"Japanese Telecommunications as Network Industry: Industrial Organization for the BISDN Generation Technology"

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Abstract

This study proposes a new industrial structure for the Japanese information infrastructure in the 21st century. The proposed industrial organization has a hierarchical structure with five layers, each of which corresponds to a functional description of BISDN technology. Each layer is then assigned a market structure (i.e., competition, regulated competition, or regulated monopoly). The proposed industrial organization can serve as not only a backbone of the BISDN-based information infrastructure but also as a conceptual framework for guiding the NTT divestiture planned for 1995.

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Introduction

The Nippon Telegraph and Telephone Public Corporation (NTT) was privatized in 1985. The NTT privatization produced a new competitive telecommunications market in which New Common Carriers (NCC) entered into all telephone businesses except local telephone services. Immediately after the NTT privatization, the Japanese government attempted the divestiture of NTT in 1985 and 1990 but was unsuccessful each time. (NTT management, labor unions, business leaders in other industries strongly disagreed with the NTT divestiture.) A new governmental review of the NTT breakup is scheduled for 1995.

The purpose of this article is to discuss a new industrial structure for the Japanese telecommunications industry in the 21st century. The new industrial structure, based upon developments in telecommunications technology, is an important research issue because NTT announced in 1992 that it would install fiber-optic cables and provide Asynchronous Transfer Mode (ATM) services nationwide. The nationwide fiber-optic network, using Broad-band Integrated Services Digital Network (BISDN), is expected to serve as the basis for the Japanese telecommunications infrastructure in the next century.

In an effort to explore the characteristics of this new Japanese information infrastructure, this article discusses which industrial structure is the best for users and common carriers (including NTT and other NCC). This study utilizes a functional description of the BISDN hierarchical network technology as a basis for describing and evaluating the industrial organization for Japanese telecommunications. This technology approach has not been fully explored in conventional studies on the industrial organization.

This article is organized as follows: the next section describes the hierarchical structure of BISDN technology. The third section presents various possible industrial structures for organizing this new technology in the future Japanese telecommunications market. Markets can be organized by region, distance (local, long-distance, and international), a service, or through vertical divestiture. The fourth section evaluates these various industrial structures and concludes that vertical divestiture is the best way to realize the benefits of competition and universal service. The fifth section then compares this ideal industrial structure with the actual structure of the Japanese telecommunications industry. Concluding remarks and future work are discussed in the final section.

BISDN Technology: Hierarchical Structure

BISDN is an integrated telecommunications network, with bandwidth capabilities from

165 (Mb/s) to 600 (Mb/s). This broad-band capacity incorporated in BISDN makes it possible that multiple users exchange image information produced by TV and HDTV (High Definition TV). BlSDN is a total communications services network, including voice, image, picture, FAX, and data (such as E-mail and file transfer) communications.

The basic technology of the BISDN includes (l) large-scale implementation of optical fiber, (2) ATM, and (3) various terminals which are particular to different users' needs. The basic BISDN technology is functionally structured by the Comite Consultatif International Telegraphique et Telephonique (CCITT) of International Telecommunications Union (ITU). This CCITT specification classifies the BISDN structure by four hierarchical layers: physical layer, ATM layer, AAL (ATM Adaptation Layer) and upper layers 1 and 2. [The International Standard Organization (ISO) proposes another classification, referred to as "Open System Interconnection," in which the BISDN could be structured by seven layers.] Following the CCITT guideline regarding BISDN, Table 1 lists these five layers with descriptions on their service functions.

Insert Table 1

The bottom of Table 1 starts with the physical layer which consists of optical fiber cables and other types of cables as the physical communications media. This physical layer treats different signal transmission methods within its layer so as to transmit cells in a standardized format.

Next, the ATM layer sends information in a cell format to a receiver. The ATM layer focuses upon the function of transmission/exchange of information cells between entities in the layer. This layer is designed to enhance the entire network communications efficiency by effectively dealing with a large amount, and various types, of cells. The ATM does not have any information regarding what media transmits information cells, because it is a task of the physical layer. The ATM layer does not need to know the content of information, because it is a task of its upper layer referred to as AAL. Thus, an important feature of the CCITT-BISDN system is that the system incorporates a cell network layer, named the ATM layer, in its hierarchical structure. The layer focuses upon only the transmission/exchange of cells as a basic function of telecommunications.

