UNIT 1

**1. With a neat diagram explain the OSI reference Model in detail. Explain the Functions performed in each layer. (NOV/DEC-2018)**

**OR**

**Explain the functionality of each layer in OSI reference model. (FEB/MARCH 2016)**

**OR**

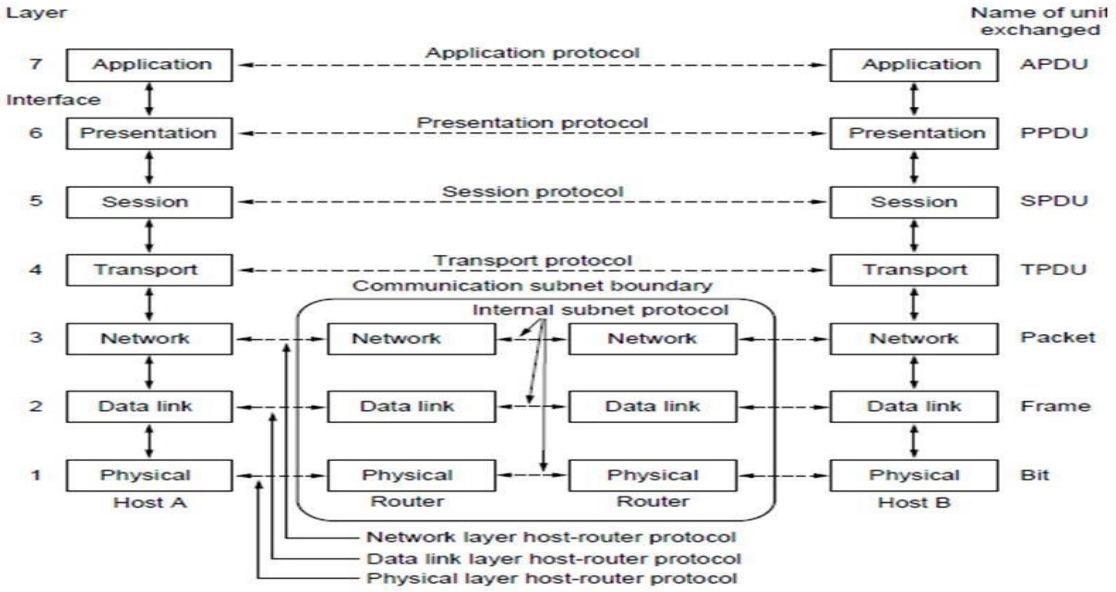
**Explain the ISO's network architecture model. (March 2016)**

OSI Model:

- This model is based on a proposal developed by the International Standards Organization(ISO).
- The model is called the ISO **OSI** (**Open Systems Interconnection**) Reference Model because it deals with connecting open systems—that is, systems that are open for communication with other systems.
- The OSI model has seven layers.
- The principles that were applied to arrive at the seven layers can be briefly summarized as follows:

1. A layer should be created where a different abstraction is needed.
2. Each layer should perform a well-defined function.
3. The function of each layer should be chosen with an eye toward defining internationally standardized protocols.
4. The layer boundaries should be chosen to minimize the information flow across the interfaces.
5. The number of layers should be large enough that distinct functions need not be thrown together in the same layer out of necessity and small enough that the architecture does not become unwieldy.

# The OSI Reference Model




**The Physical Layer**

- The **physical layer** is concerned with transmitting raw bits over a communication channel.
- The design issues have to do with making sure that when one side sends a 1 bit it is received by the other side as a 1 bit, not as a 0 bit.
- What electrical signals should be used to represent a 1 and a 0?
- How many nanoseconds a bit lasts?
- Whether transmission may proceed simultaneously in both directions?
- These design issues largely deal with mechanical, electrical, and timing interfaces, as well as the physical transmission medium, which lies below the physical layer.

