



# Data Communication & Networking

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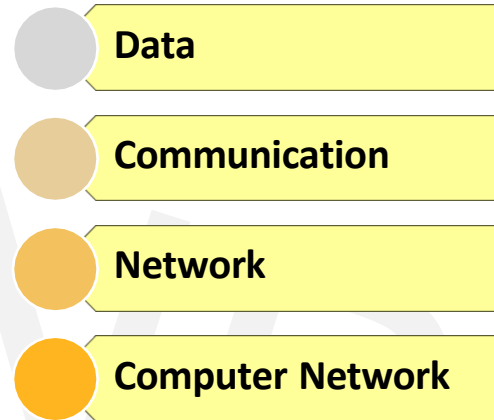
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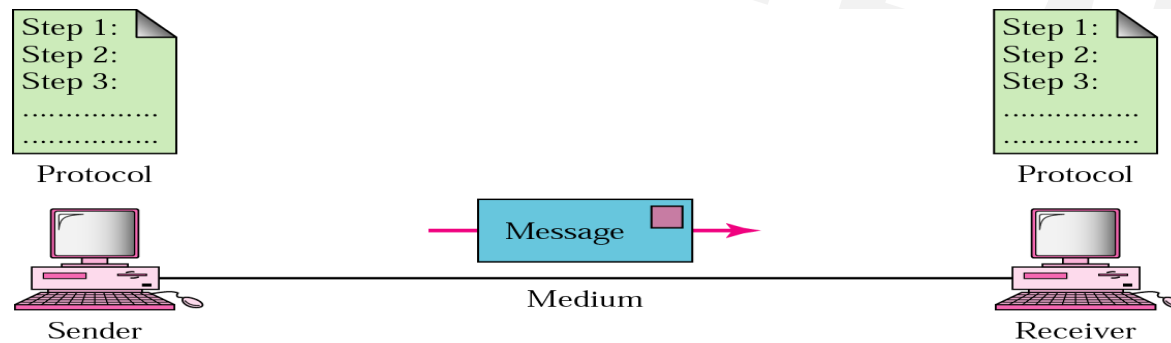


# Network Terminologies

•connecting multiple devices (computers) together to share the information group of devices/machines/IP addresses/hosts.



## Components of Data communication



## Node

- any device connected to the network(a computer, a printer etc)

## Network Interface Card (NIC)

- is the circuit board that is used to connect computers to the network.
- In most cases, this is an *Ethernet* card plugged in a computer's motherboard

**The effectiveness of a data communications system depends on four fundamental characteristics:**  
Delivery, Accuracy , Timeliness , Jitter



# Need of Network/ Applications of Network

**Information Sharing**

**Enhance communication**

**Share resources**

**Facilitate centralized management**

**Remote computing**



# Network Criteria

## Performance

- depends on a number of factors, including the number of users, the type of transmission medium, the capabilities of the connected hardware, and the efficiency of the software.
- Measured in terms of Delay and Throughput

## Reliability

- is measured by the frequency of failure, the time it takes a link to recover from a failure
- Measured in terms of availability/robustness

## Security

- Data protection against corruption/loss of data due to:
  - Errors
  - Malicious users



# Network Types

## Wired

### Medium

- Wire / Cable

### Cable Types

- co-axial
  - transfers the data in the form of electrical signals
- CAT Cable / Twisted Pair Cable (STP/UTP)
  - transfers the data in the form of electrical signals
- Fiber Optics
  - transfers the data in the form of light
  - Minimum 10gbps

### Types

- LAN , MAN , WAN

cat1 : - [it was used only for telephony network]

cat2 : 1 mbps

cat3 : 10 mbps

cat4 : 16 mbps

cat5 : 100 mbps

cat5e: 125 mbps

cat6 : 1000 mbps ~ 1 gbps

cat7 : 10000 mbps ~ 10 gbps

cat8 : 25000 mbps ~ 25 gbps

## Wireless

### Medium

- Air (EM Waves)

