Publ. Inc., 1980, p. 75.

II.126. K. Nakano, "Ryokin ni taisuru kangaekata" (CCITT ni okeru ISDN ryokin no keukyu) (How to set tariffs: study on ISDN tariffs at the CCITT), a paper delivered at the ISDN Seminar, November 14, 1983, at Tokyo, sponsored by Japan ITU Association.

II.127. ISDN, (see note I.9), Comments filed by NTIA, October 24, 1983, pp. 6-8.

II.128. M. Murata and K. Kanesaki, "Kodo Joho Tsushin Sisuten (INS) to Sono Sabis," (INS and Its Service), Deita Tsushin (Data Communications), July 1983, p. 51.

II.129. ISDN, (see note I.9), Comments filed by IBM, October 24, 1983, pp. 17-18.

II.130. ISDN, (see note I.9), Reply Comments filed by the BOCs, December 5, 1983, pp. 6-7.

II.131. Nihon Keizai Shimbun, December 24, 1984. Also suggested is the possibility that the commission prescribe the separation of data-communications services from the new NTT and the breakup of NTT as undertaken in the United States.

II.132. ISDN, (see note I.9), Comments filed by ADAPSO, October 24, 1983, p. 22. According to a survey conducted by Telematics Resource Group, users are most interested in the cost factor (price) of an ISDN. See, Marc H. Rudov, The ISDN Market, paper delivered at ISDN -- Broadband Communications Conference, November 13-14, 1984, Crystal City, VA.

II.133. See, Bob Wallace, "Beyond the Digital Horizon," Computerworld on Communications, October 3, 1984, p. 36, and T. Irmer, "The International Approach to the ISDN," Telecommunication Journal, Vol. 49, No. 7., July 1982, pp. 411-415.

II.134. See, H. E. Marks, (see note II.49), p. 5.

II.135. See, Ithiel de Sola Pool, Technologies of Freedom. Cambridge, Ma.: Harvard University Press, 1984, p. 177.

II.136. For the sake of fairness, it should be added that coders and converters have been installed since the installation of digital carrier's systems.

II.137. Ibid. Here the author speculates that "modernizing it [local loop] is less important for the phone system as a whole than is digitizing trunks. Early versions of the ISDN will use as much

of the present local loop as possible. So it will be some time before every home will have a phone connection that is both digital and very broadband." Under the competitive environment, telephone companies are offering many digital services such as T carriers. See, Part II, Section 5.a. of this paper, ISDN in Competitive Environments.

II.138. See, T. Housley, Datacommunications and Teleprocessing Systems. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1979, p. 203.

II.139. Yasusada Kitahara, Information Network System: Telecommunications in the Twenty-First Century. Tokyo: The Telecommunications Association, 1982, pp. 156-157.

II.140. See, Nikkan Kogyo Shimbun, "Kigyo tai Chiiki INS" (Firms and Regional INS), Tokyo: Nikkan Kogyo Shimbunsha, 1984, p. 11.

II.141. Nihon Keizai Shimbun, May 29, 1984.

II.142. See, H. E. Marks (see note II.49), and Marc H. Rudov, "Marketing ISDNs: Reach Out and Touch Someone's Pocketbook," Data Communications, June 1984, p. 243.

II.143. As to the distance-insensitive tariff in the U.S., see, R. C. Godbey, A Distance-Insensitive Uniform National Telephone Rate Structure. Cambridge, Ma.: Program on Information Resources Policy, Harvard University, 1981.

II.144. Distance-insensitive tariff is not integrally related to INS. Importantly, this distance-insensitive tariff was announced with INS, which is made possible because of the long-haul digital technologies such as optical fibers and satellite communications.

II.145. Ezra Vogel, Comeback. Tokyo: TBS Britanica, 1984, p. 175.

II.146. The extent of the contribution telecommunications can make toward elimination of distance is unclear. Pool believes that "for most organizations and enterprises, communications costs are significant, but far from a dominant item. One should therefore not anticipate that shifts in communications costs will produce revolutionary changes in the location of business." H. M. Shooshan, ed., (see note II.39), p. 122. Extremely high land prices in Tokyo may create a different situation in Japan.

