ISDN - Integrated Services Digital Network.

Why Is ISDN So Important?

Yet often lost in the excitement of faster, more accurate data transmission is another, equally important fact. ISDN truly represents the next generation of the world's telephone service for all forms of telecommunications, including voice.

ISDN brings the digital network to the individual user. Thus, the same twisted-pair copper telephone line that could traditionally carry only one voice, or one computer or one fax "conversation" can now carry as many as three separate "conversations" at the same time, through the same line. ISDN is the "magic" that makes this happen.

How is this possible? The basic ISDN-to-user connection, called a Basic Rate Interface, or BRI, contains three separate channels, or "pipes." Two of these channels (the B channels) carry user "conversations" from a telephone, a computer, a fax or almost any other device. The third channel (the D channel) carries call set-up information for the network, but can also carry user data transmissions.

That means that two separate "conversations" say, a voice call and a computer transmission can take place at the same time through the same ISDN line. Simultaneously, a third "conversation" a CompuServe session or a credit-card authorization, as examples could also take place through the same connection. The power of ISDN enables all three of these transmissions to happen at the same time, through the same copper twisted-pair telephone line that once could handle only one transmission at a time.
But there's more. Because as many as eight separate devices (telephones, computers, fax machines, and more) can be connected to the same ISDN line and each given as many separate telephone numbers as needed. All of which means it is no longer necessary to have multiple telephone lines to handle multiple telephone devices, or multiple telephone numbers, or multiple telephone calls. One ISDN line does it all.

Multiple devices and multiple members. Depending on the capabilities of the central office switch, ISDN can support up to eight devices and as many as 64 separate telephone numbers through a single BRI connection.

ISDN telephones can, of course, call to and receive calls from ordinary telephones everywhere, since the digital and analog systems are fully interconnected. Digital ISDN connections also produce voice conversations that are absolutely quiet and crystal-clear, every time.

ISDN Fundamentals

Integrated Services Digital Network is a set of digital transmission protocols defined by CCITT (the Consultative Committee for International Telephone and Telegraph, which was recently renamed the Telecommunications Standards Sector of its parent, the International Telecommunications Union). The protocols are accepted by virtually all the world's communications carriers as standard.

Some of the characteristics that distinguish ISDN are:

- **It builds on groups of standard transmission channels.** Bearer channels (or B channels) transmit user information at relatively high speeds, while separate Data channels (or D channels) carry call set-up, signaling and other information.
Two types of ISDN channels. B channels are clear channel "pipes" for user voice and data. D channels are packet-switched links for call set-up and user data.

- **It handles all types of information.** Unlike some other digital communications technologies, ISDN handles all types of information voice, data, studio-quality sound, still and moving images. They are all digitized, and transmitted at high speeds in the same flow of data.
- **It handles many devices and many telephone numbers, on the same line.** Up to eight separate telephones, fax machines or computers can be linked to a single ISDN connection, and have up to 64 "call appearances" of the same or different telephone numbers.
- **It supports up to three calls at the same time.** Two voice, fax or PC "conversations," and one data "conversation" can take place at the same time, through the same ISDN connection.
- **It offers variable, responsive transmission speeds.** Two or more channels can be combined into a single larger transmission "pipe." Channels can be assembled as needed for a specific application (a large video conference, for example), and then broken down and reassembled into different groups for different applications (normal voice or data transmissions). Combining B channels in this manner is called inverse multiplexing, or bonding (see diagram on next page).

**Inverse Multiplexing or "Bonding"**

Combining channels to make larger "pipes".

- User voice or data travels through one B channel at 64 Kbps.
- For higher speeds, both channels of a BRI can be combined to transmit at 112 Kbps.
- Even higher speeds are possible by combining several BRIs into increasingly larger "pipes".

**Inverse multiplexing or "bonding".** Combining channels to make larger "pipes".
- *It uses switched digital connections.* Perhaps the most important single feature of ISDN, however, is that it offers inexpensive dialed digital access to the worldwide telecommunications network. It is no longer necessary to lease costly dedicated lines for high-speed digital transmission, or to limit data speed and accuracy by using modems to convert digital signals to analog pulses.

**ISDN Basics**

**Transmission Speeds**

Transmission speeds are most often 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 major computer codes use either seven (ASCII) or eight (EBCDIC) bits to represent one letter, number, or symbol.

