LEARNING RESOLUTION

(Unit 3: Multiplexing and Switching-Data Communication and Computer Network)

Course: Data communication & Computer Network

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Preface

This document is a study material to create the students (Us) more educated about the second chapter of the course "Multiplexing. In this document we will learn the important terminologies related to this topic along with different types of multiplexing along with modulation and switching techniques.
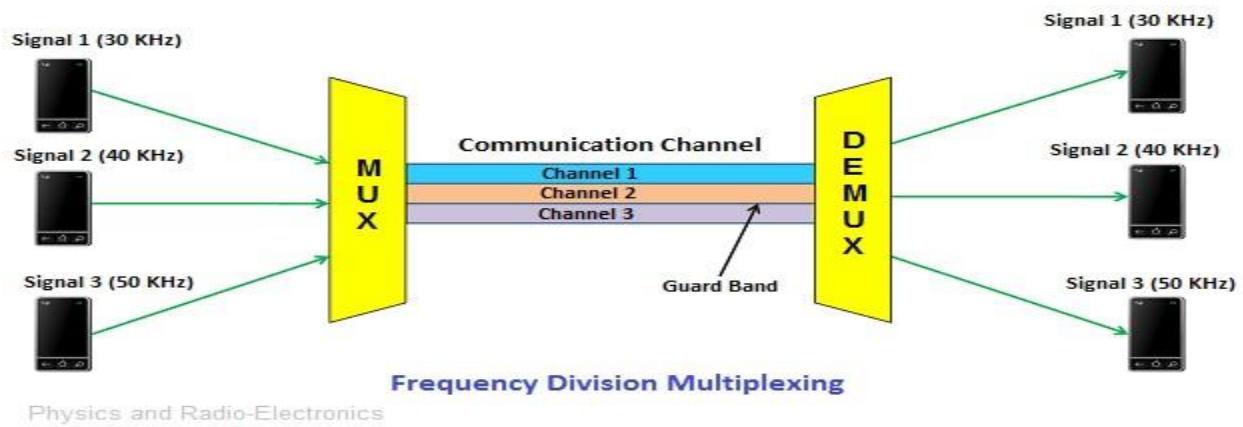
1. Multiplexing:

Multiplexing is a technique that lets multiple signals travel together on a single data line. Think of it like a single cable carrying lots of TV channels. There are three main types of multiplexing: FDM, which divides the cable into different frequency bands for each signal; TDM, which gives each signal a turn to send data in a specific time slot; and WDM, which sends signals of different colours of light through an optical fiber.
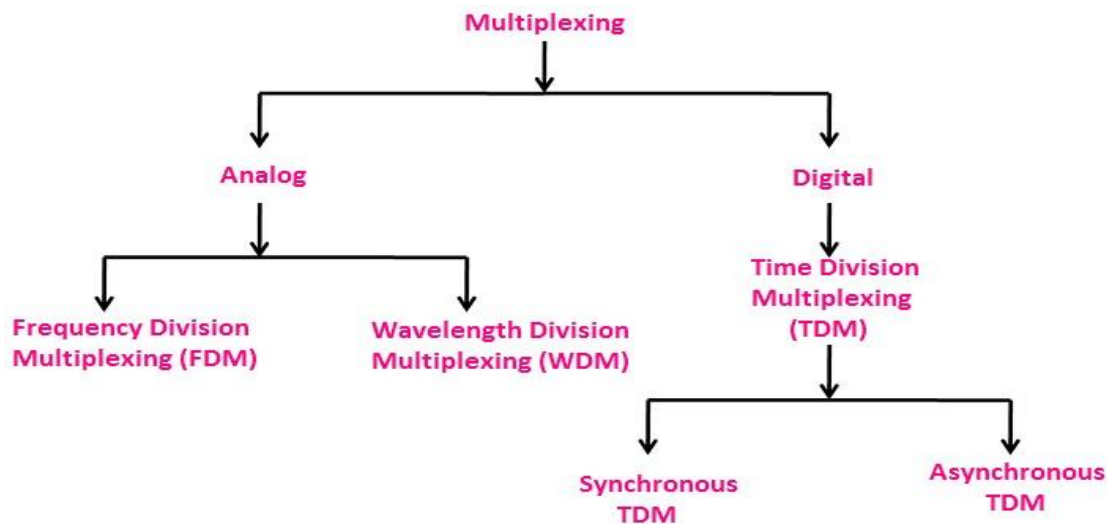
❖ Frequency Division Multiplexing (FDM):

FDM is a technique used to combine multiple analogue signals into a single composite signal by assigning each signal a different frequency range, which allows them to pass without interfering with one another.

