CHANDIGARH UNIVERSITY

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UNIVERSITY INSTITUTE OF COMPUTING

Bachelors of Science (Computer Science)

Computer Network CAT-312

Data Communication

DISCOVER . LEARN . EMPOWER

Scheme

Bachelor of Computer Applications Semester – V (2017-20)					
Subject Code	**Title**	**L**	**T**	**P**	**Credits**
CA*-301	Specialisation - I	3	-	-	3
CAT-302	Computer Graphics	3	-	-	3
CAT-309	Web Security	3	-	-	3
CAT-312	Computer Networks	3	-	-	3
CAP-306	Computer Graphics Lab	-	-	4	2
CA*-307	Specialisation – I Lab	-	-	4	2
CAR-308	Minor Project	-	-	-	2
CAY-309	Industrial Training	-	-	-	3*
CAY-311	Data Interpretations Lab	-	-	4	2*
Total		**12**	**-**	**12**	**18**

Syllabus

Unit 1

Data communications concepts: Digital and analog parallel and serial synchronous and asynchronous, simplex, half duplex, full duplex, multiplexing.

Communication channels: Wired transmissions: Telephone lines, leased lines, switch line, coaxial cables-base band, broadband, optical fiber transmission.

Syllabus

Unit-II

Wireless transmission: Microwave transmission, infrared transmission, laser transmission, radio transmission, and satellite transmission. Communication switching techniques; Circuit switching, message switching, packet switching

Network reference models: Network topologies, OSI references model, TCP/IP reference model, comparison of OSI and TCI reference model.

Syllabus

Unit-III

Data link layer design issue: Services provided to the network layer, framing, error control, flow control HDLC, SDLC, data link layer in the internet (SLIP, PPP).

Routing Algorithms: Optimality principled, shortest path routing, Concept of Internet Working and IPv4.

Application layer: DNS, E-mail, world wide web, HTTP, multimedia. Network security- basic concepts.

UNIT 1

Course Outcome

CO Number	Title	Level
CO1	Students will be able to demonstrate the basics of communication and classify different types of networks	**Remember**
CO2	Students will be able to classify various wireless transmission and switching techniques.	Understand
CO3	Students will have the ability to understand the issues and functionalities of data link layer and application layer and applications of routing algorithms to solve real world problems.	Understand

UNIT 1

- Introduction: Overview of computer networks, OSI model, TCP/IP suite of protocols.
- Network Layer: IP address classes, subnetting, Classless Inter-domain routing (CIDR), ARP, RARP and DHCP concepts, IPv4 & IPv6, The routing protocols: RIP, OSPF, BGP, IP Multicasting, Multicast routing protocols, address assignments, session discovery, etc.

Topic

- Introduction to data communication.
- Components of data communication
- Data flow:- Simplex, Half duplex, Full duplex
- Signals:- Analog and Digital signals.
- Transmission media:- Guided and Unguided media
- Networking devices

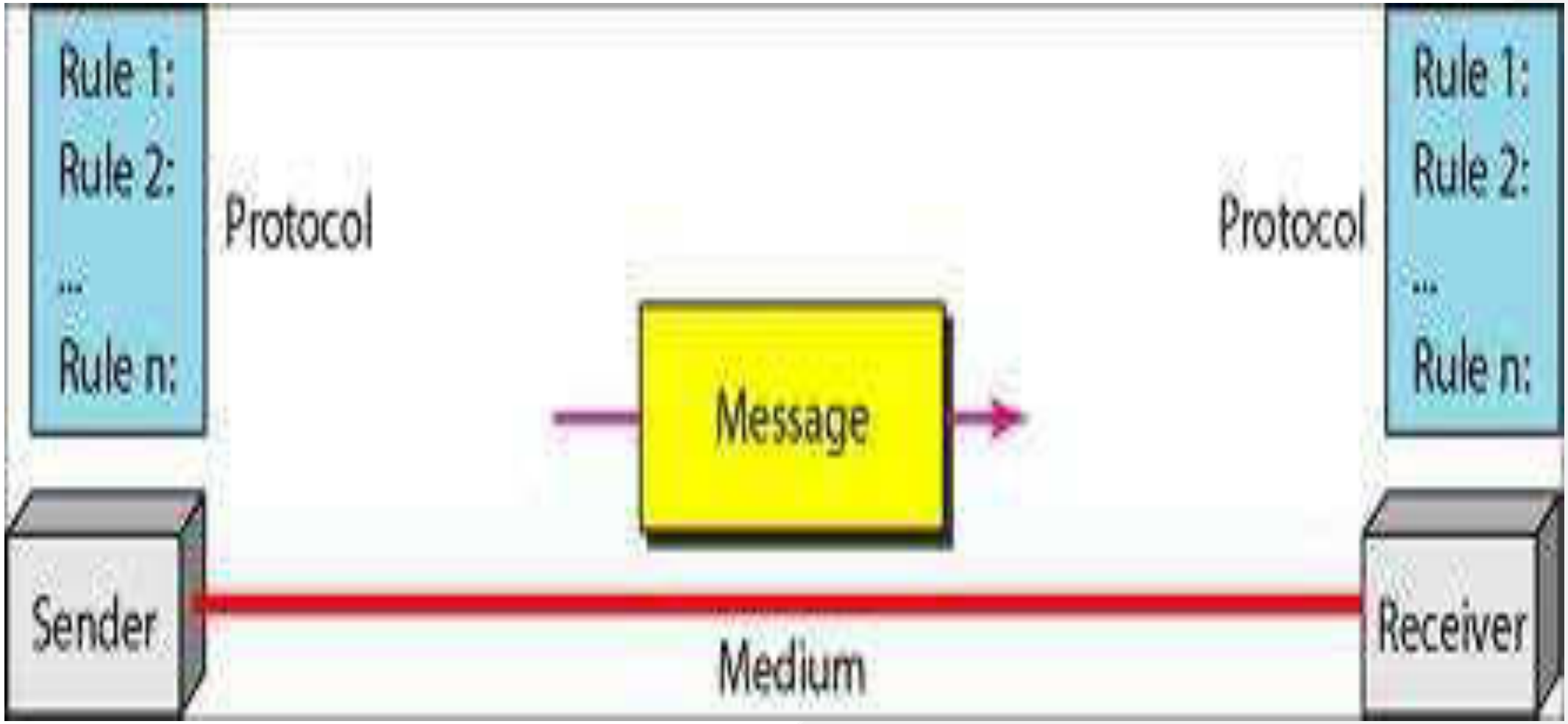
What is Data Communications?

Exchange of data between two devices via some forms of transmission medium(such as wire cable) is Data Communications. For data communications to occur, the communicating devices must be part of a communication system made of a combination of hardware and software. The effectiveness of a data communication system depends on four fundamental characteristics:-

- Delivery
- Accuracy
- timeliness
- jitter.

Components of Data Communication:

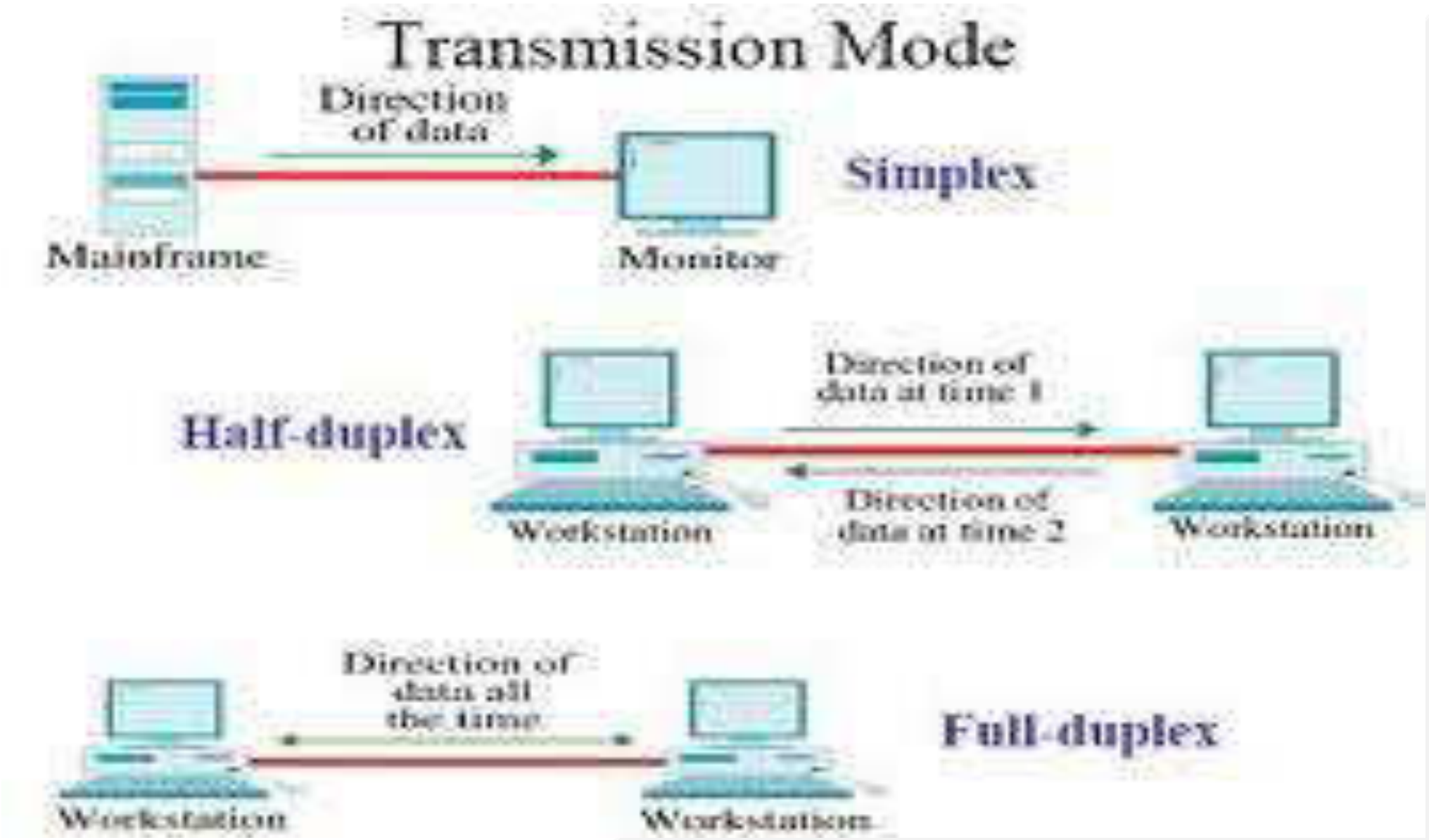
- Sender
- Receiver
- Message
- Tramsmission Medium
- Protocol


