

PHYSICAL LAYER

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TRANSMISSION MEDIA

- Transmission media is a communication channel that **carries** the information from the sender to the receiver. Data is transmitted through the electromagnetic signals.
- The main functionality of the transmission media is to carry the information in the form of bits through **LAN**(Local Area Network).
- It is a physical path between transmitter and receiver in data communication.
- In a **copper-based network**, the bits in the form of **electrical** signals.
- In a **fibre based network**, the bits in the form of **light** pulses.
- Transmission media is of two types are **wired** media and **wireless** media.
- The transmission media is available in the lowest layer of the OSI reference model, i.e., **Physical layer**.

GUIDED MEDIA

- It is defined as the physical medium through which the signals are transmitted.
- It is also known as **Bounded/Wired** media.

TWISTED PAIR

- Twisted pair is a physical media made up of a pair of cables twisted with each other.
- A twisted pair cable is cheap as compared to other transmission media.
- Installation of the twisted pair cable is easy, and it is a lightweight cable.
- The frequency range for twisted pair cable is from 0 to 3.5KHz.
- A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.
- A twist between the wire is helpful in **reducing noise**(random disturbance) and **crosstalk**(signal entering into the media). This type of cable is mostly used to provide voice and data transmission in telephone networks.
- Cables with 2pairs are use RJ-11(used in telephone) and cables with 4 pairs use RJ-45(used in ethernet) connector.

UNSHIELDED TWISTED PAIR

- UTP is more common.
- UTP cost less than STP and easily available.
- Due to its low cost, UTP is extensively used for Local Area Network and telephone connections.
- UTP cable consists of 2 or 4 pairs of twisted cables.

SHIELDED TWISTED PAIR

- The cost of the shielded twisted pair cable is not very high and not very low.
- An installation of STP is easy.
- It has a higher **attenuation**(losing strength of signal as it covers distance.).
- It is shielded that provides the higher data transmission rate.

COAXIAL CABLE

- o Coaxial cable is very commonly used transmission media, **for example, TV** wire is usually a coaxial cable.
- o The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.

Coaxial cable is of two types:

1. Baseband transmission:

- o It is defined as the process of transmitting a single signal at high speed.

2. Broadband transmission:

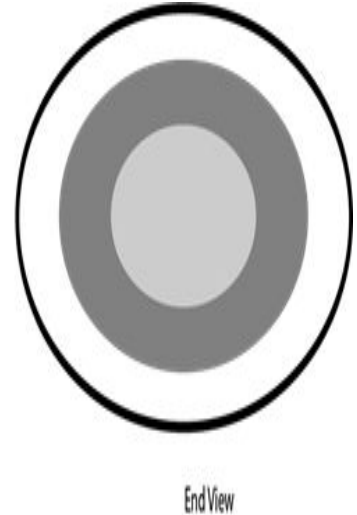
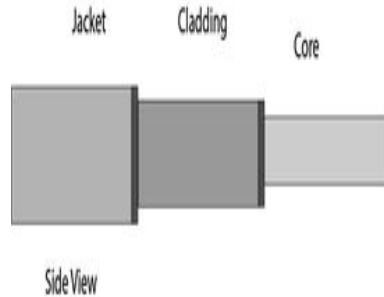
- o It is defined as the process of transmitting multiple signals simultaneously.

FIBRE OPTIC

- o Fibre optic cable is a cable that uses **electrical** signals for communication.
- o Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- o The plastic coating **protects** the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- o Fibre optics provide **faster** data transmission than copper wires.

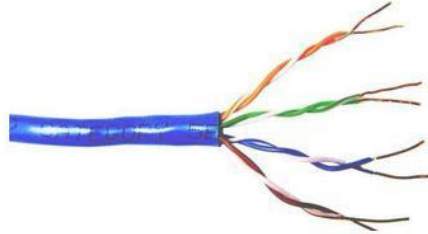
BASIC ELEMENTS OF FIBRE OPTIC CABLE

- o **Core:** The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- o **Cladding:** The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.
- o **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.



