Telecom Networks :-

Telecom networks are mostly used today for wide-area communication. Stringing a wire between every pair of telephones that might want to communicate was not a good long-term strategy. A better idea was to connect all the telephones to a central switching office. There an operator could connect one telephone to another via a switchboard.

Routing a telephone call:
A call is routed up through higher-level switching offices until it reaches a switching office that can reach the destination telephone by connecting with lower-level switching offices, which examine the digits of the telephone number you dialed to make these decisions.

Connection-Oriented Services – I :
A dedicated connection between the endpoints is maintained throughout the session. Usually, this means that the quality of service can be reasonably guaranteed to the extent of the bandwidth for the channel that is established. Message bits arrive in the same order in which they are sent.

Transmission Media in Telephone Systems:
In traditional analog telephone systems, the telephone is connected to the local exchange via category 3 UTP cables. This connection is called the local loop. It is typically between 1km and 10km in length.

The local loop:
The subscriber handsets are powered by a battery bank in the exchange. With echo suppressors, the transmission is half-duplex. With echo cancellers, it is possible to have full-duplex communication. Since the local loop is still analog, we need modems for sending digital data.

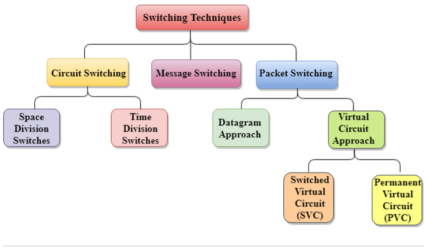
Signaling:
Signaling refers to the information exchanges between terminal devices, exchanges, and routers for setting up circuits, termination, billing, advanced network services, etc. In common Channel signaling which is in the band, some of the bits in the frame are used for this purpose, in which is SS7 is considered standard.

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

When a dedicated path is established for data transmission between sender and receiver, it is called circuit switching. When any network node wants to send data, be it audio, video, text or any other type of information, a call request signal is sent to the receiver and acknowledged back to ensure availability of dedicated path. This dedicated path is then used to send data. ARPANET used circuit switching for communication over the network.

Advantages of Circuit Switching:-

- Circuit switching provides these advantages over other switching techniques −
- Once path is set up, the only delay is in data transmission speed
- No problem of congestion or garbled message

Disadvantages of Circuit Switching:-

- Circuit switching has its disadvantages too −
- Long set up time is required
- A request token must travel to the receiver and then acknowledged before any transmission can happen
- Line may be held up for a long time

Message Switching

Message switching was a technique developed as an alternative to circuit switching before packet switching was introduced. In message switching, end-users communicate by sending and receiving messages that included the entire data to be shared. Messages are the smallest individual unit.

They provide 2 distinct and important characteristics:

- Store and forward – The intermediate nodes have the responsibility of transferring the entire message to the next node. Hence, each node must have storage capacity. A message will only be delivered if the next hop and the link connecting it are both available, otherwise, it'll be stored indefinitely. A store-and-forward switch forwards a message only if sufficient resources are available and the next hop is accepting data. This is called the store-and-forward property.

- Message delivery – This implies wrapping the entire information in a single message and transferring it from the source to the destination node. Each message must have a header that contains the message routing information, including the source and destination.

Packet Switching

Packet Switching
The data packets will contain the source and destination addresses. Every router in between will check the destination address, select the next router to which the packet should be forwarded and send it via an appropriate path. As there is no path specified, different packets may follow different paths.

Virtual circuit packet switching

This is a mix of both packet and circuit switching. A path will be set-up logically i.e. no physical path will be set-up. Packets always follow this logical path. Therefore, these are the advantages of both packet and circuit switching.

 # Frame Relay :-

Frame relay is a packet-switching telecommunications service designed for cost-efficient data transmission for intermittent traffic between local area networks (LANs) and between endpoints in wide area networks (WANs).

The service was once widely available and implemented. Today, major internet service providers (ISPs) have stopped using it. Sprint, now part of T-Mobile, ended its frame relay service in 2007. Verizon stopped offering it to new customers in 2009 and completely phased it out in 2013. AT&T stopped offering it in 2012 but supported existing customers until 2016.

The benefits of frame relay include the following:

- Efficient. It does not perform error correction, which consumes time and network resources. Its use of use variable packet sizes improves bandwidth use.
- Cost-effective. It's cheaper than dedicated lines and less hardware is required.
- Flexible. It uses a data link connection identifier (DLCI) number. The DLCI is a number that identifies the logical circuit between the router and the frame relay switch. It determines which circuit to send a frame to in a frame relay network, allowing any two stations to connect. Frame relay flexibility also comes from its ability to buffer traffic bursts.
- Low latency. It's less prone to latency because other network components handle error correction.

 # ATM :-

Asynchronous Transfer Mode (ATM):

It is an International Telecommunication Union- Telecommunications Standards Section (ITU-T) efficient for call relay and it transmits all information including multiple service types such as data, video, or voice which is conveyed in small fixed-size packets called cells. Cells are transmitted asynchronously and the network is connection-oriented.

