ST. LAWRENCE HIGH SCHOOL

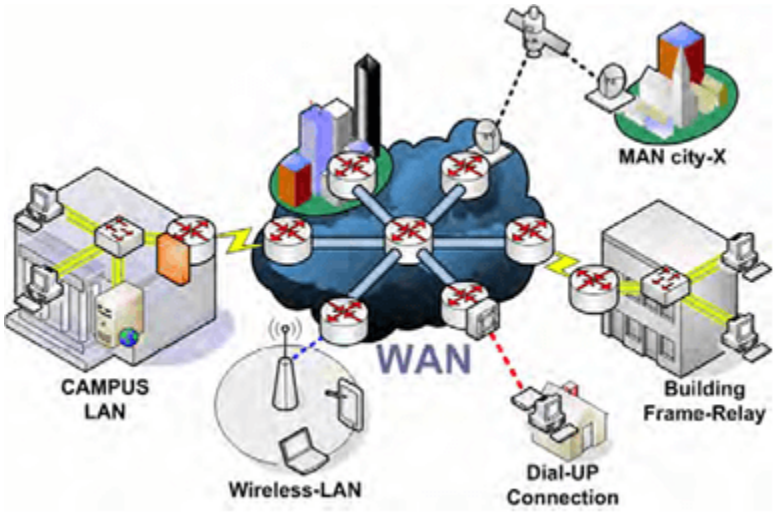
A Jesuit Christian Minority Institution

STUDY MATERIAL - 6

Subject: COMPUTER SCIENCE **Class - 12**

Chapter: Wide Area Network (Part -1) **Date: 11/06/2020**

Wide Area Network (WAN)



- A Wide Area Network is a network that extends over a large geographical area such as states or countries.
- A Wide Area Network is quite bigger network than the LAN.
- A Wide Area Network is not limited to a single location, but it spans over a large geographical area through a telephone line, fibre optic cable or satellite links.
- The internet is one of the biggest WAN in the world.
- A Wide Area Network is widely used in the field of Business, government, and education.

Advantages of a WAN:

- **Large Network Range:** It spans a large geographical area of 2000 km or more, e.g., from one country to another countries.
- **Centralized data:** It allows your different office branches to use your head office server for retrieving and sharing data. Thus, you don't need to buy email servers, files server and back up servers, etc.
- **Get updated files and data:** It provides an ideal platform for companies who need a live server for their employees to exchange updated files within seconds.
- **High bandwidth:** It offers high bandwidth than a normal broadband connection. Thus, it can increase the productivity of your company by offering uninterrupted data transfer and communication.

- **Workload Distribution:** It helps distribute your workload to other locations. You can hire employees in different countries and assign them to work from your office.

Examples of WAN:

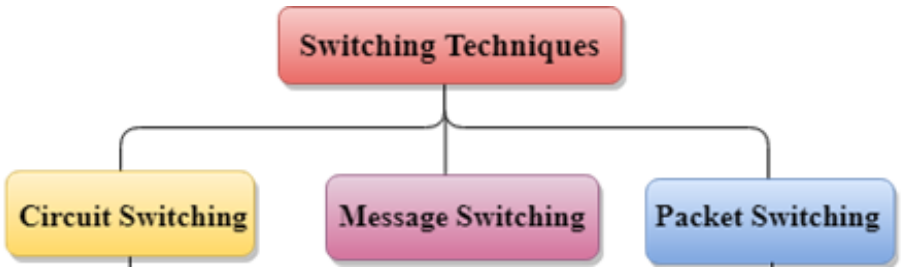
i. Internet
ii. US defense department
iii. Stock exchanges network
iv. Railway reservation system
v. Big Banks' cash dispensers' network
vi. Satellite systems

