NYNEX ISDN

*An introduction to Integrated Services Digital Network —
what it is, how it works, what it does, and why . . .
and some of the applications and services that are
changing the way we live, learn and work together.*

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NYNEX ISDN

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WELCOME TO ISDN

A letter from Ivan Seidenberg

Bandwidth is the lifeline of the information age, and Integrated Services Digital Network is the technology that is making bandwidth available and affordable to just about anyone with a computer and a telephone line — to each and every one of us.
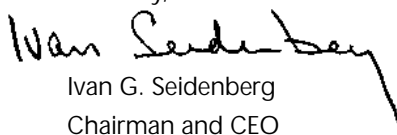
ISDN delivers medical images to remote specialists. It gives valued employees the freedom and flexibility to telecommute from home, either full-time, part-time or just when the weather shuts down the roads.

ISDN handles financial transactions of all sorts, from multimillion-dollar securities deals to $20 cash machine withdrawals and credit card purchases. It helps students, researchers and business people quickly download information from the Internet, the college library or their organization's LAN.

ISDN lets people meet through desktop video conferences, instead of traveling to meetings. They can talk face-to-face, share documents, images and data, and complete projects in a fraction of the time it used to take.

In fact, ISDN can do so much for so many people that we are proud to publish this guide describing some of its many, many uses and briefly explaining the technology.

Sincerely,

Ivan G. Seidenberg
Chairman and CEO
NYNEX

DIAGRAMS & ILLUSTRATIONS

1

Throughout the Northeast, and throughout the world, a new technology is changing the way people communicate, the way they gather and exchange information, and the way they work, learn and play together. That technology is ISDN.

From Buffalo to Montauk, from Augusta to New York City, people are beginning to work together, exchange ideas and share information in new and exciting ways:

❖ At an advertising agency in Boston, a graphic designer uses the telephone to send full-color production materials for a supermarket ad to newspapers throughout the Northeast.

❖ In a Manhattan recording studio, Barbra Streisand records a duet with Frank Sinatra. Sinatra sings in a Hollywood studio more than 3,000 miles away.

❖ At one of New England's largest hospitals, a doctor treats a woman at a nursing home miles away. Through a single video connection, he sees and talks to his patient, checks laboratory tests, and reviews her medical history.

❖ In New York, executives at an international cosmetics company hold live video meetings with counterparts in Belgium, France and Italy. They exchange documents, photographs, package designs, advertising layouts and more.

❖ Throughout Massachusetts, bankers, lawyers, engineers and others review and retrieve maps, drawings and detailed records – some more than 300 years old – from a county database.

❖ At a laboratory near Walpole, a scientist searches the Internet to find the latest work of her peers throughout the world. She gathers and prints even the most complex diagrams in minutes.

❖ At a worldwide technology company near Boston, hundreds of executives and engineers "go to work" each day by dialing into their office computer systems. They talk proudly yet matter-of-factly about their "virtual office" – their "office without walls."

New Capabilities; New Applications

These scenes and hundreds like them are happening today throughout the Northeast and throughout the nation. And all share a single phenomenon: a telephone technology known worldwide as *Integrated Services Digital Network* – or ISDN.

ISDN and today's modem. *ISDN can deliver some fifty to seventy times the throughput of a typical modem.*

ANALOG DESKTOP: 14.4Kbps+ *with* compression

Modem
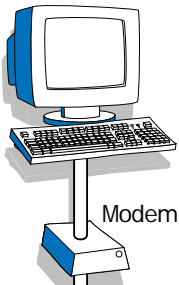
NYNEX NETWORK

Why is this technology so important? Because it offers inexpensive dialed, fully digital access to the worldwide telecommunications network. Which means it is no longer necessary to lease costly dedicated lines for high-speed digital transmission, or to limit data speeds and accuracy to the plodding modems of analog technology.

These major increases in the speed of data and document transfer, in turn, make possible and practical a whole new breed of applications – from telecommuting and inexpensive video conferencing, to teleradiology and remote health care; from distance learning and worldwide collaborative engineering, to remote broadcasting, LAN-to-LAN internetworking, interactive publishing and more.

It is also a technology that represents the next generation of the world's telephone service for all forms of communications, including voice.

NYNEX ISDN

Today, ISDN is available in a rapidly growing number of areas throughout the NYNEX region. With an estimated 300,000-500,000 lines now in service nationwide, and an annual growth rate of 40 percent a year projected well into the next century, ISDN today is one of the most rapidly growing telecommunications technologies in the world.

"There is enormous pent-up demand for increased bandwidth at an affordable price" said Dr. Robert Metcalfe, inventor of Ethernet, founder of 3Com, and formerly CEO and publisher of *InfoWorld*. "The slow speeds of modems simply can't answer the needs of today's digital desktop."

Len De Paolo of *Communications Planning & Services Inc.*, a systems consultant and integrator serving the New York metropolitan area, agrees. "Raw ISDN speeds are almost ten times as fast as the typical 14.4Kpbs modem sold today – and as much as fifty to seventy times as fast with today's still-emerging compression techniques.

"A typical 10-megabit file," he adds, "a large page-layout, spreadsheet or database file for example, can be transferred across the street or across the nation not in the 12 minutes or more a modem would take, but in less than half a minute.

"That's pretty good speed through a telephone line."

ISDN: What Is It?

At its simplest, ISDN is a telecommunications technology designed to carry the power of the worldwide digital network directly to the desktops of end users.

DIGITAL DESKTOP: 128Kbps+ before compression

NT1

NYNEX NETWORK

Using the simple concept of dialing a connection when and where it's needed, ISDN offers reduced digital communications costs, almost unlimited flexibility in gathering and using bandwidth, clearer voice conversations, improved employee productivity and literally hundreds of exciting new applications that were either not possible or not practical before.

It offers inexpensive dialed digital access to the world's telecommunications network.

And while ISDN is often found as part of a larger connectivity solution that includes many of today's emerging telecommunications technologies – ATM, SMDS, Frame Relay and others – it is, in fact, quite different. For while most of those technologies are designed *and priced* to link corporate or enterprise systems together at high speeds, ISDN is designed *and priced* for the individual end user.

The primary purpose of ISDN, in fact, is to "close the loop" from the worldwide digital telecommunications network to the desktops of individual users – from corporate managers and engineers to doctors, students, real estate agents and more.

What it brings to these users is a varied and almost limitless range of powerful capabilities:

❖ *Dialed digital connections.* It is no longer necessary to use dedicated lines to gain the benefits of digital speeds or connectivity. The flow of digital information now begins at the user's desktop, and links it to the desktops of users around the world.

❖ *All types of information.* From voice and data, to complex images, full-color video and stereo-quality sound, all are transmitted with digital speed and accuracy through what is now a totally digital network.

Transmission Speeds

Transmission speeds are most accurately measured in bits per second, or bps. Commonly used abbreviations are:

❖	Kbps	Kilobits per second	Thousand bits per second
❖	Mbps	Megabits per second	Million bits per second
❖	Gbps	Gigabits per second	Billion bits per second

The term *bit* is a contraction of *binary digit*, the smallest unit of digital information – either an on or off signal. The term *byte* is similar, but actually represents one full character – a letter, number or symbol – of seven or eight bits, depending on the computer code used. The term *baud* is an older analog designation, and refers to the number of times per second the sine wave of an analog voice line can be successfully modified.

Although the terms bit, byte and baud are frequently interchanged, they are not in fact the same. Speeds in this guide are consistently referenced in bits – or kilobits, megabits and gigabits per second – as above.

◆ *Much higher data speeds.* ISDN replaces today's slow modem technology with speeds of up to 128Kbps (kilobits per second) before compression. With compression, users in many applications today can achieve throughput speeds of from 256Kbps to more than 1,024Kbps – more than a megabit per second.

◆ *Greater accuracy; virtually no problems.* Digital lines are almost totally error-free, which means that the slowdowns and errors typically encountered in today's modem transmissions are no longer a problem.

◆ *Multiple devices and multiple numbers on the same line.* A single ISDN line can serve as many as eight devices – telephones, facsimiles, desktop computers and more. Each device, in turn, can be assigned its own telephone number, so that incoming calls can be routed directly to the appropriate device. While some tariff restrictions apply, enormous flexibility is possible.

◆ *Multiple calls or transmissions on the same line.* Any two of these devices can be in use at the same time for voice or data transmissions, and the two "lines" can also be combined for higher data speeds. In addition, an almost unlimited number of lower-speed data transmissions – for e-mail, credit-card authorizations and the like – can also go on at the same time.

◆ *Standard telephone wires.* In most cases, the same copper wires used today for what is typically called plain old telephone service – or POTS – can be used successfully for ISDN. Which means that most offices and homes are, in fact, ISDN-ready today.

◆ *Much better voice telephone service.* Often overlooked in the excitement of faster, more accurate data transmissions is the fact that ISDN represents the next generation of voice telephone service. It offers absolutely quiet, clear worldwide conversations every time, plus a host of powerful call management and call handling capabilities.

◆ *Seamless connections to other networks.* ISDN lines can be connected, or *interworked*, to virtually every other voice, data and packet network in the world – from a voice call across the street, to a private data network in a remote country, to an X.25 terminal in a developing nation.

ISDN offers, in short, a faster, better, more economical way to communicate.

Two types of channels. *Circuit-switched B channels carry user voice and data transmissions. D channels carry call set-up and signaling information, including Call ID, as well as a broad range of user-generated messages and data.*
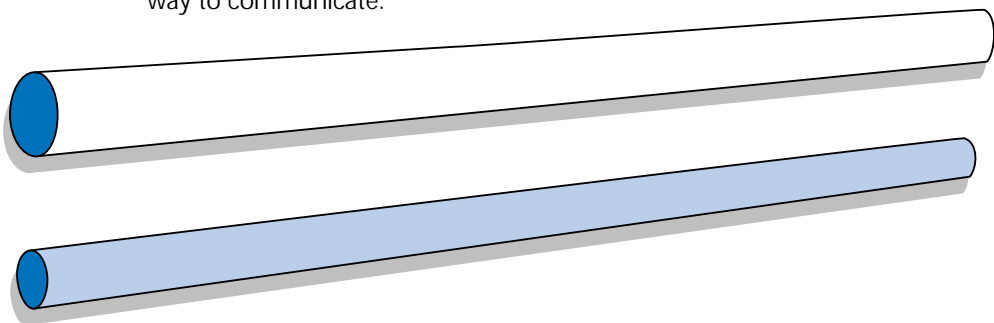
ISDN FUNDAMENTALS

Integrated Services Digital Network is based on worldwide standards developed by CCITT (the Consultative Committee for International Telephone and Telegraph) and maintained by its even more ungainly-named successor, the International Tele-communications Union – Telecommunications Standardization Sector (ITU-TSS). It is designed specifically to bring worldwide standards to digital voice and data transmissions of individual users through what is now the almost totally digital global communications network.

Two Types of Channels

Through standard telephone lines, an ISDN-capable digital switch at a local telephone company office generates two different types of "electronic channels."

Some of these channels, *B channels*, are designed to carry a full range of circuit-switched voice, circuit-switched data, and packet-switched data transmissions. Others, the *D channels*, carry call-signaling and set-up information for the network, plus a range of lower-speed packet transmissions.

There are no protocol or other restrictions for B channels. They are defined as transparent, circuit-switched, 64Kbps connections capable of carrying digital voice or digital data transmissions. B channels can also be inverse multiplexed, or "*bonded*" by customer equipment (or the local NYNEX switch) into single *n* x 64Kbps data channels.

Call signaling and set-up information traveling on the D channel is also unique, designed to travel through a separate communications network dedicated to call set-up and control. This network is called *Signaling System 7* (SS7).

The primary advantage of a separate, out-of-band signaling network is the speed with which calls can be connected – about 1-3 seconds from the last digit dialed to the first ring, compared to some 10-30 seconds without it.

In addition to transmitting call signaling and set-up information, the D channel can also be simultaneously interconnected to the worldwide X.25 packet network for user messaging, small file transfer, transaction processing, remote telemetry and a host of other applications.

Using combinations of these B and D channels, a digital switch at the user's central office generates two types of ISDN *interfaces*. These are called the *Basic Rate Interface* (BRI) and the *Primary Rate Interface* (PRI).

Multiple devices and multiple telephone numbers. *Each ISDN line is technically capable of supporting up to eight devices, each with as many telephone numbers as needed.*

Telephones

Faxes

PCs

Credit-card readers . . .

. .or cash registers
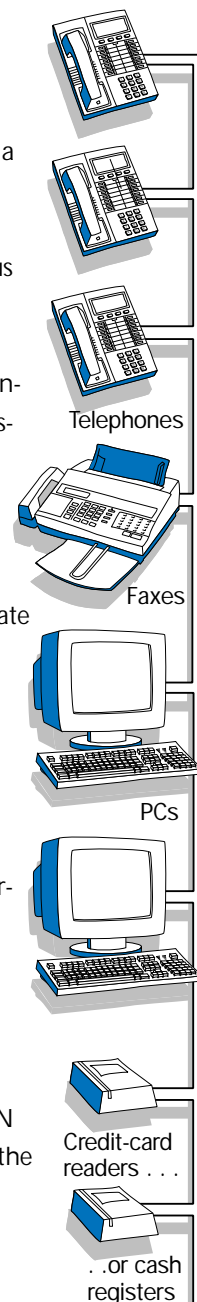
The Basic Rate Interface

The *Basic Rate Interface* – the BRI – consists of two 64Kbps B channels, and one 16Kbps D channel. Often called 2B+D connections, they link the end user directly to either a telephone company switch, or to a private branch exchange (PBX) or other ISDN call controller, which is itself linked to the telephone company's central office.

The Basic Rate Interface represents ISDN in its simplest form – a dialed, high-speed digital connection capable of carrying virtually any type of voice, data, video, image, sound or other transmission.

It should be noted that in some areas of the country where Signaling System 7 is not yet fully operational, D channel signaling information is carried *in-band*, that is within the main flow of voice or data. The result is that B channels are reduced to a speed of 56Kbps on calls from one telephone company central office to another. Nonetheless, D-channel interconnections to the X.25 packet network are still possible.

BRI:
2 B channels
+ 1 16Kbps D channel
(2B+D)

The Basic Rate Interface
The BRI delivers three separate channels through standard copper telephone lines.

The Primary Rate Interface

The *Primary Rate Interface* – the PRI – typically contains 23 64Kbps B channels, coupled to one 64Kbps D channel. Transmitted through a standard, dedicated North American 1.544Mbps (megabit per second) DS1 line or trunk, the PRI is also known as a 23B+D connection. PRIs link medium and large locations directly to a telephone central office ISDN switch.

PRIs add valuable new capabilities to a standard DS1 digital line. A key benefit is call-by-call service selection, with dynamic channel allocation. This means that a PRI lets a company flexibly allocate bandwidth as demands for that bandwidth change. A telecommunications or MIS manager can adjust the inbound and outbound calling flow on the PRI's 23 B channels to respond to specific time-of-day or day-of-week needs.

A group of six B channels, for example, could be combined – bonded – by customer equipment for a studio-quality, full-color, full-motion video conference, and afterward returned to the general pool of B-channels supporting internal and external voice and data communications. These same channels might be combined again after-hours into even larger channels for high-speed file transfers to locations around the nation and around the world.

PRI:
23 B channels
+ 1 64Kbps D channel
(23B+D)

The Primary Rate Interface
Transmitted through a standard 1.544Mbps T1 trunk, the PRI links a larger location directly to a NYNEX central office switch. Each B channel can be individually dialed by a user, or allocated by either a user bandwidth controller or the NYNEX switch itself.

Bonding B channels to make larger pipes. *An ISDN B channel transmits data at 64Kbps, before compression. These channels can also be inverse multiplexed, or "bonded," to make even larger digital channels of varying bandwidths.*

64Kbps

128Kbps

384Kbps
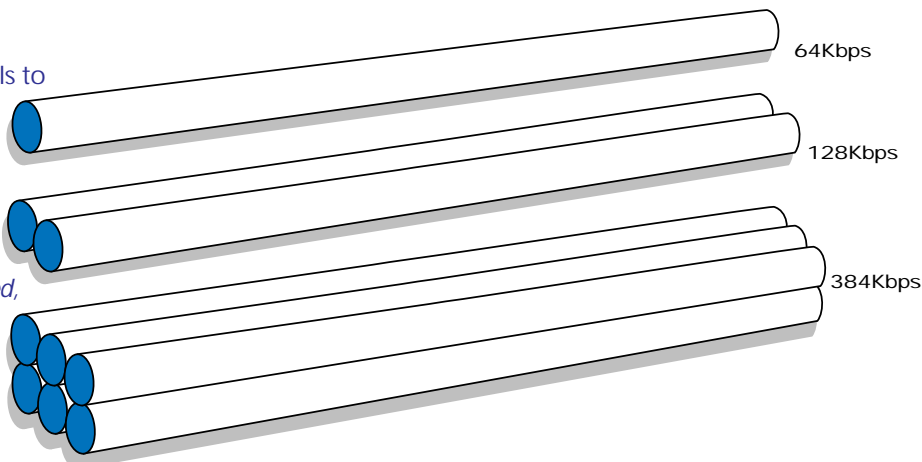
Bandwidth control can either be preprogrammed into the central office digital switch serving a location, or can be allocated on demand through a growing range of telephone and computer systems designed for the purpose. These devices include PBXs, mainframes and minicomputers, LAN and WAN gateways, multiplexers, video units and a growing breed of ISDN bandwidth-on-demand controllers.

Growing Availability

Today, ISDN-capable central office switches are being rapidly deployed throughout the NYNEX "footprint." In addition, the NYNEX "Virtual ISDN" program means that if your area does not have ISDN, NYNEX will bring service to you from the closest area that does.

NYNEX projections, in fact, show that by the end of 1995, ISDN will be available to virtually all customers in major population centers throughout the six-state NYNEX area.

The NYNEX "Virtual ISDN" program. *ISDN can be forwarded by NYNEX from an ISDN switch in a neighboring central office, through the user's central office, and on to the user.*

NEARBY ISDN SWITCH

LOCAL NON-ISDN SWITCH

USER'S LOCATION
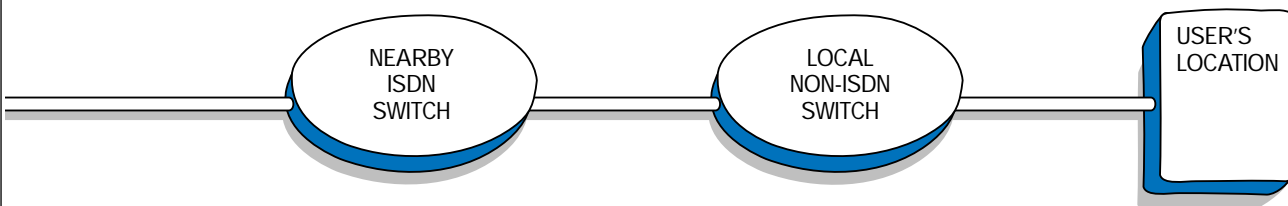
2

*ISDN links people together with powerful digital connections —
quickly, simply and inexpensively. It lets them work together in
hundreds of ways that were neither practical nor perhaps even
possible before.*

Some of the applications now made viable by ISDN are tele-
commuting, LAN-to-LAN and LAN-to-host interconnection,
remote image retrieval, inexpensive video conferencing, work-
group collaborations, high-speed access to the *Internet* and other
data sources, extended teleradiology and telemedicine, remote
security and telemetry, accelerated links to distant libraries and
research systems, and much, much more.

Through standard copper telephone lines, ISDN connections
now replace the dialed analog connections of the past with the
dialed digital connections of the future. The results of this simple
fact are significant:

❖ Expensive, dedicated digital lines are no longer the only way to
achieve digital transmission speeds.

❖ Modems to convert the digital pulses of computers to analog
pulses for an analog network will become obsolete. Digital
signals can now flow directly from one digital device (e.g., a PC
or ISDN telephone) to another through what is now an
inexpensive yet fully digital connection.

Linking LANs Together

One of the most basic connections between people who work
together today is the high-speed local area network, or LAN.
These small networks typically offer transmission speeds of 10 to
30Mbps (megabits per second) through dedicated fiber optic or
coaxial cables.

Unfortunately, LANs also have some serious constraints:

❖ *The size of a LAN must be carefully monitored.* Too many users, or
too much traffic, can rapidly overload even the fastest network.

❖ *Physical distances are strictly limited.* Most LANs must be
geographically confined to a single floor, or at best to several
floors in a single building.

❖ *The costs of extending LANs* or linking them through traditional
means can be prohibitive.

LAN — Bridge or Router — NT1 — NYNEX NETWORK — NT1 — Bridge or Router — LAN

File Server   File Server
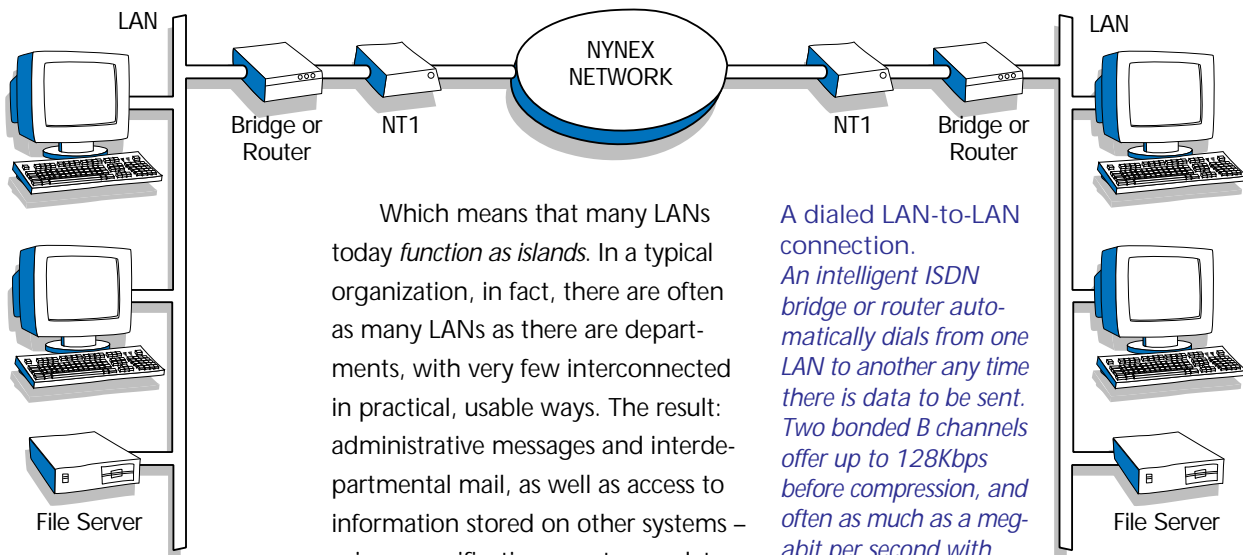
Which means that many LANs today *function as islands*. In a typical organization, in fact, there are often as many LANs as there are departments, with very few interconnected in practical, usable ways. The result: administrative messages and interdepartmental mail, as well as access to information stored on other systems – prices, specifications, customer data, orders, manufacturing and delivery schedules, inventory levels, engineering drawings and much, much more – are still relegated to mail carts, bulletin boards and a seemingly endless flow of paper.

A dialed LAN-to-LAN connection.
An intelligent ISDN bridge or router automatically dials from one LAN to another any time there is data to be sent. Two bonded B channels offer up to 128Kbps before compression, and often as much as a megabit per second with compression.

ISDN: Dialed LAN Connectivity

ISDN offers a better way. Using single BRI connections dialed through standard telephone lines, a growing array of ISDN LAN bridges and routers offer fast, virtually immediate high-speed inter-LAN connections.

When information needs to be sent to or retrieved from another LAN, an "intelligent" bridge automatically dials and establishes a 64Kbps connection through a single B channel. If higher bandwidths are needed, a second B channel is automatically dialed and bonded into the connection for transmission speeds of 128Kbps before compression.