Rule 1:
Rule 2:
...
Rule n:
Protocol
Message
Protocol
Rule 1:
Rule 2:
...
Rule n:
Sender
Medium
Receiver

The five components of data communication are:

- **Message** - It is the information to be communicated. Popular forms of information include text, pictures, audio, video etc.
- **Sender** - It is the device which sends the data messages. It can be a computer, workstation, telephone handset etc.
- **Receiver** - It is the device which receives the data messages. It can be a computer, workstation, telephone handset etc.
- **Transmission Medium** - It is the physical path by which a message travels from sender to receiver. Some examples include twisted-pair wire, coaxial cable, radio waves etc.
- **Protocol** - It is a set of rules that governs the data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

Data Flow


Transmission Mode
Direction of data
Simplex
Mainframe
Monitor
Half-duplex
Direction of data at time 1
Direction of data at time 2
Workstation
Workstation
Direction of data all the time
Full-duplex
Workstation
Workstation

Data flow can occur in three ways:

- **Simplex :** In simplex mode , the communication is unidirectional only one of the devices on a link can transmit, the other can only receive. e.g. keyboards , monitors , etc.
- **Half-duplex :** In this mode , each station can both transmit and receive , but not at the same time . When one device is sending , the other can only receive , and vice-versa. e.g. walkie-talkies , CB(citizens band) etc.
- **Full Duplex :** In full duplex mode, both stations can transmit and receive simultaneously. One common example of full duplex is the Telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time. The full-duplex mode is used when communication in both directions is required all the time.

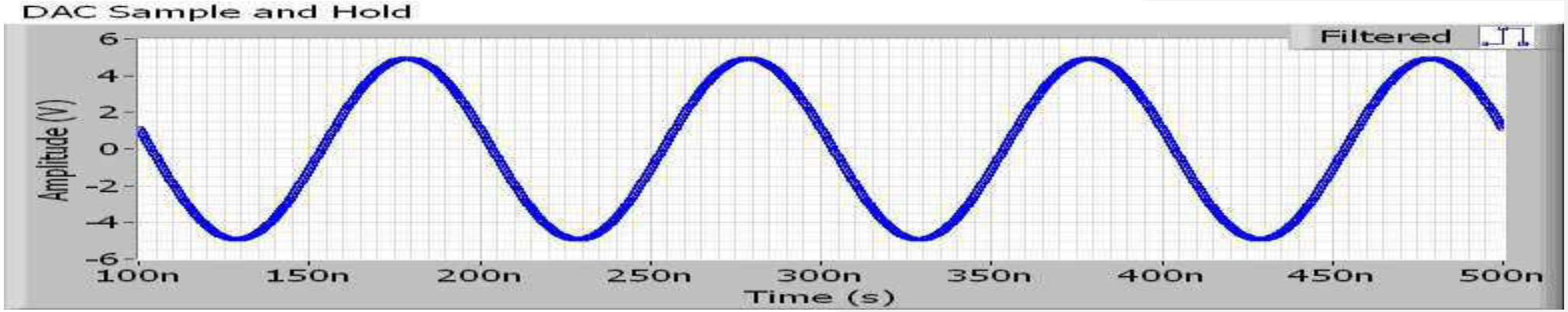
Signals

There are two types of signals to transfer data.

- Analog signal
- Digital signal

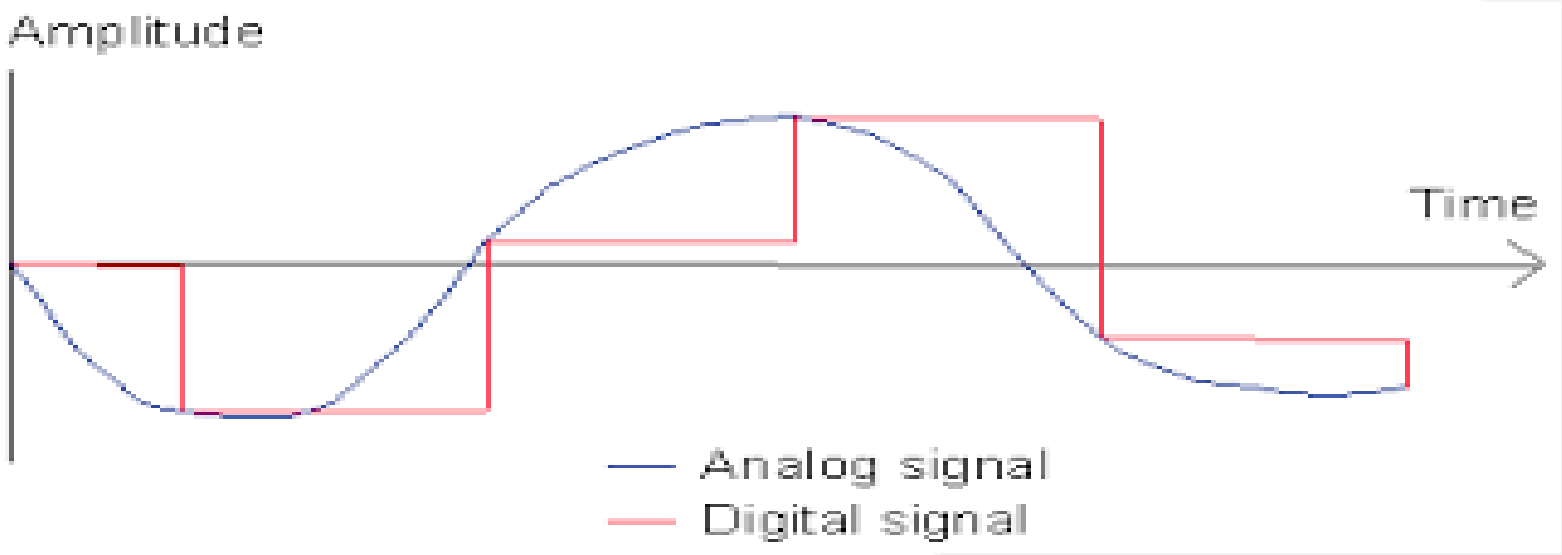
Analog Signals

An analog signal are continuous and passes through or includes an infinite number of continuous values along its path. The curve representing the analog signal passes through an infinite number of points.



Digital Signals:

A digital signal can have only a limited number of defined values. Although each value can be any number, it is as simple as 1 and 0.



Transmission Media

The means through which data is transformed from one place to another is called transmission or communication media.

Electromagnetic radiation can be transmitted through an optical media, such as optical fiber, or through twisted pair wires, coaxial cable, or dielectric-slab waveguides. It may also pass through any physical material that is transparent to the specific wavelength, such as water, air, glass, or concrete. Sound is, by definition, the vibration of matter, so it requires a physical medium for transmission, as does other kinds of mechanical waves and heat energy.

Types of Transmission Media

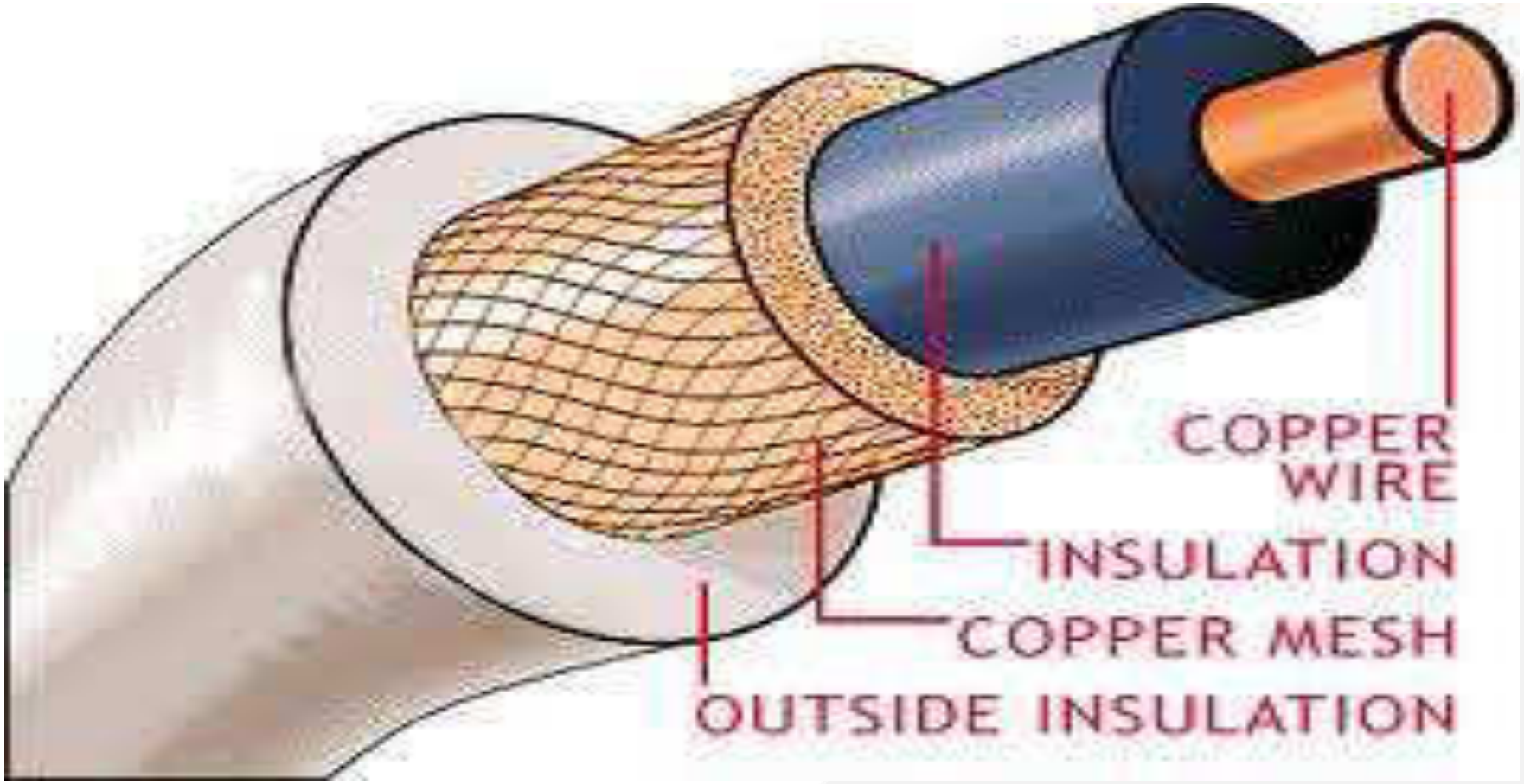
- Guided Media
- Unguided Media

Guided Media

- Guided media are the physical links through which signals are confined to narrow path. These are also called guide media. Bounded media are made up o a external conductor (Usually Copper) bounded by jacket material. Bounded media are great for LABS because they offer high speed, good security and low cast. However, some time they cannot be used due distance communication.
- Three common types of bounded media are used of the data transmission. These are
  - Coaxial Cable
  - Twisted Pairs Cable
  - Fiber Optics Cable

