CN: WEEK 4

Push vs Pull protocol

In push protocols, the client opens a connection to the server and keeps it constantly active. The server will send (push) all new events to the client using that single always-on connection. In other words, the server PUSHes the new events to the client. MTA uses PUSH protocol.

In pull protocols, the client periodically connects to the server, checks for and gets (pulls) recent events and then closes the connection and disconnects from the server. The client repeats this whole procedure to get updated about new events. In this mode, the clients periodically PULLs the new events from the server. MAA uses PULL protocol.

Multipurpose Internet Mail Extension (MIME) Protocol

MIME stands for Multipurpose Internet Mail Extensions.

It is used to extend the capabilities of Internet e-mail protocols such as SMTP.

The MIME protocol allows the users to exchange various types of digital content such as pictures, audio, video, and various types of documents and files in the e-mail.

MIME is an e-mail extension protocol, i.e., it does not operate independently, but it helps to extend the capabilities of e-mail in collaboration with other protocols such as SMTP.

Need of MIME Protocol

- The MIME protocol supports multiple languages in e-mail, such as Hindi, French, Japanese, Chinese, etc.
- Simple protocols can reject mail that exceeds a certain size, but there is no word limit in MIME.
- Images, audio, and video cannot be sent using simple e-mail protocols such as SMTP. These require MIME protocol.
- Many times, emails are designed using code such as HTML and CSS, they are mainly used by companies for marketing their product. This type of code uses MIME to send email created from HTML and CSS.

MIME adds five additional fields to the header portion of the actual e-mail to extend the properties of the simple email protocol. These fields are as follows:

MIME Version
Content Type
Content Type Encoding
Content Id
Content description

Content-Description: attachment; filename = javatpoint.jpeg; modification-date = "Wed, 12 Feb 1997 16:29:51 -0500";

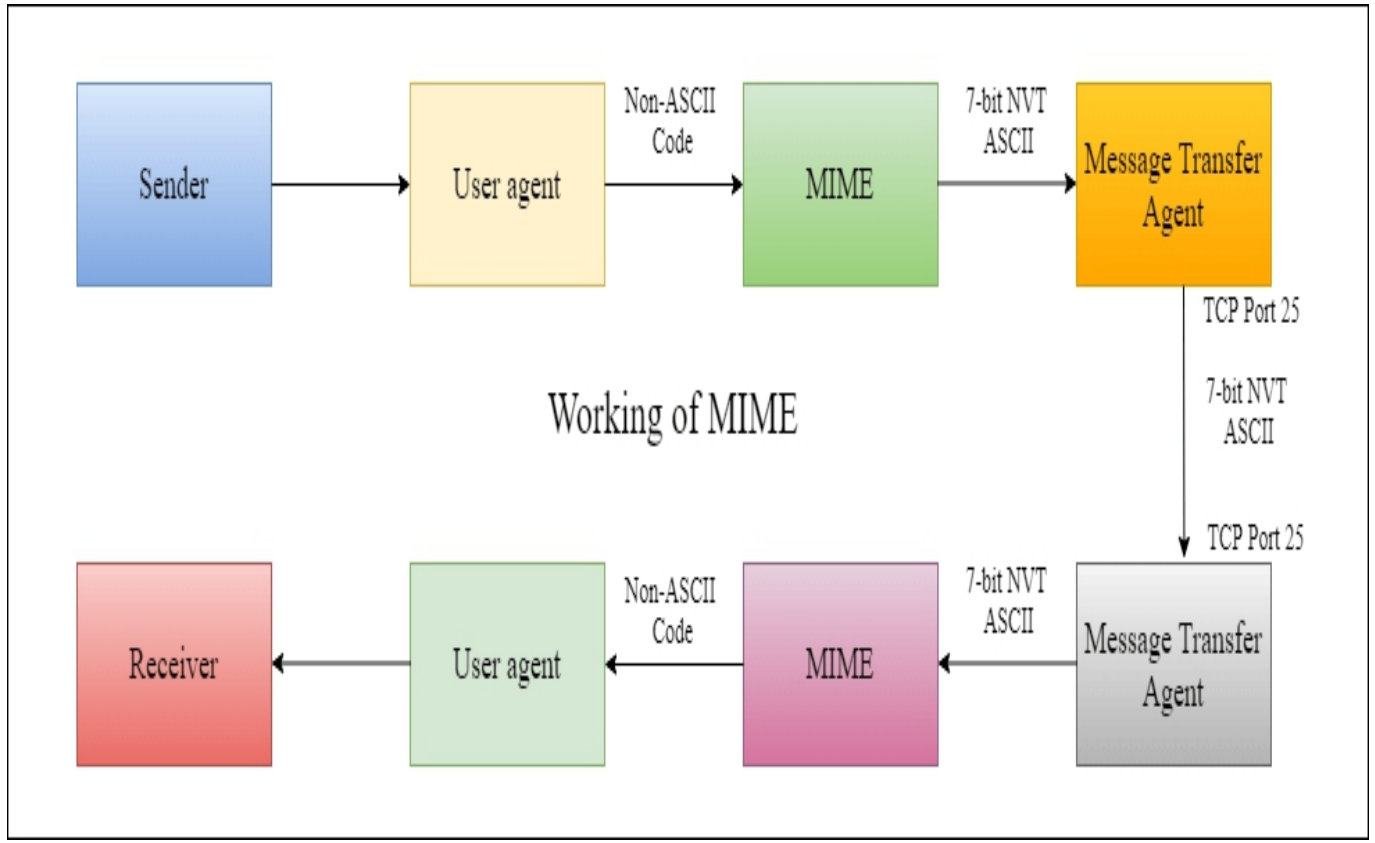
MIME Version: It defines the version of the MIME protocol. This header usually has a parameter value 1.0, indicating that the message is formatted using MIME.

