

Data Communication

Bachelor in Computer Engineering

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Unit 1: Introduction

- Outline:
- Evolution of Data Communication System
- Analog and Digital Data Transmission
- Data Communication Terminology
- Standards Organizations, Applications

Evolution of Data Communication System

- According to the History of Computing organization, data communication has its earliest roots in Samuel Morse's 1837 exhibition of a telegraph system.
- An account of data communication history posted by telecommunications experts at General Telecom, LLC also points to a telegraph patent that inventor Charles Wheatstone filed that same year.
- By 1843, telegraph service had become adopted by the Great Western Railway, an endorsement that allowed the service to expand across the nation.
- Improving on the telegraph, according to the History of Computing, Alexander Graham Bell introduced the telephone in 1876.
- Though standard telephone lines did not carry data traffic until nearly a hundred years later, the development of early telecommunications—coupled with an 1895 invention by Guglielmo Marconi, the radio—laid the groundwork for numerous subsequent developments in communication technology.

Evolution of Data Communication System

- In 1947, Bell Labs introduced the transistor, a device that found integration in myriad subsequent electronic products.
- The U.S. government expanded on these technologies in 1958 with its launch of a communication-oriented satellite, and the first facsimile transmission over standard telephone lines occurred four years later.
- In **1975**, fiber optic cables were used to link computers together in the NORAD headquarters, located in Colorado.
- It wasn't until 1996 that the first fully optic fiber cable was buried deep within the Pacific Ocean, which allowed for the Internet as we know it today to be a possibility.

Evolution of Data Communication System

- Data Communication is a process of exchanging data or information
- In the case of computer networks this exchange is done between two devices over a transmission medium.
- This process involves a communication system that is made up of hardware and software.
- The hardware part involves the sender and receiver devices and the intermediate devices through which the data passes.
- The software part involves certain rules which specify what is to be communicated, how it is to be communicated, and when.
- It is also called a Protocol.

Introduction

- The communication process involves—the sender of information, receiver of information, language used for communication, and the medium used to establish the communication.
- Communication between computers also follows a similar process.
- Data communication refers to the exchange of data between a source and a receiver via the form of transmission media such as a wire cable.
- A data communication system has five components:
- Message, Sender, Receiver, Transmission Medium, and Protocol.