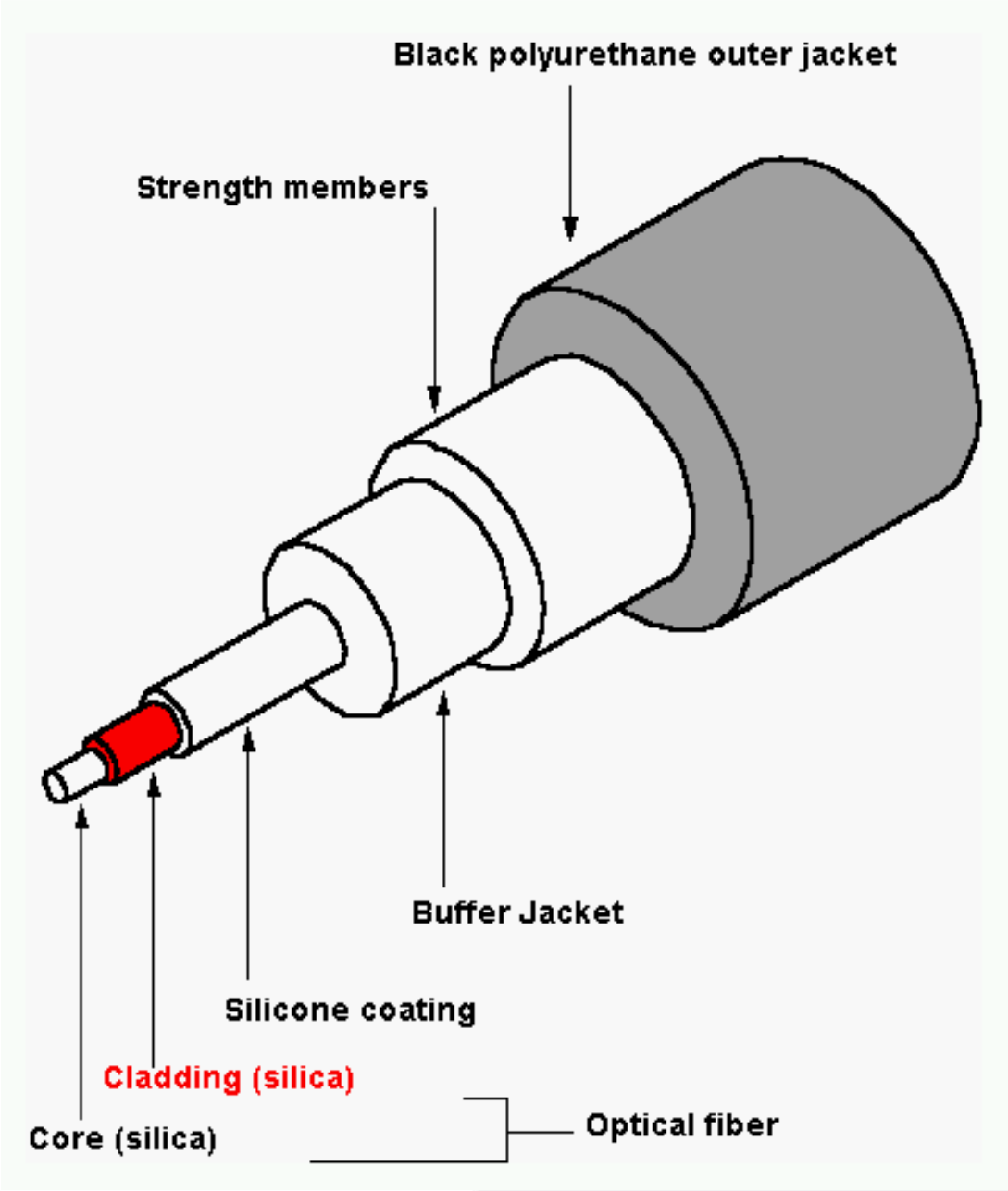
Coaxial cable

- Coaxial cable is very common & widely used commutation media. For example TV wire is usually coaxial. Coaxial cable gets its name because it contains two conductors that are parallel to each other. The center conductor in the cable is usually copper. The copper can be either a solid wire or stranded martial.
- Outside this central Conductor is a non-conductive material. It is usually white, plastic material used to separate the inner Conductor form the outer Conductor. The other Conductor is a fine mesh made from Copper.


COPPER
WIRE
INSULATION
COPPER MESH
OUTSIDE INSULATION

Fiber optic cable

- Fiber optic cable uses electrical signals to transmit data. It uses light. In fiber optic cable light only moves in one direction for two way communication to take place a second connection must be made between the two devices. It is actually two stands of cable. Each stand is responsible for one direction of communication. A laser at one device sends pulse of light through this cable to other device. These pulses translated into "**1's**" and "**0's**" at the other end.
- In the center of fiber cable is a glass stand or core. The light from the laser moves through this glass to the other device around the internal core is a reflective material known as **CLADDING**. No light escapes the glass core because of this reflective **cladding.**



Twisted Pair Cable

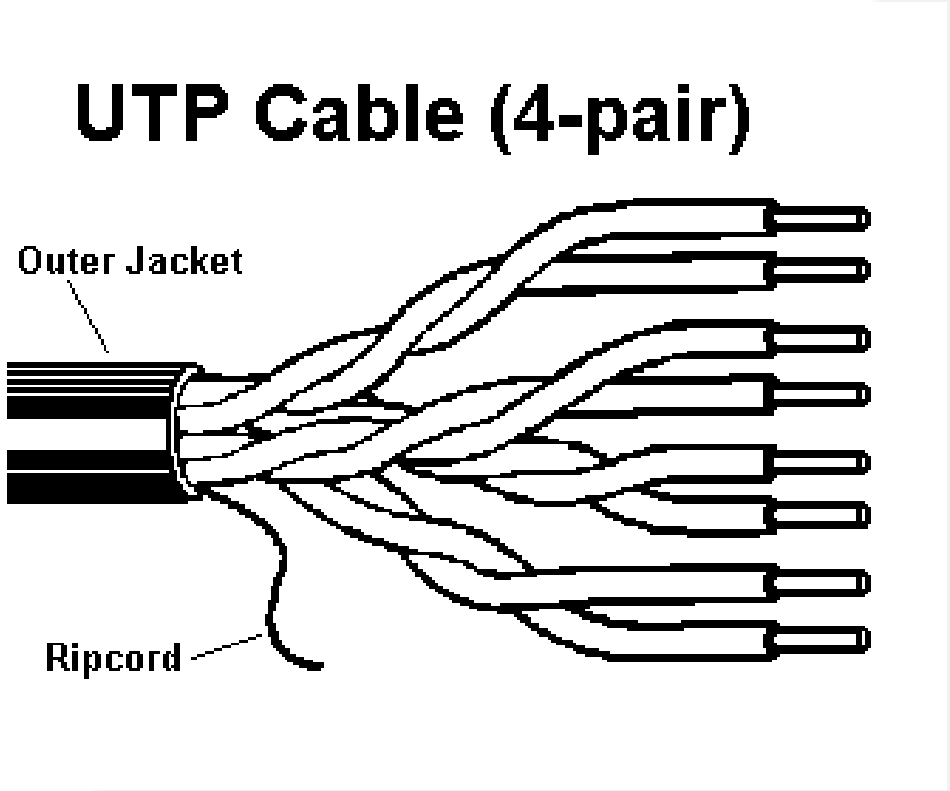
- The most popular network cabling is Twisted pair. It is light weight, easy to install, inexpensive and support many different types of network. It also supports the speed of **100 mps.** Twisted pair cabling is made of pairs of solid or stranded copper twisted along each other. The twists are done to reduce vulnerably to EMI and cross talk. The number of pairs in the cable depends on the type. The copper core is usually **22-AWG or 24-AWG, as** measured on the American wire gauge standard. There are two types of twisted pairs cabling

    1. Unshielded twisted pair (UTP)

    2. Shielded twisted pair (STP)

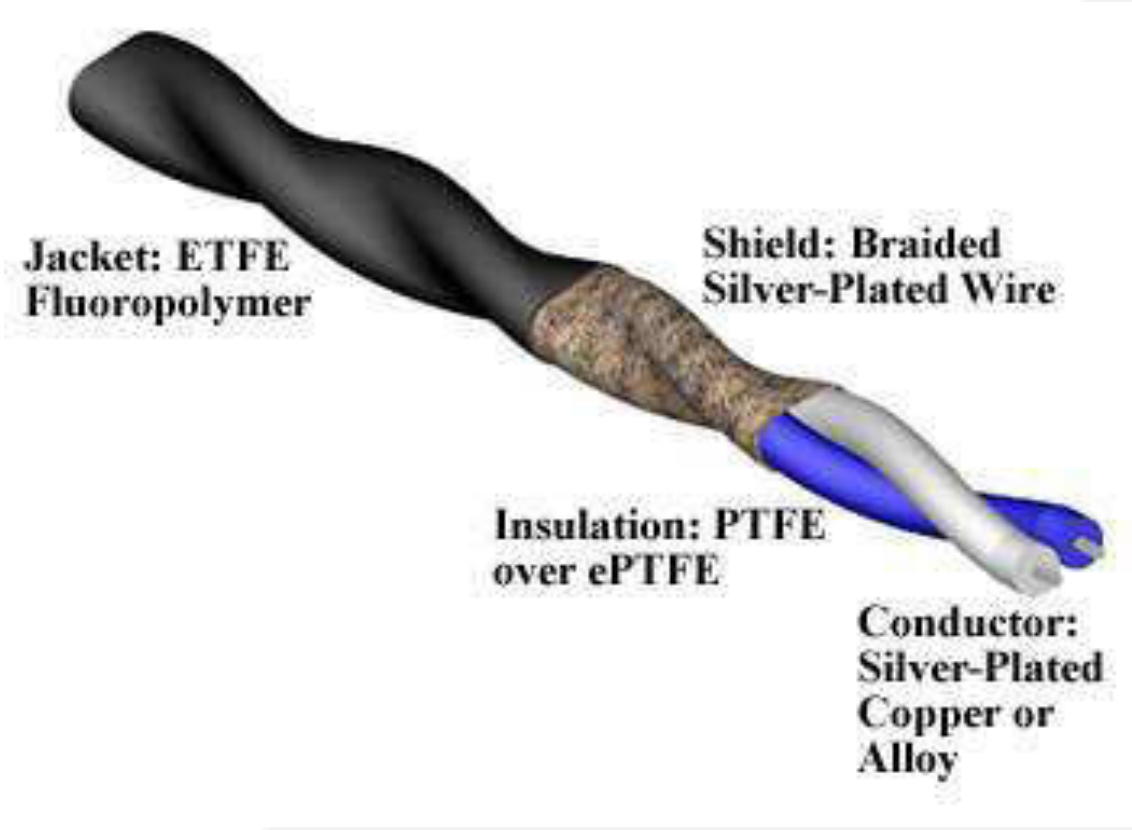
Unshielded twisted pair (UTP)

