Chapter 3

NTT's ISDN Response

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Osamu Inoue is General Manager for NTT's ISDN Promotion Department. He was involved in the first commercial ISDN service development and commencement project in Japan in April 1988 and is responsible for developing supplementary services and applications.

Telecommunications needs have outgrown the public switched network. The diversity of terminal equipment will undoubtedly increase in the future, as society's telecommunications needs become increasingly sophisticated. High-speed data transfer and video service are examples of needs that will have to be met more efficiently.

ISDNs are being installed to respond to such needs. They provide customers with a wide variety of services more conveniently and economically than previously possible. NTT's version of ISDN, called INS-Net, will provide a full range of digital telecommunications services as it develops.

Implementation History

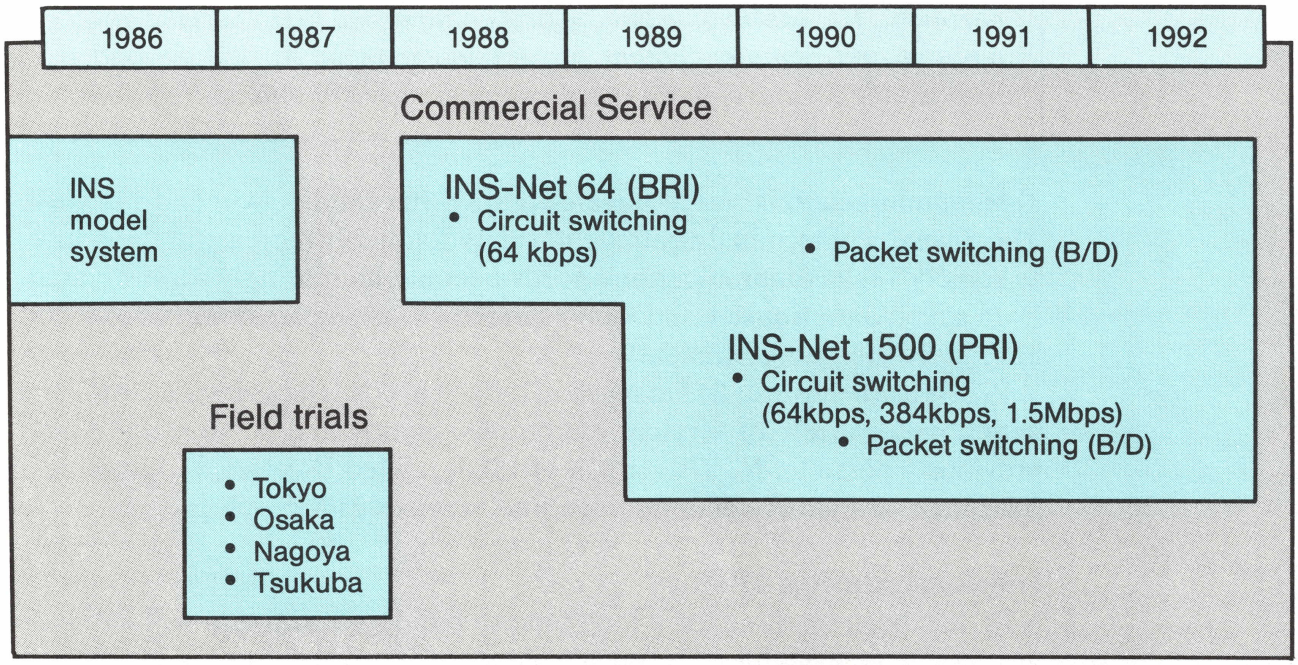
NTT has been working for a long time to build an ISDN that will enhance user convenience while offering a wide range of advanced services. Before embarking upon commercial ISDN service, NTT carried out a series of field tests between September 1984 and March 1987. This ambitious project was called the Information Network System (INS) Model System. Centered in the Mitaka area of western Tokyo, this experiment provided valuable data on 64 kb/s digital technologies, as well as user responses to a wide range of new services.

From December 1986 through April 1988, NTT carried out a wide area field trial on a digital network that stretched between Tokyo, Nagoya, Osaka and Tsukuba, located northeast of Tokyo. Detailed tests dealing with the practical problems of network operation were conducted in an environment where NTT and users jointly cooperated to create new applications.

