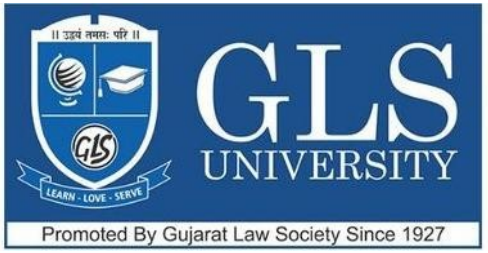


GLS University

Faculty of Computer Application & IT

SY BCA
Semester - IV
2024-2025

210301404
Data Communication & Networks (DCN)
(Core Subject)

Unit 2
Multiplexing and Demultiplexing

Supplementary Reading :

1. Forouzan, B. A. (2001). Data Communication and Networking. Tata McGraw Hill Education Private Limited.
2. Godbole, A. S. (2002). Data Communication and Computer Networks. Tata McGraw-Hill Companies.

Topics to be Covered :

Concept of Multiplexing and Demultiplexing

- Types of Multiplexing

o FDM

o TDM

o WDM

- FDM versus TDM

Transmission Errors: Detection and correction

- Introduction
- **Error classification**
  - o Delay Distortion
  - o Attenuation
  - o Noise
- **Types of Error**
- **Error Detection**
  - o Checksum
  - o VRC
  - o LRC
  - o CRC
- **Recovery from errors**
  - o Stop and Wait
  - o Go back n
  - o Sliding Window

Concept of Multiplexing and Demultiplexing

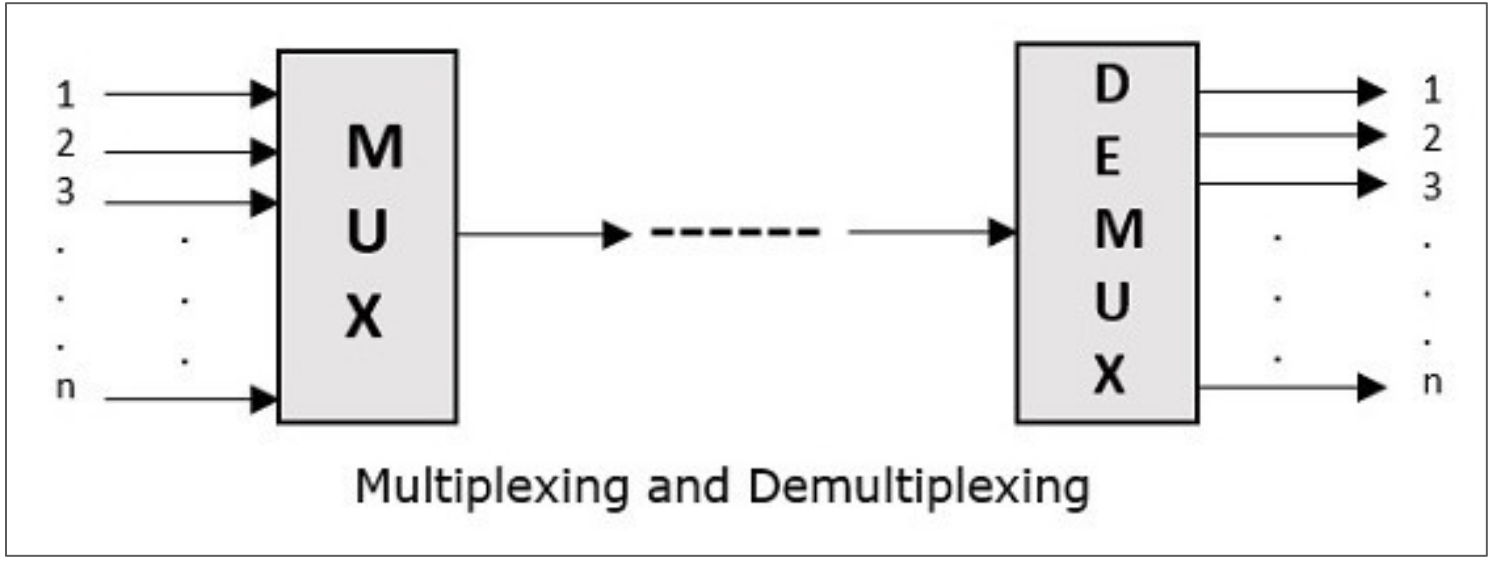
Multiplexing is the process of **combining multiple signals into one signal**, over a shared medium. It divides the physical line or medium into logical segments called channels.

