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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

II – B.Tech – II – Sem (CSE ‘C’ & CSE – DS ‘A’)

COMPUTER NETWORKS (20-CS-PC-224)
(R20 Regulations)

By

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COMPUTER NETWORKS



SYLLABUS

Unit	Title/Topics	Hours
I	Overview of the Internet, Physical layer and Data link layer	10
Overview of the Internet: Protocols and standards, Layering scenario, TCP/IP Protocol Suite, The OSI model, Internet history and administration, Comparison of the OSI and TCP/IP reference model. Physical layer: Transmission Media, Guided Media, wireless transmission Media. Data link layer: Design issues, CRC Codes, Elementary Data Link layer Protocols, sliding Window Protocol. <i>Task: Write a program to compute CRC code for the polynomials.</i>		
II	Multiple Access protocols	9
Multiple Access protocols- Aloha, CSMA, Collision free protocols, Ethernet –Physical layer, Ethernet Mac sub layer, Data link layer switching and use of bridges, learning bridges ,Spanning tree bridges, repeaters, hubs, bridges, switches ,routers and gateways. <i>Task: Write a program for 1 bit collision free protocol.</i>		
III	Network layer and Routing Algorithms	5+5=10
Part-A: Network layer: Network layer Design issues, store and forward packet switching connection less and connection oriented networks. <i>Task: Write a program to implement i) Character stuffing ii) Bit stuffing.</i>		
Part-B: Routing Algorithms: Optimality principle, shortest path, flooding, distance vector routing, count to infinity problem, hierarchical routing, congestion control algorithms and admission control. <i>Task: Implement distance vector routing algorithm for obtaining routing tables at each node.</i>		
IV	Internetworking and Transport Layer	9
Internetworking: Tunneling, internetwork Routing, Packet fragmentation, IPV4, IPV6 Protocol, IP addresses, CIDR, ICMP, ARP, RARP, DHCP. Transport Layer: Services provided to the upper layers elements of transport protocol-addressing connection establishment, connection release. <i>Task: Write a program to demonstrate ARP.</i>		
V	TCP/IP and Application Layer	10
TCP/IP: The internet Transport protocols UD-RPC, Real time Transport protocols, The internet Transport protocols-Introduction to TCP, The TCP services model ,The TCP segment Header, The connection Establishment, The TCP Connection release, The TCP Connection management modeling, The TCP Sliding Window, The TCP Congestion Control. Application Layer: Introduction, Providing services, Applications layer paradigms, HTTP, FTP, electronic mail, DNS, SSH. <i>Task: Write a program to implement RPC.</i>		

TEXT BOOKS & REFERENCES

Textbooks:
<ol style="list-style-type: none">1. Data Communications and Networking – Behrouz A Forouzan, Fourth Edition, TMH.2. Computer Networks - Andrew S Tanenbaum, 4th Edition. Pearson Education/PHI
References:
<ol style="list-style-type: none">1. Introduction to Data communication and Networking, Tamasi, Pearson Education2. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, Keith W. Ross, 3rd Edition, Pearson.

COURSE OUTCOMES

Upon completion of the course, the student will be able

CO 1: To outline the basics of computer networks and various layers (Unit – I)

CO 2: To demonstrate multiple access protocols (Unit – II)

CO 3: To interpret network layer and routing algorithms (Unit – III)

CO 4: To illustrate internetworking and various transport protocols (Unit – IV)

CO 5: To make use of various protocols of application layer (Unit – V)

UNIT – III

Part-A: Network layer: Network layer Design issues, store and forward packet switching connection less and connection oriented networks.

- *Task: Write a program to implement i) Character stuffing ii) Bit stuffing.*

Network Layer

Network layer is majorly focused on getting packets from the source to the destination, routing error handling and congestion control.

Functions of Network Layer

- Addressing:

Maintains the address at the frame header of both source and destination and performs addressing to detect various devices in network.

- Packeting:

This is performed by Internet Protocol. The network layer converts the packets from its upper layer.

- Routing:

It is the most important functionality. The network layer chooses the most relevant and best path for the data transmission from source to destination.

- Inter-networking:

It works to deliver a logical connection across multiple devices.