The results of these tests have proven useful not only to shape NTT's new service offerings, but also to provide hard data for use during standardization activities. NTT's findings have been fully reported to the CCITT's committee considering international ISDN standardization and have led to much fruitful discussion within the committee. NTT's work has also been useful in supporting the domestic ISDN standardization work promoted in Japan by the Telecommunications Technology Committee (TTC).*

Based on its extensive experiments, NTT introduced INS-Net, the world's first large-scale commercial ISDN offering, in April 1988. The ISDN service is fully compatible both with the CCITT recommendation and TTC standards. Start-up of INS-Net service marks a first major step in establishing the telecommunications infrastructure for the highly advanced information society that Japan is becoming (Figure 1).

Figure 1
NTT's ISDN Implementation



INS-Net Service

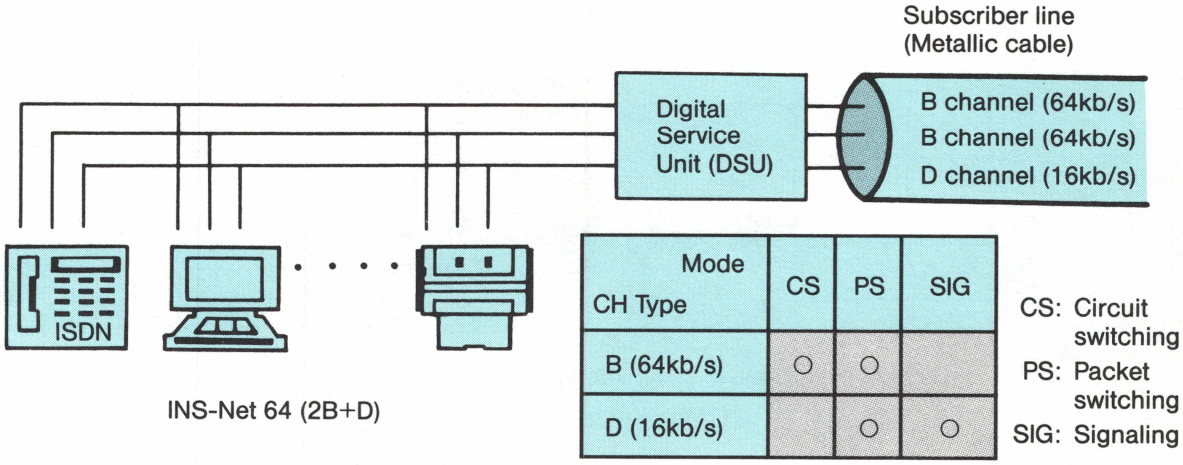
INS-Net service can be divided into two types: INS-Net 64, the basic rate interface (BRI) service that started in April 1988; and INS-Net 1500, the primary rate interface (PRI) service that began in June 1989. In June 1990, packet-switched service was added to the present circuit-switched service.

INS-Net 64 provides two B channels and a D channel (2B+D) using the existing metallic cable (Figure 2). The B channels are used for circuit/packet-switched information transfer, and the D channel for signaling and

*The Telecommunications Technology Committee was founded in October 1985 by various Japanese corporations active in telecommunications-related markets. Its main role is to coordinate activities aimed at establishing standards for domestic telecommunications networks.

Figure 2
INS-Net 64

INS-Net 64 service offers digital communications at a maximum rate of 64 kb/s. This interface provides two 64 kb/s information channels (B channel) and one 16 kb/s signaling channel (D channel), or a 2B+D configuration, on a single line. Using the existing metallic cable, INS-Net 64 service requires only the addition of a compact Digital Service Unit (DSU), not much bigger than a pocket radio.



packet-switched information transfer. The bit rate for the B channels is 64 kb/s and that for the D channel is 16 kb/s.

NTT has developed a time compression multiplex (TCM) digital subscriber transmission system using the existing pair of copper wires. This technology allows INS-Net 64 to be introduced easily without the need to install new subscriber lines. INS-Net 64 users can communicate with each other by using two communications modes: a telephone communications mode (speech and 3.4 kHz audio) and a digital communications mode (64 kb/s unrestricted).