Multiplexing is done by using a device called **multiplexer (MUX)** that combines n input lines to generate one output line i.e. (many to one). Therefore multiplexer (MUX) has several inputs and one output.

At the receiving end, a device called **demultiplexer (DEMUX) is used that separates signal into its component signals**. So demultiplexer has one input and several outputs.

Multiplexing and Demultiplexing

The following figures illustrates the concept of MUX and DEMUX. Their primary use is in the field of communications.

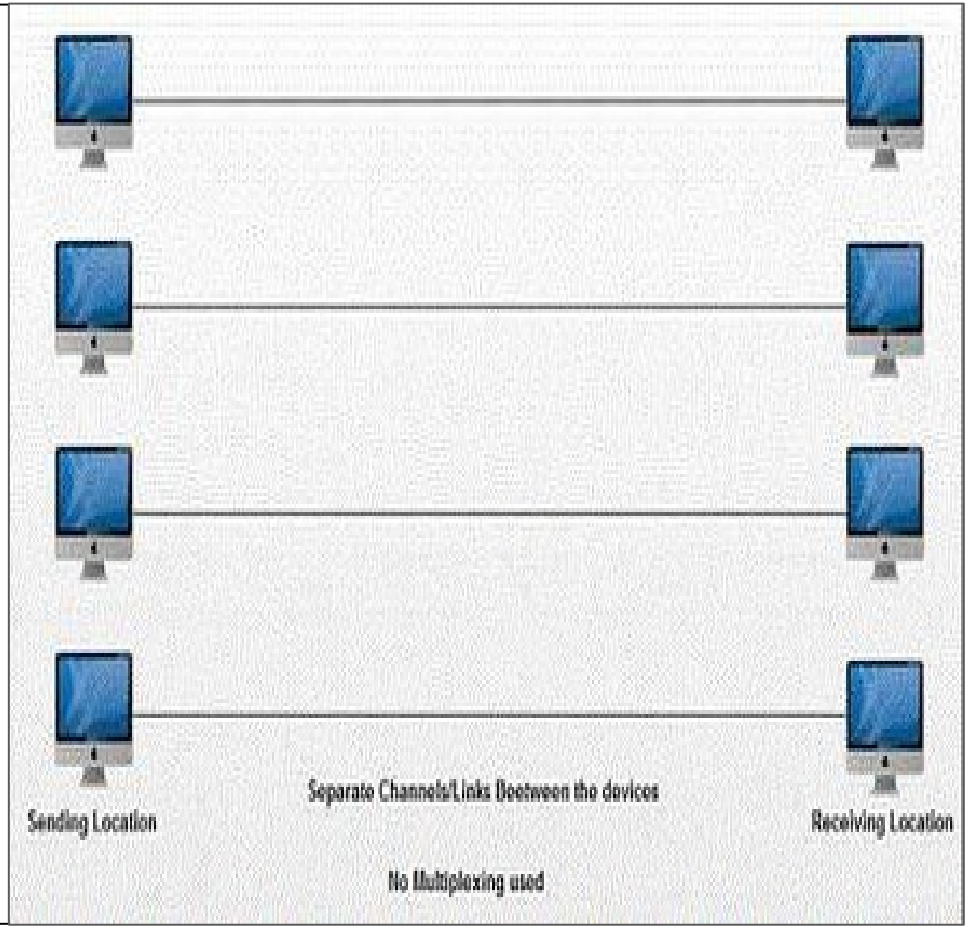


Multiplexing and Demultiplexing

Advantages of Multiplexing

If no multiplexing is used between the users at two different sites that are distance apart, then separate communication lines would be required as shown in fig.

This is not only costly but also become difficult to manage. If multiplexing is used then, only one line is required. This leads to the reduction in the line cost and also it would be easier to keep track of one line than several lines. Multiplexing efficient for utilization of bandwidth.



Analog Multiplexing

The signals used in analog multiplexing techniques are analog in nature. The analog signals are multiplexed according to their frequency (FDM) or wavelength (WDM).