Design Issues in Network layer

1. Store and Forward packet switching:

The host sends the packet to the nearest router. This packet is stored there until it has fully arrived once the link is fully processed by verifying the checksum then it is forwarded to the next router till it reaches the destination. This mechanism is called “Store and Forward packet switching.”

2. **Services provided to Transport Layer:**

Through the network/transport layer interface, the network layer transfers its services to the transport layer. These services are described below.

But before providing these services to the transfer layer following goals must be kept in mind :-

- Offering services must not depend on router technology.

- The transport layer needs to be protected from the type, number and topology of the available router.
- The network addresses for the transport layer should use uniform numbering pattern also at LAN and WAN connections.
- Based on the connections there are 2 types of services provided :

Connectionless – The routing and insertion of packets into subnet is done individually. No added setup is required.

Connection-Oriented – Subnet must offer reliable service and all the packets must be transmitted over a single route.

3. Implementation of Connectionless Service:

Packet are termed as “datagrams” and corresponding subnet as “datagram subnets”. When the message size that has to be transmitted is 4 times the size of the packet, then the network layer divides into 4 packets and transmits each packet to router via. a few protocol. Each data packet has destination address and is routed independently irrespective of the packets.

4. Implementation of Connection Oriented service:

To use a connection-oriented service, first we establishes a connection, use it and then release it. In connection-oriented services, the data packets are delivered to the receiver in the same order in which they have been sent by the sender.

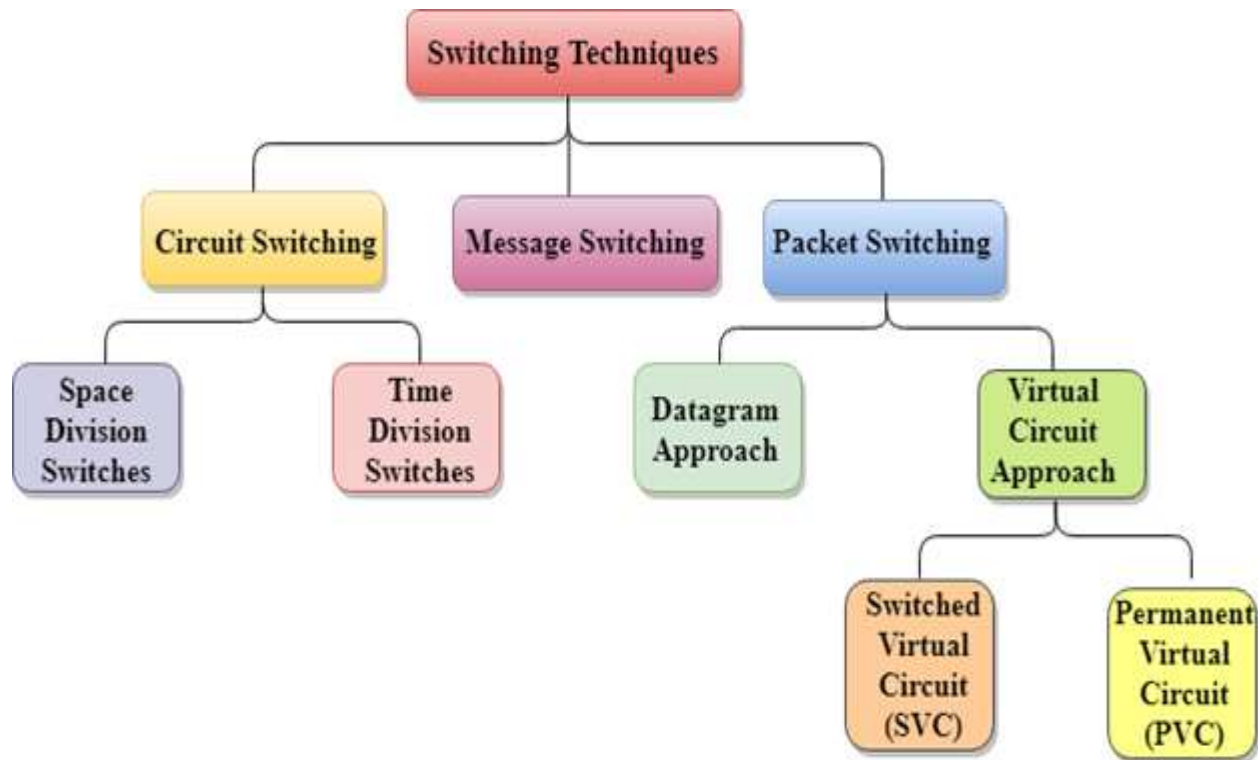
- It can be done in either two ways :

Circuit Switched Connection – A dedicated physical path or a circuit is established between the communicating nodes and then data stream is transferred.