For example, in television broadcasting, FDM is used to transmit multiple channels over a single cable. Each TV channel is assigned a different frequency range, and these channels are combined into a single signal that is transmitted over the cable. At the receiving end, the signal is separated back into the individual channels base.

Frequency Division Multiplexing

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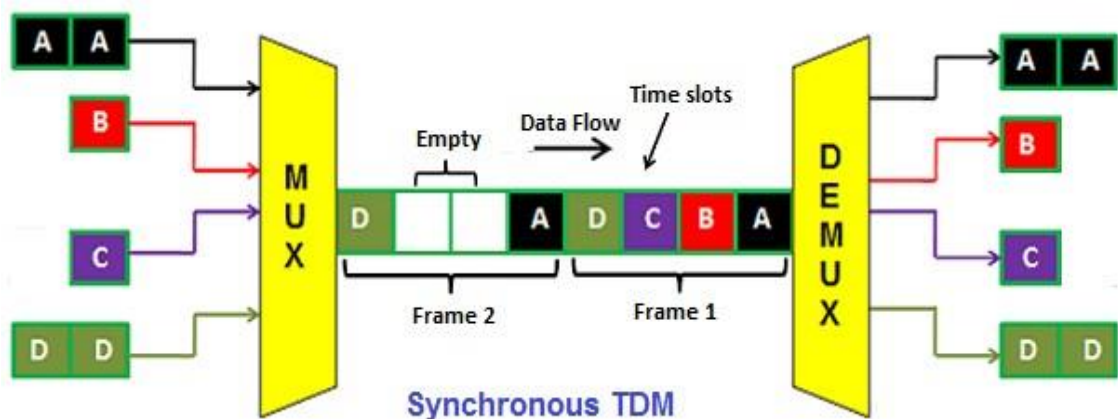
❖ Time Division Multiplexing (TDM):

Time Division Multiplexing (TDM) is a technique for transmitting multiple independent signals over a single communication channel. In TDM, the signals are divided into smaller parts and transmitted sequentially one after the other. Each signal gets its own time slot within the overall transmission cycle. So, during a single transmission cycle, multiple signals take turns to use the communication channel.

Time Division Multiplexing
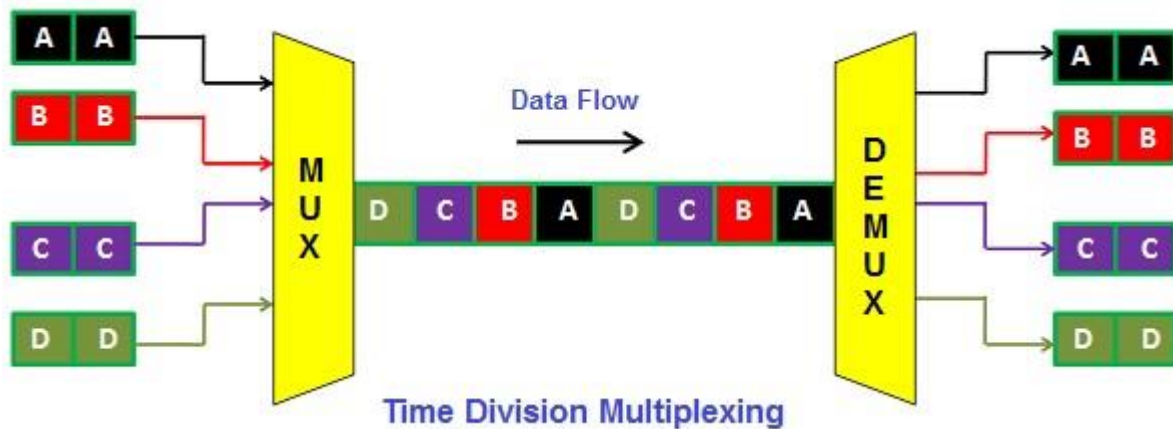
Different types of TDM:

I. Synchronous time division multiplexing:
    Synchronous time division multiplexing is a technique where each transmitting device is given a fixed time slot to send data, regardless of whether it has any data to send or not. If a transmitting device has no data to send during its time slot, the slot will remain empty.