**The Data Link Layer**

- The main task of the **data link layer** is to transform a raw transmission facility into a line that appears free of undetected transmission errors.(ERROR CONTROL)
- The sender DLL breaks up the input data into **data frames** and transmit the frames sequentially.(Framing)
- Another issue that arises in the data link layer is how to keep a fast transmitter from drowning a slow receiver in data.(Flow Control)
- Broadcast networks have an additional issue in the data link layer: how to control access to the shared channel. A special sublayer of the data link layer, the **medium access control** sublayer, deals with this problem.

**The Network Layer**

- The **network layer** controls the operation of the subnet.
- A key design issue is determining how packets are routed from source to destination.
- Routes can be static or dynamic.
- If too many packets are present in the subnet at the same time, they will get in one another's way, forming bottlenecks.

Handling congestion is also a responsibility of the network layer.

- the quality of service provided (delay, transit time, jitter, etc.) is also a network layer issue.
- allow heterogeneous networks to be interconnected.

**The Transport Layer**

- Transport layer provides services to application layer and takes services from network layer. The data in the transport layer is referred to as *Segments*.
- The Transport layer does Error and Flow Control.
- **Segmentation and Reassembly**: This layer accepts the message from the (session) layer, breaks the message into smaller units . Each of the segment produced has a header associated with it. The transport layer at the destination station reassembles the message.
- **Service Point Addressing**: In order to deliver the message to correct process, transport layer header includes a type of address called service point address or port address. Thus by specifying this address, transport layer makes sure that the message is delivered to the correct process.

**The Session Layer**

- The session layer allows users on different machines to establish **sessions** between them.
- Sessions offer various services:
  - **dialog control** (keeping track of whose turn it is to transmit),
  **-token management** (preventing two parties from attempting the same critical operation simultaneously),
  -**synchronization**(checkpointing long transmissions to allow them to pick up from where they left off in the event of a crash and subsequent recovery).

**The Presentation Layer**

- The **presentation layer** is concerned with the syntax and semantics of the information transmitted.

- Presentation layer is also called the **Translation layer**. The data from the application layer is extracted here and manipulated as per the required format to transmit over the network.
- **Translation :** For example, ASCII to EBCDIC.
- **Encryption/ Decryption :** Data encryption translates the data into another form or code. The encrypted data is known as the cipher text and the decrypted data is known as plain text. A key value is used for encrypting as well as decrypting data.
- **Compression:** Reduces the number of bits that need to be transmitted on the network.

**The Application Layer**

- The **application layer** contains a variety of protocols that are commonly needed by users.
- One widely used application protocol is **HTTP** (**HyperText Transfer Protocol**), which is the basis for the World Wide Web.
- Other application protocols are used for file transfer, electronic mail, and network news.

**2. Explain the Layers of TCP/IP Model.**

**OR**

**Elaborate the Reference model TCP/IP with a neat diagram.**

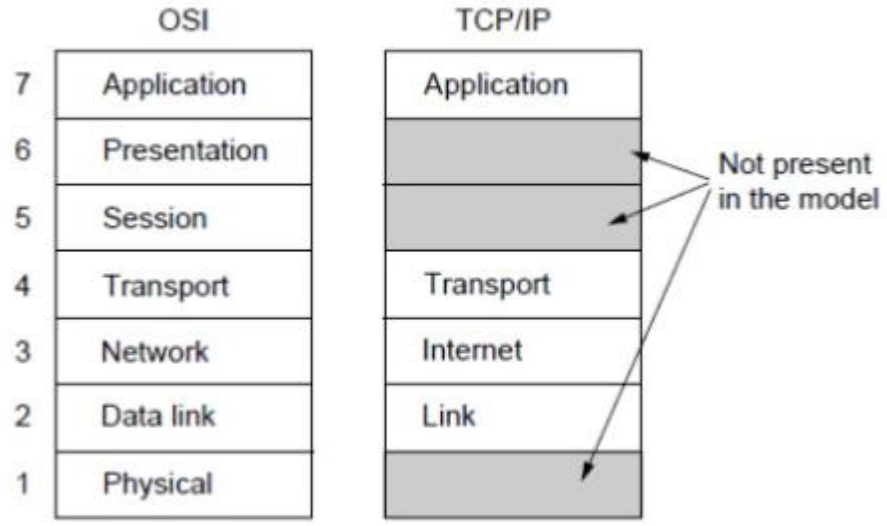
**OR**

**Describe the TCP/IP Protocol Suite.**

# TCP/IP MODEL

## Need:

- The ability to connect multiple networks in a seamless way was one of the major design goals.
- Since applications with divergent requirements can be needed in future, ranging from transferring files to real-time speech transmission, a flexible architecture was needed, so TCP/IP was introduced.