Virtual Circuit Switched Connection – The data stream is transferred over a packet switched network, in such a way that it seems to the user that there is a dedicated path from the sender to the receiver. A virtual path is established here. While, other connections may also be using the same path.

Switching Techniques

- In large networks, there can be multiple paths from sender to receiver. The switching technique will decide the best route for data transmission.
- Switching technique is used to connect the systems for making one-to-one communication.

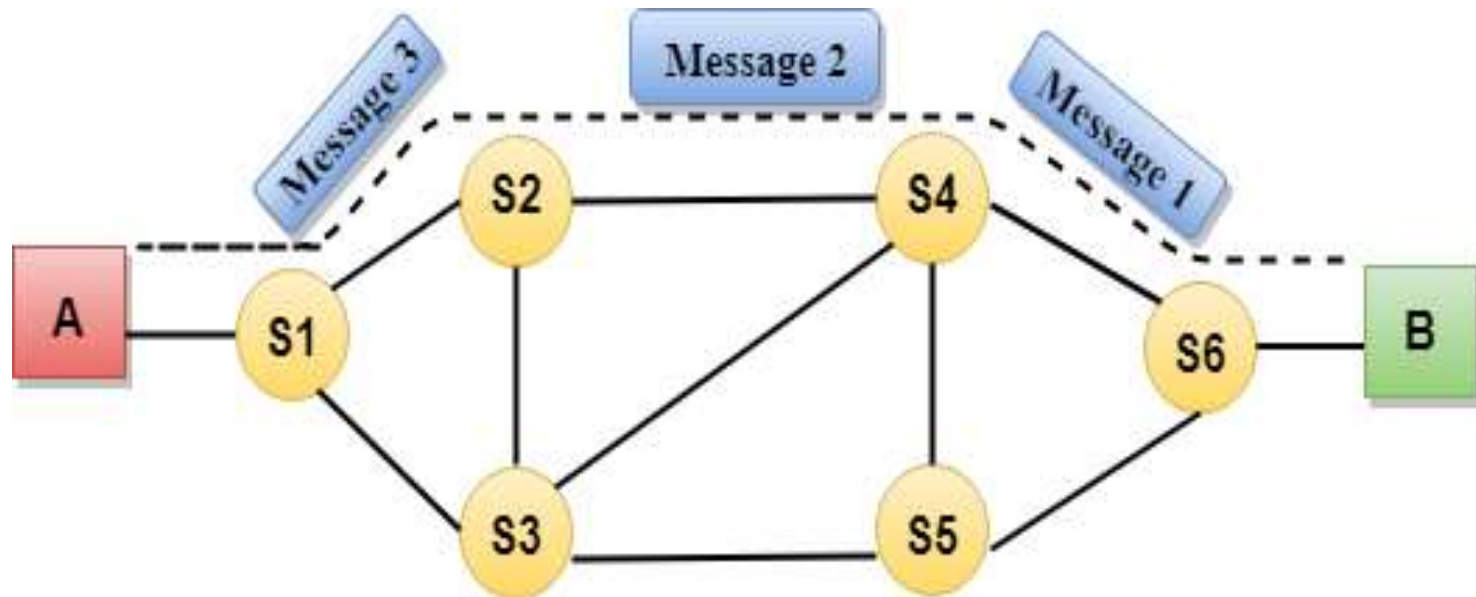


Circuit Switching

- Circuit switching is a switching technique that establishes a dedicated path between sender and receiver.
- In the Circuit Switching Technique, once the connection is established then the dedicated path will remain to exist until the connection is terminated.
- Circuit switching in a network operates in a similar way as the telephone works.
- A complete end-to-end path must exist before the communication takes place.
- In case of circuit switching technique, when any user wants to send the data, voice, video, a request signal is sent to the receiver then the receiver sends back the acknowledgment to ensure the availability of the dedicated path. After receiving the acknowledgment, dedicated path transfers the data.
- Circuit switching is used in public telephone network. It is used for voice transmission.
- Fixed data can be transferred at a time in circuit switching technology.