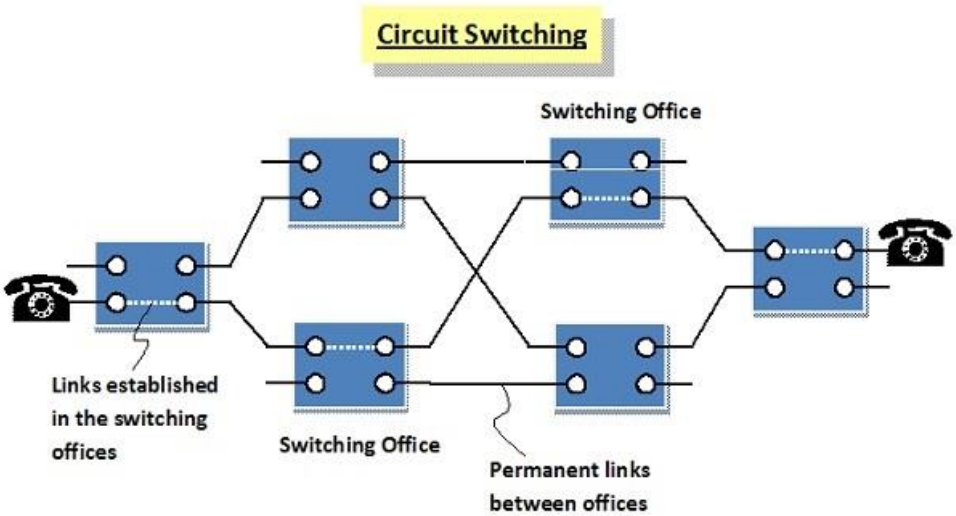
Switching techniques

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.

Classification of Switching Techniques





- 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.

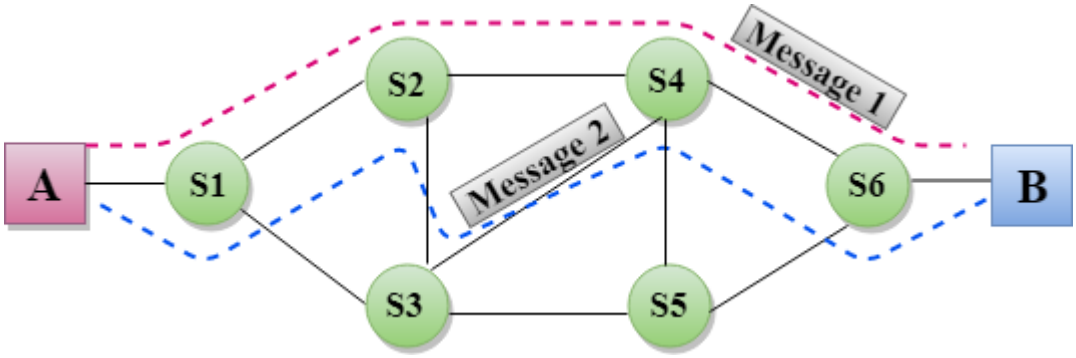
Disadvantages of Circuit Switching:

- 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 approximately 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 forwards 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.

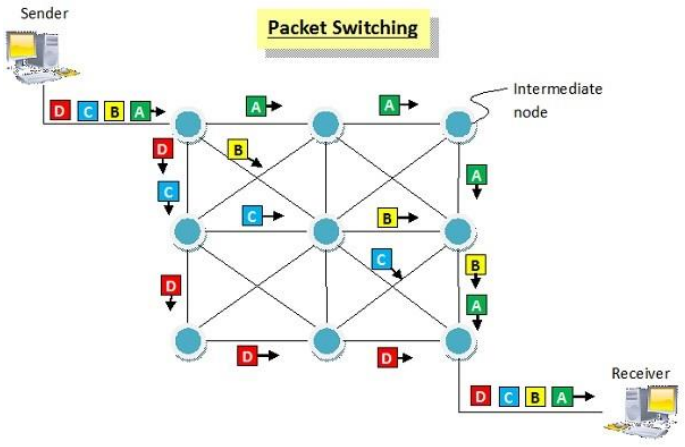


Advantages of Message Switching

- 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.



- 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.