Content Type: It describes the type and subtype of information to be sent in message. These messages can be of many types like Text, Image, Audio, Video, and they also have many subtypes such that the subtype of the image can be png or jpeg.

Content Type Encoding: In this field, it is told which method has been used to convert mail information into ASCII or Binary number, such as 7-bit encoding, 8-bit encoding, etc.

Content Id: In this field, a unique "Content Id" number is appended to all email messages so that they can be uniquely identified.

Content description: This field contains a brief description of the content within the email. This field also provides the information of name, creation date, and modification date of the file.



Features of MIME Protocol

- It supports multiple attachments in a single e-mail.
- It supports the non-ASCII characters.
- It supports unlimited e-mail length.
- It supports multiple languages.

Advantage of the MIME

- It is capable of sending various types of files in a message, such as text, audio, video files.
- It also provides the facility to send and receive emails in different languages like Hindi, French, Japanese, Chinese etc.
- It also provides the facility of connecting HTML and CSS to email, due to which people can design email as per their requirement and make it attractive and beautiful.
- It is capable of sending the information contained in an email regardless of its length.
- It assigns a unique id to all e-mails.

Persistent vs. Non-Persistent HTTP Connections

A nonpersistent connection is the one that is closed after the server sends the requested object to the client. In other words, the connection is used exactly for one request and one response. Nonpersistent connections are the default mode for HTTP/1.0

With persistent connections, the server leaves the TCP connection open after sending responses and hence the subsequent requests and responses between the same client and server can be sent. The server closes the connection only when it is not used for a certain configurable amount of time. With persistent connections, the performance is improved by 20%. Persistent connections are the default mode for HTTP/1.1.

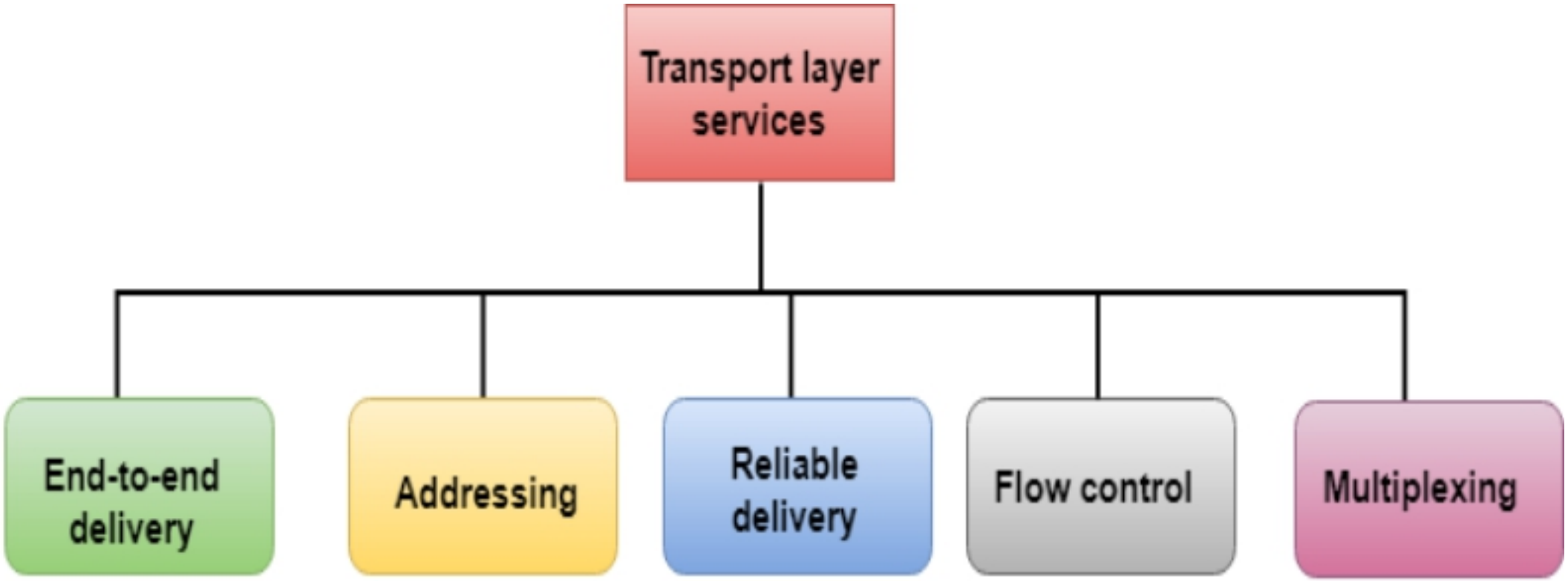
HTTP vs HTTPS

- In HTTP, URL begins with “http://” whereas URL starts with “https://”
- HTTP uses port number 80 for communication and HTTPS uses 443
- HTTP is considered to be unsecure and HTTPS is secure
- HTTP Works at Application Layer and HTTPS works at Transport Layer
- In HTTP, Encryption is absent and Encryption is present in HTTPS

Transport Layer

Main Functionalities

- The main role of the transport layer is to provide the communication services directly to the application processes running on different hosts.
- The transport layer provides a logical communication between application processes running on different hosts. Although the application processes on different hosts are not physically connected, application processes use the logical communication provided by the transport layer to send the messages to each other.
- A computer network provides more than one protocol to the network applications. For example, TCP and UDP are two transport layer protocols that provide a different set of services to the network layer.
- All transport layer protocols provide multiplexing/demultiplexing service. It also provides other services such as reliable data transfer, bandwidth guarantees, and delay guarantees.
- Each of the applications in the transport layer has the ability to send a message by using TCP or UDP. The application communicates by using either of these two protocols. Both TCP and UDP will then communicate with the internet protocol in the internet layer. The applications can read and write to the transport layer. Therefore, we can say that communication is a two-way process.