The TCP/IP reference model

1. **The Link Layer**

- The lowest layer in the model, the **link layer** describes what links such as serial lines and classic Ethernet must do to meet the needs of this connectionless internet layer.
- It is not really a layer at all, in the normal sense of the term, but rather an interface between hosts and transmission links.

2. **The Internet Layer**

- Packet Routing: Its job is to permit hosts to inject packets into any network and have them travel independently to the destination (potentially on a different network). They may even arrive in a completely different order than they were sent, in which case it is the job of higher layers to rearrange them, if in-order delivery is desired.

- The internet layer defines an official packet format and protocol called **IP** (**Internet Protocol**), plus a companion protocol called **ICMP** (**Internet Control Message Protocol**) that helps it function.
- The job of the internet layer is to deliver IP packets where they are supposed to go.

3. **The Transport Layer**

- It is designed to allow peer entities on the source and destination hosts to carry on a conversation.
- Two end-to-end transport protocols are:

1. The first one, **TCP** (**Transmission Control Protocol**), is a reliable connection-oriented protocol that allows a byte stream originating on one machine to be delivered without error on any other machine in the internet.

2. It segments the incoming byte stream into discrete messages and passes each one on to the internet layer.

3. At the destination, the receiving TCP process reassembles the received messages into the output stream.

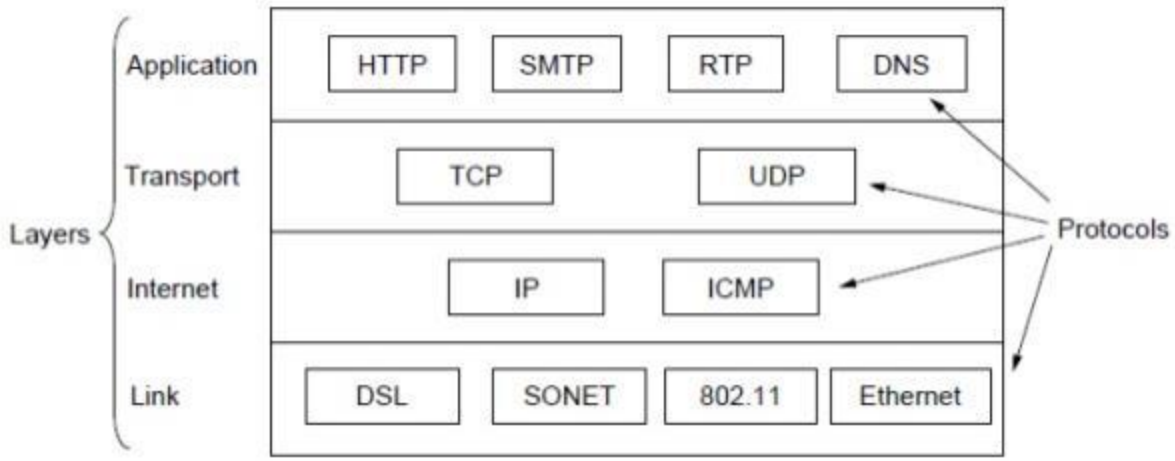
4. TCP also handles flow control to make sure a fast sender cannot swamp a slow receiver with more messages than it can handle.

5. The second protocol in this layer, **UDP** (**User Datagram Protocol**), is an unreliable, connectionless protocol for applications that do not want TCP's sequencing or flow control and wish to provide their own.

6. It is also widely used for one-shot, client-server-type request-reply queries and applications in which prompt delivery is more important than accurate delivery, such as transmitting speech or video.