Synchronous TDM

II. Asynchronous time division multiplexing:

In Asynchronous time division multiplexing, the time slots are not fixed. In synchronous TDM, the number of time slots is equal to the number of devices (transmitters). But in Asynchronous TDM, the number of time slots is not equal to the number of devices (transmitters). The time slots in asynchronous TDM are always less than the number of devices (transmitter).Data are send with an indicator.


Asynchronous TDM
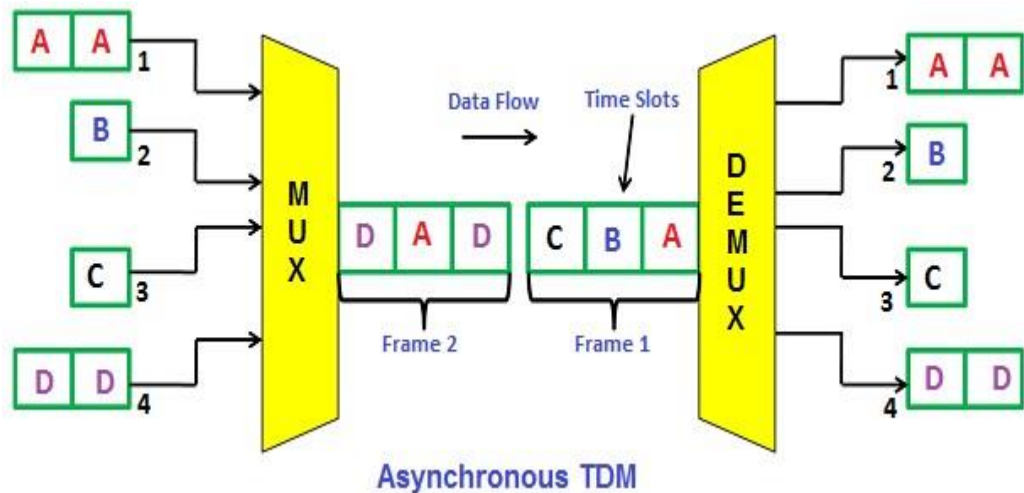
❖ Frequency Division Multiplexing (FDM):
FDM is a way to send multiple signals over a single link by combining them into a single composite signal. Each signal is generated using a different frequency carrier. This allows the signals to be sent simultaneously without interfering with each other. Once the signals are combined, they can be transmitted over a single link to their destination.

Frequency Division Multiplexing
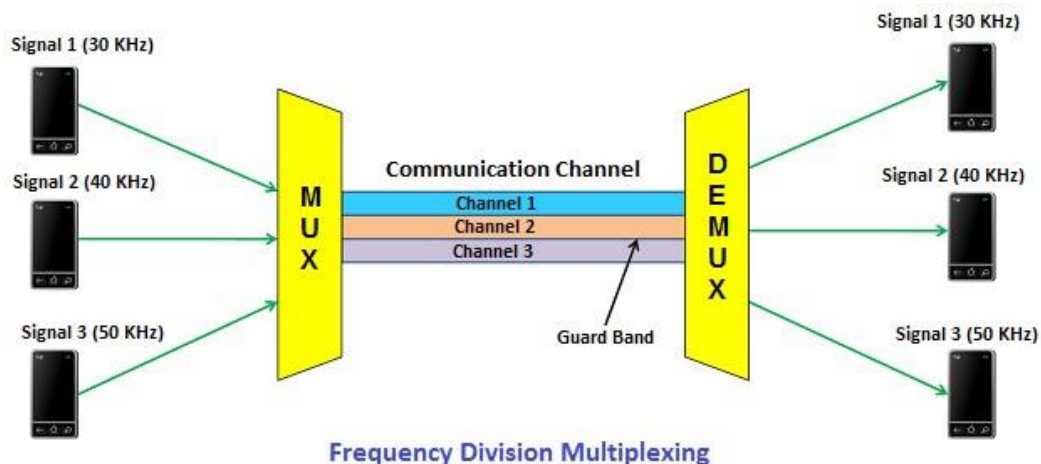
❖ WDM (Wavelength Division Multiplexing):
  WDM is a method of transmitting data over fiber-optic cables using different colours of light. This allows multiple data streams to be sent over the same cable simultaneously, greatly increasing the amount of information that can be transmitted at once.
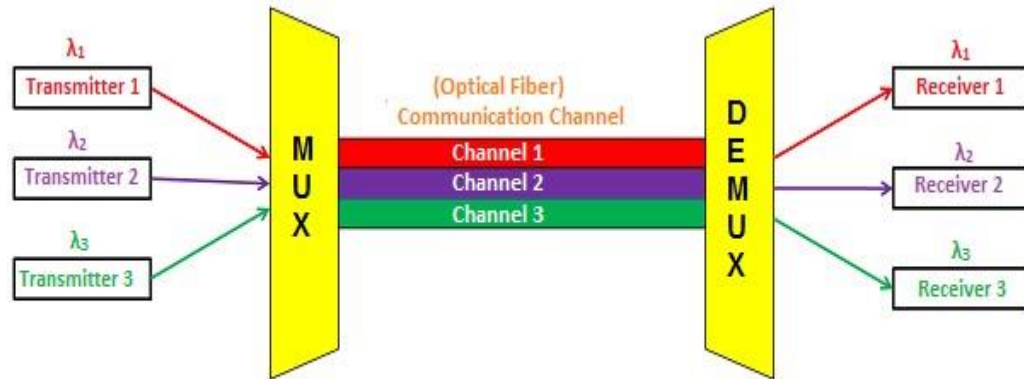