Communication through circuit switching has 3 phases:

- Circuit establishment
- Data transfer
- Circuit Disconnect



Advantages Of Circuit Switching:

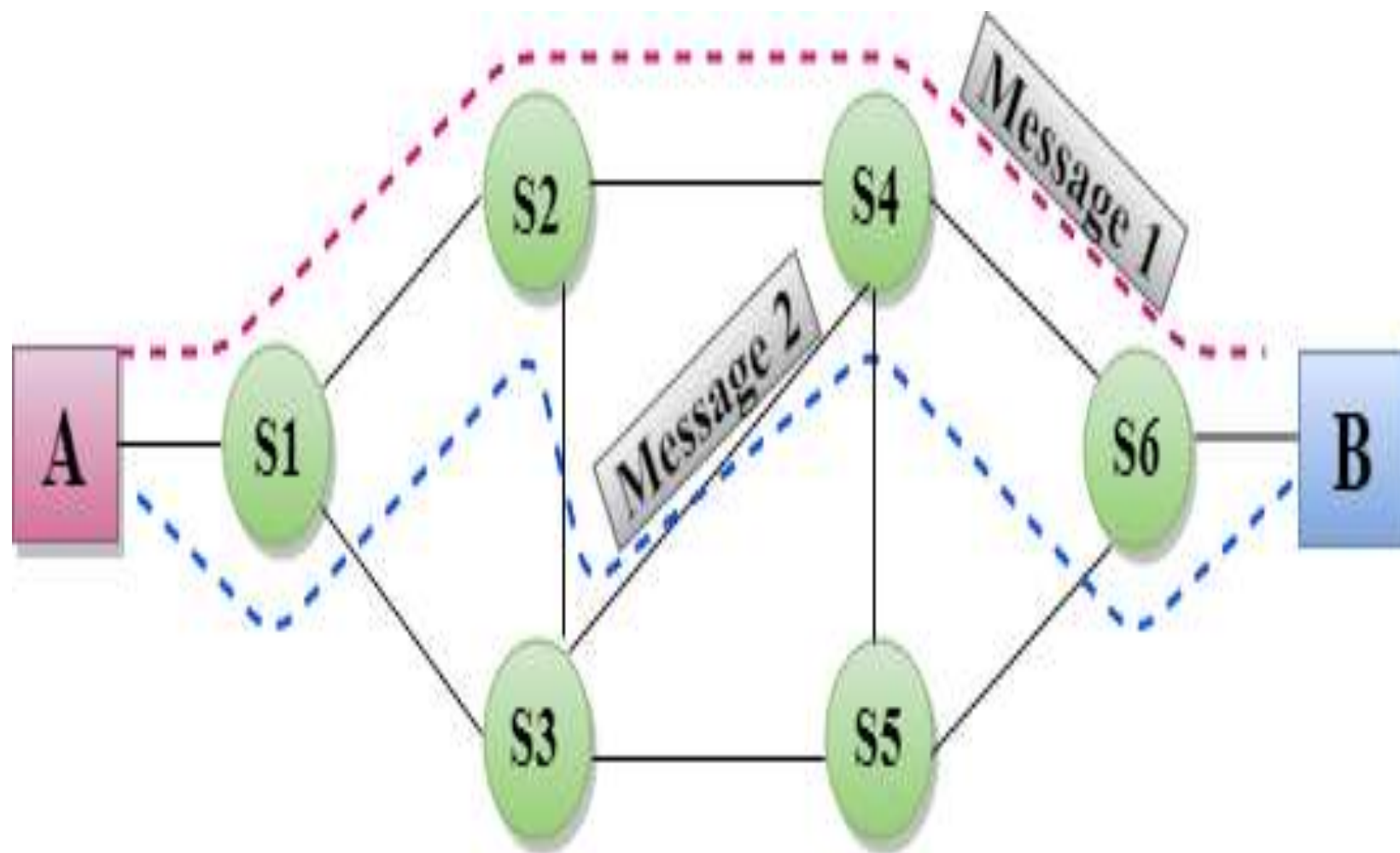
- In the case of Circuit Switching technique, the communication channel is dedicated.
- It has fixed bandwidth.