### Cable Types

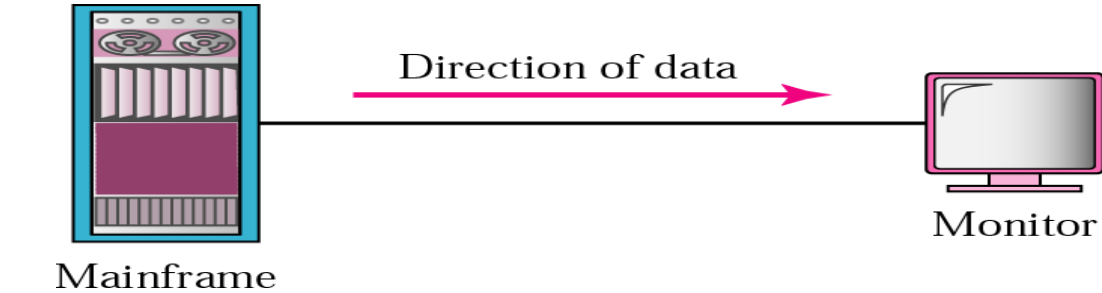
- PAN
- WLAN
- WAN (GSM)



# Media (Transmission Medium)

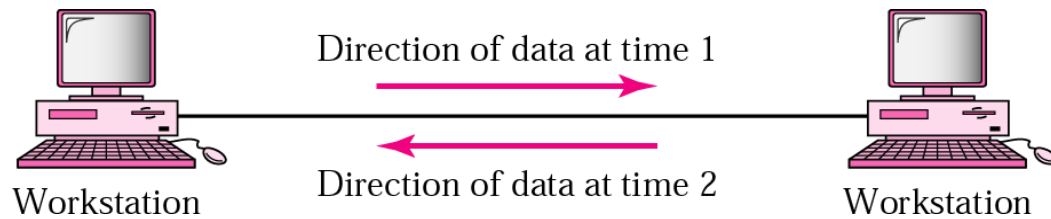


# Transmission Modes / Data Flow Direction



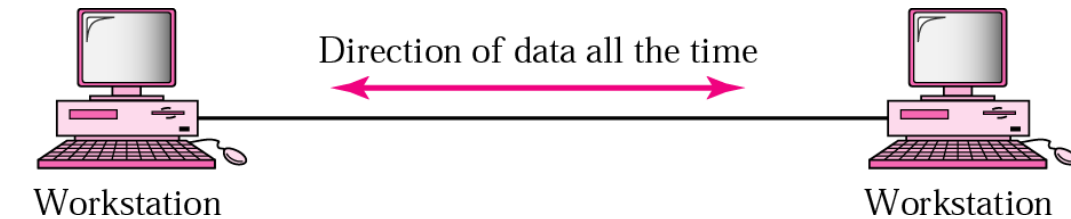
## Simplex Mode

- Example: Keyboard and traditional monitors.



## Half-Duplex Mode

- each station can both transmit and receive, but not at the same time.
- Example: Walkie- talkie



## Full-Duplex Mode

- Example: Telephone Network there is communication between two persons by a telephone line, through which both can talk and listen at the same time.





# Transmission Medium

- For any networking to be effective, raw stream of data is to be transmitted from one device to other over some medium.
- Various transmission media can be used for transfer of data.

## Types of Transmission Medium

### Guided

- Transmitted data travels through cabling system that has a fixed path.
- For example, copper wires, fibre optic wires, etc.

### Unguided

- Transmitted data travels through free space in form of electromagnetic signal.
- For example, radio waves, lasers, etc



