SATELLITE ORBIT:

↳ A Satellite can have any elliptical Orbit but most of those used for communication have Orbits that are at least approximately circular.

↳ Satellite Orbit can circle the equator; they can pass over both poles in a polar Orbit.

Orbital Calculations:

Satellites are held in Orbit by their momentum. This phenomenon is non-monly called centrifugal force, Any Satellite Orbitting the earth must satisfy this eqn,

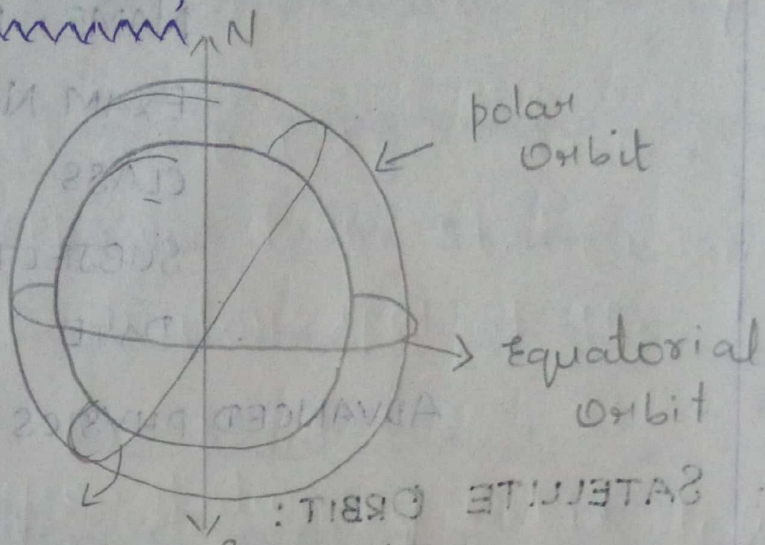
$$v = \sqrt{\frac{4 \times 10^{11}}{(d + 6400)}}$$

where,

v = Velocity in meters per second

d = distance above earth's surface in Km.

circular orbits;



Geo-stationary Orbit:

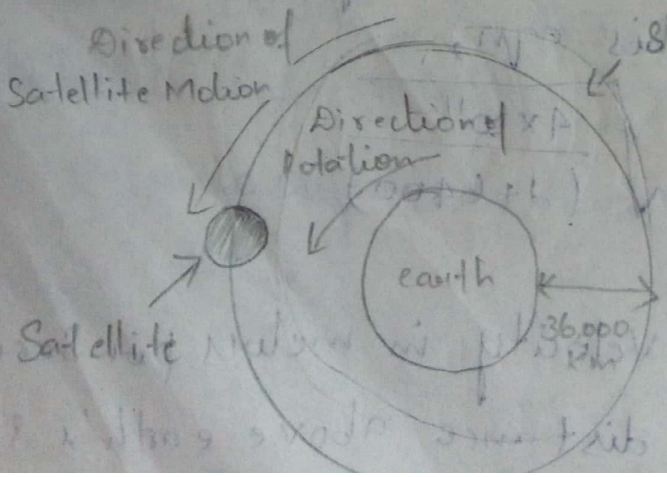
↳ The Satellite has a particularly interesting orbit.

↳ Geosynchronous,

ie., the Satellite orbits the earth in the same amount of time it takes the earth to rotate once on its axis

↳ Geostationary,

ie., it will appear stationary from the ground, because it rotates at the same rate and in the same directions as the earth.

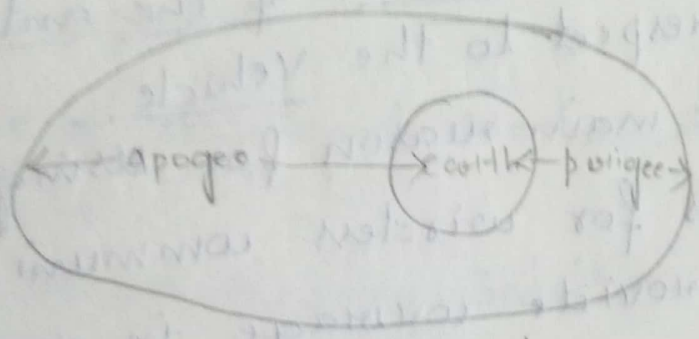


Elliptical Orbit

↳ Technically all Satellite Orbits are elliptical.

↳ A circle is a special case of ellipse where the maximum distance form from the earth (apogee) is equal to the minimum distance (perigee).

↳ This can be seen from Kepler's Second law, which states that such a Satellite sweeps out equal areas in Space in equal times.



elliptical Orbit

2. SATELLITE FOR COMMUNICATION:

↳ The traditional way to communicate with a Satellite in Non-geostationary Orbit is to use a movable, directional antenna and point it at the Satellite.