UTP is more common. It can be either voice grade or data grade depending on the condition. UTP cable normally has an impedance of 100 ohm. UTP cost less than STP and easily available due to its many use. There are five levels of data cabling.



Shielded twisted pair (STP)

- It is similar to UTP but has a mesh shielding that's protects it from EMI which allows for higher transmission rate.



Unguided Media

- Unguided media or wireless media doesn't use any physical connectors between the two devices communicating. Usually the transmission is send through the atmosphere but sometime it can be just across the rule. Wireless media is used when a physical obstruction or distance blocks are used with normal cable media.
- The three types of wireless media are:
  - Radio waves
  - Micro waves
  - Infrared waves

REFERENCES

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THANK YOU

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Multiplexing

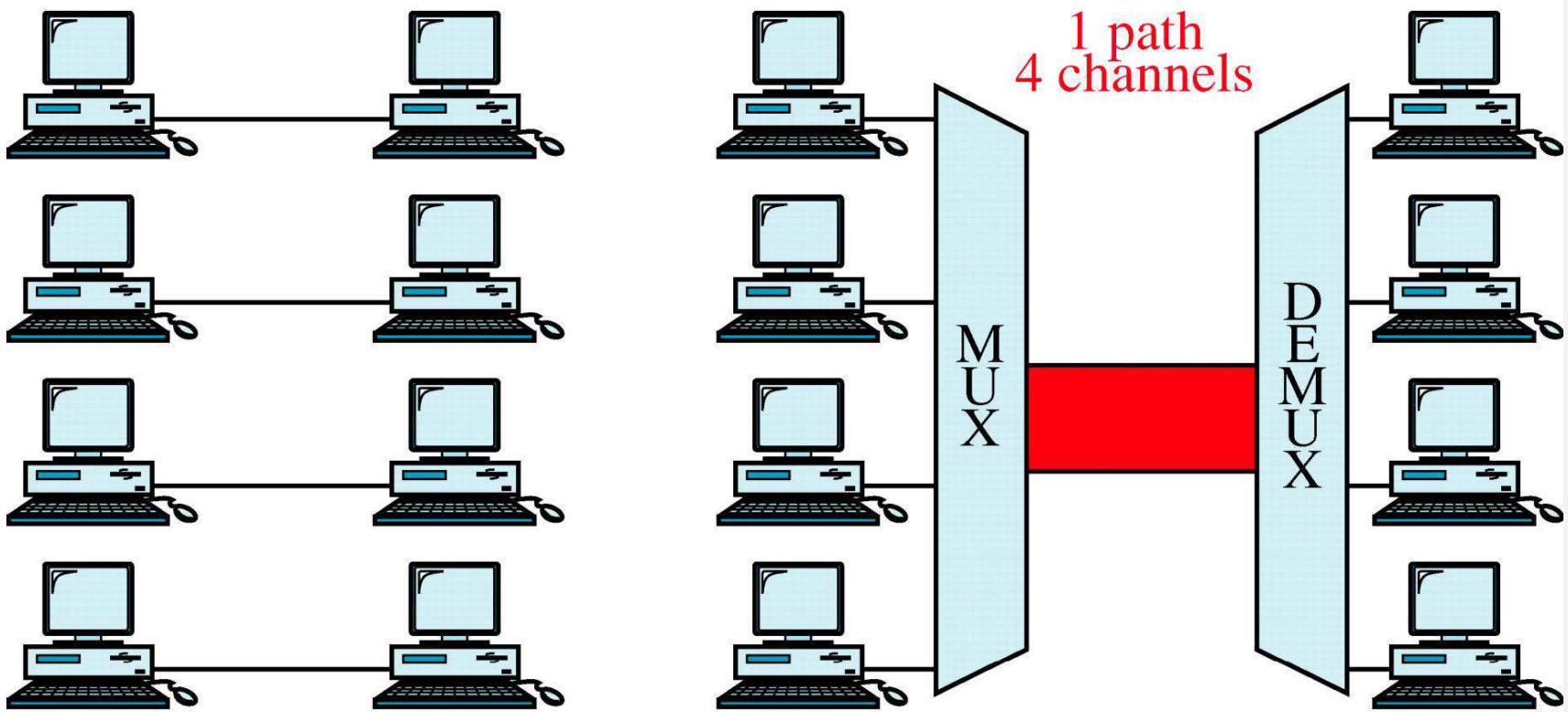
Multiplexing

- It is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link.
- Multiplexing is done using a device called Multiplexer (MUX) that combine *n* input lines to generate one output line i.e. (*many to one)*.
- At the receiving end a device called Demultiplexer (DEMUX) is used that separate signal into its component signals i.e. one input and several outputs *(one to many).*

Advantages of Multiplexing

- More than one signals can be sent over single medium or link
- Effective use of the bandwidth of medium

Multiplexing vs. No Multiplexing



a. No multiplexing

b. Multiplexing

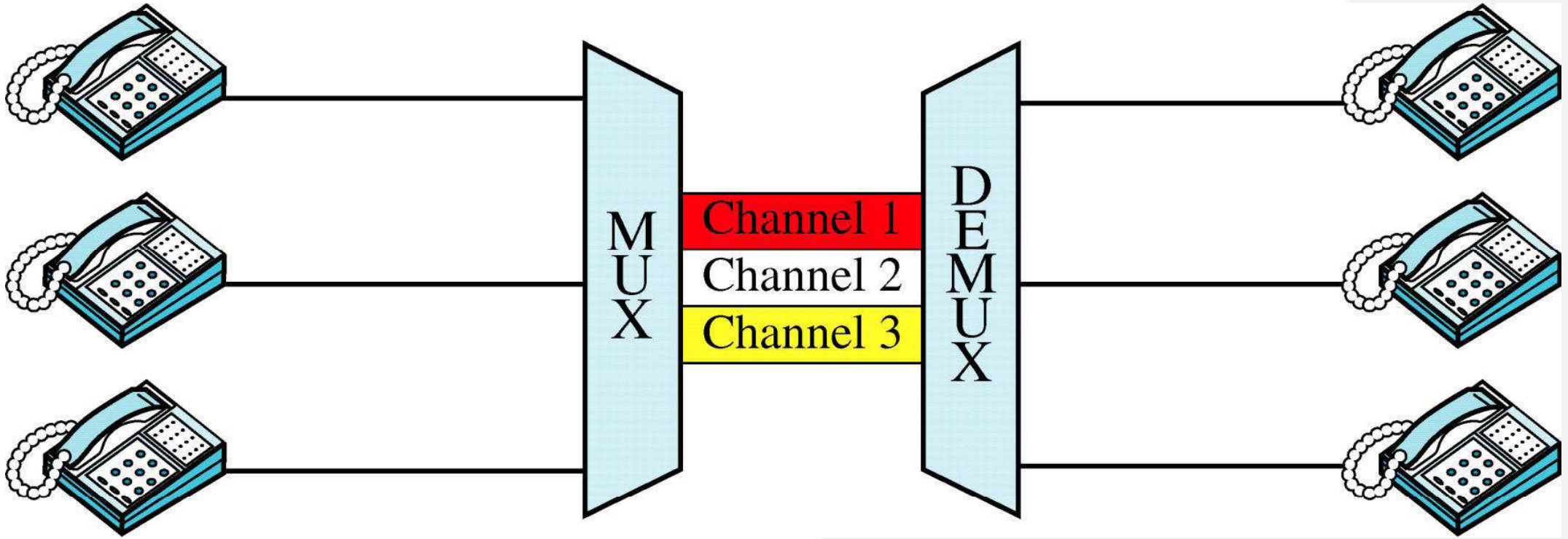
Types of Multiplexing

- Frequency Division Multiplexing
- Wave Division Multiplexing
- Time Division Multiplexing

Frequency Division Multiplexing

- It is an analog technique.
- Signals of different frequencies are combined into a composite signal and is transmitted on the single link.
- Bandwidth of a link should be greater than the combined bandwidths of the various channels.
- Each signal is having different frequency.
- Channels are separated by the strips of unused bandwidth called *Guard Bands* (to prevent overlapping).