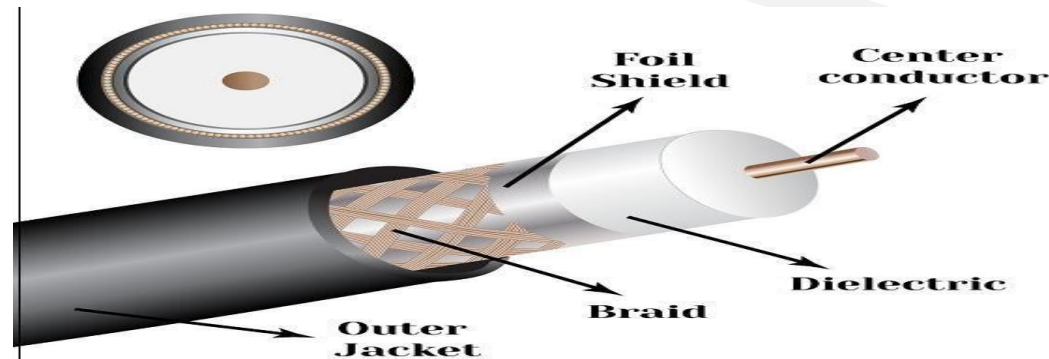
# Twisted Pair (maximum length of 100 meters)

- Most common wires used for transmitting signals
- To reduce this electromagnetic interference, pair of copper wires are twisted together.
- Shielding twisted pair cable
  - To counter the tendency of twisted pair cables to pick up noise signals, wires are shielded .
  - Such twisted pairs are called **shielded twisted pair (STP) cables**.
- The wires that are not shielded but simply bundled together in a protective sheath are called **unshielded twisted pair (UTP) cables**.



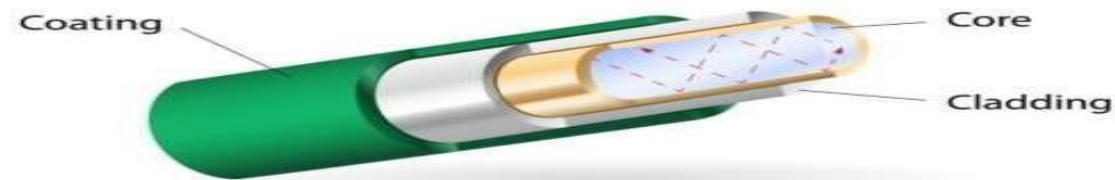
# Coaxial Cable

- Coaxial cables are widely used for **cable TV** connections and **LANs**.
- **Coaxial cables** are copper cables with better **shielding** than twisted pair cables.
- Transmitted signals may travel **longer distances** at higher speeds.
  - e.g. 1 to 2 Gbps for 1 Km cable
- Can be used for both analog and digital signals
- Inexpensive as compared to fiber optic cables
- Easy to install and maintain



# Optical Fiber

- Thin glass or plastic threads used to transmit data using light waves are called **optical fiber**.
- Signals carrying data can travel long distances without weakening
- Immune to electromagnetic interference , Suitable for industrial and noisy areas
- Three Layers:
  - **Core** made of high quality **silica glass** or **plastic**
  - **Cladding** made of high quality **silica glass** or **plastic**, with a lower refractive index than the core
  - Protective outer covering called **buffer**

