
UNIT 3 INTEGRATED SERVICES DIGITAL NETWORK (ISDN)

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3.0 INTRODUCTION

ISDN stands for *Integrated Services Digital Network*. It is an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. This system allows data to be transmitted simultaneously across the world using end-to-end digital connectivity.

The early phone network consisted of a pure analog system that connected telephone users directly by an interconnection of wires. This system was very inefficient and was very prone to breakdown and noise, and did not lend itself easily to long-distance connections. Beginning 1960s, the telephone system gradually began converting its internal connections to a packet-based, digital switching system. Still, the final connection from the local central office to the customer equipment was, and still largely is, an analog Plain-Old Telephone Service (POTS) line.

A standard movement was started by the International Telephone and Telegraph Consultative Committee (CCITT), now known as the International Telecommunications Union Telecom Sector (ITU-T). The ITU is a United Nations organisation that coordinates and standardizes international telecommunications. Original recommendations of ISDN were in CCITT Recommendation I.120 (1984) which described some initial guidelines for implementing ISDN.

In the term ISDN:

- “**Integrated Services**” refers to ISDN’s ability to deliver two simultaneous connections, in any combination of data, voice, video, and fax, over a single line. Multiple devices can be attached to the line and used as needed. That means an ISDN line can take care of most people’s complete communications needs, without forcing the purchase of multiple analog phone lines at a much higher transmission rate.
- “**Digital**” refers to its end-to-end digital transmission, as opposed to the analog transmission of plain old telephone service. ISDN transmits data digitally, resulting in a very clear transmission quality.
- “**Network**” refers to the fact that ISDN is not simply a point-to-point solution like a leased line. ISDN networks extend from the local telephone exchange to the remote user and include all of the telecommunications and switching equipment in between. When you have ISDN, you can make connections throughout the world to other ISDN equipment. If your ISDN equipment includes analog capabilities, you can also connect to analog modems, fax

machines, and telephones, even though they may be connected to plain old telephone service.

ISDN supports data transfer rates of 64 Kbps. Most ISDN lines offered by telephone companies give two lines at once, called **Bearer channels or B- channels**. You can use one line for voice and the other for data, or you can use both lines for data to give you data rates of 128 Kbps, three times the data rate provided by today's fastest modems. Some switches limit B channels to a capacity of 56 Kbps. A data channel (**D channel**) handles signalling low-speed packet mode data transfer at 16 Kbps or 64 Kbps, depending on the ISDN link location.

3.1 OBJECTIVES

After going through this unit, you should be able to:

- explain the term ISDN;
- differentiate between baseband and broadband communication;
- explain the types of ISDN services;
- discuss various advantages of ISDN, and
- explain the various applications of ISDN.

3.2 BASEBAND AND BROADBAND COMMUNICATION

When the ISDN was originally designed, data rates of 64Kbps to 1.544 Mbps were sufficient to handle all existing transmission needs. As applications using the telecommunication network advanced, however, these rates proved inadequate. To provide for the needs of the next generation of technology, called Broadband, ISDN was developed which uses high-speed communication. The original version of ISDN employs baseband transmission. Let us look at difference between the two.

Baseband communication

A type of digital data transmission in which each medium (wire) carries only one signal, or channel at a time. In contrast, broadband transmission enables a single wire to carry multiple signals simultaneously.

Most communications involving computers uses baseband transmission. This includes communications from the computer to devices (printers, monitors, and so on), communications via modems, and the majority of networks. An exception is B-ISDN networks, which use broadband transmission.

Broadband communication

A standard for transmitting voice, video and data at the same time over fiber optic telephone lines. Broadband ISDN can support data rates in excess of few million bits per second (bps).

The original version of ISDN employs baseband transmission. Another version, called B-ISDN, uses broadband transmission and is able to support transmission rates of 1.5 Mbps and more.

3.3 ISDN SERVICES

There are two basic types of ISDN interfaces:

- Basic Rate Interface (BRI), and
- Primary Rate Interface (PRI).

BRI consists of two 64 kbps B channels and one 16 kbps D channel for a total of 144 kbps. This basic service is intended to meet the needs of most individual users. BRI service is by far the most common and is typically found in homes and businesses alike.

