Where to Put the Smarts: Network or CPE?

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Program on Information Resources Policy

Harvard University

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Executive Summary

- In the mid-1980s, four major trends are shaking the delicately balanced regulatory frameworks in the telecommunications arena, especially in view of increased possibilities for locating "the smarts" in the network or customer premises equipment (CPE).

- First, technological development that has driven the convergence of telecommunications and computers has accelerated conversions to at least partial local loop digitization by making the changes economically plausible. But contrary to the dreams of telecommunications system designers in the late 1970s, the way toward local loop digitization is still, or rather increasingly, unclear as the time for it approaches.

- Second, the number of alternative equipment and system configurations that fulfill a particular service demand has increased drastically. This increase in alternatives does not always benefit network service providers' network improvement plans. To the contrary, it challenges technologically deterministic assumptions about telecommunications evolution.

- Third, the introduction of procompetitive policies and the consequent movement toward the elimination of local subsidization by long-distance further complicate current situations. Network service providers are eager to replace vintage systems not only to offer new services to fulfill changing demands of large corporate customers, but also to reduce total telecommunications system costs. However, cost reduction for the total system does not always reduce the price of a particular service, especially for historically subsidized local telephone services. A major portion of residential customers, who need only conventional voice communications services, may consider price increases in local telephone services to be the direct result of investment for esoteric new services for large corporate customers. On that ground, they may have a strong argument against replacing vintage equipment.

- Fourth, the increase in international telecommunications usage especially for business purposes and the growth of telecommunications equipment trade have brought into sharp relief the discrepancies among developed countries' regulatory regimes. Coordination of independent domestic telecommunications frameworks may be indicated. However, it is dangerous to take a particular country's current regulatory framework as an ideal model and to attempt to impose it on other countries; the transplanted regulatory framework is not likely to remain valid in a different cultural and historical context. Because existing regulatory frameworks are transitional, other revision may be needed.

- Although the same technological evolution nourishes these four trends, their implications and impacts vary. Occasionally they even adversely affect each other. Thus some may dismiss them as undesirable or irrelevant and may fail to consider their implications.

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INTRODUCTION

The convergence of telecommunications and computers is acknowledged to be one of the most significant trends in telecommunications-related areas in the last two decades. Indeed, regulatory and service frameworks for conventional telecommunications in developed countries have gradually been absorbing the impacts of evolving non-voice telecommunications applications, although the timing and degree of changes have varied according to each country's circumstances.

However, the concept that telecommunications are approximately equal to telephone services and that telephone networks are primary for carrying real-time two-way voice communications still seems to play a key role in users', regulators', and service providers' minds. Thus far, changes have been essentially ad hoc, preserving the prevailing voice orientation. But the balances between revised and preserved portions of the network are extremely delicate.

In the mid-1980s four major trends are shaking telecommunications' delicately balanced regulatory frameworks, especially in view of increased possibilities for locating the "smarts" either in the network or in customer premises equipment (CPE).

First, technological development that has driven the convergence of telecommunications and computers has accelerated, finally making at least partial local-loop digitization economically plausible. But contrary to the dreams of telecommunications system designers in the late 1970s, the way toward local loop digitization is still, or rather increasingly, unclear as the time for it approaches.

Second, with technological development in such fields as micro-processors, integrated circuits, electro-optic devices, and software, alternative equipment and system configurations available to fulfill a particular service demand have increased drastically. This increase opens a range of possibilities for locating intelligent functions in the network or in CPE, but such options do not always benefit network service providers' (especially common carriers') network improvement plans. Typical examples of this kind of situation appear in the developmental history of modem and facsimile equipment which utilize existing analog networks. Thus called into question are technologically deterministic assumptions about telecommunications evolution.

Third, the introduction of procompetitive policies and the consequent movement toward the elimination of local long-distance subsidization further complicate current situations. Network service providers are eager to replace vintage systems not only to offer new services to fulfill evolving demands of large corporate customers, but also to reduce the total telecommunications system cost for construction and, theoretically, for maintenance. However, cost reduction of the total system does not always reduce the price of a particular service, especially historically subsidized local telephone services. A major portion of residential customers, who need only conventional voice communications services, may consider price increases in local telephone services to be the direct result of investment for esoteric new services for large corporate customers. On that ground they may have a strong argument against the replacement of vintage equipment.

Fourth, the increase in international telecommunications usage especially for business purposes and the growth of telecommunications equipment trade reveal the regulatory discrepancies among the developed countries and may trigger international trade conflict. Thus, adjustment and coordination of independent domestic telecommunications regulatory frameworks may be indicated. However, it is dangerous to take a particular country's current regulatory framework as the ideal model and attempt to impose it on other countries. Since any existing regulatory framework is deeply rooted in the country's cultural and historical background, the transplanted regulatory framework is unlikely to remain valid under different cultural and historical conditions. And because existing regulatory frameworks are transitional, and the market conditions supporting their validity are rapidly changing, other revisions may be required in the near future. The trade conflict in telecommunications between the U.S. and Japan from 1984 to early 1986 and Computer Inquiry III have already shown these characteristics.

Although the same technological evolution nourishes these four trends, their implications and impacts vary. Occasionally they even adversely affect each other. From the perspective of those who firmly believe in a static hierarchy, either a "retrospective" voice-oriented one or a futuristic, centralized, digitally oriented one, current situations look clumsy and even chaotic. Thus they may dismiss them as undesirable or irrelevant and may fail to consider their implications. However, these evolving trends challenge the validity of such firm beliefs.

The purpose of this paper is to explore these four trends, especially stressing local loop digitization. Its implications and impacts are far from clear at this moment; some of the most interesting issues are still on the horizon. Therefore, discussions are descriptive rather than explanatory and aim at raising questions rather than at giving answers. However, a functional model is developed in Chapter 3 to suggest an impartial basis for further discussion. The information base for the paper ends March 1986.

1

OVERVIEW

1-1: Uneven Capitalization

Evolving technology has been capitalized unevenly both within and among nations as a direct result of differences in embedded facilities and in the degree of their depreciation, in the regulatory environments and market conditions, and in the cultures. For limited supplier-user interfaces that have remained essentially unchanged since the 1960s, the impacts of uneven capitalization have yet to be felt. However, once the spell that sustains the black-box network* begins to be broken, uneven capitalization and its effects will gradually become apparent.

Degree of digitization. During the last 20 years, the analog facilities in the telecommunications infrastructure began to be replaced by digital facilities. In a monopolistic market structure, de jure or de facto, the incentive for digitization is essentially economic: Digital facilities carry and process more information at lower cost and with substantially lower maintenance costs than analog facilities. The degree of digitization varies from sphere to sphere, and can reflect cost reduction in a particular sphere.

The advantageous cost differential was first realized with trunk transmission. Savings later accrued in switching facilities, some local conduits (especially for high-speed data-transmission purposes), and sophisticated CPE. The advent of optical fibers and very large scale integrated circuits (VLSI) has given digital technologies a definitive

*A black-box network is treated as an entity despite its internal complexity and despite the coexistence of different technologies, such as digital and analog, microwave, fiber-optic and coaxial transmission, electronic and mechanical-electric.

advantage in trunk-transmission and switching applications. However, for local conduits, digitization is still in its infancy. Only in limited uses -- dedicated data-transmission switching and large-scale transmission services (e.g., T-1 carrier for bypass use) -- are benefits to local conduits from digitization fully realized.

Replacing embedded facilities. As a rule, slow depreciation has prevailed among telecommunications carriers. A plausible means of hastening digitization to meet the challenge of newcomers equipped with sophisticated facilities would involve elimination of technologically obsolete and overvalued (though still operative) equipment. Unless an accelerated depreciation method is adopted and appropriate means are taken to ensure recovery of depreciation losses, it will be extremely difficult for dominant carriers to fulfill evolving large business-customer demands; accelerated digitization is required for these carriers to compete with participating other common carriers (OCCs) and other evolving competitors.

However, acceleration of depreciation and adoption of measures to compensate for the anticipated depreciation shortfalls may well induce a short-term rate hike in regulated telephone business, since depreciation and regulated telephone rates are so closely related. Thus it is not surprising that several states challenged the Federal Communications Commission's (FCC's) 1983 depreciation ruling (Docket No. 20188);[1] subsequently the Supreme Court overturned the FCC determination on that issue in favor of the state governments. The future of the depreciation issue and the recovery of losses, which will affect the financial well-being of the dominant carriers, may have a more profound impact on the digitization of the U.S. telecommunications infrastructure than the Computer Inquiry III order.

In Japan, Nippon Telegraph & Telephone Corporation (NTT) has adopted the diminishing-balance method of depreciation that existed before privatization. A method for faster recovery for digital equipment investment was accepted by the Ministry of Posts, Telegraph, and Telephone (MPT). However, because most embedded switchboards were electromechanical and the huge investment made in the 1960s and early '70s to clear telephone backlog has yet to be recovered, NTT's financial situation resembles that of dominant carriers in the United States.

1-2: Carrier/Customer Interface Alternatives

Alternatives in the area of carrier-customer interface are increasingly plentiful as a result of spiraling customer demand, the availability of sophisticated customer premises equipment (CPE), and heated competition among carriers.

Evolution of CPE. The same technology that supports trunk-transmission and switchboard digitization fuels the CPE evolution. Tandem-switching and multiplexing functions -- accessible only to larger customers and relatively limited in their capacities because of their enormous size and high cost in the electromechanical analog era -- are now affordable for smaller users owing to drastic reductions in size and cost per unit. These changes, in turn, have considerably enhanced larger customers' capacities. More important, digitization of private automatic branch exchange (PABX) has induced cost and size reductions, has allowed for direct connection to digital data terminals (although full digital integration of data, voice, and image transmission terminals with digital PABX has yet to be introduced), and has enhanced switching capacity. Digitization of PABX and associated equipment may have several ramifications:

- Transmission bottlenecks may simply shift from CPE to local loops unless higher-speed alternatives are provided. (The same premise holds for computers operated by enhanced-service providers.)
- For point-to-point transmission, integration of voice, data, and image at the trunk-transmission level using digital coding via high-speed digital conduit (such as the T-1 carrier) may become technically and economically preferable both to dedicated conduits and to integration by the digital-overlaid-on-analog-conduit approach. This change was typified by the attitude of analog wideband (up to 240KH/s) users in Japan at the time of NTT's introduction of T-1 type service (up to 6Mb/s).[2]
- Digital interface may be superior to analog interface primarily for connection to a switched network (local and long distance); with the digital interface, the analog/digital coder (codec) is unnecessary. Moreover, as high-speed bulk conduits (such as the T-1 carrier type conduit) become affordable, large digital PABX users will likely replace the twisted-pair interface with a higher-speed conduit.
- At the current rate of technical development, regardless of the prevailing market framework (monopolistic or competitive), high-speed digital alternative conduits may become available, as evidenced by the H interfaces (broadband digital interface) included among the International Telegraph and Telephone Consultative Committee (CCITT) ISDN recommendations. The competitive policy adopted in the United States has accelerated this change,

most dramatically illustrated by the development of bypass facilities, encouraged by the existence of the long-distance to local-loop subsidy.

Evolutionary spiral in telecommunications. The increasing use of telecommunications and computers in business accelerates demand for more sophisticated telecommunications and computing means. The upward spiral in business use of, and dependence on, telecommunications is predicated on satisfaction of three criteria: first, technological innovation surpasses customer demand; second, the regulatory climate does not constrain responses to customer demand; and, third, profits from the upgraded systems exceed the replacement costs of equipment and software. Examples, such as the functional development of automated teller machines (ATM), abound in the history of the banking industry during the last two decades.[3]

This upward spiral yields new commercial stakes. Telecommunications systems and data-communications software have been targeted in new ventures, such as resale of excess telecommunications capacity and sales of data-communications software. In addition, changes in the domestic regulatory framework can pose a threat to the value of an existing system, either in terms of competitive edge in a given business field or sales of compunications services. The affected business would emerge as the serious stakeholder. Comments from some users to Computer Inquiry III typify this response.[4] Conversely, latecomers who intend to "leapfrog" ahead have a stake in the process that is diametrically opposed to that of the existing system operator.

Local-loop digitization. The effects of digitization on the residential market are still far from clear. Average use of telecommunications circuits by residential customers is very low, even in the developed countries.[5] Most residential customers have considerable excess capacity even with current analog circuits. The briefly fashionable so-called new media services -- home banking, videotex -- have struggled to achieve critical mass. Even electronic publishing and data-retrieval services, which seem more promising, may face alternatives such as compact-disk offline delivery, especially for bulk transmission.

In the field of personal computer (PC)-to-PC communication, the lack of demand may simply indicate that customers do not have enough information to require higher-speed transmission capacity (64Kbit/s) for long durations on a daily basis. If a customer's usage is limited to voice communications, the overall cost, including CPE replacement, may surpass the cost of using conventional telephones; this is especially true in the short term. Therefore, despite long-run cost reductions and a wide spectrum of potential services, local-loop digitization for residential customers -- especially steamroller digitization -- seems not to be an immediate necessity.

1-3: Large Users as Network Operators

The dramatic rise in use of international telecommunications is characterized by the emergence of large users as potential network operators. This change is being driven by dependence on sophisticated telecommunications and data-processing tools for domestic operation. The new role for large users is also being encouraged by rate reductions and the expansion in available bandwidth capacity created by such technological developments as satellite transmission. The fact is that international telecommunications as a tool of business is no longer regarded only as a suspension bridge over a deep gorge.

For example, until 1972, the telephone and teleprinter were the major equipment in foreign-currency trading rooms throughout the world.[6] Then, in the late 1970s and early 1980s, a new business environment took shape: Born of 24-hour, worldwide trading and trading rooms equipped with online visual data-display terminals and state-of-the-art telecommunications systems, the movement evolved into marketing of software and systems planning beyond national boundaries. Combined with a strong domestic marketing effort, it was a powerful challenge to existing regulations and business procedures in the foreign markets.

U.S. firms led the field, confident in their edge over other countries in terms of service-related software and systems know-how. Thus, huge stakes were established in the packaged software sales market. Even Japanese firms -- widely criticized domestically and internationally for adhering to custom software and systems, which prevented efficient development of packaged software -- were impelled to market "homemade" software, share data-communications networks, and interconnect networks, their traditional dislike for sharing and standardization notwithstanding.[7]

When business telecommunications/data-processing systems developed for a given domestic market are exported or system developers market their systems, software, and system know-how to foreign users, it is likely that the goods and services will encounter restrictions or barriers not imposed in the country of origin. Inevitably, efforts are made to modify restrictions to make the system operable and to allow for marketing of the merchandise without substantive change. The stakes are not exclusively within the confines of the telecommunication/data-communications arena, although these stakes related to telecommunications proper can become enormously high; conflicts and controversy between participating countries become complicated, compounded by misperceptions and even deception. (This circumstance is typified by the debate over the controversial transborder data flow [TBDF] concerning privacy protection and the negotiation between the United States and Japan concerning treatment of Type 2 value-added services on the eve of Japanese telecommunications reform.)

Two hypothetical scenarios further explicate these concerns:

- Marketability of software, systems know-how, and even of systems hardware is closely related both to the prevailing legal framework, including that for telecommunications, and to the broader conventions and protocols (clerical behavior, writing systems, procurement practice, and so on) as historically evolved and refined. This is to say that, even if the legal frameworks were complementary -- an unlikely prospect -- marketability could hardly be guaranteed. Eventually, the exporting nation might blame the importer's underlying conventions and protocols for acting as nontariff barriers; the importing nation could interpret this as an attempt to mitigate national sovereignty and become inclined to protect all conventions and protocols, even those that are historical relics and that adversely affect domestic interests. Finally, even if a reasonable compromise is realized, it will be achieved at a high perceived loss by both sides.

- The negotiators and stakeholders in the nation that first initiated a successful procompetitive policy may consider their current domestic framework to be the sole model for the development of a new structure. This view was expressed by several U.S. public and private-sector representatives at the 1985 World Telecommunications Forum in Washington, D.C., jointly sponsored by the International Telecommunication Union and American Bar Association.[8]

1-4: Potential Imbalance in Telecommunications-Equipment Trade

The potential for a disruptive telecommunications-equipment trade imbalance has been engendered by disparate market conditions and equipment (mainly customer premises equipment) that reflect uniquely national regulatory practices, business procedures, and even such fundamental elements as language and alphabet.

While many PTTs (Postal, Telegraph, and Telephone Authorities) still prefer to sustain their monopoly, even in CPE, and to procure telecommunications equipment domestically, international telecommunications equipment trade among developed countries is growing. The existing dissimilarities that compose the various nations' business, political, and social identities could emerge as impasses to achievement of an equitable trade balance among the countries. These potential barriers remain latent as long as monopolistic marketing practice or strict regulations (including technical standards) prevail; once these are removed in either country, threat could become reality in a relatively short period. Asymmetry in the timing and structure of regulatory reform in the United States and Japan, and the latent disparities, created a large and growing Japanese telecommunications-trade surplus, which exacerbated existing trade conflicts. In fact, telecommunications-related disputes, despite their short history, became a major focal point under the Market-Oriented Sector Selectives (MOSS) trade negotiations between the U.S. and Japan from 1984 to early 1986.[9]

In the wake of the resolution of this first major trade conflict in the field of international telecommunications-equipment trade, the following points deserve attention:

First, even if identical regulatory environments are realized (unlikely, of course), the evolutional disparities in CPE developed in different cultures could still pose a barrier to balanced trade. Equipment tailored to and developed in one market could penetrate another market, while counterpart equipment tailored and developed in another market may not successfuly penetrate. This situation is relevant to U.S.-Japan trading in facsimile (sophisticated in the Japanese market) and personal computers (first developed in the United States, which still holds an advantage in software over Japan).

Second, the negotiators and stakeholders in the nation that first initiated a successful procompetitive policy may consider their current domestic framework to be the sole model for development of a new market structure.

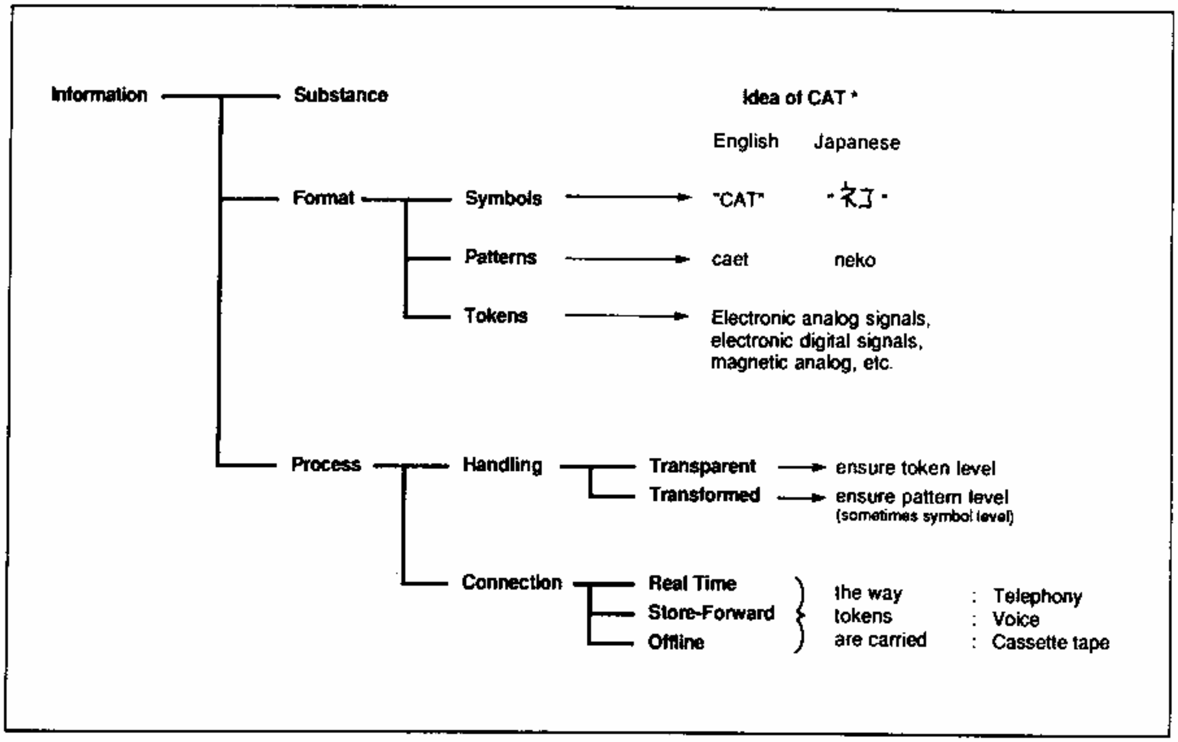
Third, increase of final-product export does not always translate into a net increase of export; degree of dependence on foreign part and component suppliers must be considered. For example, to manufacture a 16bit PC, it is common procedure to manufacture large-scale integration (LSI) circuits and other sophisticated parts in one country, export these to a developing country (in which most assembly procedures take place), then export again to yet another country for finish procedures, software loading, and fine tuning.

This well-known procedure is often unacknowledged in pertinent situations. The general U.S. frustration over the increasing trade deficit does not seem to take into account the current international trade situations outlined above. On the other hand, the rapid development of manufacturing industries in developing nations, especially in so-called newly industrialized countries (NICs), may create a dilemma for future telecommunications trade, including software and service trade. Eager to develop the assembly industry (and, in the future, a sophisticated component industry) tailored for export, these nations recognize the need to protect their fragile and, in some cases, inadequate telecommunications infrastructure, software industries, and information-related industries (particularly financial sectors) from foreign invasion.

1-5: Are Conventional Boundaries Still Viable?

Is it still practical to revise and reiterate existing frameworks (regulated/unregulated, network/CPE, basic/enhanced, conduit owned/-resale, domestic/international, and even telecommunications/data processing) to cope with the compounded, complicated telecommunications sector? Certainly, deeply felt and institutionalized elements of this sector prevail after decades of change -- the concept of universal service in telephony and the very concept of the nation state. Still, major components of current telecommunications frameworks were developed under constraints (analog technology, wired logic, lack of high-speed digital computing, and relatively low volumes of international trade, self-sustained industrial complexes, and minimal requirements for high-speed information flow) which have largely disappeared or been transformed. So it may be worthwhile to develop at least some new sets of concepts to explain the drain of interfaces (a changing and blurring customer-network boundary and increasing interface alternatives, previously kept within the monopolistic network black box) and the fusion of once distinct telecommunications systems.

Two working frameworks independent of any existing regulatory/ service framework will help in these discussions: a telecommunications-infrastructure configuration and an information-resources model. These two frameworks are detailed in Chapter 3. Figure 1-1, based on the concept of information resources as substance, format, and process,[10] and Figure 1-2 introduce this paper's nontraditional approach.



* Using vocal transmission of the idea of "CAT" in English and Japanese as an example.

Figure 1-1

Working Framework for the Nature of Information
in Telecommunications and Related Areas

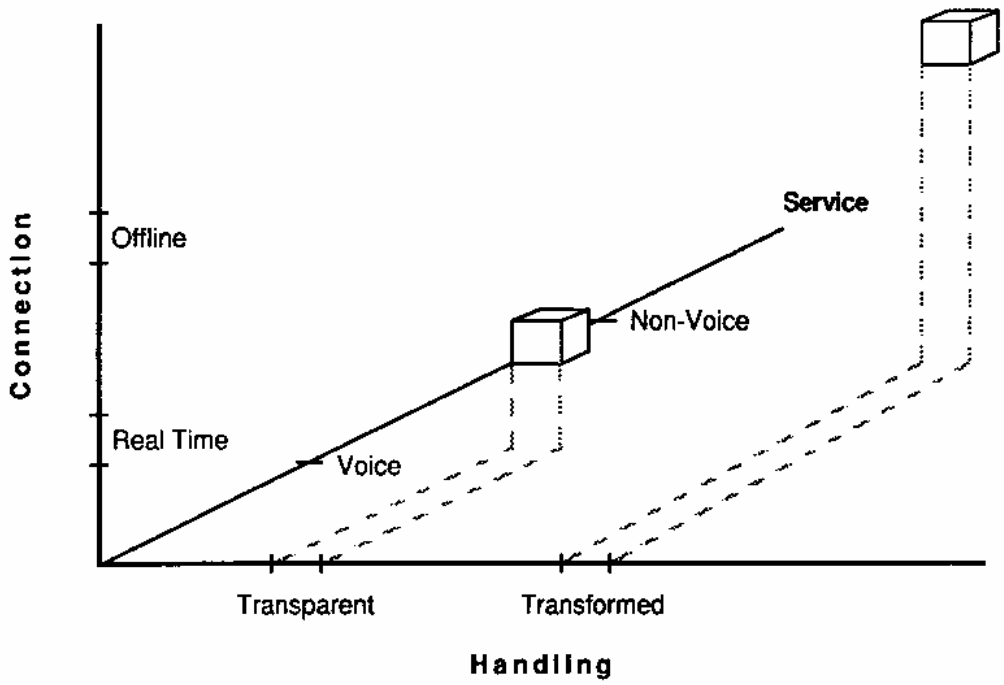


Figure 1-2

Pre-Computer-Network Age: Three-Dimensional Representation of Connection-Handling Plane with an Auxiliary Axis

Notes for Chapter 1

1-1 U.S. Department of Commerce, National Telecommunications and Information Administration. Issues in Domestic Telecommunications: Directions for National Policy. Washington, D.C.: NTIA SP-85-16, July 1985, p. 136.

1-2 Nishimoto, Kanji. "Kosoku Digital Denso Service no Juyo-doko to Kongo no Yosoku" (Current and future demand for high-speed digital transmission service), Business Communication, Vol. 21, No. 6, June 1985, pp. 32-41.

1-3 Tygier, Claude. The Foreign Exchange Market: A Descriptive Study. Cambridge, MA: Program on Information Resources Policy, Harvard Univ., Research Report P-86-8, August 1986.

1-4 Telecommunications Reports, Vol. 51, No. 46, Nov. 18, 1985, pp. 5-6.

1-5 Yasusada, Kitahara. Denkitsushin-Kakumei (Telecommunications Revolution). Tokyo: Nihon-Keizai Sinbunsha, June 1981, p. 52.

1-6 Ibid., pp. I-41-45.

1-7 Ekonomisuto (Economist), February 11, 1986, pp. 82-88. Article by Hiro-o Kinoshita.

1-8 International Telecommunication Union. Special Session. World Telecommunication Forum. Speakers' Papers. Law, Regulation, Standards of Global Communications. Geneva, Switzerland: International Telecommunication Union (ITU), 1985, p. 328.

1-9 MOSS is a method of bilateral trade negotiation taken up by the U.S. and Japan, in which several urgent matters are selected and negotiated simultaneously rather than being negotiated separately or on a general tariff basis.

1-10 See Compaine, Benjamin M., "A New Framework for the Media Arena: Content, Process and Format," in Benjamin M. Compaine, ed., Understanding New Media. Cambridge, Ma: Ballinger Publishing Co., 1984, pp. 69-95.