The layer above the ATM is referred to as AAL (ATM Adaptation Layer). This third layer of the CCITT-BISDN structure separates information formats (e.g., voice, image, ordinal data, or special data on transmission control/management) and distinguishes logical transmission

paths between users. The AAL transforms voice, image, data, and other forms of information, sent by an information source, into cells, adds them with these addresses and priorities, and transmits these cells to the ATM layer. Conversely, a receiver changes the cells sent from the ATM layer to voice, image, and data at the AAL level. Thus, the AAL needs to know information regarding an original information format, a sender, and a receiver. These data sets, in cell-transformed-signals, also convey not only the starting and ending periods for communications but also the context of information formats and transmission methods. The ATM and AAL are not separated in the conventional analog telephone network. Meanwhile, the two layers are separated in the BISDN, because the ATM needs to focus upon the cell transmission, a main function of BISDN, so as to increase the entire network efficiency. The AAL deals with other tasks. Thus, network lines and transmission machines execute the ATM task, while network terminals perform most of the AAL task so as to reduce the load of ATM.

The top layer of BISDN is named "upper layer" which is further classified into upper layer 1 and upper layer 2. The classification between the two layers depends upon its content, as presented in Table 1. The upper layer 1 supplies a specific BISDN service as an information conveyer, not having any relationship with an information context. The services of this layer include TV conference, telephone meeting with document transmission, E-mail, image transmission, broadcasting (broadcasting function without program development and supply) and LAN (Local Area Network) / WAN (Wide Area Network).

Meanwhile, the upper layer 2 provides an information service associated to a specific information content. This layer provides services such as development and supply of VTR/TV programs, maintenance of TV program library, and enhanced services (e.g., database, medical service, and TV education).

As presented above, the BISDN services can be hierarchically structured by these four layers. Thus, Table 1 separates the telecommunications services in the (upper and lower) vertical classification. An advantage of vertical separation is that it can achieve the standardization and simplification of information transmission, consequently minimizing the negative influence due to a system change. Thus, the vertical diversification is essential for the enhancement of system efficiency and innovation.

Alternatives for Japanese Telecommunications Market

Before discussing an ideal industrial structure for the BISDN technology in Japan, this article needs to present several alternatives regarding the Japanese telecommunications market.

The strengths and shortcomings of each alternative are comparatively discussed in this section.

The industrial organization for the future telecommunications infrastructure should focus on a market structure where common carriers provide BISDN services. Historically, a single public firm (NTT) provided Japanese telecommunications services under close governmental regulation and control. However, in an effort to obtain the economic and social benefits produced in a competitive market, many industrial nations divested their telecommunications markets, and regulated monopoly was shifted to competition. In the new less-regulated markets, many common carriers started new types of telecommunications services, all of which were not available in the monopolistic market. Such an example may be found in the United States. The Bell System was broken into multiple common carriers. It is widely known that the AT&T breakup allowed for the creation of many new services and companies in the U.S. communications industry. Hereafter, this study classifies the telecommunications market using several criteria, as presented in Table 2.

Insert Table 2

The first criterion for market segmentation is a regional separation by which the telecommunications market is classified into domestic and international services. The domestic services may be further classified on the basis of regional or prefecture-oriented segment (corresponding to "States" in the United States). The second criterion employs a telecommunications distance. That is, the telecommunications market is classified by local, long-distance, and international telecommunications services. The combination are the conventional criteria for organizing the provision of telecommunications services.

In addition to the region and distance criteria, this study can separate the telecommunications market by the type of services provided. For example, telecommunications services are separated into transmission services and user-access services. The user-access services can be further broken down into public switched telephone service, local network service, and wireless telephone service. This study is aware of the fact that there are many different types of telecommunications services. Therefore, this classification into transmission and user-access services is one of many possible market segmentation schemes. Another example of the service divestiture is to classify the telecommunications market into voice and image services. Finally, market divestiture could also include a vertical separation of telecommunications services: enhanced and basic services. It is also possible to use a combination of two criteria for market

divestiture. Table 3 depicts possible four schemes with different combinations of two criteria.

Insert Tables 3(1), (2), (3) and (4)

Table 3(1) is a combination of service and regional classification schemes. In this table, the Japanese telecommunications market is classified into multiple regions with alphabetical symbols (A, B, C, and others), each of which is further separated on the basis of user-access, transmission, and other services. This model reflects the current Japanese telecommunications market. Table 3(1) uses three types of symbols: RM (Regulated Monopoly), RC (Regulated Competition), and C (Competition). The symbol RM stands for the regulation towards monopolistic NTT services that provides all the divested regions with various user-access services through a public telecommunications network. Furthermore, wireless communications service is provided in multiple regions. As presented by the symbol RC, common carriers compete with each other in the divested markets within the framework of governmental regulation.