Common network cable types

- Unshielded twisted pair (UTP)



- Shielded twisted pair (STP)



- Coaxial cable



- Fiber optic



UNGUIDED TRANSMISSION

- An unguided transmission transmits the electromagnetic waves without using any physical medium. Therefore it is also known as **wireless transmission**.
- In unguided media, air is the media through which the electromagnetic energy can flow easily.

RADIO WAVES

- o Radio waves are the **electromagnetic** waves that are transmitted in all the directions of free space.
- o Radio waves are **omnidirectional**, i.e., the signals are propagated in all the directions.
- o The range in frequencies of radio waves is from 3Khz to 1 khz.
- o In the case of radio waves, the sending and receiving antenna are not aligned, i.e., the wave sent by the sending antenna can be received by any receiving antenna.
- o An example of the radio wave is **FM radio**.

MICROWAVES

- It is a technology which transmits the focused beam of a radio signal from one ground-based microwave transmission antenna to another antenna.
- Microwaves are generally an electromagnetic wave which has the frequency in the range from 1GHz to 1000 GHz.
- These are **unidirectional** waves, whereas the sending and receiving antenna is to be aligned which means the antennas are narrowly focused.
- Here antennas are mounted on the towers to send a beam to another antenna which is present at km away.
- It works on the line-of-sight transmission, which means the antennas mounted on the towers are at the direct sight of each other.
- Used for **long distance telephone services**.

INFRARED

- o An infrared transmission is a wireless technology used for communication over **short ranges**.
- o The frequency of the infrared is in the range from 300 GHz to 400 THz.
- o Infrared waves are used for very short distance communication **like TV remote, wireless speakers** etc.
- o Infrared signals have **high frequencies** and **cannot penetrate walls**. Due to its short range communication system, the use of an infrared communication system in one room will not be affected by the use of another system in the next room. This is why using an infrared TV remote control in our home will not interfere with the use of our neighbor's infrared TV remote control.

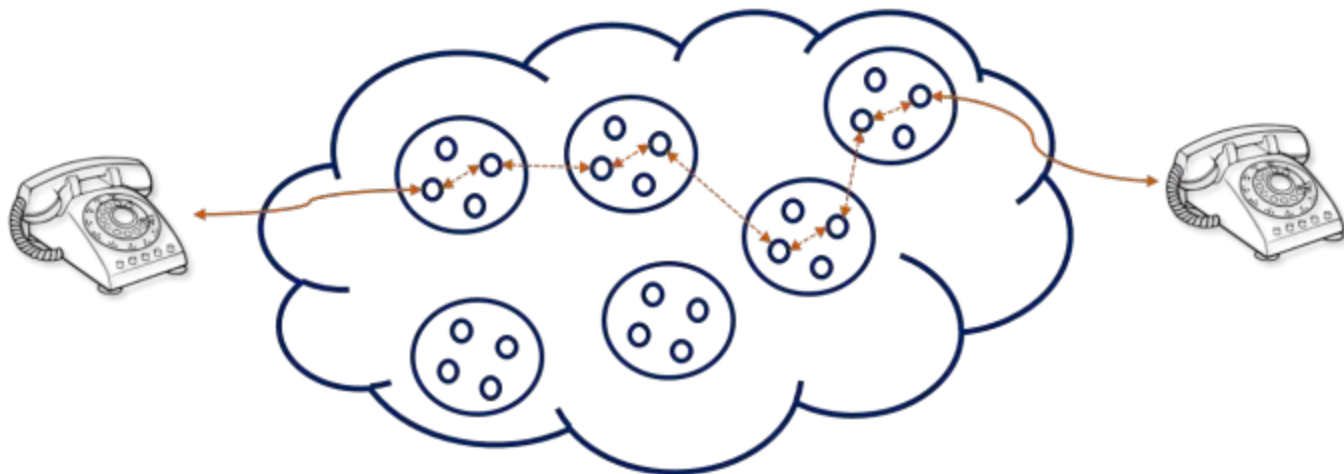
WHAT IS SWITCHING?