↳ They are two obvious problems with this for mobile and portable communication.

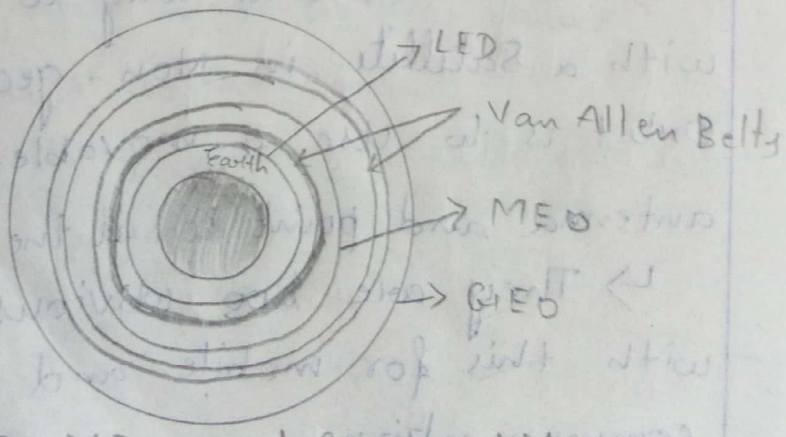
Using Satellites in Geo-stationary Orbit:

↳ There is an Orbit in which a Satellite appears to be Stationary above a particular spot at the equator.

↳ The geo-stationary Orbit does have something to be desired for portable and mobile use.

↳ The Orientation of the antenna with respect to the earth is Stable, but the Orientation of the antenna with respect to the Vehicle

↳ The main reason for using Satellites for wireless communication is to provide coverage in remote areas, which are out reach of terrestial cellular system.



LEO, MEO and GEO Orbits

LEO - Low - earth Orbit → Range from 300 to 1500 Km
MEO - Medium earth Orbit → 8000 to 20000 Km
GEO - Geo-Stationary earth Orbit → 5000 to 20000 Km

Geo-stationary Satellite Beams and footprints:

A geo-stationary satellite can be "seen" from almost half the earth's surface.

Therefore, three such satellite should be sufficient to cover the entire earth, except for the polar regions, with some overlap.

Many geo-stationary satellites are not intended to cover an entire hemisphere.

Use of low and Medium earth Orbits:

Geostationary Satellite are usable for wireless communicatio.

They main problems with such Satellites with lower Orbits,

* Their position in space is not fix w.r.to ground station.
* The annoying tendency of such Satellites to disappear below the Horizon.

1. SATELLITE AND TRANSPONDERS

↳ The Satellite as a space-craft, with its attendant guidance systems and positioning jets, is outside the Scope

↳ The traditional way to build a communication Satellite is to design it as a frequency-shifting repeater or collection of repeaters.

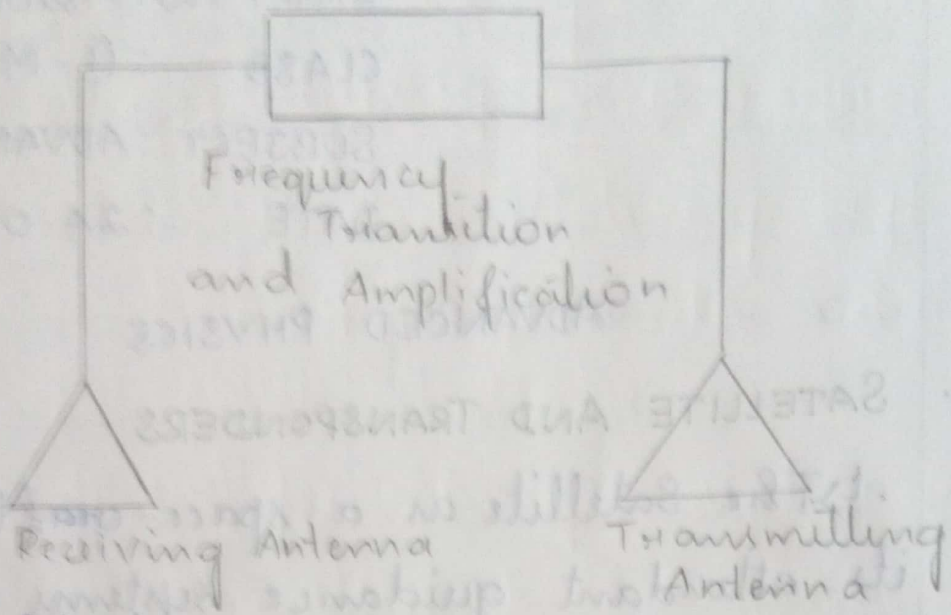
↳ One Satellites may have many transponders,