**The Application Layer**

- It contains all the higher- level protocols.
- The early ones included virtual terminal (TELNET), file transfer (FTP), and electronic mail (SMTP), Domain Name System (DNS), for mapping host names onto their network addresses, HTTP, the protocol for fetching pages on the World Wide Web, and RTP, the protocol for delivering real-time media such as voice or movies.




**3. Compare and Contrast OSI and TCP/IP Model.**

| | |
|---|---|
| TCP refers to Transmission Control Protocol. | OSI refers to Open Systems Interconnection. |
| TCP/IP has 5 layers. | OSI has 7 layers. |
| TCP/IP is more reliable | OSI is less reliable |
| TCP/IP does not have very strict boundaries. | OSI has strict boundaries |
| TCP/IP uses both session and presentation layer in the application layer itself. | OSI uses different session and presentation layers. |
| TCP/IP developed protocols then model. | OSI developed model then protocol. |
| Transport layer in TCP/IP does not provide assurance delivery of packets. | In OSI model, transport layer provides assurance delivery of packets. |
| TCP/IP model network layer only provides connection less services. | Connection less and connection oriented both services are provided by network layer in OSI model. |

4. Describe guided transmission media

Or

Explain about various transmission media in physical layer with a neat sketch

**GUIDED TRANSMISSION MEDIA**

Media are grouped into

- guided media
- unguided media

**Twisted Pairs**

.

- One of the oldest and still most common transmission media is **twisted pair**.
- A twisted pair consists of two insulated copper wires, typically about 1 mm thick.
- The wires are twisted together in a helical form, just like a DNA molecule.
- Twisting provides better immunity to external noise because the noise tends to affect both wires the same, leaving the differential unchanged.

## Applications of Twisted-Pair Cables

- In telephone lines
- In DSL lines
- In LANs

## Types of Twisted–Pair Cables

There are two types of twisted pair cables −

- Unshielded Twisted Pair ( UTP ): These generally comprise of wires and insulators.
- Shielded Twisted Pair ( STP ): They have a braided wired mesh that encases each pair of insulated wires.

## Categories of Twisted–Pair Cables

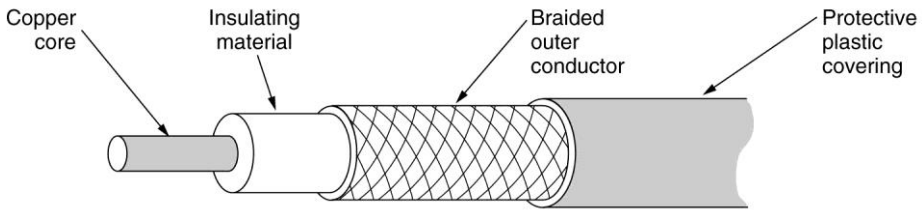
EIA has classified twisted pair cables into seven categories −

- Category 1 − UTP used in telephone lines with data rate < 0.1 Mbps
- Category 2 − UTP used in transmission lines with a data rate of 2 Mbps
- Category 3 − UTP used in LANs with a data rate of 10 Mbps
- Category 4 − UTP used in Token Ring networks with a data rate of 20 Mbps
- Category 5 − UTP used in LANs with a data rate of 100 Mbps
- Category 6 − UTP used in LANs with a data rate of 200 Mbps
- Category 7 − STP used in LANs with a data rate of 10 Gbps

Coaxial Cable:

- Another common transmission medium is the **coaxial cable** (‘‘coax’’ ’).
- It has better shielding and greater bandwidth than unshielded twisted pairs

- It can span longer distances at higher speeds.
- Two kinds of coaxial cable are widely used.
- One kind, 50-ohm cable, is commonly used when it is intended for digital transmission from the start.
- The other kind, 75-ohm cable, is commonly used for analog transmission.
- A coaxial cable consists of a stiff copper wire as the core, surrounded by an insulating material.
- The insulator is encased by a cylindrical conductor, often as a closely woven braided mesh.
- The outer conductor is covered in a protective plastic sheath.
- A cutaway view of a coaxial cable is shown in Fig. 2-4.