- Switching is the mechanism in computer networks that **helps in deciding the best route for data transmission** if there are multiple paths in a larger network.
- Larger networks may have multiple routes to link the sender and receiver. So whenever we send any information between the sender and receiver then the information switches through multiple routes.
- Whenever we send information from one device to another, that information does not directly reach that device, there are many intermediate nodes in the middle, and the information switch through these nodes.

CIRCUIT SWITCHING

- In-Circuit Switching, a dedicated channel is established for a single connection where the sender and receiver can communicate during the communication session.
- In-Circuit Switching, whenever a device communicates with another device, a dedicated communication path (circuit) is established in them over the network.
- It is a switching technique that **creates a pre-specific route** between the sender and receiver and this route is reserved for both these devices as long as the connection is active. **Both devices are connected through this specific route and data transfer can also be done only through this specific route.** Other devices cannot use this specific route for data transmission because this specific route is reserved.
- This type of network switching **was designed and used in the early analog telephone network.** We used circuit switching to physically connect devices in the telephone network.

Circuit Switching



3 PHASES IN CIRCUIT SWITCHING

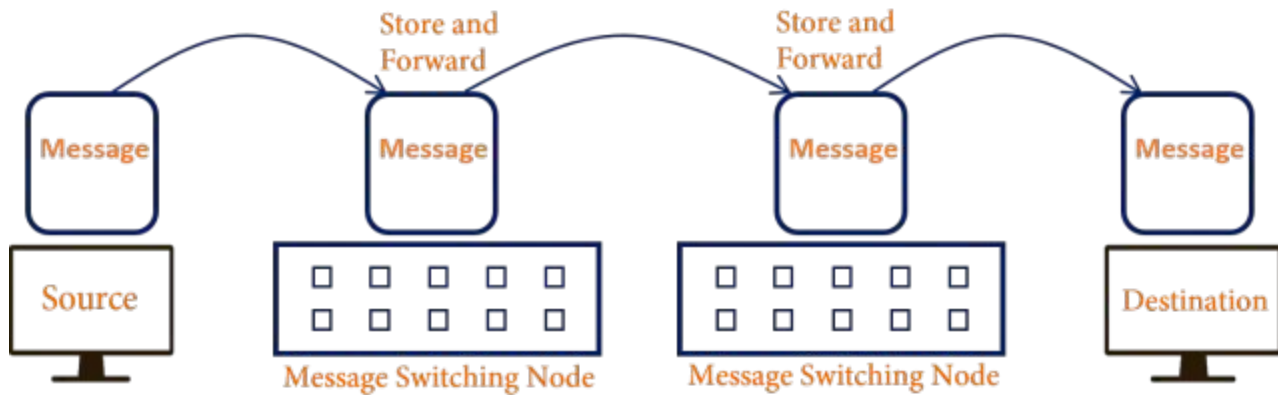
- **Establish a circuit:** In the first phase, a circuit is established means a dedicated link is established between the sender and the receiver through a number of switching centers or nodes.
- **Transfer the data:** Once the circuit is established, means the connection is established between the sender and receiver, they can communicate with each other.
- **Disconnect the circuit:** Once the communication is completed between the sender and receiver, the circuit disconnects. The circuit disconnection is done by one of the users i.e. the sender or the receiver.

Simple Example of Telephone Network: First we call the other user, once he receives the call, the connection is established and both can communicate with each other, after if one of the users disconnects the phone, the circuit disconnects.