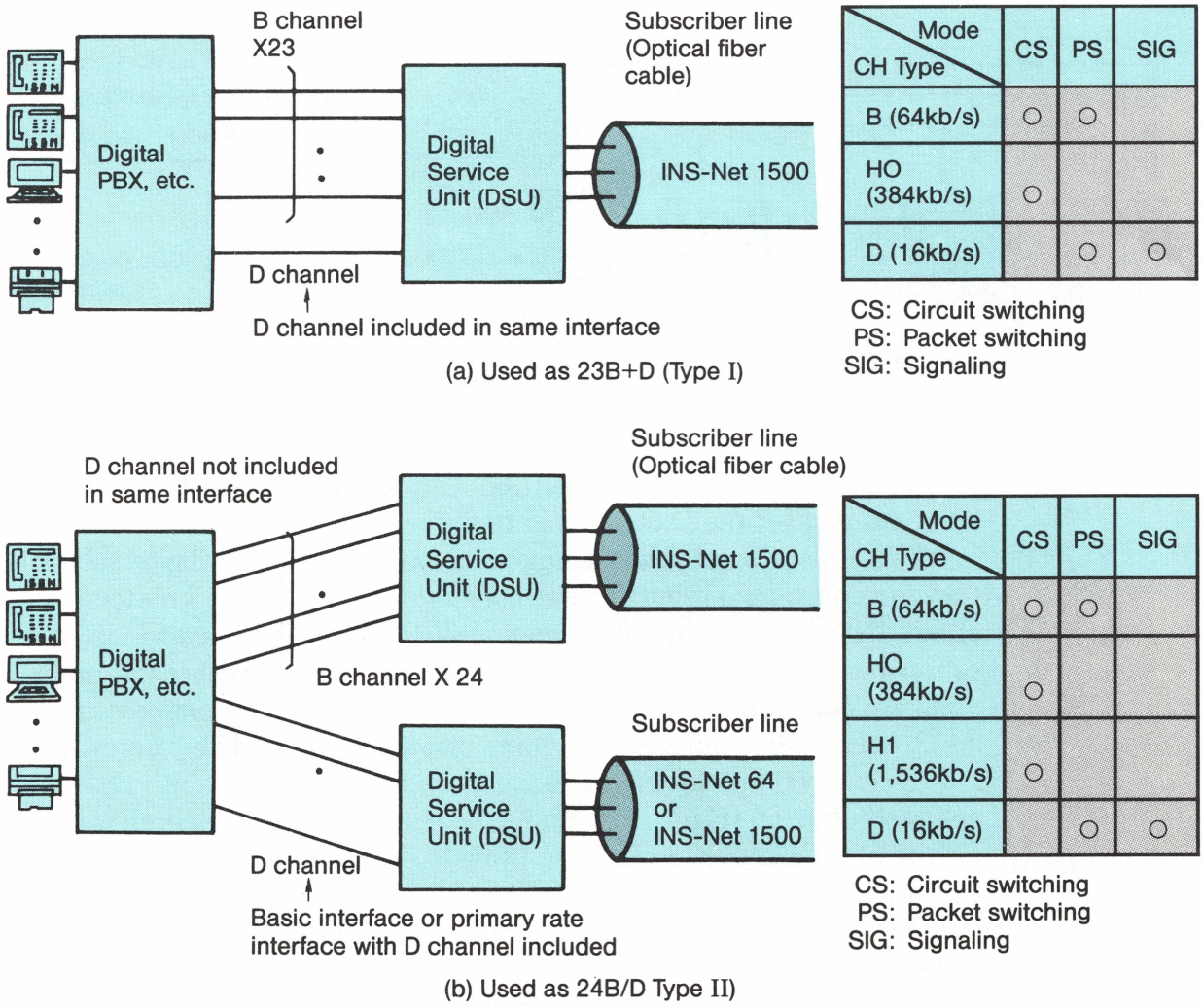
INS-Net 1500 provides 23 B channels and a D channel (23B+D), or 24 B channels (24B/D) (Figure 3). The B channels and D channel both have a bit rate of 64 kb/s. INS-Net 1500 also provides high-speed channels, called HO (384 kb/s) and H11 (1536 kb/s). Signaling for H11 is via a D channel on another interface. INS-Net 1500 uses optical fiber cable for the subscriber lines.

As Table 1 shows, various bearer services defined by CCITT are offered: 64 kb/s, 384 kb/s, 1.5 Mb/s unrestricted, speech and 3.4 kHz audio. Through effective combination of these bearer services with a variety of suitable terminal equipment, it is possible to establish systems for telephone, facsimile communications, data communications, videoconferencing and other diverse teleservices.

Supplementary services also are being made available (Figure 4). Initial INS-Net service included calling line identification, advice of charge, sub-addressing and direct inward dialing. In August 1989, Flexphone service was introduced, offering call waiting, three-party connection, call deflection and call transfer. In September 1990, user-to-user signaling was added. Other supplementary services also will be introduced according to user demand.