- **Figure 2-4.** A coaxial cable.

- The construction and shielding of the coaxial cable give it a good combination of high bandwidth and excellent noise immunity.

- **BNC connectors**
  **1.BNC connector: Used in TV**

  **2.BNCT: Ethernet network**

  **3.BNC terminator:End of the cable to prevent the reflection of the signal**

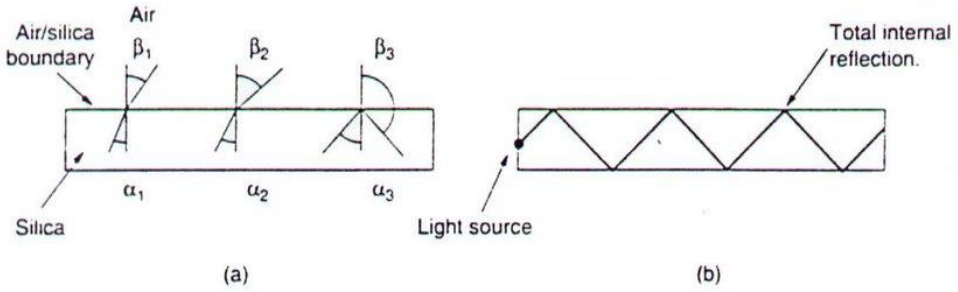
## 5. Describe in detail about Light wave transmission.

### Fiber Optics

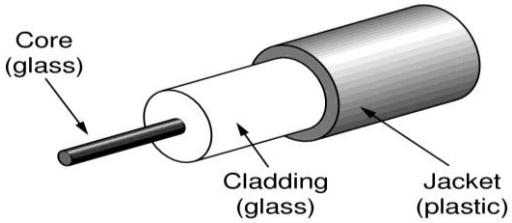
- Fiber optics are used for long-haul transmission in
  network backbones,
  high speed LANs,
  and high-speed Internet access such as **FttH** (**Fiber to the Home**).

- An optical transmission system has three key components:
  the light source,
  the transmission medium, and
  the detector.

- When a light ray passes from one medium to another—for example, from fused silica to air—the ray is refracted (bent) at the silica/air boundary, as shown in




- Fiber optic cables are similar to coax, except without the braid.




- Multi Mode Fiber
- Single Mode Fiber
- In multimode fibers, the core is typically 50 microns in diameter, about the thickness of a human hair.
- In single-mode fibers, the core is 8 to 10 microns.

**Fiber-Optic Cable Connectors:**

- **SC Connector**
- **ST Connector**
- **MT-RJ Connector**

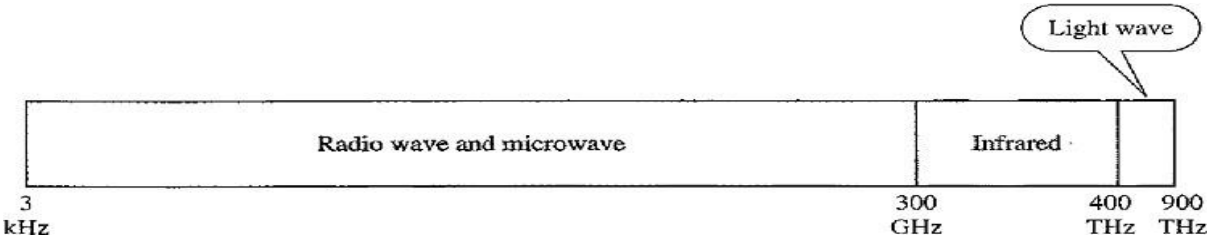
## 7. Write short notes on Wireless Transmission.

**Or**

## Describe Unguided Media in detail.

**UNGUIDED MEDIA** (or) **WIRELESS COMMUNICATION**

Unguided media transport **Electromagnetic Waves** without using a physical conductor. This type of communication is often referred to as wireless communication. Electromagnetic spectrum ranging from **3 kHz to 900 THz** used for wireless communication.