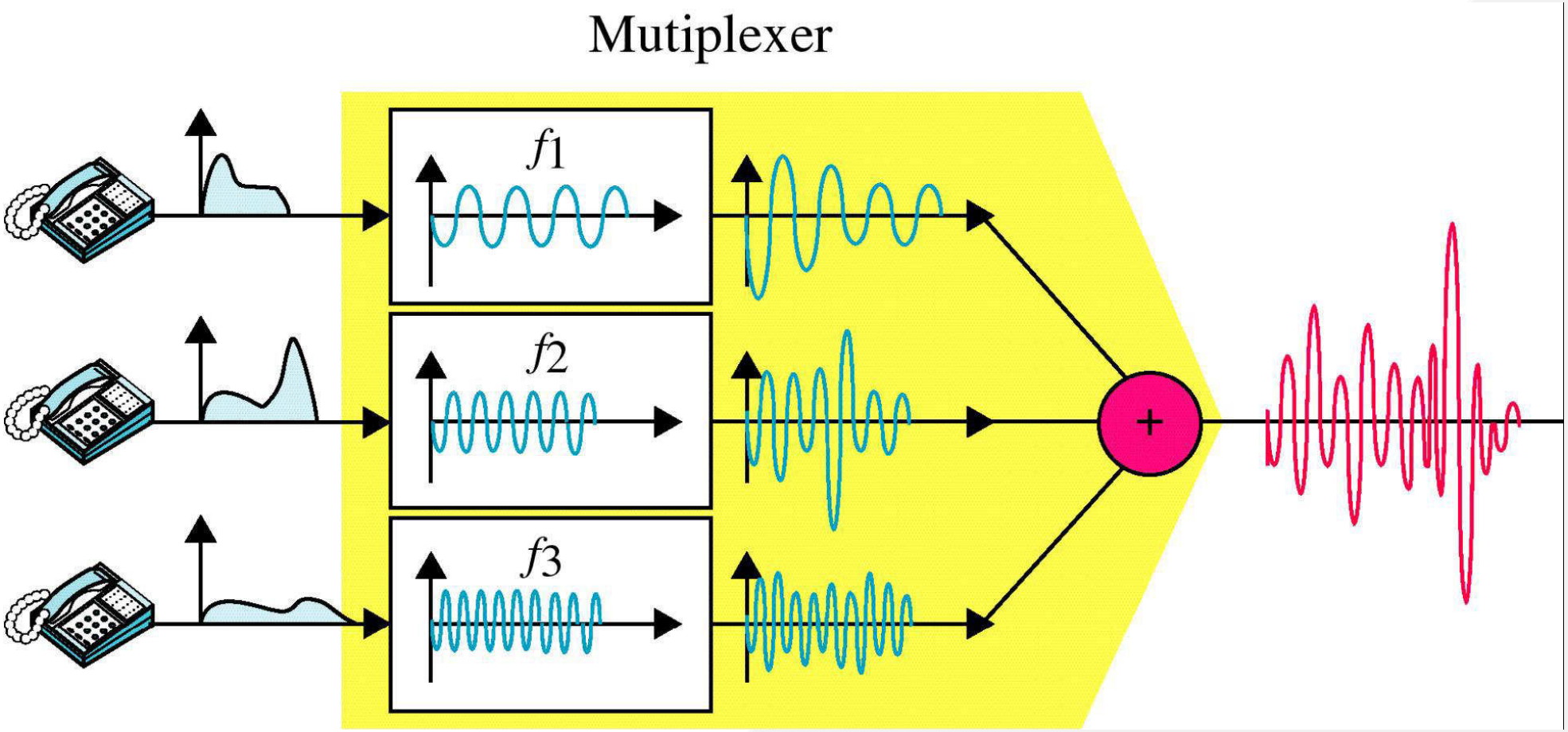
FDM



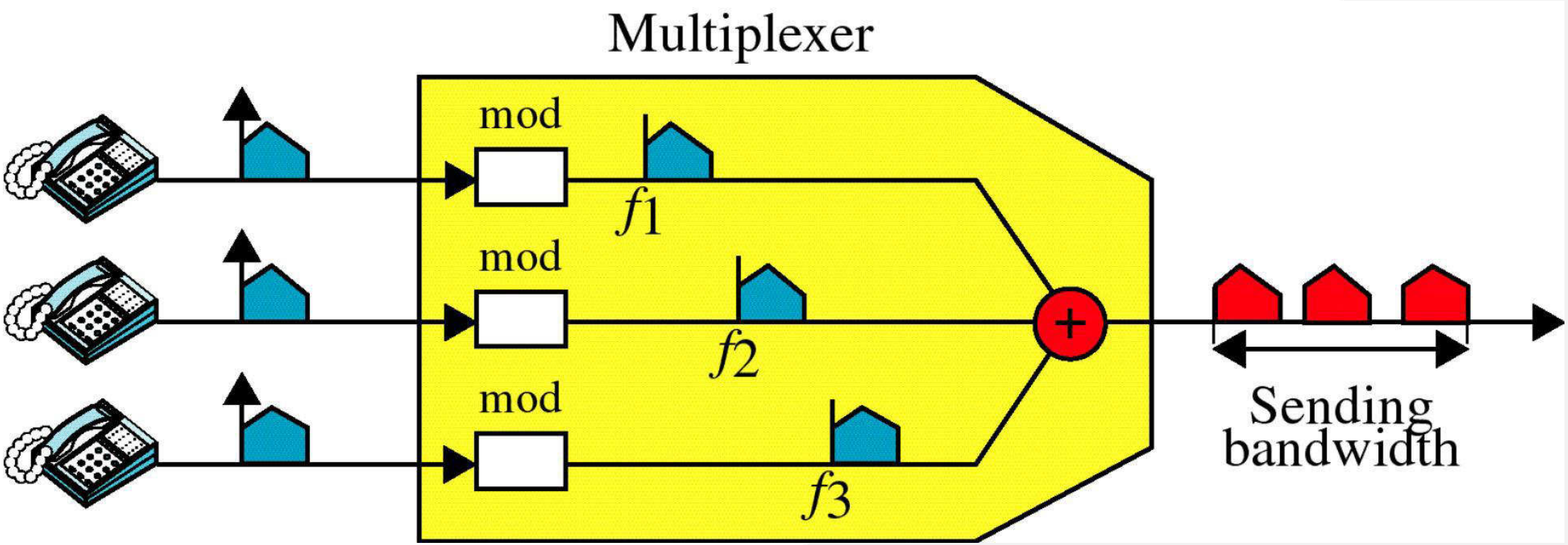
Applications of FDM

- FDM is used for FM & AM radio broadcasting.
- AM frequency = 530 to 1700 kHz.
- FM frequency = 88 to 108 MHz.
- FDM is used in television broadcasting.
- First generation cellular telephone also uses FDM.