When transmission is completed, the entire connection is automatically torn down. Users pay only for actual transmission times rather than expensive dedicated digital circuits.

The result is a virtual, on-demand connection to every LAN or host on a corporate campus – as well as most vendor and customer systems – for literally the cost of a dialed telephone call.

Are speeds fast enough? The answer is an enthusiastic yes, especially from users who have in the past tried to link LANs using analog modems or X.25 packet switching. For while the data rates of ISDN do not come close to the raw speeds of a LAN, the unshared bandwidth of ISDN has proved that it can produce almost the same response times that users expect from an office LAN. As B-channel compression speeds continue to increase, user response times should improve just as quickly.

Some typical users of LAN-to-LAN connections include:

❖ *Deutsche Telekom, Inc.*, the North American sales arm of Deutsche Telekom AG in Germany, Europe's largest telecommunications company. LANs in each of its six sales offices in the United States and Canada can quickly and effectively be linked through ISDN. "Any office can get quick access to another, for file sharing, e-mail, database lookup, sales reports and more," says Horst Schad, administrative support manager. "To make a connection, all we have to do is press a function key. Disconnecting takes longer: we have to press a key twice."

❖ *Manchester Equipment Corporation*, a major supplier of ISDN and other telecommunications equipment and services in the New York area. The firm is itself a committed user of ISDN for a range of dialed connectivity, with ten ISDN Intellipath™ lines serving its two buildings in Hauppauge. The dialed connections offer several advantages, according to Ed Hodgson, manager of consulting services. First, they establish high-speed links between LANs in each building. Using Gandalf bridges on each LAN, typical data speeds of about a megabit a second are possible.

"We used to link our LANs with Switched 56 leased lines," he notes. "Today, ISDN gives us twice the speed, and more, for about half the price."

In addition, Manchester Equipment uses ISDN to back up leased frame relay data connections to two sites in Florida, and one in Needham, MA. ISDN has also become a primary channel for video connections between these locations using Intel ProShare equipment.

LAN-to-host connections. Dialed ISDN links offer enormous savings compared to dedicated digital links.

Individual Access to LANs

ISDN is also opening LANs to easy, high-speed dialed access by individual users at remote sites – telecommuters at home, sales representatives on the road, engineers or researchers visiting another office. In forthcoming chapters, we'll examine several of these applications more closely – especially the phenomenal growth of work-at-home and video applications.

Perhaps the most dramatic example of how individual systems can be linked to a central site is the trendsetting work being done at *K&B Services*, a large retail pharmacy chain headquartered in New Orleans. Dialed ISDN BRI connections are beginning to link the company's 183 stores, located throughout the Southeast, to a central data center. The connections carry

LAN

LAN

File Server

Bridge or Router NT1 NYNEX NETWORK NT1 Bridge or Router

Host
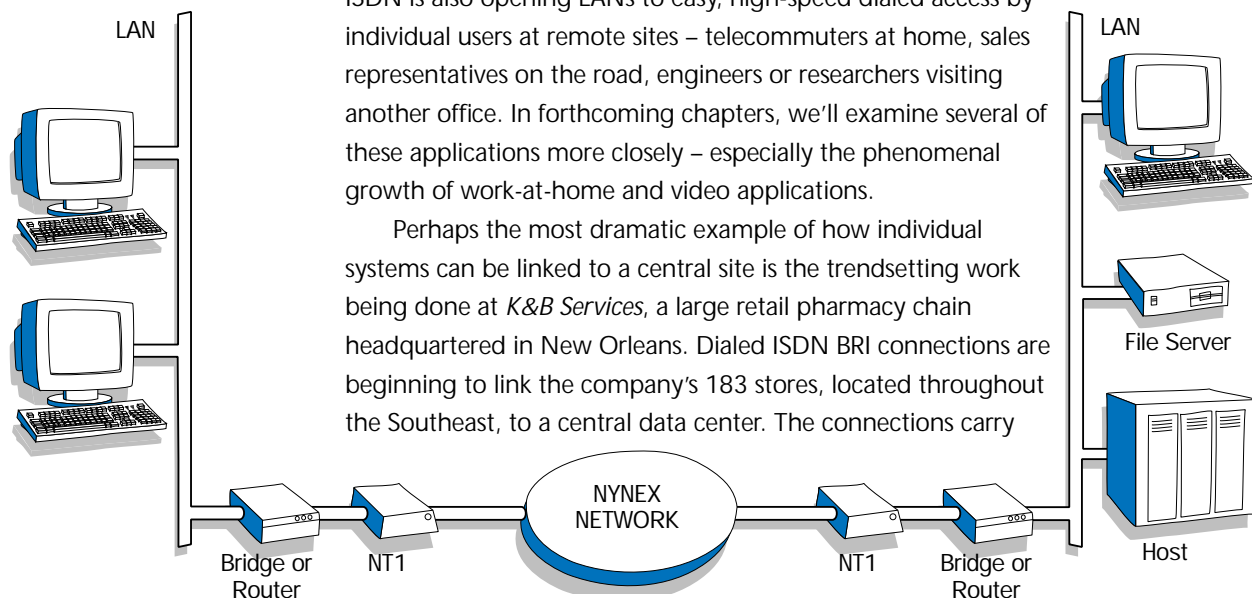
prescription and pharmacy inventory and sales information from RS6000 terminals in each location.

According to Larry Douglas, the pharmacy chain's vice president of management information services, the current links are the first steps toward a major system that will carry comprehensive sales, inventory, payroll and other information from stores to the headquarters, as well as e-mail, administrative and other information from New Orleans to the stores.

K&B's thrust will ultimately link all of its in-store cash registers and other point-of-sale devices not only to the data center, but also to a number of clearing houses for health care insurance adjudication and credit-card authorization and processing – all through a single, dialed BRI connection to each location.

Extending a Backbone

Literally thousands of universities, hospitals, corporate campuses and other multisite locations are today linked by high-speed backbone networks. These wide-area networks most often use dedicated, high-speed telecommunications channels to link many LANs in many locations into a single data network.

The one problem with these backbones, however, is that many smaller locations are often excluded because they cannot justify the cost of installing and maintaining dedicated data channels. Enter ISDN.

At *Northeastern University* in Boston, for example, dialed ISDN connections now give several student laboratories and faculty staff buildings high-speed digital access to the university's campuswide backbone. According to Chris Johnson, assistant director of systems for Northeastern's division of academic computing, dialed ISDN links now bring practical transmission speeds to these smaller locations. Combinet Ethernet bridges automatically dial and bond two B channels for effective speeds of 256Kbps with compression.

Fast, Efficient Worldwide File Transfers

The importance of timely data is hard to overestimate, and the ability to send and receive enormous quantities of information from one place to another is one of the corporate information manager's greatest challenges and responsibilities.

Today, most of these high-volume transmissions travel through dedicated channels. But many MIS managers, especially at companies with strong commitments to ISDN, find that dialed, bonded B channels give a flexibility and economy not offered by standard leased lines.

Typical International File Transfer Costs

New York City to Europe, typical daytime rates, not including taxes.

Twenty Megabit file	Time	Cost
14.4Kbps modem	23.1 minutes*	$27.13
ISDN at 128Kbps	2.6 minutes#	3.15

* Assuming full 14.4Kbps transmission speed
# Assuming 2:1 compression through a single B channel

At several locations in New York City's financial district, for example, daily and weekly updates of *stock quotations* are now forwarded by dialed ISDN links instead of the disks, magnetic tapes, messengers and couriers previously used.

ISDN for Network Overflow and Backup

The worldwide dedicated voice and data networks of many corporations are critical to the orderly, day-to-day conduct of business. A failed connection can often shut down a firm's ability to carry on its business.

For protection, many firms have traditionally maintained two separate networks – one as primary, the second as a backup. Today, however, many organizations find that ISDN lines offer a better alternative: excellent backup and overflow capabilities for either a voice or data network – at a fraction of the cost. Some typical examples include:

❖ *Avis Rent A Car.* The global rent-a-car giant, headquartered in Garden City, Long Island, chose ISDN to back up its critical worldwide reservations and information system. With operations in 140 countries, the Avis "Wizard" system is today online to 33 nations, with new countries added frequently.

The Avis network primarily handles online automobile rental reservations, with an average worldwide response time of about two seconds. It also carries sales orders and reporting, billing data, company-wide e-mail, file transfers and more. The ISDN backup system is currently deployed in eight countries including the U.S.,

ISDN as a backup to critical circuits. Within three seconds of a failure anywhere in a private dedicated network, ISDN can reestablish a corporate lifeline. Unlike dedicated backup circuits, costs are minimal for the high-speed protection offered.

CSU or ROUTER

PRIMARY DEDICATED LINE

CSU or ROUTER

ISDN Dialed Backup Connection

NYNEX NETWORK

ISDN Dialed Backup Connection
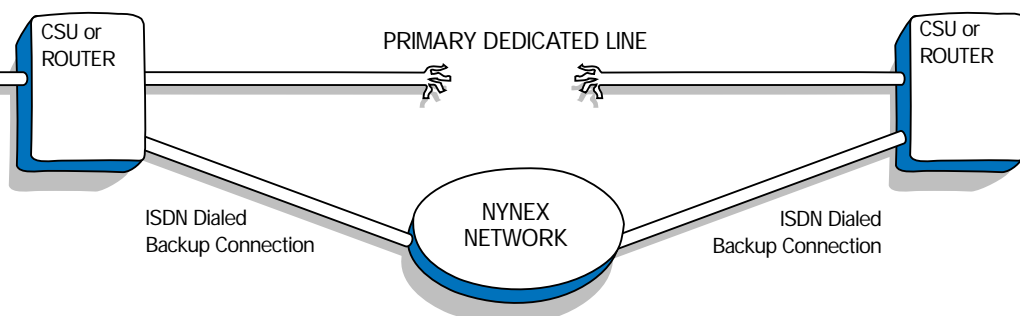
and is designed to establish dialed 128Kbps connections in less than three seconds after a network failure occurs.

❖ *William Morris Agency.* ISDN back-up capabilities are also in place for this talent agency's worldwide leased-line network, linking offices in New York, Nashville, Beverly Hills and London. The system lets agents in each office share and access information about clients and bookings.

"We use leased lines for our permanent connections in the United States," said Mike Clark, the firm's network manager, "but we rely on ISDN for backup and overflow of these critical network connections. Dialed ISDN links are also our primary connections to London."

❖ *Little, Brown and Company.* The worldwide publishing firm headquartered in Boston backs up four dedicated T1 connections using ISDN. "We back up only the data channels, ranging from 56 to 128Kbps lines," says Frank Chiacchieri, the company's director of microcomputers. Intelligent Adtran DataProbe switches monitor each channel and automatically dial 128Kbps backup connections within seconds." Chiacchieri adds that in several self-inflicted failures, the system has performed flawlessly.

❖ *Baystate Health Systems.* Baystate Health Systems in Springfield, MA, also protects key elements of its regional backbone network with Gandalf bridges, yet has this same equipment ready to assume a much larger backup role.

"We keep a complete system backup offsite," says Michael Weisse, senior systems programmer at the center, "with data records backed up every day." In the event of a disaster in the computer room – a fire or flood for example – a complete copy of the facility's records would be delivered to *Business Recovery Systems* in Sterling Forest, NY. "They maintain a physical duplicate of our system," Weisse notes, "and we would use dialed ISDN connections to access and use that system. We've tested the set-up, and it works quite well."

Intelligent switches monitor each channel and automatically dial 128Kbps backup connections within seconds.

High-Speed Group 4 Fax

The ubiquitous fax machine is one of today's most commonly used tools for person-to-person communication. And although facsimile machines have made giant steps forward since the "dark ages" of revolving drums and six-minute-a-page transmis-

sions, ISDN stands ready to make them even more usable, and *significantly less expensive*.

Today, more than 35 percent of all long distance charges incurred by a typical large company are generated by facsimile traffic. According to a recent survey by *USA Today*, the average fax is more than seven pages long, and the average page requires about a minute to transmit.

"Group 4 fax machines and dialed ISDN will probably save the typical company about 30 percent on its monthly long-distance bill."

The dialed, digital connections of ISDN offer a better, faster way to send these faxes. Group 4 fax machines, in fact, are some ten to twenty times as fast as the fastest Group 3 machine in use today. A full page Group 4 fax can be transmitted in from three to eight seconds, and quality is virtually identical to that of a high-quality laser printer.

In addition, several manufacturers now make PC-based fax cards that can send to and receive from both Group 3 and Group 4 fax systems interchangeably, as needed.

"Group 4 fax machines and dialed ISDN connections will probably save the typical company about 30 percent on its monthly long-distance bill," said Marc Josephson, president of *Advanced Digital Networks*, a systems integrator in New York. "But that's just the beginning. Because the corresponding savings in time and effort would probably be about four or five times as great."

According to Josephson, many PC-based systems today offer comprehensive facsimile store-and-forward capabilities, which can significantly cut the waiting time and delays common to sending faxes. These systems also function as fax mailboxes for incoming transmissions, and hold and deliver faxes when and where they're needed – just as voice-mail systems do now.

THE GRAPHIC ARTS

The graphic arts are typical of many industries where people need to come together, exchange images and information, solve problems and reach agreement.

The fact is that virtually every book, magazine, newspaper or advertisement prepared today, as well as every graphic image that appears on television, first began its existence in a computer, or was quickly made part of a larger computer file.

Copy is written and images drawn or scanned on desktop computers. Pages are designed and formatted, photos corrected and separated, and negatives or even final printing plates produced on these or similar desktop systems. Meanwhile, scores of others review, edit, revise and approve the work at almost every step of its development.

And throughout this intense and high-paced community of interest, ISDN is changing the way information gets from one place to another. It has begun to replace the colorful but costly army of bicycle messengers, couriers and account executives in taxis that has traditionally serviced this industry.

Prepress

New York City's *Axiom Design Systems* uses ISDN lines to offer a battery of PostScript imaging services to ad agencies, design firms, publishers and corporate art departments. In fact, today more than half of the material sent to and from the company is delivered electronically.

"When all we handled was text, modems were quite adequate," says Jim Lynch, vice president of the firm. "But modems are a pretty slow way to transmit most of today's large photo, image and layout files."

Axiom Design also uses ISDN to offer bulletin board, e-mail and electronic conferencing services, as well as typefaces, stock photos and illustrations – all of which can be electronically previewed, purchased and downloaded.

Lynch believes that ISDN will also be the catalyst for a growing number of applications, including remote image database management, and the widespread use of a service bureau's high-quality dye-sublimation color printers as an industry-wide resource.

At *Digital Pre-Press International* in San Francisco, Dr. Sanjay Sakhuja heads a staff of specialists who offer high-quality color separation for slides, artwork and illustrations.

"Once these images are in a computer," Dr. Sakhuja says, "ISDN lets us transport even the largest of them across the street or around the world in seconds." DPI serves customers from virtually every area of the country, including many in the NYNEX "footprint." DPI also receives finished computer layouts of ads, magazines, books and more through ISDN, turning them into finished printing negatives – up to 33" x 44" – customized for the printer and press to be used. The ISDN links are also used to return low-resolution copies of a separation to a designer, who then crops and positions it in the final layout. The high-resolution counterpart, stored at DPI, is then inserted into the final version.

At *Parade* Magazine, a simpler but equally time-saving exchange of files takes place each week. According to Esteban Haigler, the publication's technical services manager, Parade works closely with a key advertising agency to insure maximum reproduction quality in the many ads placed by the agency.

Parade first scans black-and-white or color photos to its exacting specifications, and then – using *Easy Transfer* software and Planet Euronis ISDN cards for Macintosh – transmits them through ISDN connections to the agency. The agency then incorporates the photos into ads and returns finished EPS files to Parade, also by ISDN, where the ads are quickly pulled into *Quark XPress* layouts for the nationwide magazine.

"The files can be as big as seven to ten megabits," says Haigler. "We used to send them back and forth using optical cartridges and messengers, but now ISDN gives us a faster, simpler way."

Photo Retrieval Systems

While a growing number of stock photos are being offered on CD-ROM, many time-dependent photos – especially news and sports images –are today being offered through the dialed connections of ISDN.

The photo department of *Business Week* magazine in New York City, for example, is beginning to

High-quality photos
Digital images can now be previewed, selected and downloaded through dialed ISDN connections. The high-resolution four-color JPEG original of this photo is more than 17 megabits in size. Using bonded B channels, it could be transmitted down the street or across the country in about two minutes or less. Photo courtesy of Allsport, Santa Monica, CA.

use ISDN to view, access and retrieve high-quality photos from around the world – from manufacturers, marketers, advertising and public relations agencies, and photo services in the United States and Europe. Michael Hirsch, the publication's picture researcher, says that the higher speeds of ISDN will enable the magazine to greatly extend its reach to a broad range of new sources.

"We measure transmission times in seconds and minutes, rather than hours and days as we did before . . ."

A typical supplier of up-to-the-minute photographic images is *Allsport*, in Santa Monica, CA. The company specializes in high-quality full-color coverage of sporting events around the world, and currently has more than 100,000 images available on-line, with thousands of new images added each month.

Through ISDN connections, editors can view thumbnail-sized pictures, call up full-screen views of selected images, and even try out various zooms and croppings. They can also place orders, and have high-resolution digital copies quickly downloaded, or shipped overnight by courier.

According to the firm's president, Steve Powell, it is relatively easy to use dialed ISDN (or Switched 56) connections to conduct detailed thematic searches, since all images are not only electronically stored but systematically cataloged.

Publishing

The *Instructional Publishing Group* of New York's *Scholastic, Inc.* develops and publishes school textbooks for a range of children – from kindergartners to sixth graders. Through the years, the company has developed close working ties with *Integrated Graphic Services* (IGS), a comprehensive prepress facility in Atlanta, GA.

"ISDN lets us maintain an around-the-clock presence in Scholastic's New York office," says Will Weaver of IGS. "In effect, our Atlanta office is actually closer and more responsive to our client than other prepress facilities just down the street. ISDN lets us give Scholastic fast, comprehensive, virtually around-the-clock service." Files transmitted to and from Atlanta through Engage routers range from small text documents and medium-sized page-layout files to multimegabit photographs and other scanned images.

"We measure transmission times in seconds and minutes, rather than hours and days as we did before," said the company's operations manager, Daniel LaBour. "ISDN has significantly reduced the time it takes to move a project from beginning to end." For IGS, the flexibility of ISDN also means that work channeled into IGS can quickly be sent for printing to affiliated companies virtually anywhere in the nation.

Barings Securities is an international brokerage firm with facilities around the world. In the company's Manhattan office, research editor Julia Cronin uses ISDN to send *Page-Maker* files of detailed research reports to printers in London and Singapore.

BARINGS

Files to printers around the world. Large PageMaker files from Barings Securities are transmitted in minutes via ISDN to printers around the world.

"We used to use electronic mail, conventional modems, and international couriers," said Cronin, "but ISDN has given us a much faster alternative. Our files can be quite massive, yet ISDN transmits even the largest anywhere in the world in minutes."

The clients of *Arnold Advertising* in Boston include such names as Volkswagen, Fleet Bank, McDonald's, NYNEX, Stop & Shop, and others. Coordinating the production of ads and other materials can pose major logistical problems, notes Joe Teixera, the firm's executive vice president and chief administrator.

"ISDN is a lifeline," he says. "Instead of sending messengers and couriers all over the Northeast, we now use ISDN to send all of our *Quark XPress* and Adobe *Illustrator* files to clients for review, and to printers and newspapers for actual production."

Bloomingdale's, headquartered in New York City, is a major advertiser in a multitude of publications. Says Chip Pursell, system administrator for the department store giant, Bloomingdale's uses ISDN to transfer files to and from artists and designers, as well as marketing and merchandising executives.

Distributing ads. Bloomingdale's has supplanted messengers and couriers with dialed ISDN connections to send final production files of advertisements to publications throughout its market area.

July HomeSale
Queen or king sheets, 29.99 each
Our most luxurious bath towel, 9.99

bloomingdale's

"We use *Adobe Acrobat*," says Pursell, "with medium JPEG compression that actually enhances much of the black-and-white art." File size for art and finished ads can be as large as ten to twelve megabits. He also uses ISDN to send final, production-ready printing materials to some 15 newspapers throughout the store's marketing area.

At *Ocean Spray* in Lakeville, MA, labels for the firm's growing array of new products marketed in the United Kingdom are actually developed in England, at the company's design firm in Oxford. Sample labels and other Macintosh files are frequently sent back and forth as designs, and the products themselves, evolve.

"We get the right labels at the right time," says David Murray, the company's financial administrator of information services. Murray notes that Ocean Spray is also becoming active in both CAD/CAM and video connections to its other offices in the U.S. and overseas.

Goodbye Couriers; Hello ISDN

"In literally hundreds of areas," says *TeleSystems Marketing Applications*' John Mazalewski, an ISDN systems integrator serving the Northeast, "people still transfer important information physically – on tape, disks and cartridges, by messengers and overnight couriers – because they don't trust analog lines to do the job."

The reason, he notes, is that analog connections are too slow for transferring large files, and too error-prone for critical information.

"The digital connections of ISDN are changing all this," Mazalewski adds. "Soon, in areas that range from printing and publishing to manufacturing and warehousing, transferring data to someone's computer will be as effortless as calling them up to leave a voice-mail message is now."

3

Across the nation, as our highways become more crowded, and the demands of family life increasingly intermingle with those of the business place, the growing response of both employees and corporations has been to search for intelligent ways to begin working productively at home.

Working at home, or telecommuting as it's often called, offers advantages to everyone:

◆ *For employees*, the idea of telecommuting makes possible a better balance to home and work responsibilities. It can drastically reduce the time spent commuting during a typical week, and – in an amazing preponderance of early programs – has often resulted in more time actually spent working, plus lower stress and improved morale.

◆ *For employers*, telecommuting has shown that it offers not only happier, more loyal employees, but significant savings as well. It can reduce hiring and turnover costs, cut workplace expenses, and make it easier to extend business hours into the evening and weekend. It can also help answer seasonal needs for extra staff – and do it without adding space.

Perhaps most importantly, however, is that early programs have shown consistently improved productivity, and happier, more loyal workers. Telecommuting also offers an answer to growing environmental movements, such as the Clean Air Act of 1994, to reduce traffic congestion and pollution, as well as social mandates to make the workplace more accessible to disabled workers.

The breathtaking fact is that today some 51 million Americans – almost 40 percent of the workforce – now regularly work at home for a significant amount of time. Which clearly argues that acceptable, easily implemented communications technology for the home is *no longer a luxury but a critical need*.

Commuting is changing. It is now easier, cheaper and faster to move work to the people than the people to work.

Peter F. Drucker, Management Consultant & Author
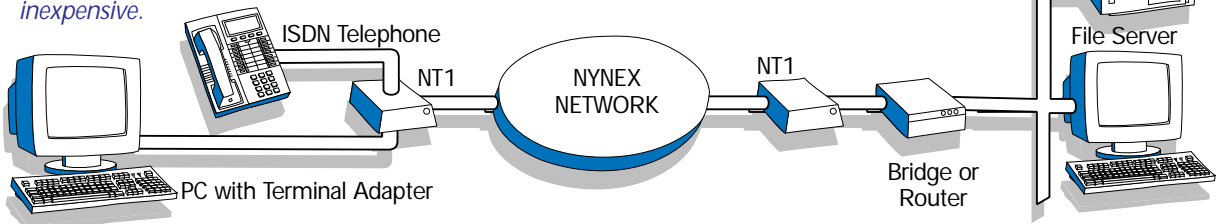
The Answer: ISDN

ISDN has spurred a rapidly growing range of simple, easily installed equipment configurations, transparent access to telephone, e-mail and other workplace services, and transmission speeds that have proved more than acceptable for full interconnection of work-at-home PCs to LANs, hosts, and even the most graphically intensive databases.

