

Multiplexing

It is the set of techniques that allow the simultaneous transmission of multiple signal across a single data link.

Importance of Multiplexing

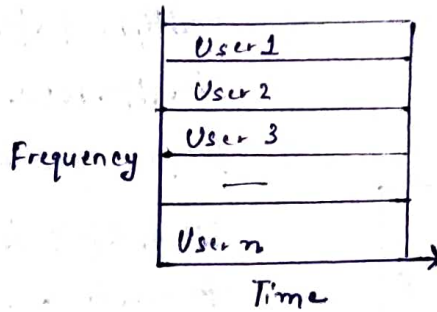
To make efficient use of high speed telecommunication line, some form of multiplexing is used. Multiplexing allows several transmission sources to share a larger transmission capacity.

Four basic multiplexing Techniques

- Frequency Division Multiplexing
- Time Division Multiplexing
- Code Division Multiplexing
- Space Division Multiplexing

Frequency Division Multiplexing

FDM is the technique used to divide the available bandwidth into a number of smaller independent logical channels with each channel having a smaller bandwidth. It must be divided into non-overlapping frequency bands.



Even though there are gaps (guard bands) between the channels, there is some overlap between adjacent channels.

Advantages

- The users can be added to the system by simply adding another pair of transmitter modulator and receiver demodulators.
- FDM system support full duplex information flow which is required by most of application.

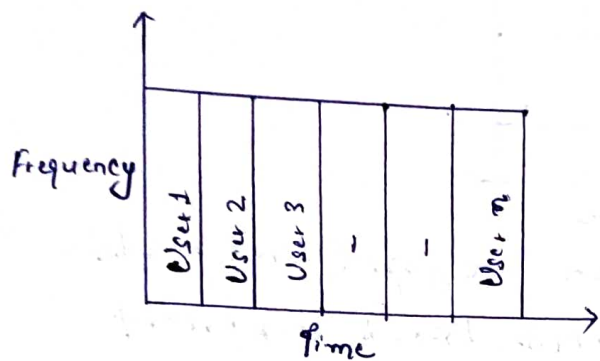
Disadvantages

- In FDM system, the initial cost is high. This may include the cable between the two ends and the associated connectors for the cable.
- A problem with one user can sometimes affect the others.
- Each user requires a precise carrier frequency for transmission of the signals.

Time Division Multiplexing

TDM is a method of utilizing the capacity of a physical channel effectively. Each user of the channel is allotted a small time interval during which it may transmit a message. Thus the total time is divided. Therefore each

user can use the full channel bandwidth. The channel capacity is fully utilized.



Advantages

- (i) It uses a single link.
- (ii) It does not require precise carrier matching at both ends of the links.
- (iii) Use of the channel capacity is high.
- (iv) Easy to expand the number of users on a system at a low cost.
- (v) There is no need to include identification of the traffic stream on each packet.

Disadvantages

- (i) The sensitivity to other users is very high and causes problems.
- (ii) Initial cost is high.
- (iii) Technical complexity is more.

Statistical Time Division Multiplexing
↳ No. of devices \gg No. of input slots

Code Division Multiplexing [CDM]

CDM is a networking technique in which multiple data signals are combined for simultaneous transmission over a common frequency band.

When CDM is used to allow multiple users to share a single communication channel, the technology is called code division multiple access.

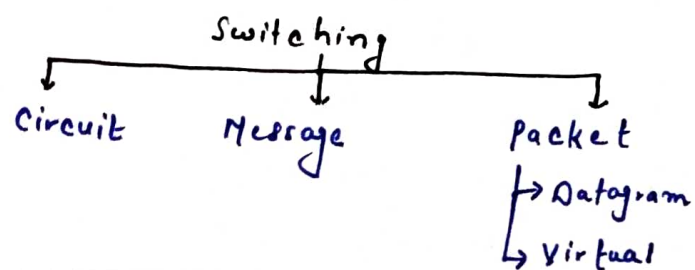
CDMA uses spread spectrum, a technology in which a data signal is sent over a range of frequencies in an assigned frequency spectrum.

A pseudo-random spreading code is used to multiplex the base signal. Multiplexing with a spreading code increases the bandwidth required for the signal, spreading it out over the available spectrum.

The receiving device is aware of the spreading code and uses it to demultiplex the signal.

Space Division Multiplexing

Switching:- Switching in computer networks help in finding the best route for data transmission if multiple paths are available in larger networks.



Circuit Switching

Circuit Switching is a connection oriented switching technique in which a dedicated route is established between the source and the destination and the entire message is passed through it.

Phases of circuit switching

- 1) Circuit Establishment:- In this phase, a dedicated route is established between the source and the destination through a number of intermediate switching centres.
- 2) Data Transfer:- Once the circuit has been established, data and voice are transferred from the source to the destination. The dedicated connection remains as long as end parties communicate.
- 3) Circuit Disconnection:- When the data transfer is complete, the connection is relinquished. The disconnection is initiated by any one of the users. The disconnection

involves removal of all intermediate links from sender to receiver.

Ex - Telephone Network.

Advantages

- 1) It is suitable for long continuous transmission. Since a continuous transmission route is established, that remains throughout the conversation.
- 2) The dedicated path ensures a steady data rate of communication.
- 3) No intermediate delays are found once the circuit is established so they are suitable for real time communication for both voice and data transmission.

Disadvantages

- 1) It is great for only voice communication. It can't be used for transmitting any other data.
- 2) It doesn't use the available resources efficiently i.e. underutilization of system resources.

3) Dedicated channels for circuit switching are unavailable for any other user.

4) There is a high cost of maintenance for one dedicated channel per user.

Message Switching

Message switching is a connection less network switching technique in which a message is transferred as a complete unit and forwarded using store and forward mechanism at the intermediary node.

In message technique, there is no establishment of a dedicated path between the sender & the receiver. Before sending the message, the sender node adds the destination address to the message. It is then delivered entirely to the next intermediate switching node.

The intermediate node stores the message in its entirety, checks for transmission errors, inspects the destination address and delivers it to the next node. The process continues till the message reaches the destination.

Advantages

1) Sharing communication channel ensures better bandwidth usage.

2) It reduces network congestion due to store & forward method.

Any switching node can store the messages till the network is available.

3) Messages of unlimited size can be sent.

Disadvantages

1) In order to store many messages of unlimited size, each intermediate switching node requires large storage capacity.

2) Store & forward method introduces delay at each switching node. This renders it unsuitable for real time application.

Packet Switching

It is the backbone of present day communication systems. In this technique message is broken into individual units called packets that are individually routed from the source to the destination.

Each packet in a packet switching technique contains information in its headers such

as source address, destination address and sequence number and these are used by intermediate routers to direct it towards its destination.

A packet is transmitted as soon as it is available in a node.

Sequence number helps the destination to (i) receive the packets (ii) detect missing packets and (iii) send acknowledgements.

Advantages

- 1) Switch devices don't require massive storage, since they don't have to store the entire message before forwarding them to the next node.
- 2) Delay in delivery of packets is less, since packets are sent as soon as they are available.
- 3) Data delivery can continue even if some parts of the network faces

link failure. Packets can be routed via other paths.

- 4) It allows simultaneous usage of the same channel by multiple users.

Disadvantages

1) It is not suitable in communication applications like voice calls as these applications can't afford any delays.

2) They require complex protocols for delivery which leads to significant misis in implementation costs.

3) Network problems may introduce errors in packets, delay in delivery of packets or loss of packets. If not properly handled, they may lead to loss of critical information.