

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

What it is
How it works
What it does
Why

NYNEX ISDN

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Colophon

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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.

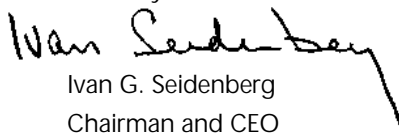
ISDN delivers medical images to remote specialists. It gives valued employees the freedom and flexibility to telecommute from home, either full-time, part-time or just when the weather shuts down the roads.

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

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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:

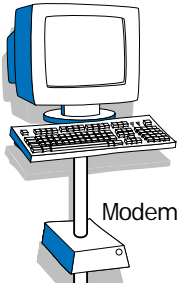
- ◆ At an advertising agency in Boston, a graphic designer uses the telephone to send full-color production materials for a supermarket ad to newspapers throughout the Northeast.
- ◆ In a Manhattan recording studio, Barbra Streisand records a duet with Frank Sinatra. Sinatra sings in a Hollywood studio 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



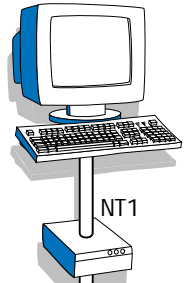
NYNEX ISDN

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.

DIGITAL DESKTOP: 128Kbps+ before compression



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 14.4Kbps 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.

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.

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.

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

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

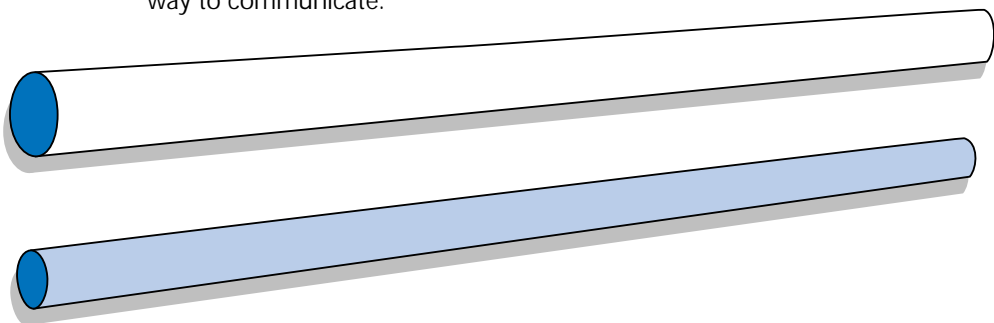
The term *bit* is a contraction of *binary digit*, the smallest unit of digital information – either an on or off signal. The term *byte* is similar, but actually represents one full character – a letter, number or symbol – of seven or eight bits, depending on the computer code used. The term *baud* 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.

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



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 Telecommunications 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.

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.

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.

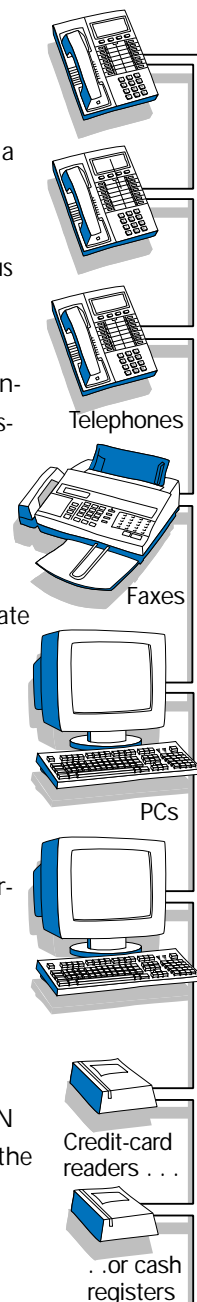
There are no protocol or other restrictions for B channels. They are defined as transparent, circuit-switched, 64Kbps connections capable of carrying digital voice or digital data transmissions. B channels can also be inverse multiplexed, or “bonded” by customer equipment (or the local NYNEX switch)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



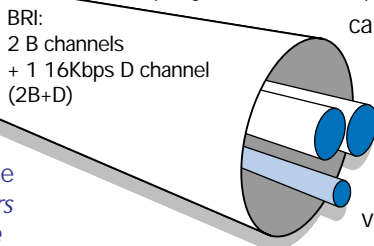
The Basic Rate Interface

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.

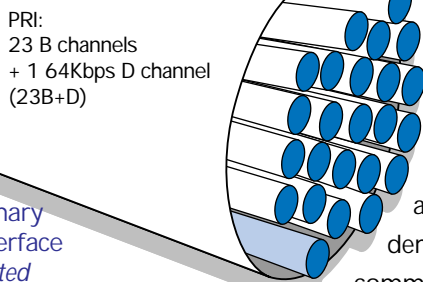
The Primary Rate Interface

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.

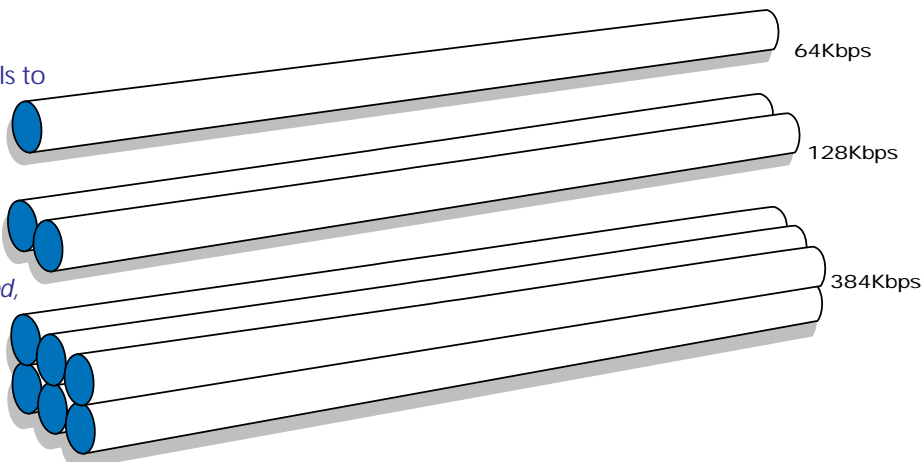
A group of six B channels, for example, could be combined – bonded – by customer equipment for a studio-quality, full-color, full-motion video conference, and afterward returned to the general pool of B-channels supporting internal and external voice and data communications. These same channels might 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.



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.

