Unit 1- Part 1
Introduction to Data communications and Networking

Note: This notes are for reference only. This is **not the only material** you need to refer for exam.

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Introduction to Data Communication & Networking

- Communication can be defined as exchange of information between two humans.
- Data communication can be defined the exchange of information between two computers.
- One computer (sender) can send a message to another (receiver) computer over a wire called Transmission Medium as shown in figure:

Introduction to Data Communication & Networking

- Message: Information(data) to be communicated
- Sender
- Receiver
- Transmission medium: Physical path by which a message travels
- Protocol: A set of rules that govern data communication
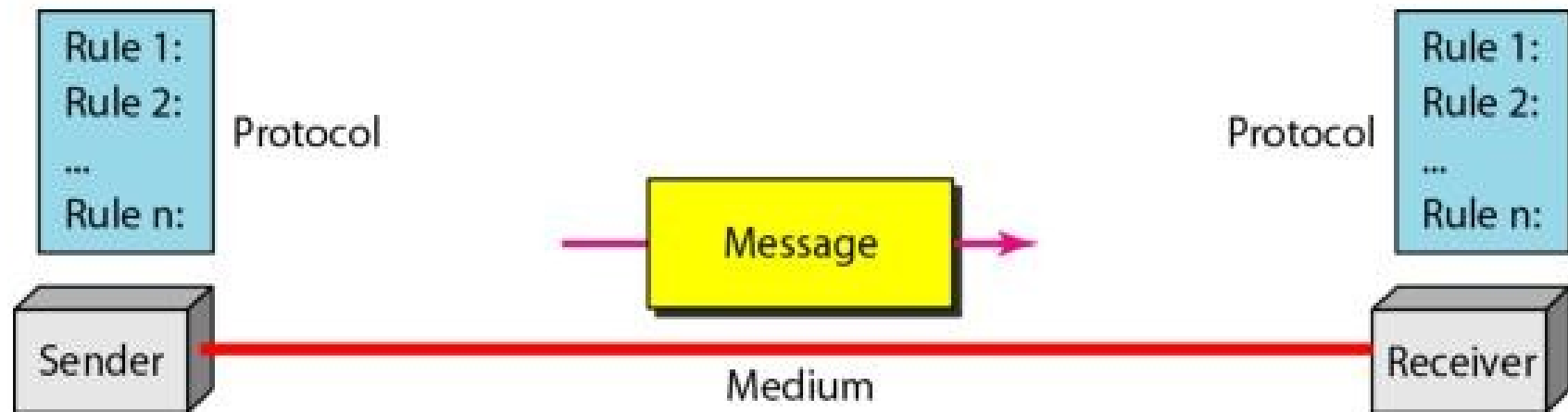
Introduction to Data Communication & Networking

- **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, fiber-optic cable, and radio waves.
- **Protocol:**
A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

