Chapter 6

Terminal Equipment Options

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When INS-Net 64 first began, NTT had only a limited number of ISDN terminals available. However, thanks to the positive development of various ISDN applications, a variety of ISDN terminals are now available. These incorporate NTT's original ideas and promote usage of ISDN circuits. There is now an array of NTT ISDN terminals to choose from, including: terminal adapters, digital telephone sets, PBX units, videoconferencing systems and G4 facsimiles. NTT had to go through various milestones before ISDN blossomed and usage increased.

Characteristics of ISDN Terminals (How to Use ISDN)

To stimulate user desire, ISDN terminals must provide more attractive services than those connected to the conventional public switched telephone network (PSTN), the public switched packet data network (PSPDN) and leased circuits. In short, service content that can persuade prudent users to introduce such services is required. For this purpose, it became necessary to convey ISDN usage values in an easy-to-understand manner by carrying out detailed analyses concerning the actual situation of circuit usage. In addition, it was necessary to explain qualitative ISDN advantages such as high-speed, high-quality and favorable economics.

As shown in Figure 1, when ISDN is seen from the standpoint of a terminal developer, there are a variety of attractive merits unimaginable with conventional networks. We tend to immediately associate ISDN terminals with multimedia terminals that make the best use of all of ISDN functions. It is important when developing terminals not to use all of the ISDN merits in a

Figure 1
Utilization of ISDN Features vis-à-vis Terminals

Features	Usage Example
(1) High Speed	High-speed transfer of visual information, etc.
(2) High Quality	Providing 7-kHZ audio.
(3) Utilization of Two B-Channels	Enabling usage of simultaneous communications between different types of media, stereophonic audio communications, and a variety of connection formats.
(4) Utilization of D-Channel	Enabling usage of calling line identification; display and advice of charge functions; permitting user-to-user information exchanges.
(5) Utilization of Packet Mode	Possible to use with circuit-switching mode in a mixed format; permitting communications with existing packet network.
(6) Utilization of Primary-Rate Interface	Permitting usage of high-speed H-channel; possible to use multiple channels in PBX by multiplexing.

composite terminal format. Rather, give individual products the most appropriate features that appeal to users.

This focus was indispensable in developing ISDN equipment for real-world uses. In other words, if ISDN is used only as a backup for leased circuits and involves very low traffic density, it may end up as a service with low investment efficiency from a carrier's standpoint. Expansion then cannot be expected, and carriers and terminal manufacturers would never be able to envision more than initial demand for service.

Various approaches are conceivable for ISDN terminal evolution, including making existing terminals compatible with ISDN.