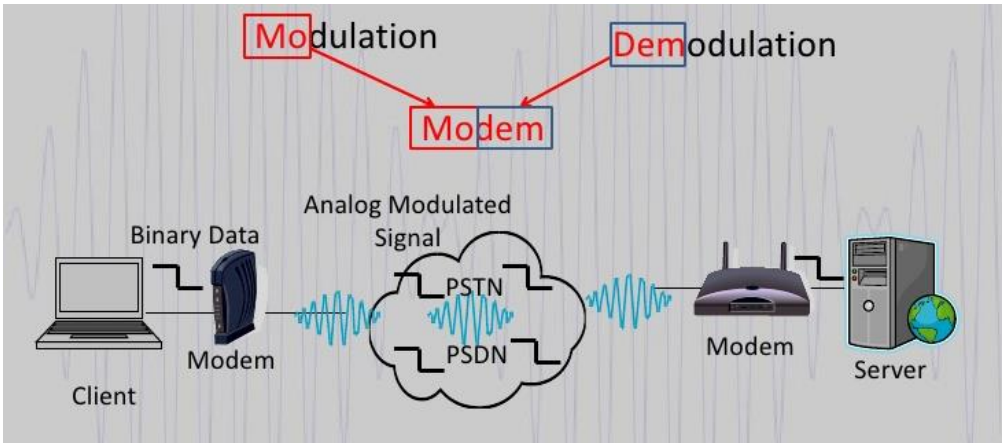
Advantage of Packet Switching over Circuit Switching:

- More efficient in terms of bandwidth, since the concept of reserving circuit is not there.
- Minimal transmission latency.
- More reliable as destination can detect the missing packet.
- More fault tolerant because packets may follow different path in case any link is down, Unlike Circuit Switching.
- Cost effective and comparatively cheaper to implement.

Disadvantage of Packet Switching over Circuit Switching:

- Packet Switching doesn't give packets in order, whereas Circuit Switching provides ordered delivery of packets because all the packets follow the same path.
- Since the packets are unordered, we need to provide sequence numbers to each packet.
- Complexity is more at each node because of the facility to follow multiple path.
- Transmission delay is more because of rerouting.
- Packet Switching is beneficial only for small messages, but for bursty data (large messages) Circuit Switching is better.

MODEM



Computer Network works on Digital Mode, without Modem Internet cannot be understood, Modem connects us with the Help of the Phone Line from Internet or helps in connecting, Modem Speed is Bit Per Second (BPS), Kilobyte Per Second (KBPS), Megabyte Per Second (MBPS), are measured in.

Modem Functions

There are many functions of Modem, but we will tell you about some of Modem's most important tasks, what Modem works -

- Modem modulator fixes Digital Signal from the computer and the rest of the Digital Device, Modem's work is modulate the Analog Signal coming from our Telephone Line and changing it to a Digital Signal that is easily understood by our Computer Read Found
- Demodulate incoming signal from computer can be converted to Analog Signal and can be sent again and this process is called Modulation and Demodulation.
- Modem is mostly used in Network Area, Modem acts as a means of communication between different networks or LANs and a different world.
- A modem connects our computer to a standard phone line or cable, so that we can send data or receive data.
- Modem is a Conversation tool that converts a Device's Signal to another device that converts into a Signal.

Integrated Services Digital Network (ISDN)

These are a set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network. Before *Integrated Services Digital Network (ISDN)*, the telephone system was seen as a way to transmit voice, with some special services available for data. The main feature of ISDN is that it can integrate speech and data on the same lines, which were not available in the classic telephone system.

ISDN is a circuit-switched telephone network system, but it also provides access to packet switched networks that allows digital transmission of voice and data. This results in potentially better voice or data quality than an analog phone can provide. It provides a packet-switched connection for data in increments of 64 kilobit/s. It provided a maximum of 128 kbit/s bandwidth in both upstream and downstream directions. A greater data rate was achieved through channel bonding. Generally ISDN B-channels of three or four BRIs (six to eight 64 kbit/s channels) are bonded.