II.147. It is unlikely that NTT will be able to eliminate the rates differential in distance completely, nor does it seem desirable, since NTT's competitors will only provide long-distance services for several years; the ratio of long-distance to local rates must be greater than one to one for the services that need local connections.

II.148. ISDN, (see note I.9), Comments filed by NTIA, October 24, 1983, p. 16.

II.149. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, and D. F. Hudson, (see note 11).

II.150. OECD, Telecommunications: Pressures and Policies for Change. Paris: OECD Pub., 1983, p. 80.

II.151. W. F. Finan, (see note II.42), p. 14. See also the statements of T. Kobayashi in M. Koyama, et. al., Nippon no Joho Tsushin Bencha (Japanese Information Communication Venture). Tokyo: Diamond, 1984, p. 100.

II.152. David Hanson, (see note I.10).

II.153. Remember the ISDN definition at the CCITT. "ISDN is a network, in general evolving from a telephony IDN . . ." (see, Part I, Section 2 of this paper).

II.154. The conditions for connection to the public networks somewhat differ between the United States and Japan as we have seen.

II.155. See, Paul T. de Sousa, "Private corporate networks are still alive and well," Telephony, Vol. 207, No. 16, October 8, 1984. See also, D. F. Hudson, (see note I.11).

II.156. See, Jerry Skene, "The Last Mile: Alternative Ways to Implement ISDN over the Local Loop," Communications News, December 1984, pp. 54-56.

II.157. See, G. S. Bhusri, "Considerations for ISDN Planning and Implementation: the rationale for accelerated development of ISDN and the architectural concept to implement it," IEEE Communications Magazine, Vol. 22, No. 1, January 1984, p. 19.

II.158. U.S. Dept. of Commerce, NTIA/ITS Staff, A Primer on Integrated Services Digital Network (ISDN): Implications for Future Global Communications, Washington, D.C.: U.S. Dept. of Commerce, 1983, (NTIA Report 83-138), p. 57.

II.159. J. Cameron and S. Moore, "Railinc on Right Track to Improve System," Computerworld on Communications, October 3, 1984, p. 13. The Department of State has recently proposed the establishment of the Office of Coordinator for International Communications and Information Policy, now pending before the Congress for approval. Telecommunications Reports, Vol. 51, No. 11, March 18, 1985, p. 10.

II.160. United States v. AT&T, Case No. 74-1698, Testimony of Irwin Dorros on the divestiture of AT&T, p. 86.

II.161. Carol L. Weinhaus and Anthony G. Oettinger, (see note II.2), Section II, v.

II.162. ISDN, (see note I.9), Comments filed by ECSA, October 24, 1983, p. 1.

II.163. ISDN, (see note I.9), Comments filed by the BOCs, October 24, 1983, p. 12; Comments filed by Contel, October 24, 1983, p. 3; Comments filed by GTE, October 24, 1983, pp. 3, 10, 13, 31 and 52; Comments filed by IBM, October 24, 1983, p. 29; Comments filed by Northern Telecom, October 24, 1983, p. 8; Comments filed by UTS, October 24, 1983, pp. 2-3.

II.164. ISDN, (see note I.9), Comments filed by ECSA, October 24, 1983, pp. 2, 4.

II.165. ISDN, (see note I.9), Comments filed by AT&T, Ocotber 24, 1983, p. 16.

II.166. ISDN, (see note II.18), para. 76-83.

II.167. "FCC is moving toward new pro-competitive International Policy . . . ." Telecom Insider, Vol. 4, No. 5, April 1984, p. 11.

II.168. Black, "How ISDN services could make or break the big network," Data Communications, June 1984, p. 248.

II.169. Julian Gresser, Partners in Prosperity: Strategic Industries for the United States and Japan. New York: McGraw-Hill, 1984, p. 97. These plans are in many cases made through government agency consultative councils' study groups. These usually consist of eminent scholars and representatives from various industries.

II.170. M. Koyama et al., (see note II.151), p. 34.

II.171. See, Ken'ichi Imai, Nippon no Sangyo Shakai (Japanese Industrial Society). Tokyo: Chikuma Shobo, 1983, p. 181, and Kazuhisa Maeno, INS no koto ga Wakaru Hon (Understanding INS). Tokyo: Nippon Zitsugyo Syuppansha, 1983, p. 183.

II.172. U.S. Dept. of Commerce, (see note II.158), p. 56.