This analysis is further elaborated in Oettinger, Anthony G. "The Information Evolution: Building Blocks and Bursting Bundles," The Compunications Age: Its Mainsprings and their Evolution. Cambridge, Ma: Program on Information Resources Policy, Harvard Univ., May 1984 (Research Draft).

2

JAPANESE TELECOMMUNICATIONS REFORM

2-1: Summary of the New Regulatory Framework

The many recent articles and books chronicling and assessing regulatory reform of Japanese telecommunications have not explained the situation sufficiently. There remains a considerable degree of misunderstanding and misinterpretation of the implications of the new framework and of its divergence from the current U.S. framework.[1] As the central concern of this paper rests on an understanding of the similarities and differences between the regulatory frameworks of Japan and the United States, recent Japanese reform and related issues are examined in this chapter and in several appendices.

Telecommunications Business Law (TB Law)

After long dispute and considerable compromise the law ensuring respective monopolies in the domestic and international arenas was replaced by the procompetitive Telecommunications Business Law on 1 April 1985 (see Appendix B for pre-enactment history). Implementation of the new law established the current regulatory framework.

Telecommunication business defined. Telecommunications business involves provision of intermediary communications via telecommunications facilities to meet a third-party demand (Art. 2). This broad definition is refined in a supplementary article (Art. 90), which excludes some businesses from the scope of the Telecommunications Business Law, in addition to those -- wired-radio broadcasting, wired-broadcast telephone service, and wired-television broadcasting service (cable television, or community antenna television [CATV]) -- excluded in Article 2. Article 90 excludes:

- businesses that only provide telecommunications service to a single person (said person must not operate a telecommunications business).
- businesses that provide telecommunications service within the limited area defined by Article 90 (2) or by the MPT ordinance. (This is interpreted to exclude shared tenant service and shared local area network service from the scope of the TB Law.)
- any Type 2 telecommunications business (defined below) that provides telecommunications services other than those for the intermediary communications of others. Although this condition is vague, it is considered as excluding time-sharing systems (TSS) and data-retrieval services.

Line-owned/line-not-owned dichotomy. A given telecommunications business is categorized according to "whether it owns transmission-line facilities connecting transmitting points with receiving points, switching facilities installed as inseparable units therefrom, and other facilities accessory to such facilities." An owner of such a facility is categorized as a Type 1 Business and any business not considered Type 1 is categorized as a Type 2 Business (Art. 6).

A Type 2 Business is classified as either a General Type 2 Business or a Special Type 2 Business. Special Type 2 businesses are those Type 2 concerns that exceed in scale the standard set by the Cabinet's ordinance for the upper limit of telecommunications lines for General Type 2 businesses or those that provide telecommunications services between Japan and foreign points. General Type 2 Business identifies a non-Special Type 2 Business (Art. 21).

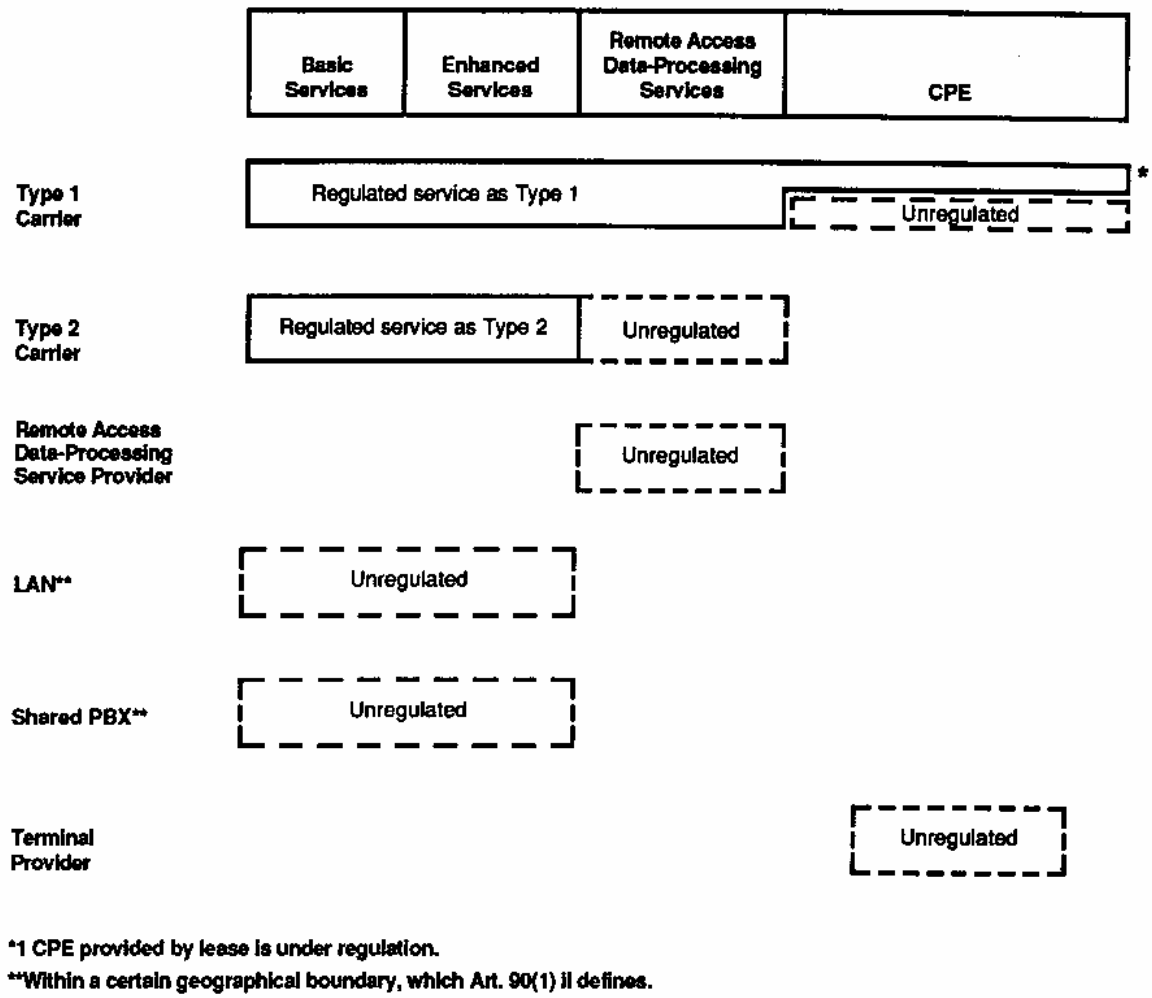
Type 1, Special Type 2, and General Type 2 businesses operate under different regulatory constraints. Type 1 are usually most strictly constrained and General Type 2 least constrained (see Figures 2-1.1 and 2-1.2).

	New Entrance	MPT's Consideration upon Filing	Obligation to Provide Service	Tariff Procedure	Foreign Capital	Facilities Requirements
Type 1	Permission from MPT	. Demand supply condition . Financial and technical capability	Within its service territory	Authorization from MPT	Less than 1/3	Defined as the requirement for Type 1 carrier
Special Type 2	Registration by MPT	. Financial and technical capability**	—	Notification of MPT	—	Defined as the requirement for Special Type 2 carrier
General Type 2	Notification of MPT	—	—	—	—	None (should fulfill terminal standards)
LAN/Shared PBX*	—	—	—	—	—	None (should fulfill terminal standards)

* Within a geographical boundary defined in Article 90(1)ii of TB Law.
**This constraint is substantially reduced as the result of U.S.-Japan MOSS negotiations.

Figure 2-1.1

Major Regulatory Characteristics under Telecommunications Business Law

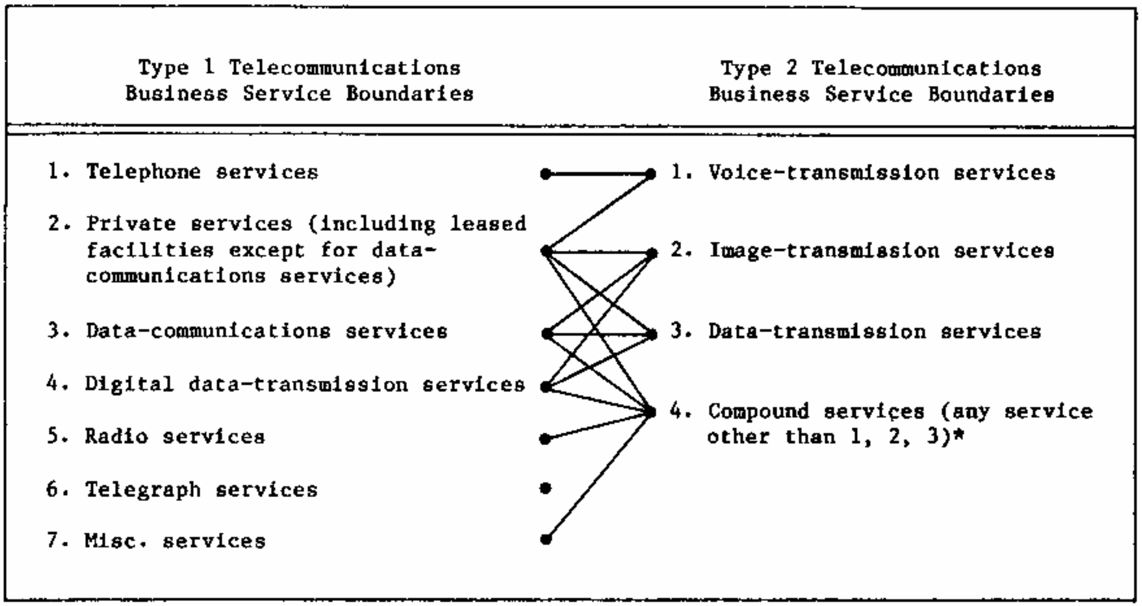


Adapted from: Japan. Fair Trade Commission. Atarashi-i Joho-Tsushin to Dokusen Kinshi Seisaku. Tokyo: Gyosei Co., 1985.

Figure 2-1.2

Regulation of Telecommunications and Related Business under TB Law

Categories of telecommunications services that may be offered by Type 1 and Type 2 business are to be defined by the MPT ordinance (Art. 9[2]ii and 22[1]ii). The various service categories of those providers are given in Figure 2-1.3. The obvious differences are definitional rather than substantive and, except for telegraph service (which is unprofitable and would not be offered without legal mandate), Type 1 and Type 2 businesses are granted nearly identical service ranges.



*The radio wave law (Japan) prohibits resale of radio services. Such resale is beyond the scope of the TB Law.

Figure 2-1.3

Service Categories and Their Relationships
for Type 1/Type 2 Carriers

Service territory of Type 1 Business. A Type 1 Business has to reveal its service territory as part of its application to MPT. However, there is no geographical constraint. This implies any Type 1 Business (except NTT) can define its service area regardless of scope, and provide either long-trunk or local transmission (Art. 9). Mitigating this relative liberty is MPT's power to decline Type 1 Business applications to control the supply of telecommunications facilities within designated areas (Art. 10).

Liberalization of terminal interconnection. The abolition of the Public Telecommunications Law, in which the "primary telephone principle" (see Appendix A) was institutionalized,[2] made possible the total liberalization of terminal interconnection (see Appendix A for a review of the terminal situation prior to privatization). To cope with the new situation, terminals are labeled as either terminal facilities (TF) or customer-provided telecommunications facilities (CPTF) under the TB Law.*

TF are telecommunications facilities which are to be connected to one end of telecommunications circuit facilities; any part of a single facility should be established on the same premises or within a range treated as if it shared the principal site (Art. 49).

CPTF refers to machines, apparatus, wires, cables, and other electronic facilities provided by other than Type 1 carriers (excluding TF). Private networks and Type 2 carrier facilities are generally considered to fall into the CPTF category (Art. 52). (The CPTF/TF dichotomy is often ambiguous; resultant problems are discussed in Chapter 4, section 2.) In short, the TF-vs.-CPTF demarcation is entirely configurational and is unlike any other terminal concept, such as NT-1 or NT-2 in the CCITT I Series Recommendation.

Type 1 carriers may not refuse interconnection of TF to their networks unless required technical standards are not satisfied (Art. 49[2]). Type 1 carriers may decline the request of CPTF interconnection with their network if required technical standards are not satisfied or if the MPT certifies that the interconnection would endanger the financial stability of the Type I carrier (Art. 52[2]).

<u>NTT Corporation Law (NTT Law)</u>

Under the new law, effective April 1985, Nippon Telegraph & Telephone Public Corporation (the former NTT) is privatized as an entity,

*Any CPE provider, including NTT, can provide both TF and CPTF.

not divested or broken up. The new, privatized corporation, Nippon Telegraph & Telephone Corporation (NTT), is allowed to provide long-distance, local, enhanced services, online data processing/switching services, and the TSS services (formerly provided by NTT) within a revised framework.

NTT is obligated to provide the nationwide telephone service that is indispensable to the individual consumer. (It is noteworthy that the word "telephone" appears without clear definition not only in this article of the NTT Law but also throughout the text of the NTT and the TB laws. The implications of this detail are examined in the following section.) The government will retain at least one-third of NTT stock (Art. 4[2]).

Any resolution for change in the articles of incorporation, disposal of profit, or merger and dissolution of the company requires authorization by the MPT (Art. 10). NTT must obtain MPT authorization to transfer or mortgage its telecommunications trunk lines or other important telecommunications facilities (Art. 13). These two restrictions may assume particular importance vis-a-vis the Type 1/Type 2 dichotomy as discussed in Chapter 4, section 1.

Although NTT is obligated to submit its annual business plan to the MPT for authorization before the start of the fiscal year (Art. 11), there is no other restriction on NTT's investment. This allows NTT to establish fully owned and jointly capitalized subsidiaries to provide enhanced services or software-related services, as well as operating enhanced-service-related divisions.

Concept and Heritage of Abolished Laws

The April 1985 legislation introduced such dramatically new and fundamental concepts as the Type 1/Type 2 distinction for carriers and potential local-loop competition, as well as trunk-transmission area competition and the TF/CPTF division of the terminal area with full liberalization of interconnection. Conversely, the new laws also carry a considerable legacy from abolished laws and ordinances, which has a considerable effect on the new regulatory framework.

The service repertoire that can be offered by any Type 1 Business is virtually identical to that of the former NTT, and appears to vary considerably from that of Type 2 businesses. However, Type 1 and Type 2 businesses can offer almost all telecommunications services. Conceivably the debate over relative ability to provide similar services could become pivotal for telecommunications issues in Japan. These categorizations are not useful bases for fairly assessing comparable aspects of identical services by Type 1 and Type 2 businesses. But under the current regulatory structure, these methods are treated as such bases for accounting separation and cost analysis.

NTT is required to offer nationwide "telephone" service (Art. 2, NTT Law), but "telephone" service is not defined. In the MPT ordinance, telephone is treated as a potential Type 1 Business service. It is unclear whether this definition is applicable to the universal service obligation in Article 2 of the NTT Law. So, the span of NTT's universal service remains vague.

The definitions of TF and CPTF and the exclusion of certain telecommunications business from the TB Law derive directly from the article of the Public Telecommunications Law covering the permissible area for terminal installation. Under strict monopolistic conditions, this broad definition was serviceable.[3] But transplanted into the new competitive framework, the definition is open to interpretation.

2-2: Passed-Over Characteristics

In the wake of a new legislative initiative, it is important to identify what is exempt, and what are the prerequisites for implementation of the procompetitive policy and privatization of NTT. The process of revising Japan's regulatory framework is one in which new and unique basic concepts depend on conventional details.

Telecommunications Rate Structure The traditional telephone rate structure in pre-privatization Japan can be characterized as including:

- Adoption of unitary-distance measure: As has every traditional monopolistic telephone-service operator, *de jure* or *de facto*, NTT adopted unitary-distance measure* for telephone transactions according to points of origination and of termination.
- Unit-time measuring: The fee for a particular long-distance call (and for a local call, as well) previously was measured by time units (which varied with distance) multiplied by a fixed fee per unit. For example, the fee for a three-and-a-half minute call within the 30 to 40 kilometers (km) range was calculated as:

  $$210(\text{sec}) \div 30(\text{sec}) = 7$$

  $$7(\text{unit}) \times 10(\text{fee per unit}) = 70(\text{yen})$$

  The fee for that call over the 160 to 320km range was 280 yen, since unit time is 7.5 sec. (see Figure 2-2.1 for unit time illustration).

*The tariff is defined solely by the distance between two points regardless of their location.

Distance	Unit Time (sec.)	Rate for 3 Min. ($U.S.)	Rate for 30 Min. ($U.S.)
Local	180.0	.05	.50
Neighboring Toll area to 20km	80.0	.15	1.15
20-30km	38.0	.25	2.40
30-40km	30.0	.30	3.00
40-60km	21.0	.45	4.30
60-80km	15.5	.60	5.85
80-100km	13.5	.70	6.70
100-160km	10.5	.90	8.65
160-320km	7.0	1.30	12.80
Over 320km	4.5	2.00	20.00

$1=200 yen

Data adapted from: NTT. Tariff for Telephone Service, Art. 36, 1984.

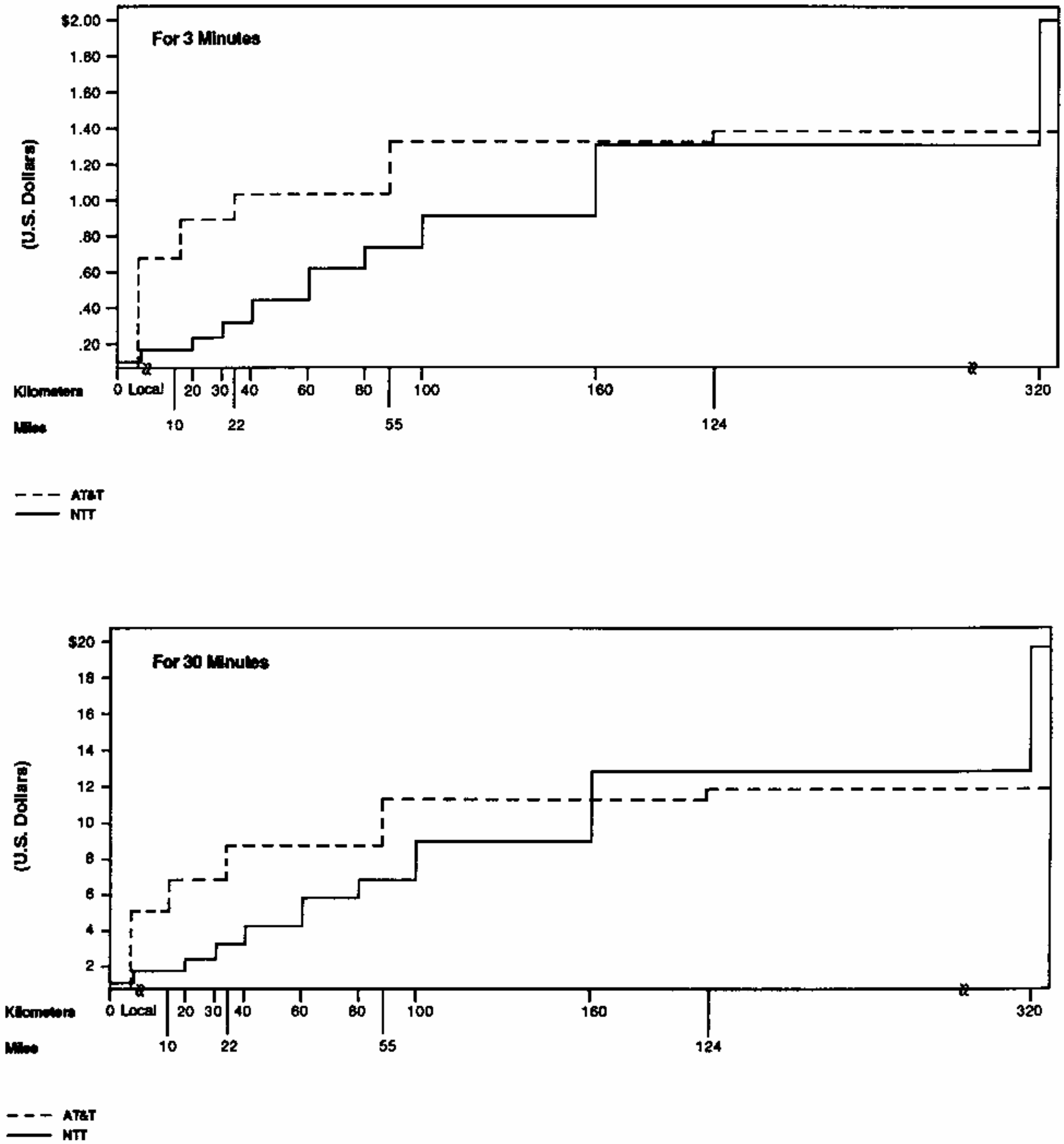
Figure 2-2.1

NTT's Public Switched Network Rate Structure

- Local measured service: Unlike many local telephone operators in the United States, NTT relied on measured local service for local telephone service. Calculation of local calls and long distance calls differed only for the unit time. In short, local calls were not given preferential treatment as is the case when fixed-rate service for local service is adopted (see Figure 2-2.1).
- Distance-sensitivity: Price differentials for local and long long-distance calls were typically severe in Japan. Time-per-unit for the range beyond 320km was 4.5 seconds,

while time-per-unit for a local call was 180 seconds; the rate difference was a factor of 40. Price differentials for local and short long-distance calls were relatively low. For example, the fee for a call to a neighboring toll area of up to 20km distance was only 2.25 times higher than local calls. (see Figure 2-2.1 and Figure 2-2.2 for the comparative telephone rate structures between the pre-divestiture AT&T and pre-privatization NTT).

So, considering the relatively low rate for short long-distance calls and the adoption of measured local service, the Japanese telephone rate structure was characterized by a high rate difference between long long-distance and short-haul calls (short long-distance and local calls) which was clearly different from the U.S. situation in pre-divestiture days.



Data for Japan adapted from: NTT. Tariff for Telephone Service, Art. 36, 1984. Data for U.S. adapted from: NARUC. Long Distance Message Toll Telephone Rates in Effect December 31, 1982.

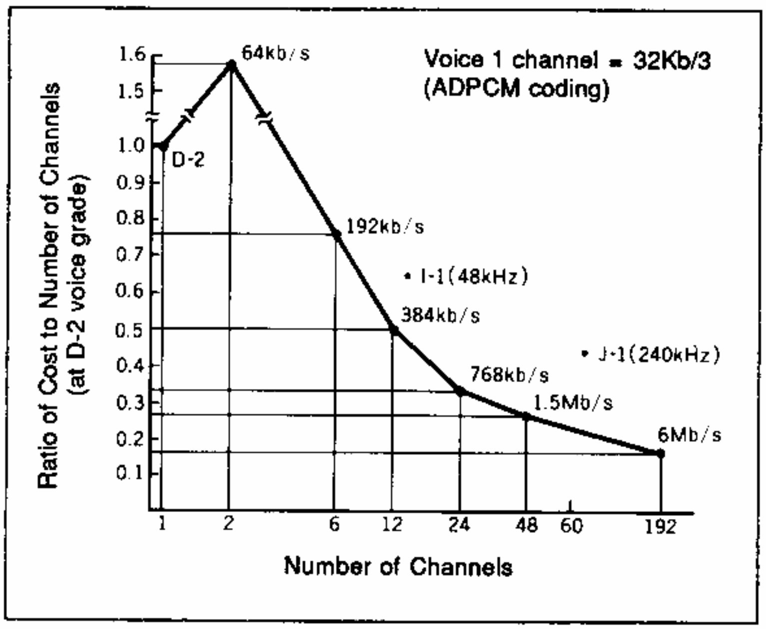
Figure 2-2.2

Comparison of 3- and 30-Minute Long Distance Telephone Rates between Pre-Divestiture AT&T (1982) and Pre-Privatization NTT (1984)

<u>Leased line</u>. Unitary-distance measure (unitary tariff) was also adopted for leased-line services. Price differentials among leased-line services were somewhat complicated. Rates for the voice-class leased-line service by distance were roughly proportional up to 360km (rate differences were slightly less severe than those for public telephone). But there were several more rate steps in the leased-line services, and the rate differential between the shortest distance (within a same end-office domain) and the longest distance over 2500km of voice-class leased-line service was roughly a factor of 86. Since distance steps are not identical between leased-line services and public telephone service, it is difficult to calculate equivalent usage time. However, the rates for voice-class leased line were roughly the equivalent of 70 to 130 minutes per day usage of public telephone network over the same distance.

The rate differential for wideband leased-line services (48kh, 240kh for analog services; 64Kbit-6.3Mbit for digital services) were moderate; the difference for the shortest distance (less than 15km) and longest distance (over 2500km) was a factor of 20 to 25. Even with moderate distance sensitivity, NTT was criticized by large users; long-distance leased rates for these sevices were disproportionately high as was the controversial voice-class leased-line-service rate. However, the contention is over the coexistence of high-priced long-distance service and low-rate short-distance service (especially last-mileage distance) that results from the rough proportionality to the public switched telephone rate structure.

Before privatization, leased-line services offered bulk discounts on wideband services. As shown in Figure 2-2.3, a major user could receive large bulk discounts by leasing wideband, leased-line services, purchasing a multiplexer and connecting its CPE directly or via voice-class leased lines for the last mileage connection. With bulk discounts and low last-mileage cost of voice-class leased-line service ($35 per line, per month within a same-end office domain; $50 within the 10km range), large users were inclined to develop a private network -- that could be called "service bypass" in the United States -- even in pre-privatization days when "leaky operation" for voice usage was strictly prohibited.[4] ("Leaky operation" refers to connection, via CPE, of leased lines and the public switched telephone network.)