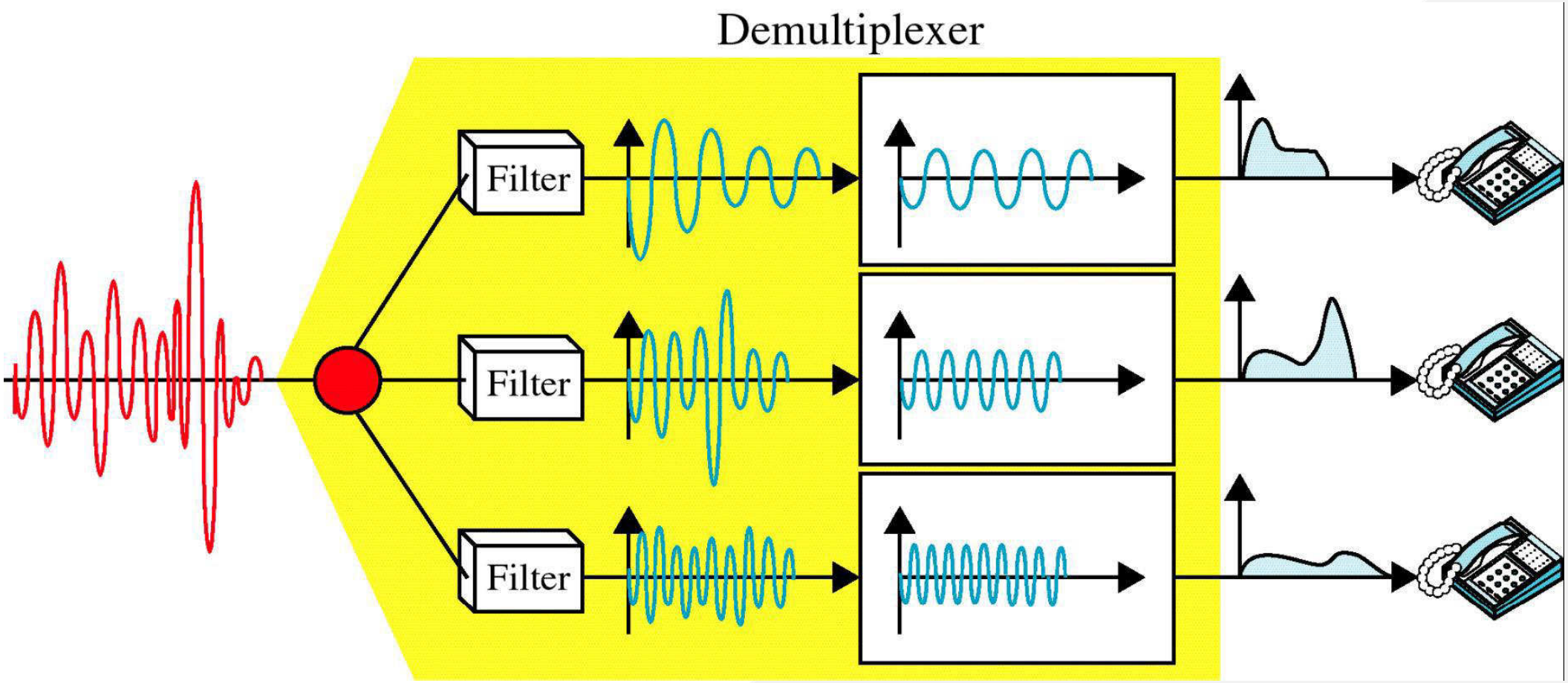
FDM, Time Domain



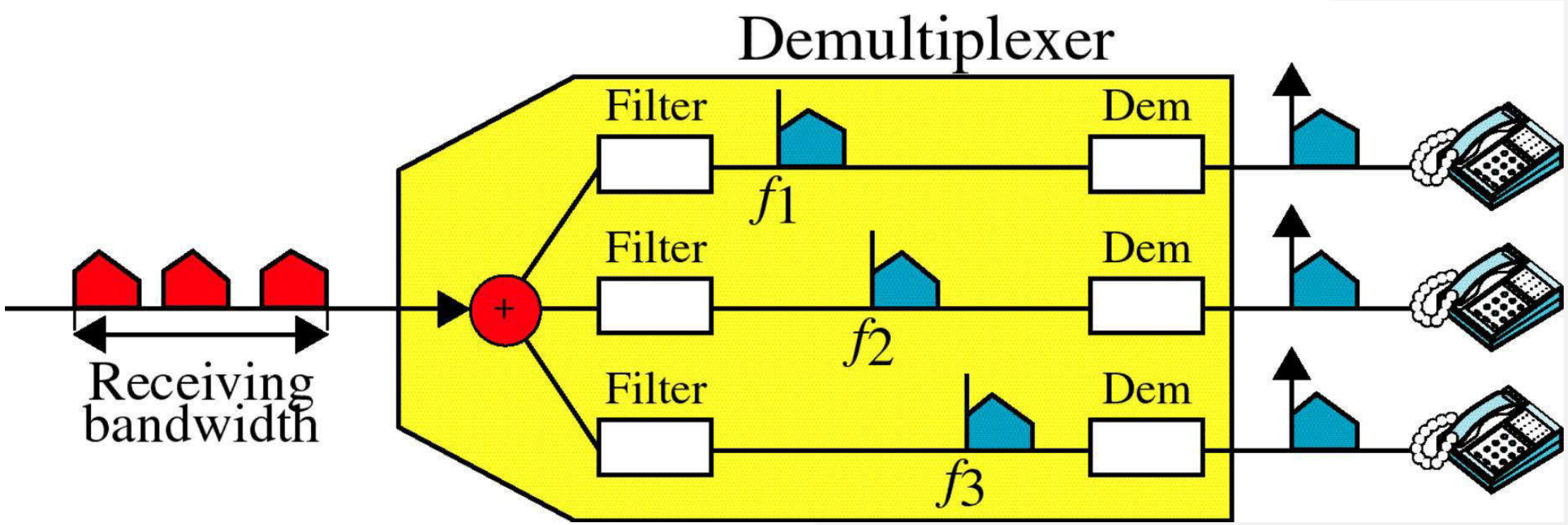
Multiplexing, Frequency Domain



Demultiplexing, Time Domain



Demultiplexing, Frequency Domain



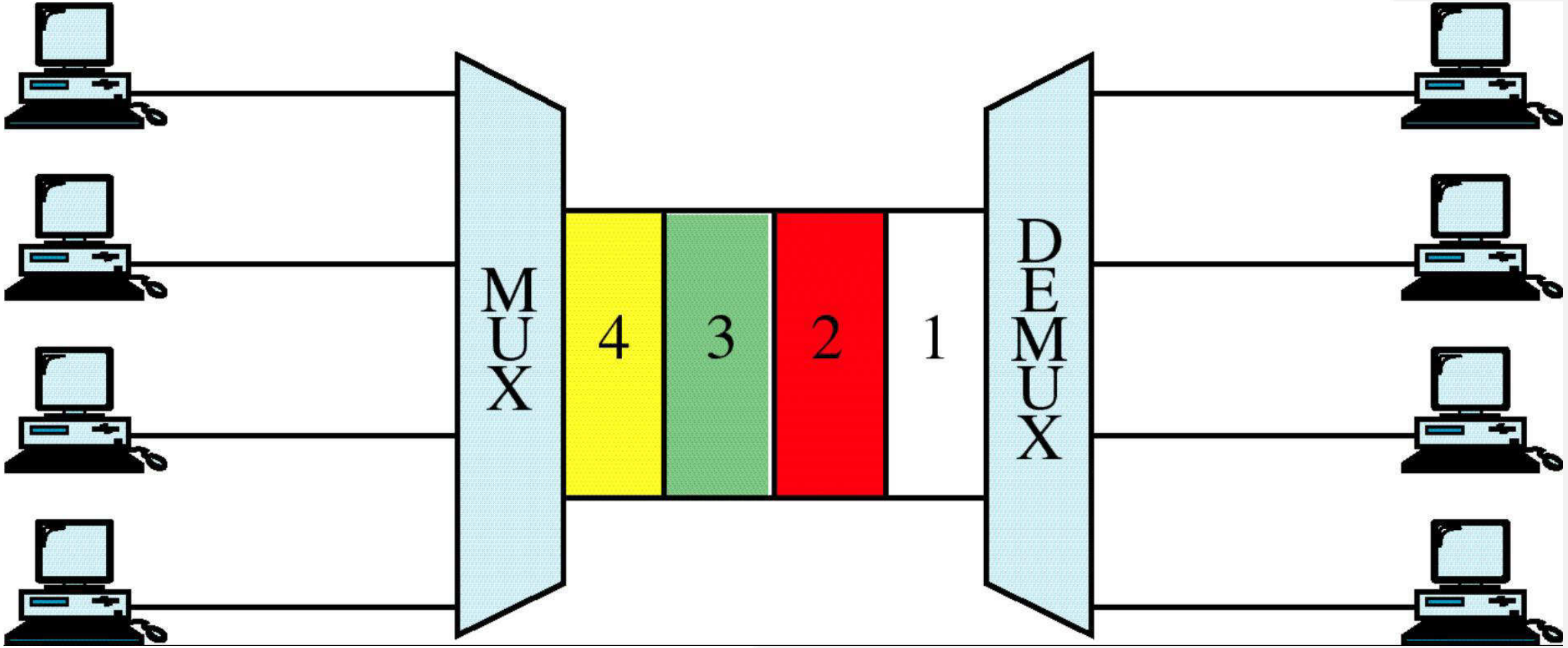
Wave Division Multiplexing

- WDM is an analog multiplexing technique.
- Working is same as FDM.
- In WDM different signals are *optical or light* signals that are transmitted through optical fiber.
- Various light waves from different sources are combined to form a composite light signal that is transmitted across the channel to the receiver.
- At the receiver side, this composite light signal is broken into different light waves by Demultiplexer.
- This Combining and the Splitting of light waves is done by using a PRISM. Prism bends beam of light based on the angle of incidence and the frequency of light wave.

Time Division Multiplexing

- It is the digital multiplexing technique.
- Channel/Link is not divided on the basis of *frequency* but on the *basis of time.*
- Total time available in the channel is divided between several users.
- Each user is allotted a particular time interval called *time slot* or *slice.*
- In TDM the data rate capacity of the transmission medium should be greater than the data rate required by sending of receiving devices.

TDM



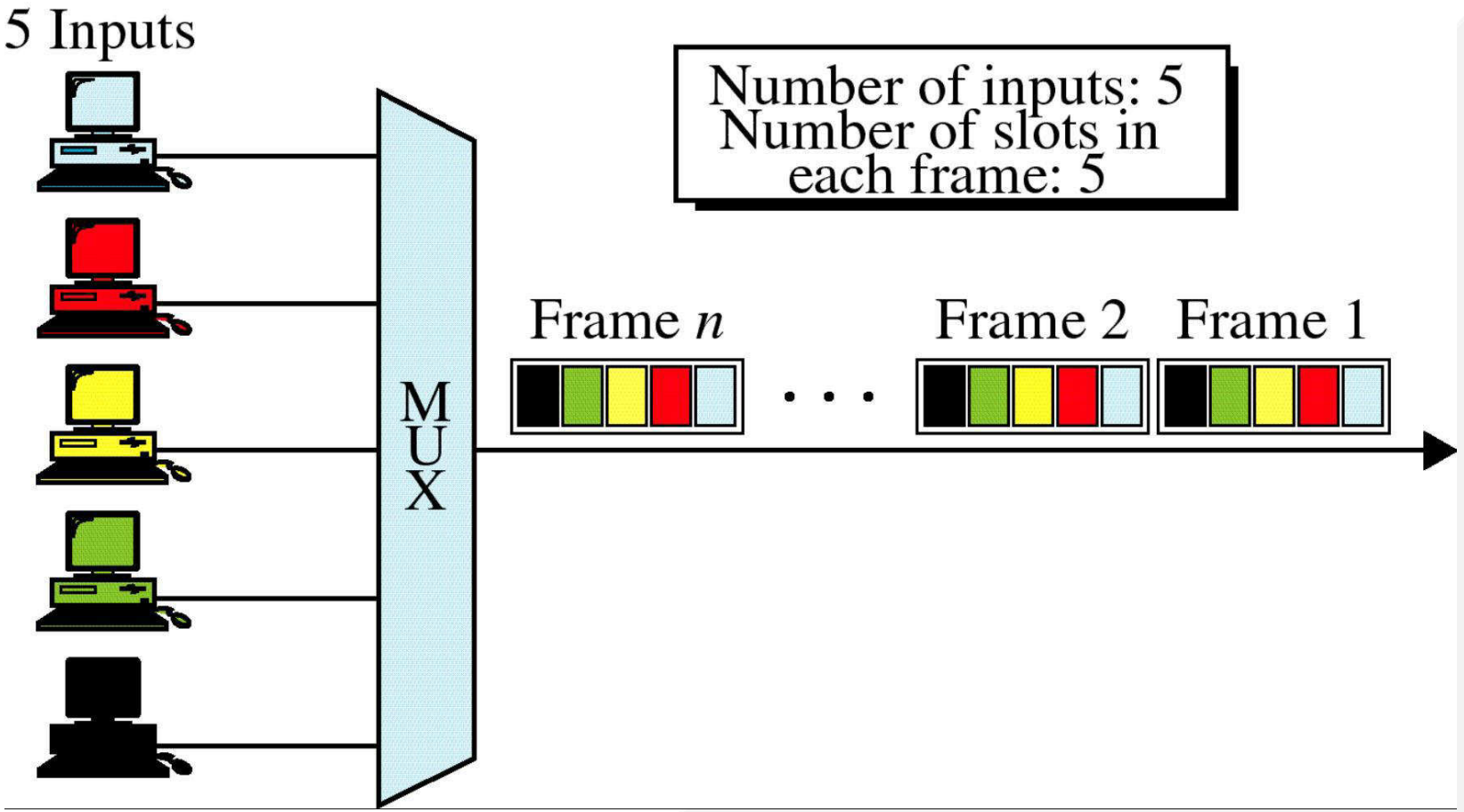
Types of TDM

- Synchronous TDM
- Asynchronous TDM

Synchronous TDM

- Each device is given same Time Slot to transmit the data over the link, whether the device has any data to transmit or not.
- Each device places its data onto the link when its *Time Slot* arrives, each device is given the possession of line turn by turn.
- If any device does not have data to send then its time slot remains empty.
- Time slots are organized into *Frames* and each frame consists of one or more time slots.
- If there are *n* sending devices there will be *n* slots in frame.