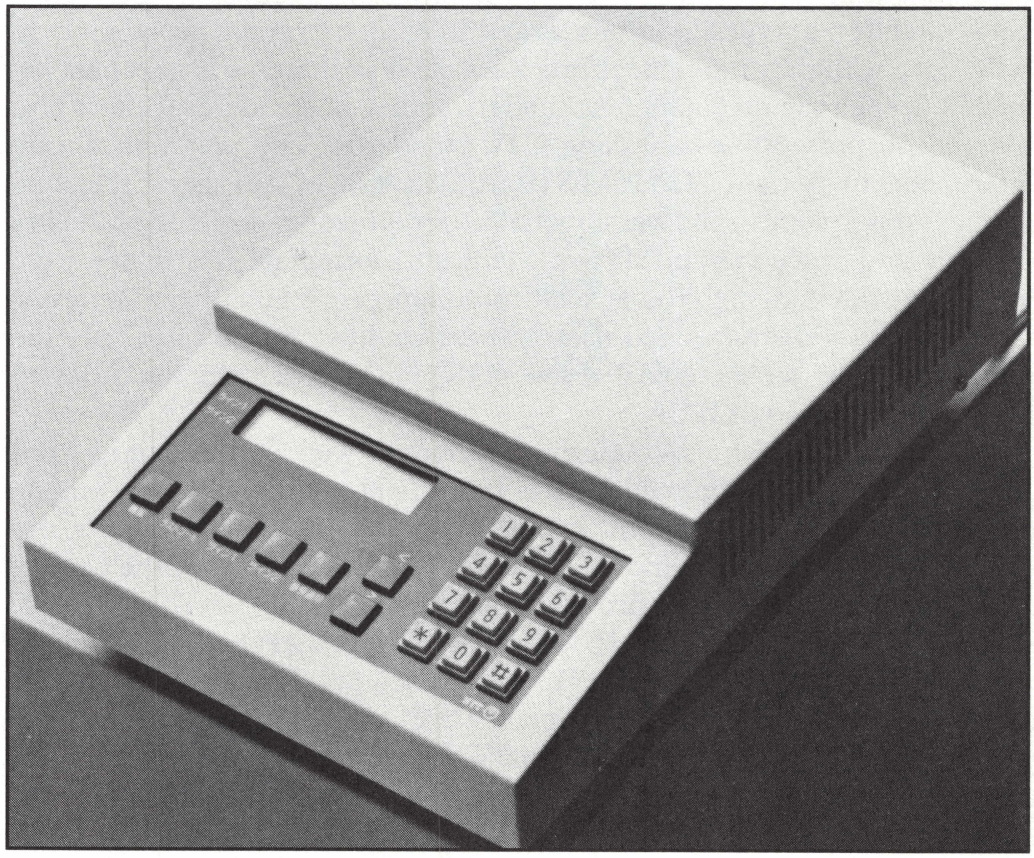
To spread new services, however, it is important to clarify the communicating party, together with enhancing service content. This fact is clear from

the experience of services such as teletex, videotex and facsimile. These services are the best precursor for the diffusion of ISDN terminals. Consider the G3 facsimile, for example, which has become an indispensable part of business worldwide. Even G3 facsimile took considerable time before it developed its current status. Accordingly, for the realistic diffusion of ISDN, it is essential to provide terminals that can be naturally incorporated into current equipment configurations. This is one important factor for the diffusion of ISDN, partly because ISDN service expansion cannot be achieved in a single day.

Therefore, in parallel with the development of terminals that take advantage of ISDN features, NTT considers the development of terminal adapters and digital telephone sets that permit interconnection with the existing telephone network important.

The most significant terminal adapter among those provided by NTT was the exclusive analog-port type, the INS-Mate D1 (see photo below), connecting only existing telephone sets. This adapter allowed service equivalent to two telephone channels via a single ISDN basic rate interface, but it was unable to provide 64-kb/s, non-restricted digital communications—the characteristic of ISDN. The retail price was slightly more than ¥80,000 ($600) in

INS-Mate D1



1988. Excluding the basic digital telephone set (S-1000) discussed later, this price was the lowest among ISDN terminals. Although an analog interface was installed in terminal adapters offered by other manufacturers, no other exclusive type adapter was available. The unit has gradually penetrated the market, and now competes for the top rank with other ISDN terminals offered by NTT in terms of shipping volume.

When connected to a G3 facsimile or a modem, this terminal functions to upgrade existing services—securing stable operations of high-speed modems, improving the bit error rate and shortening the connection delay time—by using the digital link as the telephone channel to stabilize transmission loss. The advantage offered by this terminal was first recognized by communications specialists. Moreover, because two telephone channels are available through paired wiring, this terminal was used to secure telephone channels for key telephone systems in buildings where the full capacity of wiring had already been reached. This application eventually promoted the widespread use of this terminal.

Securing Interconnections

Carrier efforts alone are inadequate to promote ISDN. Various attractive terminals are, of course, essential to increase ISDN traffic. But it was not enough for NTT to simply develop and offer such terminals. NTT had to expand terminal variations to promote co-existence with terminals from other manufacturers. The problem was how to secure interconnection between different types of terminals and to ensure terminal portability.