ISDN is delivered from a digital switch through two types of user interfaces: the Basic Rate Interface (BRI) and the Primary Rate Interface (PRI). Each consists of a number of 64Kbps bearer, or B channels, coupled to one data, or D channel. As defined, B channels are 64Kbps clear-channel connections, and can be used for dial-up voice and data connections. The D channel is defined as a packet-switched call set-up and signaling connection shared by all users of ISDN.

D-channel call set-up and signalling information is designed to be transmitted through Signaling System 7 (SS7), a separate telephone network intended specifically for statewide and worldwide call-signaling. Call set-up data is carried out-of-band rather than in-band as it is today.

**Basic Rate Interface**

The Basic Rate Interface or BRI is defined as two 64Kbps Bearer (B) channels, and one 16Kbps Data (D) channel that carries both call set-up and user packet data across the network. The BRI interface is also referred to as a 2B+D connection.
The basic rate interface. A BRI delivers three separate channels. As noted earlier, BRIs can carry a wide and flexible range of communications. A single BRI, for example, can carry two simultaneous voice or data conversations (to the same or different locations). In either example, the D channel can also be used for packet communications to a third location, also simultaneously. The two B channels can also be combined for transmitting data at uncompressed speeds of up to 112Kbps currently, and 128Kbps uncompressed in the future.

Primary Rate Interface

The primary rate interface. A PRI contains 23 B channels, plus one D channel. In Europe and the Pacific Rim, because transmission standards differ slightly, the Primary Rate Interface is supplied through a standard 2.048Mbps E-1 channel, and consists of either thirty or thirty-one 64Kbps B channels, and one 64Kbps D channel thus 30B+D or 31B+D.
Although the specifics of ISDN implementation are still slightly different from nation to nation, interconnections between any two systems in the world are now not only possible, but increasingly practical.

PRIs are dedicated trunks that connect medium and large locations to a telephone company central office. Virtually all modern telephone and computing systems can be connected to ISDN through a PRI including PBXs, mainframe and distributed systems, LANs and WANs, multiplexers and ISDN controllers, video conferencing units, and more.

PRIs are designed to facilitate the flexible use of these systems by allocating multiple channels to larger units as needed, while supporting individual BRIs for both internal and external voice and data communications.

Dynamic Allocation of B Channels in a PRI

For practical purposes, combining multiple channels in a PRI for large video conferences, data transfers and the like is most often programmed into the digital switch serving the location. However, new bandwidth-on-demand controllers have begun to enable a network manager to combine larger bandwidths in real time to meet specific needs. They can also monitor quality and traffic on both corporate leased-line and ISDN networks, and perform dynamic allocation of B-channels to relieve bottlenecks, or back-up error-prone or damaged lines.

Dialed backup. ISDN channels are dialed only as needed for overflow or out-of-service conditions.

Connecting to ISDN

There are three ways ISDN can be "delivered" from an ISDN-ready digital switch. These alternatives are:

- *Through a direct BRI connection from an ISDN switch.* One or more standard BRI (2B+D) connections can be used to link a company directly to an ISDN-ready switch. These lines can connect directly to ISDN equipment in a small office or residence, or can be connected through a PBX or key system so that devices can communicate with one another without having to call through an outside connection.
- *Through ISDN Centrex service.* One or more BRIs can also be linked to ISDN Centrex service. This arrangement offers several advantages for an individual or company. Since the ISDN switch functions as their switching system, the company
does not have to own or maintain a PBX or key system. It also offers a low-cost, virtually unlimited growth path.

- **Through a PRI connection.** A PRI delivers 30 B channels plus one D channel from the telephone company to a PBX or other control device, which then distributes the B channels as needed throughout an organization. How this configuration is set up can vary greatly. Users with heavy data traffic, for example, might configure the connection through an ISDN router, multiplexer or controller, rather than a PBX reducing the chance of congestion through the switch.

### ISDN as the Only Line, or as a Second Line

While ISDN is specifically designed to deliver digital connections through existing copper twisted-pair lines, many smaller locations (and many larger ones as well) will have to decide whether or not to use ISDN as the only telephone connection, or to install it as a separate, second line.

Depending on existing equipment and usage, an office or home might configure ISDN in several ways (see diagram on the following page):

- **ISDN as the only line.** This requires that all telephones and fax machines be ISDN systems, or be linked through a special terminal adapter, and that all PCs or other computers have special ISDN cards installed.