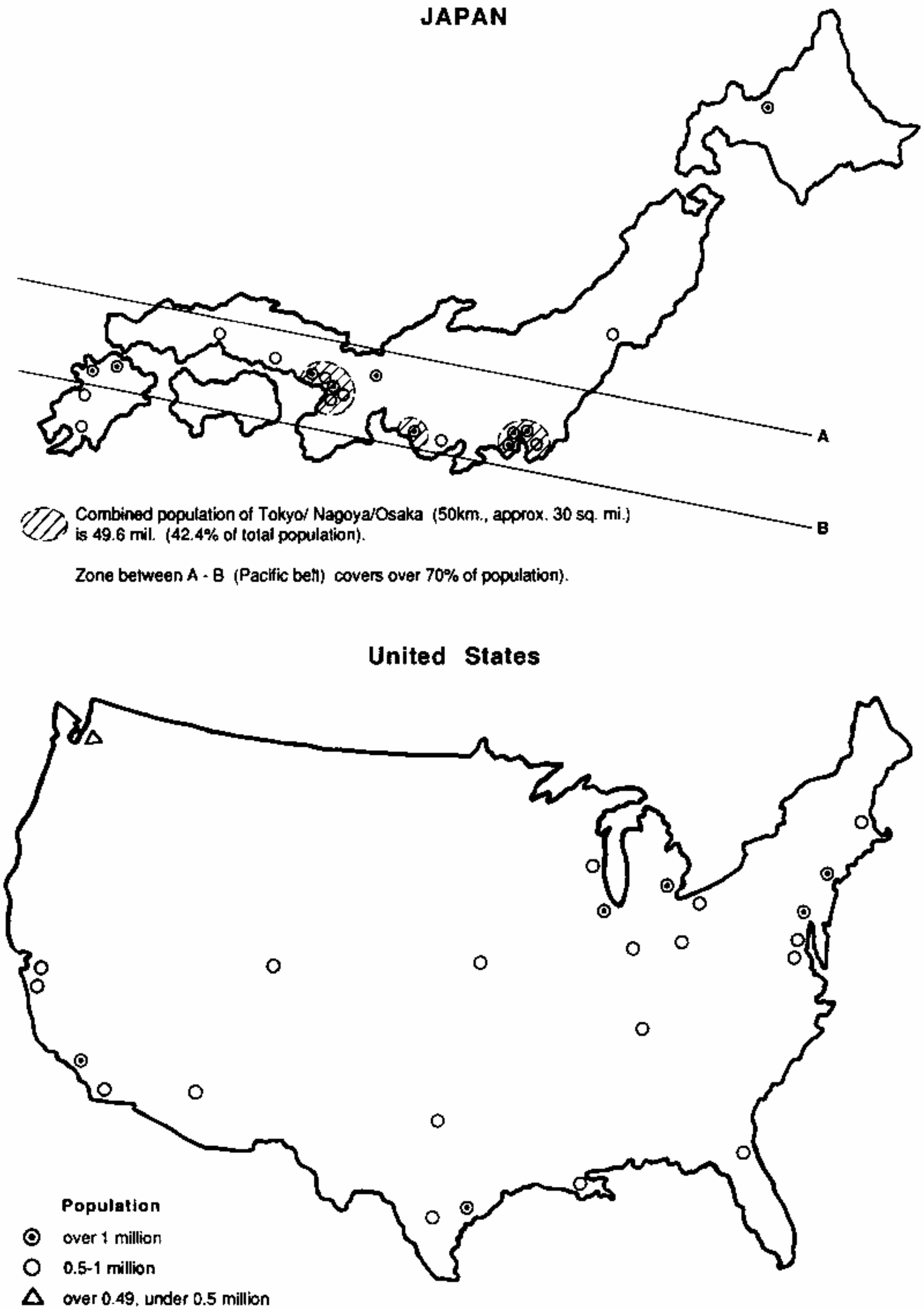
Source: Onodera, Norio. "Kosoku Digital Denso Service o mochiita Kigyonai Network no Kochikuho" (Building up intra-corporation networks utilizing high-speed digital transmission services), Business Communication. Tokyo. Vol. 22, No. 6, June 1985, p. 51, Figure 1. Adapted with permission.

Figure 2-2.3

Bulk Discount of Leased Service Offered by NTT

Traffic Characteristics in a Competitive Market

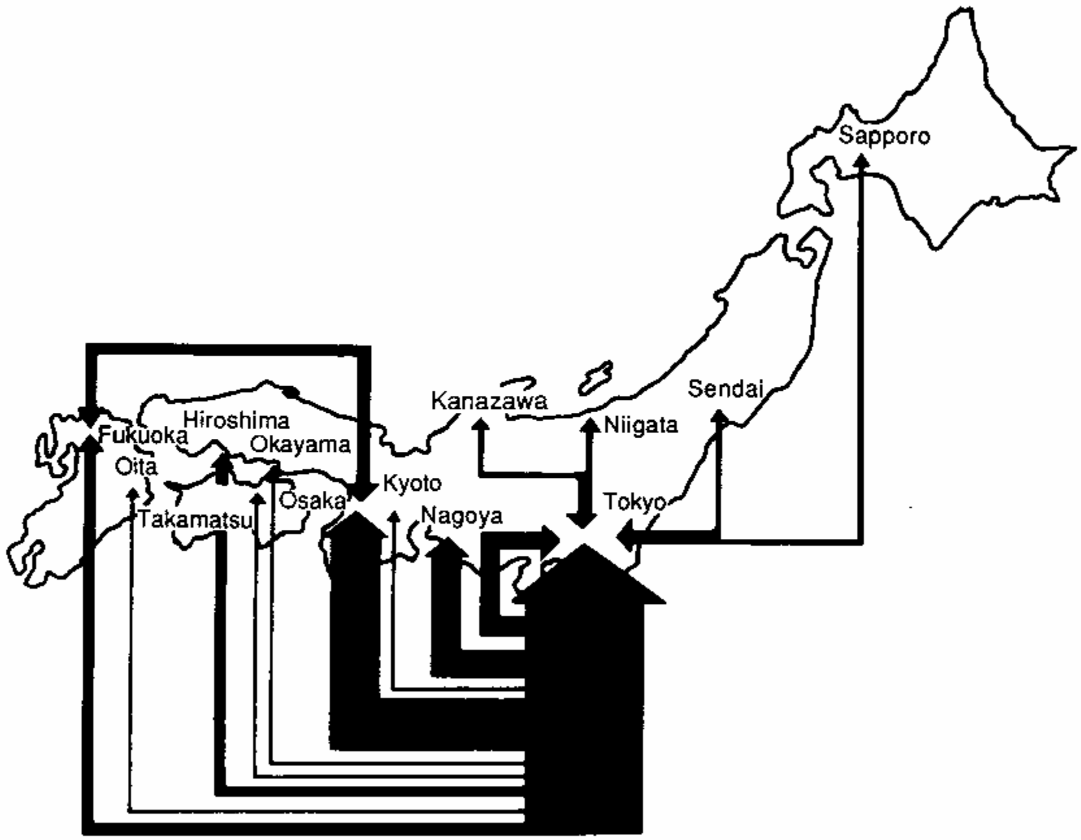
As of March 1986, no detailed traffic-data report had been issued by NTT on public switched telephone network service; income from this service represents approximately 90% of total income.[5] Map illustrations of cities with populations over 500,000 in Japan and the United States (Figure 2-2.4) and traffic data for digital data-exchange packet service (DDX packet; see Figure 2-2.5) indicate that Japan's population (the basis for projections of both business and residential use) and business activities are concentrated in the Pacific Coast area (Tokaido Megalopolis) and especially in Tokyo and its surburbs. This concentration implies that hidden cross-subsidization from the urban areas to rural areas would be enormous. Thus, geographically limited participation in telecommunications business, Type 1 or Type 2, between urban areas, and especially involving Tokaido Megalopolis, is extremely attractive. Even participation in local services in the full-scale range would be attractive in some urban areas (again, especially in Tokyo), as long as NTT maintains unitary tariff. Voice resale via leaky PBX could pose a serious threat to geographically limited participation, considering the current rate structure, which explains why the noncompulsory resolution accepting NTT tariffs to prohibit simple resale (see Appendix B for details) was attached to the TB Law.



Data from 1980 Census, Japan; and 1982 Census, U.S.

Figure 2-2.4

Location of Cities with Populations over 0.5 Million



Data from July 1985 sampling survey: Ushioda, Kunio. "Service no Riyoho" (How to use the services), Business Communication. Tokyo. Vol. 22, No. 11, November 1985, p. 61, Figure 7. Adapted with permission.

Figure 2-2.5

Inter-City Digital Data Exchange Network Packet Traffic (Sampling)

Rate Structure Unchanged

Despite controversy and the apparent effect of competition, NTT's rate structure was not changed during privatization and was effective as of March 1986. On the eve of privatization, a permanent consultative body for the MPT, the Telecommunications Council, issued a report which made the following recommendations:[6]

- The new NTT Tariff, effective 1 April 1985, should utilize the existing tariff rate structure.

- Unitary tariff and current rate of local calls should be maintained at least until other Type 1 carriers begin operations.
- Even after the entry of other Type 1 carriers, abolition of NTT's unitary tariff should be treated with extreme caution.
- Other Type 1 carriers may rely on access to NTT's network in order to reach customers. What is to be done if there emerges a deficit in NTT's existing local-loop services? The issue, whether the connection fee should include the recovery cost of such a deficit or not, should be analyzed with a clear notion of local and long-distance costs and detailed traffic data as the prerequisite for review.

This "access charge issue" also involves connection fees for leased lines but not customer-access charges. (To avoid confusion with the U.S. issue, the phrase "connection fee" will be used here).

Pre-Privatization NTT versus Pre-Divestiture AT&T

Pre-privatization NTT's active domains differed considerably from those of the former AT&T, not to mention NTT's *de jure* monopolistic status in carrier services. NTT operated as a single entity whose primary offering was long-line, local-loop services. NTT did not have a dominant marketing power in CPE for business use, despite its *de jure* monopoly in primary phones. In the field of CPE service for the large firms, NTT maintained a minimal market presence, offering CENTREX service; NTT did not traditionally offer large PABX or multiplexing equipment (see Appendix A).

NTT offered services which could be categorized as enhanced services in the U.S. regulatory framework with some restrictions, *de jure* and self-imposed. Except for digital packet-switching service and interbank services, NTT's status was far from dominant (see Appendix A).

Although NTT maintained R&D institutes comparable to the Bell Laboratories, NTT did not manufacture. NTT acquired switchboards, transmission facilities, computers, CPE for rental service, and other telecommunications equipment through an external procurement procedure, guided by specifications developed by its R&D body.

NTT's carrier services were strictly domestic and international carrier services were offered solely by Kokusai Denshin Denwa Co. (KDD). Excluding the CPE offering condition (sale of CPE is now "business activities incidental thereto,"[7] along with long-practiced CPE rental, which is regarded as a part of domestic telecommunications business) and limited liberty in investment, pre-privatization NTT business activities were passed to the new NTT, notwithstanding the recommendations of the Provisional Commission for Administrative Reform (PCAR) which advocated separation of the CPE and the Data Communication Division and divestiture of NTT (see Appendix B for the history of the movement that yielded the new regulatory framework).

Enduring Characteristics

The 1985 reform is literally creating a competitive marketplace. This "leap-frog" procedure (with the law's attempting to leap ahead of existing circumstances) is very different from the evolutionary effort in the United States.[8] Forecasting the impact of the regulatory framework with no salient data from competing companies is of limited usefulness. For example, connections-fee issues stirred controversy as the OCCs approached their deadlines for entering the market, some as early as the fall of 1986. As for leased lines, NTT and the OCCs agreed to interconnect without any connection fee. However, connection-fee issues for public telephone networks are yet to be settled as of February 1987.

The procedural details of the reform were developed in less than two years. Obviously, this left insufficient time for fine-tuning detailed traffic data for rate-structure revision and for other analysis.

It is important to bear in mind that the telecommunications reforms are among the frontrunners of the Administration Reform Movement (ARM). More controversial reform issues, such as the privatization and divestiture of deficit-driven Japan National Railway, are posed behind this vanguard, which explains the widespread effort to ensure that the telecommunications reforms take effect and succeed. To facilitate passage of the new regulatory framework in Diet, many sensitive issues were relegated to future debate. Two major untouched issues as of March 1986 were rate revision, which could raise objections from residential customers -- voters -- especially those watching the progress of the "customer access line charge" issue in the United States; and divestiture and separation, which could incur strong opposition from the NTT labor union and likely from the Japan Socialist Party, as well as some opposition from NTT itself.

Notes for Chapter 2

2-1 The accurate reviews of regulatory reform, such as Masanao Tanase's, require updating and expansion. See Tanase, Masanao. Integrated Services Digital Networks (ISDN): Concepts and Issues in the U.S. and Japan. Behind the Telephone Debates - 5. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., 1985.

2-2 Japan. Public Telecommunications Law, Chapter 7, Article 105. (Abolished).

2-3 Ibid., Chapter 3, Article 28(3).

2-4 Nippon Telegraph & Telephone (NTT). Tariff for Telephone Service, Article 36, 1984. (Abolished).

2-5 Japan. Ministry of Finance. Tsushin-Hakusho (Communications White-Book), ed. by Ministry of Posts and Telecommunications, Dec. 1983, p. 148.

2-6 Japan. Fair Trade Commission, Economics Division. Atarashi-i Joho-Tsushin to Dokusen Kinshi Seisaku (New information-communications and antitrust policy). Tokyo: Gyosei Co., 1985, pp. 131-134.

2-7 Japan. Nippon Denshin Denwa Kabushiki Kaisha Law, (Nippon Telegraph & Telephone Corporation Law), Article 1.

2-8 Hayashi, Koichiro. Infomyunikeishyon no jidai (Age of Informunication [Information & Communication]). Tokyo: Chuou-Koron Sha, 1984, p. 185.

3

DEVELOPING WORKING FRAMEWORKS

3-1: Redefining Telecommunications Terminology

Such terms as "network," "terminal," and "local loop" have been conventions of telecommunications description, but their meanings have become rather arbitrary. As was noted in The Economist in late 1985, "The network is more complicated than it used to be, with private versions springing up everywhere that co-exist with or use the facilities of the public switched network."[1] In the case of "terminal" and "CPE" the confusion is even greater: An enormously wide range of equipment is bundled into one group -- from mainframe computers and large-capacity digital PABX at the center of private networks utilizing leased or private lines as well as public switched lines, to rotary-dial residential telephones. Changing circumstances affect assumptions about the fundamental concepts of "equipment" and "services."

Thus the definitions in Table A, tailored for the purposes of this review of telecommunications, attempt to restore a one-to-one correspondence between term and content. The effects, current or historical, of the regulatory framework in any one country are de-emphasized intentionally, although the definitions inevitably reflect state-of-the art technology. Such historical distinctions as private/public and network/terminal are preserved to avoid unnecessary confusion.

Table A

Some Telecommunications Definitions

NETWORK: Complex of access nodes and interconnecting conduits.

PHYSICAL NETWORK/VIRTUAL NETWORK/HYBRID NETWORK: A physical network is composed of access nodes and operator-provided conduits. A virtual network is one with conduits leased from a third party (typically from the physical-network operators). A hybrid network is one in which conduits are partially leased and partially owned.

PUBLIC PHYSICAL NETWORK: Physical telecommunications network dedicated to third-party use. A public physical network is composed of two substructures: public switched network and leased circuit. (Conceptual block diagrams of a public physical network and its correspondence to a conventional telephone network are shown in Figures 3-1.1 and 3-1.2, respectively.)

Public Switched Physical Network: Public physical network developed to interconnect subscribers' access points (typically two points, in real time) according to specific protocols. The conventional telephone network is a public switched network, and digital-packet networks and facsimile networks in some countries developed as this kind of network. Public switched networks are usually composed of five substructures: local conduit, local gate node, local long-haul conduit, long-haul gate node, and long-haul trunk complex. However, recently developed networks do not involve certain of these substructures, or else show integrated substructures.

- Local Conduit: Conduit that connects customer's access point and local gate node. Conventional local loop and cellular waves are examples of local conduits.
- Local Gate Node: A facility that has the capability to connect customers' access points that are directly linked to this facility. Can also connect a customer's access point and a proper long-haul gate node to another local gate node to make a required connection to another customer's access point that is linked to another local gate node. A telephone company's local office is one example.
- Local Long-Haul Conduit: Conduit that connects local gate nodes and long-haul gate nodes.
- Long-Haul Gate Node: A facility that connects local gate nodes via a long-haul trunk complex or directly places the required transaction to customer's intended access point.
- Long-Haul Trunk Complex: Complex of long-distance transmission facilities (and switching nodes) that interconnect long-haul gate nodes. In a conventional telephone network, the long-haul trunk complex is a tree-like structure with numerous switching nodes.

Table A

(continued)

- Long-Haul Switching Complex: Long-haul gate node and long-haul trunk complex can be bundled and referred to as "long-haul switching complex."

Leased Circuit: A circuit provided by public physical network operators to connect two customers' access points in a fixed base, though the demarcation line between two substructures is not clear.

- Local Line: Counterpart to local conduit.

- Leased Trunk: Counterpart to local long-haul conduit and long-haul trunk complex.

PUBLIC VIRTUAL NETWORK: Virtual telecommunications network dedicated to third-party use. It is made up of tandem switching equipment and leased circuits and/or other public switched networks. Public virtual network could further be dissected into public switched virtual network and public leased virtual circuit (i.e., leased line resale).

PUBLIC HYBRID NETWORK: Partly virtual and partly physical public network that could be further dissected into public switched hybrid network and public leased hybrid circuit.

PRIVATE NETWORK: Network dedicated to the use of the contracting individual or group. (Group use is best distinguished by the term "quasi-public private network.") The network may comprise privately owned switching nodes and circuits and/or private virtual conduits.

Privately Owned Conduit: Transmission trunk facility owned privately.

Private Virtual Conduit: Leased circuit used in a private network.

TERMINAL: Telecommunications equipment at customer access points to public network. Terminals are categorized by capacity, as follows:

Transmitter-Receiver: A terminal that works as transmitting and receiving device for telecommunications; e.g., conventional telephones, simple facsimile terminals, automated teller machines (ATM).

Distributor: A terminal capable of switching telecommunications transactions between transmitter-receivers directly connected to it and among the transmitter-receivers and a public network.

Tandem Switching Equipment: A terminal that has the capacity to switch telecommunications transactions among public switched networks, a public switched network and leased circuit, and between leased circuits.

Table A

(continued)

CALLING INFORMATION: A set of codes that enables and ensures the connection of a given telecommunications transaction to the desired destination.

Physical Calling Information: Calling information treated as part of the connection procedures by public physical switched networks.

Virtual Calling Information: Calling information treated as part of a telecommunications transaction by public physical switched networks.

Private Calling Information: Calling information used in a private network.

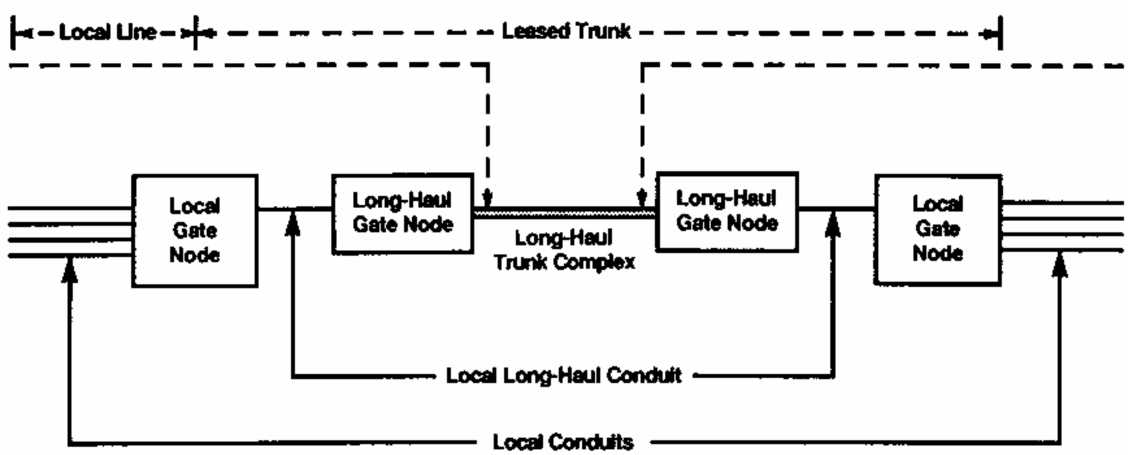
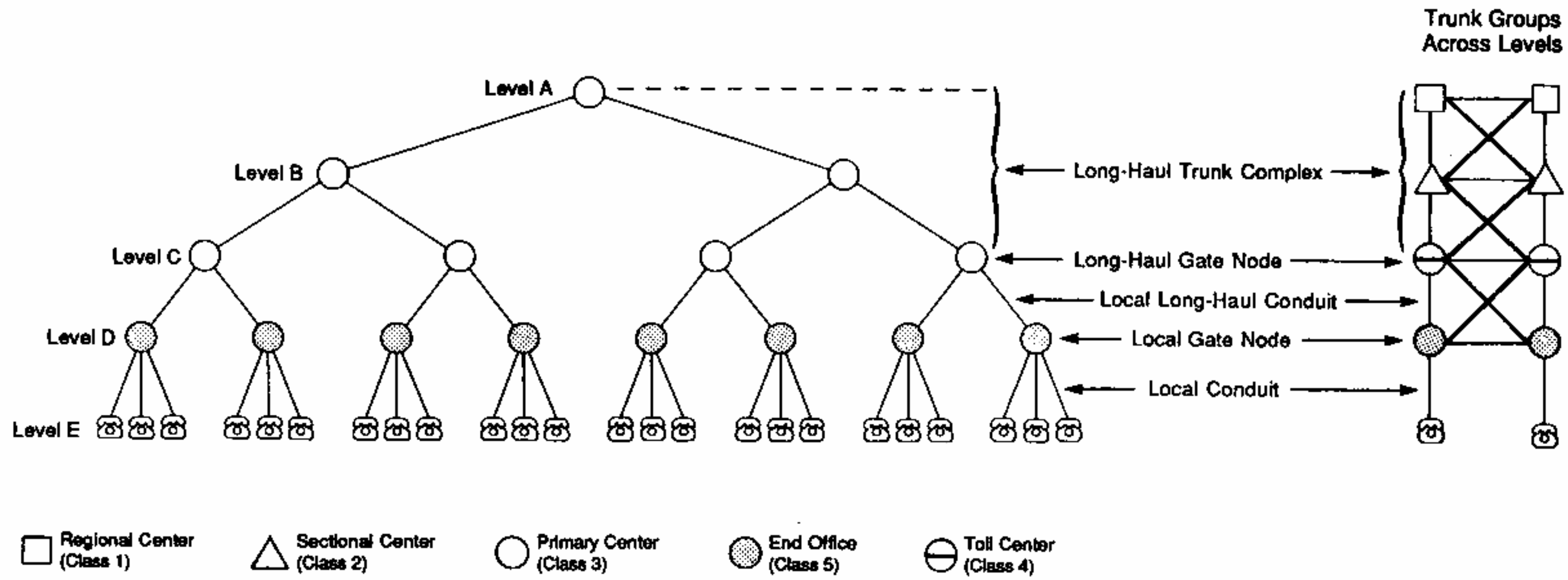


Figure 3-1.1

Public Physical Network



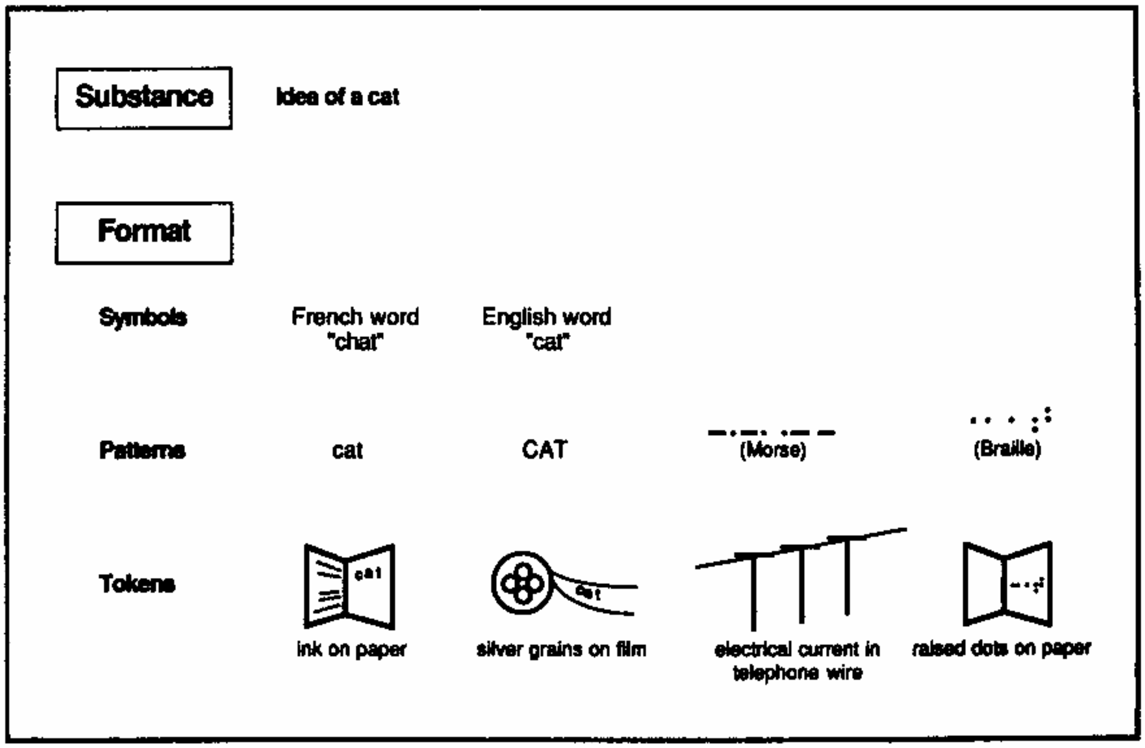
Adapted from: C. Weinhaus and A. G. Oettinger. Behind the Telephone Debates -1. At the Heart of the Debates: Costs, Control, and Ownership of the Existing Network. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., 1985, Figures 17 and 28C.

Figure 3-1.2

Relationship to the Conventional Telephone Network

3-2: The Substance-Format-Process Concept

Studies have suggested considering any information service as a bundle composed of substance, process, and format; furthermore, format can be seen as a hierarchy of symbols, patterns, and tokens.[2] (See Figure 3-2.1.)



Source: Oettinger, Anthony G. "The Information Evolution: Building Blocks and Bursting Bundles," The Compunications Age: Its Mainsprings and their Evolution. Cambridge, Ma: Program on Information Resources Policy, Harvard Univ., May 1984, Draft, Figure 2, p. 15.

Figure 3-2.1

Relationship between Substance, Symbol, Pattern, and Token, Using "Idea of a Cat" as an Example

Throughout this paper, the substance-format-process concept is wedded to the configurational concept introduced in the previous section. However, one specific clarification must be made in considering telecommunications issues: Like the format concept, process is a dual concept. Handling and connection, the two aspects of process, are defined in Table B.

Table B

Handling and Connection Definitions

HANDLING: Nature of format processing after information is received from transmitters until information is delivered to receivers.

Transparent: A receiver receives the same tokens as were transmitted. The idea of transparency holds, even if the received tokens and the patterns recovered by decoding tokens are somewhat different from the original ones, provided such distortions are caused by random jitters and errors.

Transformed: A receiver receives tokens different from those transmitted, regardless of the similarities among patterns and symbols.

CONNECTION: Nature of delivery process at the point of communication between transmitter and receiver.

Real Time: The connection by which a transmitter and a receiver concurrently pass and receive information via telecommunications conduits.

Store-Forward: The connection by which a transmitter passes information to a certain node for storage; this node passes the stored information to a receiver via telecommunications conduits. To explain conventional frames of reference, this subcategory is further divided into store-forward for transmission purposes (store-forward T) and store-forward for storage or mail-box purposes (store-forward S).

Offline: The connection of transmitter and receiver via nontelecommunications means such as magnetic tape, laser disk, and paper.

3-3: Network Complexity

The network complexity that developed during the last two decades in the United States was driven by technological evolution, user demand, and procompetitive policy. This development has had three principal phases: evolution of virtual and hybrid networks; introduction of alternative long-haul switching complex; and annulment of local gate node bottlenecks.