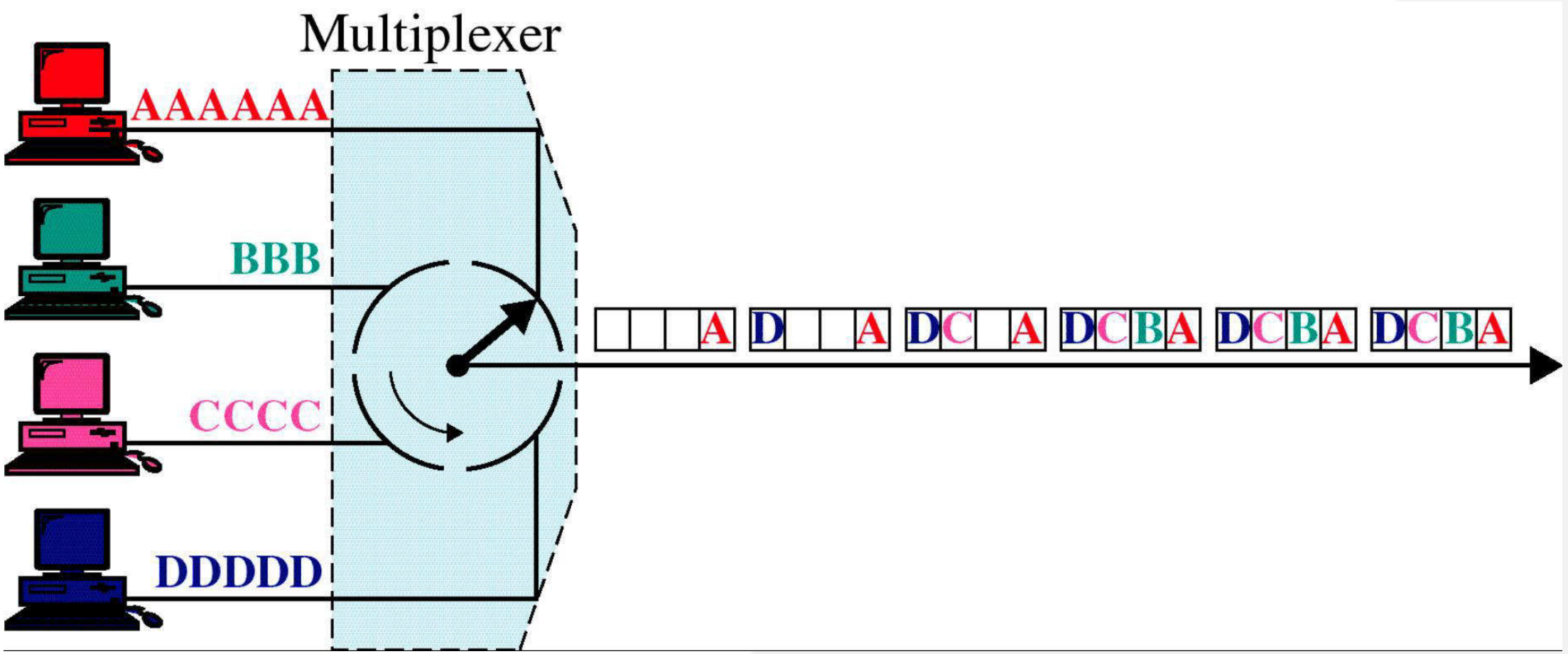
Synchronous TDM



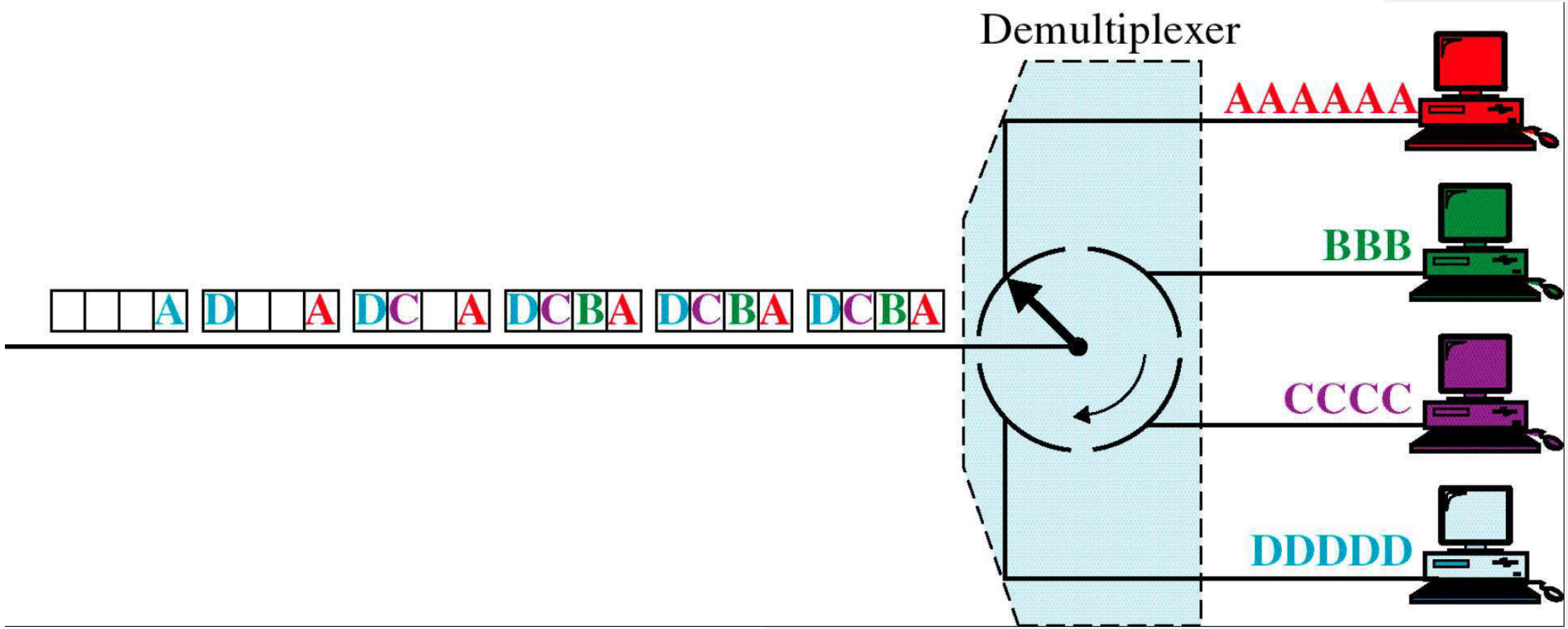
Multiplexing Process in STDM

- In STDM every device is given opportunity to transmit a specific amount of data onto the link.
- Each device gets its turn in fixed order and for fixed amount of time = INTERLEAVING.
- Interleaving is done by a character (one byte).
- Each frame consist of four slots as there are four input devices.
- Slots of some devices go empty if they do not have any data to send.