Disadvantages Of Circuit Switching:

- Once the dedicated path is established, the only delay occurs in the speed of data transmission.
- It takes a long time to establish a connection approx 10 seconds during which no data can be transmitted.
- It is more expensive than other switching techniques as a dedicated path is required for each connection.
- It is inefficient to use because once the path is established and no data is transferred, then the capacity of the path is wasted.
- In this case, the connection is dedicated therefore no other data can be transferred even if the channel is free.

Message Switching

- Message Switching is a switching technique in which a message is transferred as a complete unit and routed through intermediate nodes at which it is stored and forwarded.
- In Message Switching technique, there is no establishment of a dedicated path between the sender and receiver.
- The destination address is appended to the message. Message Switching provides a dynamic routing as the message is routed through the intermediate nodes based on the information available in the message.
- Message switches are programmed in such a way so that they can provide the most efficient routes.
- Each and every node stores the entire message and then forward it to the next node. This type of network is known as **store and forward network**.
- Message switching treats each message as an independent entity.



Advantages Of Message Switching

Data channels are shared among the communicating devices that improve the efficiency of using available bandwidth.

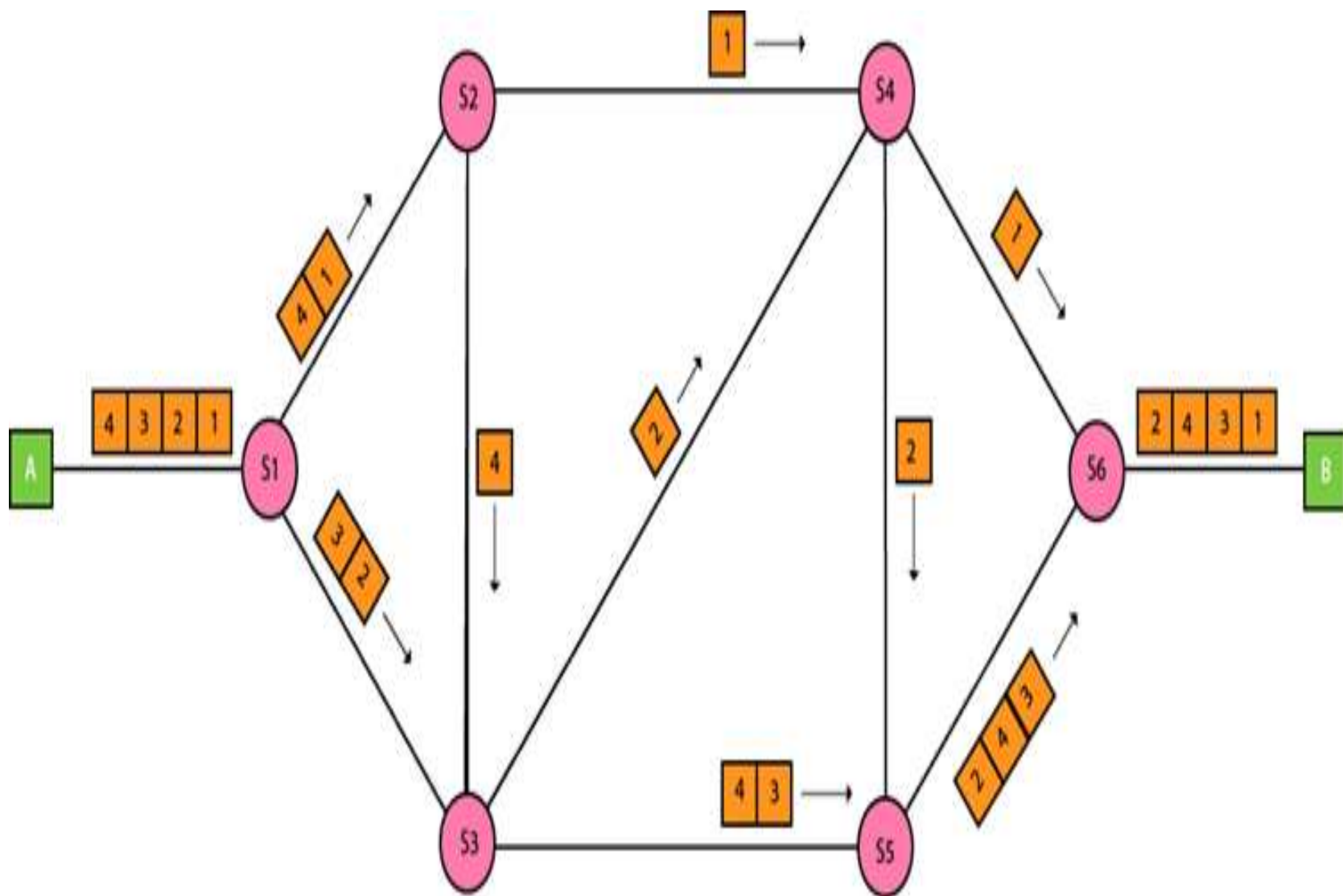
- Traffic congestion can be reduced because the message is temporarily stored in the nodes.
- Message priority can be used to manage the network.
- The size of the message which is sent over the network can be varied. Therefore, it supports the data of unlimited size.