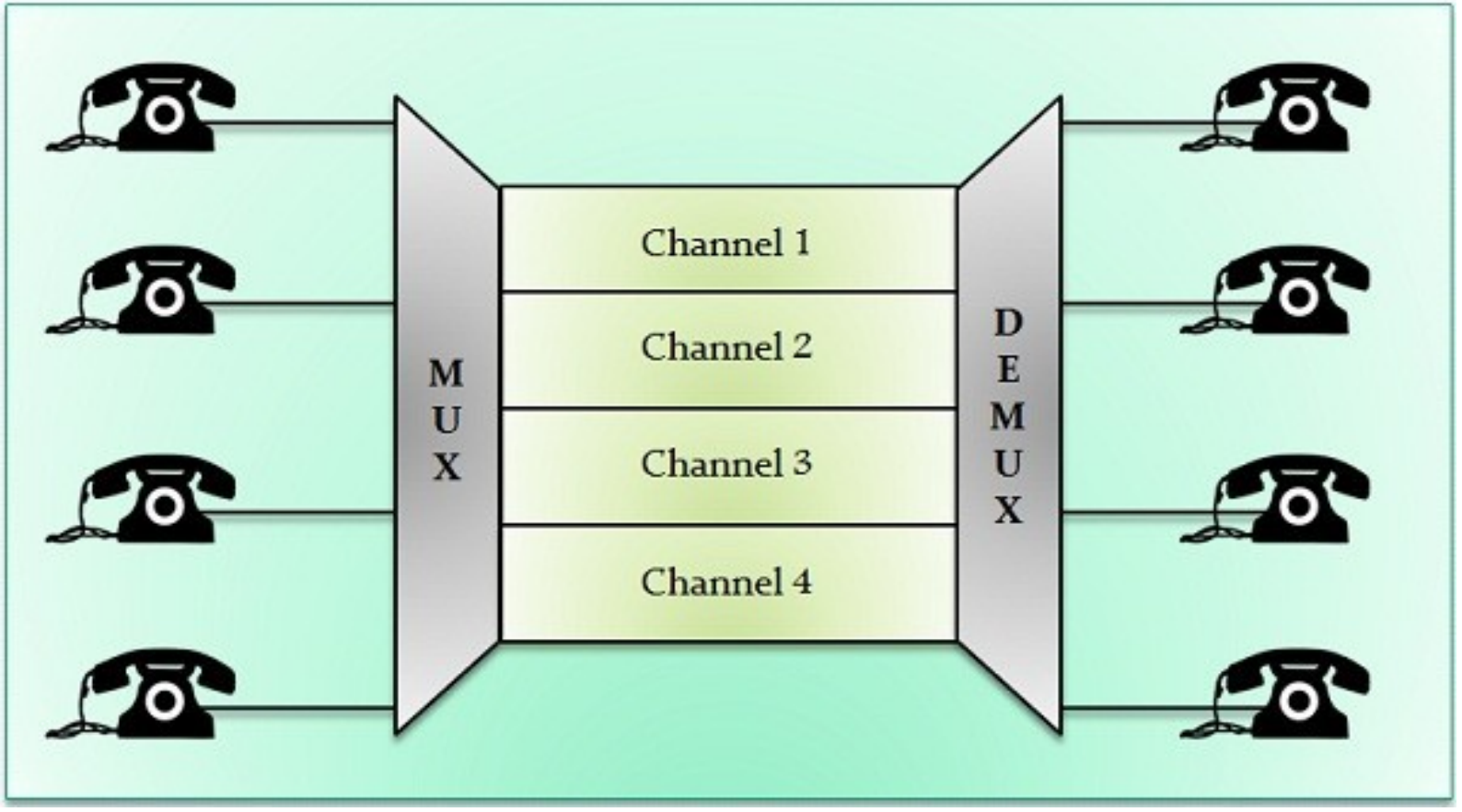
FDM - Frequency Division Multiplexing

FDM used in public telephones and cable TV systems, where a single cable carries multiple video signals from different channels to the TV set. With the remote control, we essentially activate the electronic circuits in the television to select a specific frequency band or channel and our program on TV set is set(visualize).

The signals from other programs also actually traverse to your TV set on the same cable, but they lie idle at your TV set for you to choose from.