Principle of ISDN:
The ISDN works based on the standards defined by ITU-T (formerly CCITT). The Telecommunication Standardization Sector (ITU-T) coordinates standards for telecommunications on behalf of the International Telecommunication Union (ITU) and is

based in Geneva, Switzerland. The various principles of ISDN as per ITU-T recommendation are:

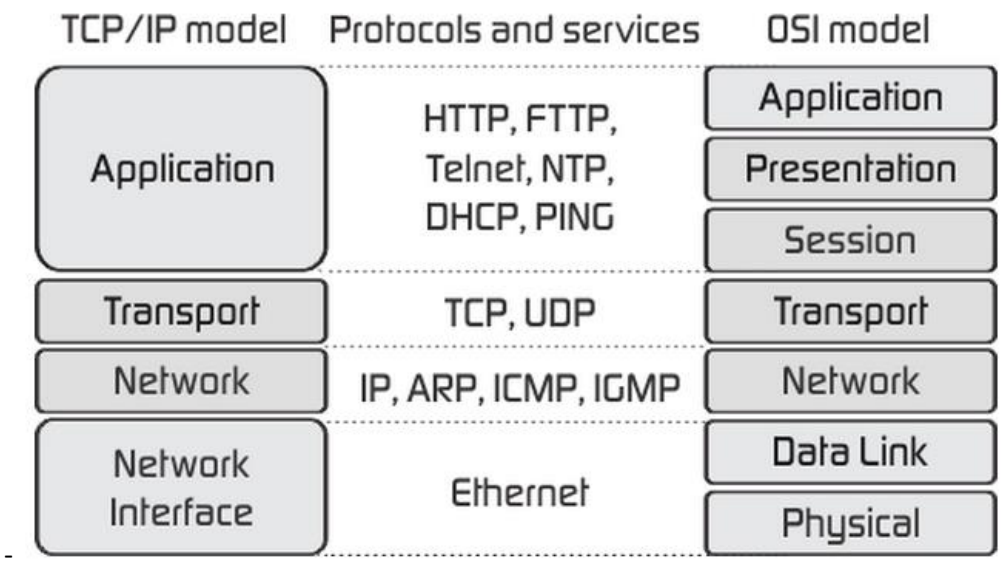
- To support switched and non-switched applications
- To support voice and non-voice applications
- Reliance on 64-kbps connections
- Intelligence in the network
- Layered protocol architecture
- Variety of configurations

TCP/IP model

The TCP/IP model was designed and developed by Department of Defense (DoD) in 1960s and is based on standard protocols. It stands for Transmission Control Protocol/Internet Protocol. The TCP/IP model is a concise version of the OSI model. It contains four layers, unlike seven layers in the OSI model. The layers are:

- Process/Application Layer
- Host-to-Host/Transport Layer
- Internet Layer
- Network Access/Link Layer

The diagrammatic comparison of the TCP/IP and OSI model is as follows:



Application Layer

Application layer interacts with an application program, which is the highest level of OSI model. The application layer is the OSI layer, which is closest to the end-user. It means the OSI application layer allows users to interact with other software application.

Application layer interacts with software applications to implement a communicating component. The interpretation of data by the application program is always outside the scope of the OSI model.

Example of the application layer is an application such as file transfer, email, remote login, etc.

The functions of the Application Layer are:

- Application-layer helps you to identify communication partners, determining resource availability, and synchronizing communication.
- It allows users to log on to a remote host
- This layer provides various e-mail services
- This application offers distributed database sources and access for global information about various objects and services.

Transport Layer

Transport layer builds on the network layer in order to provide data transport from a process on a source system machine to a process on a destination system. It is hosted using single or multiple networks, and also maintains the quality of service functions. It determines how much data should be sent where and at what rate. This layer builds on the message which is received from the application layer. It helps ensure that data units are delivered error-free and in sequence.

Transport layer helps you to control the reliability of a link through flow control, error control, and segmentation or de-segmentation. It also offers an acknowledgment of the successful data transmission and sends the next data in case no errors occurred. TCP is the best-known example of the transport layer.

Important functions of Transport Layers:

- It divides the message received from the session layer into segments and numbers them to make a sequence.
- Transport layer makes sure that the message is delivered to the correct process on the destination machine.
- It also makes sure that the entire message arrives without any error else it should be retransmitted.