Categories of Wireless Communication:

- Radio Waves ( 3kHz – 1GHz)
- Microwaves ( 1GHz- 300 GHz)
- Infrared Waves (300 GHz - 400 THz)

**Radio Waves**

- Radio waves ranges between 3 kHz and 1 GHz. Radio waves are Omni-directional.
- When an antenna transmits radio waves, they are propagated in all directions. Hence the sending and receiving devices don't have to be aligned.

### Disadvantage

- The Omni-directional property has a **disadvantage**; the radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

### Applications

- Radio waves are used in Multicasting applications such as AM Radio and FM radio, Television, Maritime Radio, Cordless Phones, and Paging.

## Microwaves

- Electromagnetic waves having frequencies between 1GHz and 300 GHz are called microwaves.
- Microwaves are unidirectional.
- This means that the sending and receiving antennas need to be aligned.

### Applications

- cellular phones, satellite networks and wireless LANs.

## Infrared Waves

Infrared waves, with frequencies from 300 GHz to 400 THz.

### Advantages

Infrared waves having high frequencies cannot penetrate walls.

### Disadvantage

- We cannot use Infrared waves for long range communication.
- We cannot use infrared waves outside a building because the sun's rays contain infrared waves that can interfere with the communication.

### Applications

- Due to its wide bandwidth, it can be used to transmit digital data at high data rate.
- It can be used in Communication between devices such as keyboards, mice, PCs, and printers

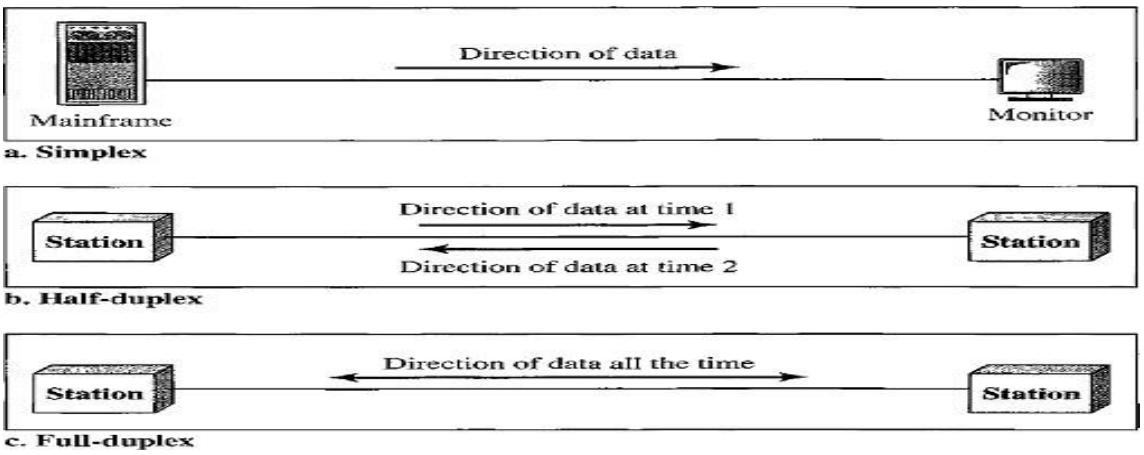
**8. Explain about the Transmission Modes in detail**

**OR**

**Explain the different data flow directions.**

## DIRECTION OF DATA FLOW

Communication between two devices can be simplex, half-duplex, or full-duplex.




## Simplex

- In simplex mode, the communication is unidirectional (i.e. one direction only).
- Only one of the two devices on a link can transmit; the other can only receive.
- The simplex mode can use the entire capacity of the channel to send data in one direction.
- Examples - **Keyboards** and **Monitors,** the keyboard can only introduce input, the monitor can only accept output.

## Half-Duplex

- In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.
- In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time.
- The half-duplex mode is used, where there is no need for communication in both directions at the same time. The entire capacity of the channel can be utilized for each direction.
- **Examples** - Walkie-talkies and CB (citizens band) radios are both half-duplex systems.