Evolution of virtual and hybrid networks. According to Oettinger, "by the 1970s the idea of distributed computing had become widespread. Many mainframes are linked to one another . . . . Many more parties are involved than just the computer owners and the communications public utilities. Some are hybrids like Tymshare."[3] With public switched networks, leased circuits, and privately owned conduits, computers began to be linked to each other. New networks -- virtual and hybrid, private and public, dedicated between computers -- gradually emerged. As these networks continued to grow, computers in some of them began to be used as counterparts of local gate nodes and long-haul gate nodes of the traditional telephone network except that their characteristic connection was "store-forward."

Parallel developments in voice communications were wrought in different chronological order. Resellers of message telecommunications service (MTS) and wide-area telecommunications service (WATS), as well as early stage OCCs, are virtual public network service providers, or hydrid public networks for OCCs. So-called service bypass and total bypass are the efforts to set up private networks connecting self-provided distributors and tandem switching equipment. Their handling and connection characteristics are not necessarily restricted to the transparent real-time domain, since they are unregulated. Their characteristics may differ, but regardless of the complexity of the network proper, their switching nodes (PABX or computers connected to the traditional public networks) were treated as terminals; calling information from an access point to the switching nodes via public switched networks was therefore treated as virtual calling information.

Introduction of alternative long-haul switching complex. Equal access made the alternative long-haul switching complex possible. In other words, OCCs' networks formerly bundled outside the public switched network shifted their configurational location to within the public switched network (see Figures 3-3.1 and 3-3.2). Local gate nodes, however, caused a bottleneck at this stage of development in terms of available bandwidth and variety of services.

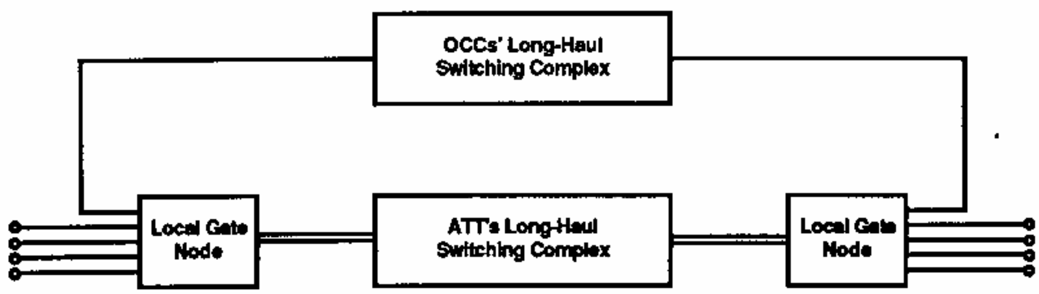


Figure 3-3.1

Initial Network Connection of OCCs

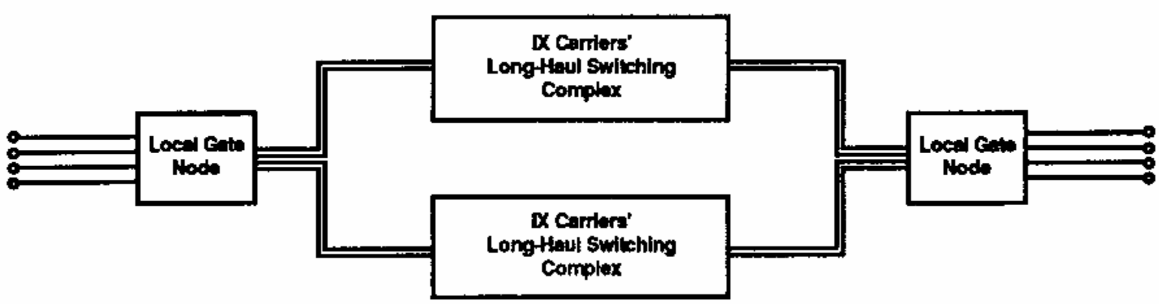
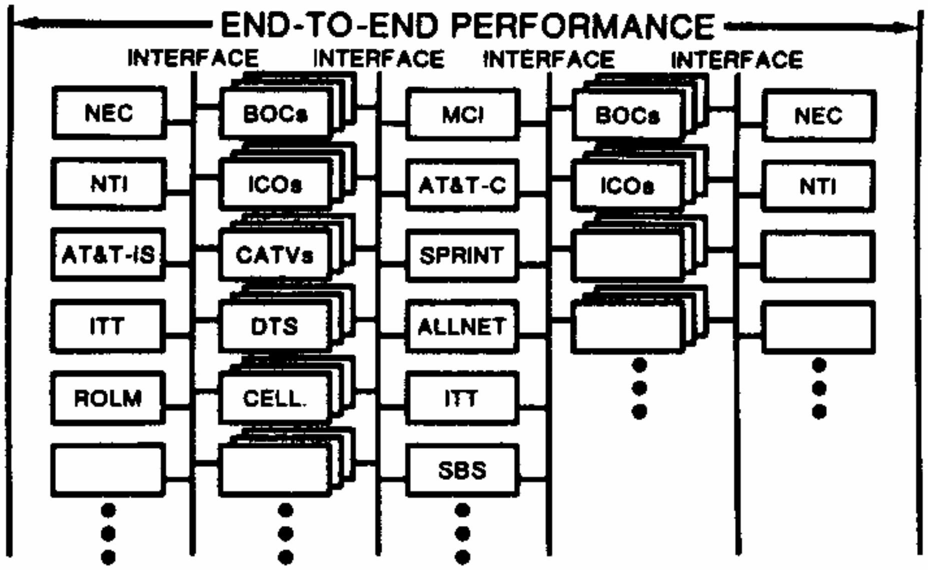


Figure 3-3.2

Interexchange Carriers' Network Connection
after Equal Access

Annulment of local gate node bottleneck. Finally, alternative local gate nodes (such as cellular phone service), direct connection to long-haul gate nodes (facility bypass), and customer-provided local gate nodes (shared PABX) seem to be easing the bottleneck at local gate nodes.

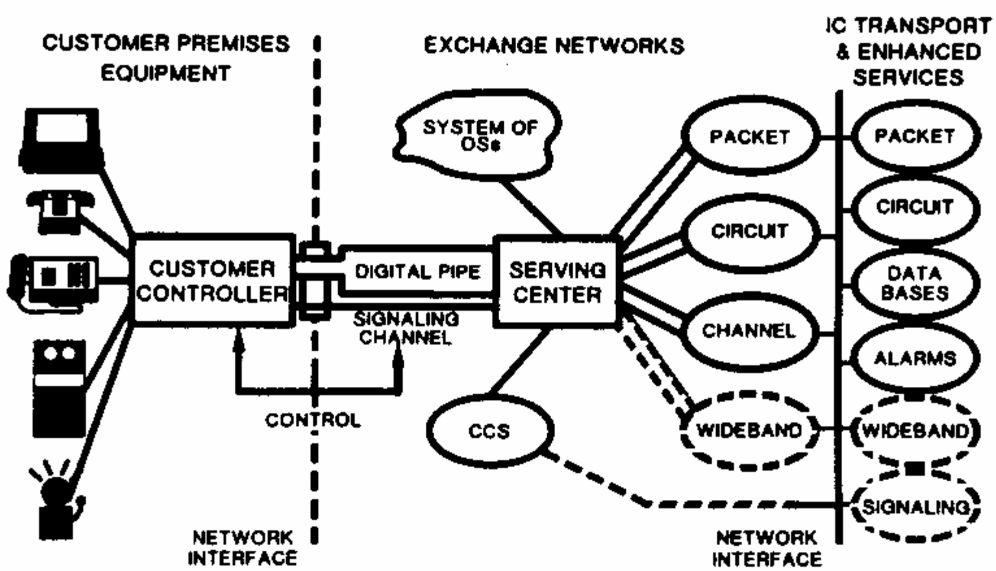
The nature of network complexity from the point of view of conventional public switched network service providers is illustrated in Figures 3-3.3 and 3-3.4.[4] As long as these carriers dominate, virtual networks (both private and public) remain marginal, and the physical public switched network carriers monopolize physical calling information, the assumption about the hierarchical architecture of telecommunications expressed in the figures (though disguised as a center-periphery relationship) is convincing. However, conventional demarcation is increasingly obscured; consider the network-terminal distinction's fate in terms of bypass and shared PABX. With the current trend toward digitization, those conditions that validated existing concepts -- displayed in Figures 3-3.3 and 3-3.4, which could be labeled "telecommunications entity as the grid" -- could become obsolete.



Source: Dorros, Irwin, "The ISDN Challenge in the United States," NTT International Symposium 85, Tokyo, 1985. Reprinted by permission.

Figure 3-3.3

Required Industry Standards



Source: Dorros, Irwin (see Figure 3-3.3). Reprinted by permission.

Figure 3-3.4

ISDN Architecture

Notes for Chapter 3

3-1 "The World on the Line," The Economist, November 23, 1985, Telecommunications Survey, p. 7.

3-2 Oettinger, Anthony G. "The Information Evolution: Building Blocks and Bursting Bundles," The Compunications Age: Its Mainsprings and their Evolution. Cambridge, Ma: Program on Information Resources Policy, Harvard Univ., May 1984, (Research Draft).

See also note I-1.

3-3 Oettinger, Anthony G. "The Abundant and Versatile Digital Way," The Compunications Age: Its Mainsprings and their Evolution. Cambridge, Ma: Program on Information Resources Policy, Harvard Univ., 1985 (Research Draft), p. 4.

3-4 Dorros, Irwin, "The ISDN Challenge in the United States," NTT International Symposium 85, Tokyo, May 20-21, 1985, Section 20, pp. 8-10.

4

CURRENT FRAMEWORKS: UNITED STATES, JAPAN, AND CCITT INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

4-1: Network Services

United States

The apparent clarity of the basic/enhanced distinction, common in Computer Inquiry II in the U.S., requires re-examination. Table C delineates two definitions as a starting point.

Table C

Basic/Enhanced Distinction

BASIC: Common-carrier offering of transmission capacity for the movement of information.[1]
ENHANCED: Any offering over the telecommunications network which is more than a basic transmission service. Computer-processing applications are used to act on the content, code, protocol, and other aspects of the subscriber's information.[2] Moreover, in an enhanced service the content of information need not be changed and may simply involve subscriber interaction with stored information.

Figure 4-1.1 illustrates this distinction in terms of service handling and connection. The offering of store and forward service (store-forward S) should not be confused with the use of store and forward technology in routing messages through the network as part of a basic service (store-forward T).[3] Thus, the fundamental framework for the basic/enhanced dichotomy may appear straightforward, but the implications of such a framework merit further consideration.

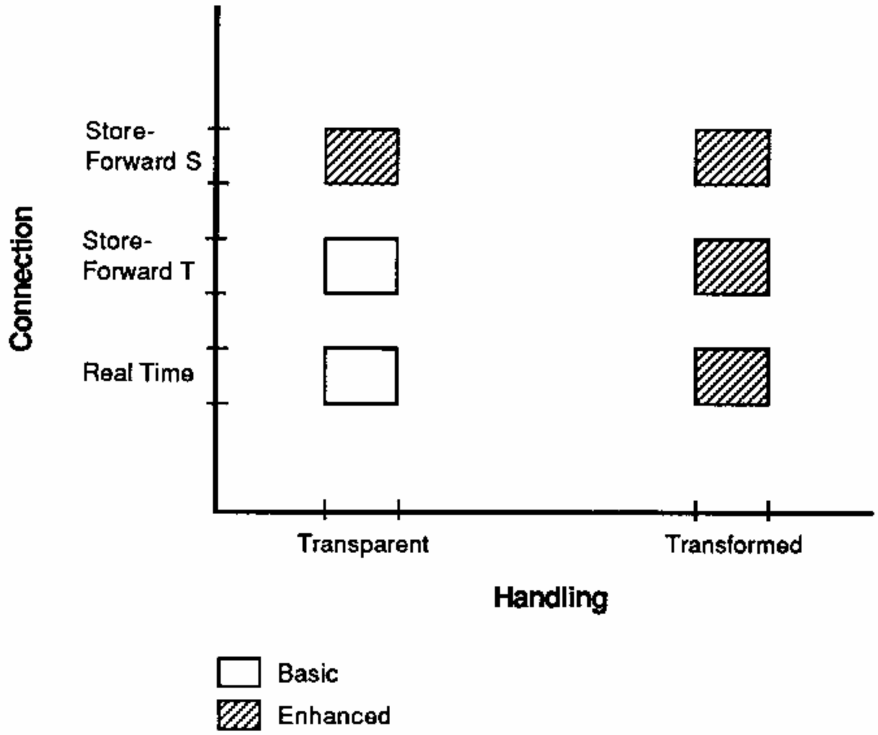


Figure 4-1.1

Basic/Enhanced Dichotomy Shown on Handling-Connection Plane

As noted in the proposed rulemaking of Computer Inquiry III, the definition of "enhanced service" is ambiguous.[4] The objective of Computer Inquiry II was

> to (a) foster a regulatory environment conducive to the stimulation of economic activity in the regulated communications sector with respect to the provision of new and innovative communications-related offerings; and, (b) enable the communications user to optimize his use of common-carrier communications facilities and services by taking advantage of the ever increasing market applications for computer-processing technology.[5]

In short, the objective was "to establish a durable dichotomy between regulated and unregulated activities, to facilitate planning and decisions by the public and by industry."[6] It is understood that, should underlying conditions change (technological development, shifts in marketing power, or other causes) or the intended result prove unobtainable, the frame of reference would be reconsidered. In fact, despite Computer Inquiry III's new outlook, its conceptual framework may still need to accommodate dramatic developments.

Computer Inquiry II recognized the role of enhanced processing-applications in voice communications and indicated voice storage and automatic call answering as examples of voice-enhanced services. But typical "traditional telephone service consisting of real-time, human-to-human oral conversation" was clearly regarded as a basic service.[7] Optional "computer-processing applications such as call forwarding, speed calling, directory assistance, itemized billing, traffic-management studies, voice encription, etc.," may be used in conjunction with voice service so long as those optional services do not change the nature of traditional telephone service.[8] Figure 4-1.1 is modified to include the voice/non-voice dimension in Figure 4-1.2 (although the final decision of Computer Inquiry II did not specify the voice/non-voice demarcation).

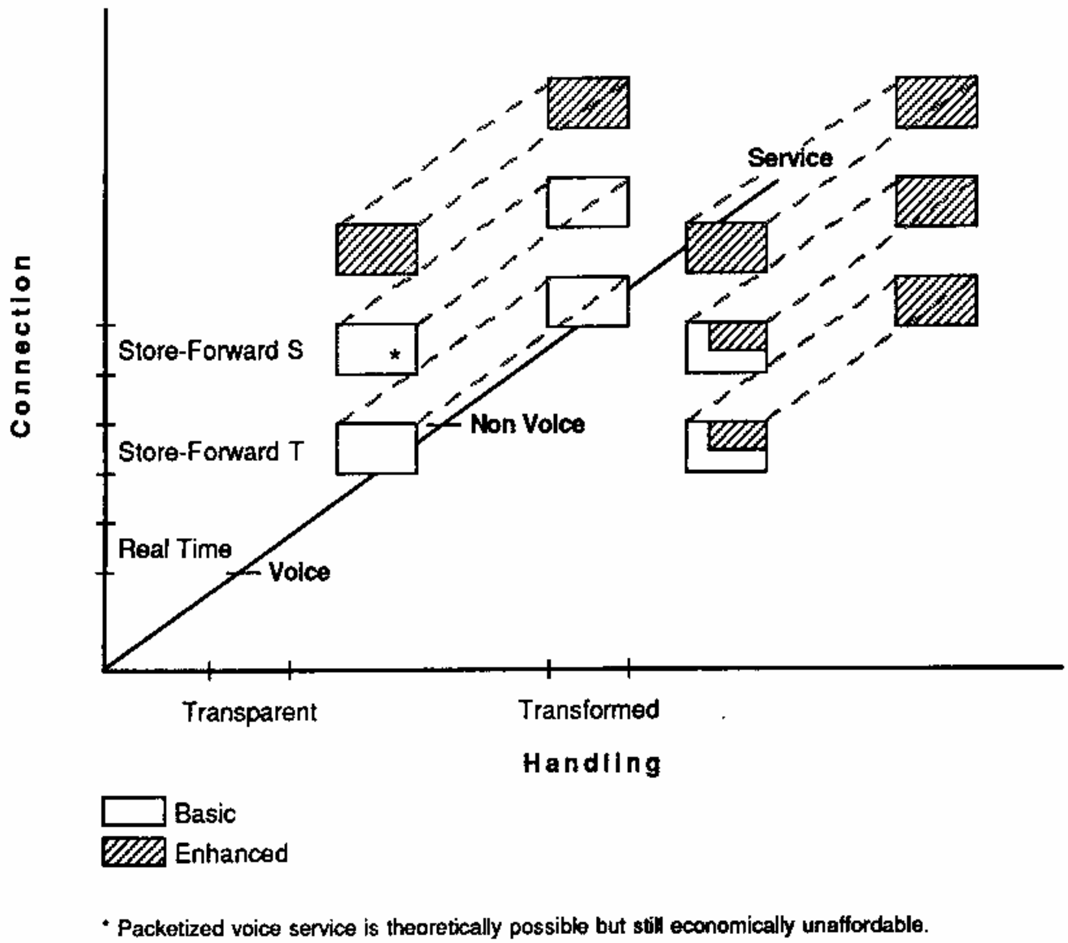


Figure 4-1.2

Basic/Enhanced Dichotomy Shown on Handling-Connection Plane with Voice-Nonvoice Distinction as the Third Axis

With analog interfaces acting as a bottleneck between public networks and terminals, there is only one plausible way to transmit and communicate voice information via a twisted pair-cable, regardless of the degree of digitization within the network's black box. But digitization of local conduits and advances in digital voice-coding technology open the system to the range of possibilities -- and problems -- already experienced in computer communications. Different protocols and bandwidths would become available at the customer-access level and within the network level, requiring, in turn, coordination among different protocols and speeds. Thus the concept of traditional telephone service (i.e., two-way voice transmission under a universal protocol) would be shaken at its foundations. Those perspectives were beyond the scope of Computer Inquiry II and seem to still be in limbo, even after the Computer Inquiry III decision.

CCITT ISDN Model

The CCITT ISDN service definition, according to the series of recommendations adopted at the Malaga-Torremolinos meeting in 1984, incorporates two fundamental service categories, outlined in Table D and illustrated in Figure 4-1.3.[9] But especially in the arena of voice communications, the demarcation line is again blurred.

Table D

Service Category Definitions

BEARER SERVICE: Telecommunications service that provides the capability for transmission of signals between user-network interfaces.[10]
TELESERVICE: Telecommunications service that provides the complete capability, including terminal equipment functions, for communication between users according to protocols established by agreement between administrations and/or recognized private operating agencies (RPOAs).[11] (See Figure 4-1.3.)

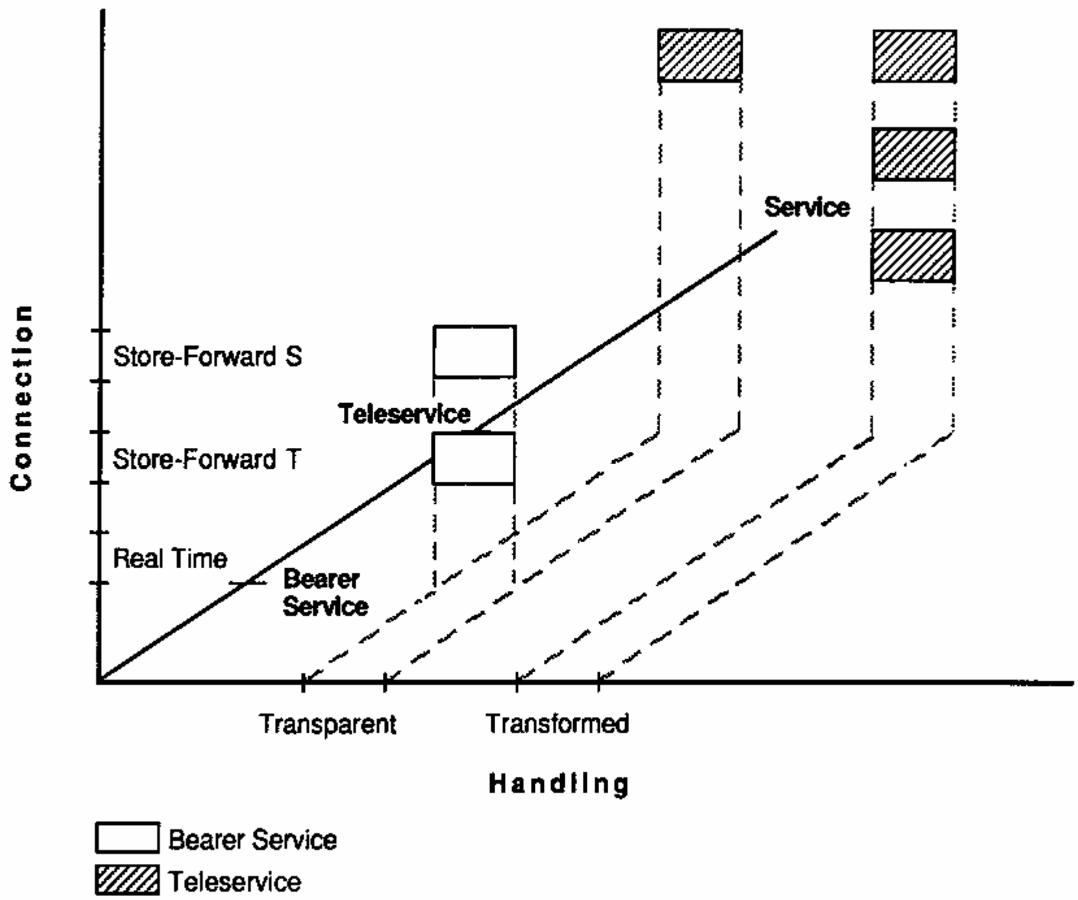


Figure 4-1.3

Relationship between Bearer/Teleservice Dichotomy and Connection-Handling Plane according to CCITT Recommendation

Aware of possible variations in voice-coding techniques, the CCITT introduced 64Kbit circuit service with a digital voice-coding technique as a 64Kbit bearer circuit service. According to the recommendation,

> This service is similar to the unrestricted service except that the digital signal at the S/T reference point [CCITT technical term for possible network-terminal demarcation point] follows the international agreed encoding laws for speech, and that the network may use processing techniques appropriate for speech such as analog transmission, echo cancellation, and low-bit-rate voice encoding. Hence, bit integrity is not assured.[12]

In effect, this is a transformed real-time service and does not strictly adhere to the Computer Inquiry II definition of traditional telephone service.

With the introduction of a family of 64Kbit bearer services for restricted purposes, Figure 4-1.3 should be modified, as in Figure 4-1.4. The ambiguity of Computer Inquiry II on voice communications services described in the previous subsection, and the remarks of CCITT Director Theodore Irmer that "Examples of teleservice are telephony, teletex, videotex and message handling,"[13] impel us to consider the similarity of Figures 4-1.2 and 4-1.4 as coincidental and not as implying that the CCITT modification dispelled the latent contradiction between the bearer/teleservice and basic/enhanced dichotomies.[14]

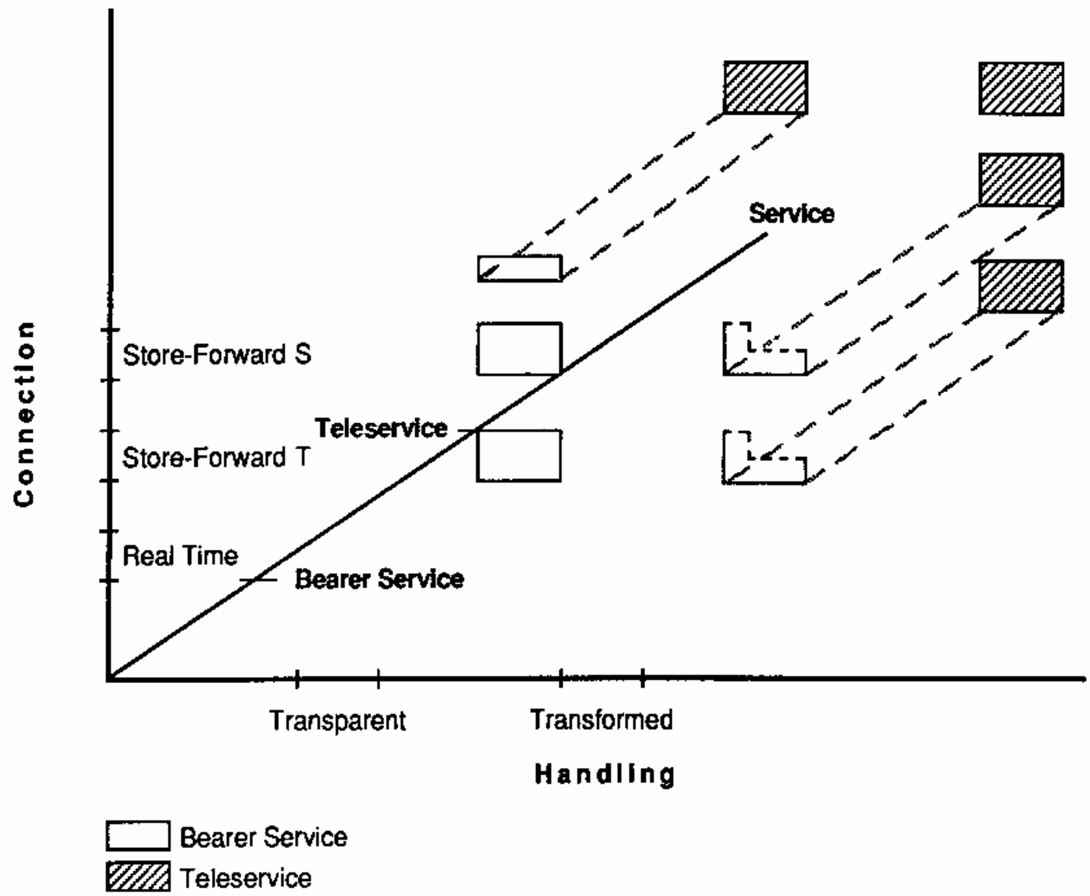


Figure 4-1.4

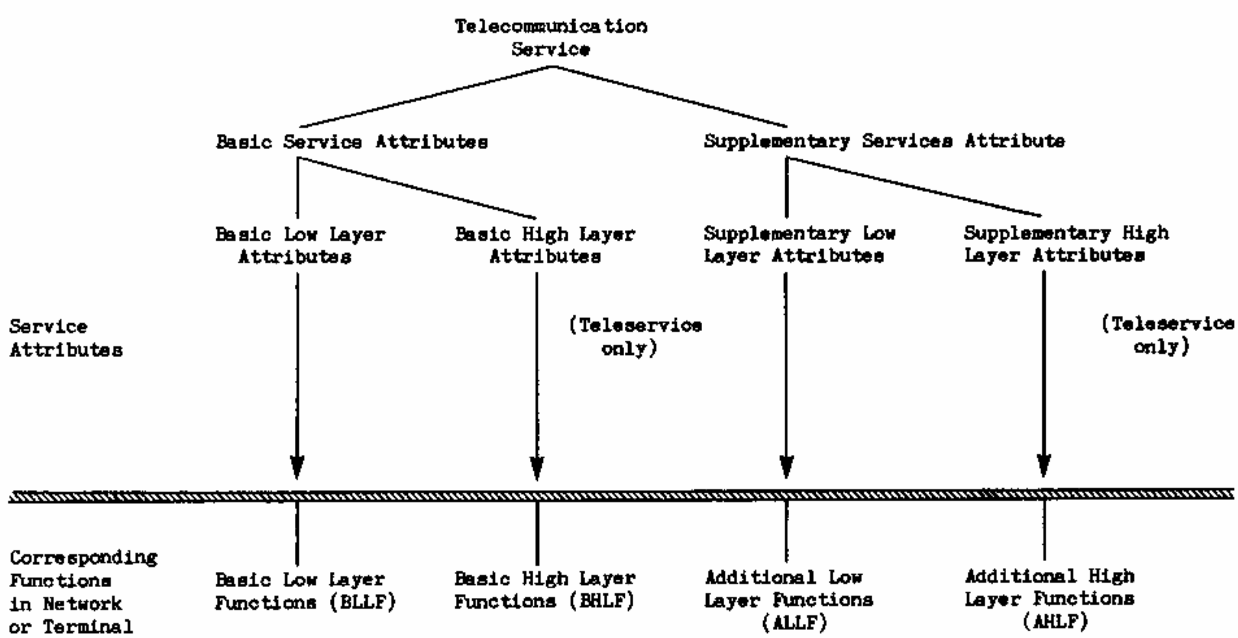
Relationship between Bearer/Teleservice Dichotomy and Connection-Handling Plane according to CCITT Recommendation with Modification

The supplementary services also increase the ambiguity of the CCITT ISDN framework. The subcategories of supplementary services and their relationship to the service structure are detailed in Figure 4-1.5a and b. However, the practical implications of these services are still too vague. According to CCITT, "A supplementary service modifies or supplements a basic telecommunication service. Consequently, it cannot be offered to a customer as a stand-alone service. . . . A supplementary service is characterized by appropriate attributes. Their characterization requires further study."[15] So, the technical clarity of the bearer/telephone service structure notwithstanding (see Figure 4-1.5b), the practical details are still not reliably fixed.