Internet Layer

An internet layer is a second layer of the TCP/IP model. It is also known as a network layer. The main work of this layer is to send the packets from any network, and any computer still they reach the destination irrespective of the route they take.

The Internet layer offers the functional and procedural method for transferring variable length data sequences from one node to another with the help of various networks.

Message delivery at the network layer does not give any guaranteed to be reliable network layer protocol.

Layer-management protocols that belong to the network layer are:

1. Routing protocols
2. Multicast group management
3. Network-layer addresses assignment.

The Network Interface Layer

Network Interface Layer is this layer of the four-layer TCP/IP model. This layer is also called a network access layer. It helps you to define details of how data should be sent using the network. It also includes how bits should optically be signalled by hardware devices which directly interface with a network medium, like coaxial, optical, coaxial, fiber, or twisted-pair cables.

A network layer is a combination of the data line and defined in the article of OSI reference model. This layer defines how the data should be sent physically through the network. This layer is responsible for the transmission of the data between two devices on the same network.

Answer the following questions:

1. List any three examples of WAN.

Ans:

i. Internet
ii. Railway reservation system
iii. Stock exchanges network

2. What are the disadvantages of WAN? Mention any two points.

Ans:

- **High Setup cost:** An installation cost of the WAN network is high as it involves the purchasing of routers, switches.
- **Troubleshooting problems:** It covers a large area so fixing the problem is difficult.

3. Differentiate between packet switching and circuit switching.

Ans:

Circuit Switching	Packet Switching
Physical path between source and destination	No physical path
All packets use same path	Packets travel independently
Reserve the entire bandwidth in advance	Does not reserve
Bandwidth Wastage	No Bandwidth wastage
No store and forward transmission	Supports store and forward transmission

4. **Write any four advantages of message switching.**

Ans:

- Sharing of communication channels ensures better bandwidth usage.
- Broadcasting messages requires much less bandwidth than circuit switching.
- Messages of unlimited sizes can be sent.
- It does not have to deal with out of order packets or lost packets as in packet switching.

5. **Differentiate between message switching and circuit switching.**

Ans:

S.NO	Circuit Switching	Message Switching
1.	Circuit Switching is done by setting a physical path between two systems.	In message Switching, data is first stored by one node then forward to another node to transfer the data to another system.
2.	In circuit switching, data is not stored.	In message Switching, data is first stored, then forwarded to the next node.
3.	Circuit Switching does not need dedicated physical path.	Message switching need dedicated physical path.
4.	Circuit Switching is costlier than message Switching.	The cost of message switching is less than circuit switching.

6. **State any four functions of modem.**

Ans:

- Demodulate incoming signal from computer can be converted to Analog Signal and can be sent again and this process is called Modulation and Demodulation.
- Modem is mostly used in Network Area, Modem acts as a means of communication between different networks or LANs and a different world.
- A modem connects our computer to a standard phone line or cable, so that we can send data or receive data.
- Modem is a Conversation tool that converts a Device's Signal to another device that converts into a Signal.

7. **Name all the layers of TCP/IP model.**

Ans: The layers of TCP/IP model are as follows:

- Network Access Layer
- Internet Layer
- Transport Layer
- Application Layer

8. Describe the application layer of TCP/IP model.

Ans: Application layer interacts with an application program, which is the highest level of OSI model. The application layer is the OSI layer, which is closest to the end-user. It means the OSI application layer allows users to interact with other software application.

Example of the application layer is an application such as file transfer, email, remote login, etc.

9. Differentiate between TCP/IP model and OSI model.

Ans:

OSI Model	TCP/IP model
It is developed by ISO (International Standard Organization)	It is developed by ARPANET (Advanced Research Project Agency Network).
OSI model provides a clear distinction between interfaces, services, and protocols.	TCP/IP doesn't have any clear distinguishing points between services, interfaces, and protocols.
OSI uses the network layer to define routing standards and protocols.	TCP/IP uses only the Internet layer.
OSI is less reliable	TCP/IP is more reliable
Protocols are better covered and are easy to replace with the change in technology.	Protocols cannot be replaced easily in TCP/IP model.
OSI layers have seven layers.	TCP/IP has four layers.