Introduction to Data Communication & Networking

Real-life Data Communication Systems
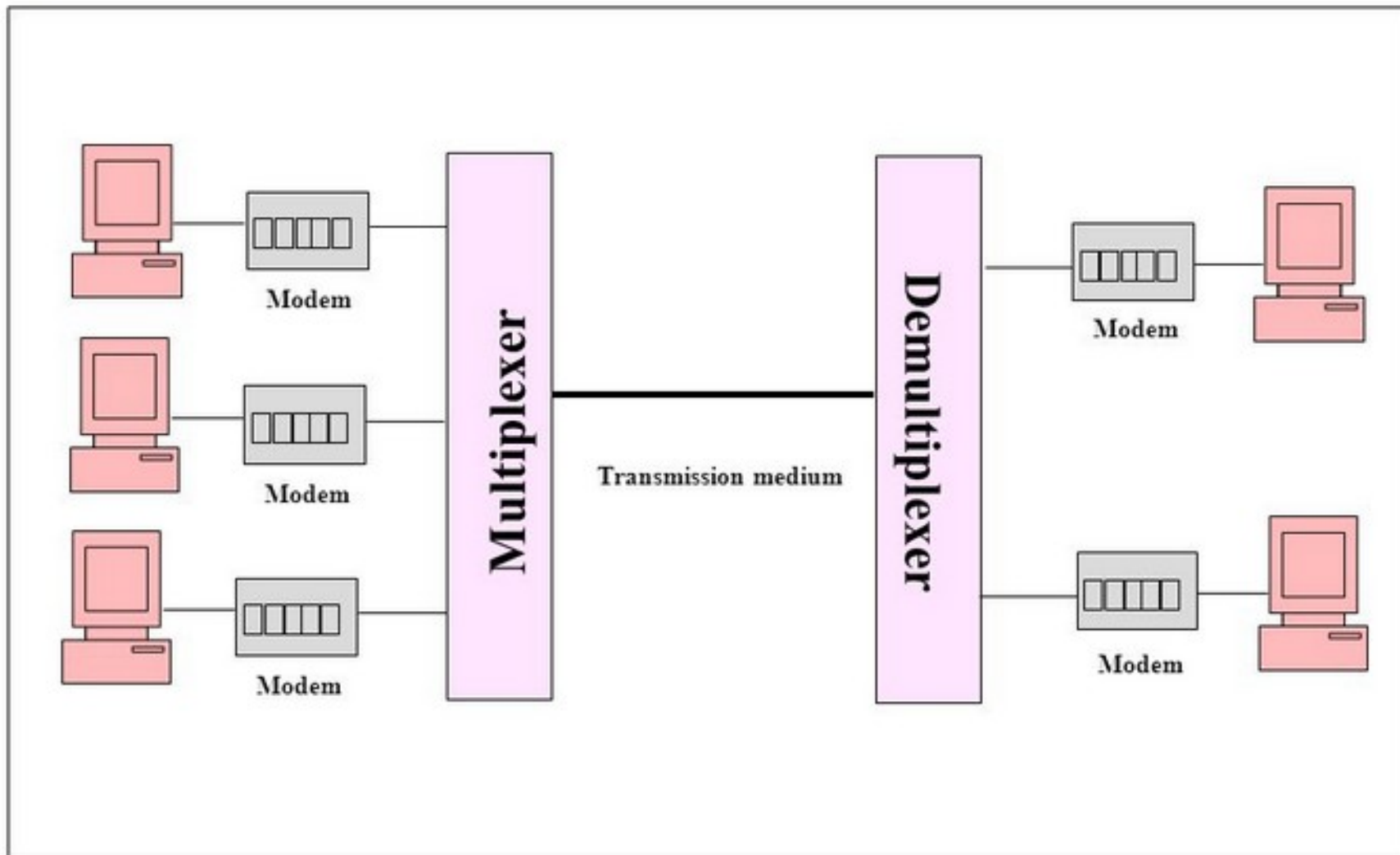
Introduction to Data Communication & Networking

- **Modem:** A modem is connected to every computer that is involved in data commnication.

- **Multiplexer and Demultiplexer:** The main function of the multiplexer is that it combines input signals, allows data compression, and shares a single transmission channel.
- A multiplexer is a circuit that accept many input but give only one output. A demultiplexer function exactly in the reverse of a multiplexer, that is a demultiplexer accepts only one input and gives many outputs. Generally multiplexer and demultiplexer are used together, because of the communication systems are bi directional.

- **Transmission medium:** Transmission medium or wire is the means of transferring data from sender to the receiver. Modern data communication can also be wireless.

Introduction to Data Communication & Networking

- The data communication involves exchange of data between two comptuers. computer works with the binary language of zeros and ones. Therefore, one computer generates a stream of zeros and sends it to another computer to which it is connected in some fashion.
- For enabling data communication, a combination of hardware and software is essential.
- Following are the characteristics of data communication system:

  - **Correct delivery:** When a sender transmits data for an intended recipient, the data must reach only the intended recipient and not someone else.
  - **Accurate delivery:** The data sent must be received in the same form as the one in which it was sent. There must not be any sort of alternations to it in transit.
  - **Timely delivery:** The data must travel from the sender to the receiver in a finite amount of time. The term finite is quite vague, and would depend on the reasons why the data communication is taking place.

Protocol

- Two key aspects of data communication systems need a good amount of understanding.
  - **Transmission media:** the physical path over which data travels from the sender to the receiver. Ex: twisted-pair of copper wires, coaxial cable, optical fiber or wireless media such as radio waves.

  - **Protocol:** a set of rules and conventions. Ex: The sender and the receiver, the two key parties in data communication must agree on a common set of rules, i.e. protocols before they can communicate with each other.

    - **The protocol defines following:**
      - Syntax (What is to be communicated?)
      - Semantic (How it is to be communicated?)
      - Timing (When it should be communicated?)

Protocol

- **Syntax (What is to be communicated)–** The syntax defines the structure or format of data. This means that the order in which it is to be sent is decided. For instance, a protocol could define that the first 16 bits of a data transmission must always contain the receiver's address.