Introduction

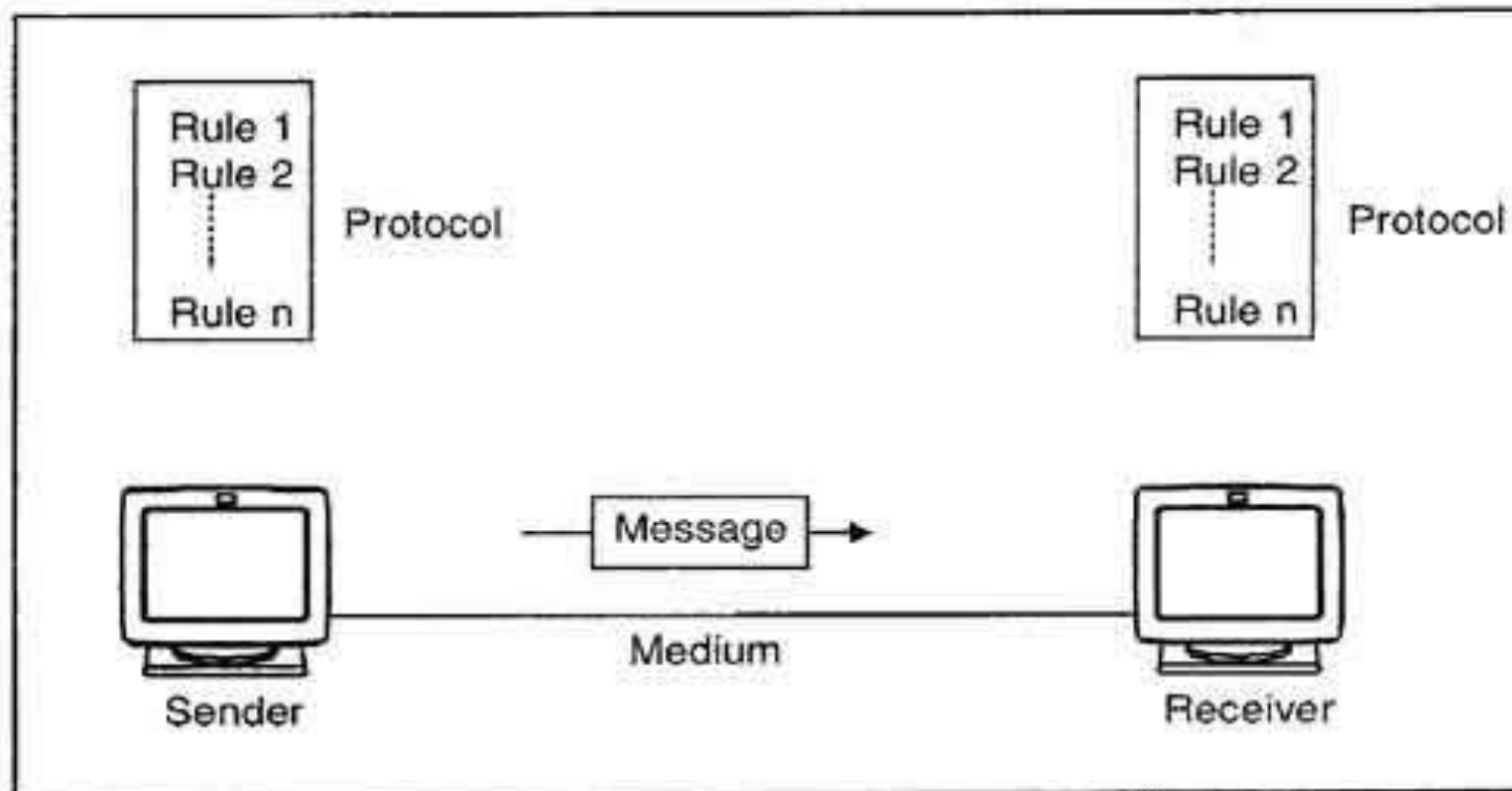


Fig: Data Communication model

Introduction

- Message: The message is the information (data) to be communicated.
- Popular forms of information include text, numbers, pictures, audio, and video.
- Sender: The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
- Receiver :The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
- Transmission medium :The transmission medium is the physical path by which a message travels from sender to receiver.
- Some examples of transmission media include twisted-pair wire, coaxial cable, fiberoptic cable, and radio waves
- Protocol :A protocol is a set of rules that govern data communications.
- It represents an agreement between the communicating devices.

Data Communication Terminology

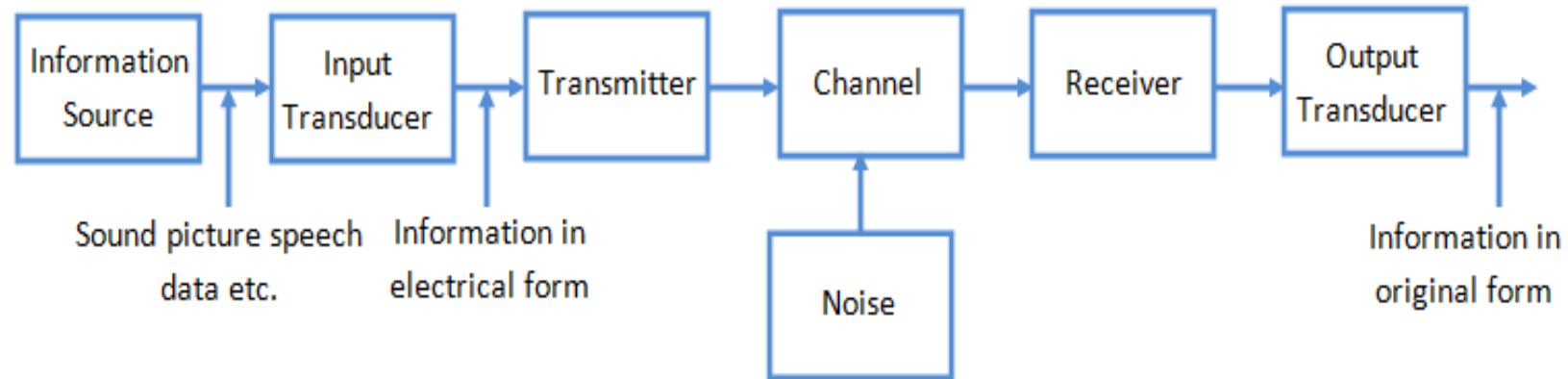


Fig: Block Diagram Of Data Communication System

Data Communication Terminology

- **Information Source**

- As we know, a communication system serves to communicate a message or information.
- This information originates in the information source.
- In general, there can be various messages in the form of words, groups of words, code, symbols, sound signals, etc.