Wavelength Division Multiplexing

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2. Modulation:

Modulation is a process of changing the characteristics of the wave to be transmitted by superimposing the message signal on the high-frequency signal.

Analog modulation

- In amplitude modulation, the amplitude of the carrier wave is varied in proportion to the message signal, and the other factors like frequency and phase remain constant.

- Frequency modulation (FM) varies the frequency of the carrier in proportion to the message or data signal while maintaining other parameters constant.

- In phase modulation, the carrier phase is varied in accordance with the data signal.
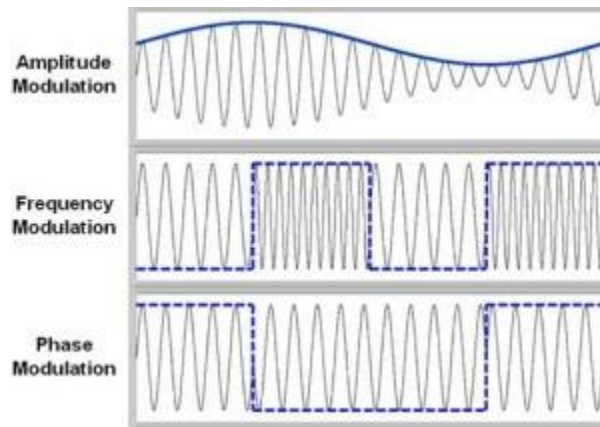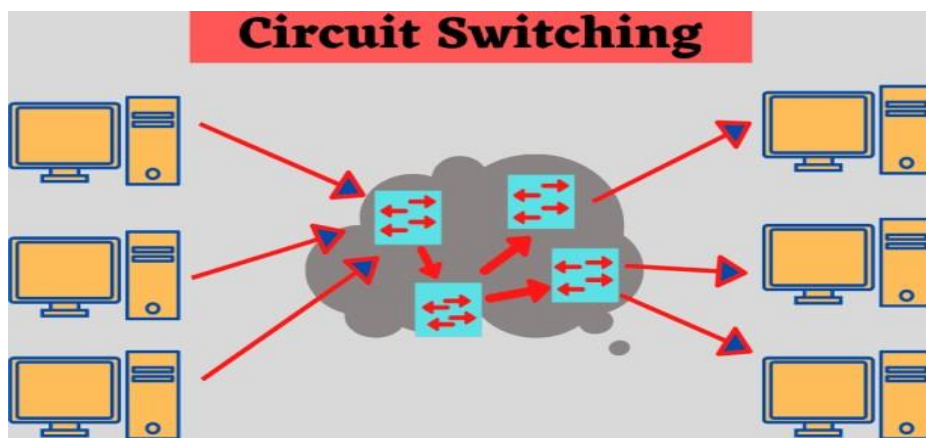
3. Switching:

Switching is a technique which is used in a large network, it means those networks that contain a large number of nodes, wires, device etc.
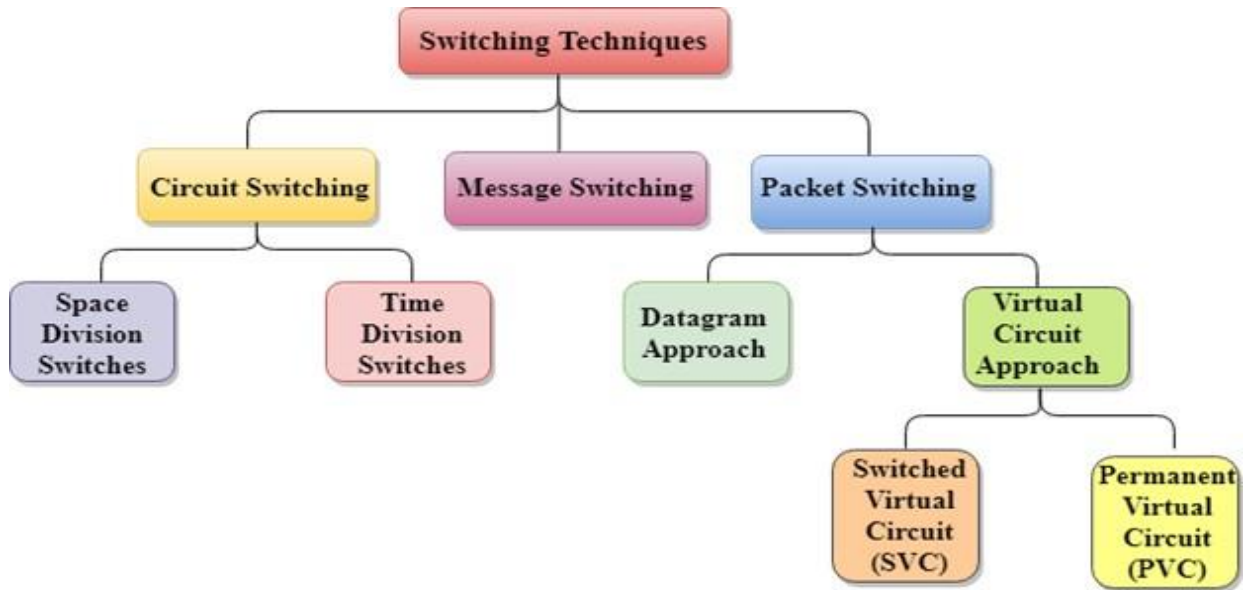
❖ Circuit Switching:

Whenever the two nodes transmit with each other on a devoted path it is known as Circuit switching. To transfer the data all the circuits must be ready and established so that the transfer of data can take place. Circuits may be permanent or temporary. Those applications that use the circuit switching have to go through three phases.
- Establish a circuit
- Transfer the data
- Disconnect the circuits

❖ Message Switching:

Message switching is a network technique in which data is routed in its entirety from the source node to the destination node, one hope at a time. During message routing, every intermediate switch in the network stores the whole message.
There are the two most important characteristics of a message:
▪ Store and forward
▪ Message delivery
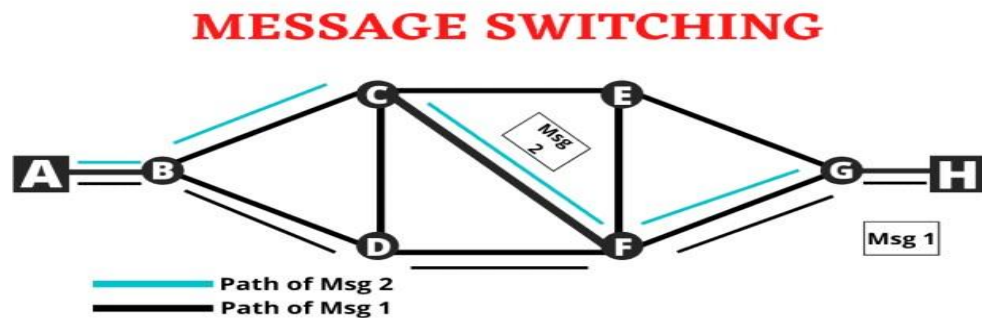
❖ Packet Switching:

Packet is the third and last type of Switching, this is a type of connectionless network switching technique, and a message is grouped and divided into a number of units called packets. There is no need to establish a dedicated circuit for communication.