↳ A range of frequencies is received from the ground via the uplinks

↳ Amplified and shifted in frequency and retransmitted on the downlink

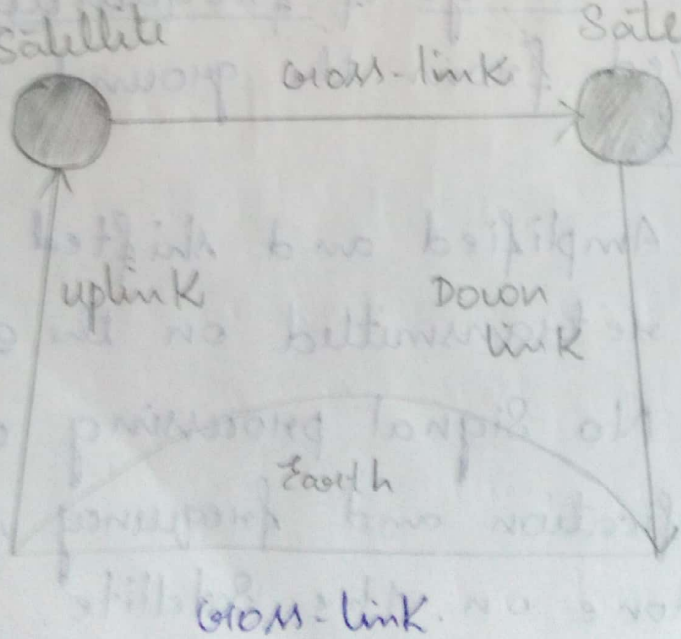
↳ No Signal processing other than amplification and frequency shifting is done on the Satellite.

Bent-pipe transponder



↳ This transponder design is extremely versatile

↳ A bend pipe transponder can be used for anything from broad-casting TV using analog wideband FM to digital telephony using either time-division or frequency division multiplexing or both.



↳ It is also possible to design Satellite transponders for specific applications.

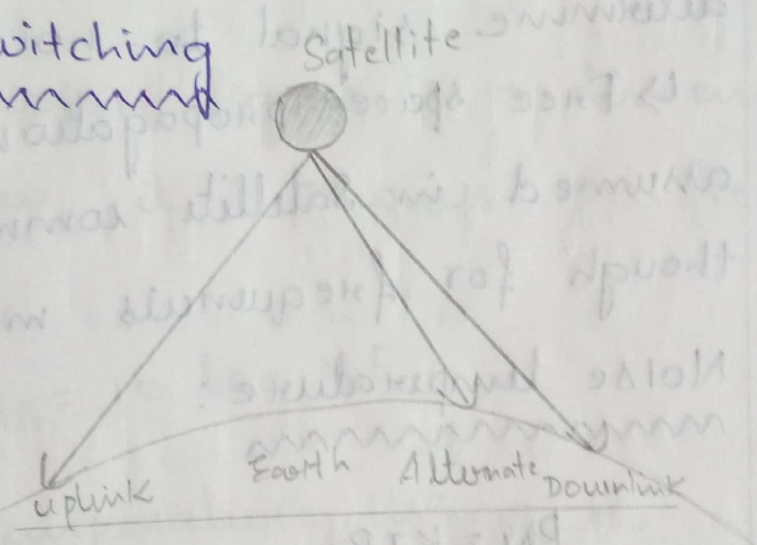
↳ It is designed to store digital information and retransmit.

↳ Using this store and forward technique data can be communicated

↳ Satellite is designed to communicates with each other.

↳ Such crosslinks can improve the efficiency of communication b/w earth station as indicated.

Beam Switching



↳ It is possible to turn a Satellite transponder into a switching center.

↳ So that a signal from a transmitter on the ground can be relayed to one of a variety of ground or Satellite based receivers as required.

SIGNAL AND NOISE CALCULATION:

↳ Because of the very weak received signals, satellite system is require low-receivers and relatively high-gain antennas for both the satellite and the earth station

↳ Especially, when geo-stationary satellite are used.

↳ A good place to consider in more detail the factors that determine signal to-noise ratio

↳ Free space propagation can be assumed in satellite communication, though for frequencis must 10GHz,

Noise temperature:

$$P_N = KTB$$

where,

P_N - Noise power in watts

K - Boltzmann constant (J/K)

T - Noise temperature (K)

B - Noise power bandwidth in Hz.