## Full-Duplex

- In full-duplex mode (or duplex), both stations can transmit and receive simultaneously.
- In full-duplex mode signals going in one direction share the capacity of the link: with signals going in the other direction
- This sharing can occur in two ways: Either the link must contain two physically separate transmission paths, one for sending and the other for receiving, or the capacity of channel is divided between signals traveling in both directions.
- The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel must be divided between the two directions.
- **Example -** Telephone network. Two people talk and listen at the same time.

**9. Discuss about example Network Models.**

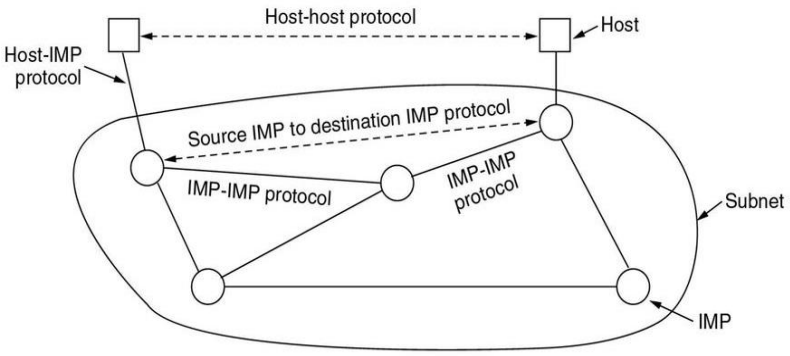
**OR**

**Discuss about ARPANET.**

**OR**

**Explain how INTERNET is administered.**

- The ARPANET was a research network sponsored by the DoD (U.S. Department of Defense). At the height of the Cold War, the U.S. DoD wanted a command-and-control network that could survive a nuclear war.
- U.S Govt decided to create a single defense research organization, **ARPA**, the **Advanced Research Projects Agency**.
- The subnet would consist of minicomputers called **IMPs** (**Interface Message Processors**) connected by 56-kbps transmission lines.
- For high reliability, each IMP would be connected to at least two other IMPs. The subnet was to be a datagram subnet, so if some lines and IMPs were destroyed, messages could be automatically rerouted along alternative paths.
- Each node of the network was to consist of an IMP and a host, in the same room, connected by a short wire. A host could send messages of up to 8063 bits to its IMP, which would then break these up into packets of at most 1008 bits and forward them independently toward the destination.
- Each packet was received in its entirety before being forwarded, so the subnet was the first electronic store-and-forward packet-switching network.
- The IMPs were interconnected by 56-kbps lines leased from telephone companies.
- The software was split into two parts: subnet and host. The subnet software consisted of the IMP end of the host-IMP connection, the IMP-IMP protocol, and a source IMP to destination IMP protocol designed to improve reliability.