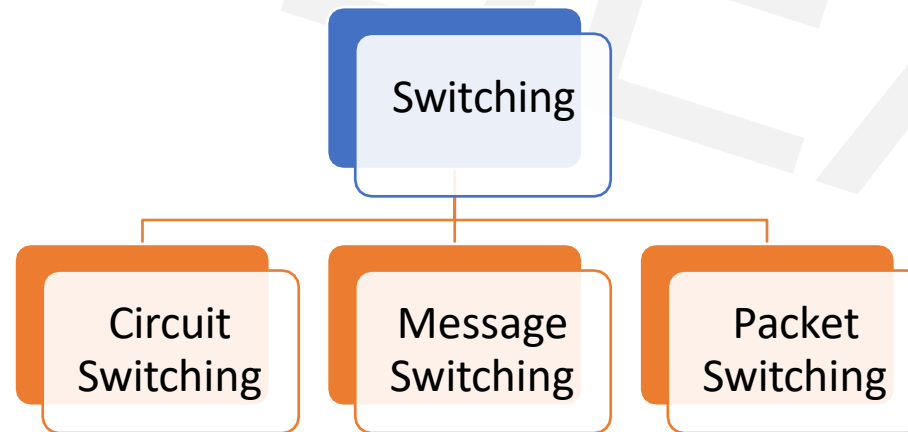


# Switching



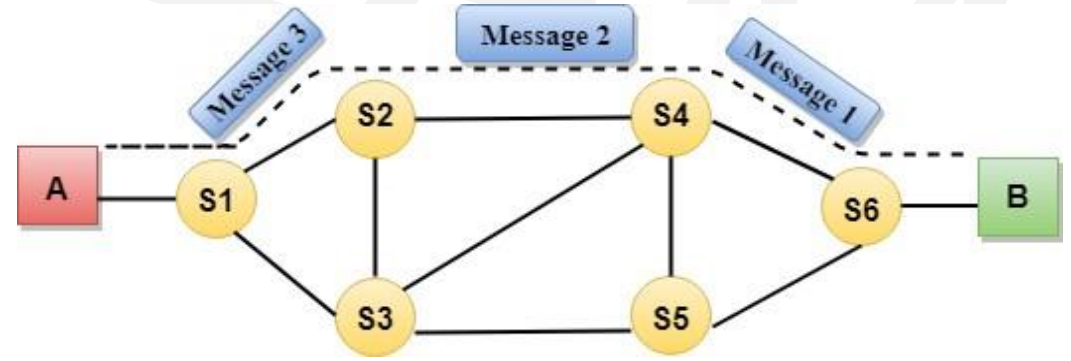
# Switching

- In large networks, there can be multiple paths from sender to receiver.
- The switching technique will decide the best route for data transmission.
- Switching technique is used to connect the systems for making one-to-one communication.
- The mechanism for exchange of information between different computer networks and network segments is called switching in Networking.



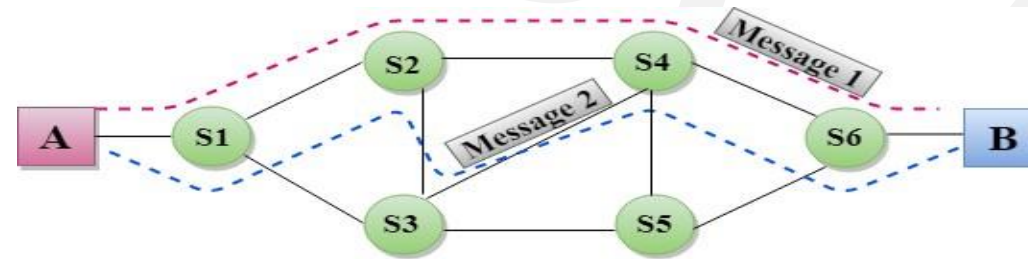
# Circuit Switching

- Establishes a dedicated path between sender and receiver.
- once the connection is established then the dedicated path will remain to exist until the connection is terminated.
- Operates in a similar way as the **telephone** works.
- when any user wants to send the data a request signal is sent to the receiver then the receiver sends back the acknowledgment to ensure the availability of the dedicated path. After receiving the acknowledgment, dedicated path transfers the data.
- Three Phases:
  - Circuit Establishment
  - Data Transfer
  - Circuit Disconnect