Transport layer services
End-to-end delivery
Addressing
Reliable delivery
Flow control
Multiplexing

End-to-end delivery:

The transport layer transmits the entire message to the destination. Therefore, it ensures the end-to-end delivery of an entire message from a source to the destination.

Reliable delivery:

The primary role of reliability is Error Control. In reality, no transmission will be 100 percent error-free delivery. Therefore, transport layer protocols are designed to provide error-free transmission.

The second aspect of the reliability is sequence control which is implemented at the transport layer. On the sending end, the transport layer is responsible for ensuring that the packets received from the upper layers can be used by the lower layers. On the receiving end, it ensures that the various segments of a transmission can be correctly reassembled.

Loss Control is a third aspect of reliability. The transport layer ensures that all the fragments of a transmission arrive at the destination, not some of them. On the sending end, all the fragments of transmission are given sequence numbers by a transport layer. These sequence numbers allow the receiver's transport layer to identify the missing segment.

Duplication Control is the fourth aspect of reliability. The transport layer guarantees that no duplicate data arrive at the destination. Sequence numbers are used to identify the lost packets; similarly, it allows the receiver to identify and discard duplicate segments.

Flow Control:

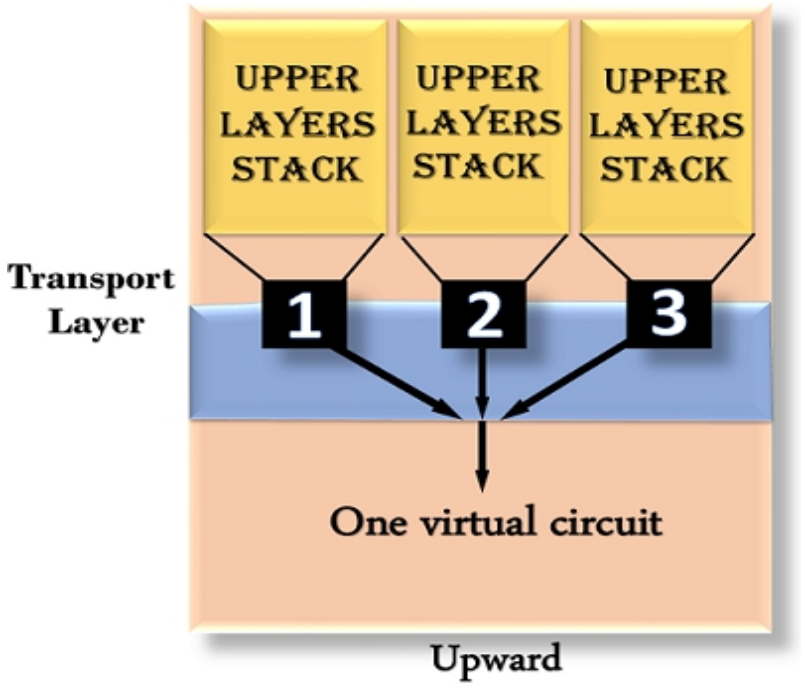
Flow control is used to prevent the sender from overwhelming the receiver. If the receiver is overloaded with too much data, then the receiver discards the packets and asking for the retransmission of packets.

This increases network congestion and thus, reducing the system performance. The transport layer is responsible for flow control. It uses the sliding window protocol that makes the data transmission more efficient as well as it controls the flow of data so that the receiver does not become overwhelmed.

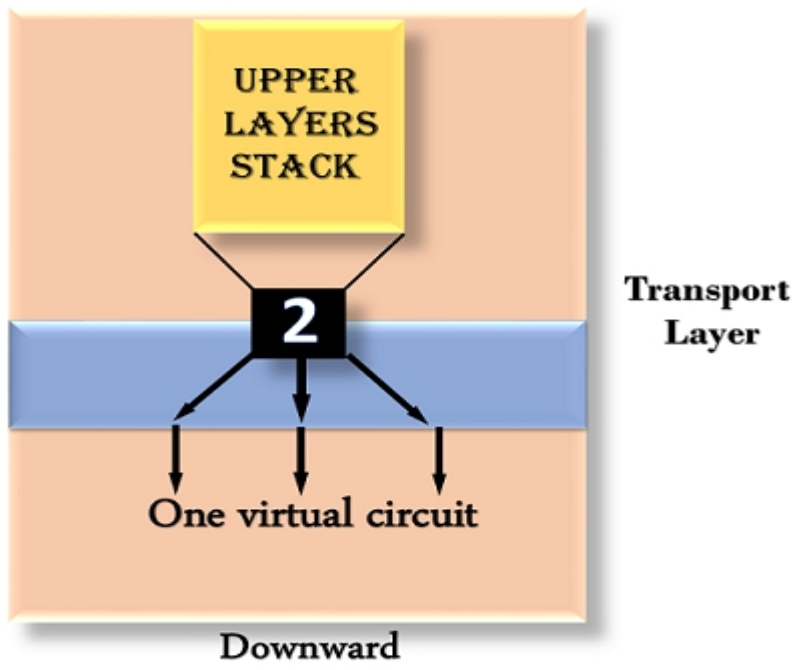
Multiplexing:

The transport layer uses the multiplexing to improve transmission efficiency.