Telecommunication Service			
Bearer Service		Teleservice	
Basic Bearer Service	Basic Bearer Service and Supplementary Services	Basic Tele-service	Basic Tele-service and Supplementary Services

Figure 4-1.5a

Supplementary Services in CCITT ISDN Recommendation



Source: ITU and CCITT. VIIIth Plenary Assembly, Malaga-Torremolinos, 1984. Report of Study Group XVIII, Doc. AP VIII-94-E, Recommendation I-210.

Figure 4-1.5b

Service Attributes and Low/High-Layer Functions

Japan: Line Owned/Line Not Owned

The Telecommunications Business Law (TB Law) introduced a distinction between regulated and less regulated telecommunications business that is quite different both from Computer Inquiry II's basic/enhanced dichotomy and from CCITT's ISDN bearer/teleservice dichotomy. The distinction rests on whether a business owns transmission conduits or not. Public physical networks (own transmission conduits and switching nodes) are considered Type 1 businesses and are subject to rather strict regulation; public virtual networks (own switching nodes and lease transmission conduits from Type 1 businesses) are labeled as Type 2 businesses and are subject to only minimal regulation. Figure 4-1.6 illustrates how this distinction differs from both the U.S. and the CCITT ISDN models as shown in Figures 4-1.2 and 4-1.4.

Unlike the current U.S. framework, the Japanese configuration is not functional and is somewhat compatible with the CCITT ISDN concept. But several regulatory conditions should be considered in evaluating the claim of an MPT official that "Judging from the worldwide trends toward ISDN, basic and enhanced services will be integrated sooner or later. Therefore, we decided to take the classifications of 'line-owned' and 'line-not-owned'."[16]

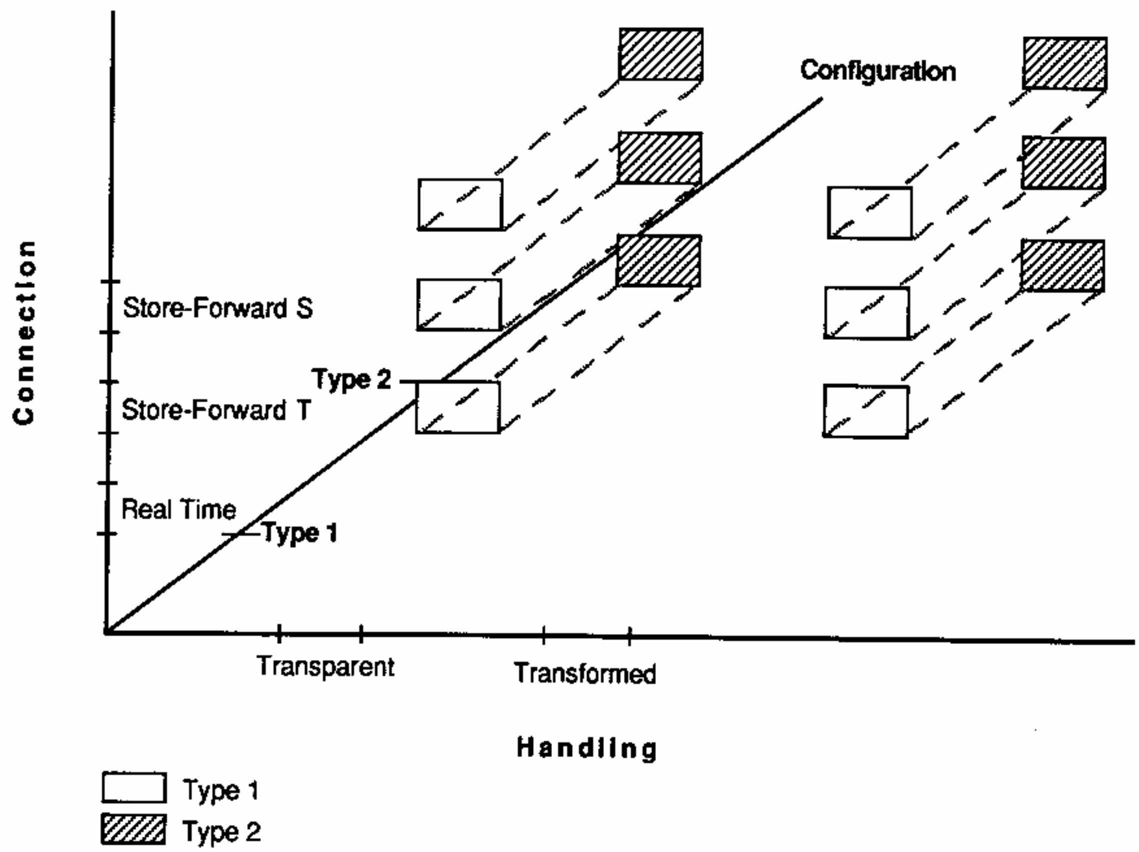


Figure 4-1.6

Relationship between Type 1/Type 2 Dichotomy and Connection-Handling Plane

The TB Law clearly divided telecommunications business into two groups: Type 1 Business (public physical network) and Type 2 Business (public virtual network). But it is unclear whether the hybrid network is either a Type 1 or Type 2 business. According to proceedings since 1 April 1985, it appears that Type 1 Business includes public hybrid networks. Still, there is room for confusion:

For example, NTT recently declared its intention to lease conduits from one of the upcoming satellite carriers, for back-up purposes. The announcement was interpreted by the Japanese media as a maneuver to avoid the unresolved satellite procurement issue.[17]

In another situation, a radical group sabotaged the metropolitan railway's telecommunications conduits in November 1985. The vulnerability of telecommunications conduits became a matter for concern in the aftermath, and several OCCs were reportedly considering conduit-leasing from NTT or other OCCs to ensure uninterrupted service.[18]

Furthermore, MPT reportedly intends to enforce equal access in the near future.[19] At this stage, not only technological details but the precise definition of "equal access" are subject to debate. Assuming adoption of the U.S. method, OCCs will have to lease conduits from NTT.

Classification of a public hybrid network as a Type 1 Business should encourage mutual conduit leasing among Type 1 Business operators, reduce conduit redundancy, and increase interoperability. On the other hand, it may force some telecommunications-service providers either to develop their own conduit facilities or become completely reliant on Type 1 businesses' conduit facilities. That this possibility was not raised during the reform process or after the new regulatory framework took effect is symptomatic of the perception that Type 2 businesses are the resellers. This understanding of Type 2 Business as public virtual networks could be a source of future U.S.-Japan conflict, since Type 2 Business is sometimes regarded as a rough equivalent of the U.S. enhanced-service business, despite their differences. (See Figure 4-1.7 and Appendix D).

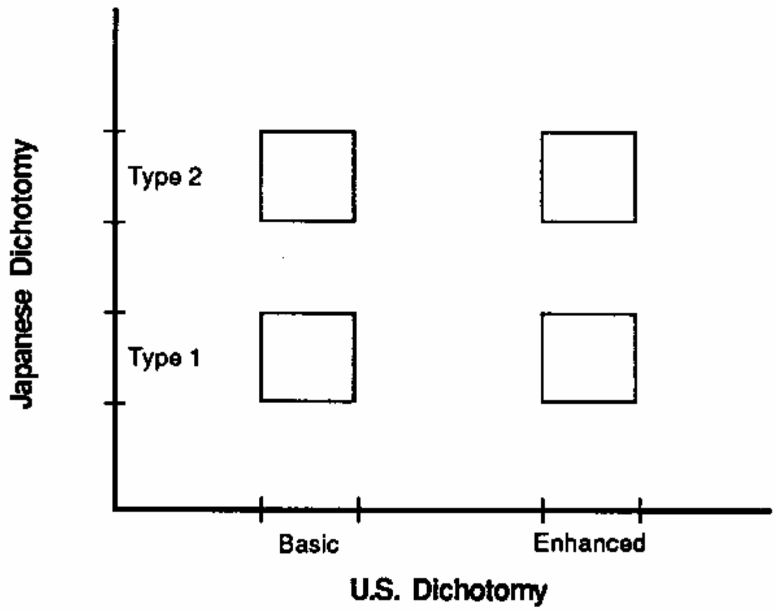


Figure 4-1.7

Relationship between Type 1/Type 2 Dichotomy and Basic/Enhanced Dichotomy

The TB Law does not restrict the relationship between Type 1 and Type 2 businesses. Theoretically, any Type 1 Business other than NTT that sets up Type 2 Business subsidiaries for retail services and is dedicated to offer wholesale leased-line services can avoid most restrictions when it offers retail services directly (the NTT law prohibits NTT from making such a maneuver). According to Article 90, which exempts several specific telecommunications businesses from the scope of the TB Law, any telecommunications business that exclusively provides telecommunications service to an individual is generally unaffected by the TB Law. However, if an individual is either a Type 1 or Type 2 business operator, this exemption does not apply.

In addition to these ambiguities in the TB Law treatment of Type 1 and Type 2 business, Article 6 defines Type 1 Business as "that business which provides telecommunications service by establishing telecommunications circuit facilities (which mean transmission line facilities connecting transmitting points with receiving points, switching facilities installed as inseparable unit therefrom. . . .)" Type 2 Business is simply defined as "any telecommunications business other than Type 1 telecommunications business." Those that only offer transponder-lease service by satellite and avoid acquiring switching capability could be categorized as Type 2 businesses though according to the basic concepts of the TB Law they should be categorized as Type 1.

Service-oriented criteria. The MPT ordinance for the execution of the TB Law calls for separate service-oriented criteria for Type 1 and Type 2 business activities. Application of different criteria not only confuses comparisons of comparable services offered by Type 1 and Type 2 businesses; it also heightens the likelihood of inequality. Recently, the Fair Trade Commission (FTC) decided to supervise possible antitrust violations on a service-by-service basis, regardless of the network-regulation guidelines of the TB Law.[20] A simple question arises: According to what criteria is a universal standard for service in a competitive market to be developed? The United States has struggled for 20 years to obtain a "less bad" solution. The MPT's rather conventional service-oriented criteria with details of TB Law, NTT Law, ordinances, and tariff structure, and the FTC's attitude toward antitrust concerns yield a regulatory environment that roughly parallels the problematic American environment.

4-2: Japan's Classification of Terminals

An important distinction exists in the area of terminals, which are divided into two groups -- terminal facilities (TF) and customer-provided telecommunications facilities (CPTF), each under different regulatory constraints. The primary regulatory difference is that a Type 1 Business can refuse connection of CPTF to its network by convincing the MPT that this connection endangers its financial stability. Switching nodes of any Type 2 Business are treated as terminals in the TB Law. Despite the nickname, so-called "simple resale prohibition articles" in the new NTT tariff only prohibit leaky connection between leased lines and public switched networks for voice-dedicated service beyond the local area.[21] Taking into account approval of the leaky-capacity-constraint condition, the TF/CPTF distinction apparently was meant to distinguish tandem switching equipment and distributor/-transmitter-receivers regardless of their applications, for private networks and for telecommunications business. However, the TB Law incorporates complex topographical criteria -- the permissible domain for terminal installation in the pre-privatization era -- instead of developing a functional criterion. Whether these criteria are effective in distinguishing between tandem switching equipment and distributor/ transmitter-receiver remains to be seen. It is quite likely that by requiring auxiliary interpretation codes, the situation could increase regulatory ambiguity and result in arbitrary interpretation.

The same criterion was applied to an exempted area; it is generally believed that shared tenant service, as well as local area network (LAN) service for the third party, are exempted from the scope of the TB Law by this condition as long as their topographical configurations satisfy this condition. Any LAN service that has no connection to other networks and restricts its physical domain to satisfy the condition is definitely exempted from the scope of the TB Law. The ambiguity of shared tenant service and LAN service with access nodes to other networks has left unclear whether these services are exempted from the TB Law.

Notes for Chapter 4

4-1 In the Matter of Amendment of Section 64.702 of the Commission's Rules and Regulation (Second Computer Inquiry), Docket No. 20828, Final Decision, 77 FCC 2d 384 (1980).

4-2 Ibid., at 385-386.

4-3 Ibid., n. 35 at 386.

4-4 In the Matter of Amendment of Sections 64.702 of the Commission's Rules and Regulations (Third Computer Inquiry), CC Docket No. 85-299, Notice of Proposed Rulemaking, Adopted: July 25, 1985, FCC 85-397 (1985).

4-5 See note 4-1 at 425.

4-6 See note 4-4 at para. 25.

4-7 See note 4-1 at 421.

4-8 Ibid.

4-9 International Telecommunication Union (ITU). International Telegraph and Telephone Consultative Committee (CCITT). VIIIth Plenary Assembly, Malaga-Torremolinos, 1984. Report of Study Group XVIII, Document AP VIII-94-E, Recommendation I-210.

4-10 Ibid., Recommendation I-112.

4-11 Ibid.

4-12 Ibid., Recommendation I-211.

4-13 Irmer, Theodor, "Research and Development at CCITT on ISDN," NTT International Symposium 85, Tokyo, May 20-21, 1985, Section 19, p. 6.

4-14 Tanase, Masanao. Integrated Services Digital Networks (ISDN): Concepts and Issues in the U.S. and Japan. Behind the Telephone Debates - 5. Cambridge, Ma.: Program on Information Resources Policy, Harvard Univ., 1985, p. 49.

4-15 See note 4-9, Recommendation I-210.

4-16 See note 4-14 at 51.

4-17 Nihon-Kogyo-shinbun (Japan Industrial News), November 14, 1985.

4-18 Nihon-Keizaishinbun (Japan Economic Daily), November 30, 1985.

4-19 Ibid., November 17, 1985.

4-20 Japan. Fair Trade Commission. Economics Division. Atarashi-i Joho-Tsushin to Dokusen Kinshi Seisaku (New information-communications and antitrust policy). Tokyo: Gyosei Co., 1985, p. 17.

4-21 Nippon Telegraph & Telephone. Telephone Tariff, Chapter 6, Article 84.2(2), April 1985.

5

EFFECTS OF LOCAL-CONDUIT DIGITIZATION

5-1: The Trend Toward Digitization

The history of digital telecommunications now spans nearly half a century since its birth in England, where the concept of pulse code modulation (PCM) transmission was first proposed in 1937. Practical applications -- notably short-haul, 24-channel PCM transmission systems in place in both the United States (AT&T T1 carrier) and in Japan (PCM-24) -- were widespread in the 1960s. The application of PCM transmission to the black-box trunk-transmission complex affected short- and long-haul coaxial transmission and microwave transmission. The remarkable growth of applications technologies is reviewed in Figure 5-1.1, in which Japan serves as the example.

However, until the 1980s, digitized equipment was limited primarily to the transmission arena; large-scale digitization was still hypothetical for most network telecommunications customers. Even in France, where the PTT has been aggressively engaged in its public network digitization to improve its telecommunications infrastructure, the digital portion of switchboards was approximately 10% in 1980.[1] This situation was altered by the introduction of the fully digitized switchboard (time division switchboard) for long-haul gate node, local gate node, and tandem switching equipment or distributor (digital PABX), replacing electromechanical switchboards (cross-bar switch) and semi-computerized hybrid switchboards (space division switchboard). Even then, local conduits were largely monopolized and the only available interface was analog, except for the limited offer of digital interface for dedicated data-transmitting purposes and for some leased-line purposes. The implications of digitization were still alien to most public switched network subscribers, and the capabilities and utilities of digitization were yet to be realized.

Year	Trunk-Transmission	Switching Node	Local Conduit
1965	Introduction of short-haul PCM transmission, PCM 24 (equivalent T-1 carrier)		
1969	Introduction of short-haul digital microwave transmission (15Mbit)		
1975	Introduction of improved short-haul digital microwave transmission (60Mbit) Introduction of long-haul coaxial digital transmission (100Mbit)		
1977	Introduction of improved long-haul coaxial/microwave digital transmission (400Mbit)		
1979		Introduction of digital switch for digital data service	
1980		Introduction of digital inter-exchange switch	
1981	Introduction of optical fiber digital transmission (up to 100Mbit)		
1982		Introduction of digital local switch	
1983	Introduction of optical fiber digital transmission (up to 400Mbit)		
1984			INS model system field test

Data from NTT.

Figure 5-1.1

Early History of Digital Equipment Development in Japan

Finally, local conduit digitization is becoming an affordable alternative. Fortunately or unfortunately, evaluation depends upon each stakeholder's perspective on these trends. Digitization's arrival is accompanied by the introduction of procompetitive policy and a variety of alternative services into telecommunications proper, and in some cases by the broadcasting-media and offline options made possible by the same technology that underlies the evolution of telecommunications with, for example, microchips, software development, mass storage devices, and fiber optics. Further complicating matters, options are not introduced sequentially, and availability differs from one country to another and even within specialized areas in the same country.

5-2: Digitizing Local Conduits

A wide variety of necessary considerations precede local conduit digitization given any set of market conditions -- degree of competition within the telecommunications industry, regulatory constraints (such as obligatory universal service), percentage of low-traffic customers, geographical nature of service areas, and maturity of potential alternative services (for example, CATV). However, the following two extreme cases are useful as ideal models by which to illustrate the domain of possible local conduit digitization.

Scenario 1. Begin local conduit digitization where it is economically efficient, both in terms of geographical area and the particular customer subset whose demand for high-speed, wideband, digitized conduits is urgent. Determine speed and bandwidth of conduits according to customer demand and technological constraints; that is, concurrently develop a variety of conduits with divergent speed, bandwidth, and other characteristics. Digitize conduits for other areas and for customer subsets as doing so becomes economically efficient.

Scenario 2 (steamroller approach). Introduce total digital conversion area by area, with a particular subset of technology. (For the first stage, two 64Kbit information channels with one 16Kbit signal channel combination -- so-called 2B+D, according to the CCITT ISDN terminology -- is a likely candidate.) Digital terminals, especially those for low traffic, voice-oriented customers, would be offered with a heavily subsidized leasing fee, as necessary, to achieve area-by-area digitization. Facilities for higher and wider-band services, such as sporadic megabit transmission service, are developed as the second phase infrastructure.

The pattern of local conduit digitization is not clear yet in any country. It is difficult for physical network carriers to adopt the steamroller approach where a procompetitive policy has been introduced into the physical network arena. The same is true even with limited liberalization of the private physical network (in which case the so-called "economic total bypass" will result) or virtual public network (in which case user demand is unleashed and virtual network operators emerge as new stakeholders). In the United States and Japan, the range of options is limited by market and regulatory structures. For example, NTT's Information Network System (INS) concept seems to have been moving toward the approach outlined in the first scenario after adopting a steamroller-like image in the late 1970s and early 1980s.[2] Conversely, under totally monopolistic telecommunications business practice by PTTs, a wide range of choices is available, though most seem to be opting for the steamroller approach.[3]

5-3: Technological Determinism

Advocates of the steamroller approach and some others believe that the course of local conduit digitization is predetermined. Such technological determinism -- driven by either fascination about the possibilities of digitization (especially true among technological amateurs in the news media) or by overconfidence in digitization's advantages relative to analog (the case among so-called technocrats) -- once was prevalent in Japan, especially when "INS fever" and "new media fever" peaked in the early 1980s.

Advocates of determinism, in their efforts to promote local conduit digitization, tended to confuse urgent demands, mainly for business uses, and long-term possibilities, mainly for residential uses, and invented a technological hierarchy, although disputes over the hierarchy divided many advocates.

Advocates tend to classify services according to the technology involved, rather than according to their applications. In other words, they tend to assess services on the basis of their parts rather than on the sums of those parts. This is typified by the videotex case in Japan, and the quandary over whether data-retrieval services that use ASCII (American Standard Code for Information Interchange) should be defined as videotex.[4] Consider the comments of a confused customer:

> Teleguide is the service that provides various information, including town information at the street corner . . . Teleguide is a kind of Videotex that utilizes the NAPLPS protocol, which was developed in North America, and is similar to the CAPTAIN system, a kind of still-picture information providing service in the Newmedia age.[5]

The complex, confused statement emanates from a rather simple truth. Closed-circuit/stand-alone videotex service via NAPLPS (North American Presentation Level Protocol Syntax) is referred to as Teleguide; when accessed via CAPTAIN (Character and Pattern Telephone Access Information Network) PLPS, it is called Private Captain. The marketing tactics used by service providers to distinguish their service from similar services tend to confuse the potential user. Despite the apparent mildness of such problems, the implications may become more severe when the hidden assumptions about a particular technological hierarchy are subsumed into the general debate about the validity of an existing legal framework -- a framework institutionalized in an earlier era when particular technological bundles and offered services still had a one-to-one correspondence.

The initial enthusiasm of residential customers and the media paled when it was made clear that software, system sophistication, and daily demands fall short of the bright promises that brought on the "fever." Disillusionment was uncovered among residential customers and the news media itself.[6] The fact that such pendulum-like mood swings have precedents does not dismiss the severe ramifications of such disappointment: a consensus that digitization delivers esoteric services useless to individual customers and only beneficial to large businesses. This swell turns to hostility when residential customers confront such serious issues as revision of the long-distance local subsidy for telephone rates. The problem has already been seen in the United States:

> Some suggest that the new telephone plant is too costly and provides services to business customers which are of little use to the basic residential customer. They argue, therefore, that ordinary subscribers, receiving no clear benefits from new investment, should not be obligated to pay for this equipment.[7]

Motivated, at least in part, by the "catch-up syndrome" that has dominated the Japanese outlook for a century, advocates adopted the situation in the most advanced country (in this case, the United States) as a reference model. Display services that did not exist in Japan were touted as immediate, promising services somehow suppressed in Japan by regulatory restrictions; overlooked were environmental differences, cultural dissimilarities, business traditions, and available alternative services. Some claims proved to be accurate, as was the case with value-added network (VAN) service (though value-added services in Japan were considerably modified during the adoption procedure).

However, many claims have been shown to be unfounded, even after allegedly detrimental regulations were lifted, dramatically illustrated in the case of PC-to-PC communications. An article written on the eve of the telecommunications reforms criticized NTT's regulatory practice of suppressing the potential transmission demand for word-processed documents via telecommunications lines, claiming that this blocked "the desire of advanced businessmen who utilize interconnected telephone lines and make them efficient business tools."[8] In fact, it became clear that the important efficient business tool of choice is the portable word processor with printing capability, which does not rely on transmission interfaces (see Appendix C).

Further objections were raised about CATV, where regulatory constraints apply. In the late 1970s and early 1980s, urban CATV was touted as the most promising new medium of the next decade. After five or six years, not one urban CATV service has a large number of subscribers in metropolitan areas. Clearly, some services will not penetrate the market for reasons unrelated to telecommunications per se. This is yet another example of the feverish expectations/reality/ disillusionment process.

This repeated process of disillusionment may have yet another iteration. Even sober appraisal of the domestic experience could convince the involved American businesses (with their limited knowledge of Japanese environments) of the applicability of the services offered in the United States to the Japanese market. Should the market prove to be unsusceptible, U.S. businesses' frustrations could easily escalate into accusations about hidden or implicit protectionism.

5-4: Technological Impetus

One of the most frequently cited characteristics of the development of technology is the rapid and significant decrease in cost. Although it undoubtedly exists, the cost factor is not as monolithic as it appears. The decreases in cost are related to 1) cost reductions in material (hardware costs and the increasingly important software costs); 2) increasing capacity/capability per unit; and, 3) decreases in the amount of information necessary to recover patterns, made possible by data compression technologies. These related trends combined to yield vast cost reductions and a wide spectrum of alternatives -- the boundary of which extends well beyond the limits of telecommunications. Cross-overs are increasingly important, as with the compact disk distributed by courier services that may prove a formidable opponent to both online data-retrieval services and online game services between PCs.[9]

Compression of information and expansion of carrying capacity. In the late 1970s, the upper limit of digital information carried (economically) via twisted pair local conduits approached 48Kbit to 56Kbit per second. Even in the current ISDN experiments in Japan and Great Britain, transmission capacity is limited to 80Kbit per second. NTT's innovation was a time-division technique called "ping-pong transmission," which can carry two-way 64Kbit voice coding.

Current plans for ISDN treat 144Kbit transmission capacity (made up of two 64Kbit communications channels and one 16Kbit information channel) as the standard, referred to as "2B+D". Even utilizing twisted pair cable, transmission capacity has increased by a factor of 250% in a decade. If new technologies such as short-distance digital microwave transmission (digital termination systems, or DTS) or fiber optics are used for local conduits, transmission capacity per physical conduit will ascend to the megabit level and beyond. Moreover, the cost of physical conduits for wideband use is rapidly decreasing, drastically reducing per-bit (or per-channel) costs.

At the same time, technological evolution has reduced the number of tokens necessary to pass a pattern from one point to another. The amount of tokens necessary to offer TV conference service is now 768Kbit/second, down from 1.536Mbit, and could reach the 64Kbit range if substantial restrictions are tolerated by customers. The area of voice transmission is no exception; 32Kbit voice coding, increasingly in demand, applied to the voice-transmission capacity of the T-1 carrier, resulted in an almost doubled capacity with conventional 64Kbit coding without replacing the T-1 carrier itself. Even lower-bit voice coding (16Kbit or 4.8Kbit) is on the way.