ISDN responds to the needs of the telecommuter in many ways:

❖ *For basic connectivity.* For those who predominantly make and manage work-related telephone calls, the ISDN solution is both inexpensive and elegant. A sales representative, for example, needs a telephone, perhaps a fax and some method of accessing basic e-mail and similar services through a desktop computer. A single BRI line offers D-channel access to e-mail, bulletin boards and data servers, while keeping two voice channels open for both incoming and outgoing calls.

❖ *For connectivity to LANs and co-workers.* For those who work with computers, the ISDN solution is equally responsive. Through a single ISDN BRI connection, major components of the office's functionality can be "transported" to equipment in their homes. This functionality includes: high-speed access to the user's LAN, file server, and other data; full access to voice and e-mail messages; and interconnections to other company LANs or hosts, remote systems, and perhaps other networks such as the Internet or distant research systems. In many early trials, desktop video capabilities have also made possible face-to-face meetings with co-workers.

❖ *For work-at-home call-center connectivity.* From airline reservations to computer service information – the sales and service call centers operated by hundreds of firms have begun to rapidly embrace the concept of allowing agents to work at home. The two B channels of an ISDN BRI respond perfectly, giving these agents simultaneous voice and data access to voice calls forwarded from a toll-free number, *and* the customer's record stored in the firm's central computer.

In many programs, desktop video conferencing capabilities are also becoming an important feature. "Making video an integral part of telecommuting solves a number of problems,"

A typical ISDN connection between a single user and a LAN. *ISDN gives telecommuters dialed access to their office that is fast, easy and inexpensive.*

OFFICE LAN

File Server

ISDN Telephone

NT1

NYNEX NETWORK

NT1

PC with Terminal Adapter

Bridge or Router

said Anthony Antonuccio, vice president of marketing at *VIVO Software*, Inc. in Waltham, MA. "It addresses telecommuters' isolation by letting them see and work with others in their group, and lets managers work naturally and effectively with remote colleagues."

Equipment Needs for the Central Location

For the company supporting work-at-home alternatives, equipment needs and configurations are relatively straightforward. In fact, LAN bridges and gateways capable of supporting the terminal adapters and other devices used by telecommuters may already be in place – serving remote LAN connections – or can be quickly installed. Since many of the calls received from telecommuters are relatively short, this gateway equipment already in place can often be used without upgrading.

SOME TRENDSETTING PROGRAMS

Enterprising work-at-home programs throughout the Northeast are proving the value of telecommuting to both employers and workers:

✦ After an exhaustive study and several successful tests, a leading *New York City investment banking firm* is in the process of installing more than 600 ISDN lines for high-speed, work-at-home connections to the company's central backbone network.

> The program . . . also represents a major strategy to deal with . . . natural and manmade barriers that make it impossible for employees to reach their offices

The program enables most of the firm's key traders and analysts to telecommute one or more days a week, and also represents a major strategy to deal with snowstorms, transportation strikes, bridge closures and other natural and manmade barriers that can make it impossible for employees to reach their offices in lower Manhattan.

Similar programs are now being implemented at several other investment and financial firms in both New York and Boston.

✦ *Bausch & Lomb's Polymer Technologies Corporation* is the world's leader in the design, manufacture and sale of rigid gaspermeable contact lenses. It is also a company with a major commitment to ISDN.

"ISDN makes possible the concept of a *virtual company*," says Dr. Daniel Gingras, director of the corporation, "because it transports both the expertise of our people and the power of our

systems wherever and whenever we need them." Virtually anyone in the corporation, for example, can access almost any LAN, WAN or mainframe system from their office, from another office or from their home through dialed ISDN connections.

"Home becomes an integral part of the office," said

"ISDN makes possible the . . . *virtual company."*

Dr. Gingras, "which means that we can truly start balancing the needs of our jobs and families. Any member of our staff can complete much of a project at home. Our jobs deal basically with information, and information can be delivered where we need it." Polymer Technologies uses a range of AccessWorks equipment to link its central systems, offices and homes.

The company has also committed to a range of video conferencing applications, with high-speed T1 links between its major sites. It is also extending this backbone video network with dialed ISDN connections to offices in Hong Kong, London, Rochester and San Antonio, as well as to desktop video connections in key executive's homes.

❖ *Lotus Development Corporation* in Cambridge is testing an ambitious work-at-home program, says Jerry Audet, the firm's telecommunications analyst. "We have about 30 people now," he says, "and expect to be ramping up to about 100 in the near future." Telecommuters include consultants, sales people, and a range of others.

"They all need high-speed access to their office LANs and servers," he notes, "and ISDN gives them that." Lotus uses Gandalf equipment capable of compressed transmission speeds up to a megabit a second.

❖ *McDonald's Corporation*, the fast-food restaurant chain based in Oak Brook, IL, sees telecommuting as an effective response to the Clean Air Act and other legislation. According to Patrick Krause, director of network systems, they also saw the potential to increase employee productivity, improve morale with more flexible working arrangements, and defuse what had become a chronic need for space.

Bringing the work to the worker.
With high-speed access to office LANs, file servers and other data, plus full access to the Internet, voice and e-mail, ISDN truly transports the work to the telecommuter. Desktop video can also facilitate face-to-face meetings with co-workers and managers.

Today, some 250 employees work at home, linked through ISDN to the company's various information systems. Many also have desktop video conferencing capabilities, and some even

conduct meetings from their homes with key suppliers. In addition, a growing number of field representatives, who travel to restaurants around the nation, often dial into company databases through ISDN connections.

- At the regional headquarters of *Silicon Graphics Incorporated* in Hudson, MA, a significant portion of its software and systems engineers currently work at home through ISDN connections. Using Motorola and Northern Telecom equipment for their home-based SGI Unix workstations, the engineers dial into the company's PRI hub to work on a range of computer and applications software. Through their video-equipped systems, they can also do person-to-person video conferencing to share and exchange ideas with their peers.

  A number of the company's sales representatives also use SGI workstations and ISDN to tap into their headquarters' LAN for e-mail and bulletins, and to access a range of sales and marketing databases. Some of the sales reps can also use their systems for brief video meetings with co-workers at headquarters and at home.

- *Lawrence Livermore National Laboratory*, in Livermore, CA, has more than 200 employees currently telecommuting. Virtually all need extended high-speed access to the company's scientific, engineering or administrative LANs according to Natalie Clinton, operations manager of the LLNL telecommunications systems department

  Clinton, who heads this growing program, notes that work-at-home scientists use the ISDN facilities for everything from community service to moon watching via satellite image transmissions (see above). She herself telecommutes one day a week, accessing a range of LANs on the sprawling campus.

  "Modems were useful for text-based e-mail," she said, "but for real telecommuting people need to have high-speed Ethernet access at home. Today, ISDN gives them this kind of performance, and equipment prices keep getting better all the time."

- More than 160 executives of *Microsoft Corporation* in Redmond, WA – including its chairman Bill Gates – have been telecommu-

A Physicist Telecommutes

At the Nuclear Chemistry Division of Lawrence Livermore National Laboratory, physicist Joseph Carlson likes to work at home, especially after hours and on weekends.

"I've always done that," he says, "but in the past I used a modem which did not allow me to duplicate my work environment." On a Unix workstation, he employs various data visualization techniques to identify trends or patterns in large quantities of data. The resulting images can have from 10,000 to 50,000 points, and were simply too large for transmission through a 14.4Kbps modem. He often brought home high-capacity disk cartridges, but still lacked access to much of the software on his office system.

Today, he works at home regularly. A Combinet bridge offers access to his workplace LAN at 128Kbps (or roughly 512Kbps with compression), and lets him access both software and images as he needs them.

"A typical megabit-sized file," he notes, "downloads in about two seconds."

ting through ISDN since October 1993. In addition, some 500 vendors and suppliers have BRI connections to access the company's systems for product testing, uploading and downloading of software, and a host of administrative and scheduling data.

> "It's definitely an idea whose time has come."

Microsoft's program is also a test-bed for the company's growing commitment to ISDN products and software – for group collaborations, video conferencing, ISDN extensions of its *Windows* technology, and PC-based control of ISDN voice and data telephone installations.

The Wave of the Future

"There is a strong and growing trend towards thoughtful and effective telecommuting," says Marc Josephson, president of *Advanced Digital Networks*, a broad-based telecommunications equipment and support firm in the New York area.

"It reduces costs, cuts space requirements, cleans up the air and makes for happier, more loyal workers. It's definitely an idea whose time has come."

4

In organizations where people from many departments and even many locations work together toward common goals, meetings can become important, even pivotal events. For in these regular convocations mutual progress is reported, ideas and alternatives explored, decisions made, and the future charted. ISDN now makes them convenient and inexpensive as well.

As important as meetings may be, they often consume major segments of our business life. Travel can mean hours and even days of pressure and inconvenience, while costs soar for transportation, accommodations, meals and more. In addition, the meetings themselves can frequently seem like free-form assemblages determined only to fill the time available for their completion.

ISDN offers a better way. Because in company after company, meeting participants have found that electronic meetings – often through simple, inexpensive ISDN video connections – can bring workgroups together in ways that are not only easier, faster and less expensive, but in ways that produce better meetings as well.

Better, Less Costly Meetings

Electronic meetings can offer critical advantages:

❖ *Easier scheduling.* Since each meeting participant can attend from his or her own office, or sometimes even from home, time commitments are dramatically reduced.

❖ *Reduced costs.* Travel is virtually eliminated; special accommodations are no longer needed. Meetings are now carried on from each participant's office or from a nearby conference room.

❖ *Better information.* Information to answer questions, present facts or draw conclusions is now close at hand. Other staff members with special expertise can be quickly added to a meeting for specific ideas or opinions. Video meetings also make it possible to share documents, images and detailed files through the computer or video screen.

❖ *Higher productivity.* Perhaps most important, video meetings consistently seem to improve meeting focus, adherence to an agenda, and the exchange of information to all participants. They also seem to reduce small talk and curtail long digressions.

The result is that more and more companies are beginning to use electronic alternatives to the in-person, on-site meetings of the past. With the growing array of video equipment available today, in fact, it is possible for even the smallest businesses to gain the tremendous productivity advantages of dynamic, on-the-spot video conferencing.

AN OVERVIEW OF VIDEO EQUIPMENT

A breathtaking array of video systems is becoming available, most designed specifically to use the digital speeds and dialed flexibility of ISDN.

❖ *The traditional industrial video system.* At their best, these full-motion, full-color systems can rival broadcast television in image and sound quality. Designed for transmission through larger digital channels, usually at speeds of 384Kbps and above, these systems have in the past required dedicated broadband lines set up especially for the purpose, or leased virtual connections scheduled for specific daily or weekly time segments. With ISDN the same high-quality video meetings can be transmitted either by allocating six B channels in a corporate PRI (6 x 64Kbps equals 384Kbps), or by combining the B channels in three standard BRI connections. Not only are costs significantly less, but the convenience and flexibility of ISDN mean that meetings can be scheduled when they're needed, rather than around the availability of specialized facilities. After a meeting, the six B channels can be returned to the pool available for general communications.
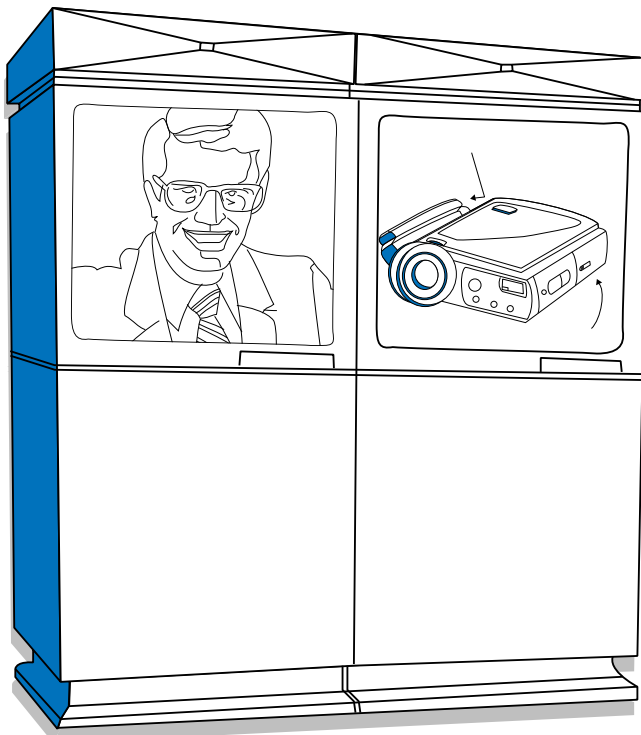
Three types of video systems for ISDN. *A broad range of video systems has been developed specifically for the speed and flexibility of ISDN. Large systems are designed to use six or more B channels. Desktop systems can deliver good quality through the bonded B channels of a single BRI, and roll-about systems can be used either way.*
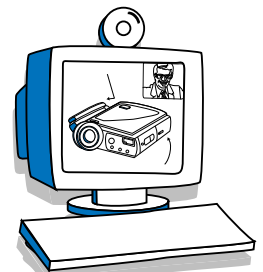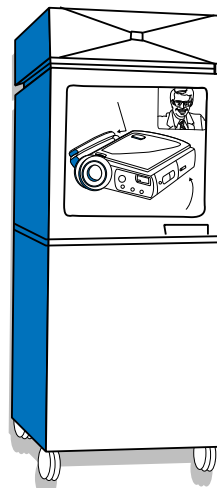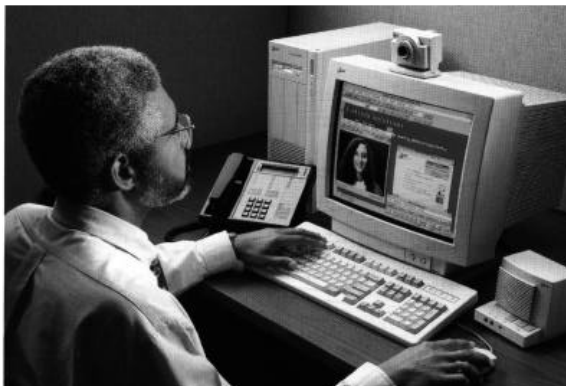
- *Midsize, Portable Video Systems.* A growing number of midsize video systems has been specifically designed to respond to a range of environments and bandwidths – ranging from full 384Kbps of six B channels to the 64kbps of a single channel. Often called "roll-about" systems, they can adapt, through either reduced color or slower refresh rates, to the line speed actually available.
- *Desktop Video Systems.* One of the most rapidly growing areas in the marketplace is ISDN desktop video. Using the high-resolution monitor of a standard desktop computer or workstation, these systems offer one-on-one video that is more than acceptable, according to most users – for telecommuting, small executive meetings, face-to-face collaborations, sales follow-up, and a host of other activities.

Desktop video. The award-winning AT&T Vistium PC-based system offers video refresh rates of roughly 15fps (frames per second) with simultaneous two-way image and sound. Most video systems offered today are H.320 compatible, which means that they can intercon-nect with virtually any other system.

Most of these video systems, large and small, have been engineered or updated to meet standard H.320 specifications – which means that it is technically possible to link virtually any two video systems anywhere in the nation, and even in the world. Many of these emerging systems are also beginning to incor-porate the new set of personal confer-encing specifications, which means that collaborative video, voice and data conferences can be designed and assembled.

Most of today's systems also have built-in facilities to accept overhead and other special cameras for presen-ting maps, documents, printed pieces and other items.

Understanding Video Specifications

The generally accepted international standard for video transmissions on a switched digital network such as ISDN is called *H.320*. Virtually all video manufacturers now support this worldwide speci-fication – which means any H.320 video system can transmit to and from *any other* H.320 system.

Even Intel, which initially developed its own standard for its ProShare systems, now ships H.320 software that lets its systems interconnect with other desktop or room systems.

In the *Personal Conferencing Specification*, Intel and other major manufacturers have taken the next step towards total compatibility. PCS is an *open standard* for both video and data trans-mission through digital connections, and also includes standards that let analog locations join a workgroup session through ordinary voice and modem connections. The PCS *umbrella* also includes the *T.120* specification for digital "multi-point communications and data sharing."

Among the vendors also supporting the PCS standard are AT&T, Compression Labs, Compaq, Hewlett-Packard, Lotus Development, NEC, Novell, Word Perfect and others.

PUTTING VIDEO TO WORK

ISDN gives range and diversity to meetings, large and small, and has begun to alter perceptions of what a meeting is:

◆ *Chase Manhattan Bank* offers a typical example of how a major corporation uses ISDN video to not only improve communication, but save time and money in the process.

According to Isaac Yohanan, global videoconferencing manager, more than 30 Chase business units around the world are in almost constant contact for executive and project-group meetings, worldwide business gatherings, presentations, product introductions and more.

"We use primarily PictureTel room systems," notes Yohanan, "which means that any location can talk to any other. It also means that we can use a single BRI connection for good quality, or three connections for full-motion, full-color worldwide video."

◆ At the Long Island headquarters of one of the world's leading manufacturers and marketers of *perfumes, cosmetics and other women's fashion items*, executives regularly hold quick video meetings with peers in six locations in the New York-Long Island area, as well as with European offices in Paris, Brussels and Rome.

"A video meeting is usually shorter, more to the point," notes the firm's executive director of video conferencing. "Executives are conscious of paying, so they seem to keep more closely to an agenda."

He notes that the firm uses video in many ways, including worldwide product launches in Europe and Asia, conferences with customers and vendors throughout the world, and interviews with job applicants from around the United States.

"What we appreciate most is that we don't have to spend hours traveling to a half-day meeting," he adds. "In a recent New York opening, for example, we had eight executives from all over the world participating. We saved hundreds of hours of travel time and expenses, and the video connections added excitement and glamour to the event."

◆ *PictureTel*, one of the country's leading manufacturers of video equipment, is itself one of the most avid users of ISDN-based video. For example, weekly staff meetings between the company's two major locations in Danvers and Andover, MA, are conducted through video

A product launch *Video not only saves time and money in assembling key participants for a product or market introduction, it can also add drama and excitement to the occasion. Photo from PictureTel.*

connections linking the two sites. Often executives and engineers visiting other sites throughout the country also participate in the meetings through dialed ISDN connections.

Kevin Flanagan, PictureTel's manager of public relations, notes that he personally uses ISDN video links to discuss projects and strategies with his agency in New Hampshire, as well as with peers in the U.S., Europe and Pacific Rim.

The company also uses worldwide dialed video links for preliminary interviews with job applicants, for executive meetings with mutual fund managers and other investors in Boston, New York and other financial centers, and for training and update sessions for its nationwide staff of sales representatives.

Video and more.
Many companies are including desktop video, screen sharing and file transfer functions, as well as high-speed LAN and Internet access, in their systems. In several – such as this one from VIVO Software, Inc. – all capabilities, including video, are generated by software. Several also include standard fax and modem capabilities for transmitting to and from the analog world.

❖ *Mullen Advertising*, in Boston, uses video extensively to service its blue-chip nationwide list of clients – including Gitano, Money magazine, Rolls Royce, Bentley, Reebok and Dun & Bradstreet software. Video accelerates the production process, said agency owner James Mullen in an interview, by letting Mullen writers, artists and account executives meet with clients at a moment's notice. The quicker and more directly the agency's staff gets feedback, he noted, the quicker and better will be the ad it delivers.

❖ *Deutsche Telekom, Inc.* uses video for frequent executive conferences from its New York sales office to Hamburg, Frankfurt and other parent-company locations throughout Germany, as well as to several sites in Paris. "ISDN gives us fast, easy video to any of our home offices," says Horst Schad, administrative support manager. "It lets us stay in touch around the world."

❖ *Lotus Development Corporation* in Cambridge uses their PictureTel room and desktop video systems "all the time," says Jerry Audet, telecommunications analyst for the firm. Some meetings are conducted through mutliplexed lines at 384Kbps; others through the 128Kbps connections of a single BRI.

Meetings range from regular staff meetings to product introduc-
tions and demos for the field sales force. Video is also used to link
development teams in Cambridge and California, and for internal
and customer briefings to sites around the world.

◆ The *New York VideoConference Center* in midtown Manhattan is
typical of many public video facilities. The center's facilities can
be linked to virtually any H.320 system in the world through
dialed ISDN connections. The center also offers nationwide video
networking.

Video Collaborations & One-on-One Conversations

ISDN connections can also bring people in different offices and
different locations into virtual work groups. Using dialed BRI
lines, they can work together on documents, files or spread-
sheets, annotate a shared "whiteboard," interconnect to LANs or
other networks as needed, and in general interact with one
another in much the same way as if they shared an office.

A video meeting, of course, can also be as simple as a face-
to-face conversation between two people in different locations
exchanging ideas and information:

◆ The *State University of New York in Buffalo* uses Intel desktop
video equipment to let graduating students be interviewed by
corporations around the country. According to Gene Martell,
director of career planning and placement, the school is part of
InterviewNet, in which students from forty-plus colleges and
universities can be interviewed by any corporation with access to
compatible equipment.

"Video cuts screening costs for potential employers," says
Martell, "while opening up hundreds of opportunities for our
graduating students." Martell expects
that within a few years video will be
as common as the fax is today.

◆ In *Boston City Hall*, chief information
officer Michael Hernon, uses Intel
ProShare video systems as one of his
tools to contact cabinet members and
department heads throughout the city.
"We cut meetings to quick, meaningful conferences," says Hernon.
"We get the job done, and save time and money in the process."

> "We get the job done, and save time and money in the process."

Video Banking

A growing number of banks across the country are beginning to
implement extensive programs of ISDN-linked video kiosks and
walk-in centers as a way of extending their reach to new
customers and new areas without expanding their workforce.
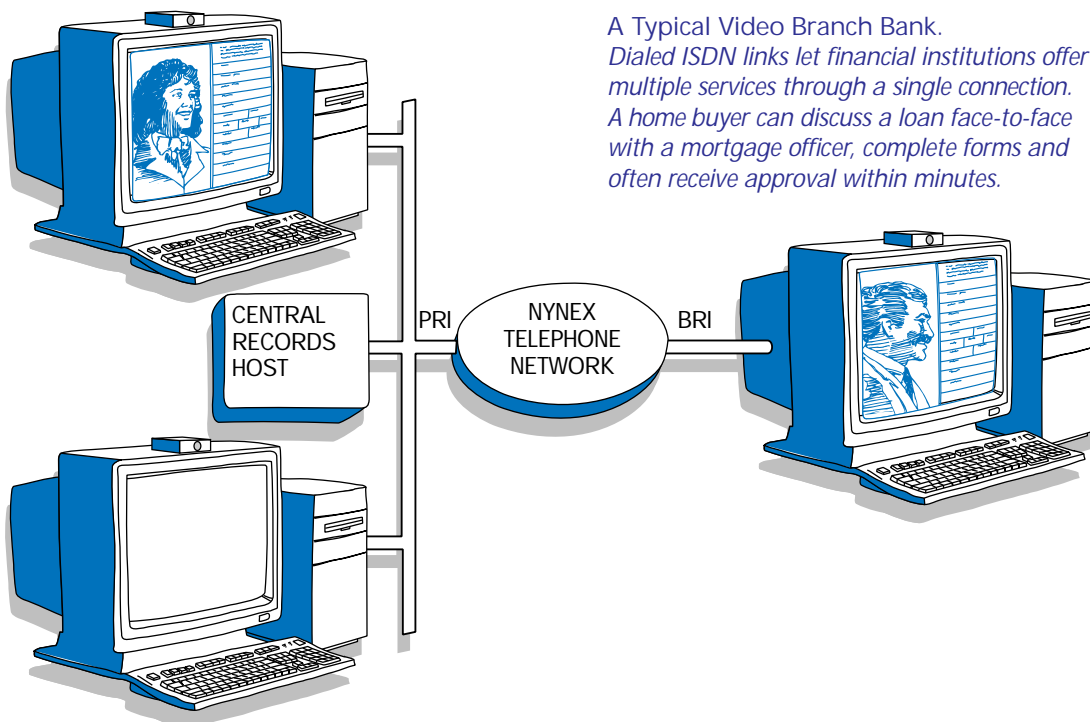
A Typical Video Branch Bank.
Dialed ISDN links let financial institutions offer multiple services through a single connection. A home buyer can discuss a loan face-to-face with a mortgage officer, complete forms and often receive approval within minutes.