Upward multiplexing: Upward multiplexing means multiple transport layer connections use the same network connection. To make more cost-effective, the transport layer sends several transmissions bound for the same destination along the same path; this is achieved through upward multiplexing.



Downward multiplexing: Downward multiplexing means one transport layer connection uses multiple network connections. Downward multiplexing allows the transport layer to split a connection among several paths to improve the throughput. This type of multiplexing is used when networks have a low or slow capacity.



Addressing:

According to the layered model, the transport layer interacts with the functions of the session layer. Many protocols combine session, presentation, and application layer protocols into a single layer known as the application layer.

In these cases, delivery to the session layer means the delivery to the application layer. Data generated by an application on one machine must be transmitted to the correct application on another machine. In this case, addressing is provided by the transport layer.

Multiplexing & Demultiplexing

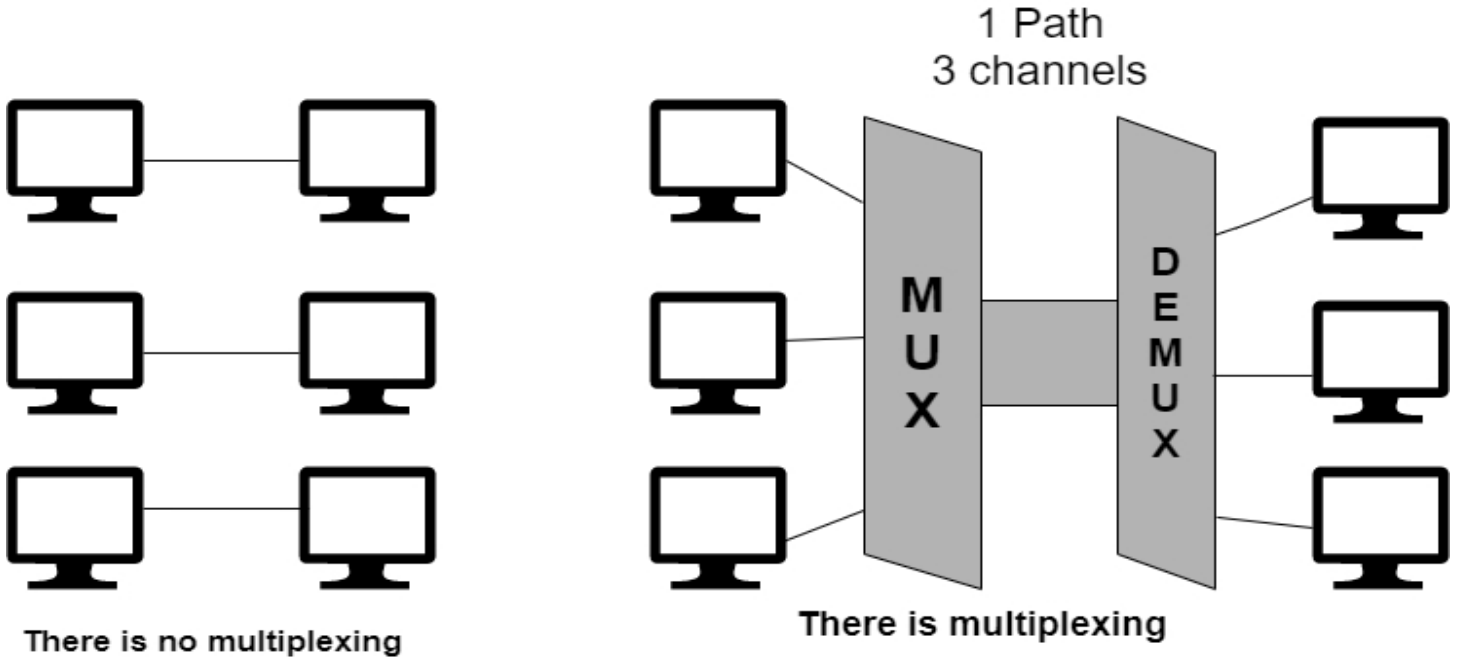
What is Multiplexing?

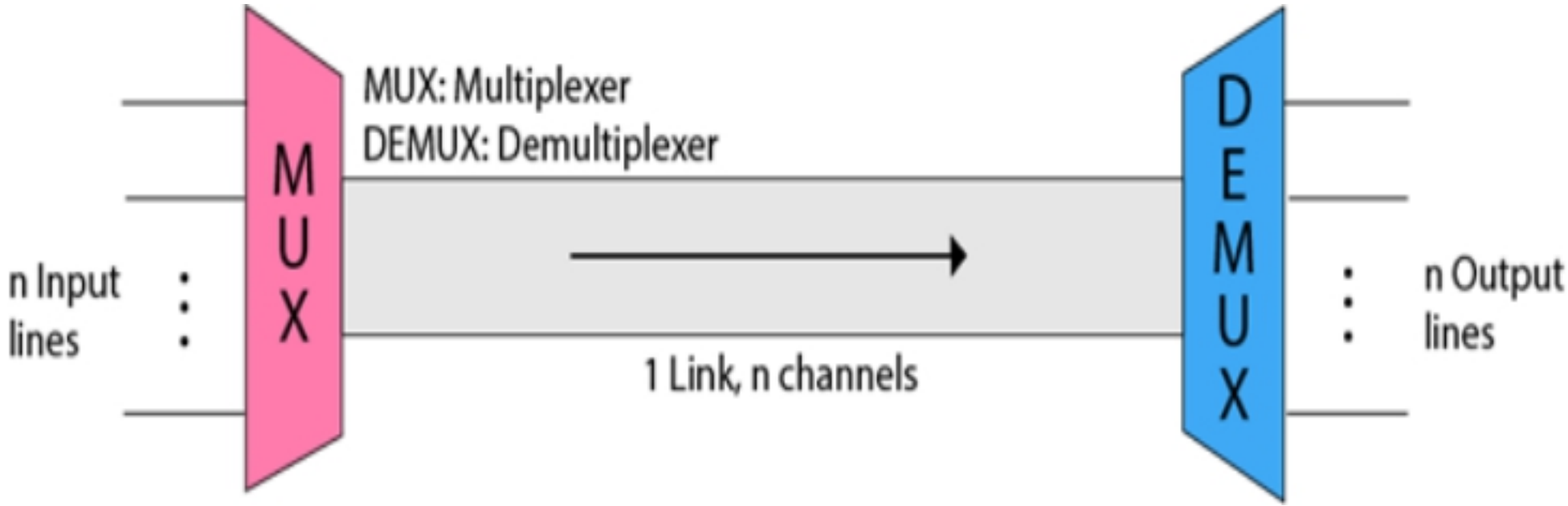
The set of techniques that allows the simultaneous transmission of multiple signals across a single data link is commonly referred to as Multiplexing. Multiplexing is done by using the hardware that is called as Multiplexer(MUX).