The expansion of pattern-transmission capacity is increasing as the token-transmission capacity expands and the compression technique is refined. Still, transparency is not assured when compression techniques are used, and the price of coding equipment and the necessary number of tokens used to recover patterns are inversely proportional. This means that, given the service chosen, the level of terminal costs and transmission costs (as reflected in overall telecommunications costs) are inversely proportional among possible alternatives.

Cost reduction and capacity expansion. Behind the above-mentioned trends are more general movements that support digital-technology-related goods and equipment -- from digital watches to automatic, independent four-wheel braking control systems, and desktop computers with capacities equal to those of mainframes built 10 years ago. Directly related to the digitization of the telecommunications infrastructure are expanding capacity (memory chips) and capability (microprocessors), the reduced cost of microchips, and the increasing importance of software. With the accelerated development of mass-storage systems, these factors have contributed to physical-network digitization and to the viability of virtual networks.

By no means do these factors always favor centralization, however. The centralization-versus-decentralization controversy in computer networks has a long history. Even in the area of conventional voice telecommunications, the very technologies that drive physical-network digitization make new features that were formerly the exclusive domain of networkers -- itemized billing, virtual routing (sometimes called least-cost routing), and digital multiplexing -- available first to PABX users and then to key-system users. Two fashionable topics in telecommunications, shared-PABX and bypass (especially facility bypass), would not exist as effective options, were it not for these technologies. It is hard to predict whether the trend favors centralization or decentralization in terms of functional allocation. Even in the voice telecommunications arena, alternatives for functional allocation and system configuration are becoming plausible, including nonvoice and data communications.

In nonvoice communications, the same bundle of technologies is complicating matters. Services that many industry observers in the media consider most attractive for residential customers -- computer-assisted instruction (CAI), data-retrieval, online video games, and electronic magazines[10] -- are no longer restricted to online services. The evolution of mass-storage systems and enhanced PCs, equipped now with 16bit microprocessors, and 128 to 512Kbit DRAM (dynamic random access memory), and soon with 32bit microprocessors and several megabit DRAM, have paved the way for alternative, offline delivery services or online-offline hybrids (quasi-offline), once technologically restricted to online-oriented services. The same holds true for some business-oriented services, although the impact is reduced where the time factor is crucial.

At this stage, it is far more difficult to predict which particular configuration or hybrid configuration will dominate, since mass-storage offline services are in their infancy.[11] It is clear that such predictions about the future telecommunications environment (especially in Japan) as multi-megabit conduits for every customer of video-type services must be reconsidered in terms of offline alternatives.

<u>The many paths of evolution</u>. Despite deterministic arguments, predicting the course of telecommunications is ever more difficult. The challenge is greater now, with enormous technological changes developing in brief periods of time.

The increasing freedom in functional allocation may encourage development of analog-digital hybrid equipment, systems, and services that capitalize on existing tariff structures and embedded facilities as efficiently as do evolving digital technologies. Those who believe in the *a priori* supremacy of digital over analog consider such hybrids technological chimeras that will disappear when the next generation of the digital era matures.

In the facsimile-transmission arena, however, the Japanese market has been taught that there are no such assurances to be made. G3 facsimile terminals (digital-overlay-analog-transmission type) with special compressed-transmission protocols (even one manufacturer's machines may not be able to communicate with each other with these special compressedtransmission protocols) and such features as multi-destination handling, password reception, and poling have outperformed the stored-forwardoriented facsimile network. The new G3 facsimile terminals' brief transmission time (9 to 20 seconds for letter size) capitalize on the time-sensitive telephone-tariff structure to overcome the distance sensitivity of telephone tariff, and have achieved efficient turn-around performance. The facsimile network suffered with its poor turn-around (90 seconds for letter size) despite its distance insensitivity. Ironically, most of the G3s have facsimile-network interfaces to ensure basic interoperability, since the compressed-transmission protocols work within a very limited domain. Still, the G3s perform poorly when transmitted by 32Kbit digital voice coding and cannot be connected to digital local conduits, so their future is as unpredictable as that of facsimile networks, considering the adaptability to digitized local conduits. The clear implications of this pitched battle are these:

- Economic efficiency and utility, not _a priori_ technological supremacy, determine short-term market edge.
- Fundamental and long-range economic advantages of digitization do not always apply in the short run.
- CPE providers may disagree with network providers not only about functional allocation but about the course and nature of network evolution, especially in short-term marketing strategy.

5-5: Diversified Demand

Increasing business demand. Demand for efficient telecommunications for business purposes has a long history, illustrated by the development of PBX. But even such allegedly "new" phenomena as bypass would have been available in the era of electromechanical technical equipment had certain conditions been met. Indeed, from the pre-reform days, service bypass was rather popular among large firms in Japan, because of the time- and distance-sensitive tariff structure and available bulk discounts for leased circuits. The significant circumstances that distinguish the current market are:

- The expansion of the affordable user cluster due to cost reductions and capacity/capability increases has enabled many business customers to develop their own virtual or physical networks that their scale previously prevented.
- Alternatives are available in the now competitive market.
- There has been a shift from paper to electromagnetic (and next, optic) devices for record storage and information delivery within and among offices.

As the movements of several large companies, such as GE, Federal Express, and Kobe Seiko, have indicated over the last five years, large private-system users, virtual or physical, enhance their capacity and capability and transform themselves from mere users into <u>de facto</u> network operators. Then, some are tempted to offer their excess capacity for sale and even attempt to operate a public network. As the percentage of telecommunications costs represented among total business costs grows, and as capacity becomes more insensitive to price, economic and psychological barriers to entrance into public network business will decrease. Large users are now assessing the market as consumers and as operators.

Considering the potential power of offline or quasi-offline alternatives and the implausiblity of subcategorizing terminals with current technology and regulations, it is doubtful whether there exists an efficient method to control or direct the progress of development. No doubt, even the industrialized nations will differ dramatically in terms of telecommunications infrastructure development and its degree of freedom, all of which may yield considerably different systems. Perhaps the most potent force for adoption of cooperative development models is the shift away from paper transactions, which has already left its mark on foreign-currency trading.

<u>Unclear residential demand</u>. Figure 5-5.1 shows the distinctive character of potential digital services and the gap between wideband video (1.5Mbit to 200Mbit) and other services, including videotex service (up to 64Kbit).[12] For practical purposes it is difficult to speculate about demand for particular services that fill the gap. High-speed interactive services with some video features (the CAI system and video magazine) could help bridge the gap. However, as the bandwidth increases, the likelihood of competition with offline and

quasi-offline services also increases. Still, in addition to the unpredictability of demand due to technological immaturity, there is an untested question about the necessity for interactivity and the realization methods for interactivity even if it is considered necessary. As a result, the demand and need for residential wideband local conduits remain unknown.

Service	Uncompressed Data Rate (kbps)
Telephone	64
Alarms	0.1
Utility metering	0.1 - 1
Energy management	0.1 - 1
Videotex	
1984	1.2
late 1980s	4.8 - 64
Electronic mail	1.2 - 64
Home computer networks	
1984	0.3 - 1.2
late 1980s	1.2 - 64
Slow scan video	1.2 - 64
Video teleconferencing	1500 - 6300
Television (NTSC)	90,000
High definition television	200,000+

Source: Baer, Walter S. "Telephone and Cable Companies: rivals or partners in video distribution?" Telecommunications Policy, Vol. 8, No. 4, December 1984, Table 1. Reprinted by permission.

Figure 5-5.1

Required Bandwidth for Respective Services

In the area of narrowband (up to 64Kbit) services, as implied by the experimental videotex services throughout the world, penetration of the residential market is extremely difficult without heavy subsidies or bundling with other services. And even if current videotex-type services solve several rather marginal problems (insufficient information provided, hierarchic data-retrieval structure, terminal device price problems) they may face the turnaround-time problem due to the transmission display protocols. If efficient offline or quasi-offline alternatives are developed, even narrowband services may face competition. As for electronic mail, facsimile, and PC-to-PC communications, their future might be more promising than that of other new media services. Still, their transmission speeds are rather low and within the range of voice coding. Considering the low-traffic nature of the current residential market, it seems unlikely that dedicated channel is necessary for those services, even if they manage to acquire critical mass. Thus, ISDN 2B+D (up to 144Kbit) capacity might become excessive even for residential customers equipped with nonvoice terminals.

Application of compression technology in the residential market is plausible. If the following conditions are satisfied, shared PABX-key systems with low-bit voice coding and detailed billing capabilities will at least be an available alternative for low-use residential customers:

- Interoperability between different bit voice codings are realized within an affordable price range.
- Subchanneling of B channels is permitted at at least 32Kbit per subchannel.
- Terminal ID numbers (telephone numbers) become independent of physical channel and can be allocated to each terminal (per logical subchannel).
- A fixed monthly charge is applied per physical channel or at least per B channel.

In addition, should cost revisions for long-distance and local or short-haul calls be hastened by competition, the potential for small, shared PABX will be greater. Currently there is no convincing demand-and-supply basis in the residential telecommunications market to justify a steamroller approach. However, this does not dismiss the likelihood of large-scale future wideband usage by residential customers. It simply reinforces the continuing unpredictability of the residential market. In fact, the very idea of a "future residential market" might be inaccurate, since it is highly difficult to predict whether such categorizations will hold. If high-resolution TV does find a penetrable market and achieves critical mass, the shift to transmission via cable will proceed because of the required bandwidth for high-resolution TV transmission. If Japan's urban CATV market is still minuscule, and star-structure fiber-optic CATV systems develop a pricing advantage over tree-structure coaxial CATV systems, fiber-optic megabit-transmission local conduits will outperform offline or quasi-offline alternatives. Of course, these are only a few of the imaginable composites of the nearly infinite, unstable assumptions.[13]

The play of cultures. Demand and development are responsive to cultural peculiarities -- language and alphabet, embedded facilities (e.g., CATV), differences in long-distance rate structures, and the kind of information deemed proper for such systems, such as the status of personal checking accounts. The fundamental factors of language and alphabet are used as illustrative examples here and in Appendix C.

It may be an exaggeration to relegate all differences in clerical-work practice between the United States and Japan to the dissimilar alphabet and writing system. Conversely, it also seems tautological to use a generalized label such as "Japanese management" to explain distinct social systems, including clerical practice.[14] The lack of efficient and usable typewriting devices had a considerable impact on the development of Japanese clerical practice for a very long time, and the practice based upon that, in turn, shows its mark on modern service and equipment. The relatively low domestic usage of telex systems and users' strong response to facsimile as it became available, the rapid price decreases in facsimile, capability enhancement, and sales increase of facsimile terminals cannot be explained without acknowledging Japan's dependence on handwritten documents. Even word processors that print an ideographic-phonetic hybrid of the Japanese writing system have yet to unsettle clerical practice (see Appendix C). Though the future is by no means knowable, the mere availability of office automation seems unlikely to provide sufficient incentive to bring about a substantive change in longstanding clerical and business procedures.

5-6: Voice Coding and Its Allocation

Standard bandwidth and audio-electronic wave conversion conventions for analog telephone systems were, in effect, mandated, because the network system was developed to optimize the adopted bandwidth, and subchanneling with given bandwidths was expensive and compromised the quality of the transmitted voice. Hence, *de facto* universal interoperability in voice telecommunications was established not only within public switched networks, where strict technical standards further encouraged it, but also in private networks that conventionally had no point of connection with public switched networks (even though private networks utilized developed analog public switched network construction). This one-to-one relation between adopted convention and network-terminal interface seemed to guarantee that voice telecommunications would remain in, or at least remain an intrinsic part of, basic service.

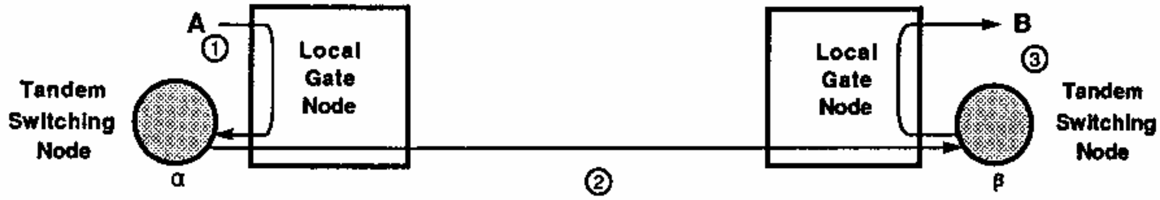
Introduction of point-to-point digitization and alternative digital-coding methods (alternatives to 64Kbit) began to erode the unconditional universal interoperability of voice telecommunications. In private networks where point-to-point digitization was first realized, several 32Kbit voice coding methods are already used in some systems to almost double existing T-1 carrier capacity. In the arena of switched networks, point-to-point digitization is still experimental. So the coexistence of several alternative voice-coding methods, and the potential for interoperability problems similar to those that plague intercomputer communications, are still marginal. However, the upcoming large-scale introduction of point-to-point digitization will expose questions so far unanswered and sometimes not even asked. And the possible impacts of point-to-point digitization will not be restricted to the regulatory framework proper. The following are but a few of the potential alternatives for coping with those impacts; presumably, less problematic solutions will be developed.

I. Divide digital bearer service into two subcategories: digital transmission services and digital voice service. Adopt a digital voice-coding method for the digital voice service.

Ia. Then adopt a two-tiered pricing scheme, artifically deflating digital voice service rates and artifically inflating digital transmission service rates. Offer digital voice service on a transformed basis: Although patterns would be transmitted from one end to the other, tokens would not be kept inviolate in voice communications. Hence, if the attempt is made to use digital voice service for transmitting non-voice information, patterns for data transmission will be transformed and made unrecognizable. For customers who cannot afford digital telephony, the system will continue to offer an analog interface and convert it to the digital voice service protocol at local gate nodes.

While this approach sustains voice interoperability and alleviates the sneak-in problem of non-voice disguised as voice (which the artificial two-tiered pricing scheme invites), it may face two other kinds of problems:

First, unless long-haul/short-haul rate differentials are substantially revised and the price of digital voice service is lowered enough, an alternative long-haul transmission service may gain marketing power. Such a service for long-haul transmission would accept standardized digital voice tokens from one transmitter-receiver using digital voice service and then recode them into low-bit coding and send them through wideband digital transmission service conduits. They would then be recoded into transmitter-receiver using digital voice service. (See Figure 5-6.1)



α,β :Tandem switching node that offers compression/recovery function.
Information is carried by this procedure between A and B:

1. ① by standard code, for example 64Kbit coding
2. at α, standard ——► lower bit conversion
3. ② by lower bit coding
4. at β, lower bit ——► standard conversion
5. ③ by standard code

Figure 5-6.1

Possible Configuration for Low-Bit Voice-Coding
Virtual Network Service

This is another phase of the existing resale/leaky services problem and thus not a new problem per se. However, considering the current evolutionary trends in compression technology, digital voice service rates will have to be lowered as voice-code compression technology advances. This reduction, in turn, accelerates the increase in digital transmission service prices. And high rates for such services will curb demand or encourage a shift to offline/quasi-offline alternatives.

Second, without either a complicated scheme to eliminate the interoperability of non-voice information in the digital voice service or legal proscriptions against code-breaking, many users will undertake the development of devices to transmit patterns of non-voice information via digital voice service. The economic and social costs to block such sneak-in attempts could be enormous.

Monopoly conditions — separate networks for narrowband digital and wideband digital connection between networks only via special nodes offered by the monopoly -- would mitigate these potential problems, but a long-term drain toward offline or quasi-offline alternatives is an unavoidable tradeoff. And there is the more serious problem, similar to the problem of domestic scale cited by a state Public Service Board in a 1985 report of the National Telecommunications and Information Administration (NTIA):

> New enterprises often require diverse and modern telecommunications systems, much as they demand good roads, universities, and the like . . . . States with advanced telecommunications systems will have an advantage, occasionally even a decisive edge, in the search for business investment. With telecommunications playing an increasingly vital role in both service and manufacturing firms, overly stringent regulation will be, to some degree, self-limiting.[13]

Ib. Interoperating service is limited to the interface between the adopted digitized voice service and the existing analog interface. This will encourage the shift toward lower-bit coding among those who can afford expensive coding devices, yielding the same problems as does the bypass issue. And it would be very difficult to block the market participation of virtual network services that offer lower-bit/standard-coding interoperation.

II. Adopt a limited number of digitized voice coding methods as standard and ensure interoperability among those coding interfaces and analog interface by:

IIa. limiting this capability to public physical switched networks and forcing them to offer interoperating services on regulated basis;

IIb. encouraging public virtual switched networks to offer interoperating services on an unregulated basis; or, IIc. mixing tactics IIa and IIb.

All of these face potential problems similar to those of the bypass issue. While approaches IIa and IIc may avoid the elimination of universal interoperability of voice telecommunications, this framework (sustained by regulation) would face a problem similar to the access-charge issue, especially in the shift from carrier access charge to customer access charge as large users shift toward lower-bit coding to maintain traffic-sensitive standard voice coding. IIb might avoid such problems; however, it would suffer from asymmetrical accessibility among customers in voice communications -- gradually decreasing correspondents accessible to the lower-end customers who cannot afford an optional fee for interoperation. Even if economically justifiable, this is tantamount to abandoning universal service, still a daunting prospect for any regulator or system planner.

5-7: Signaling and Numbering

Signaling (calling information) and numbering are among the less well-examined topics in point-to-point digitization, yet their impact on the future telecommunications infrastructure will be major. The 1984 CCITT ISDN recommendation only succeeded in creating skeletal resolutions of these issues.[16] Still unanswered are the following questions:

1. PABX dial-in and ongoing facility bypass seem to be opening interfaces that were previously the exclusive province of black-box networks. Will some of the large customers' tandem switching equipment replicate local gate nodes or even long-haul gate nodes?

2. With a dedicated information channel (D-channel, according to the CCITT ISDN terminology), will virtual calling information (formerly

treated as an aspect of information tokens by physical networks) receive the same treatment as physical calling information?

3. How are calling information and substance tokens carried through D-channel to be distinguished if substance token transmission and virtual calling information transmission through D-channel are institutionalized?

4. If the following two conditions are met -- (a) some differences still exist between treatment of physical calling information and that of virtual calling information and (b) no restriction is imposed on services offered, regardless of the operators' natures (physical or virtual) -- will objections be raised about the treatment of physical and virtual calling information? Such objections surfaced during Computer Inquiry III over the colocation issue, about the location of the enhanced service gate node.

5. How many channels are usable simultaneously per physical channel? For example, for every twisted pair cable, two (or, three -- 2B+D) are maximal. Further subchanneling and simultaneous usage of those channels are possible.

6. By what convention is the ID number assigned? per physical channel, per virtual channel, or per terminal?

7. To what extent are physical network operators responsible for the ID number, for calling information passing other than their own, and for connection? When will physical network operators -- and then virtual network operators -- start and terminate charges?

8. By what criteria is the basic flat fee applied if such a system survives? per physical channel, per virtual channel, or per terminal?

5-8: Convergence of Nodes and Conduits

Assume the most extreme case: no discrimination among calling information; no service restrictions on services offered by any network; coexistence of different code-protocols for voice coding; convergence of some tandem switching equipment and local gate nodes/long-haul gate nodes. All the conditions that sustain the network-terminal distinction may disappear and the entire telecommunications infrastructure could be explained by the combination of various nodes. Conduits and access points differ in characteristics and capabilities (see Figure 5-8.1).

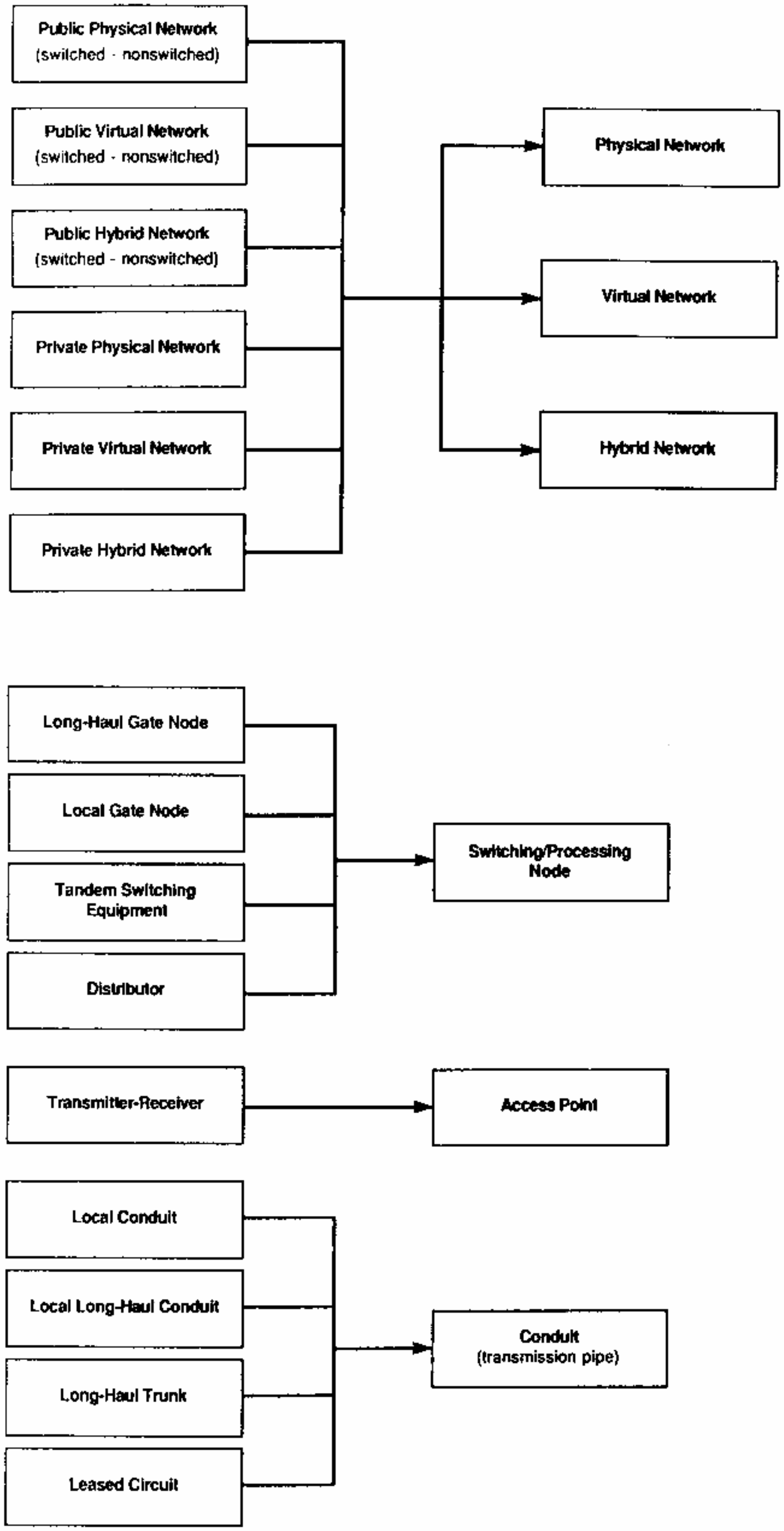
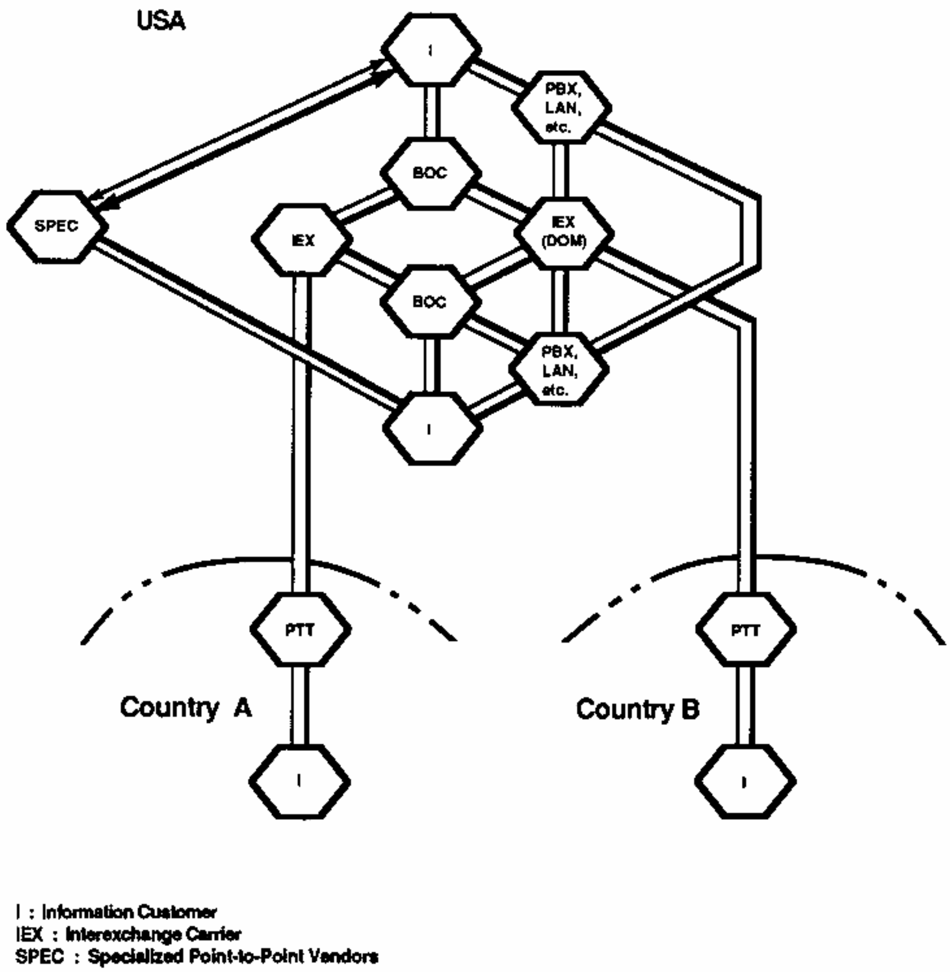


Figure 5-8.1

Possible Reduction of Categories for Telecommunications Infrastructure

At the 1985 World Telecommunication Forum, a speaker presented a model for a telecommunications infrastructure of the future (see Figure 5-8.2). He postulated:

> It is obvious that the information revolution has also allowed for incredibly complex communications networks. The new telecommunications environment is virtually a multidimensional array with the opportunity available to a great many entities to provide information services to others. Those possessing telecommunication links can provide all seven OSI layers; those without, only the higher layers, but request lower from others. The entrepreneurial opportunities for creating and distributing information will be unlimited.
>
> Many of the old classic regulatory concepts that are service oriented, or rely on notions of "public" and "private," or that attempt to control "value-added" or "resale" seem to lose their meaning. With this kind of diversity and connectivity, the ultimate marketplace emerges. The price charged for each discrete information attribute should be driven close to its true cost or value. Hidden cross-subsidization becomes virtually impossible to achieve, and if desired, would need to be emulated through across-the-board funds.[17]



Source: Rutkowski, A. "Transborder Data Flow: User Responsibilities and Obligations in the New Telecommunication Environment," in ITU, World Telecommunication Forum, Law, Regulation, Standards of Global Communications, Geneva, 1985, p. 134. Reprinted by permission. (Legend added.)

