Section 2: An Introduction to ISDN

Objectives

After successfully completing this section, you will be able to answer questions such as these:

- How did the need for ISDN arise?
- Who is the ITU, and why did they create ISDN standards?
- What are the advantages of digital technology?

1. The ISDN Goal

The overall purpose of ISDN is to develop a single set of standards for digital communication (voice, data, and video) in local networks. A top priority of ISDN is to standardize those parts of telecommunications that integrate analog with digital signals voice with computer data communications into a single, purely digital system of transmission. Another essential concern is to standardize interfaces between types of equipment that perform diverse tasks.

The creation of a standard for a single communication network was an original goal of ISDN. ISDN would replace the current hodgepodge of analog and digital networks with a single set of network standards, limited enough to assure compatibility between different kinds of equipment, but flexible enough to serve a wide range of applications. In recent years, this goal has been modified. ISDN is now considered one of several digital communications services. ISDN is useful for specific applications and flexible enough to work with other digital communications services.

You must keep in mind that ISDN is not a technology. It is a set of rules that govern the functions that the technology must perform and the standards that it must meet. How the functions get performed and what types of hardware and software will perform them is left entirely to the design engineers.

Before we can talk about ISDN, we have to review the background of the communication industry to understand which forces drove the need for a digital communications network.

- What sort of signal must be communicated?
- How has it been communicated?
- How should it be communicated, and who will decide?

As you consider these questions, you will begin to get a feeling for the forces that gave rise to ISDN's creation.

The Telephone Companies

In Europe, many telephone networks were destroyed by the Second World War. Thus, current networks date back to the years immediately following the war when they were rebuilt. After that, new technology was rarely implemented. The post telephone & telegraph administration (PTT) in each country was content with maintaining the existing system.

By the late 1970s, however, it became clear that maintaining an old system was no longer cost-effective. Also, the PTTs recognized that modern telecommunications was important for economic growth as the European Economic Community continued to develop. The old system would have to be replaced.

In Asia, the situation was different. The booming Pacific Rim countries had never had an effective telephone system. But like their European counterparts, leaders in industry and government realized that if they wished to become competitive in the world market, an effective communication system must be built. In both Europe and Asia, leaders realized that they had a unique opportunity to prepare for the future.

Joining them were the American telecommunications companies (telcos) and vendors. While current systems in the U.S. were not yet obsolete, many aging analog switches would soon need to be replaced. Meanwhile, customers were demanding faster services and more features than an analog system could economically provide. The industry agreed that new equipment would be digital.

Here and abroad, in government and in industry, everyone recognized that there was more at stake than simply a new telephone system. The growing international market, combined with the popularity of the microcomputer, required a whole new concept in telecommunications. Worldwide-compatible digital systems would replace analog systems. An important piece of the new digital networks is based on the ISDN standards.

Standards and the ITU

Standards are a set of rules by which a technology must abide. A manufacturer who designs hardware or software for a technology must follow standards to ensure compatibility with other manufacturers. There is a standard for electrical plugs in the United States—imagine how difficult it would be if every manufacturer designed its own type of plug.

A United Nations body, the International Telecommunications Union, or ITU, formally known as the CCITT, sets telecommunications standards. Such standards are voluntary, but since national governments and individual corporations have the opportunity to offer their viewpoints, most recognize the advantage of supporting these standards. ANSI (the American National Standards Institute) is the standards-making body that provides the United States' official input to the ITU. ANSI works through the state department and is a leading standards-making body within the United States. Other standards groups that affect how we implement ISDN include BellCore (a telecommunications research and development corporation) and the IEEE (Institute for Electrical and Electronics Engineers).

In the 1970s, European and Asian organizations, supported by North American telcos, proposed that the ITU develop standards for the digital integration of voice, data, and video communications. The first set of what we now know as ISDN was published in 1980.

Digital technology continues to develop at an explosive rate. The committees that provide input to ITU have had to work fast to ensure that standards will be in place when a new digital communications technology is ready to be implemented. ITU publishes updated ISDN standards every four years.