In FDM , **the medium is divided into number of channels, each with a frequency bandwidth.** Though the composite signal ultimately carried by the medium in analog the input signals can be analog or digital. If the input

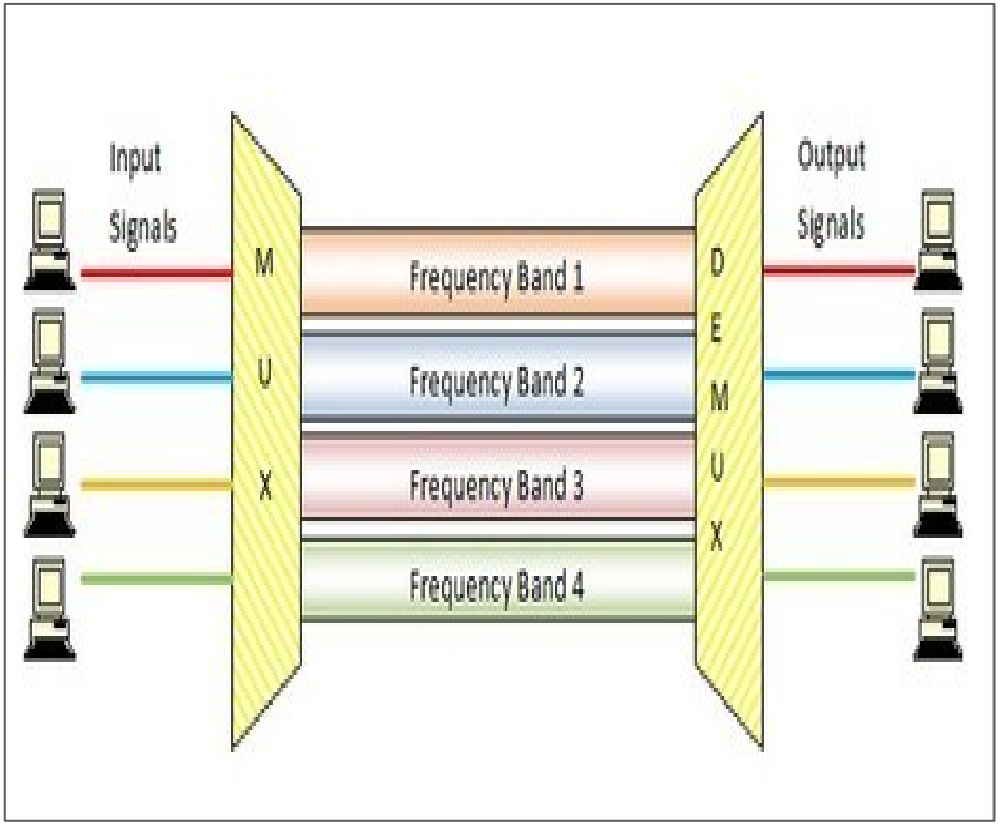
FDM - Frequency Division Multiplexing



FDM - Frequency Division Multiplexing

Frequency division multiplexing (FDM) is a technique of multiplexing which means combining more than one signal over a shared medium. In FDM, signals of different frequencies are combined for concurrent transmission.

In FDM, the total bandwidth is divided to a set of frequency bands that do not overlap. Each of these bands is a carrier of a different signal that is generated and modulated by one of the sending devices. The frequency bands are separated from one another by strips of unused frequencies called the guard bands, to prevent overlapping of signals.



FDM - Frequency Division Multiplexing

Advantages:

- It does not need synchronization between its transmitter and receiver.
- Frequency division multiplexing (FDM) is simpler and easy demodulation.
- It is used for analog signals.
- A large number of signals (channels) can be transmitted simultaneously.

Disadvantages:

- It suffers problem of cross-talk.
- It is used only when a few low speed channels are desired.
- Intermodulation distortion takes place.
- The communication channel must have a very large bandwidth.
- Large number of modulators and filters are required.