Table 3(2) indicates a market divestiture by the combination between vertical service segment (i.e., enhanced and basic services) and communication distances (i.e., local, long and international). This is another example for the market divestiture. The enhanced service in a local market is supplied in the form of a perfect competition (C), while minimal regulation is applied to the international enhanced services market. Furthermore, basic service in a local market is monopolistically supplied by NTT, while basic service in toll and international services are under regulated competition (RC).

Tables 3(3) and 3(4) describe market segment schemes obtained by the application of distance and regional criteria. Table 3(3) visually describes the current Japanese telecommunications market. Both toll and international telephone services are under regulated competition, while the local market is monopolistically supplied by NTT. Table 3(4) denotes an NTT divestiture plan in 1990. As indicated in Table 3(4), NTT was to be regionally divested in its local market.

Tables 2 and 3(1)-(4) visually describe some of theoretically possible alternatives regarding the market divestiture for restructuring the Japanese telecommunications market. The research objective of this study is to explore the most desirable industrial structure for the future Japanese telecommunications infrastructure in the context of the BISDN technology development.

Desirable Industrial Organization for BISDN

Competition and regulation

The essential policy issue underlying industrial organization for telecommunications is how to maintain a balance between the benefits produced by a competitive market and other benefits, public and private, due to economies of scale. Competition of multiple suppliers in a perfect competition market or an oligopolistic market is expected to produce desirable results such as price reduction, service enhancement, and the creation of new services. Meanwhile, a large-scale common carrier can achieve economies of scale and economies of scope. Consequently, the common carrier can reduce its production cost and enhance various benefits due to the large-scale operation. Furthermore, the common carrier can more easily pursue public goals including providing universal services, technical standards, investment for risky research and development, ability to absorb more financially risky investments, protection of communication rights and public regulation. Such public goals are most easily achieved in a regulated monopoly market, while an oligopolistic market can more easily achieve these social benefits than a competitive market. Therefore, a tradeoff between competition and monopoly/regulation needs to be always considered in investigating what market structure is the best for telecommunications services. In part, the market structure depends upon the number of common carriers and the type of regulation.

Vertical divestiture

As an ideal framework for market segment, this article proposes the use of a vertical divestiture, separating the telecommunications market into hierarchical service layers. This approach is expected to produce simultaneously both benefits due to competition and regulated monopoly. This study considers that the vertical divestiture yields the best market structure for future Japanese BISDN development, after determining the type of market regulation for each layer in terms of maximizing the entire network performance.

However, this type of vertical divestiture has several strengths and weaknesses. This article needs to describe all of them. First, the economies of scope may be lost through vertical divestiture. For example, when enhanced and basic services, operated and controlled by a single common carrier, are divested and owned by several firms, these firms must pay a technological interface cost, an operations cost, and an accounting cost. Moreover, since the existing telephone network in Japan was designed and constructed without vertical divestiture in mind, this type of vertical divestiture may produce some extreme inefficiencies in network operation. In this sense, it is not realistic for NTT to be broken into firms with some owning telephone lines and other

firms providing basic services.

Meanwhile, the vertical divestiture has some benefits: First, telecommunications services are classified into several hierarchical layers where similar services are operated in each hierarchical layer. Thus, it is easy to promote competition within each hierarchy. It is also easier to implement governmental regulation. Furthermore, these homogeneous services within a hierarchical layer produce simple business transactions and yield reduced service transaction costs between the upper and lower layers. Consequently, firms in each hierarchy can have a simple accounting structure and, therefore, an auditor can easily identify internal and external cross-subsidiaries. Second, when the vertical divestiture is executed, services at each hierarchy are provided across all the regions to the entire Japanese economy and therefore can potentially achieve economies of scale. More importantly, Japanese government can increase its regulation influence by focusing upon the regulation at a specific hierarchy level. Third, the market price of telecommunications services is determined by the summation of added-value prices at each divested hierarchy level. Selecting an appropriate mixture between a competitive market structure and regulated monopoly at each level, a value-added price due to regulated monopoly is reduced to its lowest level. Thus, it is possible to minimize the level of inefficiency due to monopoly/regulation in the vertical divestiture. Finally, the interface cost between upper and lower levels, being mostly an information cost, can now gradually be reduced through technological development. Further cost reduction is expected in the future. The current analog telephone network can be classified into at most three levels; upper service, basic service and traffic line infrastructure, as presented in Table 2. Meanwhile, as presented in Table 1, BISDN may be broken into five hierarchical levels. It is expected that the loss in economies of scope will be smaller with the vertical divestiture.