- **Input Transducer**

- A transducer is a device that converts one form of energy into another form.
- The message from the information source may or may not be electrical in nature.
- In a case when the message produced by the information source is not electrical in nature, an input transducer is used to convert it into a time-varying electrical signal.
- For example, in the case of radio broadcasting, a microphone converts the information or message which is in the form of sound waves into a corresponding electrical signal.

Data Communication Terminology

- **Transmitter**
- The function of the transmitter is to process the electrical signal from different aspects.
- For example in radio broadcasting the electrical signal obtained from the sound signal, is processed to restrict its range of audio frequencies (up to 5 kHz in amplitude modulation radio broadcast) and is often amplified.
- In wire telephony, no real processing is needed. However, in long-distance radio communication, signal amplification is necessary before modulation.
- Modulation is the main function of the transmitter.
- In modulation, the message signal is superimposed upon the high-frequency carrier signal.

Data Communication Terminology

- **The Channel and The Noise**
- The term channel means the medium through which the message travels from the transmitter to the receiver.
- In other words, we can say that the function of the channel is to provide a physical connection between the transmitter and the receiver.
- During the process of transmission and reception the signal gets distorted due to noise introduced in the system.
- Noise is an unwanted signal which tends to interfere with the required signal.
- Noise signal is always random in character.
- Noise may interfere with the signal at any point in a communication system. However, the noise has its greatest effect on the signal in the channel.

Data Communication Terminology

- **Receiver**
- The main function of the receiver is to reproduce the message signal in electrical form from the distorted received signal.
- This reproduction of the original signal is accomplished by a process known as demodulation or detection.
- Demodulation is the reverse process of modulation carried out in the transmitter.
- **Destination**
- Destination is the final stage which is used to convert an electrical message signal into its original form.
- For example in radio broadcasting, the destination is a loudspeaker that works as a transducer i.e. converts the electrical signal into the form of the original sound signal.

Analog Transmission

- Analog transmission consists of sending information over a physical transmission medium in the form of a wave
- In an analog transmission system, signals propagate through the medium as continuously varying electromagnetic waves.
- Data is transmitted via a carrier wave, a simple wave whose only purpose is to transport data by modification of one of its characteristics (amplitude, frequency or phase), and for this reason analogue transmission is generally called carrier wave modulation transmission.