Figure 3
INS-Net 1500

INS-Net 1500 service offers digital communications at a maximum rate of approximately 1.5 Mb/s. In addition to 64 kb/s, high-speed channels of 384 kb/s and 1,536 kb/s are provided. The service is accessed by means of optical fiber cable and Digital Service Unit (DSU) about the size of three encyclopedia volumes.



INS-Net System

As shown in Figure 5, INS-Net is composed of three networks: a 64 kb/s digital network, a high-speed digital network for 384 kb/s and 1.5 Mb/s transmission, and a packet-switched network. The packet-switched network is partly shared with NTT's existing commercial packet-switched network called DDX-P. As a result, INS-Net users can communicate with those of DDX-P in packet mode. The 64 kb/s digital network is in reality part of the existing telephone network. INS-Net users can therefore communicate with existing telephone network subscribers in voice mode.

Table 1
INS-Net Bearer Services

Information Transfer Mode	Information Transfer Capability	Transmission Speed	Channel Type
Circuit Mode	Unrestricted	64 kbps	B
		384 kbps	H0
		1.5 Mbps	H11
	Speech	64 kbps	B
	Audio	64 kbps	
Packet Mode	Unrestricted	Depending on throughput class	B,D

Figure 4
Supplementary Services

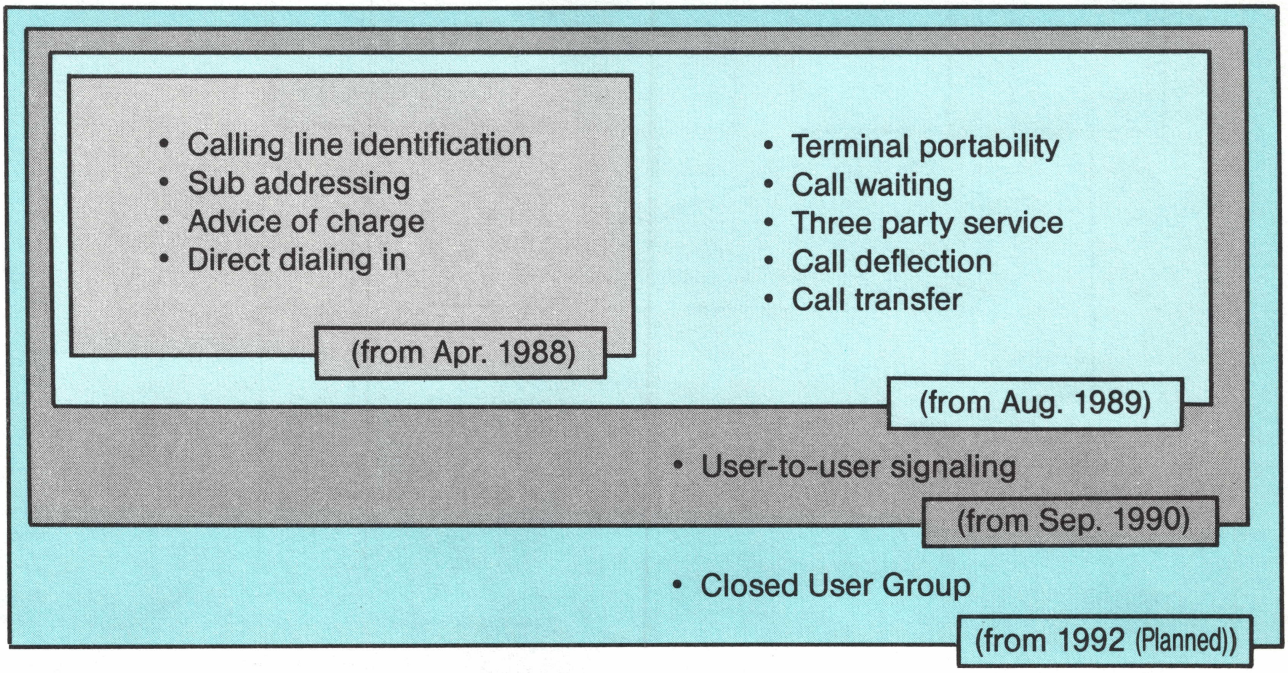
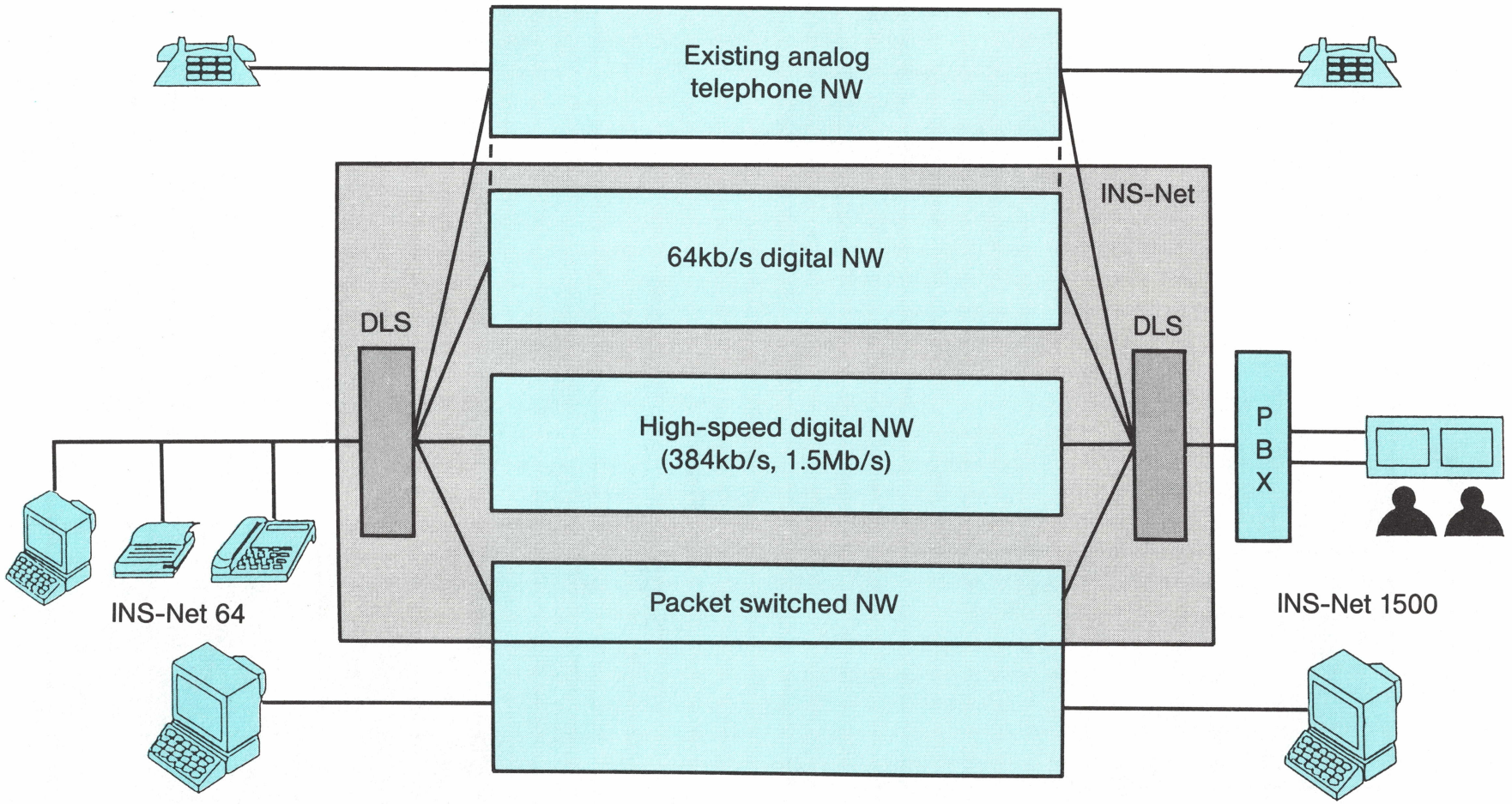


Figure 5
Network Configuration



INS-Net systems have, in the interests of system efficiency and economy, been configured into a number of basic modules. Each of these modules is provided with a standard interface, thus assuring flexibility of network configuration. What this means is that INS-Net systems can be realized fairly simply through modular attachment to the existing network, which itself has already begun evolving on the way toward full digitalization (Figure 6).

INS-Net subscriber accommodation is carried out using an I-interface subscriber module (ISM). Packet call switching is done using a packet handler module (PHM). H channel transit circuit switching is conducted by an H1 Module (H1M). The ISM is attached to NTT's current digital local switch D70.