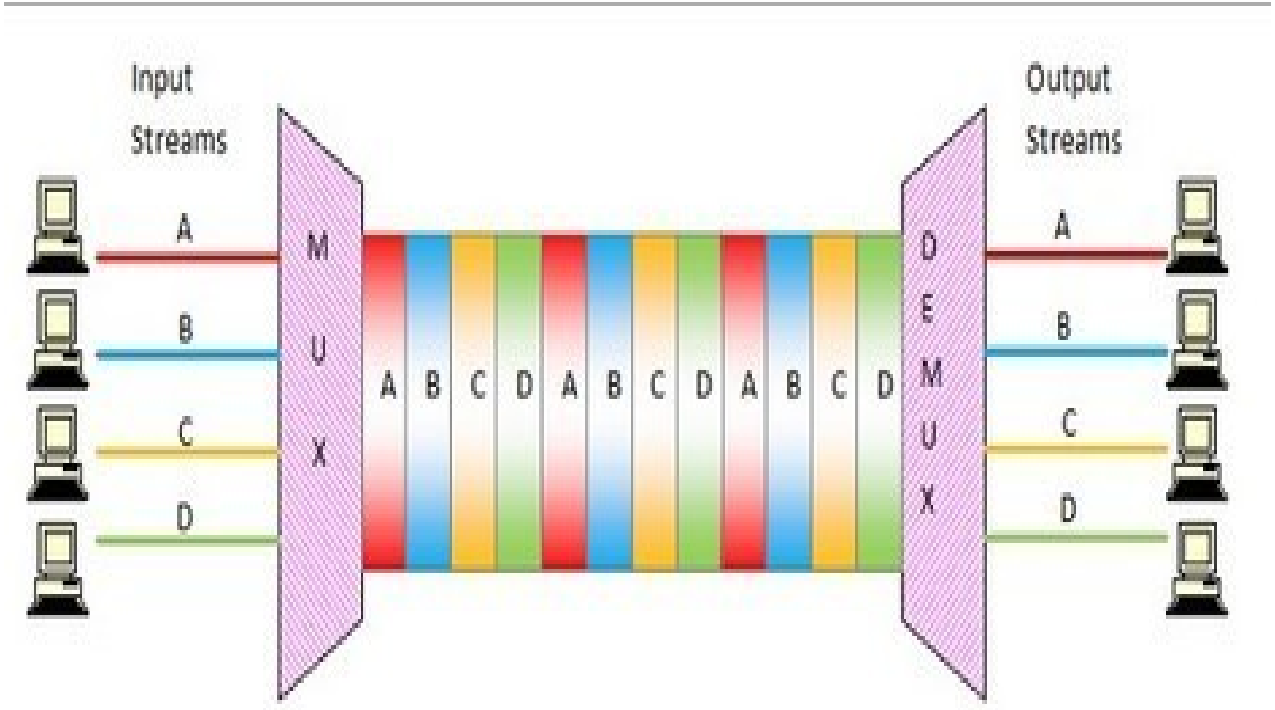
TDM – Time Division Multiplexing

- Time division multiplexing (TDM) is a technique of multiplexing, where the users are allowed the total available bandwidth on time sharing basis. Here the time domain is divided into several recurrent slots of fixed length, and each signal is allotted a time slot on a **round-robin basis.**

- In TDM, the data flow of each input stream is divided into units. One unit may be 1 bit, 1 byte, or a block of few bytes. Each input unit is allotted an input time slot. One input unit corresponds to one output unit and is allotted an output time slot. During transmission, one unit of each of the input streams is allotted one-time slot, periodically, in a sequence, on a rotational basis. This system is popularly called round-robin system.
- **Synchronous TDM (also known as TDM)**
- **Statistical TDM**

TDM – Time Division Multiplexing

Consider a system having four input streams, A, B, C and D. Each of the data streams is divided into units which are allocated time slots in the round – robin manner. Hence, the time slot 1 is allotted to A, slot 2 is allotted to B, slot 3 is allotted to C, slot 4 is allotted to D, slot 5 is allocated to A again, and this goes on till the data in all the streams are transmitted.



TDM – Time Division Multiplexing

Statistical Time Division Multiplexing (STDM)

In STDM, the time slots are dynamically allocated to the slots according to demand. The multiplexer checks each input stream in a round – robin manner and allocates a slot to an input line only **if data is present there, otherwise, it skips to the next stream and checks it.**

TDM – Time Division Multiplexing - Synchronous

Synchronous TDM (also known as TDM)

- In synchronous TDM, each device is given same time slot to transmit the data over the link, irrespective of the fact that device has any data to transmit or not.
- The time slice is allocated to a source node regardless of whether it wants to send some data or not.
- Each device places its data onto the link when its time slot arrives i.e. 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.
- The various time slots are organized into frames and each frame consists of one or more time slots dedicated to each sending device.
- **If there are n sending devices, there will be n slots in frame i.e. one slot for each device.**
- A small buffer is associated with every source node. At any time, note all nodes may want to send some data.
- If there was no data to be transmitted, the buffer will be empty, but it will still be sent.
- Hence it can be a very wasteful scheme, because the time slot is allotted to a source node even if it has nothing to send.