CENTRAL RECORDS HOST

PRI

NYNEX TELEPHONE NETWORK

BRI

According to the industry newspaper *American Banker*, most of these efforts across the nation are built on a growing belief that younger and higher-income consumers are ready to use video banking. With ISDN now able to transport good quality images at cost-effective rates, video banking seems destined to grow as an avenue to this upscale market. The newspaper noted:

◆ *Chemical Bank* has announced plans to close 50 of its 320 branches in the New York metropolitan area. Since some 40 percent of its business is conducted today by telephone and through ATMs, the bank expects the growing availability of these machines to offset the move.

◆ *Chase Manhattan Bank*, also headquartered in New York, is currently testing three video kiosks. Using ISDN connections, the systems offer face-to-face contact with a live banking executive for a range of financial activities. Acceptance has been "extremely high," and the bank plans to expand the program to a growing number of its branches throughout the area.

Perhaps the most aggressive competitive program in the nation built on the power of ISDN is being implemented at *Huntington National Bank* in Columbus, Ohio. In the next three years, the bank plans to extend and expand telecommunications-based solutions to a range of banking needs, while physically closing as many as 40 percent of its traditional branches.

Huntington plans to install a battery of automated teller machines and specialized video phone service centers – most based on the growing speeds and availability of low-cost ISDN

connections. Bank executives believe the centers will draw and retain a growing generation that actually prefers the fast, machine-oriented method of conducting bank business at any hour of the day, any day of the week.

The bank's chairman, Frank Wobst, expects to cut branch-banking costs by more than 25 percent while offering improved services such as 24-hour video availability of a live, human banker for a range of loan, investment and other transactions.

According to industry analysts, Huntington represents the vanguard of a movement that by the end of the decade will close some 40,000 of the nation's existing 100,000 traditional branch banks. Analysts also believe that remote banking, from single cash machines to unmanned walk-in video centers, are the wave of the future – and that the growing availability of ISDN video, voice and data connections will play a key role.

At the *Mortgage Network* in Boca Raton, Florida, an aggressive ISDN-based expansion program is underway to make the firm a major mortgage lender to Florida's real estate market. The firm is now using Intel PC-based ProShare video systems to extend its home mortgage capabilities to specific sites where homes are being sold – builders' offices, model homes and apartments, realty offices and other locations.

Using laptop computers linked through ISDN, prospective home buyers can talk directly to the company's loan officers, complete minimal paperwork, and have a loan approved – all in about ten minutes. According to managing director Dave Patten, the company plans to install PC laptop video systems at more than 1000 builder and real estate offices within two years.

"The flexibility that ISDN gives us is important," he said. "Setting up a video connection is as simple as installing a telephone line."

Distance Learning

Distance learning comes in many forms. Each takes advantage of high-speed digital connections to bring interactive combinations of voice, data, image and video to the challenge of helping people learn. Some dramatic examples of this process are unfolding rapidly throughout the northeast and the nation:

❖ At New York City's *School of Visual Arts*, computer-graphics expert David Biedny recently conducted an interactive, hands-on course in *Adobe Photoshop* and other programs for students in the school's advanced computer graphics program.

What made the occasion significant was that Biedny taught the course from a studio 3,000 miles away in San Francisco. The dialed cross-country ISDN connections carried voice and video

connections as well as interactive computer links between the two locations.

"I think the students and I were all amazed at how successful it was," said the artist. "We used ISDN lines for remote control of a Macintosh in New York using *Timbuktu*, and for video links carrying me to the class and the class to me." As part of the session, students took control of the Mac, and the renowned videographer critiqued their work as they presented it.

> "A good teacher can use technology to reach students like never before."

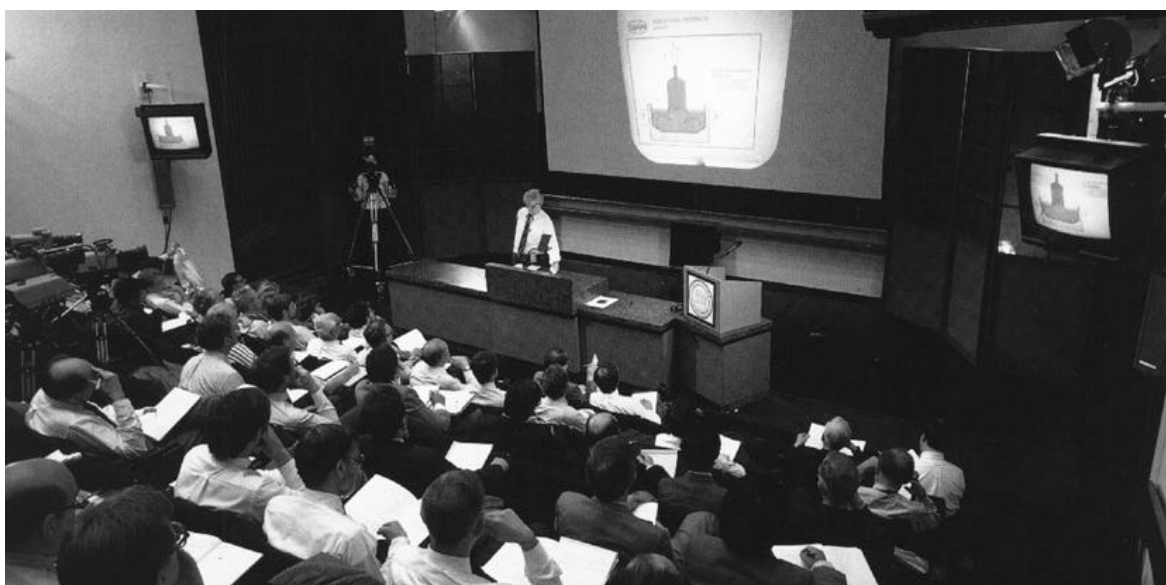"Teleteaching offers enormous potential, but also puts enormous demands on the teacher," says Biedny. "Boring teachers can still put kids to sleep, despite being surrounded by technology. A good teacher, on the other hand, can use technology to reach students like never before. The key is bandwidth, and lots of it. ISDN is a good start."

❖ At *Massachusetts Institute of Technology* in Cambridge, an ISDN-linked PictureTel 4000 video system has begun to open new worlds for students and faculty alike at MIT's Center for Advanced Engineering Study.

Linking a university and the world.
At MIT, video helps students reach out for discussions with experts, worldwide symposia and meetings, as well as lectures and courses around the globe.

"We use video in many, many ways," says Dr. Shaoul Ezekiel, Professor of Electrical Engineering, Professor of Aeronautics and Astronautics, and Director of the Center. "We use it for video exchanges with outstanding individuals from all over the world, as well as for lectures and courses given by experts in many disciplines. We also originate our own classes for other schools, participate in professional conferences, and hold joint meetings with a wide range of research groups in many other locations."

Professor Ezekiel notes that video meetings are frequently held with groups in Japan, Singapore and even China, as well as throughout Europe. The PictureTel system operates through either two B channels in a single ISDN BRI line, or six B channels in three dialed ISDN lines. Because the system adheres to the H.320 video standard, connections with virtually any other video system are possible and practical.

❖ At *New York University* in Manhattan's Greenwich Village, video is only part of the school's innovative and ground-breaking 16-credit "teleprogram" in Information Technology. The program lets advanced students in systems analysis and management – all of whom have full-time jobs – participate in the course at any time of the day or night from the convenience of their own home or office. The curriculum makes heavy use of both live-action and animated video segments to add interest, as well as explain and enhance difficult conceptions.

The new face of education.
A 16-credit tele-course at New York University's Information Technologies Institute offers inter-active problems, self-paced lectures, experiments, animation, and more – all on demand. ISDN speeds also make possible high-speed interaction with the school's host computer.

"Too often, we think of distance learning as someone lecturing for two hours on TV," said Dr. Richard Vigilante, director of NYU's Information Technologies Institute. "But that's not the case. We do use some lectures, of course, but in our self-paced program lectures, experiments, animation and other video sequences are all on-demand – that is, they can be called up and viewed at any time, and replayed as often as needed."

The program also makes heavy use of interactive problem solving using *Lotus Notes*, and gives students direct interactive access to *Excelerator*, a powerful computer-aided software engineering (CASE) program.

"CASE gives computer engineers the same benefits that CAD (computer-aided design) offers architects," says Dr. Vigilante, "for it helps automate the analysis and design of even the most complex structures." The 128Kbps speeds of ISDN let students access the centrally stored program from their own PCs, just as if they were physically on-campus in a computer lab, he adds.

"Using a program like that through a modem would be almost impossible," Dr. Vigilante notes. "It would simply take too long to be of any use." The teleprogram uses two Dell Pentium servers equipped with Netware and DigiBoard ISDN bridges. Students use 486 or Pentium machines with SoundBlaster audio systems and DigiBoard ISDN cards that integrate both terminal adapter and NT1 equipment on a single PC circuit board.

✦ At *Beacon Learning Inc.* in Boston, an ISDN-based Intel ProShare video system adds new capabilities to the firm's computer-based training solutions, says David O'Connell, director of sales and marketing. Beacon incorporates video help connections into their client's customized training, which means that anyone taking a course at a remote site can simply press a PC function key for immediate assistance.

> "Too often, we think of distance learning as someone lecturing for two hours on TV . . . . But that's not the case."

The PC automatically dials and establishes a video connection with a knowledgeable administrator who appears on-screen to offer face-to-face help and guidance.

The firm is also building customized programs of video "classroom" training through the ISDN video links. In effect, students will be able to "attend class," carry on discussions and interactively solve problems through their PCs using the ProShare desktop video connections.

Video Security

ISDN today offers an economical, high-speed alternative to the digital microwave and satellite connections that have traditionally been used for video security installations.

Perhaps the most aggressive implementation of this new technology has been in the *Huntsville, Alabama, school system*. From a single headquarters location, security personnel can monitor television images from 41 separate school locations throughout the area. Video images

BRI
BRI
BRI
BRI
NYNEX NETWORK
BRI
BRI
PRI
CENTRAL VIDEO SURVEILLANCE SITE
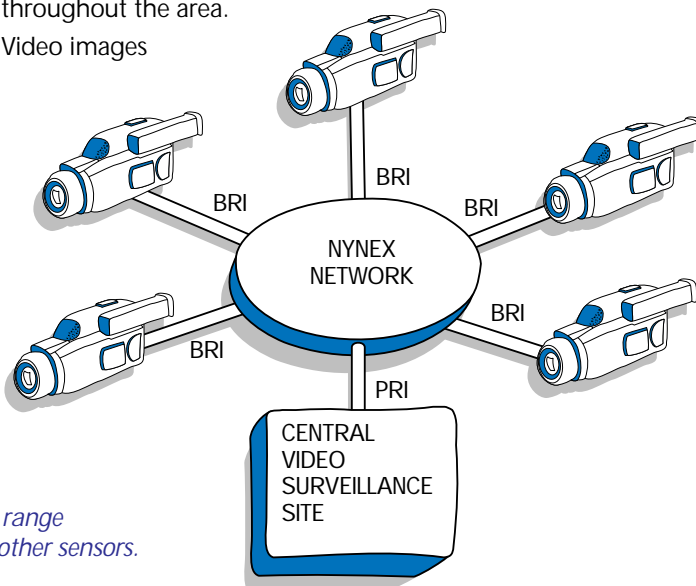
Video security. ISDN offers an inexpensive alternative to microwave or satellite transmissions. ISDN is also unaffected by weather and similar problems, and offers D channel connections for a range of heat, motion, sound and other sensors.

from each school are multiplexed, and forwarded through ISDN BRI connections to a central site where they are displayed on standard PC monitors.

The innovative security saved some 24 percent on insurance premiums.

The system also incorporates a wide array of access-control devices, heat sensors, motion detectors, and magnetic stripe badge readers. Signals are sent directly to the central location through the D-channel links.

School system superintendent Ron Saunders notes that the innovative security installation has saved his school system some 24 percent on its annual insurance premiums. In addition, it has significantly reduced the number of security personnel physically needed at each site, while dramatically improving security coverage.

"ISDN has proven to be more reliable than either microwave or satellite systems," Saunders noted, "because telephone lines are not affected by severe weather or distance limitations. ISDN also lets us expand our system more quickly and much more inexpensively. The same system also gives us powerful back-up channels when and if we need them."

A Video Revolution

"We're just starting to uncover all the uses for this new and exciting way to communicate," says Len De Paolo of *Communications Planning & Services Inc.*, an ISDN systems integrator in Farmingdale. "New uses for easy, convenient video are being discovered every day. This is truly just the beginning."

5

Back in the dark ages of computing – perhaps ten or even twelve years ago – modems and analog telecommunications came into popularity. They were intended primarily for the transmission of words and numbers. Yet in today's increasingly complex world of information, words and numbers are just the beginning.

The typical database of the '90s contains a growing array of still and moving images – from high-resolution photographs and graphics, to full-color video segments, sound samplings and even complete orchestral sequences.

And in the face of this emerging data, modems and analog transmissions have faltered badly. For while it is technically possible to send and receive images, graphics, video, sound and other digitized files at modem speeds, few users have the time or patience to make it practical. Conventional bandwidths and modems not only constrict the amount of information that can be accessed, but limit the range and availability of database information itself.
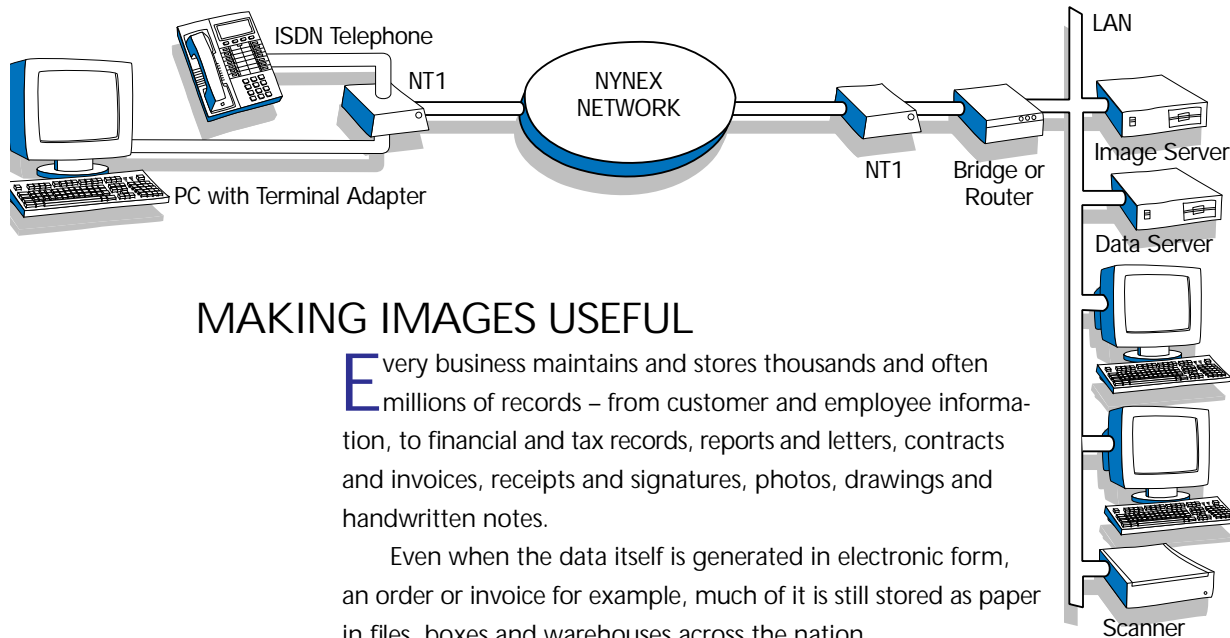
Enter ISDN

With its digital speed and throughput, ISDN has already begun to increase the power and reach of today's databases. Because it is now economical to search through even the largest files of complex, digitally stored images – from diagrams and drawings on a specialized database, to the worldwide warehouse of facts and images on the Internet.

ISDN offers digital access without the need for costly dedicated lines, yet at speeds that outstrip modems by factors of almost *ten-to-one* without compression, and as much as fifty, sixty or *seventy-to-one* with today's still-emerging compression algorithms.

To a student chatting on *Compuserve*, this increase in speed may be all but unnoticeable. After all, one can only type so fast.

Yet to an engineer or physicist searching for specialized images on a remote database, it might mean hours or even days saved – or may, in fact, be the difference in conducting the search at all.

ISDN Telephone
NT1
NYNEX NETWORK
NT1
Bridge or Router
PC with Terminal Adapter
LAN
Image Server
Data Server
Scanner

An image retrieval system. ISDN offers access to images or information at 128Kbps before compression.

MAKING IMAGES USEFUL

Every business maintains and stores thousands and often millions of records – from customer and employee information, to financial and tax records, reports and letters, contracts and invoices, receipts and signatures, photos, drawings and handwritten notes.

Even when the data itself is generated in electronic form, an order or invoice for example, much of it is still stored as paper in files, boxes and warehouses across the nation.

ISDN offers an alternative. It lets corporations and government agencies store, access and use these mountains of information. It lets them convert images – photos, forms, signatures, fingerprints and more – into digital form, and store, reference and access them just like any other data in a computer.

What's more, the digital speeds of ISDN mean that instead of sending millions of paper copies and faxes from place to place, virtually any office, anywhere, can have fast, efficient access to the *original* – simply by dialing the computer where the information is stored:

❖ One *manufacturer,* for example, has scanned product documentation from the past 15 years into an image database. Service representatives at headquarters or in the field now have instant access to data and drawings to help with troubleshooting and repair.

❖ A *magazine publisher* has put scanned advertiser claim forms on-line. With immediate access to the data, customer service agents have reduced settlement times from 70 days to under 30 days.

❖ A *major bank* now scans forms, reports, signatures and other visual data used every day. Its studies show that imaging not only improves a document's usefulness, but reduces the number of times it is physically handled from 14 to four.

❖ In Europe, both *Apple*, for computer retailers in France, and *Philips*, for repairers of its CD units, electronically "publish" manuals and other tech-

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"The light at the end of the tunnel for analog modem vendors is not *V.fast* but a train wreck," writes Jay Batson of *Forrester Research, Inc.*, a Cambridge, MA, market research firm, "unless their plans include a migration path to ISDN."

"Modem speeds have definitely peaked," adds John Mazalewski of *TeleSystems Marketing Applications*, an ISDN systems integrator. He notes that modem industry projections of 64Kbps and up have proved difficult to achieve in real life. "Basically, modems are forcing increasingly compressed files through what are still 4.5 kilohertz analog lines."

In contrast, he adds, digital compression is just emerging. While 2:1 and 4:1 ratios are common today, many manufacturers are now implementing solid 8:1 algorithms – the equivalent of 1,024Kbps or more than a "meg a second" – through a single bonded BRI.
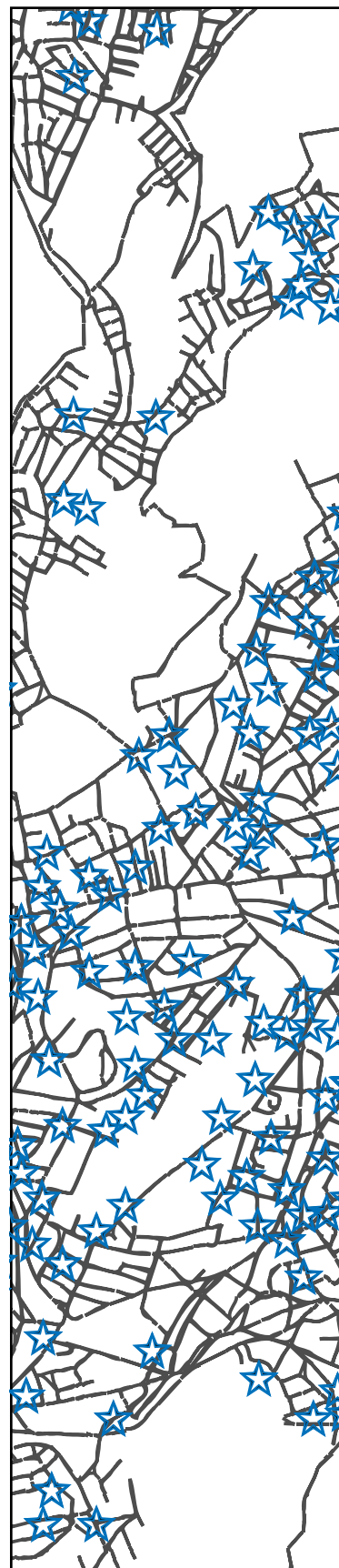
nical documents. Text, diagrams and illustrations can all be accessed through ISDN-linked desktop systems. Customers use only the most recent updates, while manufacturers significantly reduce the cost of maintaining and upgrading huge volumes of paper.
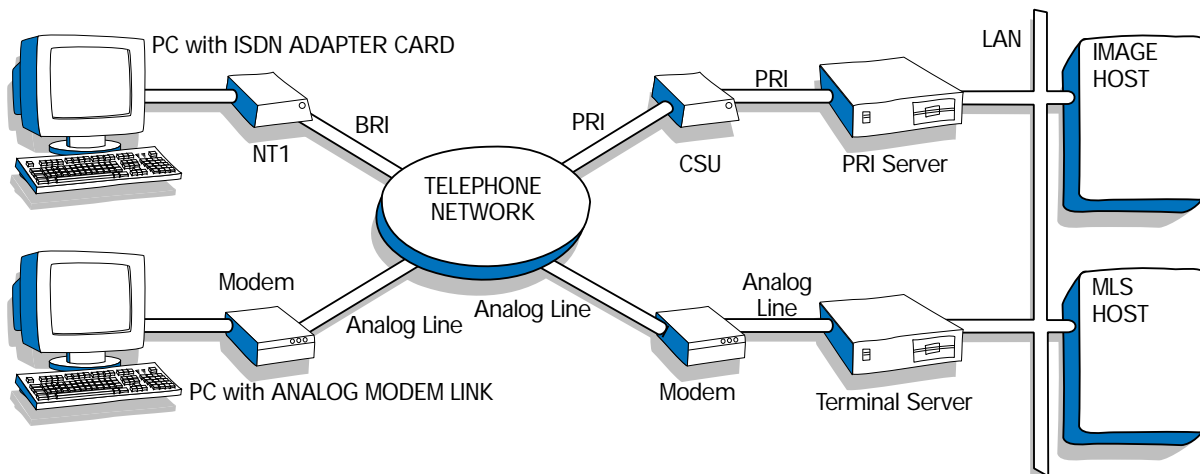
Coping with Government Records

Across the nation, city, county and state governments have begun to scan and electronically store the millions of documents they process each year, including birth certificates, licenses, permits of all types, property records and more. Not only is access dramatically improved, but costs and space requirements are greatly reduced. Some typical examples are:

❖ *Middlesex County, MA,* where land records including mortgages, deeds, titles, liens, property holders, property maps and more – some dating back to 1620 – have been systematically scanned and put in a modern data/image server. The electronic files are not only less expensive to maintain but dramatically reduce storage and handling requirements. The county processes some 200,000 new transactions a year.

❖ *Quincy, MA,* where both the tax assessor's office and planning board currently retrieve computerized town maps from the public works department three miles away. "We're just beginning," says Dominic Venturelli, the city's principal programmer. "Our goal is to link all city buildings and LANs with ISDN, and make the wealth of the information at each location available to everyone who needs it."

❖ An upstate New York *metropolitan police force* is using an ISDN-based imaging system to handle the thousands of motor vehicle accident reports processed each year. With an annual load of some 16,000 multipage documents, department heads note that electronic reports are not only easier to prepare, but easier to find, access and read.

❖ Other *police departments* throughout the nation have installed data imaging systems to handle everything from fingerprints and mug shots to daily assignment schedules and handwritten records. Images can be accessed from virtually any location, at any time of the day or night.