All of the INS-Net systems are interconnected through the ISUP (ISDN User Part) of the common channel signaling system. Calls are sent at 64 kb/s from the ISM through the D70 distribution stage to the 64 kb/s circuit-switched network. H channel calls are connected directly from an ISM to an H1M, and are sent to an H channel circuit-switched network separate from the 64 kb/s network. Packet calls are, in both the B channel packet and D channel packet cases, connected directly from an ISM to a PHM. At the PHM, layer 3 processing takes place in accordance with the X.25 protocol. Connection is then made with a packet transit network shared with the conventional DDX-P packet-switched network. The INS-Net approach to realizing packet-switched service is to build packet handling functions into the ISDN, thus achieving the configuration of Case B in CCITT X.31.

The INS-Net system can easily and economically accommodate scattered customers. A new customer located near a D70 digital switching system is directly connected to an ISM, while a new customer located away from the D70 is accommodated via a remote terminal (RT) at a remote office. A subscriber radio system also is available to meet early demand at remote locations, when bursts in demand outpace the tempo of network construction. Referring once again to Figure 6, we can see the INS-Net structure in block diagram form.

Digital Service Units (DSUs) that carry out two-wire subscriber loop transmission using a time-compression multiplexing method (so-called "ping-pong" transmission) for the basic interface, and a 1.5 Mb/s DSU for the primary rate interface, are both provided. A DSU also can be provided by the customer; here an equipment rental charge is not applied.

Interconnection With Other Networks

Besides interconnectivity among NTT's other networks using a variety of communication modes, INS-Net also interworks with other carriers' networks. It thus supports interconnectivity with equipment used in other networks (Figure 7).

With respect to voice mode, mutual connections with other carriers offering mobile communications services were initiated in April 1990.