The Noise figure is a measure of how much an electronic system degrades the signal to-Noise ratio of signal at its input,

i.e., $$NF = \frac{(S/N)_I}{(S/N)_O}$$

where,

$(S/N)_I$ = Signal to Noise ratio at the input

$(S/N)_O$ - Signal to Noise ratio at the output

The Noise figure is a dimensionless ratio, it is always specified in dB,

$$NF_{dB} = 10 \log NF$$

Noise temperature using the equation,

$$T_{eq} = 290 (NF - 1)$$

where,

T_{eq} - equivalent Noise temperature in Kelvin

NF - Noise figure as a ratio

↳A receiver has an equivalent Noise of 2 dB:

$$NF = \text{antilog}\left[\frac{NF_{dB}}{10}\right]$$

$$= \text{antilog}\left[\frac{2}{10}\right]$$

$$= 1.58$$

$$T_{eq} = 290(NF-1)$$

$$= 290(1.58-1) = 170K$$

↳The Total (Net) amount Noise temperature,

$$T = T_{eq} + T_a$$

where,

T = System Noise temperature in K

T_{eq} - receiver equivalent Noise temp

T_a - antenna Noise temp in K.

↳Losses in the antenna system contribute to Noise temp,

$$T_a = \frac{(L-1)290 + T_{SKY}}{L}$$

where,

T_a - effective noise temp. of antenna and feedline referenced to receiver antenna input in K.

L - Loss in feedline and antenna as a ratio of input to output power.

T_{sky} - effective sky temperature in Kelvins.

In MARSAT SYSTEM:

In MARSAT [International Maritime Satellite Organization] was established on July 16, 1979 at the intiative of the International Maritime Organization [IMO] and initially had a status of an interstate Organization.

↳ The main purpose of InMARST was to provide marine vessels with reliable communications for enhancement of safety shipping, transmission of SOS signals, Operative interaction with other vessels and shore services and communication blw the Numbers and passengers.

↳ InMARSAT system operates within frequency ranges allocated by the International Tele-communication Union

for mobile Satellite Service.

Structurally INMARSAT system consists of three main ports. They are:

↳ Space segment consisting of working and reserve geo-stationary Service.

↳ Earth Segment which includes technical facilities for receipt, processing and transmission of information in band earth stations.

↳ Subscriber Satellite stations and terminals:

* Mobile
* portable and
* Stationary Satellite terminals.

↳ At moment the Satellite constellation consists of 14 geostationary Satellite and belongs to INMARSAT.

↳ Earth Segment includes:

* Control and management facilities for satellite communication.

* System control and management facilities includes

Network Operation Center [NOC], Network co-ordination Station [NCS] and Satellite Access Stations [SAS].

↳ Land earth Station [LES] belong to national operators of InMARSAT network and provide Switching of Subscribes terminals with land line network [PSTN, Internet, X-25]

↳ InMARSAT system is the aggregate of Standards and systems [subsystems] using the same satellite and common Land Earth stations. Then, the Satellite terminals differ significantly by their facilities, structure and technical parameters.

↳ At a moment InMARSA System has terminals that submit to subscribes services which do not require high-speed information exchange [MSM solutions, remote location Monitoring etc] as well as

modern services providing high quality tele-phone connection, transmission of video online in IP Networks at speed up to 0.5 mbit/s.

MAST System:

In MAST [Multi Application Survivable Tether] system consists of three tube sats launched together as a Sinck. It was an in space investigation designed to use "cube sat" Space craft connected by fethers to bether understand the Survivability of fethers in space.

↳ The MAST payload incorporated three pico-satellites. They are:

* Ralph
* Ted
* Gadget

which were intended to separate and deploy a 1 Kilometer tether.

Ralph:

Ralph is at the other end of the stack and is described as simply

a "tether and mass". It was design to include a radio, but the ground station has not received any signal from Ralph. The Ralph battery charge has dropped below level needed to sustain radio operation.

Ted: [The Tether deployer pico-satellite]

Ted is at the tether deployer Satellite, is at one end of the stack. Researches were unable to establish contact with Ted and remain Uncertain of its status.

Gadget:

The middle satellite in the stack called "gadget" is the tether inspector. Gadget was designed to study Slowly crawl up and down the tether after deployment acquiring images as it moves.

SYSTEMS USING MEDIUM EARTH ORBIT SATELLITE:

↳ Satellite in medium earth orbit are a components b/w the LEO and GEO systems more satellites are needed than for GEO can the order of 6 to 20 for real-time communication but favor than 100

↳ Delay and propagation loss are much less than GEO, but greater than LEO. portable phones are possible with MEO systems, but they must be heavier and bulkier than for LEO systems.

↳ The main advantages of using MEO rather than LEO satellites is financial. These system promise rates for a time that are atleast on the same order of those for terrestial cellular system, Unlike LEO systems

Ellipse:

Ellipse uses an interesting combination of elliptical and circular orbits

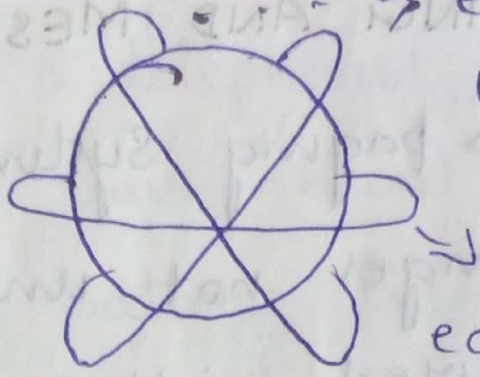
A glance at any globe will confirm that most of the world's land mass is north of 40 south latitude.