H channels provide a way to aggregate B channels. They are implemented as:

- $H_0 = 384$ kbps (6 B channels)
- $H_{10} = 1472$ kbps (23 B channels)
- $H_{11} = 1536$ kbps (24 B channels)
- $H_{12} = 1920$ kbps (30 B channels) - International (E1) only.

To access BRI service, it is necessary to subscribe to an ISDN phone line. The only limitation to access BRI service is that the customer must be within 18000 feet (about 3.4 miles or 5.5 km) of the telephone company central office for BRI service; beyond that, expensive repeater devices are required, or ISDN service may not be available at all. Customers will also need special equipment to communicate with the phone company switch and with other ISDN devices. These devices include **ISDN Terminal Adapters** and **ISDN Routers**.

In BRI service at an office or a home, the ISDN line consists of the same twisted pair of wires traditionally used for analog telephones. Numerous ISDN devices can connect to this single line.

The BRI line provides two types of ISDN communications channels

- Two “bearer service” B-channels, which carry data and services at 64 Kbps (or 2B channels i.e. 128 Kbps), and
- A single, 16 Kbps D-channel, which usually carries signalling and administrative information used to set up and terminate calls.

Up to eight ISDN devices can be connected to a single BRI line, and can all share the B-channels and D-channel. Individual devices are distinguished through the use of multiple subscriber numbers, with a different ISDN number assigned to each device. D-channel signals automatically route communications to the appropriate ISDN device.

Although only two B-channels are available at any point in time, numerous other calls may be put “on hold” via D-channel signalling, a feature referred to as “**multiple call appearances**”.

PRI is intended for users with greater capacity requirements. Typically the channel structure is 23 B channels plus one 64 kbps D channel for a total of 1536 kbps. (In Europe, PRI consists of 30 B channels plus one 64 kbps D channel for a total of 1984 kbps. It is also possible to support multiple PRI lines with one 64kbps D channel using **Non-Facility Associated Signalling (NFAS)**).

The higher capacity PRI service is a central-site solution for extending applications to large numbers of remote users, who communicate through their BRI connections.

With its BRI and PRI services, ISDN has the flexibility to meet the bandwidth needs of a home office, branch office, or company headquarters. A small office can use ISDN BRI to support all of its voice and data communications requirements. In a larger office, multiple ISDN BRI lines can be divided among multiple users and applications via a server or PBX. And users in a very large office can benefit from ISDN PRI's capacity to provide a large quantity of multiple B channels.

3.4 ADVANTAGES OF ISDN

There are many advantages of ISDN. In this section we will look at them.

- **Speed :** The modem was a big breakthrough in computer communications. It allowed computers to communicate by converting their digital information into an analog signal to travel through the public phone network. There is an upper limit to the amount of information that an analog telephone line can hold. Currently, it is about 56 kbps. Commonly available modems have a maximum speed of 56 kbps, but are limited by the quality of the analog connection and actual speed goes to about 45 kbps. ISDN is a replacement for plain old telephone service, which was never designed to meet the needs of the information age. ISDN allows multiple digital channels to be operated simultaneously through the same regular phone wiring used for analog lines. The major advantage here is that 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. You get ISDN service from the same companies who provide telephone service, and you use it to connect telephones, computers, and fax machines. The difference is that you get much faster, much more dependable connections for voice, data, fax, and even video - all through a single line. BRI ISDN, using a channel aggregation protocol such as BONDING or Multilink-PPP, supports an uncompressed data transfer speed of 128 kbps. In addition, the latency, or the amount of time it takes for a communication to begin, on an ISDN line is typically about half that of an analog line. You can plug an ISDN adapter into a phone jack, like you would an analog modem, and get a much faster connection with no "line noise."
- **Multiple Devices:** Before the advent of ISDN, it was necessary to have a phone line for each device that has to be used simultaneously. For example, one line each was required for a telephone, fax, computer, bridge/router, and live video conference system. Transferring a file to someone while talking on the phone or seeing their live picture on a video screen would require several potentially expensive phone lines. With ISDN, it has become possible to combine many different digital data sources and have the information routed to the proper destination. Since the line is digital, it is easier to reduce the noise and interference while combining these signals. ISDN technically refers to a specific set of digital services provided through a single, standard interface. Without ISDN, distinct interfaces are required instead.
- **Signalling:** It provides a dedicated signal of channel which is common to all B-Channels: This is called Common Channelling Signalling. Instead of the phone company sending a ring voltage signal to ring the bell in your phone ("In-Band signal"), it sends a digital packet on a separate channel ("Out-of-Band signal"). The Out-of-Band signal does not disturb established connections, and call setup time is very fast. For example, a V.34 modem typically takes 30-60 seconds to establish a connection, whereas an ISDN call usually takes less than 2 seconds. The signalling also indicates who is calling, what type of call it is