# Message Switching

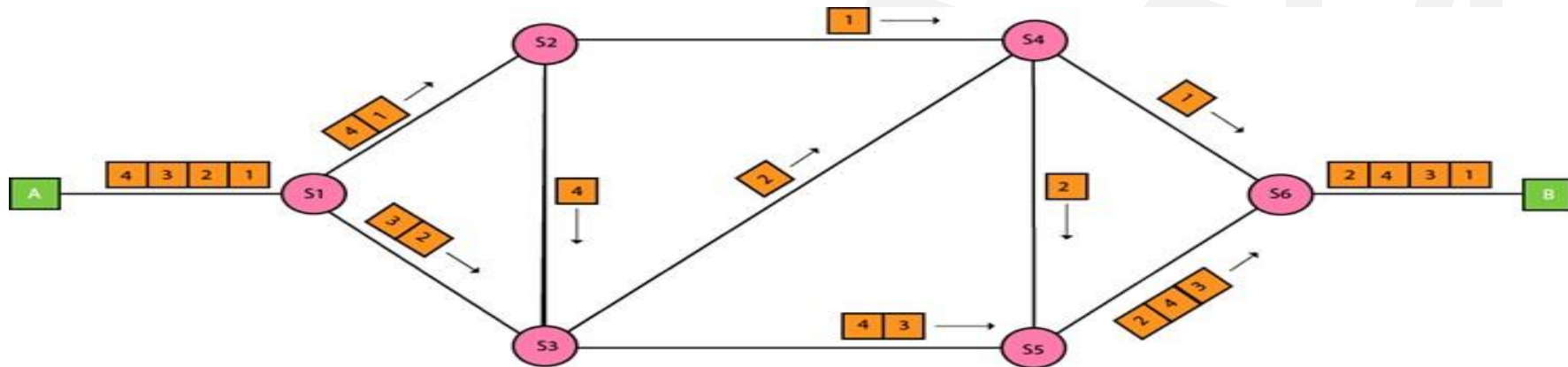
- There is no establishment of a dedicated path between the sender and receiver.
- The destination address is appended to the message.
- provides a dynamic routing as the message is routed through the intermediate nodes based on the information available in the message.
- they can provide the most efficient routes.
- Uses a method of **store and forward network**





# Packet Switching

- Message is divided in packets , packets are given a unique number to identify their order at the receiving end.
- Every packet contains some information in its headers such as source address, destination address and sequence number.
- Packets will travel across the network, taking the shortest path as possible.
- All the packets are reassembled at the receiving end in correct order.
- If any packet is missing or corrupted, then the message will be sent to resend the message.
- If the correct order of the packets is reached, then the acknowledgment message will be sent