ATM is a technology that has some event in the development of broadband ISDN in the 1970s and 1980s, which can be considered an evolution of packet switching. Each cell is 53 bytes long – 5 bytes header and 48 bytes payload. Making an ATM call requires first sending a message to set up a connection.

 # MPLS :-

Multi Protocol Label Switching (MPLS) is an IP packet routing technique that routes IP packet through paths via labels instead of looking at complex routing tables of routers. This feature helps in increasing the delivery rate of IP packets.

MPLS uses layer 3 service i.e, Internet Protocol, and uses router as forwarding device. The traffic of different customers is separated from each other because MPLS works somewhat like VPN. It does not work like regular VPN that encrypts the data but it ensures packet from one customer cannot be received by another customer. An MPLS header is added to packet that lies between layers 2 and 3

VSAT Communication:-

VSAT (Very Small Aperture Terminal) is a technology that is used for effective communication in remote areas using Satellites and components located on ground. This article briefly covers the details on the uses of VSAT and how the signals are transmitted.

VSAT – 2 Main Components
A VSAT has 2 main components, which are given below

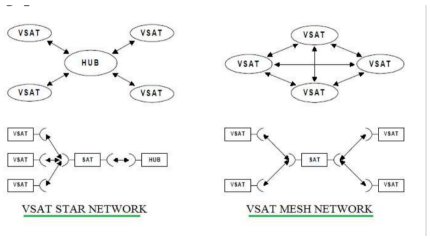
A transceiver placed outdoors in direct line of sight to the satellite, and
Interfacing of the transceiver and the users communication device will be done through a device placed indoors.

VSAT – Functions and its Uses

VSAT is a technology that represents another option for Internet connectivity in extremely remote areas and distant field locations because there are very limited choices for telecommunications and Internet connectivity.
It is used for communication at seas, and in distant locations such as on oil rigs and utility services.
VSAT terminals are used by Armed forces located in remote mountainous regions or by the Navy while operating in seas.
Can be used for disaster relief operations, as well as industrial applications, or even for communication while carrying out scientific studies in remote locations like Antarctica or in Oceans.

Broadly VSAT network as a whole consists of VSAT terminals distributed across different regions on the Earth and Hub station located at one central place. Communication between Hub station and VSAT terminals is carried out using RF frequencies in different bands (e.g. C band, Ku band) as per applications and regions of use.

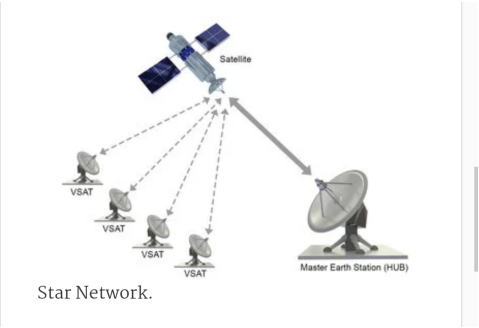
VSAT network topology types:-



As shown there are only two topologies viz. Star and Mesh.
In Star type of VSAT network, all the communications occur through Hub station using multi hop communication.

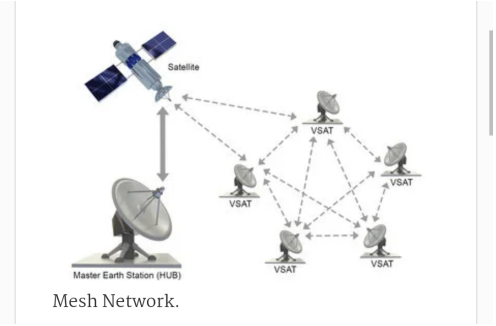
Star Network topology:-

The star network is the most commonly used topology for both unidirectional and bidirectional networks providing much greater flexibility. This network allows transmission of information in both directions but cannot be transmitted directly from one VSAT to another. All information is routed through the hub station.



Mesh Network topology:-

A mesh network is mainly used for real-time telephony or video-teleconferencing applications. It allows several remote sites (VSATs) to communicate with each other via a single link through the satellite resulting to a minimal time delay between signal transmission and reception due to its “single hop” nature.



Mesh Network.

#BandWidth Reservation:-

VSAT Bandwidth
The bandwidth of VSAT is referred as total frequency allocation allocated to any VSAT at RF center frequency by RF engineers. For example, if IF frequency allocated to VSAT is 71.02 MHz and there are 1 voice and 1 data channels operating at 19.2 Kbps and 9.6 kbps respectively are used. Here total VSAT Bandwidth is (19.2 + 9.6) = 27.8 KHz provided 1 bit is used per carrier (i.e. BPSK modulation is employed).

Wireless Networks :-

Computer networks that are not connected by cables are called wireless networks. They generally use radio waves for communication between the network nodes. They allow devices to be connected to the network while roaming around within the network coverage.