Making street maps more useful. *In Quincy, MA, typical demographic street maps (at right) are being made available through ISDN for many uses: from land use and road improvement to zoning, crime statistics and more.*

PC with ISDN ADAPTER CARD — NT1 — BRI — TELEPHONE NETWORK — PRI — CSU — PRI — PRI Server — LAN — IMAGE HOST

Modem — Analog Line — Analog Line — Analog Line — Modem — Terminal Server — MLS HOST

PC with ANALOG MODEM LINK

California's RealtyLink

RealtyLink is the nation's first multiple listing service (MLS) designed specifically to use the speeds of ISDN. Developed jointly by the *San Fernando Valley Association of Realtors* and *Pacific Bell,* the system stores and makes available color photographs, renderings, floor plans, property maps and other documents that can be used by realtors to interest prospective buyers in an available home.

According to Mary Lou Williams, executive director of the association, full-screen color images are retrieved from the system and drawn on a broker's PC monitor in seconds. Plans include full-color video tours of an area or major property, to be called up at a broker's command.

The system can also access a growing number of mortgage and land records, title and lender guarantees and the like – all designed for use at a property's closing. These documents are scanned as needed throughout California, and made a permanent part of a statewide thrust to virtually eliminate the physical transfer of paper within five years.

California's RealtyLink. *The first ISDN-based Multiple Listing Service offers high-speed access to full-color photographs, drawings, floor plans, area maps and other images of homes for sale. Analog links also offer data-only access to the MLS.*

SURFING THE INTERNET

ISDN speed makes "surfing the Internet" a fast-moving and exciting adventure. Which means that this graphically intensive worldwide information highway becomes just that – *graphic*. User interfaces such as *Mosaic, Netscape* and others come alive – with full-color visuals, previews and other images replacing unrelenting pages of underlined type.

The Internet, of course, offers an almost unbelievable array of information, from recipes for chocolate cookies and around-the-clock discussions of current soap operas, to worldwide e-mail, international research data, and earnest disputations on the swirled tracks of a top quark.

Yet the Internet is also the most visually intensive system in the world – with photographs of almost every conceivable kind, art from museums and collections around the world, scientific and engineering images from virtually every discipline, global video discussions, and more. They are all on-line, available to the persistent researcher.

It is speed, too, that makes this incredible size and complexity less daunting, more accessible, more useful.

Getting on the Information Highway

While thousands of business, government, research and educational organizations today reach the Internet through dedicated high-speed lines, many more use standard telephone lines. In fact, as many as twenty to thirty million users currently link their PCs and workstations to the Internet through the limited speeds of analog modems, with dialed connections to the "hubs" of service providers or the "e-mail gateways" of *Compuserve, GEnie, America On-Line, Prodigy* and other information services.

Yet the slow speeds of modems actually undo much of the Internet's graphic power. *Mosaic,* for example, "the most elegant, powerful, intuitive and beautiful knowledge tool ever created" – as well as *Netscape*, *Hot Java* and other key browsers – can often appear not as a fast-paced flow of images from around the world, but as a seemingly endless wait for endlessly evolving screens.

ISDN changes this, and lets this most graphic of databases come to life for millions of potential users.

Internet Hubs

A growing number of public Internet service providers – or Internet *hubs* – offer high-speed, dialed ISDN access to the network through what are often local calls. *Performance Systems*
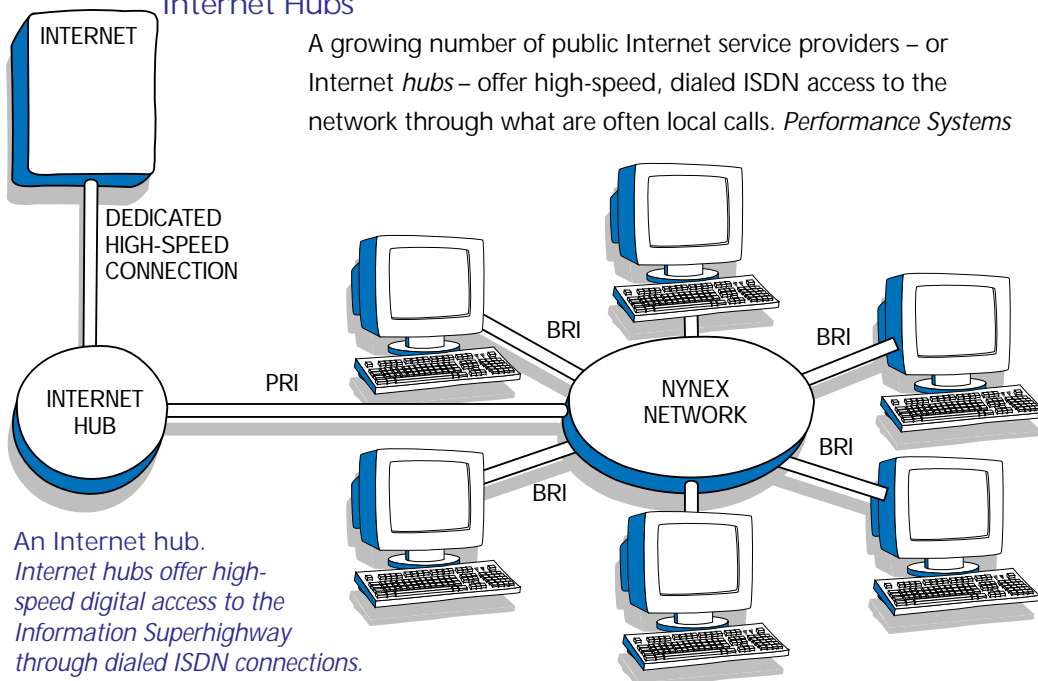
An Internet hub.
Internet hubs offer high-speed digital access to the Information Superhighway through dialed ISDN connections.

International, for example, offers ISDN-to-Internet nodes throughout the country, including metropolitan areas such as Albany, Boston, Islip, New York City, Portland, Rochester, and White Plains.

Other typical hubs are *Digital Telemedia, Inc.* and the *Internet Channel Corporation*, both in Manhattan. "One major reason to use a hub is cost," says DTI's Karl Kister. "Many companies don't need to camp on the Internet. Rather they just want access when they need something."

"A dedicated line could cost $1,200-1,500 a month," adds Internet Channel president Hal Eisenstein, "while the same high-speeds through ISDN, with reasonable usage, could save as much as a thousand dollars a month." The Internet Channel's Ascend Pipeline equipment offers speeds of up to 512Kbps.

> "High-speed access through ISDN, with reasonable usage, could save . . as much as a thousand dollars a month."

In the Boston area, both *The Internet Access Company* and *Terranet* offer dialed Internet access through ISDN Intellipath™ switches. Lines to remote users can be "foreign exchanged," and while line costs increase, the Intellipath connections offer unlimited usage at no additional charge.

6

A growing number of studies have shown that the aggressive deployment of telecommunications can control and even reduce the runaway costs of today's health care. Estimates suggest that as much as $2 billion a day – almost five percent of the nation's total daily expenditure for health care – can be cut simply by implementing a range of existing telecommunications-based information applications.

The delivery and processing of health-care information appears to be a major key to reducing administrative costs, expediting patient care, speeding claims processing, reducing duplication and waste, and perhaps most importantly increasing accessibility to quality health care.

And just in time. For while the actual buying power of the average American has increased about one percent since 1980, the cost of health care during that time has ballooned by more than 163 percent. Health care costs, in fact, are growing today at about 13 percent a year.

Yet the studies say telecommunications can stem this tide, and that the aggressive deployment of electronic data systems offers two major benefits:

❖ First, it can significantly reduce the cost of handling, storing and processing this mountain of information. According to the consulting firm of *Arthur D. Little*, almost 14 percent of the nation's total expenditure for health care is spent on managing this data – most of which is still *initiated, transferred and at least partially processed as paper.*

❖ Second, the easy availability of information appears to be a major factor in reducing the duplication of routine tests, radiological workups, and the perpetually repeated entry of basic patient medical histories.

Making Information Available

Today most modern hospitals have begun to address these challenges by making the rapid, easy transfer of information a reality. Using sophisticated high-speed backbone data networks, virtually all of the facilities, departments and offices on a hospital's campus can be joined together to give physicians, nurses and others immediate access to up-to-the-minute information stored anywhere in the facility.

In addition, many metropolitan, university and teaching hospitals are becoming part of regional networks joined by similar ultra-high-speed connections. These dedicated networks often include key medical and diagnostic laboratories, major radiological clinics, and a host of similar locations.

In effect, they bring together many facilities into total medical data systems for the rapid exchange of information, and the timely collaboration of individuals in many disciplines in many locations.
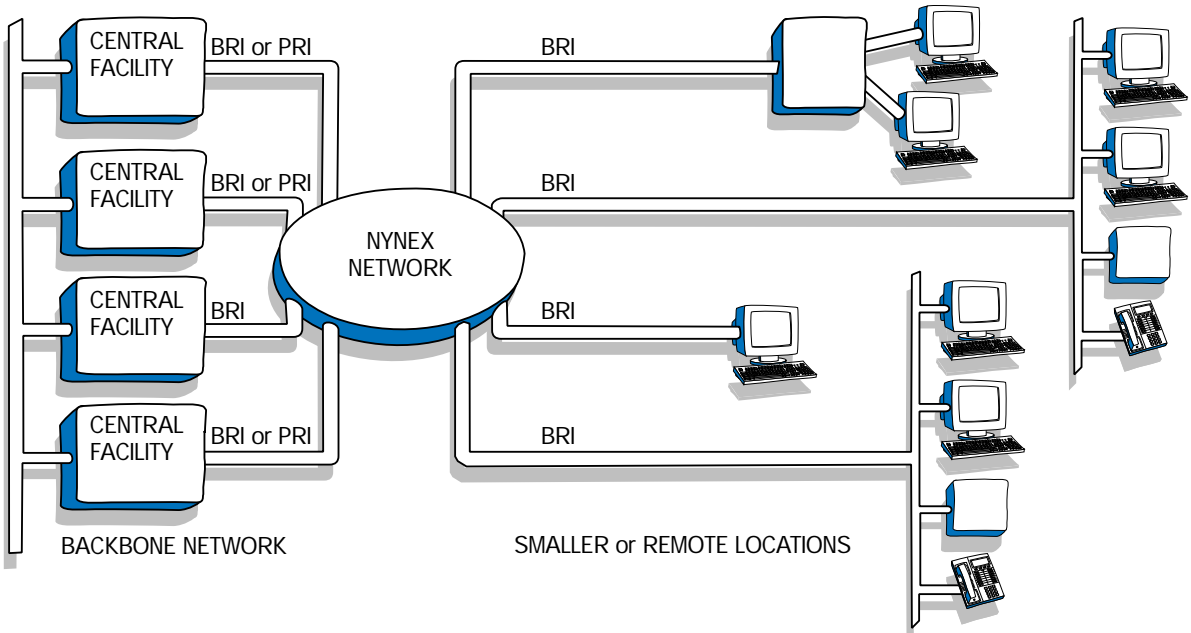
At *Massachusetts General Hospital*, for example, a dedicated data network – with data speeds as high as 45Mbps (megabits per second) – now brings together some five regional hospitals. This network carries a staggering array of applications, from remote video diagnostics to consultations among physicians simultaneously sharing radiological images, medical records and complete clinical and laboratory test results.

Extending a Backbone with ISDN

The one limitation of these systems, however, Is that they are typically closed – not by choice, but by the economics of extending expensive, dedicated high-speed digital connections to hundreds of smaller, often remote locations.
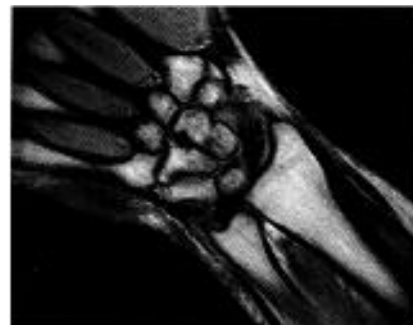
The answer again, of course, is ISDN. Dialed BRI connections can quickly and inexpensively extend these networks to distant locations, to smaller hospitals in rural areas, to nursing homes, hospices and special care facilities, and to doctors, nurses and others at their offices and even their homes.

Extending a backbone.
Dialed ISDN connections can open a backbone to thousands of locations where dedicated lines are too costly. Result: smaller facilities, rural clinics, even individual physicians at home can become part of the network. The network itself can also reach out to any resource, anywhere in the world.

CENTRAL FACILITY — BRI or PRI

CENTRAL FACILITY — BRI or PRI

CENTRAL FACILITY — BRI

CENTRAL FACILITY — BRI or PRI

NYNEX NETWORK

BRI
BRI
BRI
BRI

BACKBONE NETWORK

SMALLER or REMOTE LOCATIONS

One of the nation's best examples of extending a backbone is at *St. Vincent's Hospital* in Birmingham, AL, a member of the Daughters of Charity National Health System.

According to Russell Wilson, the entire hospital campus is linked by a single, high-speed data network. Fiber-optic connections link every department on the campus for access to host computers, medical records and patient information, for reports from medical and radiological laboratories, for operating room and other schedules, for pharmacological data, accounting and billing data, as well as e-mail and other administrative information.

Transmitting radiological images. *All types of medical images are now being sent and retrieved through the digital channels of ISDN. Faster ISDN speeds mean that even diagnostic-quality images can now be transmitted.*

"Our medical record department today is totally paperless," said Wilson. Which means that doctors, nurses and other health care practitioners have immediate access to each patient's complete records, no matter where the patient is, and no matter where the information is needed.

The role of ISDN in this environment is obvious: to *extend* this central backbone to off-campus locations that are part of the hospital's care system. These include radiology and medical laboratories throughout Birmingham, clinics and offices of doctors associated with the hospital, doctors' homes for weekend and evening access, and even insurance companies and others who need patient billing information.
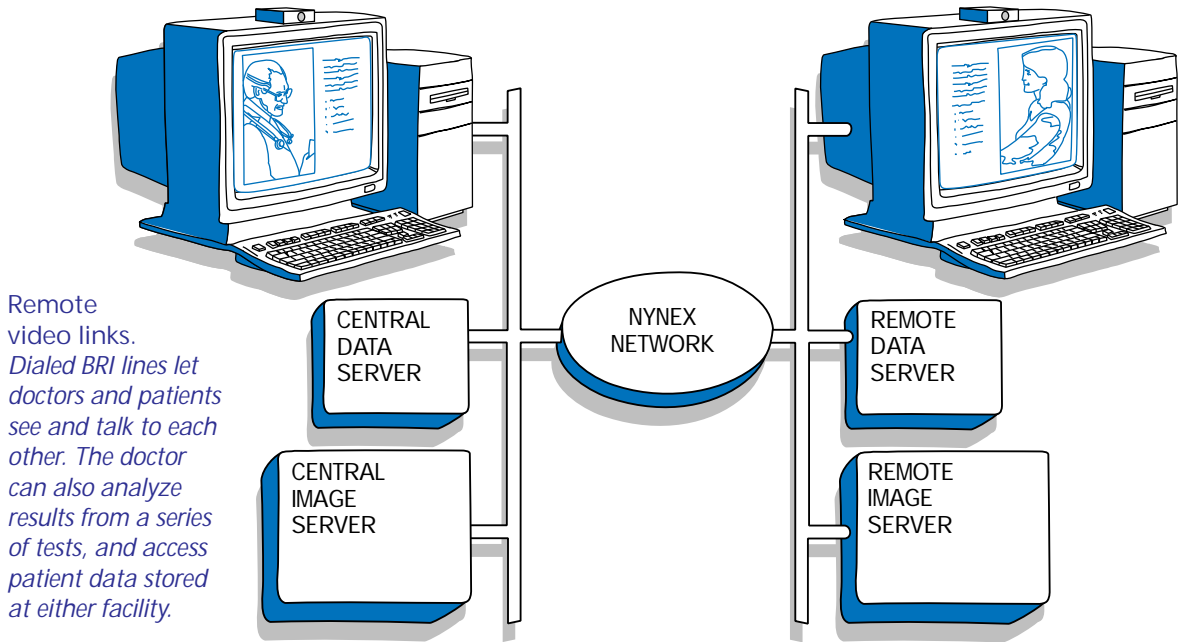
Equipment used includes a Gandalf concentrator at the hospital linked to Gandalf routers at remote LANs and individual desktop computers. Speeds through bonded B channels in a single ISDN BRI average about 600Kbps, according to Wilson.

"Users at remote sites really cannot see a difference," he said. "Dialed connections are set up in less than three seconds, and transmission and response times are so fast that users feel like they are actually on the LAN."

Teleradiology

A major component of today's medical diagnostics is the growing radiological capability to look carefully and deeply within the human body. The images produced include Computerized Tomography (CT or CAT) scans, Ultrasound, Nuclear Medicine, Magnetic Resonance Imaging (MRI), and of course the traditional X-ray. All except X-rays, in fact, originate as digital files viewed on

Remote video links. *Dialed BRI lines let doctors and patients see and talk to each other. The doctor can also analyze results from a series of tests, and access patient data stored at either facility.*

CENTRAL DATA SERVER

NYNEX NETWORK

REMOTE DATA SERVER

CENTRAL IMAGE SERVER

REMOTE IMAGE SERVER

ultra-high-resolution computer screens. In addition, many X-rays, although they begin as photographic film, are being scanned into digital files for storage or transportability.

The ability to transmit these files – to specialized radiologists for analysis and diagnosis, to remote experts for consultation, to surgeons preparing for an operation, to expert technicians for image enhancement, and more – not only saves time and travel, but dramatically expands the circle of expertise available to the care of any patient. Unfortunately, the enormous size of these digital images (as much as 10-20 megabits and more each) has traditionally limited their availability to those directly linked to the higher speeds of a backbone network.

Yet ISDN has begun to answer specific needs, and to save time when time is critical. With the increased speeds of ISDN, even diagnostic-quality images are now transmitted beyond a hospital complex for emergency diagnosis, remote consultation, or timely review and comparison.

At *Richland Memorial Hospital* in Richland, SC, for example, radiologists affiliated with the hospital receive good quality radio-logical images at their homes through ISDN BRI connections. Instead of rushing to the hospital in pre-dawn hours to look at an accident victim's x-ray or CT scan, key images are transmitted to a high-resolution monitor at a radiologist's home, where he or she can prepare an initial diagnosis while still in robe and

slippers. The system uses Macintosh-based ICON video-capture boards and software with Gandalf routers. The images are good enough to let doctors consult with emergency room physicians, and decide whether a trip to the hospital is, in fact, necessary.

Patient Information and Medical Records

ISDN also lets virtually any physician or qualified health-care practitioner at any location access a patient's medical history stored at virtually any medical facility, doctor's office or laboratory. The result is better data for physicians, faster and better diagnoses, less duplication of specialized testing, and more efficient patient health care.

At *Baystate Health Systems* in Springfield, MA, for example, access to the high-speed backbone has now been opened to physician's offices through ISDN connections. According to Michael Weisse, senior systems programmer at the facility, doctors can dial into a patient-care information database for complete patient histories and medical records, for pharmaco-logical data and synopses of laboratory test results. They can also access the laboratory system database to study detailed results from a range of labs associated with the hospital.

"ISDN also gives them quick and easy access to e-mail, bulletins, schedules and more," notes Weisse.

Remote Video Consultations

Video links between doctors and their patients has just begun to be tested in hospitals nationwide. Yet early practitioners have been amazed at the thoroughness and accuracy these remote consul-tations have brought to patient care, and point to the enormous potential for extending these links to rural clinics, nursing homes, hospices and literally scores of similarly remote locations.

The *New England Medical Center*, a 450-bed hospital complex in Boston, for example, is beginning to develop video conferencing capabilities that will reach out to long-term health facilities, such as nursing homes, hospices and the like. According to John Patterson, the hospital's director for advanced planning, many nursing-home patients who travel to a hospital are not admitted, but are returned to their facilities for treatment. By installing an ISDN video link, he noted in an interview, patients can have immediate access to quality healthcare without the time and cost of hospital visits.

Remote telemetry. *Temperature, blood pressure and pulse readings, as well as electro-cardiograms and a broad range of other diagnostic tests, can be quickly and accurately transmitted through ISDN connections.*
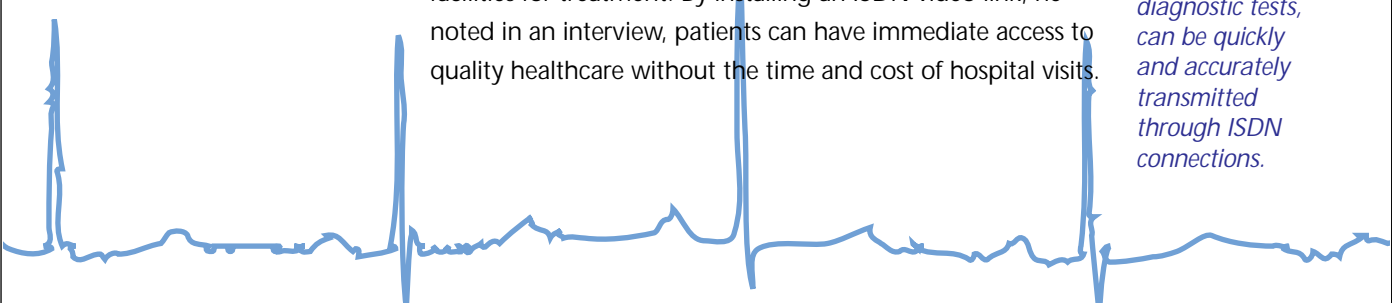
At the *Medical College of Georgia* in Augusta, a similar program is already in place. Doctors use BRI video links to extend modern medicine to rural areas throughout the state. These video consultations put the diagnostic expertise of a doctor on one end of the connection, and the patient with a caring health-care professional on the other.

The doctor can see and talk with the patient, employ a wide range of instrumentation – from blood pressure readings and electrocardiograms to results from a series of medical devices – and examine the patient as thoroughly as if they were in the same office.

Tests indicate that electronic claims processing can save as much as $50-60 billion a year.

Electronic Claims Processing

The insurance industry processes more than 200 billion claims for medical care each year – more than 90 percent still submitted on paper. Yet a number of Blue Cross and Blue Shield offices nation-wide have shown that medical claims received in electronic form are not only significantly less expensive to handle, but can be processed much more quickly and accurately.

Typical results from their controlled tests indicate that electronic claims processing could in fact save as much as 30 cents a claim – or a *potential savings of some $50-60 billion a year.*

"ISDN is the first step towards better, more accurate, faster health care" says Len De Paolo, vice president of marketing at *Communications Planning & Services.* "ISDN is also the first step towards saving enormous amounts of money in the process. Many of the systems are already in place: what we need now is the will to make it happen."

7

Often lost in the excitement of high-speed data transmission, multiple channels on the same line, and unique full-time packet connections is another simple fact: ISDN also offers better, more responsive, and much more sophisticated voice telephone services. ISDN is, in fact, the telephone service of the future.

It also offers the digital connections to make high-speed, high-quality transfer of sound an economic reality.

D ialed digital ISDN connections offer a broad range of advanced features and capabilities:

❖ *Clear, quiet digital connections.* Digital lines are so quiet that several telephone carriers have seriously considered generating artificial "white noise" when calls are put on hold so callers will know they're still connected.

❖ *Much faster connections.* From the last digit dialed to the first ring often takes less than a second, even for long distance calls.

❖ *Call intelligence.* The ISDN D channel carries information about where the call is coming from, and the type of transmission being received (voice, data or other).

❖ *Multiple devices.* Up to eight devices (telephones, PCs, faxes and more) can be attached to and use the same line.

❖ *Two conversations at once.* Two voice conversations (or a conversation and a facsimile or data call) can travel through a single copper twisted-pair wire at the same time. Both calls could also take place while the D channel was being used for packet transmission of data.

❖ *Multiple telephone numbers.* Not only can each device have its own telephone number, but any device can have multiple appearances of the *same* number, as well as up to 64 other unique numbers. A single phone in a busy office, for example, could be properly answered, by name, for many individuals.

What these many capabilities give an ISDN-based system is an enormous responsiveness to almost any need, and the equally significant potential to save money.