ISDN is a continuously evolving set of standards that governs the implementation of an integrated digital network of voice, data, and video communications. These standards ensure compatibility among the many manufacturers of digital communication equipment. ISDN standards address all aspects of digital communication. The standards are open and flexible allowing the individual hardware manufacturer, software developer, or network services provider to interpret certain areas.

As you continue to learn about ISDN and its implementation, keep these points in mind:

- ISDN provides access over a single digital line to voice, data, or video communications.
- ISDN supports flexible, user-controlled communication over a digital network.
- ISDN is a set of standards for local end-to-end digital communications.

The Nature of the Signal: Analog vs. Digital

The human voice is analog. Until now, the job of a telecommunications network has been to transmit analog signals as accurately as possible. The human voice, as represented by an analog signal, consists of a continuously fluctuating number of physical variables. These variables include volume and pitch. As the human voice fluctuates in volume and pitch, the corresponding analog signal fluctuates in frequency and amplitude to reproduce all the physical variables of the human voice. In contrast, a digital signal has a fixed frequency and amplitude and translates physical variables into a binary number. Binary numbers are made up of only 1s and 0s. (See figure 2.1.)

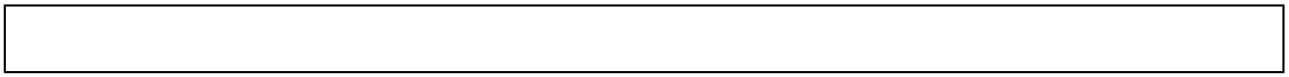

Figure 2.1

These values are also referred to as states, 1 for the on state and 0 for the off state, much like a light switch that is either on or off. Digital equipment translates an analog signal to digital by sampling the signal thousands of times per second. Each sample measures the frequency and amplitude of the analog signal at a particular point in time and translates the variables into a binary number. Sampling is like taking thousands of snapshots of the signal where each snapshot represents an eight-bit binary code (00101100). At the other end of the telephone connection, the binary code is translated back into a human voice. (See figure 2.2.)

Figure 2.2

Digital technology makes it more efficient to translate analog signals into digital equivalents for switching and transmission. The equipment involved in switching and transmission have to work with only two variables, 1 and 0 or on and off, rather than the greater number of variables inherent in an analog signal. This increased efficiency supports a better overall signal quality in

comparison to analog. All signals transported over wire degrade over distance and are subject to a certain amount of interference or noise. Due to degradation and interference, signals require a boost in order to get from one phone to another. Boosting an analog signal also boosts the noise it picks up along its route. Instead of using amplification to transmit a digital signal over distance, a method is used that reconstructs the incoming signal and retransmits that signal to its destination. By reconstructing just the signal and not the noise, the data arrives at the destination essentially in its original state. The efficiency of digital switching and transmission also supports signal correction. If a part of the signal isn't received at the other end of the connection exactly as it was sent, that part is resent until it's properly received. This correction process happens so quickly that it is undetectable to the person on the receiving end.

Over a digital network designed according to ISDN standards, the analog to digital translation process converts a human voice to a digital signal at the telephone and carries it to the network for transmission. The signal is then sent through the PSTN in the traditional way. That way an ISDN user can carry on a conversation with a non-ISDN user without any problems. (The MasteryPOINT module, *Digital Telecommunications Technology*, explains these conversions in detail.)

Data Communications

Until recently, businesses have rarely mixed data communication with voice communication; thus analog and digital systems in telecommunications networks have not conflicted. Two separate networks served two separate functions. The functional requirements of the networks were different, and the technologies used to meet these requirements were also different. Today, networks designed to provide voice communications have been pressed into data communications service. Businesses, homes, and schools frequently need to support phone conversations with computer outputs. The results have not always been satisfactory, but the need continues to rise.

Suppose you want to transfer information from your computer at home to a computer at your office. In most cases, you have one of four choices.

1. Copy the information to a diskette and carry it to the other computer.

2. Use the analog public switched telephone network (PSTN) to connect to the other computer. A modem converts your computer's digital information into an analog signal. It is transmitted through the public network, decoded with a modem at the other end, and then fed into the other computer.