In addition, mutual connections also were established with the new Japanese

Figure 6
ISDN System Configuration

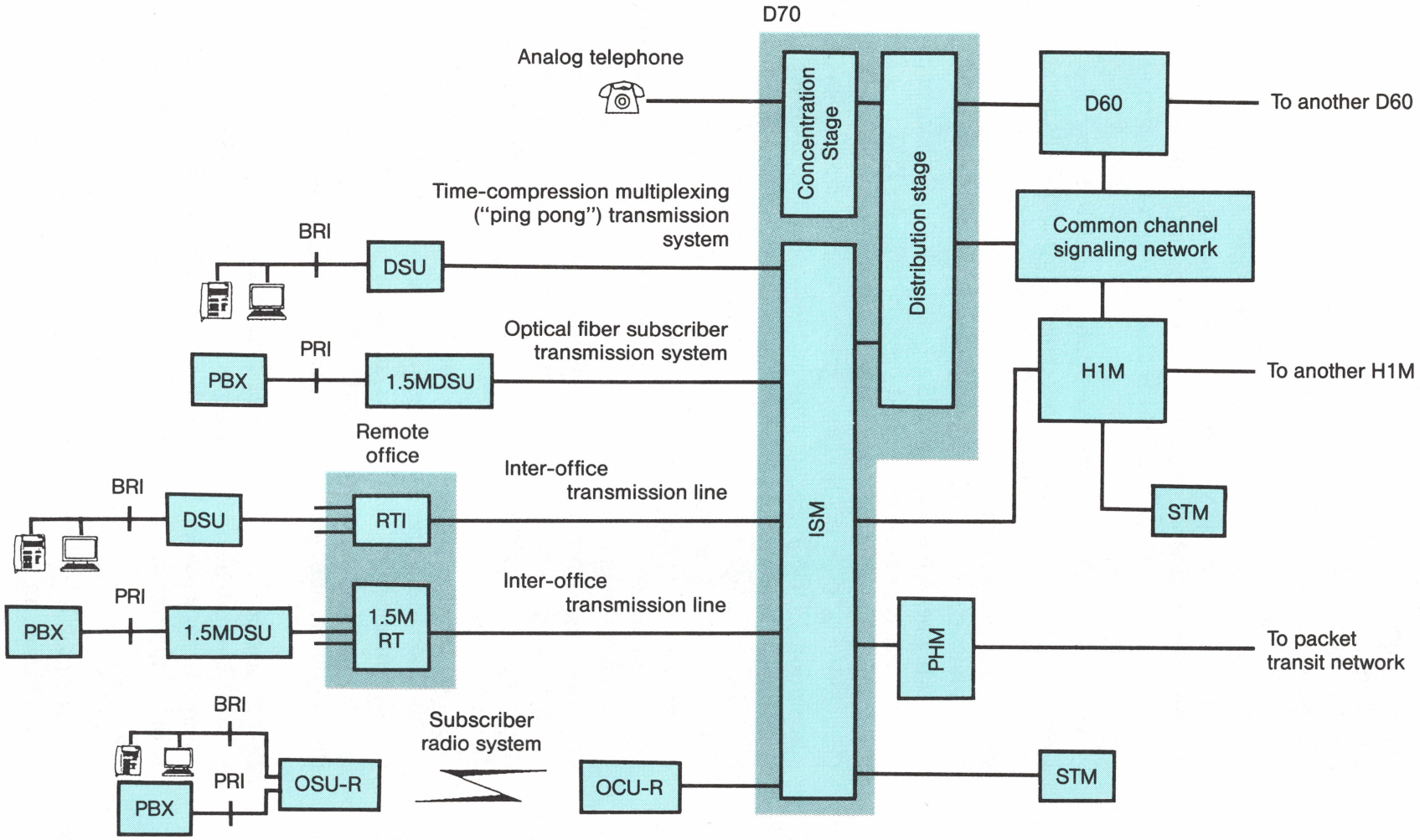
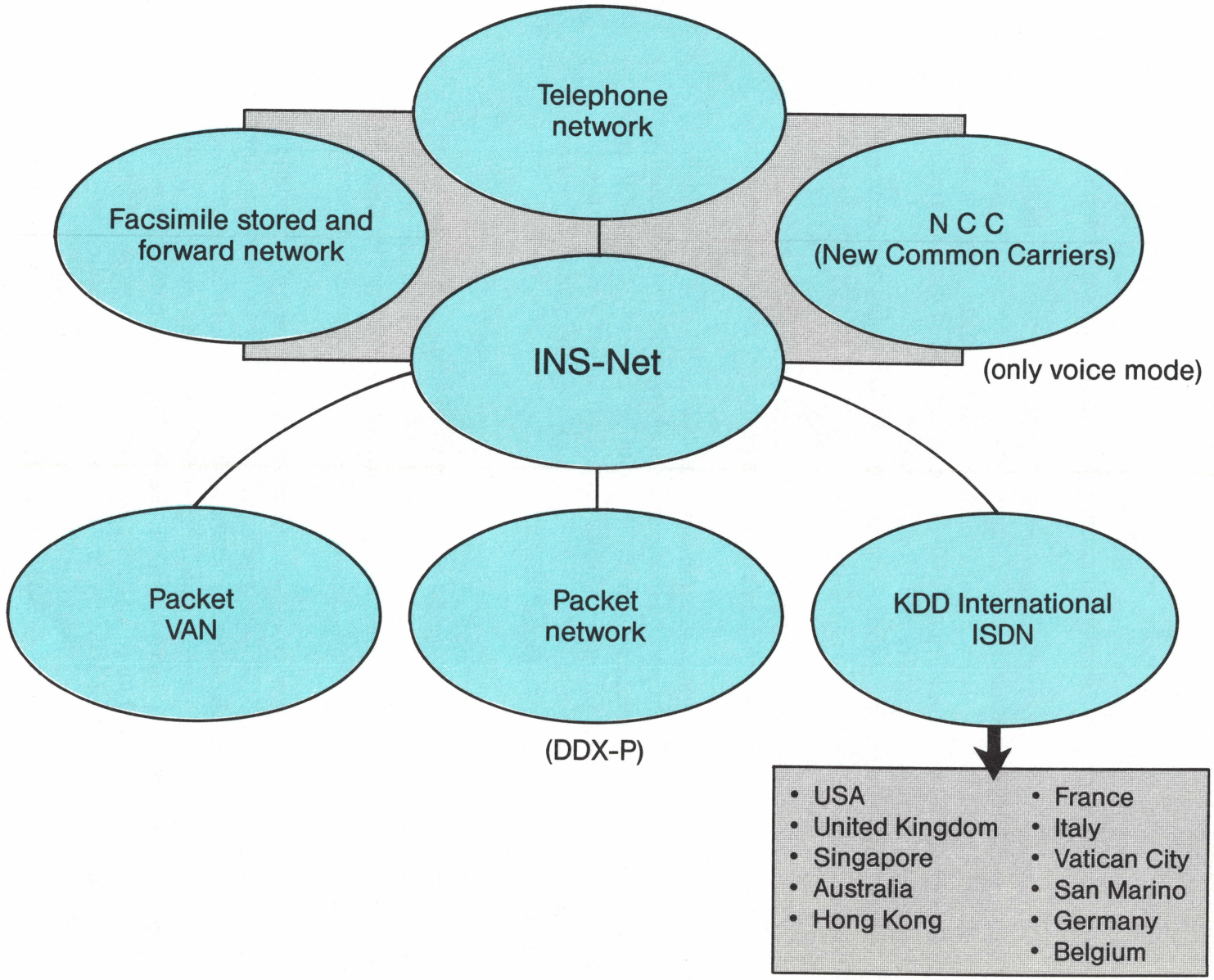