The elliptical orbits have a maximum height of approximately 7800 Km and a minimum height of approximately 520 Km the Orbital periods are three hours.

Ellipse system Orbits:

These satellites can provides convert of about 80% of world's population.

The main focus of the ellipse system is expected to be voice communication.



ICO:

ICO abbreviate for Intermediate Circular Orbit. This plan initiated in marsat but since off and privatied, and their Orthogonal in at an attitude of 10,355 Km each at 45° angle to the equator thus provides global coverage.

PAGING AND MESSAGING SYSTEM:

↳ paging systems have undergone changes not unlike those that have occured with wireless voice communication.

↳ The traditional pageing system uses widely spaced transmitted, each covering a considerable geographic area.

↳ In addition all transmitter in a given system operate on the same frequency, either in VHF range at about 152 or 158 MHz and all pages are sent by all the transmitter in the System.

↳ The System, wasteful of Spectrum through it is, works because short paging messages require little time or bandwidth.

↳ The traditional pages is simply a fixed-tuned receiver that uses a transmitted code to identify messages meant for it.

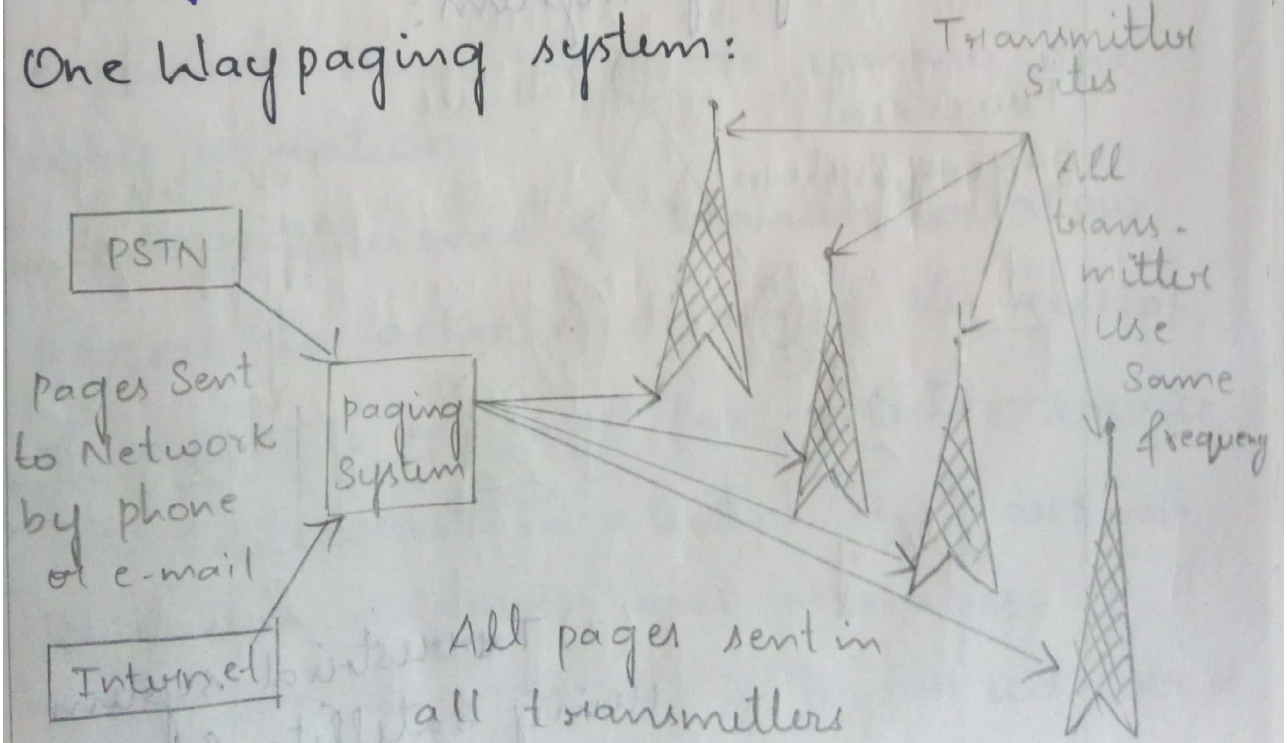
↳ Simple paging systems like very popular in spite of increased popularity of cellular and PCS telephones.

Advantages of their small size, low cost and long battery life.

↳ The ultimate paging is for user to be able to send a reply.

↳ Some system even allow a voice message to be received and answered.