Analog Transmission

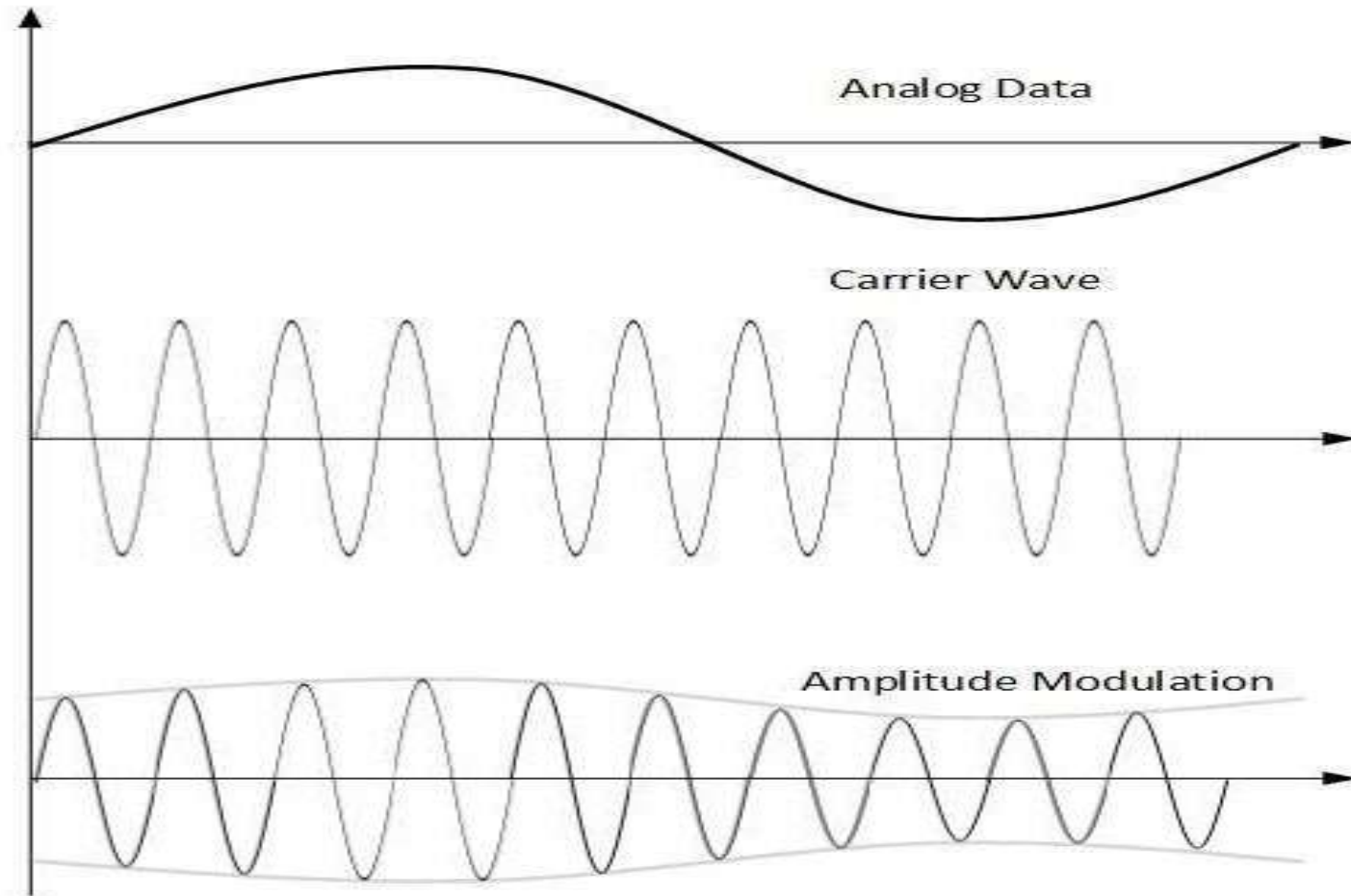


Figure : Analog Data Transmission

Digital Transmission

- Digital transmission is the sending of information over a physical communications media in the form of digital signals.
- Transmission of signals that vary discretely with time between two values of some physical quantity, one value representing the binary number 0 and the other representing 1.
- Digital signals use discrete values for the transmission of binary information over a communication medium such as a network cable or a telecommunications link.
- On a serial transmission line, a digital signal is transmitted 1 bit at a time.