Disadvantages Of Message Switching

- The message switches must be equipped with sufficient storage to enable them to store the messages until the message is forwarded.
- The Long delay can occur due to the storing and forwarding facility provided by the message switching technique.

Packet Switching

- The packet switching is a switching technique in which the message is sent in one go, but it is divided into smaller pieces, and they are sent individually.
- The message splits into smaller pieces known as packets and packets are given a unique number to identify their order at the receiving end.
- Every packet contains some information in its headers such as source address, destination address and sequence number.
- Packets will travel across the network, taking the shortest path as possible.
- All the packets are reassembled at the receiving end in correct order.
- If any packet is missing or corrupted, then the message will be sent to resend the message.
- If the correct order of the packets is reached, then the acknowledgment message will be sent.



Approaches Of Packet Switching:

There are two approaches to Packet Switching:

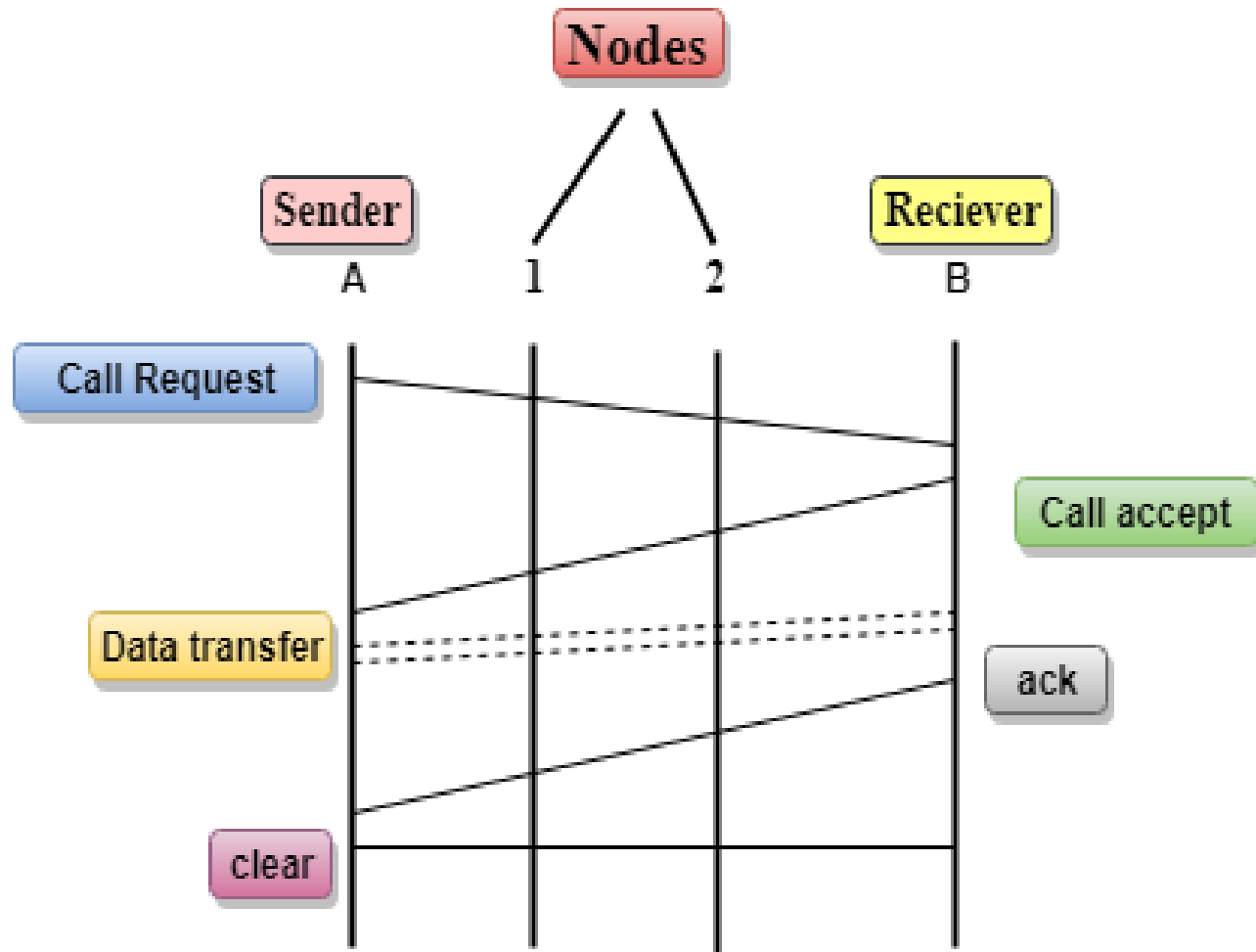
Datagram Packet switching:

- It is a packet switching technology in which packet is known as a datagram, is considered as an independent entity. Each packet contains the information about the destination and switch uses this information to forward the packet to the correct destination.
- The packets are reassembled at the receiving end in correct order.
- In Datagram Packet Switching technique, the path is not fixed.
- Intermediate nodes take the routing decisions to forward the packets.
- Datagram Packet Switching is also known as **connectionless switching**.

Virtual Circuit Switching

- Virtual Circuit Switching is also known as **connection-oriented switching**.
- In the case of Virtual circuit switching, a preplanned route is established before the messages are sent.