One Way paging system:



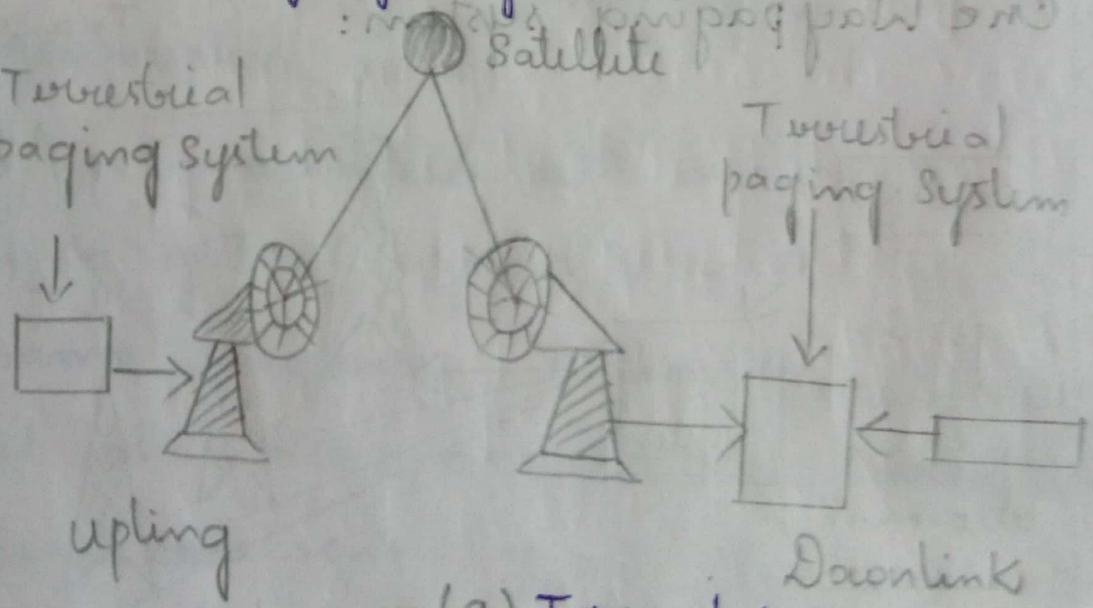
↳ The traditional way to handle paging is to have a Network of relatively powerful transmitters all pages on the same frequency.

↳ Frequency are re-used by using the same frequencies for every transmitter

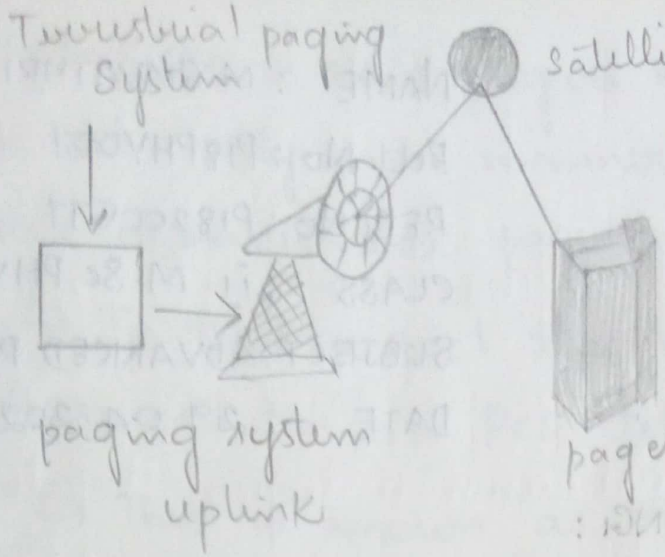
↳ Transmission addressed to other pages are simply ignored.

These systems are more expensive but are useful in remote areas without traditional paging systems.

They are two types of Satellite based paging system:



(a) Terrestrial system using Satellite for National coverage.



b) Direct Satellite transmission to pagelink.

Two-way paging System:

↳ The Motorola REFLEX System is the de-facto Standard of two way alphabet-numeric pager.

↳ It is much more complex and expensive than the more commo one-way operation.

↳ The presence of transmitter allow pagers to acknowledgement the receipt of masseges making for reliable servic.

↳ Codewords in a batch that are not used for addresses and messages.

There are 20 messages bits per codecoord as may be used as necessary transmit to the messages.

↳ REFLEX paging system operates in frequency ranges of 928-932 MHz for outbound channel and 896-902 MHz inbound channel.