3.5 ISDN APPLICATIONS

There are many application of ISDN. In this section we will briefly describe about some applications.

- **Internet Access :** Internet access is one of the most popular applications for ISDN. Compared with even the fastest modem access, ISDN makes Web graphics appear almost immediately, and can reduce download times by over 75%. ISDN can even provide advantages over shared, higher-bandwidth office connections.
- **Telephony:** ISDN provides two exceptionally clear, all-digital telephone connections per BRI line. Connections are established in 2 to 4 seconds, versus the 10 to 30 seconds required for analog telephone connections. The digital ISDN telephone sets include microprocessors that can drive features unavailable in regular telephones, such as automated call-back and direct links to computer-based call center applications. The savings in connection establishment time alone can be extremely beneficial. Though 10 to 30 seconds doesn't sound like much, it can mount up quickly in large-scale phone centers. For example, USA, today uses ISDN in its Maryland customer service center. The database links provide the same benefits found in analog-fed CTI systems, but the reduction in connect time has cut an average of 15 seconds each from more than a million calls received each year – that's a total savings of over 4,000 hours, the equivalent of two full-time operators.
- **Telecommuting:** It is the latest buzzword in IT which is described as the modern way of working from home. ISDN has made Telecommuting a reality. With a single ISDN line and an ISDN adapter, telephone, and fax machine, remote professionals can enjoy the same communications capabilities as office-bound workers. Because of the high transmission speed, ISDN succeeds in making remote LAN access seem very much like being locally attached to the LAN. And because a single ISDN line can carry simultaneous data and analog communications, such as telephone calls and faxes, one line can turn the home desktop into an efficient, cost-effective communications center.
- **Video Conferencing:** ISDN also supports videoconferencing. One channel is used for voice, and the other channel is used for the display of moving video pictures. Thus the remote professionals can actually communicate face-to-face with each other. Video conferencing is an emerging ISDN application that's growing fast in popularity, and ISDN is currently the only practical way of making it happen. The ability to transmit quality video and voice across distances used to require very expensive equipment, and costly leased lines, that were justified only by the most rigorous needs in the largest of companies. And because they depended on leased lines, those video conferencing solutions were point-to-point; a headquarters facility could be linked to satellite facilities, for example, but video conferencing on the scale of teleconferencing was simply impractical.

ISDN, along with new, lower-cost hardware, is changing that - rapidly. Both desktop video conferencing (where a participant joins from a PC equipped with ISDN, a video camera, and a microphone), and conference room video conferencing (where more sophisticated equipment such as remote control cameras allow group participation) have become as easy to set up as voice conferencing. And because of ISDN's versatility, video conferences can include the sharing of documents, images, and other

files with all participants, through file transfers or screen display. This capability is proving highly popular for workgroup collaboration, telecommuting, security and surveillance, and dozens of highly innovative applications.

For general business use, ISDN video conferencing can make meetings much more practical and productive. There is far less travel time and expense involved, as participants no longer need to physically congregate. That also makes scheduling much easier. And since participants are typically at their own offices, video conferencing means everyone has access to their computers and file cabinets for information during the meeting. Other people can also be called into the meeting as needed.