Types of Wireless Networks
Wireless LANs − Connects two or more network devices using wireless distribution techniques.
Wireless MANs − Connects two or more wireless LANs spreading over a metropolitan area.
Wireless WANs − Connects large areas comprising LANs, MANs and personal networks

 # Wifi :-

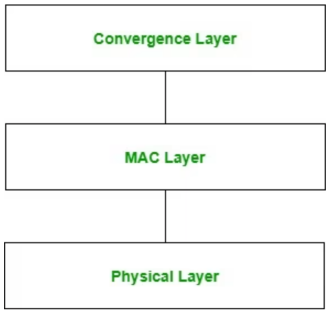
Wi-Fi is a wireless networking technology, by which we can access networks or connect with other computers or mobile using a wireless medium. In Wi-Fi, data are transferred over radio frequencies in a circular range.

Wi-Fi, a brand name given by the Wi-Fi Alliance (formerly Wireless Ethernet Compatibility Alliance), is a generic term that refers to the communication standard for the wireless network which works as a Local Area Network to operate without using the cable and any types of wiring. It is known as WLAN. The communication standard is IEEE 802.11. Wi-Fi works using Physical Data Link Layer.

#Wimax:-

WiMax stands for Worldwide Inter-operability for Microwave Access. This technology is based on IEEE 802.16. It is used to provide higher data rates with increased coverage. It is based on MAN (Metropolitan Area Network) technology. Its range is upto 50 Km. It may provide speed upto 70 Mbps and it can operate in Non-Line-of-Sight. This technology is fast, convenient and cost effective.

Architecture:



Physical Layer: This layer specifies frequency band, synchronization between transmitter and receiver data rate and multiplexing scheme.
This layer is responsible for encoding and decoding of signals and manages bit transmission and reception. It converts MAC layer frames into signals to be transmitted. Modulation schemes which are used on this layer includes: QPSK, QAM-16 and QAM-64.

MAC Layer:
This layer provides and interface between convergence layer and physical layer of WiMax protocol stack. It provides point to multipoint communication and is based on CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance). The MAC layer is responsible for transmitting data in frames and controlling access to shared wireless medium. The MAC protocol defines how and when a subscriber may initiate a transmission on the channel.

Convergence Layer:
This layer provides the information of the external network. It accepts higher layer protocol data unit (PDU) and converts it to lower layer PDU. It provides functions depending upon the service being used.

Cellular Phone Technology:-

Cellular Phone Technology is a general term for a series of different technologies that enable cell-based wireless communication. A variety of different cellular phone technologies have evolved in recent years through the efforts of different vendors and standards organizations. This evolution is expected to continue as technologies mature and develop.

#GSM :-

GSM stands for Global System for Mobile Communication. GSM is an open and digital cellular technology used for mobile communication. It uses 4 different frequency bands of 850 MHz, 900 MHz, 1800 MHz and 1900 MHz . It uses the combination of FDMA and TDMA. This article includes all the concepts of GSM architecture and how it works.

GSM is having 4 different sizes of cells are used in GSM :

- Macro : In this size of cell, Base Station antenna is installed.
- Micro : In this size of cell, antenna height is less than the average roof level.
- Pico : Small cells' diameter of few meters.
- Umbrella : It covers the shadowed (Fill the gaps between cells) regions.

Features of GSM are :

- Supports international roaming
- Clear voice clarity
- Ability to support multiple handheld devices.
- Spectral / frequency efficiency
- Low powered handheld devices.
- Ease of accessing network
- International ISDN compatibility.

#CDMA:-

Code Division Multiple Access (CDMA) is a sort of multiplexing that facilitates various signals to occupy a single transmission channel. It optimizes the use of available bandwidth. The technology is commonly used in ultra-high-frequency (UHF) cellular telephone systems, bands ranging between the 800-MHz and 1.9-GHz.

CDMA Capacity
The factors deciding the CDMA capacity are −

- Processing Gain
- Signal to Noise Ratio
- Voice Activity Factor
- Frequency Reuse Efficiency

Capacity in CDMA is soft, CDMA has all users on each frequency and users are separated by code. This means, CDMA operates in the presence of noise and interference.

#3G:-

3G refers to the third generation of cellular technology that enables mobile telephony. The third-generation standard follows two earlier generations that were deployed on mobile networks and across mobile phones.

The International Telecommunication Union (ITU) defined the third generation of mobile telephony standards International Mobile Telecommunications 2000 (IMT-2000) to facilitate growth, increase bandwidth and support more diverse applications. For example, Global

System for Mobile Communications (GSM) technologies could deliver not only voice, but also circuit-switched data across mobile phone networks at speeds up to 14.4 kilobits per second (Kbps). To support mobile multimedia applications, however, the 3G standard had to deliver packet-switched data with better spectral efficiency at far greater speeds.

#4G:-

4G is the short name for fourth-generation wireless, the stage of broadband mobile communications that supersedes 3G (third-generation wireless) and is the predecessor of 5G (fifth-generation wireless).

The 4G wireless cellular standard was defined by the International Telecommunication Union (ITU) and specifies the key characteristics of the standard, including transmission technology and data speeds.

Each generation of wireless cellular technology has introduced increased bandwidth speeds and network capacity. 4G users get speeds of up to 100 Mbps, while 3G only promised a peak speed of 14 Mbps.