Figure 7
Interconnection between INS-Net and Other Networks



long-distance carriers in July 1990. Regarding packet-switched service, packet VANs also are connected to INS-Net for packet mode service.

ISDN is being put into commercial service in many parts of the world. As it becomes possible to interconnect these networks, the effectiveness of ISDN will be considerably heightened.

International connections for voice mode already have been made to other countries through Kokusai Denshin Denwa (KDD) and the new international carriers in a similar manner to existing international telephone service.

Turning to digital communication mode, in October 1989 connections were first established through KDD's international ISDN network to AT&T of the U.S. and British Telecom of the U.K. The list of destinations was further expanded to include France, Italy, Vatican City, San Marino, Germany, Belgium, Australia, Singapore and Hong Kong.

Regarding connections with Bell operating companies and Bell regional holding companies in the U.S. for digital communications mode, Illinois Bell and Pacific Bell were initially connected to INS-Net through KDD and AT&T in November 1989 and July 1990, respectively. BellSouth's ISDN network and New York Telephone's as well have also recently connected to INS-Net.

To promote the actual use of commercial ISDN services on a global scale, carriers must advise customers on the user-network interface in each country and the customer premises equipment that can be used. NTT is therefore working to strengthen this aspect of its services to meet a wide range of customer needs in a timely fashion. It is also moving to include a greater number of countries in the global ISDN.

Applications

INS-Net services are now being tested in a variety of forms at different kinds of businesses. A number of applications have proven their worth and are being permanently adopted. Specific application examples are described in Chapter 7 and two basic features of INS-Net applications are described below.

INS-Net offers high-speed communications so a large volume of information can be sent quickly at significantly reduced costs. Moreover, the same line can be used for both telephone service and digital communications service (circuit switching and packet switching), eliminating the need to install separate lines for each service, which also reduces the cost. These two cost-saving features add up to an economical integrated network system.

The special features of INS-Net can be used to realize applications not possible with the existing telephone network. These value-added services include high-fidelity audio (7 kHz), high-speed and high-resolution G4 facsimile, high-resolution still image transmission, videoconferencing and other visual communications applications, as well as high-speed file transfer. A variety of other applications can be created using the separate signaling channel (D channel) provided with INS-Net. The caller identification feature,

for example, is appropriate for telemarketing systems and receptionist agency systems (Table 2).

INS-Net makes new forms of communication possible that transcend the conventional concept of traditional telephone services. More than ever, NTT must learn from its customers and work hand in hand with them to develop applications. To do this, NTT must establish new ways of providing services that go beyond present methods.

To help INS-Net service grow steadily and realize its potential as a main NTT network service, various policies are being put into effect.

Table 2
Example of Value-added Applications

Main Media		Main Equipment or Technology	INS-Net Features Utilized					Typical Applications or Results
			Speed	Quality	Digital	ID signal	Multiple channels	
Speech/ Audio		Hi-Fi telephone (7kHz, Stereo)			○		○	Music transmission Live radio broadcasts on location
		Telemarketing system				○		Receptionist agency system
Image	FAX	G4 facsimile	○	○				Gateway multi-address system
		G4 facsimile + Database	○	○				Database of newspaper and magazine articles
	Still images	Color image communication unit	○	○	○			Transmission of news photographs Electronic pamphlets
		High resolution image communication unit	○	○	○			Transmission of design drawings
	Natural motion picture	Video conferencing unit or videophone	○	○	○			Video conferencing Financial consulting
		Remote monitoring unit	○	○	○			Cash dispenser corner monitoring
Data		High speed file transfer	○	○				Transmission of floppy disk data CAD/CAM data transfer
		LAN-to-LAN connection	○	○				Database sharing between head office and branches