- **ISDN as the only line, using a "digital modem."** By adding a specialized device such as an IBM WaveRunner digital modem to the line, both ISDN equipment and existing telephones or faxes can share a single ISDN line. A digital modem can cost less than a single fully equipped ISDN telephone.
• **ISDN as a second line.** This alternative, often the least expensive, lets ISDN bring higher data speeds and other advantages to ISDN equipment, while existing analog lines serve existing analog phones and faxes. The drawback: it is not possible to "roll over" calls from ISDN to the analog lines, or vice versa.

**Telecommunications**

**ISDN as an Only or as a Second Line**

Alternate wiring plans. *A decision based on user needs and existing equipment.*

Depending on needs and expectations, these alternatives let users migrate to ISDN in one sweeping move, or in measured steps replacing older equipment in a systematic, economical way.

**The Unique Value of ISDN**

To many users, especially individuals and those in smaller companies, ISDN is by far the most important of these technologies. To literally millions of users, it offers inexpensive dialed service, high-speed data transmission, and the ability to send and receive voice, data, still and moving images through the same fully digital connections. It is also a communications standard accepted throughout the world, which means that voice and high-speed data connections to most of the major business centers of Europe and the Pacific Rim are literally no more than a simple, dialed phone call away.
**ISDN (Integrated Services Digital Network)**

**Introduction**

ISDN is a digital network that is capable of producing maximum transmission speeds of about 1.4Mbps. Speeds of 128Kbps are however more common in this digital technology.

ISDN is an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires.

ISDN uses UTP (Unshielded Twisted Pair Wiring) and carries digital signals. **UTP - multiple, individually insulated wires that are twisted together into pairs without any outer shielding.**

Most ISDN lines offered by telephone companies give you two lines at once, called B channels. It is three times the data rate provided by today's fastest modems.

**How ISDN Works**

In an analog network, a two-wire loop from the telephone company's local central office to the customer's premises, supports a single transmission channel, which can carry only one service--voice, data, or video--at a time.

With ISDN, this same pair of twisted copper wires is logically divided into multiple channels. A typical ISDN line has 2 types of channels.

The first type of channel is called a Bearer or B channel. This channel can carry about 64Kbps of data. A typical ISDN line has 2 B channels where one channel can be used for a voice call, while the other, can be used for data transmission. This process occurs on one pair of copper wire.

The second type of channel is used for link management and call setup. This channel is known as the Signal or D channel (often referred to as the Delta channel).

The third channel has only 16Kbps of bandwidth.

**Types of ISDN Service**

There are two basic types of ISDN service:

*Basic Rate Interface (BRI)*

*Primary Rate Interface (PRI).*

BRI consists of two 64Kbps B channels and one 16Kbps D channel for a total of 144Kbps. This basic service is intended to meet the needs of most individual users.
To access BRI service, it is necessary to subscribe to an ISDN phone line. Customers will also need special equipment to communicate with the phone company switch and with other ISDN devices. These devices include ISDN Terminal Adapters (sometimes called, incorrectly, "ISDN Modems") and ISDN Routers.

**Advantages of ISDN**

**Speed**
Using a dial-up connection, there is an upper limit to the amount of information that an analog telephone line can hold. Currently, it is about 56Kbps. Commonly available modems have a maximum speed of 56Kbps, but are limited by the quality of the analog connection and routinely go about 45 Kbps.

ISDN allows multiple digital channels to be operated simultaneously through the same regular phone wiring used for analog lines. The change comes about when the telephone company's switches can support digital connections. Therefore, the same physical wiring can be used, but a digital signal, instead of an analog signal, is transmitted across the line. This scheme permits a much higher data transfer rate than analog lines.

**Multiple Devices**
One line each was required for a telephone, fax, computer, bridge/router, and live video conferencing system. A separate line was required for each device using normal dial-up connection.

ISDN can handle multiple devices on a single line. Up to eight telephones, computers, workstations, faxes, credit card readers, cash registers or other devices can be directly attached to a single ISDN line, all in use simultaneously.

**Connection Time**
V.34 modem typically takes 30-60 seconds to establish a connection; an ISDN call usually takes less than 2 seconds ie. Fast dial-up establishment.

**Disadvantages**

1. More expensive than the Plain Old Telephone System (POTS)
2. The telephone company and the remote computer both need specialized equipment

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