The Multiplexer(MUX) mainly combines 'n' input lines in order to generate '1' output line(this is simply many-to-one) on the sender side. And on the receiver side, this stream is fed into the demultiplexer(DEMUX), which then separates the stream back to its component transmission (this is one-to-many) and then directs them to their corresponding lines.

Why Multiplexing?

- The transmission medium is used to send the signal from sender to receiver. The medium can only have one signal at a time.
- If there are multiple signals to share one medium, then the medium must be divided in such a way that each signal is given some portion of the available bandwidth. For example: If there are 10 signals and bandwidth of medium is100 units, then the 10 unit is shared by each signal.
- When multiple signals share the common medium, there is a possibility of collision. Multiplexing concept is used to avoid such collision.
- Transmission services are very expensive.

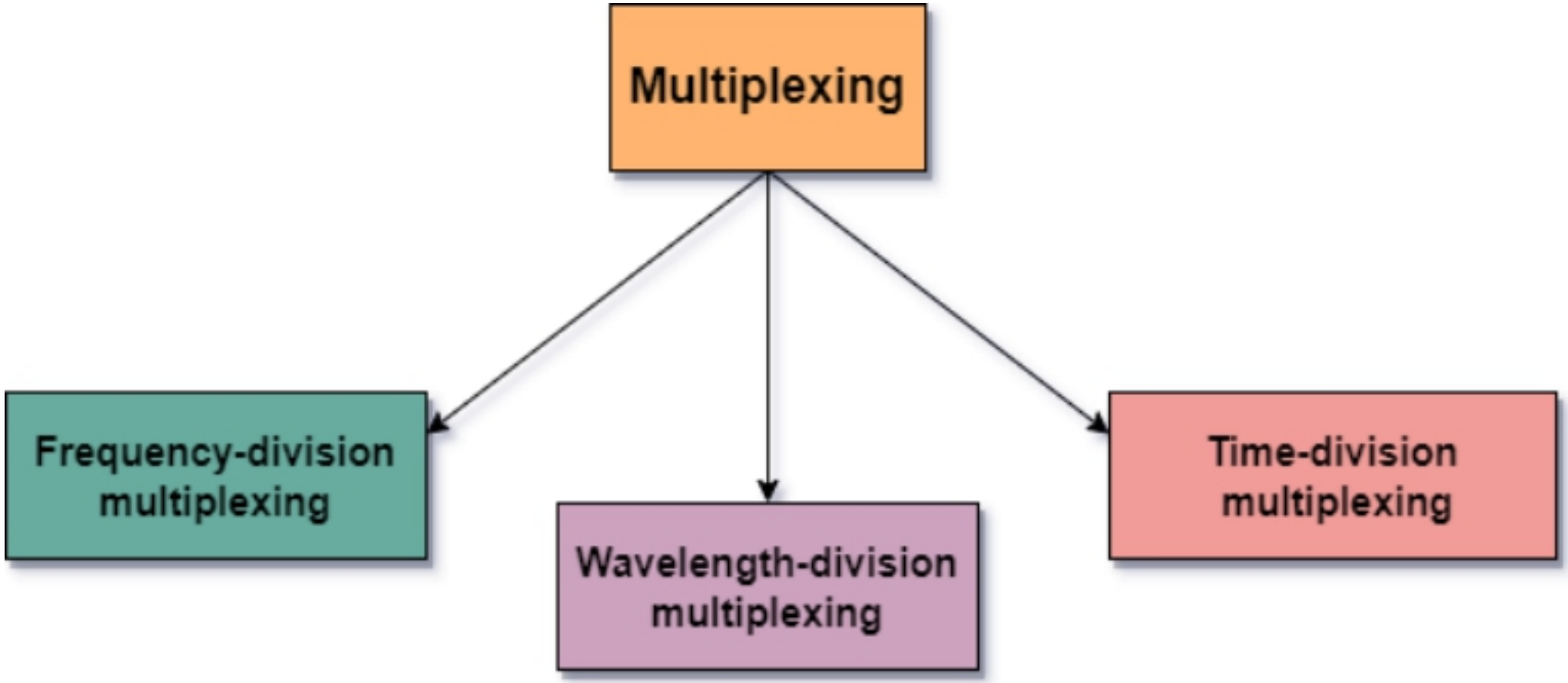




- In the above diagram, the word link refers to the physical path, and the word channel simply refers to the portion of the link that carries a transmission between a given pair of lines. Thus 1 link can have many channels.
- The 'n' input lines are transmitted through a multiplexer and multiplexer combines the signals to form a composite signal.
- The composite signal is passed through a Demultiplexer and demultiplexer separates a signal to component signals and transfers them to their respective destinations.