- **Semantics (How it is to be communicated) –** The semantics define the interpretation of the data that is being sent. For example, the semantics could define that if the last two bits of the receiver's address field contain a 00, it means that the sender and the receiver are on the same network.

- **Timing (When it should be communicated) –** This refers to an agreement between the sender and the receiver about the data transmission rates and duration. For instance, a protocol could demand that the sender must send 1000 bytes and then wait for an acknowledgement from the receiver before sending any more data.

Standards

- **Standards**
- Standards are necessary in every walk of life. For instance, when you want to replace a light bulb in your home because it has been damaged, you expect the new bulb to fit in the holder straightaway and work like the old bulb did. What is the use if the bulb does not fit in the holder, or if it fits in the holder but does not illuminate because it requires a different voltage level?

- Data communication standards are classfied into two categories:
  - **De facto**
  - **De Jure**

Standard

- **De facto Standard**
- Standards developed by a private company which are used widely as a result of the choices of consumers.
- Are adopted widely by an industry and its customers. They are also known as market-driven standards.
- Eg: Something that is used so widely that it is considered a standard for a given application although it has no official status.(Driving seats)

- De facto standards can be divided into proprietary and non-proprietary.
- **Properitary** - Closed proprietary standards are owned by a single company. Only that company's customers and partners are allowed to use them. Competitors are banned from implementing products that use closed proprietary standards.
- **Non- Proprietary** - Open proprietary standards also are owned by a single company, yet the company allows anyone to use them.

Standard

De jure Standard
- De jure means according to "Law and Regulation."
- Standards registered at a recognized standards organization such as the International Electrotechnical Commission (IEC) and the International Telecommunication Union (ITU), The International Organization for Standardization (ISO) etc.
- They are endorsed by a formal standards organization. The organization ratifies each standard through its official procedures and gives the standard its stamp of approval.

Analog and Digital Signal

- **Analog and Digital Signal**
- Analog and digital signals are used to transmit information, usually through electric signals.
- Analog signals are signals with continuous values in both time and value.
- Digital signals are discrete in time and value where we have nothing or something. Digital signals are signals that are represented by binary numbers, "1" or "0".
- **The difference between analog and digital technologies is that in analog technology, information is translated into electric pulses of varying amplitude. In digital technology, translation of information is into binary format (zero or one).**
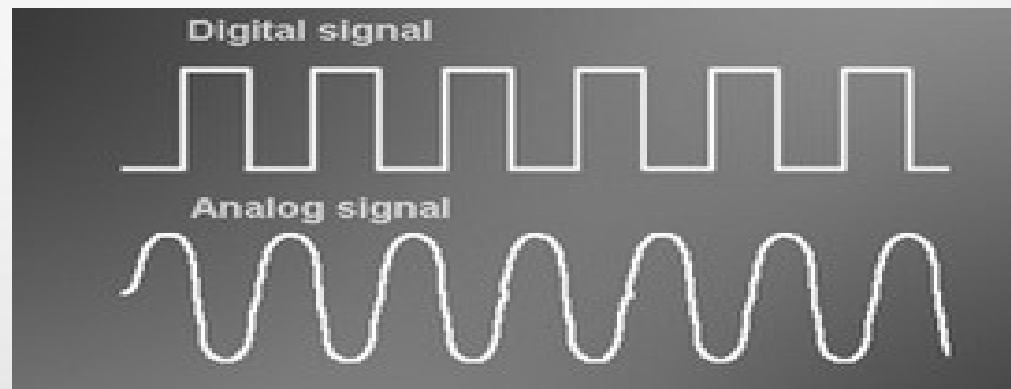
Bandwidth
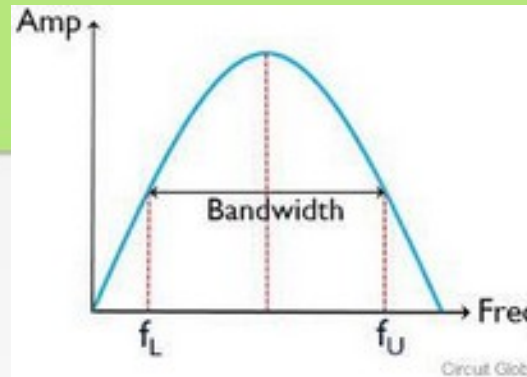
- **Bandwidth**
- **Bandwidth** describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time.
- The **bandwidth** of a composite signal is the difference between the highest and the lowest frequencies contained in that signal.
- A strength of the signal at any point is known as **amplitude**.
- Time taken for the completion of one cycle is called **period**.
- The number of cycle or periods a signal completes in one second called **frequency**.
- In analog transmission (such as of voice signals) bandwidth is measured in cycles per second (or Hertz)
- In digital transmission (such as of data from one computer to another) bandwidth is measured in bits per second (BPS).
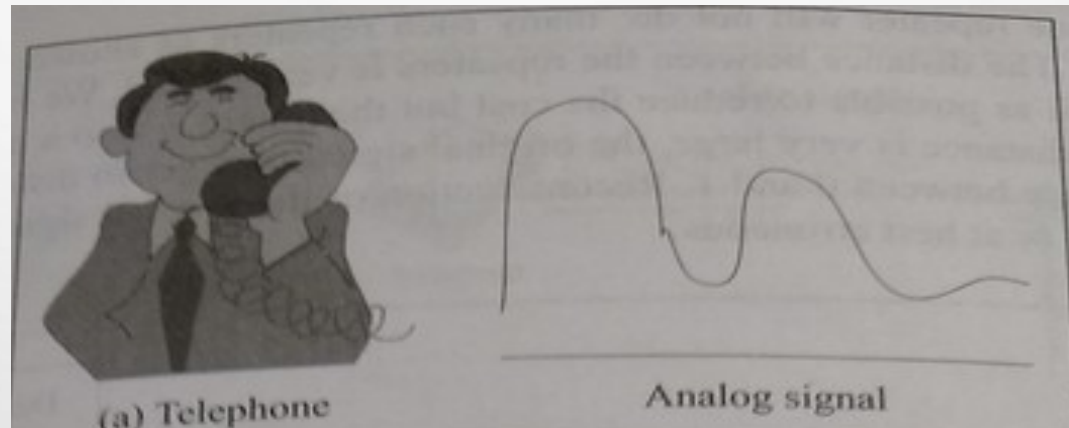
Signal Transmission