- Call request and call accept packets are used to establish the connection between sender and receiver.
- In this case, the path is fixed for the duration of a logical connection.

Let's understand the concept of virtual circuit switching through a diagram:



- In the above diagram, A and B are the sender and receiver respectively. 1 and 2 are the nodes.
- Call request and call accept packets are used to establish a connection between the sender and receiver.
- When a route is established, data will be transferred.
- After transmission of data, an acknowledgment signal is sent by the receiver that the message has been received.
- If the user wants to terminate the connection, a clear signal is sent for the termination.

Differences b/w Datagram approach and Virtual Circuit approach

Datagram approach	Virtual Circuit approach
Node takes routing decisions to forward the packets.	Node does not take any routing decision.
Congestion cannot occur as all the packets travel in different directions.	Congestion can occur when the node is busy, and it does not allow other packets to pass through.
It is more flexible as all the packets are treated as an independent entity.	It is not very flexible.

Advantages Of Packet Switching:

- **Cost-effective:** In packet switching technique, switching devices do not require massive secondary storage to store the packets, so cost is minimized to some extent. Therefore, we can say that the packet switching technique is a cost-effective technique.
- **Reliable:** If any node is busy, then the packets can be rerouted. This ensures that the Packet Switching technique provides reliable communication.
- **Efficient:** Packet Switching is an efficient technique. It does not require any established path prior to the transmission, and many users can use the same communication channel simultaneously, hence makes use of available bandwidth very efficiently.