Advantages of Multiplexing:

- More than one signal can be sent over a single medium.
- The bandwidth of a medium can be utilized effectively.


Multiplexing
Frequency-division multiplexing
Wavelength-division multiplexing
Time-division multiplexing

Frequency-division Multiplexing (FDM)

- Frequency-Divison Multiplexing is an analog technique.
- With this technique, signals having different frequencies are combined in a composite signal and then transmitted on the link
- It is mainly applied at the time when the bandwidth of the link is greater than the combined bandwidths of the signal to be transmitted.
- In this, each signal is of a different frequency.
- The channel is usually separated by the strips of unused bandwidth that is the guard bands in order to prevent the signals from overlapping.
- In the case of frequency division multiplexing, suppose the input signal is in the digital form then it must be converted to analog before giving it as the input to the modulator.

Advantages Of FDM:

- FDM is used for analog signals.
- FDM process is very simple and easy modulation.
- A Large number of signals can be sent through an FDM simultaneously.
- It does not require any synchronization between sender and receiver.

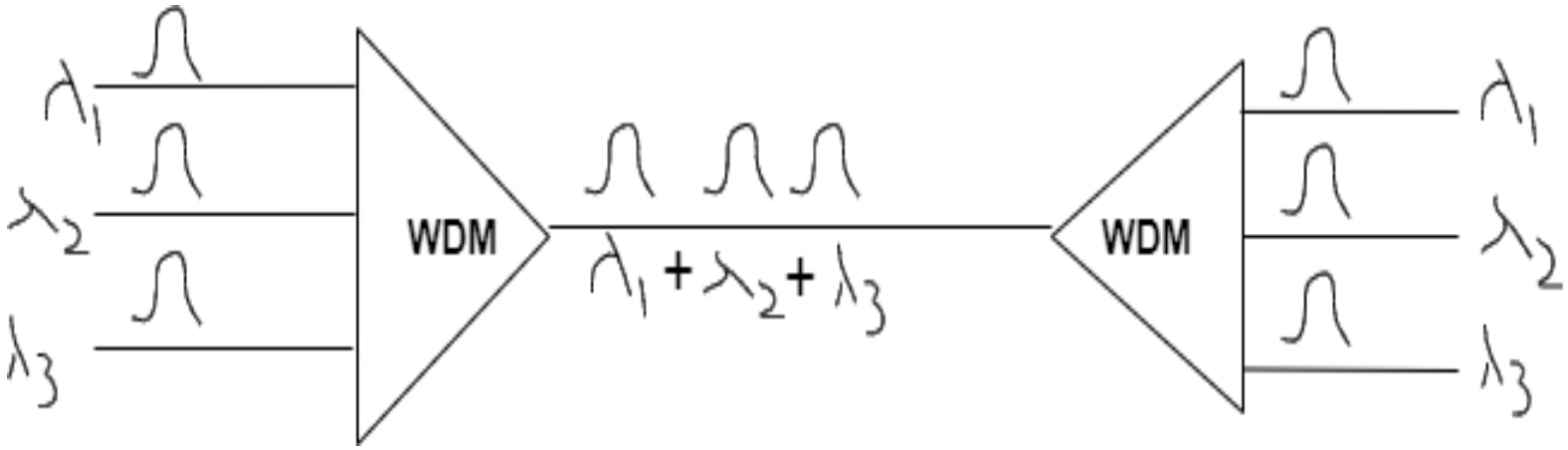
Disadvantages Of FDM:

- FDM technique is used only when low-speed channels are required.
- It suffers the problem of crosstalk.
- It requires a high bandwidth channel.

Applications Of FDM:

- FDM is commonly used in TV networks.
- It is used in FM and AM broadcasting. Each FM radio station has different frequencies, and they are multiplexed to form a composite signal. The multiplexed signal is transmitted in the air.

Wavelength-Division Multiplexing (WDM)



- Wavelength-Divison Multiplexing is an analog technique.
- With the help of Wavelength Divison multiplexing different signals that include: optical or light signals are transmitted through the Optical fiber.
- With the help of the WDM technique, the high data rate capability of optical fiber cable gets utilized.
- With this technique, various light waves from different sources are combined into a composite light signal and this signal is transmitted across the channel to the receiver.
- On the receiver side, this composite light signal gets broken down into different light waves with the help of Demultiplexer.
- The process of combining and splitting the light waves is done with the help of Prism.
- This Prism helps to bend the beam of light on the basis of the angle of incidence and frequency of light.
- Here the role of the multiplexer is played by the Prism and it then combines the various optical signals in the order to form a composite signal after that this composite signal is transmitted through an Optical fiber cable.