Figure 5-8.2

Information System Model Applied to a New Telecommunications Environment

If Figure 5-8.2 is superimposed on a "topological doughnut," where no center or peripheral sectors exist, the implications of this model become evident (see Figure 5-8.3a). This "Doughnut Model" is plausible as a theoretical model, considering current technology and competitive policy. (For other alternative models, see Figures 3-3.4 and 3-3.5; see also Figure 5-8.4, a separated, multilayer network in which the central-peripheral concept holds.)

But imagine that this doughnut is made of an elastic rubber tube filled with an appropriate air mass. When the tube is deflated and some portions are stretched as far as possible, it looks like a chain of rectangles and stripes.

Now draw on each rectangle a hierarchical network image similar to that of Figure 3-1.2. Assuming these rectangles are domestic telecommunications markets and the stripes are monopolistic international carriers, Figure 5-8.3b represents the worldwide telecommunications arena of 30 years ago.

As air has been added with increasing traffic and the introduction of procompetitive policies, the circular chain of rectangles and stripes has gradually changed into a doughnut-like shape. Through this period new configurations, primarily OCCs, were drawn to fill the previously blank areas. So far, with few exceptions, new figures have been drawn outside the rectangular portions. At the same time, the already existing figures (monopolistic common carriers) have changed their shape voluntarily or involuntarily to cope with new circumstances.

Thus has emerged the structure shown in Figure 5-8.3a. National sovereignty still holds sway, as do hidden assumptions about the hierarchical order of respective networks. However, as air continues to be added, as emerging stakeholders -- OCCs and large users -- add new connections by joining the market, and if international bypass twists the doughnut, both national sovereignty and the hierarchical (or central-peripheral) assumptions are likely to meet serious challenges in the next decade.*

*Despite the dramatically new, even esoteric, outlook of open network architecture (ONA), a core concept of the Computer Inquiry III decision, the author fears that ONA is still based on the "central-peripheral" assumption.

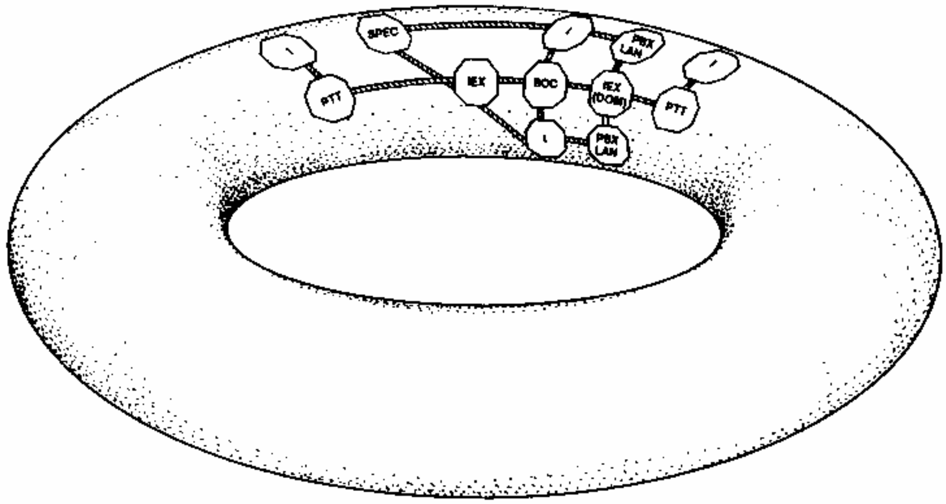


Figure 5-8.3a

Topological Doughnut as Telecommunications Framework

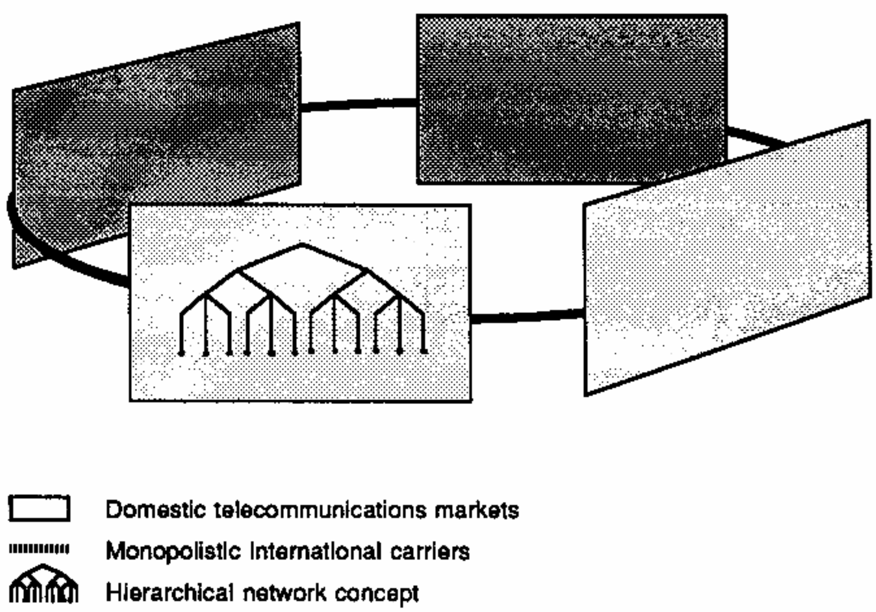


Figure 5-8.3b

Deflated Doughnut as Telecommunications
Framework in the Monopolistic Era

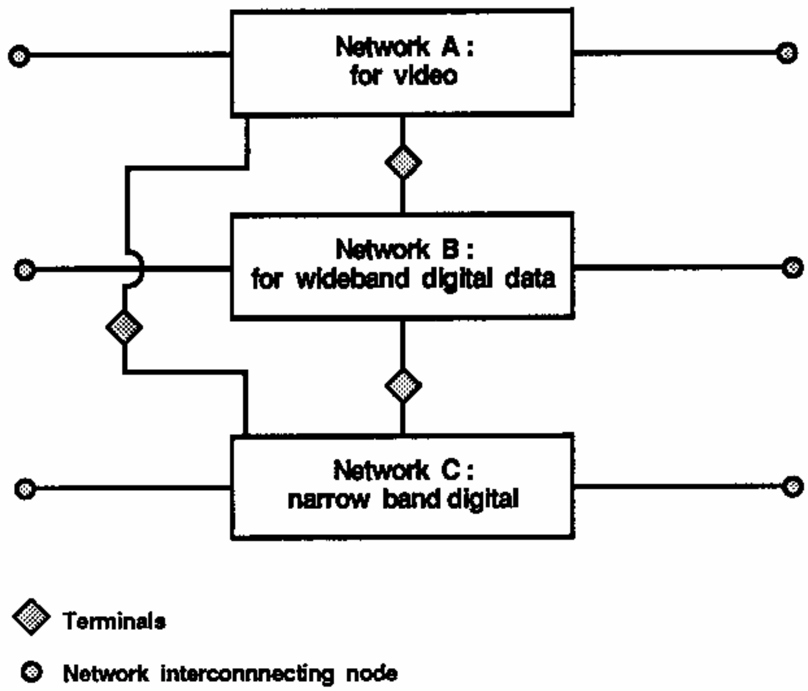


Figure 5-8.4

Separated Multilayer Model for Digitization

However, it is not certain that the Doughnut Model has a distinctive edge in practice, even in the United States where network integration and competition are fierce, since the future implications and tradeoffs with such a model -- issues associated with voice interoperability, signaling, and numbering -- are not yet explicit. Moreover, despite fade-away technological bases and shaky industrial and regulatory environments, users still hold fast to their belief in the distinctions among voice, data, and broadcasting (see Figure 5-8.5). The optimum choice, if one exists, will be achieved only after exhaustive debate among all stakeholders on tradeoffs (which may change with demand and supply) including offline alternative drifts and interactive trial-and-error procedures. Given varying time frames and perceived needs, the general debate may well give rise to conflict even among procompetitive countries.

Criteria	Distinctions		
	Voice	Data	Broadcast
Customers	Firm	Firm	Firm
Laws	Wobbly	Wobbly	Firm
Industries	Crumbling	Crumbling	Holding
Technologies	Going	Going	Going
Sciences	Optional	Optional	Optional

Source: Anthony G. Oettinger.

Figure 5-8.5

Summary of Demarcation Boundary

Technological and economic necessity will eventually resolve all but the political stakes. Therefore, comprehensive political resolutions will tend to stand longer than those proposed by economic or technological experts. What is to be averted is political compromise that creates the semblance of a classical, service-oriented framework further confused with fundamental, nonservice-oriented elements, on the false pretense that one-to-one correspondence among technology, media, and service still holds. This kind of approach reflects an outmoded service demarcation concept and technological determinism, which cannot be proven, as we discussed in this chapter.

Notes for Chapter 5

5-1 "Les reseaux numeriques a l'integration de services, " Revue Francaise des Telecommunications, Vol. 54, February 1985, pp. 52-58.

5-2 Nippon Telegraph & Telephone. INS Working Group. INS Kodo-Joho-Tsushin Shisutemu (Integrated Information and Telecommunications System). Tokyo: NTT, July 1982.

NTT International Symposium 85, Tokyo, May 20-21, 1985.

5-3 See note 5-1.

5-4 Japan. Research Institute of Telecommunications and Economics. Kokusaiteki-Sogoizon no Takamari ga Tsushinseisaku ni Oyobosu inpakuto no kenkyu (A study on the impact of increasing international interdependency on telecommunications policy). Tokyo: Research Institute of Telecommunications and Economics, March 1985.

5-5 Yushun (Quality Horse), Vol. 45, No. 12, December 1985, p. 160.

5-6 Sankei, September 28, 1985.

5-7 U.S. Department of Commerce. National Telecommunications and Information Administration. Issues in Domestic Telecommunications: Directions for National Policy. Washington, D.C.: GPO, (NTIA SP 85-16), p. 8.

5-8 Nikkei Communications. Tokyo: Nikkei McGraw-Hill Books, 1984, pp. 155-159.

5-9 Bulkeley, William M. "Compact Disk Technology is Finding New Niches in Computer Data Field," The Wall Street Journal, November 11, 1985, p. 17.

5-10 See note 5-2 (a).

5-11 See note 5-9.

5-12 Baer, Walter S. "Telephone and cable companies: rivals or partners in video distribution?" Telecommunications Policy, Vol. 8, No. 4, December 1984, pp. 271-289.

5-13 An example of arguments based upon certain sets of those assumptions can be seen in Ekonomisuto (Economist), February 11, 1986.

5-14 Vogel, Ezra F. Japan as Number 1: Lessons for America. Cambridge, Ma: Harvard Univ. Press, 1979, pp. 131-157.

5-15 See note 5-7, at 102-103.

5-16 International Telecommunication Union (ITU). International Telegraph and Telephone Consultative Committee (CCITT). VIIIth Plenary Assembly, Malaga-Torremolinos, 1984. Report of Study Group XVIII, Document AP VIII-94-E, Recommendation I-330.

5-17 Rutkowski, A. "Transborder Data Flow: User Responsibilities and Obligations in the New Telecommunication Environment," in International Telecommunication Union. World Telecommunication Forum. Law, Regulation, Standards of Global Communications. Geneva, Switzerland: ITU, 1985, p. 132.

6

EXAMINING FURTHER IMPLICATIONS

This chapter raises questions about the implications of digitization. The scope of international and domestic concerns considered here is far from comprehensive. It is hoped that this concluding look at the topics raised by this paper will bring into sharper focus the political, social, economic, and technological challenges that present themselves in the guise of telecommunications.

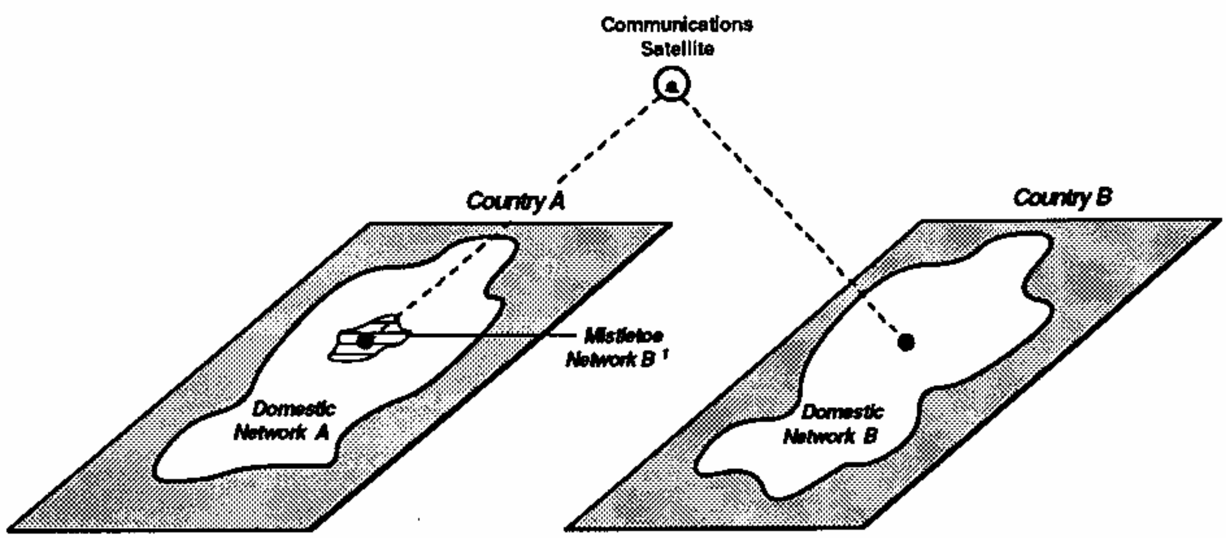
6-1: Diversified Technology and Demand

Offline and quasi-offline alternatives as the principal information carriers seem to have promising futures, especially in residential use and services in which time factors are not crucial. In the applications in which time factors are crucial (for which online system construction is necessary) offline and quasi-offline alternatives may be utilized if substantial regulatory restraints are imposed on the operation of online systems; magnetic-tape swapping among major banks was common in Japan when direct computer-to-computer connections between different firms, via telecommunications conduits, were tightly restricted.

In international telecommunications, where transborder data flow is a central concern, these alternatives may become important in upcoming years. As long as there are effective constraints on online operations, offline or quasi-offline alternative are likely to be utilized to transmit contents restricted under privacy provisos and to send time-insensitive portions (to mitigate the effect of bulk-sensitive tariffs). There will even be examples of complete reliance on offline delivery to avoid restrictions on database access. To some extent, the methods adopted to protect national interests in the late 1970s and the early 1980s, the effectiveness of which has been a subject of much debate, will be challenged. Restrictions resulting from legislation, regulation, and tariff policies may only encourage offline and quasi-offline development to a degree that would have eluded these alternatives were there no such restrictions. The information transmission-dependent industries -- banking, insurance, security businesses, and even telecommunications industries -- would pay in such a balance. As long as the procompetitive policy is effective only in the United States, this challenge is likely to be limited. Transportation costs and time-distance factors in trans-ocean offline delivery would eliminate the advantages of the alternatives. However, Great Britain and Japan have adopted procompetitive telecommunications policies domestically, and it is likely that new international common carriers will emerge before the end of the 1980s in Japan. As of March 1986 Great Britain follows a CCITT recommendation that prohibits the resale of international leased circuits,[1] though this recommendation is being reconsidered.

If those countries with substantial restrictions on transborder data flow intend to maintain that level of protection for their perceived national interests after offline or quasi-offline alternatives successfully penetrate the market, they may be forced to rely on tariff and custom procedures, which a considerable portion of the world's nations have in place for transportation of VCR tapes. Ironically, if these nations fail to develop domestic industries to supply devices and software for offline or quasi-offline services, the services trade problem will be reduced to the status of a conventional trade-imbalance issue as in equipment trade.

The fusion of tandem switching nodes and network gate nodes (local gate nodes and long-haul gate nodes) has considerable potential. The combination of satellite transmission or international fiber-optic cable and sophisticated PABX or limited fully digitized network is making international-scale facility bypass affordable (see Figure 6-1.1) not only for data transmission but also for a spectrum of services including voice communications.



Network B[1] works as a part of network B.

Figure 6-1.1

Potential International Facility Bypass

From the point of view of developing nations, for both telecommunications and related areas such as broadcasting, it is highly unlikely that international facility bypass services will become a reality before the end of this decade. However, with minor modifications, such as PTTs' operating a facility bypass alongside the conventional nationwide telecommunications network, the arrangement presents a possible solution to the financial burden of modernizing and maintaining a network and -- simultaneously -- provides a structural means for industries in deficit-driven countries to cope with increasing telecommunications dependence for market success. If such an arrangement were to be realized, the existing international numbering scheme, and to some extent the very concept of international telecommunications, would have to be transformed.

Standardization. As a presenter at the 1985 World Telecommunication Forum in Washington, D.C., noted, "standardization in the telecommunications field gives all the classical benefits common for all standardization" -- cost reduction, equality of equipment, less lead time, and prevention of possible misconceptions and misunderstanding[2] -- if it is considered on a stand-alone basis. But if current technological and market trends are taken into account, the validity of standardization "benefits" can be questioned:

- Is the time-consuming procedure typically associated with standardization, such as the ISDN standardization effort, worthwhile? Consider that 64Kbit voice coding, which at least partially defines ISDN B-channel bandwidth, is becoming obsolete, and not until 1988 will final ISDN recommendations be endorsed.[3]
- Bearing in mind technological and market trends toward fast-paced diversification and fusion, what method of categorization will allow for economies of scale without blocking technology and market evolution?
- Is standardization in technology and manufacturing, unmatched in telecommunications regulations and regulations in such businesses

as banking, sufficient to achieve the desired degree of standardization?

- Is there any danger that some arguments advocating particular standardization procedures in the name of technological necessity are disguised attempts to protect particular interests?

In addition to the familiar, problematic relationship with the GATT, especially concerning service trade issues, the ITU/CCITT must co-ordinate other institutes' standardization efforts.[4] Another noteworthy political problem for the ITU arose at the Nairobi conference in 1982 -- sharing of the expense and treatment of Israeli-Arab issues.[5] Decisions were postponed until the 1988 World Administrative Telegraph and Telephone Conference (WATTC) at which standardization for the future international telecommunications infrastructure is to be discussed. The 1988 WATTC should be of great interest to all nations.

6-2: Domestic Revisions

Domestic regulation of U.S. telecommunications, which has a history of fluctuations, is likely to undergo yet more change as implementation of the Computer Inquiry III decision begins. This round of revision may have a negative impact on those nations attempting to exert their influence in telecommunications whose regulatory frameworks are not accordingly revised. As the United States Council for International Business pointed out in its comments to Computer Inquiry III:

> The United States has broken new ground in creating a liberal telecommunications environment, with its Computer Inquiry II policies. Some transitional problems have naturally arisen as the telecommunications market in the United States has evolved. On the surface, several proposals contained in the "Notice" are being mistakenly perceived by other countries as a reversal of U.S. policy and an indication that liberalization has failed. Computer

> Inquiry III has been intepreted by many countries as advocating a totally different regulatory framework. We are deeply concerned that some countries will use this inquiry as an excuse to stop liberalization efforts in their own countries.[6]

Despite the dubious aptness of the implied mistakes on the part of other nations, this comment highlights an important impact of domestic reform on the international arena.

Procompetitive policy. U.S. regulators, negotiators, and businesses have occupied the driver's seat so far in the pro/anti-competitive policy debates. Mark S. Fowler, FCC chairman, has commented:

> We're all aware of extraordinary growth in telecommunications during the last decades. Innovations in communications technology have made standard regulatory approaches obsolete.
>
> The Federal Communications Commission has witnessed this parade of technological and regulatory change. In fact, the FCC has been the drum major for regulatory change in the United States. We have concluded that our politics move with the times.
>
> As a result, we've seen in telecommunications a conversion to new ideas, fresh ways of thinking, in a field long thought to be immutably fixed in its workings. Remove what was thought an essential ingredient -- heavy government regulation -- and our domestic telephone system still works. In fact, it works better. The pace of innovation to meet the information needs of our society accelerates. Unfetter the dreamer and the world spins on. The idea is not new, but its application to telecommunications is.[7]

And the United States managed to convince two of its competitors -- Great Britain and Japan -- to introduce procompetitive policies, though their approaches differ considerably from the U.S. approach.

Ironically, as more nations adopt procompetitive policies, the U.S. position vis-a-vis other nations' market policies is destabilized. If a nation achieves a relatively more competitive status than that of the United States, the conventional wisdom will be inverted. Any nation with a trade surplus with the United States, as is the case for Japan, is likely to encounter U.S. charges of excessive competition, such as hidden subsidies for international companies. This argument could also be forwarded by PTT countries, as an outgrowth of the implicit "necessity of universal service as a social contract."[8] Indeed, variations on this theme were heard in the U.S. domestic arena throughout the late 1970s and early 1980s among the FCC and several PUCs.

6-3: Trade Implications

The NTIA in 1985 put forward recommendations for the deficit-ridden telecommunications-equipment trade:

> Absent more affirmative American communications policies, our international trade posture will be eroded further. This possibility can be lessened through adoption of policies that: (1) ensure the trade implications of domestic actions are taken more into account; (2) eliminate or alter the AT&T consent decree's restrictions on Bell Company International activities; (3) remove needless anticompetitive restraints placed on AT&T and the Bell Operating Companies under the FCC's regulations; (4) seek to expand overseas market access on the part of U.S. firms; and, (5) encourage more cooperative research and development activities.[9]

At least where equipment and component production are concerned, the situation is not so simple. AT&T joint ventures overseas, cited in the report as an example for the asymmetric treatment of Bell companies in terms of "line of business" restrictions,[10] betrays the report's theses. As experience in PC equipment trade has clarified,[11] lifting constraints on Bell companies could increase original equipment manufacturing (OEM) purchasing or the importation of parts and components from Japan and from newly industrialized countries (NICs) such as Korea, Taiwan, Brazil, Spain, and Singapore, even if they operate their own manufacturing unit; these imports could undermine the increase in exports, or the reductions in equipment import.

Conversely, the increases in exports to the sophisticated, integrated U.S. market could produce undesirable effects in NICs. In those countries, not only do strict regulations exist to protect still-fragile telecommunications infrastructures and industries that depend on telecommunications industries in more industrialized countries, but demand for sophisticated equipment will remain low, even if existing retrictions are lifted. The NICs would have to produce equipment that cannot be tested in a domestic market, reducing the chance of outgrowing subsidiary status and developing original equipment. And they would be forced to open up their fragile domestic market or at least produce comparable equipment (U.S. actions with Korea and Brazil, based on Article 301 of the 1974 Trade Act, seem to be examples of the latter case). For those countries still struggling with deficits and not prepared for full-scale competition, despite excellent performance in selected sectors, these problems and the urgency of export success will be key factors into the 1990s.

Notes for Chapter 6

6-1 Asahi Research Center. TDF Wozu (TDF Wars), paper supervised by Ministry of Posts and Telecommunications (MPT), Telecommunications Policy Bureau. Tokyo: Shuppan-Kaihatsu-Sha, 1985, p. 94.

6-2 Ito, Youichi and Morikazu Takahashi, "Implications of Japanese Telecommunications Policy: Reform for International Telecommunication," in International Telecommunication Union. Special Session. World Telecommunication Forum Speakers' Papers. Law, Regulation, Standards of Global Communications. Geneva, Switzerland: ITU, 1985, p. 87.

6-3 International Telecommunication Union (ITU). International Telegraph and Telephone Consultative Committee (CCITT). VIIIth Plenary Assembly, Malaga-Torremolinos, 1984. Report of Study Group XVIII, Document AP VIII-94-E, Section I: General Remarks.

6-4 For example, UNCITRAL, BIS, and ISO TC68 in the banking industry. See note 6-2 at 108-109.

6-5 Kokusaitsushin ni Kansuru shomondai (Issues in International Telecommunications), Vol. 29, No. 10, January 1983, pp. 1-13.

6-6 In the Matter of: Amendment of Sections 64.702 of the Commission's Rules and Regulations (Third Computer Inquiry), CC Docket No. 85-299, Comments of the United States Council for International Business, November 13, 1985, p. 3.

6-7 Fowler, Mark S., "'We ARC the World': Interconnection and Imagination," in International Telecommunication Union (see note 6-1 at 197).

6-8 "The World on the Line," The Economist, November 23, 1985, Telecommunications Survey, p. 25.

6-9 U.S. Department of Commerce. National Telecommunications and Information Administration. Issues in Domestic Telecommunications: Directions for National Policy. Washington, D.C.: GPO, (NTIA SP 85-16), p. 182.

6-10 Ibid., p. 39.

6-11 ASCII - A Monthly Magazine of Home and Computer Science, December 1985, p. 207.

Gray, Patricia B. "Asian Computer Firms Invade the U.S. Market for Personal Machines, The Wall Street Journal, January 10, 1986, p. 1.

APPENDIX A: PRE-PRIVATIZATION JAPAN -- TERMINAL MARKET

A-1: The Primary Telephone Principle

Under the former Public Telecommunications Law in Japan, primary telephone services were provided as part of telecommunications services, with pertinent exceptions. PBX, computers, and leased-line service terminals were exempt; these could be connected to NTT's conduit directly or via line-protecting devices; certain types of terminals also could be connected to NTT's network as secondary equipment (see Figure A-1), including key telephone systems and facsimile. Secondary equipment could not be installed without a primary telephone, although enforcement of this primary telephone principle in the case of multiline key telephone systems was relaxed by internal NTT code. Actual connection of customer-provided key telephone systems is illustrated in Figure A-2.