Based upon the above four strengths, this study believes that vertical divestiture is better than other types of divestiture. The hierarchical divestiture is a timely public policy concept, because the function of many industries, including the telecom industry, are now structured in the hierarchical form of upper and lower separation. Hereafter, this article applies the concept of vertical divestiture to discuss an ideal industrial structure as a backbone of Japanese BISDN.

IDEAL AND ACTURAL INDUSTRIAL STRUCTURES FOR THE JAPANESE TELECOMMUNICATIONS INDUSTRY

Telecommunications laws in Japan and carrier classification

In an effort to determine the ideal industrial structure for future BISDN services in Japan,

this article needs to return telecommunications laws that provide a legal classification of common carriers. Then, starting with the legal classification, this study discusses the structure of the BISDN hierarchy levels and the type of market structure. Such decisions on the BISDN structure needs to be simultaneously designed in terms of maximizing the efficiency of the entire network.

In April 1985, competition was introduced by privatizing NTT. Along with the NTT privatization, two business laws were enacted for restructuring the Japanese telecommunications industry. Thus, the governmental regulation on the telecommunications industry was established in 1985, and since then, it has been maintained until now. The two laws are Telecommunications Business Law (TBL) and Nippon Telegraph and Telephone Corporation Law (NTTCL). The TBL provided a legal framework for the restructuring of Japanese telecommunications industry, while the NTTCL was used to change the old public corporation to the new NTT.

TBL devised Japanese telecommunications sector into two categories: type I and type II, depending upon the availability of circuit facilities. Type I represents common carriers that operate these circuits under the permission from MPT. Meanwhile, type II carriers cannot own the transmission circuits but may lease them from type I firms. Type I carriers are regulated by the MPT in their entry/exit, pricing, service provision and other business activities. Conversely, telecommunications business by type II carriers was almost completely liberalized in April 1985. There is free entry to this type of business and no restriction on pricing and operation, including leased circuits (Oniki, 1993).

In addition to the classification of type I and type 11 carriers, Hayashi (1989) presented type O carriers, indicating telephone users who develop their own local networks and provide telecommunications services within their firms. Thus, the users in type zero function like common carriers. However, there is a major difference between the type zero and other types of carriers. Common carriers in types I and II develop the telecommunications network, not paying attention to the context of services. Meanwhile, the service context is the most important for the type zero users/carriers. The users/carriers in type zero carefully incorporate the service context in the development process of their local networks.

Ideal and actual telecommunications structures

Using this legal classification on common carriers (Types 0, I, and II) and the CCITT-BISDN system, this study may summarize the industrial structure for future BISDN telecommunications in Table 4. The first column of Table 1 indicates the type I, type Ⅱ, and type 0, while denoting the five layers of the CCITT-BISDN at the third column.

In order to provide a detailed description on Table 4, this article starts with the five hierarchical levels of the CCITT-BISDN system. This study pays attention to the allocation of RM, RC, and C to each of five hierarchical levels of BISDN. Examining the extreme case in which all the levels of services are provided by a freely competitive market (C), this study suggests that the benefits due to free competition are fully obtained, but the full benefits of universal services and standardization may not be achieved. Therefore, we must incorporate some degree of RC and RM in order to obtain these public benefits while minimizing the negative effects of regulation and maximizing the positive effectiveness of regulation wherever it is implemented. The best level fitted for RM is the ATM layer of Table 4, because the ATM layer focuses upon the function of cell exchange/transmission so as to enhance the entire BISDN network. Both technological standard and straight-forward control/management are achieved in this layer. Moreover, focusing upon the cell exchange/transmission, the ATM layer is technically designed in a way that it delegates other telecommunications functions to its upper or lower layer of BISDN. Consequently, the added-value associated with the ATM layer is minimized in a manner that the RM structure for the ATM layer may produce relatively small inefficiency and does not significantly influence market prices for telecommunications services. Meanwhile, the BISDN services depend upon the cell exchange/transmission at the ATM layer and control effectively operations at the other layers, only managing the ATM layer. In other words, the RM incorporation in the ATM layer insures the development of a thin universal service within the ATM layer. This type of industrial structure can minimize various shortcomings related to regulation, while simultaneously making an industrial controllability possible. Since type I common carriers provide services related to the ATM and AAL layers, Table 4 lists "IA" for the ATM/type I combination and "IB" for the AAL/type I combination.