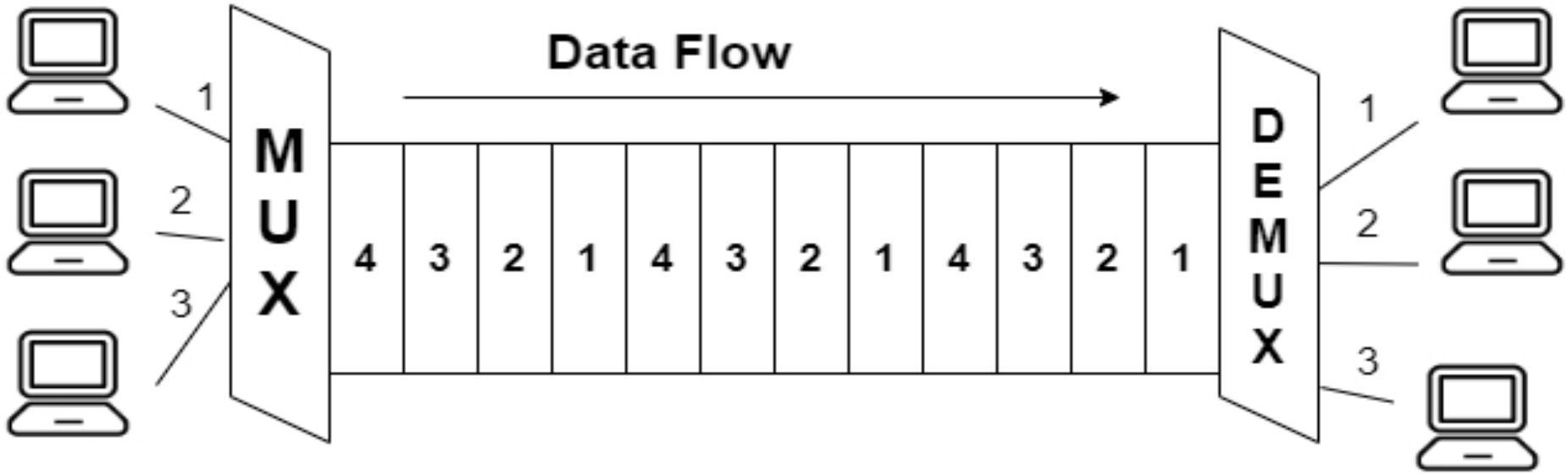
Advantages

With the help of WDM, the full-duplex transmission is possible.
WDM is easy to reconfigure.
Various Signals can be transmitted simultaneously with the help of WDM.
This technique is less expensive and the expansion of the system is easy.
This technique provides high security.
Optical components are more reliable and they also provide high bandwidth.

Disadvantages

There are some drawbacks of using WDM:
There is the use of optical equipment so cost increases.
Utilization of bandwidth can be inefficient which causes difficulty in wavelength tuning.
The main concern in this technique is scalability.

Time-Division Multiplexing (TDM)

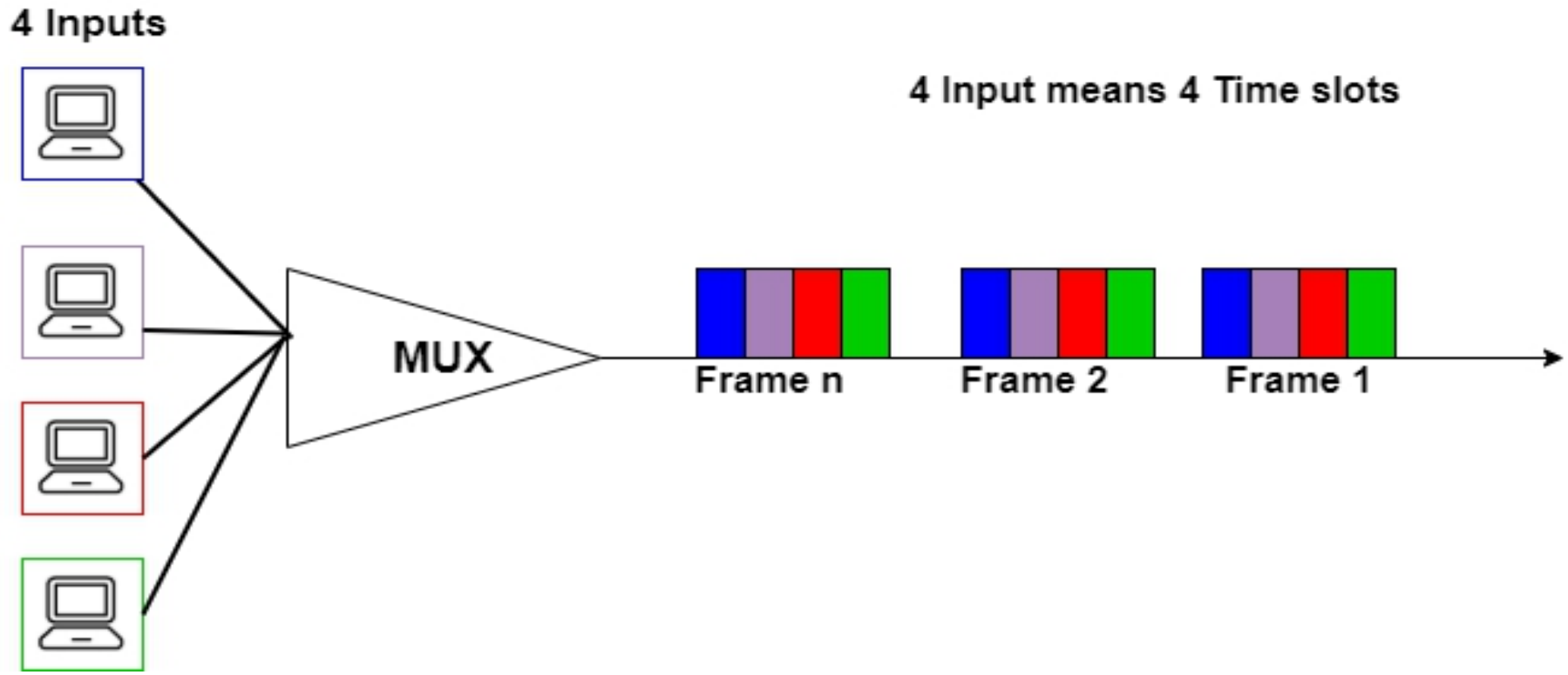


- Time-Divison multiplexing is a digital technique for multiplexing.
- In this technique, the channel/link is divided on the basis of time instead of frequency.
- The total available time on the channel is divided between the different users on the channel.
- A particular time interval is allotted to each user on the channel and it is known as time slot/slice.
- In the time-division multiplexing, the data rate capacity should be much greater than the data rate that is required by the sending and receiving device.