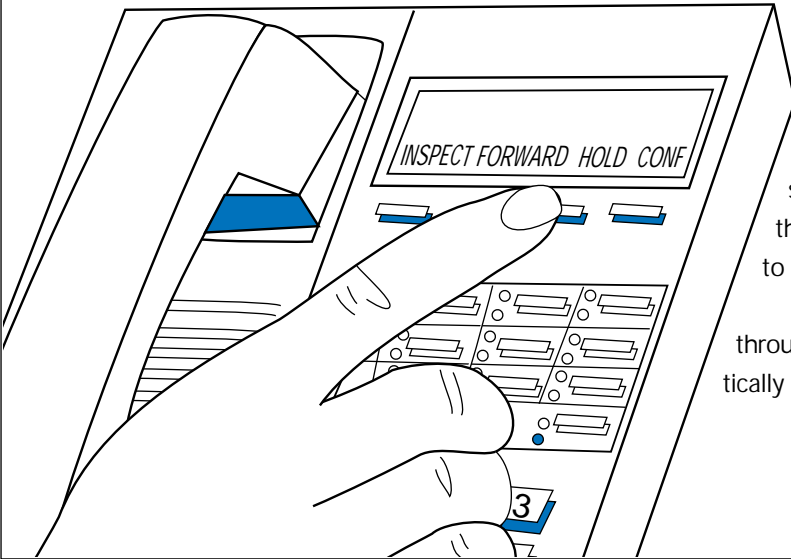In a number of controlled tests throughout the country, ISDN dramatically reduced the number of lines

Softkeys.
The softkeys of an ISDN telephone give quick access to a range of important features such as hold, call forwarding and three-way conferencing. An inspect button reveals even more features.

INSPECT FORWARD HOLD CONF

3

and telephones needed, simplified wiring, and produced quieter calls, faster connections and much higher data speeds as well. One corporate office building of 580 people reported that ISDN reduced telephone and telecommunications operating costs by more than a million dollars a year – or about $1,725 per employee per year.

Better Call Handling

ISDN also offers better call handling – that is, the ability to control, route and manage phone calls. Virtually all ISDN telephones have liquid-crystal displays (LCDs) linked to the D channel.

The result: useful telephone functions are offered as simple softkey options under the LCD screen, rather than buried in a complex system of dialing codes. Some of the universally available functions include hold, call transfer to another number, and three-way conferencing.

A broad range of additional features are also becoming available, depending on the type of switch that serves a location, and the functionality available in that switch. For ISDN Centrex users, many of these features are available now for calls within the same switch. Features include:

❖ *Call Forwarding, Busy.* Forwards calls when the called number is busy or unanswered.
❖ *Call Forwarding, Variable.* Incoming calls can be forwarded at the central office switch (which means quickly and transparently) to off-site locations, car and mobile phones.
❖ *Directed Call Pickup.* Calls *from* specific numbers or extensions can be automatically forwarded to another number.
❖ *Call Pickup.* Lets calls be answered from another phone.

PC-Aided Call Handling

The next step in using ISDN for voice is to link the D channel not directly to phones, but to a PC or similar desktop system equipped with one of today's ISDN call handling software packages. The PC reads and displays the calls received for an attendant, and either automatically responds to the call, or displays options on the computer screen.

These systems can operate in a busy message center, for example, or can help a small to mid-size group better access and use the many office systems – telephones, fax machines, voice and image mail box systems, PCs, LAN servers, printers, modems and more – at their command.

Some simple math in a typical office. *The typical small analog office (right) compared to the same office with ISDN (far right).*
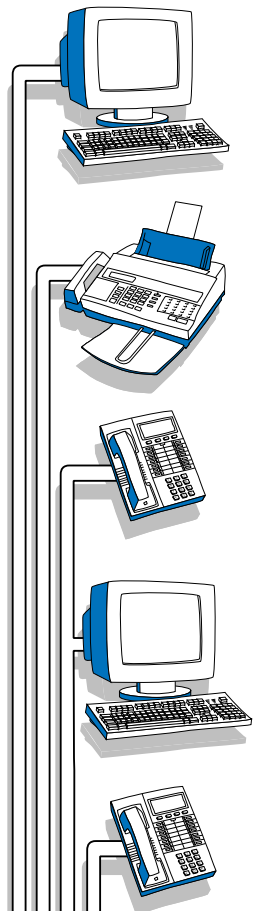
Two phones, two PCs, one fax on four analog lines.

Using mouse clicks on a screen, an attendant or user can handle a full range of voice, data, fax and other calls. In a busy call center, the advantages are many:

❖ *Visually displayed call intelligence.* The system reads the incoming Call ID, and displays the caller's telephone number and name when available. *Even when the called phone is in use*, this data can be received. An attendant can connect or redirect a call as appropriate.

❖ *Automatic routing.* The system also knows what kind of call is being sent, and automatically routes fax calls, for instance, to an appropriate fax machine.

> We can take today's office phone, with all those features you can't figure out, put a screen on it and make it do what we want. It can even do video conferencing.
>
> William Gates, Chairman
> Microsoft Corporation

❖ *Call status displays.* Each active call is displayed. Calls on hold for more than a set time turn to red or flash to let the attendant offer assistance.

❖ *Screen-based call handling.* A single attendant can typically handle up to 60 calls at a time, compared to a fraction of that number with traditional systems. Messages require no more than a mouse click and a brief typed entry, since both the calling and called number are automatically logged.

❖ *Comprehensive call records.* A computer-stored record of all calls and messages helps in tracking calls, measuring usage, and calling back those who hang up while on hold.

Most of these call handling systems are designed to run on standard PCs. In a smaller office, they can be simply another application running on a normal desktop system.

A call handling system.
Calls are visually displayed and can be connected, forwarded, transferred and more with the click of a mouse.

Two phones, two PCs, one fax on two ISDN lines.

NT1s
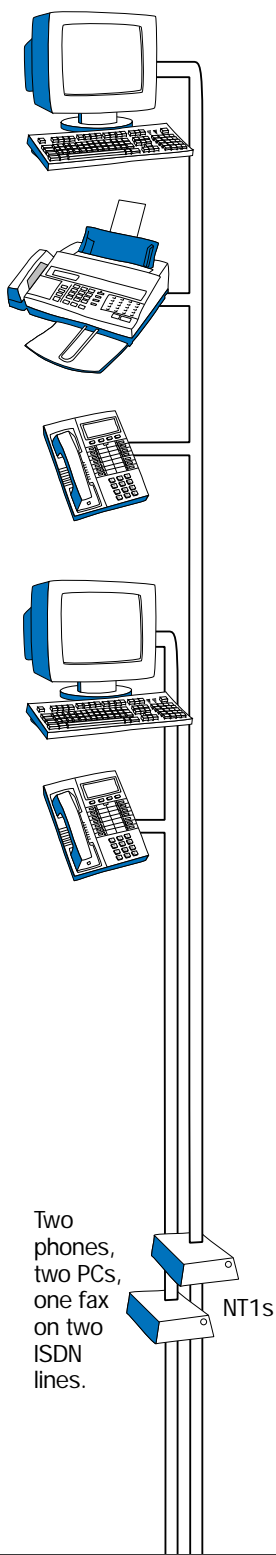
CALL CENTERS FOR SALES AND SERVICE

The most advanced capability of ISDN to control and manage calls is in the typical sales or service center. For not only can incoming data from the D channel shape the way calls are answered and handled, but D-channel signals from the call center can, in fact, control much of the functionality of the public telephone network itself.

Today, almost everything we buy can be purchased by phone – from airline tickets and hotel reservations to computers and televisions; from stocks and bonds to shirts and socks. These and hundreds of other products and services are offered through telephone agents who greet customers, discuss options, and take orders on the spot.

And sales are only the beginning. Companies in hundreds of fields – computer and automobile makers, power and water utilities, food and toy companies – all maintain call-in product and technical service centers to answer questions, solve billing or service problems, and help users and technicians maintain and repair installed equipment.

Automatic Call Distributors, and More

Virtually all of these call centers use the power of the telephone with some sort of system that answers incoming calls, plays an appropriate message, offers the caller a series of options, queues each call and forwards it intelligently to the next appropriate agent. Generically, these systems are known as *automatic call distributors* (ACDs), and today more and more of them are incorporating the exceptional responsiveness and control offered by ISDN.

Almost always, call center systems include a computer that contains appropriate sales, service or product records. ISDN opens the path to simple and almost seamless integration of this data into the call-center system. It offers:

❖ *Information about the caller.* The D channel carries complete Call ID information for an incoming call, which can be sent directly to the computer to access the caller's record or other information – and deliver it automatically to the correct agent's screen. Several ISDN-equipped call centers report that Call ID cuts some 15 to 45 seconds from the typical call. The results: better service, more calls handled by each agent, lower phone bills, happier customers. When the Call ID is not available, the system can also prompt for an account number or similar data.

❖ *Greatly simplified wiring.* A single ISDN connection can carry voice calls to two separate agents through its two B channels,

CALLER DIALS CENTRAL NUMBER

NYNEX NETWORK

PRI

ACD & IVR

CALL ID OR IVR RESPONSES SENT TO COMPUTER

COMPUTER WITH CUSTOMER RECORDS

CALLER RECORDS DELIVERED TO AGENT WITH CALL
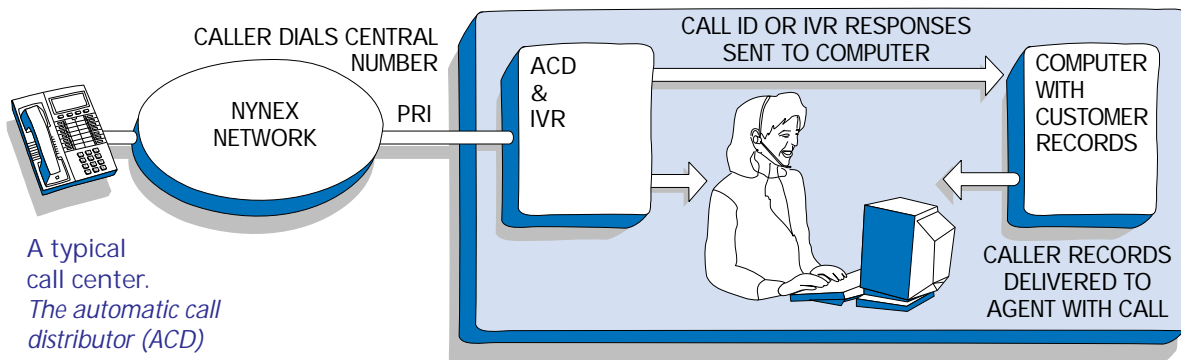
A typical call center. *The automatic call distributor (ACD) reads the incoming Call ID – or the integrated voice response (IVR) unit prompts the caller for key data. When an agent is ready, the ACD delivers the call while the D channel tells the computer to deliver the caller's record. The result: better service, shorter calls, happier customers.*

while computer records travel to and from both agents through the D channel.

❖ *Better call routing.* The power of the D channel also lets the call center system automatically forward calls to virtually any agent in any location, including those working at home.

The design of these ACD systems varies widely with the size and physical distribution of the call center itself, the maximum number of agents to be served at any given time, and the number of calls to be received.

❖ *On-site systems* range from small PC systems designed to serve ten to twelve agents to large mainframe systems handling thousands of calls and hundreds of agents.

❖ *Intellipath-based systems* use a NYNEX central office digital switch equipped for ACD applications. These systems tap the enormous power of today's digital telephone switches and offer exceptional flexibility for future growth.

❖ *Distributed Call Centers* can literally direct and shape the nation's public switched telephone network through the D channel. In effect, they turn the network itself into a powerful worldwide virtual automatic call optimizer by forwarding calls directly to any agent, in any office, anywhere in the world.

Long Island Lighting Company

The customer service center at *Long Island Lighting Company* is one of the largest in the nation, with more than 200 agents serving customer needs, responding to service problems and outages, answering billing questions.

"We used to have four centers around Long Island for handling service problems ," says Chris Bishop, LILCO's training and contingency administrator, "as well as eleven district offices answering billing and similar questions." The difficulty, he noted, was that during storms and the like, individual centers would be badly overloaded – yet other centers couldn't help out.

The answer was the consolidation of the offices in a central location in Melville. It offers a single number for all of LILCO's customers, better resource scheduling and management and, in general, better service for customers. Agents can now help each other respond to any kind of question from any customer.

LILCO uses a NYNEX Digital ACD Prime system which is an integral part of the AT&T 5ESS switch serving the location. The system offers a host of advantages, says Bishop, including the ability to route calls logically to any agent.

"The system sends calls to the most appropriate agent whenever possible," he notes, "but in busy times it will also route calls to any available agent."

Information from the ISDN D channel also offers a powerful management tool. Supervisors now have the real-time status of every agent displayed on their PC screen. "We can see exactly how many calls are coming in at any time," says Bishop, "and react immediately to almost any need. It takes the weak links out of our system."

The system handles a virtually unlimited number of calls, and gathers much better statistics, including the number of calls, call length, how long people waited, and if any callers hung up during busy times. "The numbers help us plan our staffing for maximum response," he adds.

The Call ID information received through the ISDN D channel also lets calls be handled faster, according to Bishop. "We know where the call is coming from, and often who is calling, so the right records can be quickly called up to the agent's computer screen."

A distributed call center.
Using D channel signals, the system "controls" the telephone network, and routes calls logically to any agent, at any location.

NYNEX NETWORK

OR

DISTRIBUTED CALL CENTER

| A customer calls a central number through the public network, as usual. | The D channel tells the distributed call center system what it knows about the call. The system selects the optimum agent, and tells the network.. | The network routes the call to the selected agent . . . | . . . or to the most appropriate telemarketing center. |
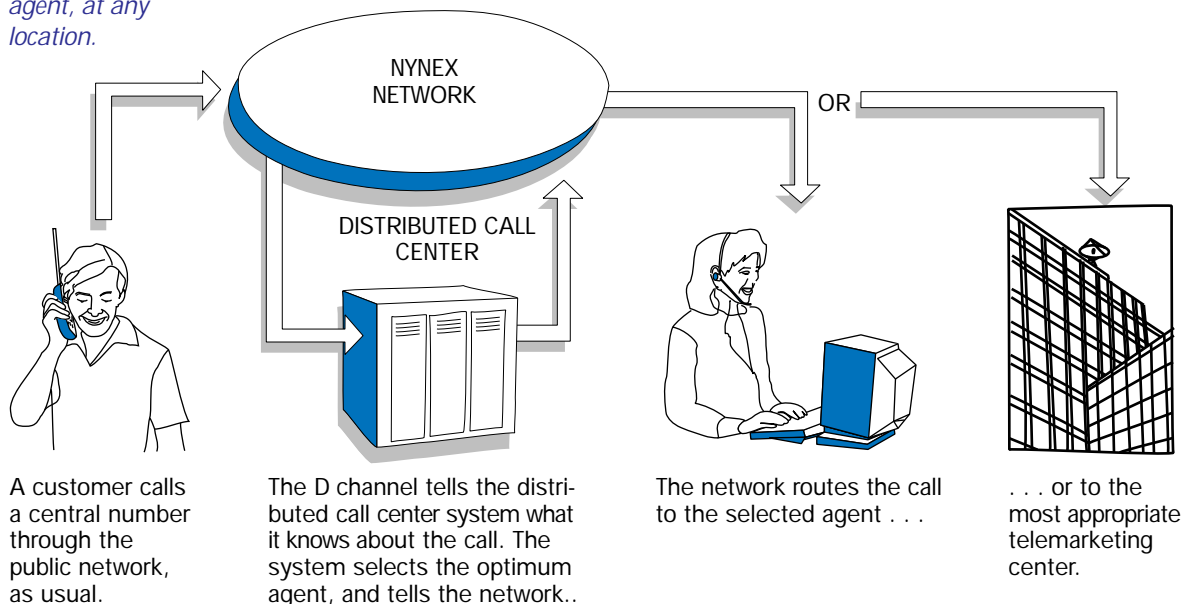
Visiting Nurse Association of Boston

The *VNA of Boston* is the second largest organization of its kind in the nation, with some 300 registered nurses on staff and more than 1000 other health-care professionals. It handles more than a million in-home visits a year.

"We receive almost 100 calls a day," says Carol O'Leary, the VNA's administrative services manager. "They're from physicians, nurses, hospital discharge planners, a range of social-service agencies and even family members." Calls come into a single central number, she explains, and routing them correctly is a major requirement.

"Calls need to be routed logically to the right one of our four offices throughout the city, and to the right specialty group, such as the special HIV nurses, if necessary." A Teloquent Distributed Call Center responds to the need by linking agents at the four offices into a single virtual office through the ISDN D channel.

"The system lets all of our locations act like one office," says O'Leary, "and also gives us great statistics for planning and scheduling."

BROADCASTING AND SOUND

The growing availability of audio *codecs* (*co*der-*dec*oders that transform audio signals into digital pulses, and vice versa) has opened a wave of high-quality sound transmissions through the end-to-end dialed digital connections of ISDN. Today, high-quality 15KHz (kilohertz) monophonic sound can be sent through a single B channel, with 20KHz stereo transmitted through the two bonded B channels of a BRI.

Worldwide Duets

Two recent albums featuring Frank Sinatra are probably the most celebrated uses of ISDN for the transmission of high-quality sound. For both CDs, Sinatra recorded duets with other leading singers from around the world. At the time the recordings were made in Los Angeles, however, many of the collaborating artists were on location in other cities and even other countries.

In both CDs, titled *Duets* and *Duets II*, almost half of the more than twenty artists featured with Sinatra literally "phoned in" their performances through ISDN connections. Aretha Franklin, for example, sang in Detroit, Tony Bennett called in from New York, Charles Aznavour from London, and Liza Minelli from a studio in Brazil. The recordings were taped "live" in Hollywood. After the live recording, both the voice and instrumental tracks recorded in Los Angeles were transmitted back to the East Coast for final editing and production at Manhattan's *Music Factory*.

Sound transmitted through ISDN has "excellent quality," said Phil Ramone, who produced both albums. "When you hear how wonderful it sounds," he said in an interview, "there is no question about its quality."

The Sinatra recording used *EdNet*, one of the nation's first networks devoted exclusively to sound transmission. EdNet uses private high-speed T1 connections between New York and San Francisco, with other dedicated connections to Los Angeles, Berlin, Paris and Rome. Dialed ISDN connections "open" this network to individual studios.

EdNet and a similar but unaffiliated company, *IDB*, offer proprietary sound transmission networks that currently transfer works between many of the nation's most notable studios. Locations around the world use dialed ISDN to tap into these high-speed backbone networks. Both EdNet and IDB use proprietary encoded transmission equipment, which makes them effectively closed systems.

"These proprietary networks are only a beginning," says David Immer of *DIGIFON* in Fairfield, CT. "Because ISDN makes it possible to establish a direct "virtual network" between any two points, anywhere in the world." Immer is a sound engineer and producer, who also helps production studios, radio stations and others around the nation select and set up ISDN audio systems.

"A host of new equipment is responding to this market," he says, "and prices are rapidly coming down." Immer also distributes a worldwide directory of ISDN-capable studios, with the types of codec capabilities each has.

Linking Facilities Together

Today, more and more sound production studios are beginning to work together on virtually every type of project, from commercials and voice-over narrations to music scores for films and television.

Nutmeg Recording, in Manhattan, for example, helps ad agencies and producers around the nation tap into New York's outstanding pool of voice-over talent. "We frequently link up with Philadelphia, Boston, Atlanta, Chicago, Denver and others," says Rick Granoff, an engineer at the

Microphones or Other Input

Audio Codec

Terminal Adapter

NT1

ISDN BRI

NYNEX NETWORK

ISDN BRI

Recording or Transmission Equipment

Audio Codec

Terminal Adapter

NT1

Quality ISDN sound connections. Transmitting high-quality sound across the street or across the continent is as simple – and inexpensive – as a dialed telephone call. Single B channels offer 15 kilohertz connections for monophonic transmission, while two bonded B channels can carry 20 kilohertz for full high-quality stereo.
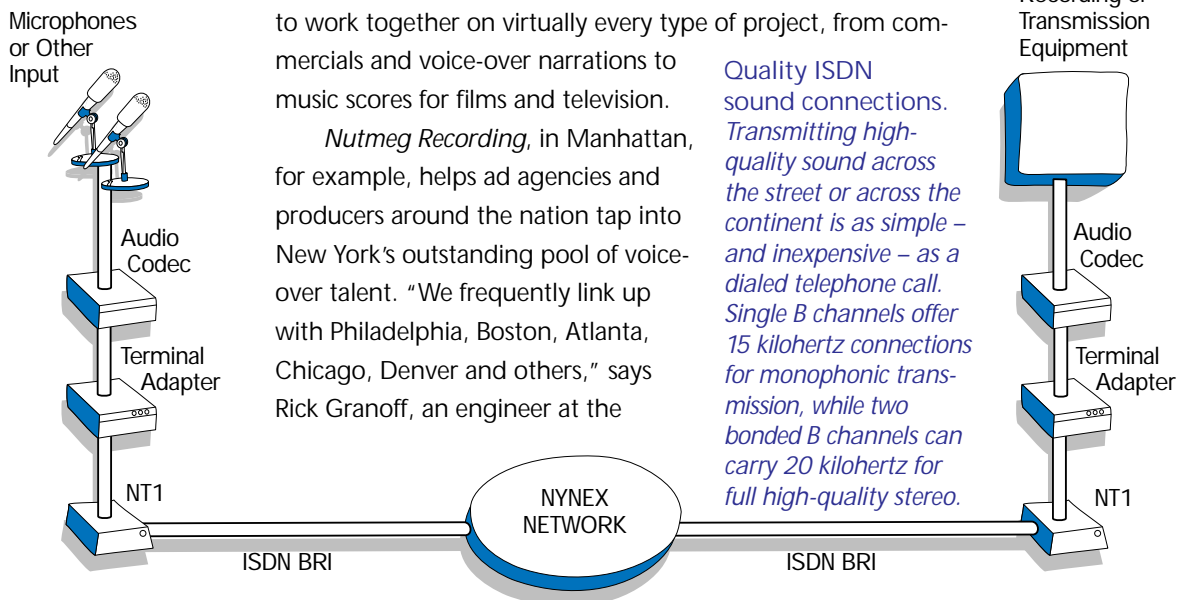
Sound Algorithms Explained

"An algorithm is a set of rules," says David Immer, an expert sound engineer who also helps other studios define needs and install equipment. "It's built into an audio codec and defines how to reduce the size of a digital sound bitstream so that it can be transmitted efficiently."

Sound algorithms are like compression, he explains, but different. "Compression implies that something can be decompressed back to its original form. But bit reduction actually throws information away. The object, of course, is to throw away only that information we don't really need."

Most of the algorithms offered today are based on "psycho-acoustic" models, notes Immer – which means they were tested extensively to determine what sounds best to the human ear. "And each algorithm throws away something different, so it's impossible for one to talk to another."

There are five dominant algorithms being used in today's codecs, he notes. They are:
❖ *G.722*, the original algorithm, developed by AT&T for mono transmissions through Switched 56 lines. It is widely used for voice-overs, remote feeds and the like.
❖ *MPEG Layer 2*, perhaps today's most widely used algorithm. It is versatile and scalable, which means it can adapt to the bandwidth actually available for the transmission. It was developed by the German *Institut Fur Rundfunktechnik* and selected by the International Standards Organization as the algorithm of choice for ISDN at bit rates of 192Kbps and up. It is featured in the CGQ2000: Musicam from CCS, and offers up to 12:1 bit reduction.
❖ *MPEG Layer 3*, used by the Telos Zephyr, is optimized for transmission at low bit rates. It offers 15KHz channels for good fidelity through a single 56Kbps line.
❖ *Dolby AC 2*, is the high-end system of choice for many major production houses. It is, however, expensive and requires 256Kbps, the equivalent of four bonded B channels. It is one of the algorithms used by EdNet.
❖ *APT-X*, developed by Audio Processing Technologies in Ireland, requires bandwidths of 192Kbps for each mono channel. It offers, however, minimal delay, or *coding latency*, and easily supports simultaneous live performances in multiple locations. This is the main algorithm used by the IDB network.