To cope with this situation, efforts were made to increase interconnectivity and deepen the manufacturers' understanding of standards. Efforts also focused on promptly establishing TTC standards. The policy to ensure interconnectivity was called HATS (Harmonization of Advanced Telecommunications Systems), and was initiated under the leadership of the Ministry of Posts and Telecommunications. Studies to formulate this policy were joined by wide-ranging groups such as common carriers, manufacturers, standardization institutes and users. These studies provided not only the opportunity for technological discussions, but also a common front to promote the spread of ISDN.

As a result, the first tests on terminal adapters were carried out in April 1989. As many as 13 companies participated and interconnectivity among them was confirmed. Since the focus was placed on connectivity in the circuit-switching mode during the first tests, interconnectivity in the packet-switching mode was not confirmed at that time.

However, in June 1990, interconnectivity in the packet-switching mode was confirmed when the third tests were carried out. Following that, interconnectivity confirmation tests were periodically carried out and have played a major role in the spread of ISDN. As a result, the majority of ISDN customers now use the service for data communications, and the most common usage format involves the connection of terminal adapters to existing data terminals.

One unique characteristic of ISDN is that one NCTE can handle two switching formats: circuit switching and packet switching.

Using the packet-communications mode, it is easy to assume that a usage format providing an access line to the existing packet network would become the mainstream format in ISDN. This is mainly because the host system, in the existing data communications system, is connected to the packet-switching network. Packet communications in Japan began June 1, 1990, two years after the start of ISDN service. This delayed start stalled terminal development. Therefore, developing terminals to exclusively accommodate ISDN packet communications simply wasn't the best approach in the beginning. Development based on facilitating the connection of existing equipment to ISDN and providing host access made more sense. Three types of terminal adapters were developed that could connect to various types of terminals. The common characteristic of the three was the exclusive focus on D-channel packet capability.

Consequently, as a result of aggressive equipment pricing and setting a low fee for the packet communications mode, usage spread so quickly that it almost seemed as if ISDN packet meant the D-channel packet. These terminal adapters were called packet links and enabled Japanese users to enjoy ISDN service before users in other countries.