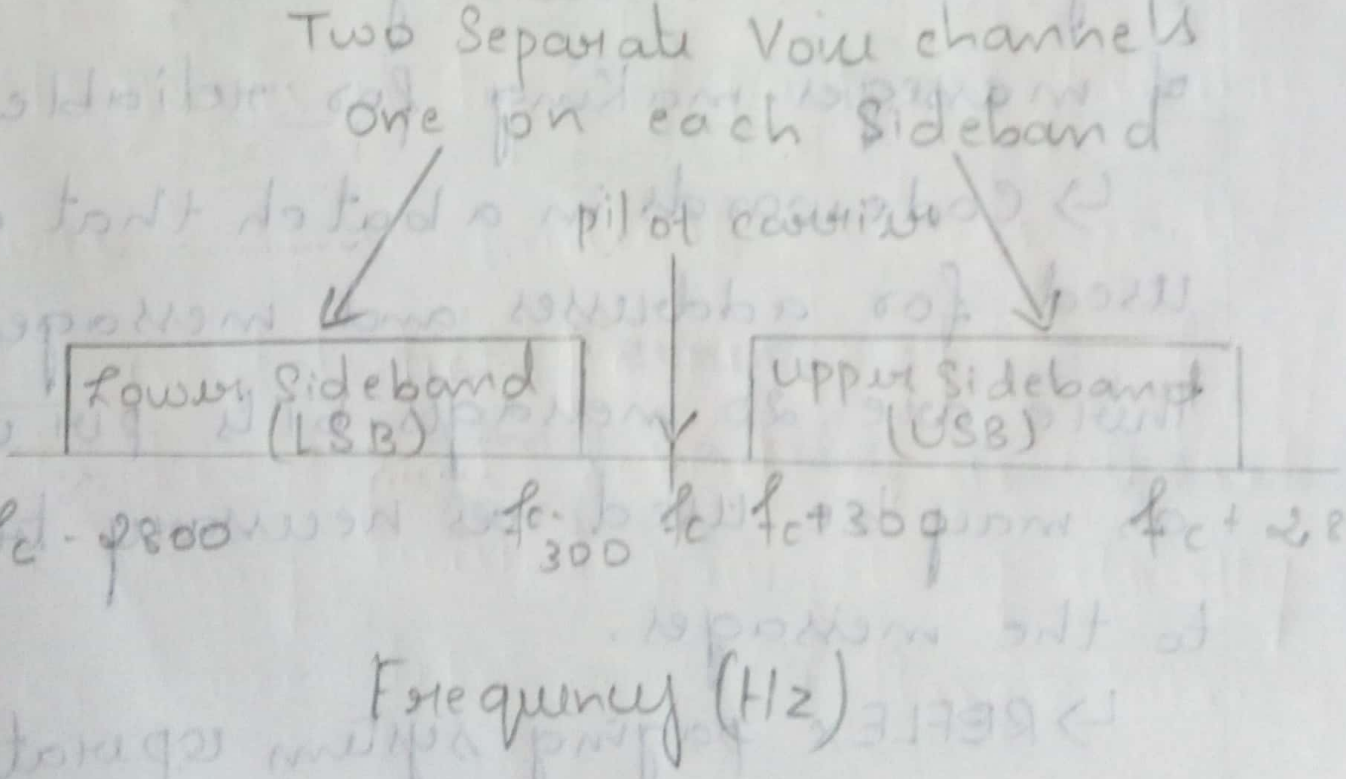
VOICE PAGING:

L> It allows a pager to function in a manner similar to a telephone answering machine

L> The Motorola INFLEXion system is the most popular voice paging protocol.

L> It uses analog compression and SSB AM to transmit voice messages from the base station to the pagers.

L> This system allows two voice messages to be transmitted simultaneously on a channel 6.25 KHz wide.



↳ InFLEXion Voice pagers normally allow a text reply in a manner similar to two alphanumeric pagers.

↳ In that respect they are less flexible than cellular or PCS telephones.