Which is best? "They're all good, all different, and all incompatible," says Immer, "but things are getting better fast." Several services now exist, he notes, including both EdNet and IDB, that can link equipment at one site to different equipment at another studio. Using ISDN, both locations merely dial into the service, which then literally "hard-wires" the two together.

studio. "The quality is so good, the talent might as well be standing at a mike in the other city." The firm uses a CGQ2000: Musicam codec, and Motorola ISDN equipment.

While many studios are accessed through EdNet, the studio also uses its ISDN connections to forward finished commercials to DG Systems in San Francisco for redistribution to radio stations worldwide, and for links to other studios around the country. "It works like a charm," notes Nutmeg's Byron Campbell.

Max Music in Miami, FL, adds an international beat by transmitting digital sound files to and from its headquarters in Spain. The company is the largest distributor of recorded dance music in Europe, and both the American and Spanish locations are actively involved in recording and mixing sound tracks.

"ISDN makes it possible and simple to send music back and forth across the ocean," said Mel Carmona, head of the Miami studio. "In effect, the connections let us exchange digital sound files as if we were in the next room, rather than thousands of miles apart." The firm uses Euronis Planet-ISDN systems and *TheLink* software to join Macintosh networks at each location.

Following the Action

Hundreds of radio stations are now using ISDN for the broadcast of sporting events, concerts, political conventions, and other news-worthy happenings. Just a few of the stations using ISDN are:

✦ *WGBH*, Boston, one of the leading public radio stations in the nation. According to John Voci, operations director for radio, the station uses ISDN for live and taped spoken-word transmissions to National Public Radio, as well as to networks in Canada, Britain and Australia. "We're also initi-ating an international news program with the BBC," says Voci. "Hosts and commentators on both sides of the Atlantic will often be linked through ISDN connections."

> "The connections let us exchange digital sound files as if we were in the next room . ."

✦ *ESPN Radio*, which offers extensive pre-game and live coverage of major sporting events, including the Super Bowl, NCAA Final Four, World Series and others. According to the network's opera-tions manager, Bob Sagendorf, ISDN is used for live transmissions from many remote sites to ESPN studios in Bristol, CT – as well as for feeds of complete programs to *ABC Radio* in New York.

✦ *WSYR*, the flagship station covering Syracuse University sports for a network of some 16 affiliates throughout New York. "In the past, our options were to use frequency extenders (to combine three standard phone lines for 5KHz audio signals) or micro-wave," said Conrad Trautmann, the station's chief engineer. "One option gave us poor quality," he said, "the second was expensive." ISDN has solved both problems.

✦ At the *1996 Olympic Games* in Atlanta, ISDN capabilities will be installed at every competitive site. While these preparations are focused on scoring, competitor accreditation and other data and security systems, ISDN will also make low-cost, high-quality sound channels available to virtually any broadcaster who needs them.

Worldwide Sound Distribution

Digital Courier International in Vancouver, BC, accepts finished commercials from its subscribers, and forwards them through ISDN connections – with attached scripts, confirmations and traffic instructions – to radio stations and production studios.

"Speeds are very fast," said technical director Pat White of Vancouver's KOKO Productions. "If something has to get to a station in an hour, it's no problem – even if that station is on the other side of the continent."
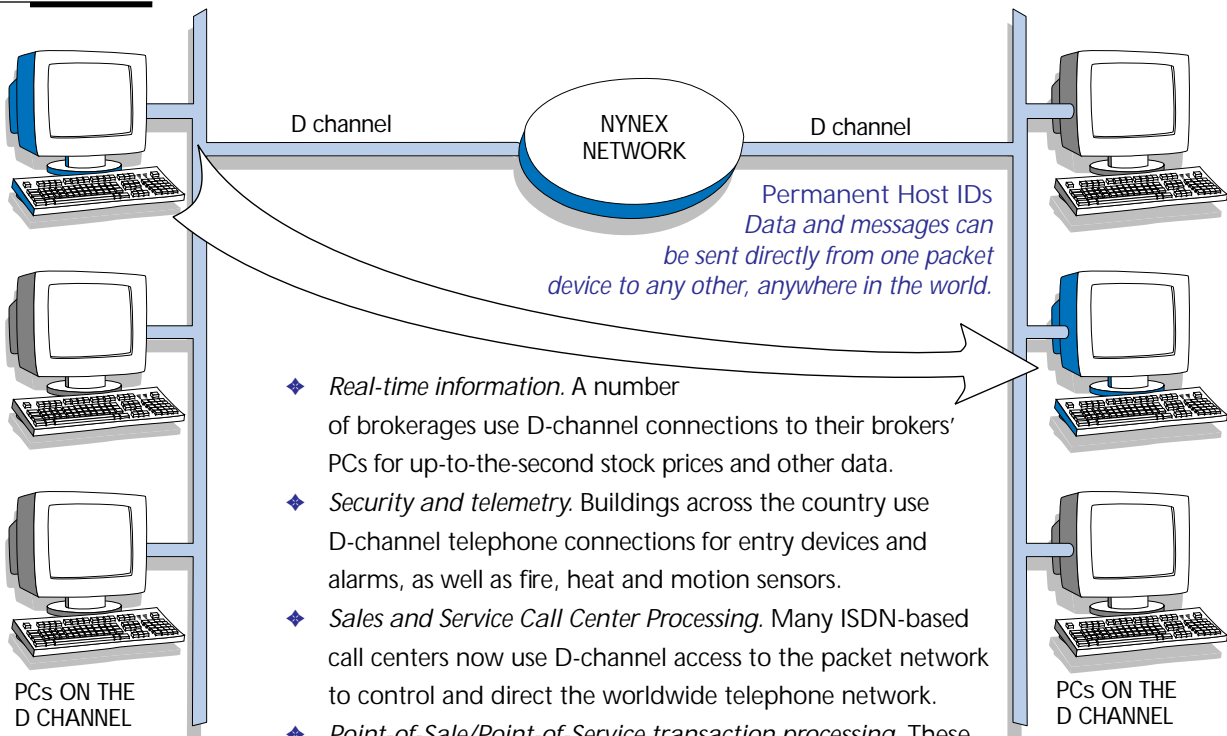
The excitement ISDN brings to what is broadly called *POS* (for Point-of-Sale or Point-of-Service) *transaction processing* flows directly from the capabilities and technologies involved.

The Power of the D Channel

The ISDN D channel is, by definition, an X.25 packet-switched channel designed for call signaling and set-up. Yet because it is packet-switched, it can also be used for hundreds of other purposes: caller-to-caller messages, for commands that can control the telephone network, and – most important here – for user interconnection to the worldwide X.25 packet network.

This direct interconnection of the D channel to the X.25 network gives virtually any data device, from a telephone to a cash register, a dedicated, full-time connection to the NYNEX X.25 packet network – and thus, through interexchange carriers and public networks, to any other computer or data device, anywhere in the world. The potential uses are almost limitless:

❖ *Transfer files and messages.* Users can send and receive electronic mail, as well as share many smaller computer files. For these small messages and files, the speed of X.25 is quite acceptable.

❖ *Access information services.* Most users today access data and information services through dialed analog connections to either the public packet network or the private X.25 networks of major services. Direct ISDN D-channel connections, however, mean *lower costs and faster response times.* Several of today's most popular services, including *Compuserve* and *GEnie,* are instituting special direct packet connections to accommodate ISDN users.

❖ *Access databases.* Many systems, including those for work-at-home and call-center applications, offer access to a mainframe database through the D channel. Data most often consists of small alphanumeric files where packet speeds are more than adequate. A typical 500-character customer purchase record, for example, could be transmitted in less than half a second.

D channel   NYNEX NETWORK   D channel

Permanent Host IDs
*Data and messages can
be sent directly from one packet
device to any other, anywhere in the world.*

PCs ON THE
D CHANNEL

PCs ON THE
D CHANNEL

❖ *Real-time information.* A number
of brokerages use D-channel connections to their brokers'
PCs for up-to-the-second stock prices and other data.
❖ *Security and telemetry.* Buildings across the country use
D-channel telephone connections for entry devices and
alarms, as well as fire, heat and motion sensors.
❖ *Sales and Service Call Center Processing.* Many ISDN-based
call centers now use D-channel access to the packet network
to control and direct the worldwide telephone network.
❖ *Point-of-Sale/Point-of-Service transaction processing.* These
range from credit card authorizations and medical insurance pro-
cessing to bank-card debiting and gasoline sales.

Understanding Packet Switching

What all of these applications share is the almost universal avail-
ability of twisted-pair copper telephone connections, and the
exceptionally low costs of reaching and using the X.25 network.

X.25 packet switching was defined by CCITT (now ITU-TSS)
in the early 1970s, and is an accepted worldwide communications
standard. Data to be transmitted is divided into small "packets,"
and routed through the network.

Packetizing is done by a *Packet Assembler/Disassembler* (or
PAD) at the sending end. At the receiving end, another PAD
accepts the hundreds of packets that may be involved, and
forwards them as a continuous message to their destination.

Since packet switching was originally developed for accurate
data transmission through what were often noisy and inter-
ference-prone analog lines, X.25 also performs very high-level
error-checking and error-correction. If any packet is not received
correctly, based on elaborate parity checking schemes, the
receiving network location signals for retransmission until the
packet comes through correctly.

The result is exceptional accuracy through lines that were –
and in many areas of the world still are – less than perfect for
data transmission. The price of this accuracy, however, is a
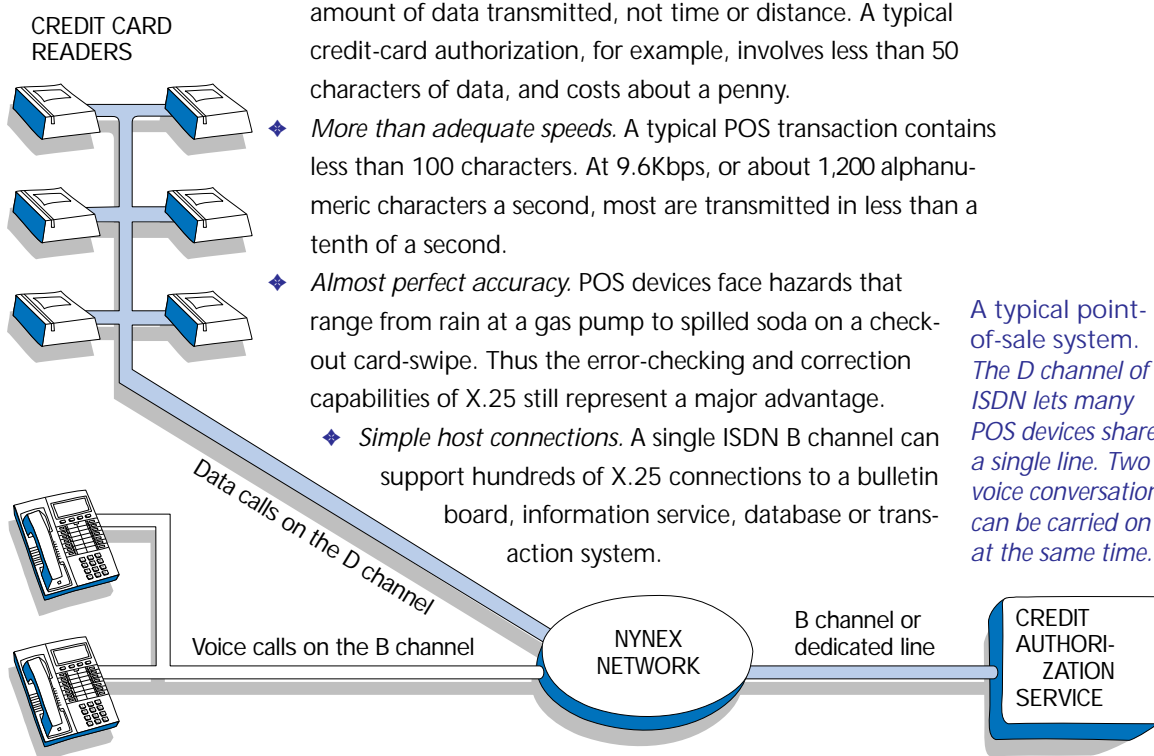D-channel transmission speed limited to 9.6Kbps.

"D channel speeds are fairly mundane by today's standards," said *TeleSystems Marketing Applications*' John Mazalewski, an ISDN consultant serving New York and New England. "Yet the primary need for most POS applications isn't speed but low cost, and end-to-end accuracy. In these uses, packet switching is as important today as it ever was in the past."

X.25 and ISDN

Packet today has become the almost perfect vehicle for extending and exploiting the power of ISDN. It offers:

❖ *Dedicated user dial-out capabilities.* Because most ISDN telephones and terminal adapters contain PADs, virtually every ISDN telephone, PC or data terminal can be a *dedicated host station* on the NYNEX X.25 network. It can *direct packet messages to – and receive messages from – virtually any location on any public packet network anywhere in the world.*

❖ *Fast connections.* Because D-channel devices are linked directly to the X.25 network, there is no dialing into modem pools, no waiting for a connection. Credit authorizations that took 12-45 seconds on analog lines are now completed in 2-7 seconds.

❖ *Low access costs.* Packet network access costs from $2-4 a month for each D channel, and up to eight primary devices can be linked to an ISDN BRI . In addition, several "access controllers" exist that let multiple point-of-sale terminals send and receive through the D channel simultaneously.

❖ *Low transmission costs.* Transmission costs are based on the amount of data transmitted, not time or distance. A typical credit-card authorization, for example, involves less than 50 characters of data, and costs about a penny.

❖ *More than adequate speeds.* A typical POS transaction contains less than 100 characters. At 9.6Kbps, or about 1,200 alphanumeric characters a second, most are transmitted in less than a tenth of a second.

CREDIT CARD READERS

❖ *Almost perfect accuracy.* POS devices face hazards that range from rain at a gas pump to spilled soda on a checkout card-swipe. Thus the error-checking and correction capabilities of X.25 still represent a major advantage.

❖ *Simple host connections.* A single ISDN B channel can support hundreds of X.25 connections to a bulletin board, information service, database or transaction system.

A typical point-of-sale system. *The D channel of ISDN lets many POS devices share a single line. Two voice conversations can be carried on at the same time.*
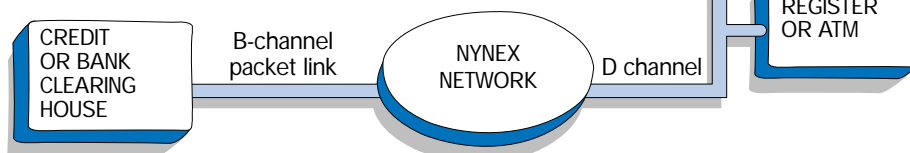
Data calls on the D channel

Voice calls on the B channel

NYNEX NETWORK

B channel or dedicated line

CREDIT AUTHORI-ZATION SERVICE

❖ *Simplified host equipment needs.* A host's permanent B-channel packet link to the X.25 network can totally eliminate the need for modems at the host site.

❖ *All this and telephones, too.* While transactions take place on the D channel, B channels of a BRI can simultaneously carry telephone and fax calls, video meetings, and more.

A VIRTUAL TRANSACTION NETWORK

ISDN offers closed, private networks through public telephone lines – for a growing number of transactions:

❖ Several major oil companies, including *BP Oil* and others, are using ISDN telephone lines to carry information from gas pumps and cash registers to regional data networks. BP, for example, has ISDN links to more than 500 stations nationwide. It uses ADAK terminal controllers that allow multiple gas-pump and in-station credit-card readers to be linked to a single D channel. Regional computers authorize purchases, control inventory, and schedule timely gas and oil replenishment. "Credit processing with ISDN takes about eight seconds now," says BP Oil's Tony Gibbons, "compared with 25-30 seconds before, and our line costs are significantly less. Higher speeds, greater functionality and lower costs: it's a combination that's hard to resist."

❖ In tests conducted by all major card processors, transaction times have been reduced from 30-plus seconds through dialed analog lines to less than four seconds with ISDN. Costs have been cut to literally pennies per transaction.

❖ Many health maintenance and health insurance companies use ISDN-linked point-of-sale card readers at clinics and physicians' offices to authorize medical insurance benefits.

❖ A growing number of state agencies are using "food stamp debit cards" to reduce fraud and speed payment

❖ Many banks now link remote ATMs through ISDN. D channels virtually eliminate the need for dedicated lines, and make it economical to reach many more locations.

❖ State lottery agencies are experimenting with ISDN for state lottery and numbers games. D channels can replace dedicated analog connections, and make lotto terminals much more widely available.

❖ Colleges and universities use D channels and student ID cards for meal payments, library check outs and more.

Multiple devices. *While up to eight devices can be linked to an ISDN D channel, each device can itself be an access controller supporting additional card readers, scanners or the like. The result: virtually any number of POS terminals can share a single D channel – up to the capacity of the D channel itself to handle the transmission load.*

CASH REGISTER OR ATM

ACCESS CONTROLLER WITH ATMs OR READERS

ACCESS CONTROLLER WITH ATMs OR READERS

CASH REGISTER OR ATM

CASH REGISTER OR ATM

CASH REGISTER OR ATM

CASH REGISTER OR ATM

CASH REGISTER OR ATM

CREDIT OR BANK CLEARING HOUSE

B-channel packet link

NYNEX NETWORK

D channel

9

ISDN is beginning to change the way people work and learn, how they come together, and how — as individuals and as groups — they gather and exchange information. And every day it becomes easier and more convenient to bring this power to to your desktop.

Today, almost all NYNEX central offices have at least one digital, ISDN-capable switch installed. Plans indicate that by the end of the decade, virtually all switches throughout the NYNEX area will be either AT&T 5ESS or Northern Telecom DMS-100 systems – both digital switches designed to support the ever-growing range of advanced telecommunications services, including ISDN.

NYNEX is also implementing a *Virtual ISDN* program that allows users in areas not yet served by an ISDN switch to obtain ISDN lines "imported" from a nearby central office. While these remote *Virtual ISDN* connections may require a change in telephone numbers when a customer's local switch does become ISDN-ready, they can and do offer access to ISDN today..

In addition, NYNEX is working to overcome the technical restriction that limits ISDN connectivity to a distance of about 18,000 feet (slightly less than three and a half miles) from the user's local telephone switch. Using line boosters, that distance can be effectively doubled.

The goal of both these programs is to enable any individual or company in the NYNEX "footprint" to obtain ISDN by the end of 1995. Both programs do incur small additional installation and monthly charges.

ISDN is also being broadly implemented in many other areas of the United States. Through the long-distance ISDN services of the major interexchange carriers (IECs) such as AT&T, MCI or Sprint, dialed digital connections can now reach out to locations throughout the nation and the world. For international applications, many European and Pacific Rim countries also offer ISDN connections to most overseas commercial centers.

Which means that it is now increasingly practical to begin implementing even the most ambitious worldwide telecommunications strategies using the high-speed digital connections of ISDN to "close the loop" to user desktops around the globe.

Extending an Application with Switched 56

For applications that extend into areas still not served by ISDN, it is also possible to use universally available Switched 56 services offered by all regional and interexchange carriers. These are single-channel, dialed, data-only connections, capable of uncompressed data speeds up to 56Kbps.

All Switched 56 services are connected to the nationwide networks of the interexchange carriers, and thus to each other. The result: ISDN applications can be successfully extended through Switched 56 if they do not require voice, do not use two channels simultaneously, and do not depend on D-channel signaling.

Nationwide interconnection. Almost any ISDN desktop can be connected to any other, anywhere in the world.

OTHER NETWORK

INTER-EXCHANGE CARRIER

NYNEX NETWORK

THE MOVEMENT TOWARDS UNITY
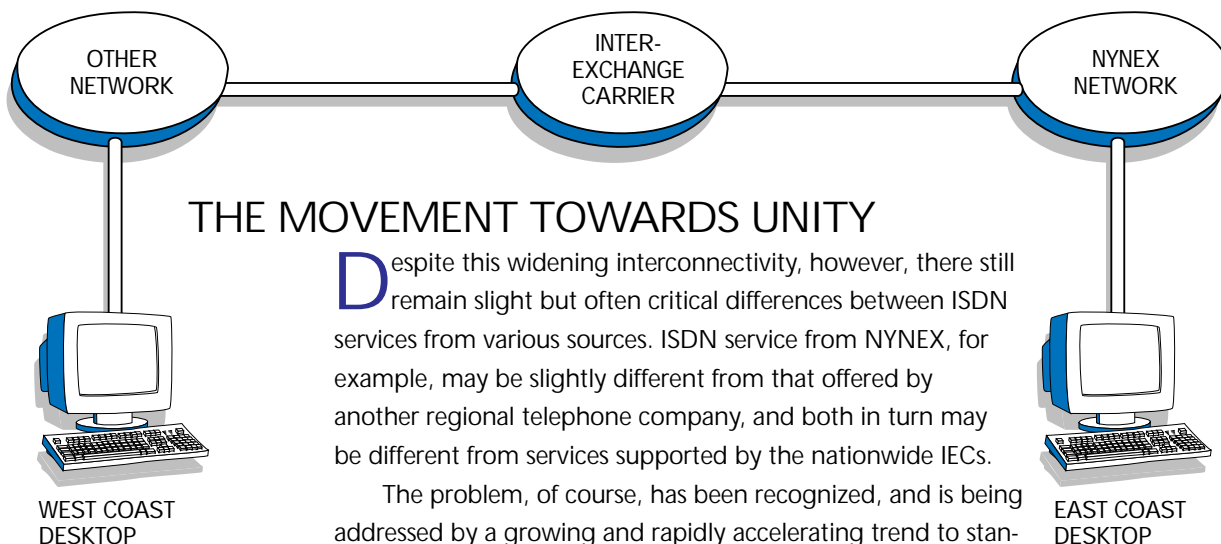
Despite this widening interconnectivity, however, there still remain slight but often critical differences between ISDN services from various sources. ISDN service from NYNEX, for example, may be slightly different from that offered by another regional telephone company, and both in turn may be different from services supported by the nationwide IECs.

The problem, of course, has been recognized, and is being addressed by a growing and rapidly accelerating trend to standardize ISDN services throughout the nation, and the world.

WEST COAST DESKTOP

EAST COAST DESKTOP

National ISDN

In 1992, NYNEX and the other major regional telephone operating companies, as well as major telephone switch manufacturers, made a commitment to move towards a uniform, nationwide ISDN service.

This thrust, as detailed by Bell Communications Research (Bellcore), is called *National ISDN*. It specifies that every central office ISDN switch throughout the nation should operate in a standard way, and offer a standard interface to the telephones, terminals and other Customer Premises Equipment – CPE in telephone jargon – from many different manufacturers.

National ISDN is being deployed in phases, each building on the one before. National ISDN-1 (or NI-1), for example, calls for a uniform Basic Rate Interface, the implementation of basic switch features, and the availability of a Primary Rate Interface. NI-2 adds a uniform Primary Rate Interface, consistent end-user services, and the availability of the even higher-speed dialed

capabilities of Switched Fractional DS-1. NI-3 holds the promise of full compatibility and equipment interoperability between all ISDN switches, and adds additional end-user features.

Ordering Codes

A corresponding thrust is also bringing order to the world of customer equipment. All major telephone carriers, as well as telephone switch and customer equipment manufacturers, are now implementing "central office switch translations" – called *ISDN Ordering Codes.* These describe the capabilities and needs of customer premise equipment, and tell a telephone company how an ISDN line should be configured, or "provisioned," for that equipment. Today, hundreds of ISDN products have successfully completed this translation and coding procedure, with hundreds more – from virtually every major equipment manufacturer – in the process.

"National ISDN and Ordering Codes mean that ultimately customers will be able to buy equipment, plug it in anywhere in the nation, and have it work right out of the box." says Ralph Nultemeier of *Digital Equipment Corporation,* which offers full ISDN equipment, installation and support services in New York City. "Like any new technology, ISDN still has its problems and growing pains," he said, "but things are getting better fast."