Signal Transmission
- Analog Signal, Analog Transmission
- Digital Signal, Digital Transmission
- Digital Signal, Analog Transmission
- Analog Signal, Digital Transmission
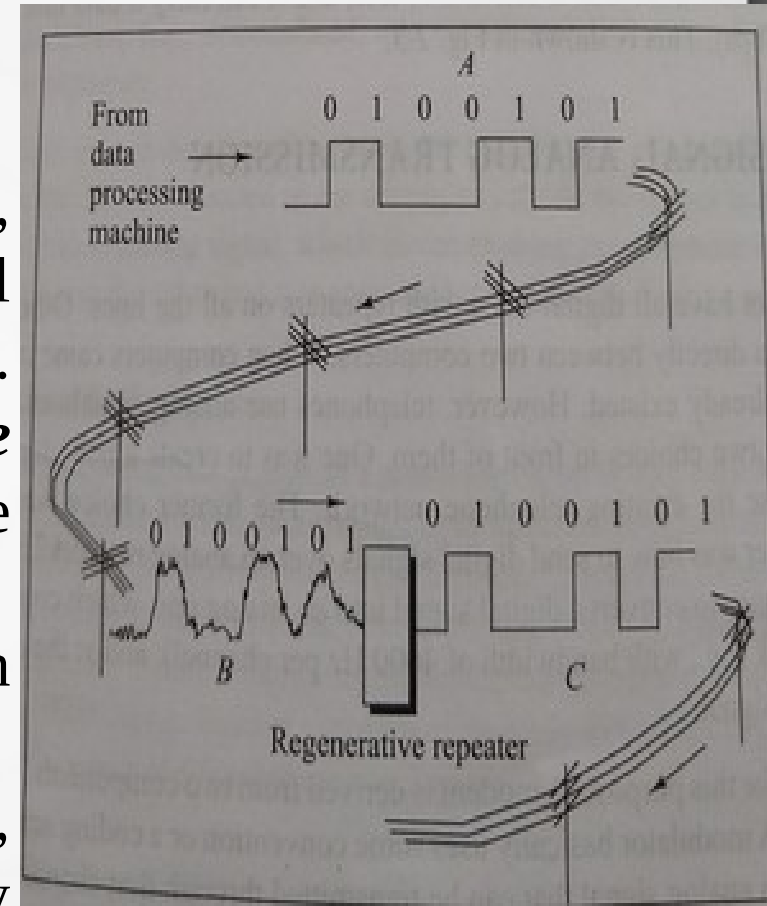
Signal Transmission