Voice Communications in ISDN

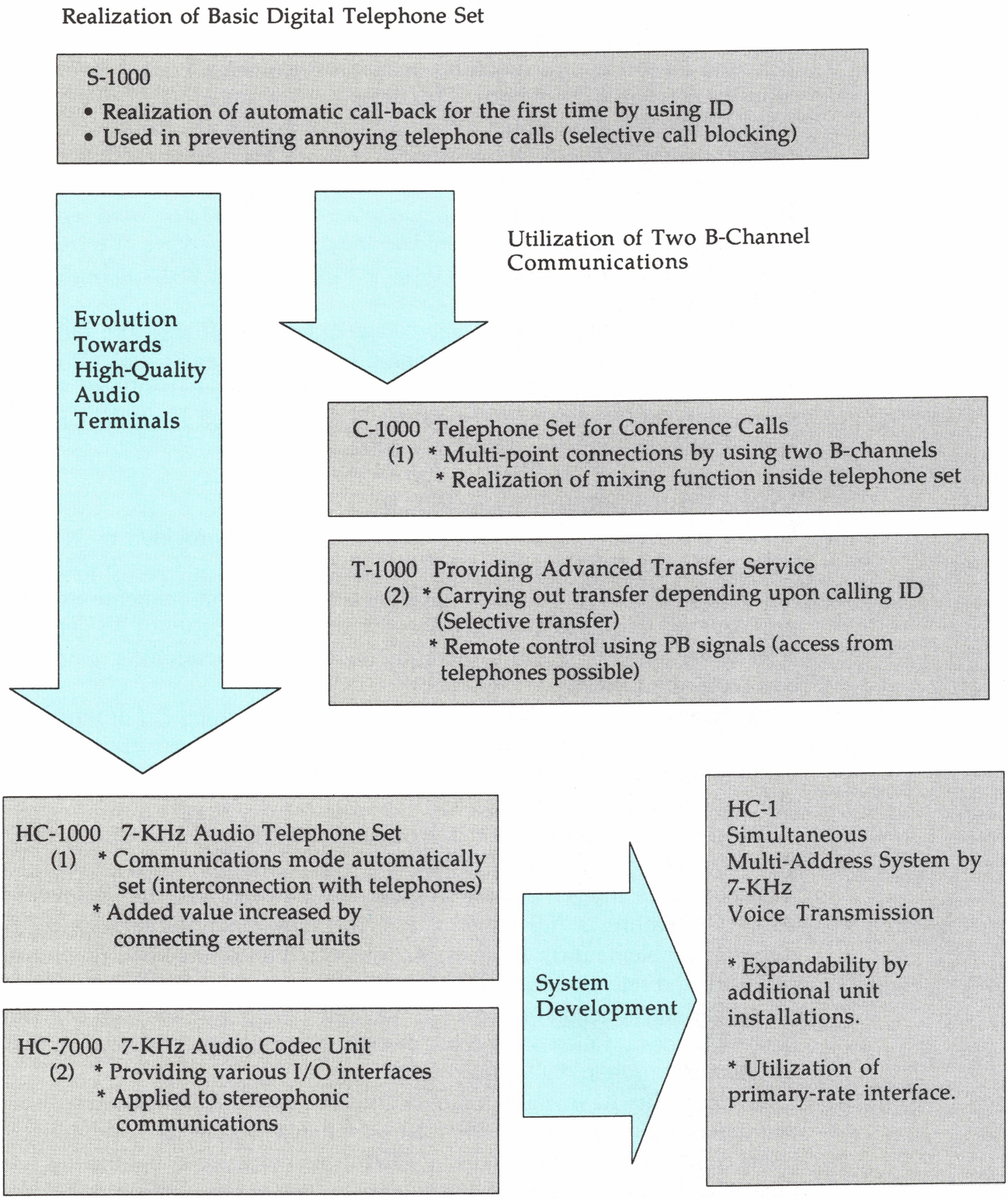
One of the major characteristics of ISDN terminals provided by NTT is enhanced voice ISDN communications. In short, because voice traffic continues to play a major role in supporting today's telecommunications business, quality improvements in voice communications cannot be ignored. NTT has made every effort to enhance voice communications as an important element of ISDN.

As shown in Figure 2, NTT has continued the development of terminals that can make high-grade usage formats available, as well as offering strong individual characteristics such as the digital telephone series. Specific examples are described as follows:

The digital telephone S-1000 (see photo on page 67), which retails for less than ¥30,000—probably the lowest-priced digital telephone in the world—is a unit to which the NTT research group has devoted its full development efforts. It features a full range of typical ISDN functions such as ISDN network supplementary services, charge-information memory functions, call back and selective caller ID acceptance in a novel design. The original model was introduced at the start of the digital telephone series in September 1990 and was followed by other models. Accordingly, 1990 was the year for diversification in digital telephones.

Stable quality in voice communications is a major ISDN characteristic, and deterioration in voice quality can be reduced even in cases of multiple-point connections. For this reason, ISDN usage in voice conferencing systems always has been considered a highly effective application. NTT has provided a voice conferencing system for ISDN that is used in combination

Figure 2
Evolution of Digital Telephone Sets



S-1000

with digital telephones. However, it could only provide for conferencing between two points, and there was a limit on the usage format because it was necessary to use the voice teleconferencing service, which is a supplementary service of the telephone network, to connect many points. NTT developed a telephone set that could provide voice conferencing capability among multiple points by using the two ISDN B channels, and without the need for using the supplementary service function of the telephone network. This service started in 1990. As shown in the photo on page 68, the digital telephone C-1000 has buttons that can register up to 30 conferencing members, and provides for simple operation by the host telephone to begin a conference by automatically dialing the parties and setting up the conferencing situation. In other words, various remote-control functions are possible using ISDN's digital communications mode for voice communications and by transmitting the voice data and control data at the same time via the B channels.