NYNEX ISDN SERVICES

NYNEX today offers BRI and PRI connections through digital switches located throughout the Northeast.

ISDN Basic Service

ISDN Basic Service is NYNEX's implementation of the standard BRI. It offers integrated voice, data and video transmission over a single dialed telephone line, as well as the quality and increased data speeds of digital transmission.

It accommodates multiple phone numbers and can carry two simultaneous voice conversations through the same twisted-pair line. It offers such easy-to-use features as hold, three-way conference calls, and call transfer from one phone to another.

ISDN Basic Service can also be used, of course, for dialing to and receiving calls from ordinary voice telephones everywhere, since the digital and analog systems are fully interconnected.

For data, the service offers two 64Kbps clear-channel, circuit-switched digital B channels – capable of bonded speeds of up to 128Kbps before data compression. It also offers a 16Kbps D channel for call signaling and setup, as well as for direct interconnection to the worldwide X.25 packet-switched network.

ISDN Basic Service uses standard 1MB, 1MR or Intellipath lines, and is fully compatible with other NYNEX digital services. It can be readily interconnected to AT&T, MCI, Sprint and other IECs to make long distance ISDN channels for global applications.

Lines can be linked directly from the NYNEX local office to the user's desktop, or can be linked to a company's PBX so that dialed ISDN connections can be used within the company.
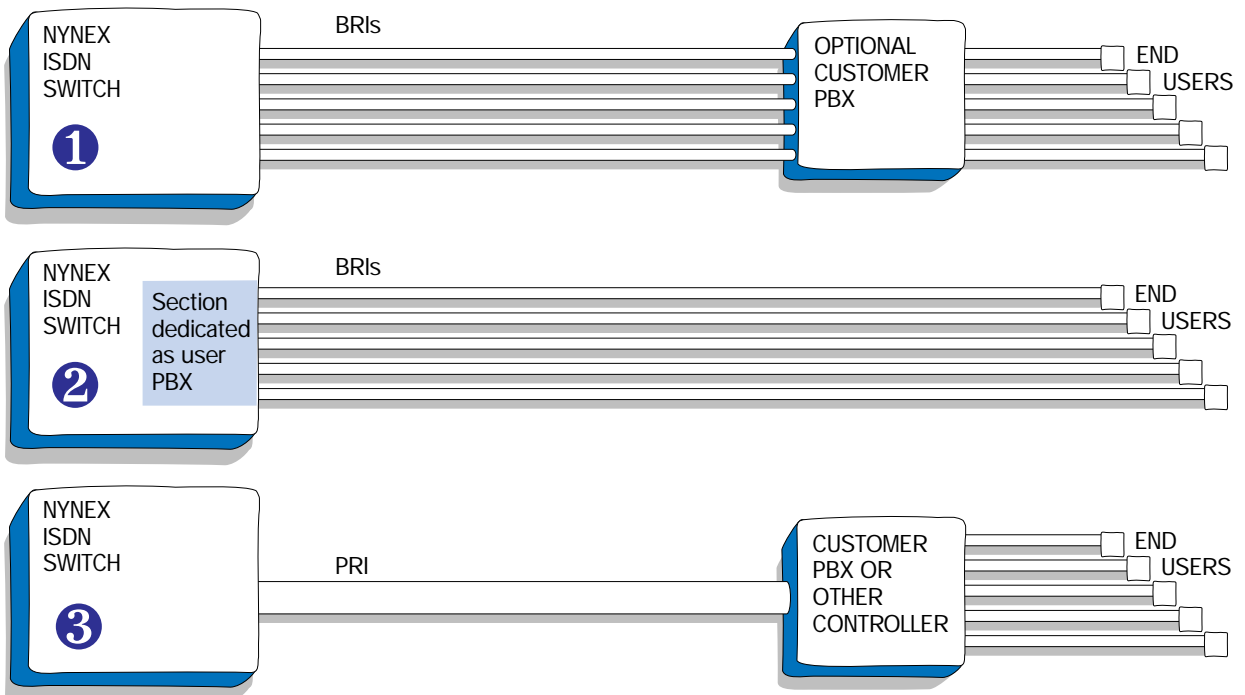
ISDN Intellipath

ISDN Intellipath is NYNEX's Digital Centrex service for business. In effect, NYNEX allocates a segment of its central office ISDN switch to act as a dedicated PBX for the customer's ISDN system. The customer thus has a PBX of almost unlimited power, without the cost and effort of installing one.

The advantages of ISDN Intellipath include advanced call management and call handling features. The switches are state-of-the-art digital systems, staffed around the clock by trained engineers and technicians. They are also fully "disaster-prepared" and equipped with uninterrupted power backup.

Three types of service.
ISDN can be delivered from a digital switch in three ways:
❶ through BRI connections from the central office to the user's desktop or to a PBX;
❷ through ISDN Intellipath, which lets the NYNEX switch serve as the user's PBX; and
❸ through a Primary Rate Interface, which brings multiple B channels to a corporate PBX or bandwidth controller.

ISDN Primary Service

NYNEX's implementation of the standard PRI is called ISDN Primary Service, and is most often provided through a standard T1 (1.544Mbps) dedicated point-to-point line. The service enhances the capabilities of the

NYNEX ISDN SWITCH ❶ — BRIs — OPTIONAL CUSTOMER PBX — END USERS

NYNEX ISDN SWITCH ❷ Section dedicated as user PBX — BRIs — END USERS

NYNEX ISDN SWITCH ❸ — PRI — CUSTOMER PBX OR OTHER CONTROLLER — END USERS

Making Sense of SPIDs

"Some day soon," says Ralph Nultemeier of Digital Equipment Corporation, "installing ISDN will be as simple as putting in a regular POTS (*Plain Old Telephone Service*) line." Until then, he advises, there are a few things the customer needs to watch. Nultemeier should know, because as product manager of Digital's ISDN service business, he installs and supports ISDN lines for customers throughout New York City.

"Probably the most important items to look for, and certainly the least understood, are *SPIDs – Service Profile Identifiers*" he says.

"Basically, a SPID is simple. It's your ten-digit telephone number, with a suffix of one to four numbers that describe a specific ISDN device to the telephone network."

Why a SPID? Because since it's technically possible to attach up to eight different devices with some 64 separate telephone numbers to a single ISDN telephone line, there must be some way to identify each device to both the local switch and the worldwide telephone network. The SPID does that.

"For example," notes Nultemeier, "I have a telephone, a PC and a fax machine on my desk, all served by a single ISDN line. I also have two different numbers on the telephone, each with different call-forwarding options, and I can bond the two B channels for higher-speed transmissions from my PC to my corporate LAN. SPIDs help sort and describe these capabilities to the network."

Unfortunately, he adds, things can get even more complicated, depending on the type of digital switch that serves your area. AT&T 5ESS switches, for example, require only one SPID for a bonded data transmission using both B channels, while Northern Telecom DMS-100 systems require two SPIDs, one for each B channel. There are other small differences, as well.

"For the time being," says Nultemeier, "do yourself a favor and get involved with SPIDs when you order an ISDN line. Ask the order clerk *if* you will need a SPID, and if so *how many*. Then, when the line goes in, make sure that you get and understand *all* of your SPIDs before the installer leaves.

"You will have to enter correct SPIDs into each of your ISDN devices, because they will not function without them."

basic T1 digital trunk by giving the user hour-by-hour or even minute-by-minute control over each individual 64Kbps channel.

For example, instead of having separate trunks for voice access, for incoming 800-number lines, for outgoing WATS services and the like, it is now possible to allocate almost any channel to any function, wherever and whenever it's needed. This variable allocation of trunks can either be programmed into a NYNEX central office switch, or can be offered through a growing range of bandwidth-on-demand controllers, multiplexers, codecs and other equipment at the customer's location.

The result, of course, is that more voice and data traffic can be handled through existing facilities, with a much more productive use of each trunk.

While one 64Kbps channel must be reserved for D-channel signaling, those installations with multiple PRIs may choose to have one D channel serve two, three or even four PRI trunks. Large customers can also consolidate their traffic to one or more interexchange carriers through a PRI connection to the central office, thereby eliminating separate connections to each IEC.

NYNEX's ISDN Primary Service is available today from many central offices throughout NYNEX. Its flexibility, power and call-by-call service capabilities can also be added to existing T1 trunks served by an appropriate digital switch.
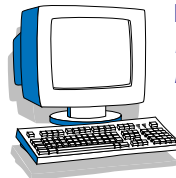
ISDN EQUIPMENT

Agrowing range of LAN servers, bridges, routers, bandwidth controllers and other equipment is rapidly becoming available. Many manufacturers and suppliers of this equipment are listed in the appendix of this guide, and most provide expert advice and assistance in planning for ISDN.
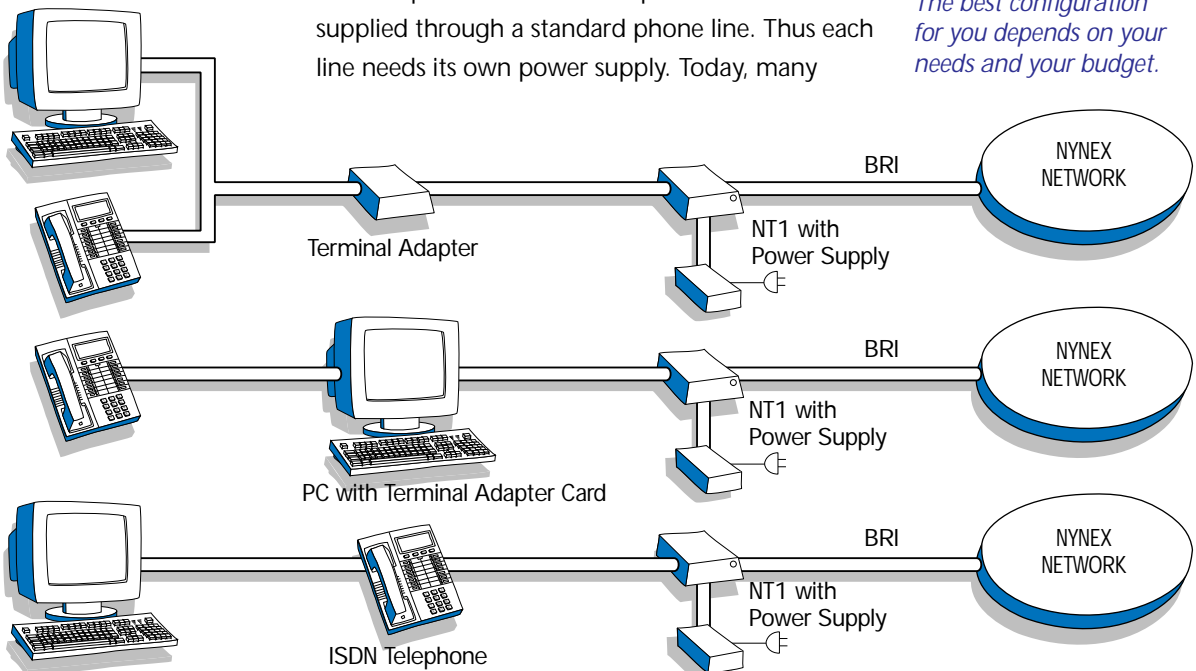
Some Basic User Needs

The equipment needs of the individual user are relatively simple. The typical user will require some of the following:

PC circuit boards.
ISDN circuit boards for PCs and workstations are, in effect, terminal adapters. Many include jacks for analog telephones and other devices. Many also include a built-in power supply.

❖ *A Network Termination Device.* An NT1, as it's called, links a BRI connection to the telephone network. It offers both line-conversion and line-testing capabilities. Some manufacturers incorporate this device into other components. For example, many terminal adapters and desktop computer circuit boards come with a built-in NT1.

❖ *A Terminal Adapter.* The TA is a protocol converter that adapts PCs, workstations and other equipment to ISDN. Some terminal adapters, especially those that come as a circuit board, include telephone jacks for connecting analog telephones or faxes, while many ISDN telephones come with a built-in terminal adapter and appropriate jacks for connecting a PC.

Some typical desktop configurations.
Using ISDN telephones or terminal adapters, it's possible to link analog devices (PCs, analog telephones, faxes and more) to an ISDN line. The best configuration for you depends on your needs and your budget.

❖ *A Power Supply.* Unlike analog telephone service, ISDN requires more electrical power than can be supplied through a standard phone line. Thus each line needs its own power supply. Today, many

Terminal Adapter — BRI — NT1 with Power Supply — NYNEX NETWORK

PC with Terminal Adapter Card — BRI — NT1 with Power Supply — NYNEX NETWORK

ISDN Telephone — BRI — NT1 with Power Supply — NYNEX NETWORK

NT1s, TAs and PC circuit boards come with their own built-in power supply.

❖ *An ISDN Telephone.* Powerful digital telephones that most often include a terminal adapter, an LCD screen for D-channel messaging and "softkeys" for call-management and call-control features.

❖ *An Aggregation Device.* While some aggregation devices are still sold as stand-alone units, a growing number of terminal adapters now include the electronics to aggregate, or bond, two B channels into a single higher-speed connection. Some, especially PC boards, also include an Ethernet bridge.
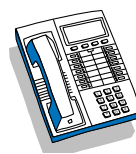
ISDN telephones. Most often come with built-in LCD screens for "softkey" call control. Most are also terminal adapters, and come with jacks for linking PCs and analog faxes to the B channel. Many also include a PAD (packet assembler-disassembler) for linking PCs and point-of-sale devices to the D channel.

Also required, of course, is the equipment – PCs, workstations, video or sound systems, credit-card readers and the like – and software to be used in a specific application.

"Prices for ISDN equipment are declining rapidly," said DEC's Nultemeier. "As the market grows, prices will continue to come down while capabilities keep going up."

Wiring for ISDN

In more than 80 percent of existing locations, the copper twisted-pair lines that currently serve analog telephones can be success-fully used for ISDN. Nonetheless, depending on the usage of the ISDN line, and the number of existing handsets or other devices currently installed, those who plan to order ISDN may want to consider the costs and advantages of several alternatives.

❖ *ISDN as the only line.* This requires that all equipment (telephones, terminal adapters and the like) be ISDN-compatible. Several variations of equipment can be used to configure the line, depending on needs and projected customer applications.

❖ *ISDN as a second line.* This alternative can also be configured in several ways, and lets existing analog lines serve analog phones and faxes. A drawback: it may not be possible to "roll over" calls between equipment on the various lines. An advantage: analog lines can function through a power outage, while ISDN lines can not without adequate battery or other power backup.

GETTING STARTED NOW

Perhaps the hardest thing about getting started with ISDN is changing our perception of what, in fact, a telephone line can do – venturing beyond the slow modems and analog connections of yesterday into the digital connections and multi-megabit speeds of tomorrow.

The purpose of this guide, of course, is to enlarge that perception – to shed light on the hundreds of viable, powerful applications for ISDN that are being used today by thousands of companies and organizations throughout the world.

Determining a Need

In most organizations, the initial thrust towards ISDN will be driven by a single application: opening a backbone network to smaller locations, or linking multiple stores or offices together. It might be the opportunity to try video conferencing or telecommuting, or to find an economical way to back up a critical worldwide network.

The NYNEX ISDN Hotline number is 1-800-GET-ISDN

Whatever the need, however, a wealth of information, help and advice is literally as close as the nearest telephone. Perhaps the best and most obvious place to start is with a call to your own local NYNEX account team or, if you don't have a regular account team, to your local business office.

Both large and small customers can also call a special NYNEX hotline designed specifically to help in the ordering and installation of ISDN and other NYNEX digital services. The toll-free number is 1-800-GET-ISDN.

Most ISDN switch and equipment manufacturers also provide ISDN hotlines or customer service numbers in the NYNEX area – many of them toll-free. They offer helpful information, as well as service and availability information. Many are also set up to actually take orders, or arrange meetings with a knowledgeable account team. In addition, a growing number of consultants, system integrators and value-added resellers are offering their expertise in many specialized applications. A list of these NYNEX authorized Sales Agents and Business Alliance Partners appears in the appendix to this guide.

The Future Starts With a Phone Call

Today, ISDN is a reality – ready to bring the speed, power and control of the worldwide digital network to your desktop, and the desktops of users throughout the Northeast and the world. Finding out just how much ISDN can mean to you and your work begins with a simple phone call.

ISDN is ready. We hope that you are, too.

A

A wide range of expertise and assistance is available to help you select, acquire, install and maintain your ISDN applications and equipment. The listings that follow — which include equipment manufacturers and suppliers, NYNEX authorized sales agents, other telephone companies throughout the United States and more — should help you get started.

Equipment & Software Suppliers and Service Providers

The manufacturers, suppliers and service providers listed here offer ISDN equipment and services with specifications that respond to a broad range of ISDN applications. It is not a complete list, however. New products are continually introduced, and equipment from companies not listed here may work equally well. This information has been compiled from a range of sources, including Solutions '94, the North American ISDN User's Forum catalog of ISDN applications and solutions, and other documents.

This list does not imply any endorsement of these products by NYNEX, although as part of our Business Alliance program (noted below with a ◆), the products and services of many companies can be leased or purchased through NYNEX.

The telephone numbers listed are correct to the best of our knowledge. For more information, contact your NYNEX account team, or the NYNEX ISDN Hotline, 800-GET-ISDN, or any of the numbers shown in this appendix.

Other non-ISDN equipment and software is also needed, of course, to implement the applications illustrated in the text of this document, including PCs, workstations, computers and file servers, LANs and LAN-access hardware, video and/or sound equipment and the like. Manufacturers of many of these products are not listed here.

Company	Telephone
3Com ◆	800-NET-3COM
Adak Communications	517-887-5800
Adtran ◆	800-397-3146
Ameritech	800-TEAMDATA
Ascend Communications, Inc.	800-621-9578
AT&T WorldWorx Solutions	800-828-WORX
AT&T Business Communications Services	800-222-0400
AT&T Global Business Communications	800-325-7466
AT&T Network Systems ◆	800-257-8699
AT&T Power Systems	214-284-2948
Bell Atlantic	800-570-ISDN
Bellcore	800-992-ISDN

BellSouth	800-428-ISDN
BT Visual Images	800-778-6288
Cincinnati Bell Telephone	513-566-5050
CISCO Systems, Inc.	415-326-1981
Compression Laboratories Inc.	408-428-6759
Connective Strategies, Inc.	703-378-ISDN
Controlware Communications Systems	908-919-0400
Digiboard ❖	800-344-4273
diehl isdn GmbH	011-49-7152-9329
Eicon Technology	800-80-EICON
Electronic Cafe International	310-828-8732
Engage Communications, Inc.	408-688-1021
EuRoNis	407-363-9008
Extension Technology	800-856-2672
FastComm Communications Corporation ❖	800-282-9642
Fujitsu ISDN Division	800-228-ISDN
Fujitsu Network Switching of America ❖	800-228-4736
Gandalf Technologies	800-GANDALF
GTE	800-448-3795
Hayes Microcomputer Products, Inc.	404-441-1617
Hewlett-Packard	800-637-7740
Hitachi America	404-242-1410
Integral Communications, Inc.	800-ICI-8234
Integrated Network Corporation	800-662-5515
Intel Corporation ❖	800-538-3373
International Transware, Inc.	800-999-6387
IBM Corporation	800-IBM-CALL
ISCOM	301-779-1368
ISDN Systems Corporation	703-883-0933
ISDN*Tek	415-712-3000
Link Technology	215-357-3354
MCI Telecommunications Corp.	800-727-5555
Memotec DataComm, Inc. ❖	800-766-7782
Mitel Corporation	613-592-2122
Motorola Transmission Products	800-451-2369
NEC (Dr. Bond)	800-222-4NEC
netCS Informationstechnik GmbH	011-49-30-8569990
Newbridge Networks Inc.	201-818-2766
Northern Telecom ❖	800-NORTHERN
NYNEX	800-GET-ISDN
Obertronics Software, Inc. ❖	508-664-2205
Pacific Bell	8004PB-ISDN
PictureTel ❖	800-874-2835
Pierce-Phelps, Inc. Integrated Comm. Systems ❖	800-262-6800
Primary Rate Inc.	800-950-ISDN
Racal-Datacom, Inc.	305-846-6762
Siemens Stromberg-Carlson	407-955-6054
Silicon Graphics Inc.	415-390-2522
Southern New England Telephone	800-430-ISDN
Southwestern Bell Telephone Company	800-992-ISDN
Sprint	800-546-1828
Sun Microsystems Computer Company	800-821-4643
TELES GmbH	512-990-0780
TeleSystems Marketing Applications ❖	800-334-9334
Teloquent Communications ❖	800-872-2272
Telrad Telecommunications, Inc.	516-921-8300
Tone Commander Systems	800-524-0024
TxPort ❖	800-926-0085
Vitel	800-856-8835
VIVO Software, Inc.	800-848-6411
U. S. West	800-288-4044

NYNEX Authorized Sales Agents

A full range of equipment and services, as well as installation and applications assistance is offered by many NYNEX Authorized Sales Agents. Most represent a wide range of equipment manufacturers and providers, and offer an extensive line of installation and post-sales service and support. This list was compiled in September, 1995.

Company	Location	Telephone	Area Codes Served
Advanced Digital Networks, Inc.	New York, NY	212-944-5400	212 516
Advanced Information Sys, Inc.	Quincy, MA	617-773-3110	617 508
All-Mode Communications, Inc.	Freeville, NY	607-347-4164	718 914 607
Annese & Associates, Inc.	Herkimer, NY	315-866-2213	518 914
Associated Telephone Dsgn, Inc.	New York, NY	212-532-6800	212 914 516
Birns Telecommunications	New York, NY	212-807-6000	212
Com/Peripherals, Inc.	Great Neck, NY	516-487-0690	212 718 516 914
Comlink Incorporated	Marlboro, MA	508-460-7800	617 508 413 401 802 603 207
Communications Plnnng & Svs.	Farmingdale, NY	516-753-2150	516 212 718 914
Computer Telephone Corp.	Waltham, MA	617-466-8080	617 508 413 401 802 603 207
	New York, NY	212-608-2200	212 516 914
Cortel Business Systems, Inc.	New York, NY	212-627-4200	212 718
Delta Data Net, Inc.	Teterboro, NJ	201-288-9444	212
DSS-Net, Inc.	New York, NY	212-695-5559	212
Eagle InterCommunications	New York, NY	516-777-1200	212 516 718 914
Eastern Datacomm, Inc.	Emerson, NJ	201-262-9022	212
Eastern Telecom, Inc.	Cranston, RI	401-946-9500	401 413 617 508
	Albany, NY	518-464-0244	518 914
Executone Information Systems	Westwood, MA	800-852-3122	401 617 508 413
Gaffney Communications	Utica, NY	800-962-2000	315
IBM Corporation	New York, NY	212-745-4334	212 516
ICS/Executone Telecom Inc.	Rochester, NY	716-427-7000	716 315 607
	Buffalo, NY	716-633-8200	716 315 607
Kern Telemanagement	New Rochelle, NY	914-636-2342	212 516 914
Network Research & Control	Stratham, NH	800-445-4541	603 508
Network Services, Inc.	Burlington, VT	802-864-0300	802 603
PRF Systems, Inc.	New York, NY	212-354-4290	212
Ronco Comm. & Electronics	Tonawanda, NY	716-879-8133	716
Taylor Telephone Services, Inc.	Brewer, ME	207-989-7926	207 603
Telecom Consultants, Inc.	Greenvale, NY	516-484-7494	212 516 718 914
Telecom Ventures, Inc.	Brooklyn, NY	718-238-3340	212
Telenetwork Services, Inc.	E. Providence, RI	800-525-0032	401 508 413
TIE Communications, NY	New York, NY	212-768-2000	212
USTeleCenters	Boston, MA	800-441-3211	617 508 413 401 603
	New York, NY	212-221-9911	212 718 914
Whitcom, Inc.	Islandia, NY	800-338-3940	212 516

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