Having discussed the important ATM layer, the next question is what type of market structure is appropriate for the other layers. Either RC or C is incorporated into other layers from the view of optimizing two conflicting benefits due to competition and economies of scale, scope and network. First, the C structure is desirable for the physical layer (belonging to type zero common carriers/users), as presented at the bottom of Table 4. However, it is also true that there is a natural monopoly in user's private lines, and therefore, the RM structure is the best for the private lines. Thus, it is expected that the C/RM mixed structure will be applicable for the physical infrastructure development in the twenty-first century (Oniki, 1993).

It is important to note that the C structure is appropriate for type 0 users who own circuit facilities, such as type I carriers. An example supporting such an assertion can be found in the

installment for cable radio services in Japan. Numerous users have developed their own local circuit facilities for cable radio services. [The cable radio installment was illegal at the initial stage.] The installation of new telecommunications facilities is always associated with various levels of risk and opportunities. For example, a telecom facility may become obsolete through the development of a new technology. Moreover, new technology often produces new business opportunities.

Next, this study considers the AAL layer. Type IB indicates type I carriers whose functions are AAL and the upper layer 1 in the CCITT-BISDN system. This IB hierarchy supplies telecommunications services not directly associated with information context. We combine AAL and the upper layer 1, because both belong to the type I category of Japanese Telecommunication Business Law. Furthermore, hierarchy II indicates enhanced telecommunications services representing information context. This type of services belong to the upper layer 2 in the CCITT-BISDN. Both hierarchies use a competitive (C) market, where free entry and exit, and free price setting are introduced so as to maximize benefits due of a competitive market. However, it is important to note that we cannot clearly distinguish hierarchy levels IB and II so as to separate supplying services between the two levels. Table 4 depicts a market structure with separated IB and II. This study, however, cannot immediately conclude whether a single hierarchy, integrating IB and II, is better than one with separated IB and II. Trial and error attempts are need to determine which is a better industrial structure for future Japanese telecommunications. For now, this study distinguishes IB from II, presenting four hierarchical levels for the Japanese telecommunications infrastructure.

Insert Table 4

Table 5 visually describes the current market structure for Japanese telecommunications industry. The spaces between levels II and IB, and between IA and 0 indicate where the ideal structure would separate services but are not separate under the current industrial structure. The four-level hierarchical structure corresponds to the left column of Table 4. Table 5 depicts television services in the left column, public network services in the center, and wireless communication services in the right column. The comparison of Table 4 with Table 5 clearly indicates several differences between the proposed vertical divestiture and the current industrial structure. For example, NTT provides all the services from type 0 to type Il. However, the common carrier provides little services related to type II, because NTT established a new firm

named "NTT Data Communication" to supply this type of telecommunications services. A major difference between the central column of Table 5 and Table 4 is that currently, NTT business incorporates type IB with RM as depicted in Table 5. The two hierarchical levels IA and IB are completely unified in the NTT business. Thus, it will take a long time and a considerable expense to shift from the current structure in Table 5 to the ideal structure in Table 4.

Insert Table 5

Conclusion

This article proposes a new industrial structure for the Japanese information infrastructure of the 21st century. The newly proposed industrial organization has a hierarchical structure with five layers, each of which is specially designed in the framework of the development of BISDN technology. Moreover, this article proposes the type of a market structure (i.e., competition, regulated competition and regulated monopoly) for each layer for the enhancement of network efficiency. The proposed industrial organization will serve as not only a backbone of the BISDN-based information infrastructure, but also as a conceptual framework for guiding the NTT divestiture. The governmental review on the NTT divestiture will be scheduled in 1995. The NTT breakup will have a major impact on the future information infrastructure in Japan.

The proposed industrial structure is a future vision where BISDN will become the backbone of the Japanese information infrastructure. Japan has recently installed BISDN in the science/technology city in Osaka and its current industrial structure is by far different from the proposed one. As a future extension, this study needs to explore how to make such a major shift to the future structure. Finally, it is hoped that this study will make a contribution to the development of the future Japanese information infrastructure.