- **Signal Transmission: Analog Signal, Analog Transmission**
- Analog transmission refers to the transmission of analog signal.
- The human voice generates an anlog (i.e. continuously varying) signal, which is transmitted as an analog signal over the medium.
- The signal suffers **Attenuation**.
- Amplifiers are used to overcome this problem, but then amplifiers amplify noise along with the original signal. Singal gets distorted, it can't be reconstructed at all.
- At the destination, it is very difficult to imagine, from the received distorted signal, what the signal shoul have been.

(a) Telephone   Analog signal

Signal Transmission

- **Signal Transmission: Digital Signal, Digital Transmission**
- Computer generates digital signal
- As digital signal traverses over the medium, noise adds further distortion. The signal becomes unrecognizable from the original one.
- The hardware equipment called *regenerative repeater* or *repeater* is used to regenerate the digital signal.
- Only one repeater will not do it, many such repeaters will be required on the same line.
- If the distance between repeater is very large, the original signal may get so distorted. Any line with repeaters placed at the appropriate distance is called a digital line.

From data processing machine

A

0 1 0 0 1 0 1

0 1 0 0 1 0 1

B

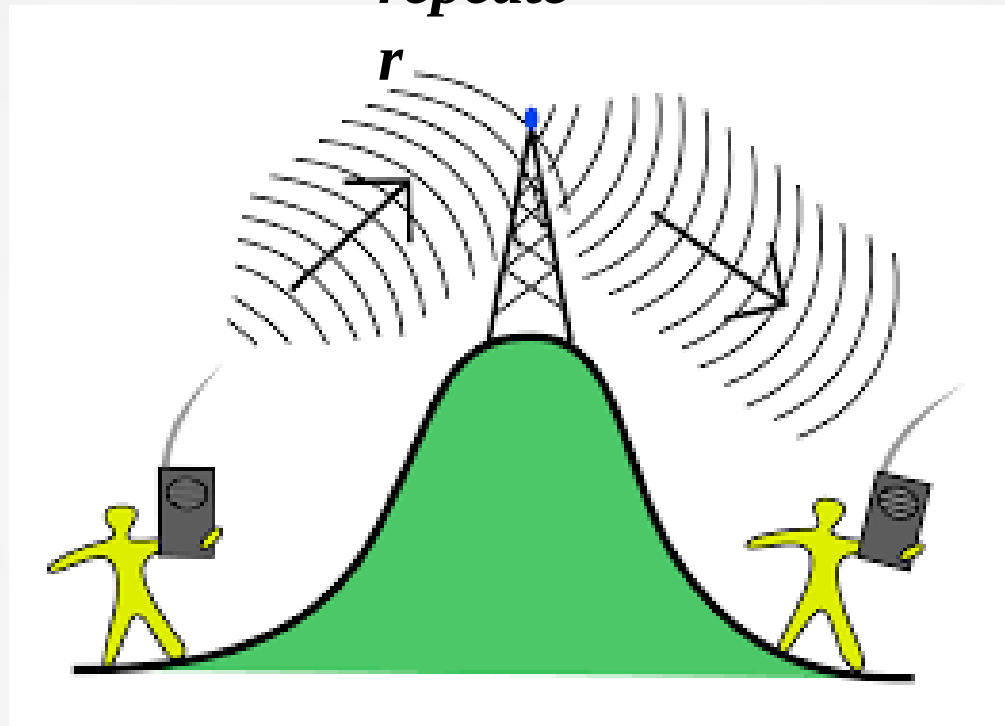0 1 0 0 1 0 1

C

Regenerative repeater

repeater

Figure 14.19 Repeater

Signal Transmission

- **Signal Transmission: Digital Signal, Analog Transmission**
- Some technique is necessary to convert a digital signal into analog, which could be carried over the telephone network, and at the other end, convert it back into a digital signal. **Modem** is used for this purpose.
- A modem is derived from two components: **A Modulator and A Demodulator**
- **A modulator** uses some convention or a coding scheme and converts a digital signal into an analog signal.

- **A demodulator** converts the analog signal back into the digital signal.
- When data from one computer is sent to another via some analog carrier, it is first converted into analog signals. Analog signals are modified to reflect digital data, i.e. binary data.