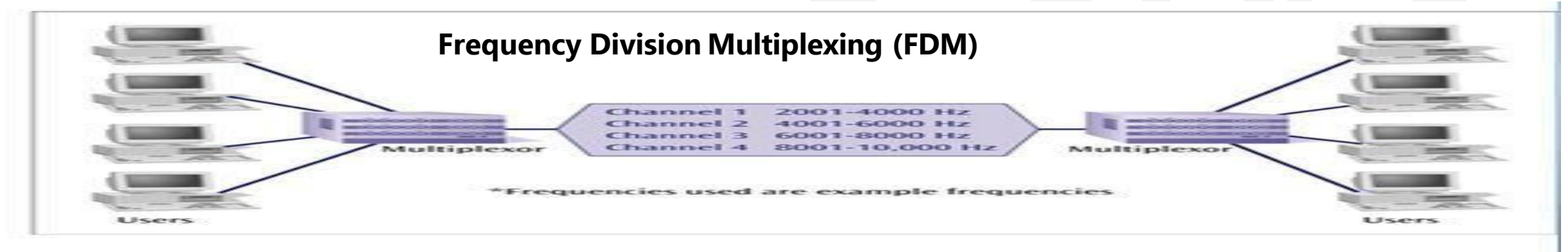


# Multiplexing



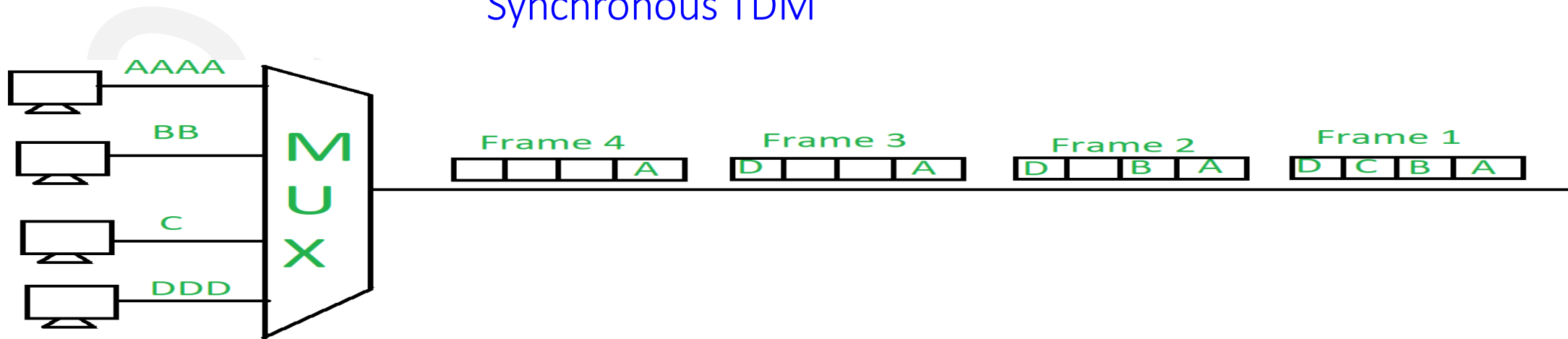
# Multiplexing

- A communication channel such as an optical fiber or coaxial cable can carry only one signal at any moment in time. **Wastage of Bandwidth**
- Multiplexing is the process of combining multiple signals into one, in such a manner that each individual signal can be retrieved at the destination.
- **Multiplexing** is used in the cases where the signals of lower bandwidth and the transmitting media is having higher bandwidth.
- Methods of Multiplexing;
  - FDM (Frequency Division Multiplexing)
  - TDM (Time Division Multiplexing)

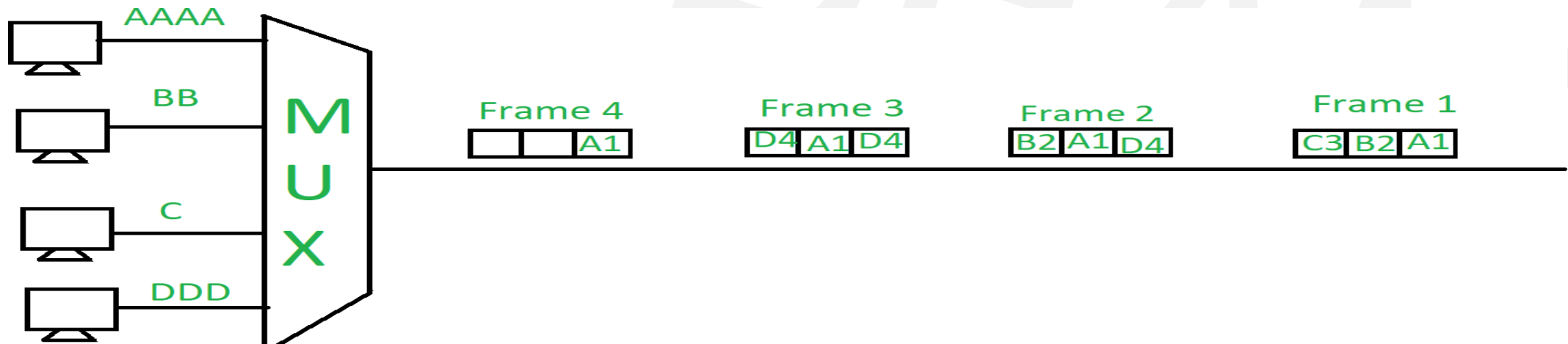


# Time Division Multiplexing (TDM)

## Synchronous TDM



## Asynchronous (or statistical) TDM



# TDM VS FDM

	TDM (Time Division Multiplexing.)	FDM(Frequency Division Multiplexing)
1	TDM works with digital signals as well as analog signals.	While FDM works with only analog signals.
2	TDM has low conflict.	While it has high conflict.
3	TDM is efficient.	While it is inefficient.
4	In TDM, time sharing takes place.	While in this, frequency sharing takes place.
5	Here synchronization pulse is necessary.	Here Guard band is necessary.
6	Framing bits (Sync Pulses) are used in TDM at the start of a frame in order to enable synchronization	FDM uses Guard bands to separate the signals and prevent its overlapping



Thank You!!