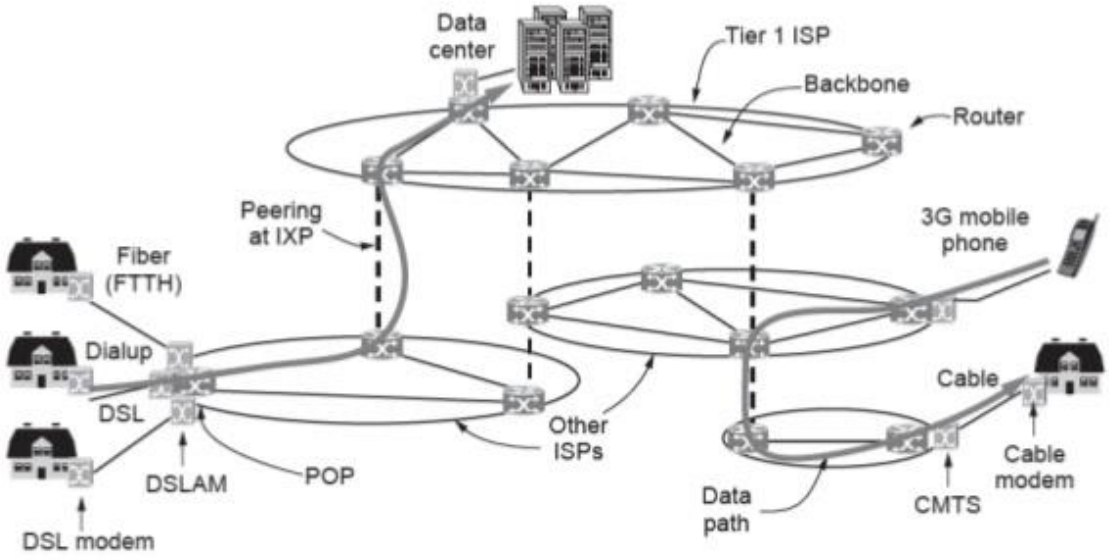

The original ARPANET design.

Ch 1.4

**INTERNET- Network of networks**

- This architecture is based in the very specification of the standard TCP/IP protocol, designed to connect any two networks which may be very different in internal hardware, software, and technical design.
- Once two networks are interconnected, communication with TCP/IP is enabled end-to-end, so that any node on the Internet has the near magical ability to communicate with any other no matter where they are.
- This openness of design has enabled the Internet architecture to grow to a global scale.

# Architecture of the Internet




- To join the Internet, the computer is connected to an **Internet Service Provider**, or simply **ISP**, from who the user purchases **Internet access** or **connectivity**.
- A common way to connect to an ISP is to use the phone line to your house, in which case your phone company is your ISP.
- **DSL** (**Digital Subscriber Line)**, reuses the telephone line that connects to your house for digital data transmission. The computer is connected to a device called a **DSL modem** that converts digital packets to analog signals that can pass over the telephone line.
- At the other end, a device called a **DSLAM** (**Digital Subscriber Line Access Multiplexer**) converts between signals and packets.
- Several other popular ways to connect to an ISP are shown in Figure . DSL is a higher-bandwidth way to use the local telephone line than to send bits over a traditional telephone call instead of a voice conversation. That is called **dial-up** and done with a different kind of modem at both ends.
- The word **modem** is short for ‘‘*mo*dulator *dem*odulator’’ and refers to any device that converts between digital bits and analog signals.
- Another method is to send signals over the cable TV system. Like DSL, this is a way to reuse existing infrastructure, in this case otherwise unused cable TV channels.

- The device at the home end is called a **cable modem** and the device at the **cable head end** is called the **CMTS** (**Cable Modem Termination System**).
- DSL and cable provide Internet access at rates from a small fraction of a megabit/sec to multiple megabit/sec, depending on the system.
- These rates are much greater than dial-up rates, which are limited to 56 kbps because of the narrow bandwidth used for voice calls.
- Internet access at much greater than dial-up speeds is called **broadband**. The name refers to the broader bandwidth that is used for faster networks, rather than any particular speed.
- **FTTH** (**Fiber to the Home)** is the design which uses optical fiber cable to connect to internet for high data rates.
- **POP** (**Point of Presence**) is the location at which customer packets enter the ISP network for service.
- **Backbone** of the ISP is architecture is made up of long-distance transmission lines that interconnect routers at POPs in the different cities that the ISPs serve. If a packet is destined for a host served directly by the ISP, that packet is routed over the backbone and delivered to the host. Otherwise, it must be handed over to another ISP.
- ISPs connect their networks to exchange traffic at **IXPs** (**Internet eXchange Points**). The connected ISPs are said to **peer** with each other.
- **Transit** : There are a number of ISP'S connected together. So , may be a small ISP will pay a large ISP for internet connectivity. This payment for service is called as transit.
- Now, there may be some ISP which have thousands of routers connected by high-bandwidth fiber optic links. These ISPs do not pay for transit. They are usually called **tier 1** ISPs and are said to form **the backbone** of the Internet, since everyone else must connect to them to be able to reach the entire Internet.
- Companies that provide lots of content, such as Google and Yahoo!, locate their computers in **data centers** that are well connected to the rest of the Internet.