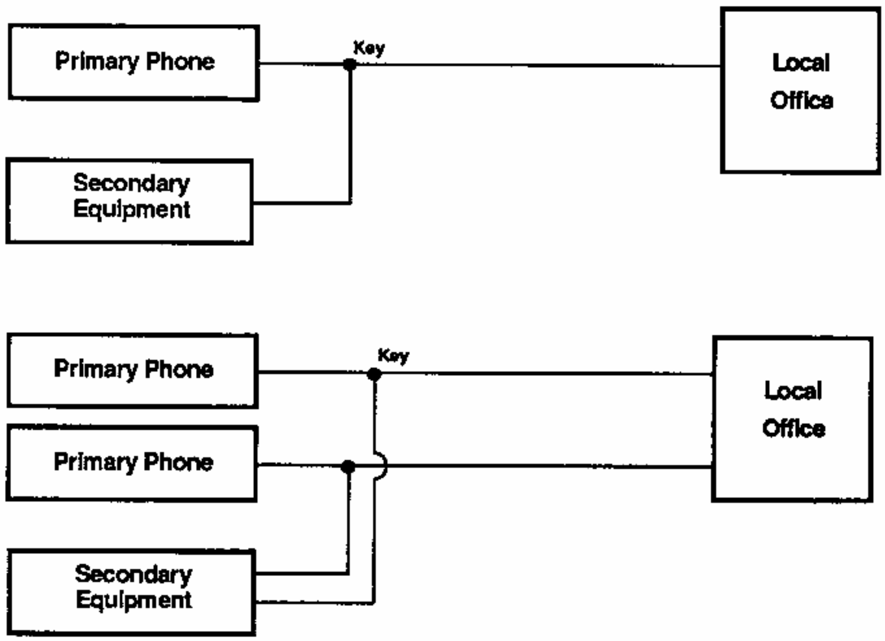


Figure A-1

Connection Method for Customer-Provided Terminals, as Defined by Public Telecommunications Law

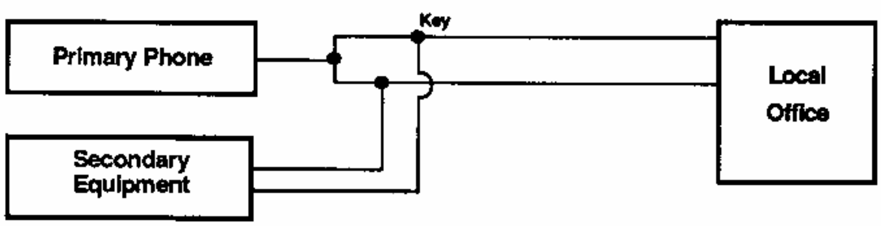


Figure A-2

De Facto Connection Method for Multi-Line Customer-Provided Equipment

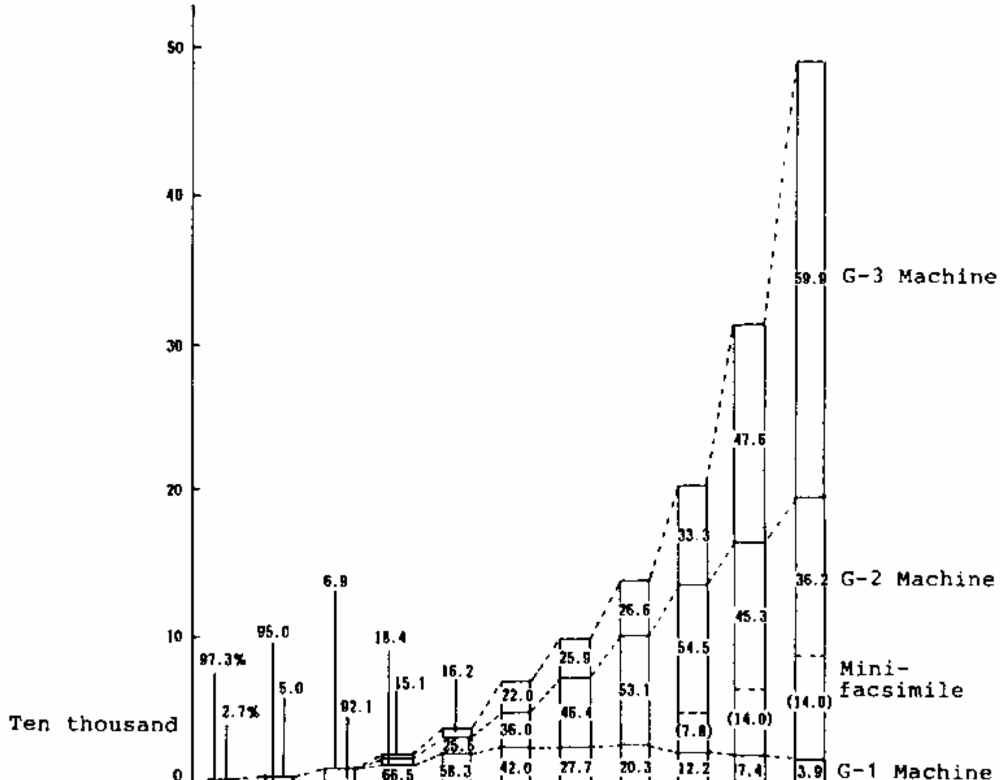
A-2: Respective Terminals

PBX. The large- (more than 500 extensions) and medium- (100 to 500 extensions) capacity PABX markets were dominated by four companies (Fujitsu, Hitachi, NEC, Oki) which also dominated switchboard supply for the NTT network. In the small-capacity (less than 100 extensions) PABX market, along with these four companies, several medium-sized and small companies participated aggressively. Most of the latter are telephone and key-system providers for NTT and are strong competitors of NTT in the key-system market. The small and diminishing PMBX (private manual branch exchange) market had few active suppliers (NTT and one small company for the last decade). Except in the PMBX market, NTT's status in PBX was marginal; it did not market large-capacity PABX for many years, though for its large customers, NTT marketed CENTREX. Even counting CENTREX customers among NTT's total of PABX customers, NTT's share in the PABX market was approximately 15%, ranking third or fourth in market share.

Until ROLM entered the market with its digital PABX in 1983, there was no foreign participation in the PBX market. ROLM's role in the market was nominal, until 1984, when NTT decided to procure large-capacity PABX from ROLM and Northern Telecom to re-enter the long-deserted market; and 1985, when Mitsubishi Electric, a major electrical equipment supplier with no historical interest in the telecommunications equipment market, decided to market ROLM's digital PABX.

Key Telephone Systems (KTS). Until the mid-1970s KTS was dominated by NTT. Other suppliers remained marginal, though competition had been admitted at its inception in the '60s. At its height in 1975, NTT's market share topped 80% in sales and 70% in usage. Then NTT's downturn began. Armed with new equipment -- electromechanical microchip-oriented hybrid machines and then fully microprocessor/microchip designs (offcall electronic-key telephone systems, or EKTS) -- major telephone and KTS suppliers to NTT and Matsushita Eletronic aggressively marketed in the mid-'70s. Lagging in the introduction of new equipment and burdened with the inflexible lease-fee tariff, NTT watched its market share fall off; embedded electromechanical equipment was especially vulnerable to replacement. In 1983 the amount of canceled equipment equaled the amount of newly contracted equipment as competition hit its peak. On the eve of privatization, competition was stalemated. As of mid-1986, NTT retains its lead position both in sales and in stock. However, its market share has dropped to around 40% (both in sales and stock), and no one company has a decisive competitive edge.

Facsimile. The distinctive characteristics of the facsimile market are an accelerated growth rate and extremely short life cycle of each generation of equipment (see Figure A-3.) Even within a given generation of equipment, advances in transmission speed are encouraged by the time-sensitive rate structure and competition. Relative newcomers in the telecommunications-equipment field, such as Matsushita and copy-machine suppliers RICOH and CANON, played major roles in competition with their highly sophisticated equipment. NTT held onto its substantial market share but its sales activity became marginal, except for sales of the minifax (an inexpensive machine tailored to transmit up to greeting-card size and developed to interoperate with NTT's facsimile network).



Fiscal Year End		'73	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83
No.of the Installed		3,700	6,000	11,400	21,800	39,600	64,600	98,800	138,500	203,200	311,400	486,500
Break-down	G-1 Machine	3,600	5,700	10,500	14,500	23,100	27,100	27,100	28,100	26,700	22,000	19,000
	G-2 Machine	100	300	900	4,000	10,100	23,300	45,800	73,600	110,700	141,200	176,200
	G-3 Machine	–	–	–	3,300	6,400	14,200	25,600	36,800	67,800	148,200	291,300

(Notes) 1. G-2 machines after '81 include mini-facsimile machines
2. Number in bar graph indicates the ratio of each machine

Source: Miyakawa, Hiroshi. "Research and Development Targets of Telecommunications Technologies in the Age of Diversified Tele-communications Service," NTT International Symposium 85, Tokyo, 1985, Sec. 21, p. 16.

Figure A-3

Number of Facsimile Machines Using the Telephone Network (Japan)

Leased line terminals. The only terminals NTT marketed for leased-line service involved fundamental telephone equipment. Sales of sophisticated equipment such as multiplexers and signaling units were dominated by four switchboard and large-PABX manufacturers -- Fujitsu, Hitachi, NEC, and Oki. Strictly speaking, NTT offered equipment such as multiplexers via bundled base as a part of its telecommunications system in some restricted cases. However, its role was nominal.

NTT's data-communications service. In pre-privatization days, NTT could only market computers, terminals, and other related equipment as bundled services along with necessary conduits. NTT could not sell hardware and software independently, a tradeoff for monopoly in intercompany data-communications services. Except for intercompany and time-sharing services, NTT's activity in data communications was marginal. (For a detailed discussion of the regulatory history of data communications, see Appendix B.)

A-3: The Overall Market

In spite of the existence of the primary telephone principle, the business-telecommunications equipment market was competitive even before privatization. In the residential telephone market, which NTT monopolized until March 1985, sales were below expectations even after April 1985; new participants in the residential telephone market were reportedly reconsidering their market tactics at the end of 1985. The role of personal computers and word processors as telecommunications terminals in the pre-privatization market was virtually nonexistent. This strict regulatory practice was blamed for discouraging alternative use in telecommunications, although Appendix C presents a different perspective on this issue.

APPENDIX B: TELECOMMUNICATIONS REFORM IN JAPAN

B-1: Constraints

In 1971, strict constraints on the use of lines, both switched and private, were relaxed to allow private companies to operate online data-transaction transmission (data communications) services. Although several strict constraints prevailed, various data communications services and businesses gradually appeared.

Party usage of computers via online and offline for data-communication purposes, and direct connection of variously owned computers via online, were severely restricted. Switching services for the third party were the province of NTT and KDD only.

By the end of the decade data communications users and service providers began to feel that their regulatory framework was too tight. They adopted from Computer Inquiry II (then ongoing in the United States) the prototype of their revisional plan -- abolition of line-usage restrictions and permission to offer enhanced services. (Those services came to be called "VAN.") Although they accepted the U.S. model as the prototype, Japanese companies' procedures and applications distinguished the model from both U.S. enhanced services and value-added services -- thus the use of quotation marks in Japanese telecommunications revision procedure references to VAN. (See Appendix D for details of the transformation of the meaning of the word VAN.)

The dispute began as a search for the appropriate relaxation of the regulational framework for data-communications purposes. Switched voice telecommunications service was regarded as a sacred sector to be monopolized until privatization of NTT became plausible and the idea of competition in trunk-transmission services was introduced by the Provisional Commission for Administrative Reform (PCAR).

In August 1981, an ad hoc consulting body to the MPT, the Telecommunications Advisory Council, submitted a report, "A Vision of Telecommunications Policy in the 80's." The controversial document covered a wide range of topics, from the urgent to the long term. A synopsis of the report that later became the basis of the aborted "VAN" act follows:

- Restriction of line usage for data communications should be lifted.
- Existing restriction of data communications services for the third party, such as prohibition of message-switching service, should be abolished to open those services to companies other than NTT. New, streamlined laws for these service providers should be established.
- To avoid cross-subsidization, strict regulatory practices, such as separate accounting procedures for monopoly and competitive services, should be applied to the existing carriers, NTT and KDD.
- Extremely distance-sensitive tariff on NTT for data-communications private lines (identical to the ordinary private-line tariff and proportional to the long-distance tariff) should be treated separately from other tariffs and gradually be made proportional to actual costs.[1]

The MPT developed the required revision of the Public Telecommunications Law and drafted the "VAN" act in December 1981. This proposed bill met severe opposition, especially from the Ministry of International Trade and Industry (MITI), before the act reached the Diet; MPT finally gave up on the "VAN" act. Revision of the Public Telecommunications Law, including the abolition of line-usage restrictions for data-communications purposes and limited liberalization of the "VAN" business, restricted to services for small businesses, finally came about in October 1982 as a compromise.

B-2: Privatization Urged

To trim the administrative structure to cope with increasing financial deficit, the PCAR was established by the Japanese government in March 1981. The committee submitted its first interim report in July 1981, declaring that "This committee will explore the future administrative structure of NTT, including the nature of the current public corporation system, possibility of privatization, etc. . . ."[2]

The third interim report of the PCAR, submitted in July 1982, was almost identical to the final report in its position on NTT's administrative structure. In the March 1983 final report, NTT was to be divested into a central company owning long-line trunk-transmission facilities and several local companies providing telecommunications services at local areas. All these companies were to be privatized. In addition, procompetitive policy was introduced in the long-line trunk-transmission arena. CPE, data communications service, and part of the maintenance division were to be separated from the body of NTT before divestiture. And to avoid service differences among local companies, the distance-sensitive tariff structure was to be revised and made cost proportional; appropriate division of revenues between companies was to be institutionalized.

The committee's proposal was heavily influenced by the contemporary U.S. movement, Computer Inquiry II, and by the Modified Final Judgment. It was reasonable, therefore, to assume that the concept of the basic/-enhanced dichotomy lay beneath this report, if only implicitly.

B-3: Line Owned/Not Owned Dichotomy

In November 1982, another *ad hoc* consulting body to MPT issued a report with the first mention of the line owned/not owned dichotomy.[4] After the final report of the PCAR was submitted, yet another consulting body to MPT took up this dichotomy, later known as the Type 1/Type 2 dichotomy.[5] Those reports forwarded the idea of introducing pro-competitive policy in trunk transmission under the influence of the PCAR. They fell short of introducing full-scale competition by permitting resale of basic services, which is the logical consequence of the Type 1/Type 2 dichotomy.

Divestiture and separation of several divisions (mainly CPE or data-communications related divisions), proposed by the PCAR, were finally dropped and a remodified structure was instituted as a tradeoff.

After a long and fierce dispute and a compromise involving sister ministries and the leading Liberal Democratic Party (LDP), in August 1984, MPT submitted to the Japanese Diet the NTT Corporation Act (NTT Co. Act), the Telecommunications Business Act (TB Act), and an act related to the execution of the NTT Co. Law and the TB Law. The acts passed the Diet in December 1984, and took effect on 1 April 1985 (see Appendix D). The Diet and the U.S.-Japan MOSS Negotiation produced several noteworthy nonlegislative revisions late in 1984 and early in 1985:

First, as the logical consequence of the Type 1/Type 2 dichotomy, under the proposed TB Act, there is no distinction between Type 1 telecommunications business (Type 1 Business) and Type 2 telecommunications business (Type 2 Business) as concerns service provision. Type 2 Business, considered identical to "VAN," was the subject of a nonbinding resolution. "Considering NTT's current rate structure on private-line services, simple resale of private lines by Type 2 Business endangers NTT's management. Therefore, MPT should accept NTT's tariff in order to prohibit simple resale of private lines".[6] Although vague as to the definition of resale, the controversy was temporarily quelled by the belief that Type 2 Business is identical to the "VAN" and by the ambiguity of the new legal framework.

Second, NTT was prohibited from the manufacture of telecommunications equipment for the near term as the result of another nonbinding resolution attached to the TB Act.

Third, Type 2 Business was divided into two categories, General Type 2 Business and Special Type 2 Business, by certain criteria. Under the TB Act, considerable regulatory differences exist between General and Special Type 2 business. Most of the criteria were left to the governmental ordinance to be developed after passage of the acts. As the result of the U.S.-Japan MOSS negotiation, the initial criteria were relaxed (see Chapter 2 and Appendix D).

Fourth, MPT's ordinance for technical standards for CPE, which took effect on 1 April 1985, also was considerably relaxed as a result of the U.S.-Japan MOSS negotiation.

Notes for Appendix B

B-1 Denkitsushin Seisaku Kondankai, ed. 80 nendai no Denkitsushi Seisakuuno Arikata (A vision of telecommunications policy in the 80's). Tokyo: Dai-ichi Hoki Shuppan, 1981, pp. 39-65.

B-2 "Dai-ichiji Toshin, Rinji Grosei Chosakai" (Provisional Commission for Administrative Reform. First Interim Report, July 1981), in: Japan. Fair Trade Commission. Economics Division. Atarashi-i Joho-Tsushin to Dokusen Kinshi Seisaku. (New information-communications and antitrust policy). Tokyo: Gyrosei Co., 1985, p. 121.

B-3 "Dai Sanji-Kihon-toshin, Rinji Grosei Chosakai" (Provisional Commission for Administrative Reform. Third and principal report, July 1982), in: Japan. Fair Trade Commission. Economics Division. Atarashi-i-Joho-Tsushin to Dokusen Kinshi Seisaku. (New information-communications and antitrust policy). Tokyo: Gyrosei Co., 1985, pp. 121-123.

B-4 Denden Kosha Keiei Keitai Mondai-to Chosa Kenkyu Kai, ed. Kokunai Koshu Denki-tsushin Jigyo no Keiei Keitai-to ni kansuru kenkyu. (A study on administrative structure of domestic public telecommunications industry). Tokyo: Teishin Bunka Sha, November 1985, p. 32.

B-5 Denkitsushin Shisutemu no Syoraizo ni kansuru Chosa kenkyu kai, ed. 21 Seiki no Denkitsushin (Telecommunications in the 21st century). Tokyo: Nihon Keizai Shinbun Sha, October 1983, p. 99.

B-6 Computopia, Vol. 18, No. 217, October 1984, p. 69.

APPENDIX C: LANGUAGE AND ALPHABET IN JAPAN

Unlike European, Arabic, and Indian languages, the East Asian system developed under the influence of the Chinese ideographic writing system. Variations on the Chinese system range from slight modification to the invention of phonetic characters and virtual abolition of Chinese character usage according to each language's structure and history.[1] In modern Japanese, the phonetic character system (approximately 50 characters) and several thousand Chinese characters are used to produce ordinary documents. Following are the major characteristics of modern Japanese and its writing system.

Nouns, stems of verbs, and adjectives are usually written with Chinese characters. Some adverbs are written with Chinese characters, although the writing system set by the government council recommends rendering them in one form of phonetic characters (hira-gana).

Other parts of speech, such as auxiliary verbs, inflections for verb endings, and adjectives are written in hira-gana. Nouns, stems of verbs, and adjectives of distinctly native origin are rendered in hira-gana.

Words borrowed from European languages are usually written in the other form of phonetic characters (kata-kana). Words that reflect particular sounds (onomatopoeia) and simulate particular situations (mimesis) are also rendered in kata-kana.

In short, the modern Japanese writing system is complicated and may look clumsy from the Western point of view. However, this system solves possible ambiguity caused by the existence of numerous homonyms, applying different Chinese characters (or different combinations of Chinese characters) and avoiding the necessity of separating words.

Modern Japanese could be written with either Japanese phonetic characters or the Roman alphabet by adopting word-by-word separation. Such reforms were advocated several times since the late 19th century, but the proposition was never taken into serious consideration -- the various outcomes were largely incomprehensible.

As readers can easily imagine, it was extremely difficult to make a dependable, mechanical Japanese typewriter within an affordable price margin. So, two types of typewriter, with respective limitations, came onto the market as compromises. One type of machine could type mixed-mode Japanese. However, the ideographic capability was limited and its operation was so complicated that only trained people could utilize it. The other machines could handle only two phonetic characters; its use was very limited.

Even after the computer was introduced, input-output by a full set of Japanese characters was long unavailable, due to the lack of font-memory for output and efficient kana-kanji (phonetic-ideographic) conversion for input.

Until the early 1980s, Japan was forced to rely on handwriting for documentation of daily business activities, and documents even at the higher levels of decision making were handwritten until the final draft stage.

The hand-rendering practice was incompatible with the European/ American counterparts. Secretarial jobs, vertical filing, and dictation devices did not exist in any practical sense in Japan. Photocopying, and before that, printing, was indispensable. Filing was possible only on an individual or, at best, a small-group basis. Revision of hand-written documents was routine. Facsimile immediately advanced to a prominent position after its introduction into interoffice communication. Thus began the fierce competition in the facsimile market.

With the rapid development of microchip memory capacity and kana-kanji conversion software, the Japanese word processor was realized. In spite of its short history, the fourth-generation machine is on the market and prices continue to fall; a low-end, limited-capability, portable machine is priced in the $200 to $250 range in 1986 -- $600 to $800 only a year earlier.[2] While popular, the word processor is not yet a fixed product.

Personal computers (PC) on the market have a capacity more or less equal to that of the Japanese word processor when used with factory-provided or independent software. (Interestingly, the Apple machines finally achieved Japanese word processing capability by the summer of 1985, although this capability had been a requisite feature for market success since the early 1980s.) Furthermore, despite the availability of word processing software for PCs, dedicated word processors dominate the market, for such reasons as easy handling of the Japanese language and lower price.

Although a type of keyboard compatible with the PC is dominant, most of these dedicated word processor keyboards provide for make-by-make modification, adding various function keys to facilitate kana-kanji conversion. This prevents cooperative literacy among word processors, added to the fact that several keyboards are not compatible with PC keyboards.

Memory devices, such as floppy disks, usually are not compatible with different makers' machines. As the popularity of word processors increases, these problems become more evident. But since word processors lack transmission capability, compatibility shortcomings only affect the enthusiast. Almost every low-end machine is marketed with the idea of adding a printer, not of memory devices or transmission interfaces.[3] Even with expensive word processors and PCs that are reported to have transmission interfaces, telecommunications protocols sometimes must be written in machine language; it is almost impossible for ordinary customers to use such interfaces. This trend indicates that these devices are used for applying finishing touches and that the introduction of PCs and word processors has only slightly changed existing business practice. In short, transmission capability is not yet necessary for business practice. Of course, the development of these devices has just begun.

Notes for Appendix C

C-1 Nishida, Tatsuo. Kanji-Bunkaken no Shikochizu (Conceptual framework for the world of Chinese ideographics). Tokyo: PHP Kenkyusho, June 1984, introduction.

C-2 Yomiuri Shinbun, February 5, 1986, pp. 6-7.

C-3 Ibid.

APPENDIX D: "VAN" -- U.S. INFLUENCE ON JAPAN

Since the first stage of the dispute over line-use liberalization, the notion of "VAN" has been somewhat ambiguous. Most of the prevalent interpretations fall into two groups.

The first group can be summarized as a network that offers telecommunications services with added features while leasing and utilizing common carriers' conduits. This notion, one of the earliest and simplest versions, appeared in the Policy Designing Forum (a private group of influential scholars) proposal of 1980; a similar definition was adopted for the glossary of <u>Telecommunications in the 21st Century</u>,[1] edited by an <u>ad hoc</u> consulting body to the Ministry of Posts and Telecommunications (MPT).

The second group is typified by a definition from a major industry publication, <u>Nikkei Communications</u>: "'VAN' is a network that offers protocol conversion, format conversion, transmission-speed conversion, code conversion, media conversion, or electronic-mail service in the process of telecommunications."[2]

"VAN" in Japan gradually lost the link with the original words "value-added network" as the dispute over line-use liberalization continued. With the introduction of Type 1 and Type 2 business, as explained in <u>What is the VAN</u>, "if you want to place a call from Tokyo to Osaka using the phone in your home, you can choose among carriers, for example, by dialing 06 via NTT, 1116 via JNR, 1226 via 'VAN-A,' and their service levels and rates differ."[3]

On the eve of reform, such expressions as "Type 2 ('VAN')" were popular in newspapers and magazines; "NTT's Type 1 service sector and

Type 2 service sector should be divested," was printed as a formal proposal to the MPT.[4]

After the reform, the equation of "VAN" and Type 2 Business inhered; the resale for voice communication was even considered to be the major feature of the "VAN" business. The clumsy confusions about "VAN" persist.

It is not surprising that U.S. observers of Japanese telecommunications reform were often confused, tending to regard Type 2 services as similar to the U.S. enhanced services[5] (although the two notions are not similar at all; see Chapter 2).

A simple definition suffices to allay confusion. Any telecommunications-service provider that offers services defined as enhanced services within the U.S. regulatory framework is defined as a Type 1 Business if the provider owns the lines used in the network.[6]

Notes for Appendix D

D-1 Denkitsushin shisutemu no Syoraizo ni kansura Chosa kenkyu kai, ed. 21 Seiki no Denkitsushin (Telecommunications in the 21st century). Tokyo: Nihon Keizai Shinbun Sha, October 1983, p. 192.

D-2 Nikkei Communications. Tokyo: Nikkei McGraw-Hill Books, 1984, p. 37.

Another version appeared in:

"Deta-tsushin Jiyuka ni Tsuite" (Liberalization of Datacommunications-media briefing by MPT, Dec. 1980), in Nihon Data-tsushin Koykai, ed. Deta-Tsushin (Datacommunications). Tokyo: Dai-ichi Hoki Shuppon, February 1983, p. 388.

D-3 Aoi, Koya. Van Towa Nanika (What is VAN?). Tokyo: Nihon Keizai Shinbun Sha, August 1984, p. 171.

D-4 "Ware ware no Yotsu No Teian": by Seisaku Forum (Our four proposals: by Policy Forum, March 1984), in: Japan. Fair Trade Commission. Economics Division. Atarashi-i Joho-Tsushin to Dokusen Kinshi Seisaku (New information-communications and antitrust policy). Tokyo: Gyrosei Co., 1985, p. 126.

D-5 Foster Associates, International. Draft Legislative Analysis: Telecommunications Enterprise Act. Tokyo: Foster Associates, 1984.

D-6 For a detailed discussion, see Shukunami, Tatsushiro. The Race for Value-Added Services: Challenges and Opportunities in the U.S., Japan, and U.K. Cambridge, MA: Program on Information Resources Policy, Harvard University, Draft, 1987.

ACRONYMS

ARM	Administration Reform Movement
ATM	automated teller machine
ASCII	American Standard Code for Information Exchange
BIS	Bank for International Settlements
CAI	computer-assisted instruction
CAPTAIN-PLPS	Character and Pattern Telephone Access Information Network - Presentation-Level Protocol Syntax
CCITT	International Telegraph and Telephone Consultative Committee
codec	analog/digital coder-decoder
CPE	customer premises equipment
CPTF	customer-provided telecommunications facilities
DDX	digital data exchange
DRAM	dynamic random access memory
DTS	digital termination systems
FCC	Federal Communications Commission
GATT	General Agreement on Tariffs and Trade
INS	Information Network System
ISDN	Integrated Services Digital Network
ISO-TC 68	International Standards Organization - Technical Committee 68
ITU	International Telecommunication Union
IX	interexchange
KDD	Kokusai Denshin Denwa Co.
KTS	key telephone system
LAN	local area network
LDP	Liberal Democratic Party
LSI	large-scale integration
MITI	Ministry of International Trade and Industry
MOSS	Market-Oriented Sector Selectives
MPT	Ministry of Posts, Telegraph and Telephone
MTS	message telecommunications service
NAPLPS	North American Presentation Level Protocol Syntax
NICs	newly industrialized countries
NTIA	National Telecommunications and Information Administration
NTT	Nippon Telegraph & Telephone Corporation
OEM	original equipment manufacturing
OCCs	other common carriers
PABX	private automatic branch exchange
PC	personal computer
PCAR	Provisional Commission for Administrative Reform
PCM	pulse code modulation
PLPS	presentation level protocol syntax
PMBX	private manual branch exchange
PTT	Postal, Telegraph, and Telephone Authority
RPOAs	Recognized Private Operating Agencies
TBDF	transborder data flow

ACRONYMS (continued)

TB Law	Telecommunications Business Law
TF	terminal facilities
TSS	time-sharing system
UNCITRAL	United Nations Commission on International Trade Law
VAN	value-added network
VLSI	very large scale integration
WATS	wide area telecommunication service
WATTC	World Administrative Telegraph and Telephone Conference