Digital Transmission

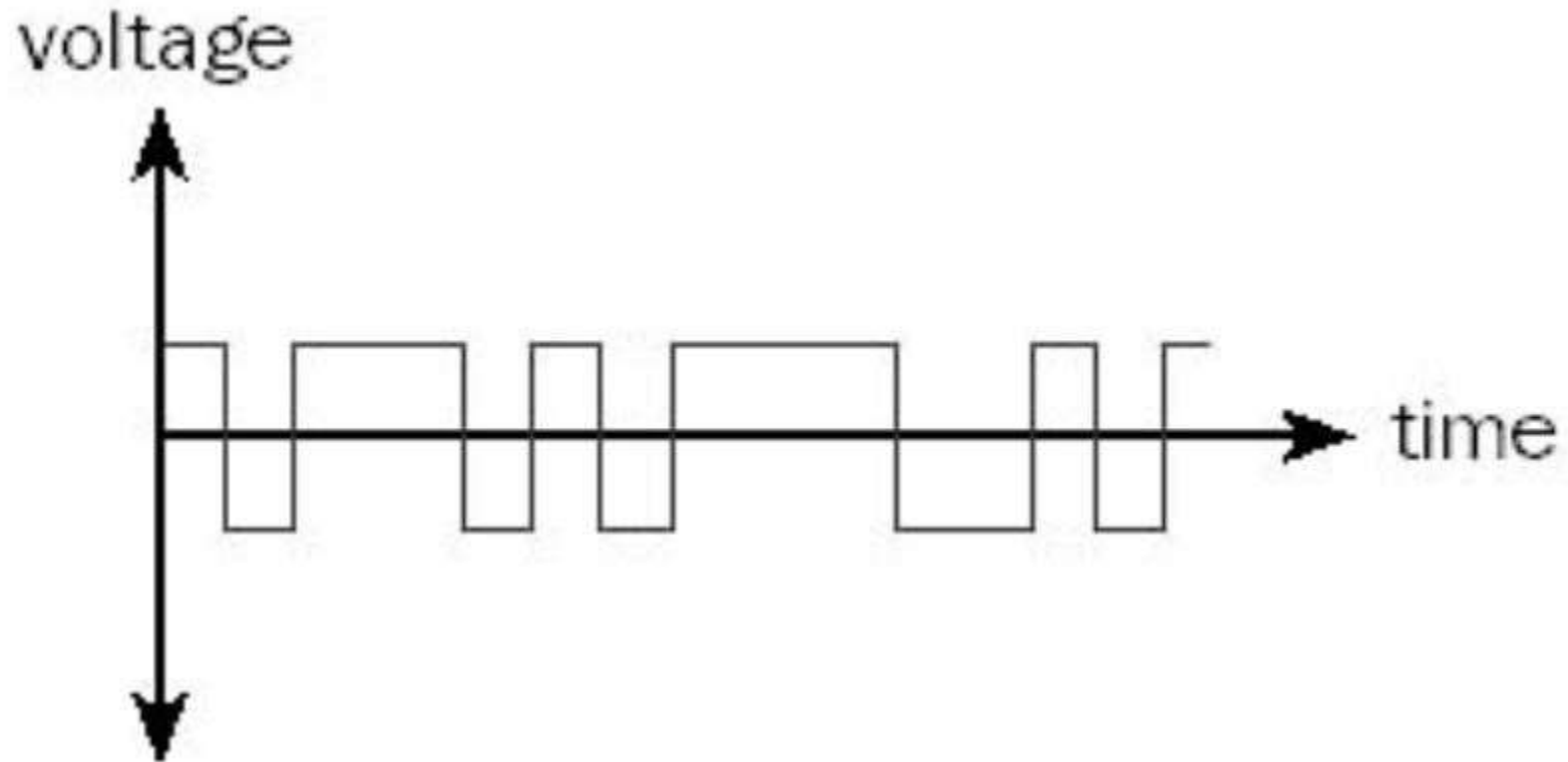


Figure : Digital Data transmission

Analog and Digital Transmission

Feature	Analog Characteristics	Digital Characteristics
Signal	Continuously variable, in both amplitude and frequency	Discrete signal, represented as either changes in voltage or changes in light levels
Traffic measurement	Hz (for example, a telephone channel is 4KHz)	Bits per second (for example, a T-1 line carries 1.544Mbps, and an E-1 line transports 2.048Mbps)
Bandwidth	Low bandwidth (4KHz), which means low data transmission rates (up to 33.6Kbps) because of limited channel bandwidth	High bandwidth that can support high-speed data and emerging applications that involve video and multimedia
Network capacity	Low; one conversation per telephone channel	High; multiplexers enable multiple conversations to share a communications channel and hence to achieve greater transmission efficiencies
Network manageability	Poor; a lot of labor is needed for network maintenance and control	Good; smart devices produce alerts, alarms, traffic statistics, and performance

Standards Organizations

- **Standards**
- Standards are necessary for networking to ensure interconnectivity and interoperability between various networking hardware and software components.
- Without standards we would have proprietary products creating isolated islands of users that cannot interconnect.
- Standards provide guidelines to product manufacturers and vendors to ensure national and international interconnectivity.
- Data communications standards are classified into two categories:
- **De facto Standard**
- **De jure standard**

Standards Organizations

- **De facto Standard**
 - These are the standards that have been traditionally used and meant **by fact** or **by convention**.
 - These standards are not approved by any organized body but are adopted by widespread use.
- **De jure standard**
 - It means by **law** or **by regulation**.
 - These standards are legislated and approved by a body that is officially recognized.

Standards Organizations

- **Standard Organizations**
- Standards are created by standards creation committees, forums, and government regulatory agencies.
- **Examples of Standard Creation Committees :**
- International Organization for Standardization(ISO)
- International Telecommunications Union –Telecommunications Standard (ITU-T)
- American National Standards Institute (ANSI)
- Institute of Electrical & Electronics Engineers (IEEE)
- Electronic Industries Associates (EIA)

Applications

- Airline reservation system
- Automatic teller machine
- Sales order entry
- Unstructured data application
 - Electronic mail
 - Simple mail transfer protocol (SMTP)
 - Multipurpose Internet mail extensions (MIME)
- Image application
 - Facsimile (FAX)
 - Television

Applications

- Internet
 - Browser program
 - Netscape's Navigator
 - Microsoft's Internet Explorer
 - Uniform Resource Locator (URL)
 - World Wide Web (WWW)
 - Hypertext transfer protocol (HTTP)
 - Internet service provider (ISP): tier 1, tier 2, tier 3
- Intranet
- Extranet

THANK YOU