The 7-kHz voice service that covers a bandwidth twice that of the telephone and faithfully reproduces human voice is a form of voice communications that cannot be realized in the telephone network. Standardization studies concerning 7-kHz voice service have long been carried forward because it can be used in digital leased circuits. This is covered under G.722 in the CCITT recommendations, and has also received attention as 7-kHz

C-1000

bearer service in the vision for ISDN. However, to concretely demonstrate the high quality of ISDN in voice transmissions, NTT has studied the use of 7-kHz voice service via ISDN since the early stages, and began to develop a codec method exclusively for this purpose. Although there have been some systems used all over the world to transmit radio programming, via unit-type codecs, NTT appears to have been the first to develop this method for compact telephone sets (see photo on page 69).

Providing Original Functions Using ISDN

Efforts have been made to develop ISDN terminals that make the best use of high speed to provide original communications services that meet user needs. This essentially meant competition in ideas on how to use the 64-kb/s information-bearing channel, something that weighed heavily on the minds of researchers. To demonstrate excellent applications for users, NTT devel-

HC-1000

oped various terminals and asked users to determine the service capabilities. Two specific examples have emerged.

In developing the visual supervisory system, the SCOPE PORT D64, NTT focused on an arrangement that attached greater importance to economy, thus separating codec functions into machines exclusively for coding and exclusively for decoding. In particular, with respect to site-monitoring equipment that involves monitor cameras installed at many sites, NTT made efforts to simplify such installations as much as possible. In terms of the coding method as well, NTT introduced a system that made a variable video mode possible from multiple cameras during communications to meet monitoring purposes covering all circumstances.

Moreover, NTT realized various functions such as: a camera-switchover function; an automatic transmission function linked to a sensor switch; and automatic access functions to multiple centers. This is accomplished while using compact hardware to realize a low price just a tenth of usual video codec systems. The introduction of the programmable coding method through the application of DSP greatly contributed to the realization of this terminal.

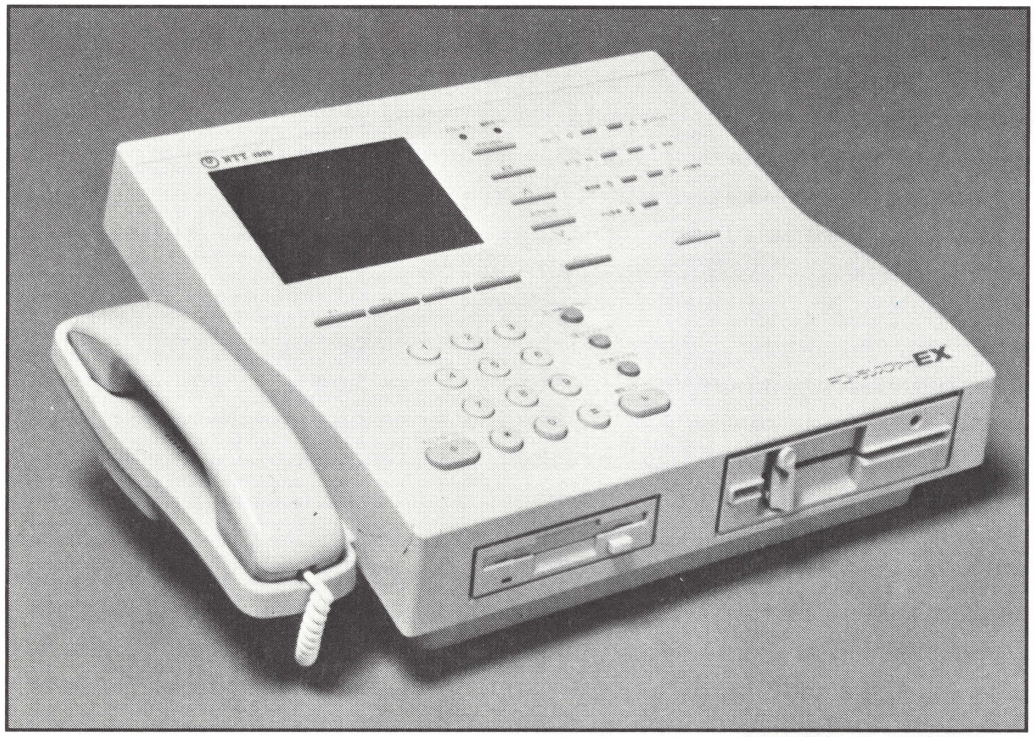
Since the video image allows for a much clearer understanding of the situation at the "other end of the line," this system has spread to a wide range of fields, including taxi companies, pinball parlors, restaurant chains and hotels, as well as financial institutions.