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Table 1: Hierarchical Structure for BISDN Services Supply (BISDN Protocol)

Hierarchy (Layer)		Function
Upper Layer	2	Video, Broadcasting Supply (Library), Enhanced Information Service, Teleservice (Data Base, Education and Medial Applications), and Various Services Associated with Information Context
	1	Telephone, TV-Telephone, TV-Conference, Telephone-Meeting, E-mail, Image Transmission, Public Broadcasting, LAN, WAN and Specific Services not Associated with Information Context
AAL (ATM Adaptation Layer)		Information Formats such as Voice, Image, Data, Signal (Control Data), information Transmission Methods Depending Upon Specific Transmission (One-to-One Connection, and One-to-Many Connections)
ATM Layer		Transmission for ATM Cell (Not Depending upon Specific Service and Information Format)
Physical Layer		Optical Fibers, Coaxial Cables and Information Transmission between Two Physical Facilities

Table 2: Market Divestiture of Telecommunications Services

Criterion for Market Divestiture	Divested Markets
Regional Divestiture	Domestic (Area or Prefecture) International
Distance Divestiture	Local Long-Distance International Communications
Service Divestiture	User Access (Public Switched Telephone Network, Private Network and Wireless Services) Transmitting Services
Vertical Divestiture	Enhanced Services Basic Services Infrastructure

Table 3: Divestiture of Telecommunications Market: Segment of Multiple Criteria

(1) Service and Region

Service \ Region		A	B	C	.....	The United States
User Access	Public Network	RM				RM
	Private Network	RC				RC
	Wireless	RC	RC	RC	RC	RC
Transmitting Service		RC				C
Others						

Note: RM (Regulated Monopoly), RC (Regulated Composition), and C (Competition).

(2) Vertical Separation and Distance

Vertical Separation \ Distance	Local	Long-Distance	International
Enhanced Service	C		RC
Basic Service	RM	RC	RC
Lines (Infrastructure)			

(3) Distance and Region

Region / Distance	A	B	C	.....	The United States
International	RC				
Long-Distance	RC				
Local	RM				

(4) Distance and Region (NTT Divestiture Plan in 1990)

Region / Distance	A	B	C	.....	The United States
International	RC				
Long-Distance	RC				
Local	RM	RM	RM	RM	RM

Table 4: Industrial Structure for Future Japanese Telecommunications (Upper and Lower divestiture, BISDN/FTTH, Long Term Objective)

Level	Services	Layer	Market Structure
II	Enhanced Information Services: Broadcasting, Video Program, Education and Medical Service, Data Base Service, Supply and Transmission of Information Environment	Upper Layer 2	Competition
IB	Telecommunications Services: User Access (Telephone, TV-Telephone, Private Connection, VAN), TV Conference, E-Mail, Image Transmission, CATV, LAN/WAN	Upper Layer 1	Competition
		AAL	
IA	ATM Network Services: Cell Transmission/Control	ATM Layer	Public or Regulated Monopoly
0	Telecommunications Facilities Services: Physical Line Services (Information Transmission between Two Points), Transmitting Machine Service	Physical Layer	Competition (User Lines under Regulated Monopoly)

Table 5: Current Industrial Organization for Japanese Telecommunications

<table>
<tr><td>Level</td><td colspan="6">Services</td></tr>
<tr><td>II</td><td colspan="2">Program Making
Broad-casting Agents</td><td></td><td colspan="2">Type II Common Carriers</td><td></td></tr>
<tr><td>IB</td><td rowspan="2">Broad-casting Suppliers (Public, Private)</td><td rowspan="2">Broad-casting Agents, and CATV Suppliers</td><td rowspan="2">NTT</td><td></td><td rowspan="2">NTT DoCoMo NCC (Wireless)</td></tr>
<tr><td>IA</td><td>KDD and NCC (Transmis-sion, Interna-tional)</td></tr>
<tr><td rowspan="2">O</td><td>Broad-casting Facility and Satellite</td><td rowspan="2">Lead-in Cables</td><td rowspan="2">Leased Circuit</td><td rowspan="2">Transmitting Fiber-Optic Cables</td><td>Wireless Communi-cation Facility</td></tr>
<tr><td>Broad-casting Wave (MPT)</td><td>Wireless Wave</td></tr>
</table>