TDM, Multiplexing



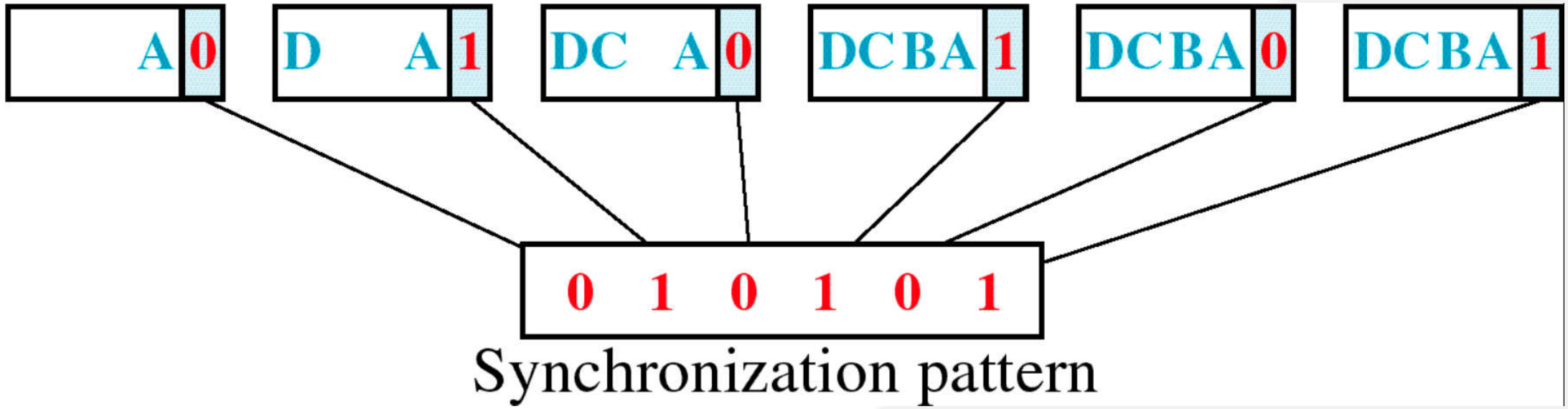
TDM, Demultiplexing



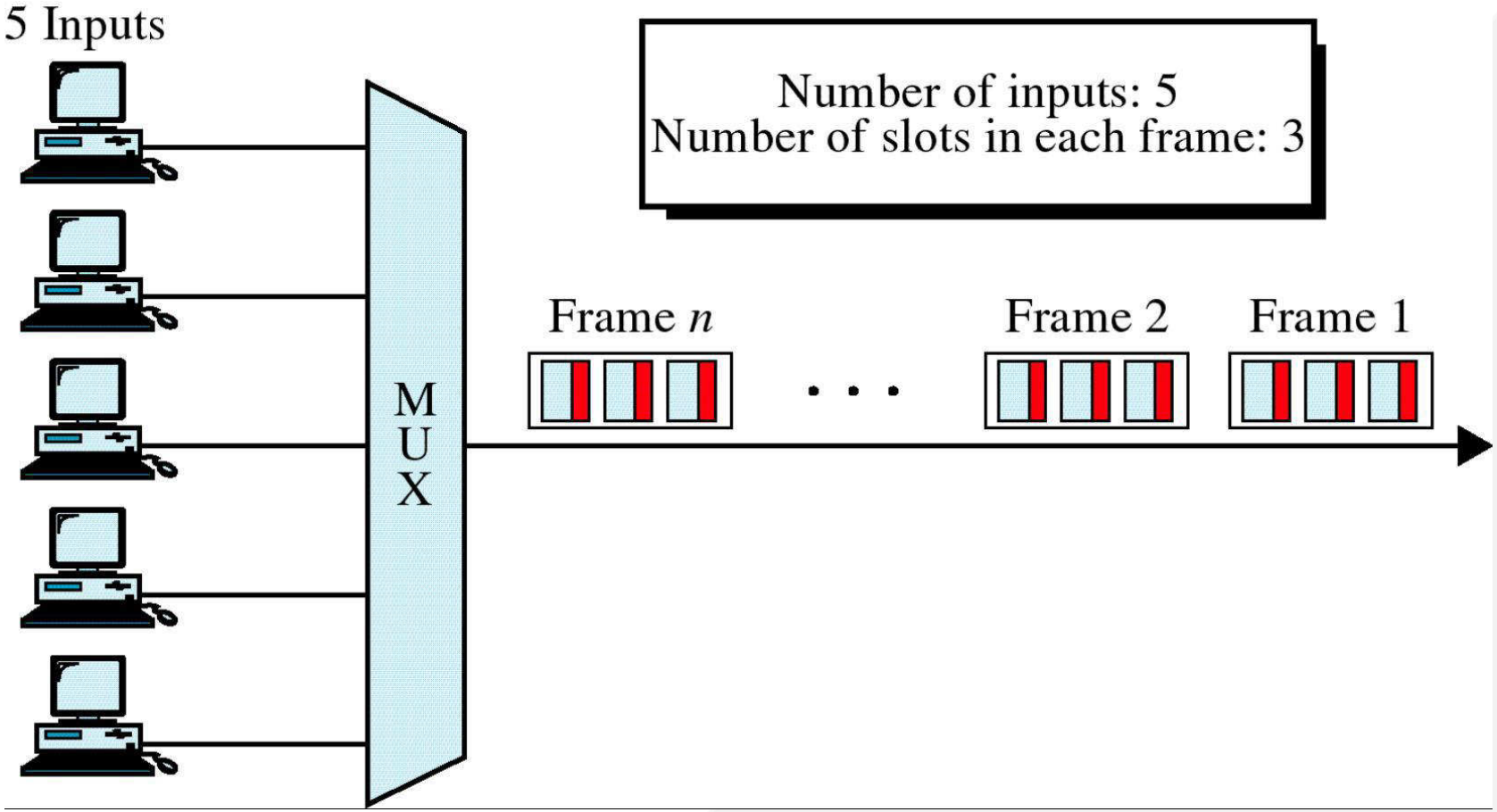
Disadvantages of STDM

- The channel capacity cannot be fully utilized. Some of the slots go empty in certain frames.

Framing Bits



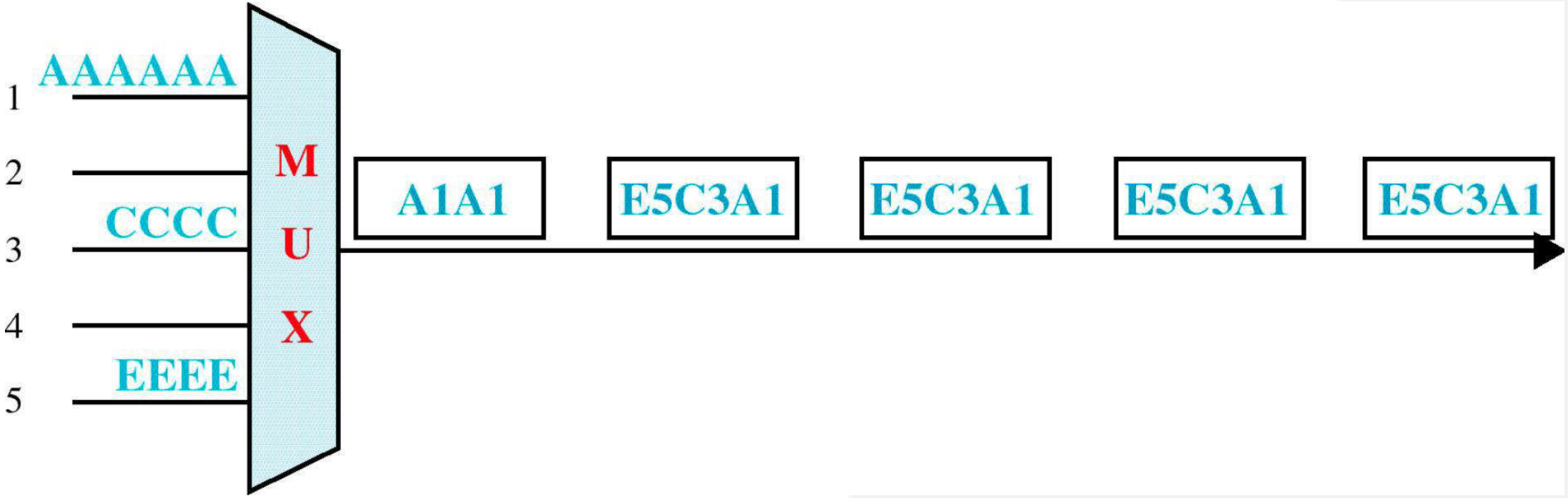
Asynchronous TDM



Asynchronous TDM

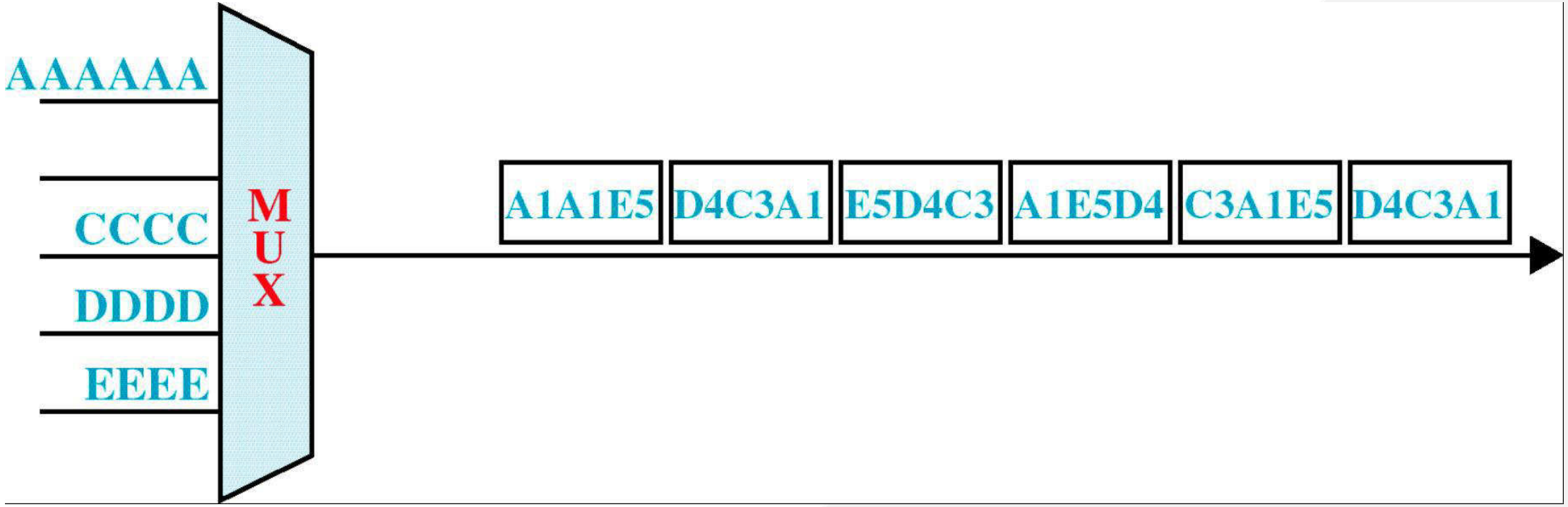
- Also known as Statistical Time Division *multiplexing*.
- In this time slots are not *Fixed* i.e. slots are Flexible.
- Total speed of the input lines can be greater than the capacity of the path.
- In ASTDM we have *n* input lines and *m* slots i.e. *m* less than *n (m<n)*.
- Slots are not predefined rather slots are allocated to any of the device that has data to send.

Frames and Addresses



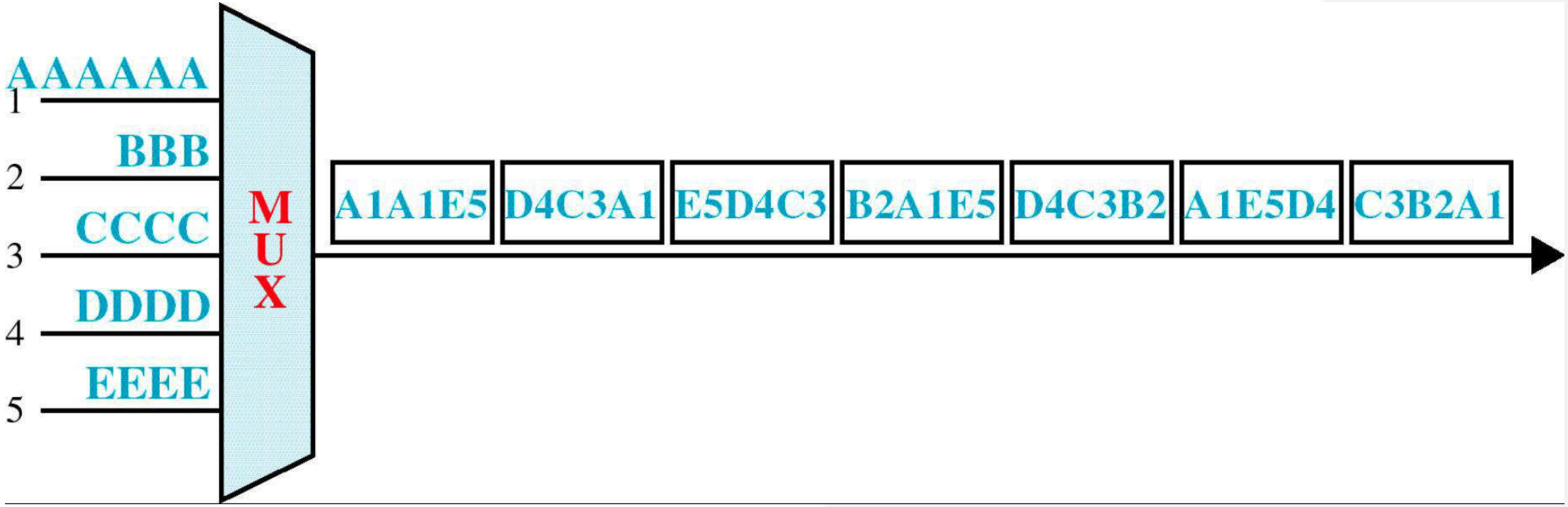
a. Only three lines sending data

Frames and Addresses



b. Only four lines sending data

Frames and Addresses



c. All five lines sending data

REFERENCES

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