High-speed data communications are possible using ISDN. It was this so-called file transfer application that occupied an important position in conventional data communications.

Among ISDN systems, file transfer functions—using an ISDN board for PCs—occupy an important position. In the case of file transfers it is necessary to recognize the file format defined by the system. Because this requires special knowledge, it was important to construct an ISDN system in which data communications could be easily carried out without specialized knowledge. NTT paid attention to the flexible disk, which had become widespread as a memory device and had experienced remarkable drops in prices, in producing an experimental FD transfer system that realized data transfers, regardless of memory content, in the same manner as a facsimile machine. In doing market research for these experimental products, NTT verified the validity of such applications through trial usage by actual users before making such products commercially available (see photo below).

Although NTT did not have enough data about the demand and market scale for these systems, the products were favorably received because they were easy to use and provided high-speed transmission. In particular, because it is possible to transfer word-processing FDs that record documents, this system is being used in the printing and book publishing industries. In addition, the diffusion of the system also is proceeding in various design-related industries because of the ability to transfer CAD/CAM data. Because this system is similar to facsimile machines in terms of operability, it has given rise to new terms such as floppy-disk facsimile and disk facsimile.

FD-Tranfex



Providing Low-Cost G4 Facsimile Machines

The rapid development and spread of facsimile machines all over the world was originally expected to promote ISDN. While great expectations surrounded the ISDN-based G4 facsimile, it was hard to see any substantial superiority above the G3 facsimile, which were high-function machines that sold well despite high costs. The spread of G4 machines was therefore slow, contrary to expectations. NTT provided several models of G4 machines, but they did not sell rapidly. As a drastic measure to promote G4 usage, NTT started to develop economically priced G4 facsimiles that could break the cost barrier by being retailed for less than ¥1 million.

A G4 facsimile machine can transmit documents at high speed and high resolution without transmission errors and is positioned to improve the potential for facsimile communications made available by the most advanced versions of the G3 machine. Although international ISDN service is available only between some countries, the great advantage is that the high speed can substantially reduce the costs involved in facsimile communications, and thereby contribute to increases in international traffic. (Actually, a great part of the traffic in international ISDN is occupied by G4 facsimile and videoconferencing transmissions.)

Accordingly, NTT started providing the G4-type D4300 facsimile machine with various functions built into a compact body in March 1991.

ISDN terminals cover a broad range of applications. NTT already has developed other terminals and this discussion only introduces part of the ISDN applications in Japan. The development of ISDN terminals means the creation of applications. An important factor is how to make ISDN's unknown potential familiar to users.

In the future, visual services will be important as easier-to-understand services. NTT is studying ways to enhance visual services. The latest communications technology in the world seems to be going forward at full speed toward broadband ISDN. Whether the forthcoming BISDN environment will be just a dream or will become reality hinges on narrowband ISDN. And N-ISDN depends on the completion of various standards for videoconferencing systems, progress in video compression technology and progress in examining color facsimiles.

Practical ISDN will emerge through the unified efforts of common carriers that provide the services, the suppliers of communications terminals that realize applications and users who buy the services.