TDM is further categorized into two:

- ✓ Synchronous Time-Divison Multiplexing
- ✓ Asynchronous Time-Divison Multiplexing

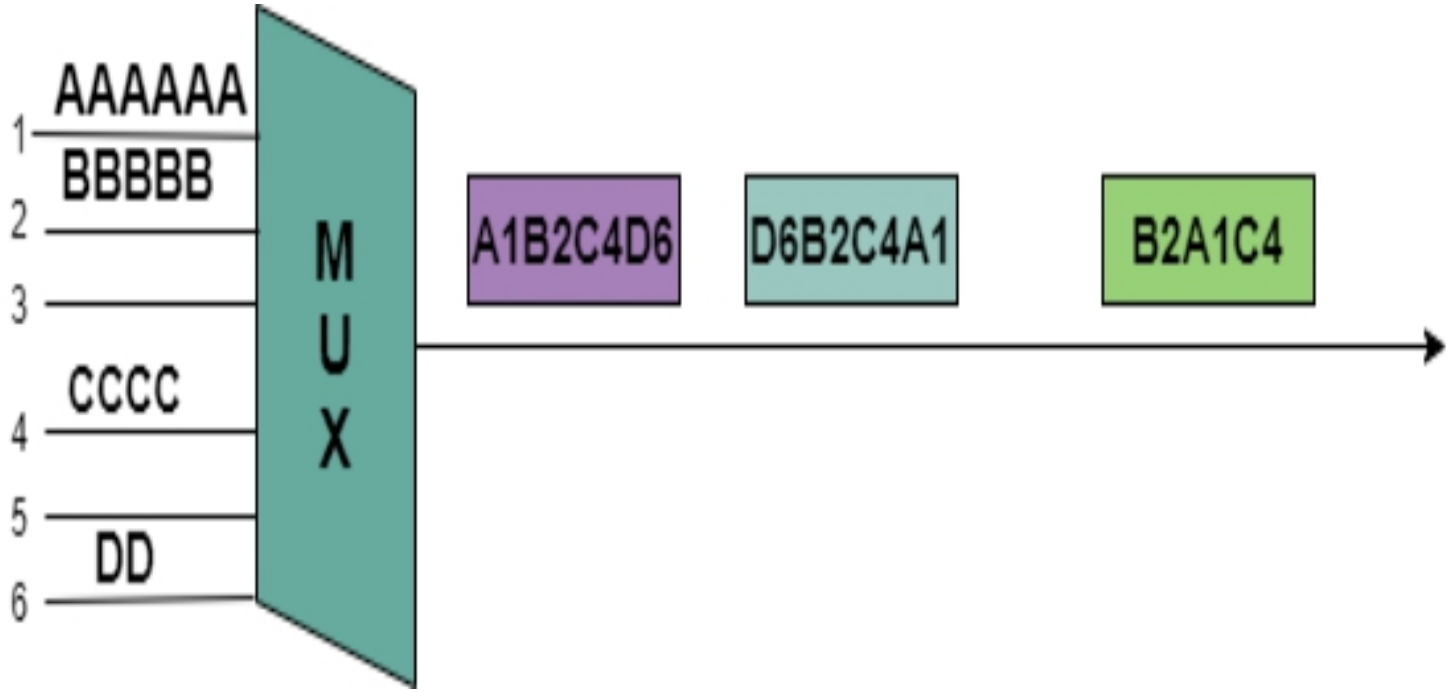
Synchronous Time-Divison Multiplexing



- In Synchronous TDM, each of the Input connection has an allotment in the output even if it is not sending the data.
- Here each device is given the same time slot to transmit data over link whether it has to send data to the receiver or not.
- Each device places data on the link whenever its time slot arrives Thus control is given to each device turn by turn.
- In case if any devices do not have any data to send then in that case the time slot for that device remains empty.
- Here, if there are 'n' sending devices then simultaneously there will be 'n' time slots (one time slot for each device).
- Also, time slots are organized in the form of frames, where each frame consists of one or more time slots.

Asynchronous Time-Divison Multiplexing

In the figure, out of 6 only 4 devices are sending data that are 1,2,4,6. In the above diagram, you can see that the data part contains the address in order to determine the source of the data.



- Here, time slots are not fixed, rather time slots are allocated dynamically in order to improve the efficiency of bandwidth.
- The total speed of all the Input lines can be greater than the capacity of the path.
- In this Multiplexing, there are n input lines and m slots; thus always (m<n).
- There is no concept of predefined slots rather than slots are allocated dynamically on demand.
- Here, the multiplexor accepts the incoming input data and creates a frame that contains only data without empty slots.
- Each slot mainly contains the address part that is used to identify the source of the input data.
- The number of frames in this multiplexing depends upon the statical analysis of the number of input lines.

END