- **Education:** “Distance learning” can be thought of as telecommuting for students. And just as ISDN has made telecommuting a reality for thousands of professional workers, it is making distance learning a practicality for groundbreaking public and private grade schools, high schools, and colleges throughout North America. Computer-based, interactive voice, data, image, and video can go a long way toward helping students who are unable to physically visit a classroom to participate in the learning experience. For example, the College of Education at Ohio State University links elementary schools in the Appalachian region to the university via ISDN, bringing advanced courses to even the most remote locations. At Michigan's Upper Peninsula Intermediate school district, students who formerly travelled up to 80 miles to school now attend 11 local facilities to participate in a full roster of classes, delivered by ISDN. There are many additional examples of similar successful programs throughout the U.S.
- **Large-scale file transfers:** As computer applications have become increasingly graphically oriented, PC communications have the ability, more than ever, to include the pictures, sounds, and even full-motion video that enable people to show rather than just tell. Before ISDN, it wasn't practical to communicate this way over distance - downloading a 1-megabyte file with even the fastest modem takes several minutes. With ISDN's faster speed and compression, it takes seconds.

If you've ever encountered a Web site that features a video clip you're supposed to watch on your screen, you understand the limits of modems in multimedia communications. With ISDN, however, multimedia is going to be practical. Many organizations are beginning to turn to imaging systems to store documents, rather than keeping endless files of paper. Once a document has been scanned, it is a graphical file that can be viewed on a computer screen. To transmit it to someone requires the bandwidth of ISDN, and ISDN is becoming very popular with publishers, banks, photo agencies, hospitals, police departments, manufacturers, government agencies, and countless other industry segments that are driven by digitally stored documents that need to be sent to others.

Check Your Progress 1

1. Define ISDN.

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2. Differentiate between baseband and broadband communication.

Integrated Services
Digital Network (ISDN)

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3. List down a few applications of ISDN.

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3.6 SUMMARY

In this unit we covered the following topics related to ISDN:

1. ISDN stands for *Integrated services digital network*. It is an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires.
2. ISDN supports data transfer rates of 64 Kbps and its multiples. Most ISDN lines offered by telephone companies give two lines at once, called **Bearer channels or B- channels**.
3. Baseband communication is a type of digital data transmission in which each medium (wire) carries only one signal, or channel, at a time.
4. Broadband communication is a standard for transmitting voice, video and data at the same time over fiber optic telephone lines.
5. ISDN provides two types of services:
 - Basic Rate Interface (BRI) and
 - Primary Rate Interface (PRI).
6. Basic Rate Interface consists of two 64 kbps B channels and one 16 kbps D channel for a total of 144 kbps. BRI service is by far the most common and is typically found in homes and businesses alike.
7. Primary Rate Interface is intended for users with greater capacity requirements. Typically the channel structure is 23 B channels plus one 64 kbps D channel for a total of 1536 kbps. (In Europe, PRI consists of 30 B channels plus one 64 kbps D channel for a total of 1984 kbps. It is also possible to support multiple PRI lines with one 64 kbps D channel using **Non-Facility Associated Signalling (NFAS)**).
8. ISDN is a replacement for plain old telephone service, which was never designed to meet the needs of the information age. ISDN allows multiple digital channels to be operated simultaneously through the same regular phone wiring used for analog lines. The major advantage here is that the telephone company's switches can support digital connections.

9. With ISDN, It has become possible to combine many different digital data sources and have the information routed to the proper destination.
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3.7 SOLUTIONS/ANSWERS

Question 1:

ISDN stands for *Integrated services digital network*. It is an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires. This system allows data to be transmitted simultaneously across the world using end-to-end digital connectivity.

Question 2:

1. Baseband communication: It is a type of digital data transmission in which each medium (wire) carries only one signal, or channel, at a time. The original version of ISDN employs baseband transmission.
2. Broadband communication: It is a standard for transmitting voice, video and data at the same time over fiber optic telephone lines. Broadband ISDN can support data rates of 1.5 million bits per second (bps), but it has not been widely implemented. B-ISDN uses broadband transmission and is able to support transmission rates of 1.5 Mbps.

Question 3:

A few applications of ISDN are:

1. Telephony
2. Fast internet access
3. Videoconferencing
4. Distance Education
5. Large-scale file transfers
6. Telecommuting.