3. Use the same process with a private analog line. Businesses usually lease private lines from a telco. These phone lines are dedicated to the sole use of the business and are not accessible to the public. For many customers, this arrangement can be too costly.

4. Use a private digital line. The situation is the same as example 3 but uses an end-to-end digital connection. This too can be costly for the occasional user. No digital conversion is needed.

Now that many desks hold both a computer and a phone, why can't we put both on the same network? If that can be done, why not have it work on the PSTN? The gain would be full use of a reliable public network without the costs of the private line. A disadvantage would be the loss of security and control that a private line can provide. Of the four options just described, the fastest and most reliable one is a digital private line. There is a fifth optionÑdigital dial-up.

5. With digital dial-up, a switched network replaces dedicated lines. When two computers communicate through the network, control signals sent to the switch tell the switch to connect the computers. Switching eliminates dedicated lines and can make networks very efficient. Digital dial-up, like a private digital line, offers end-to-end digital connection. Two versions are available:

   — Switched digital service, offered by the telco, is a private voice/data dial-up service. It uses the telco's lines and switches. Telco networks are designed to be broadly useful, particularly for analog voice communication. It is more difficult to optimize a telco's switched digital service to meet the needs of a private network.

   — Private switched digital service is similar. The user provides the switch and some of the lines. Other lines may be leased from the telco. Currently, this version is more powerful because private networks and data-only switches can be designed to meet the specific needs of the network owner. The downside is that this service may not be universal.

Often, the digital dial-up offered by the telcos is based on ISDN. Growth in this segment of the telecommunications market indicates strong potential for ISDN-based services.

For the company that needs fast data transfer, some form of private-line network is best. The network will be as simple as possible to manage, dedicated to the company's exclusive use and designed to meet the company's specific needs. But that results in at least two sets of telecommunications lines—a private line for data (and perhaps voice communication within a limited network) and a separate set of lines providing access to the PSTN.

Summary

- a single communication network. ISDN would replace thTelephone network providers and equipment vendors have been working to find the best compromise for the integration of voice and data communications in terms of control, cost, and security. Many view the ISDN standards as an answer.

- ISDN, or integrated services digital network, was developed to create a single set of standards for digital communication (voice, data, and video).

- It is important to remember that ISDN is not technology or equipment; it is the standard that governs the functions that the technology must perform and the standards that it must meet.

- ISDN-based digital telephone communication is more efficient than analog communication. The equipment used to switch and transmit a digital signal has to handle only two variables instead of the continuously fluctuating variables of an analog signal.

Progress Check

1. What does ISDN stand for?

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_____

Answer: integrated services digital network

2. What new technology influenced the need for digital communication?

A. Fax Machines

B. Video Conferencing

C. Computers

D. Modems

Answer: C

3. What is the purpose of ISDN standards?

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_____
_____
_____

Answer: ISDN standards ensure compatibility among many manufacturers who will design hardware and software for this technology.

4. The ITU is a part of what organization?

A. The state department

B. The Institute of Electrical and Electronic Engineers

C. The European Economic Community

D. The United Nations

Answer: D

5. What standards-making body provides input to the ITU for the United States?

A. BellCore

B. ANSI (American National Standards Institute)

C. IEEE (The Institute of Electrical and Electronic Engineers)

D. North American telcos

Answer: B

6. What is ISDN?

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Answer: A set of standards that govern the implementation of an integrated digital network of voice, data, and video communication.

7. Over an ISDN-based connection, where does analog to digital translation occur?

A. At the modem

B. At the switch

C. At the users' phones

D. Translation is not necessary.

Answer: C

8. What are the components of a digital signal?

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Answer: 1s and 0s or an on state and an off state.

9. Why is ISDN-based digital telephone communication more efficient than analog telephone communication?

_____
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Answer: The equipment used to switch and transmit a digital signal has to handle only two variables instead of the continuously fluctuating variables of an analog signal.

10. What two versions of digital dial-up are available?

A. Dedicated digital and public digital

B. Switched and public switched

C. Private digital and public digital

D. Private switched and switched

Answer: D