MESSAGE SWITCHING

- There is no dedicated path established between the sender and receiver in message switching, as in circuit switching.
- For sending the message, there are many intermediary message switching nodes that are responsible for transferring the message, and the message is transmitted as a whole from the source node-to-destination node.
- In Message Switching, when the source node sends a message, the destination address is appended to the message. So in message switching, there is no need to establish a dedicated path between two communication nodes.
- **When a sender sends a message, the message sends as a whole to the next message switching node, store it in its entirety on the disk, and then transmit the whole message to the next switching node and so on, until the message reaches the destination.**
- If the next message switching node does not have enough space to store the message, the previous switching node has to wait. When the next node has enough space to store the message, then the previous forwards the message to the next node. That's why this type of network is also called a **store-and-forward network**.

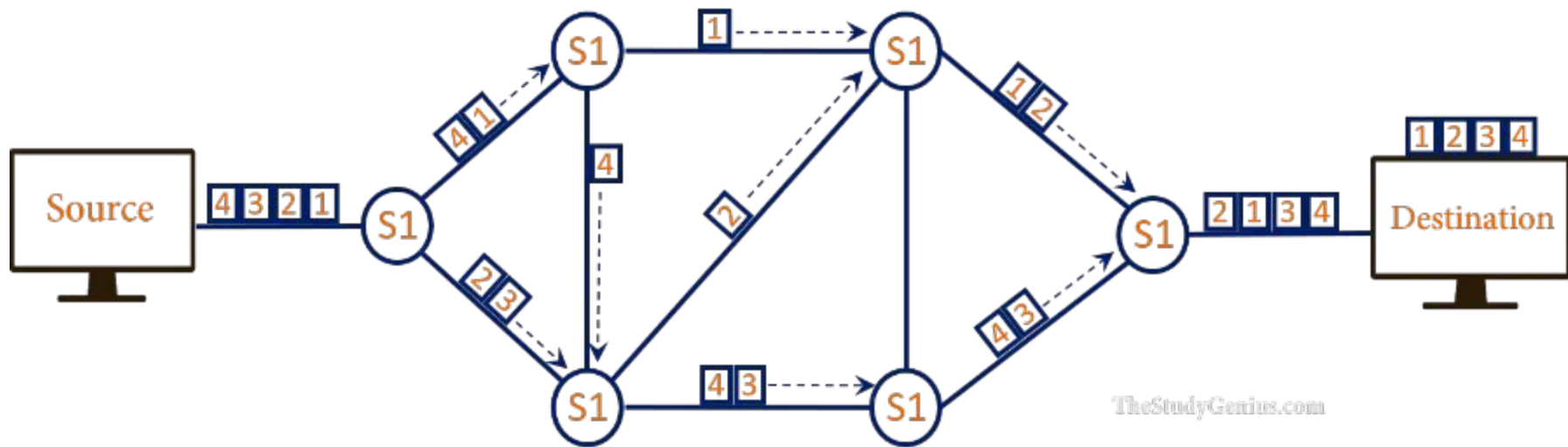
Message Switching



PACKET SWITCHING

- In packet switching, when we send a message, then the whole message **is divided into smaller pieces called packets**. These pieces or packets travel across the network and take the shortest path possible.
- Every packet has a **sequence number** to identify their order at the receiving end.
- Each packet contains some information including a source address, a destination address, intermediate node address information, sequence number, etc. so that individual packets can be routed through the internetwork independently.

Packet Switching



BANDWIDTH

- Bandwidth is the data capacity of a channel.
- The potential of transferring data in a particular period of time is bandwidth.
- In networking, it measures the maximum rate at which the data can be transmitted by a device.
- If a network has high bandwidth, it means that the high amount of data can be transferred and received.
- It does not affected by the physical obstruction.

THROUGHPUT

- Throughput can be defined as the actual measure of data transmitted in a specific period of time.
- Throughput can be affected by the network traffic, transmission errors, change in interference, or the network devices.

LATENCY

- Latency is an expression of how much time it takes for a data packet to travel from one designated point to another.

JITTER

- Jitter refers to small intermittent delays during data transfers. It can be caused by a number of factors including network congestion, collisions, and signal interference.