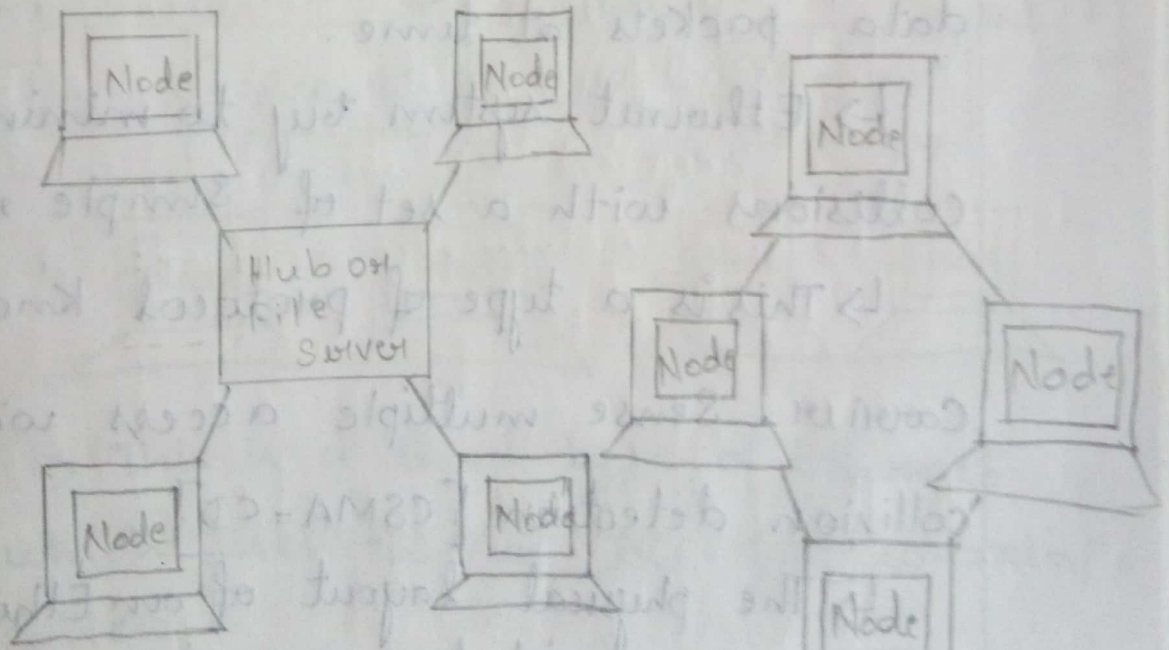
↳ This is known as Voice paging Signal.

LAN TOPOLOGIES:

↳ There are three basic ways to Organize a local-area Network.

↳ They are:

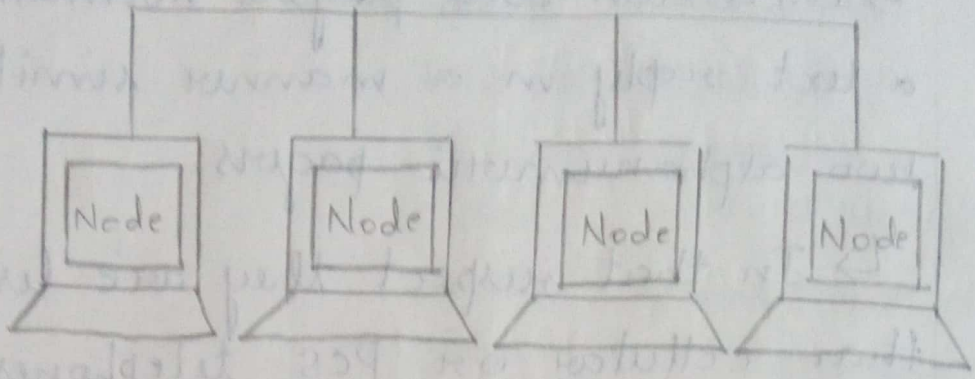
* The Star
* The ring and
* The bus



a) Star

b) Ring

c) Bus



↳ The most common logical topology for LANs, however is the bus.

↳ The majority of local-area Network use the Ethernet standard, a logical bus topology usually running at either 10 or 100 Mb/s.

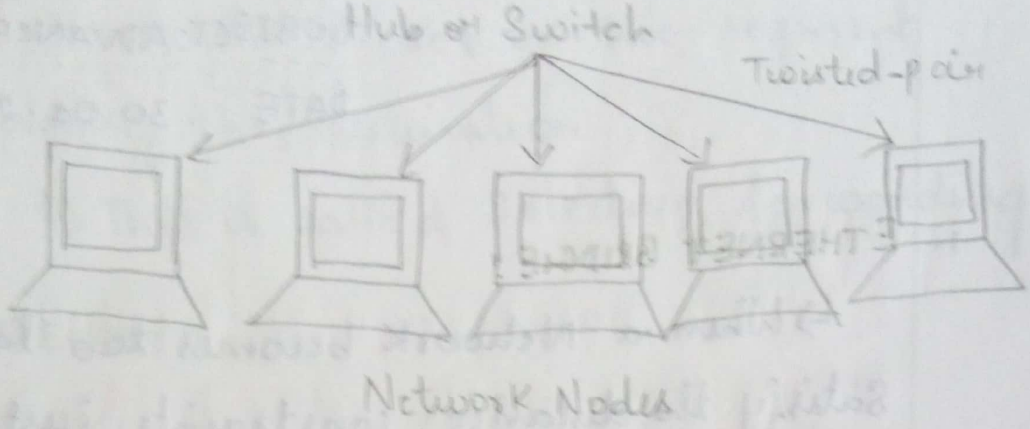
↳ With a basic Ethernet system, all stations are connected to the bus at all times and any station can transmit data packets at time.

↳ Ethernet system try to minimize collisions with a set of simple rules.

↳ This is a type of protocol known as Carrier-Sense multiple access with collision detection [CSMA-CD]

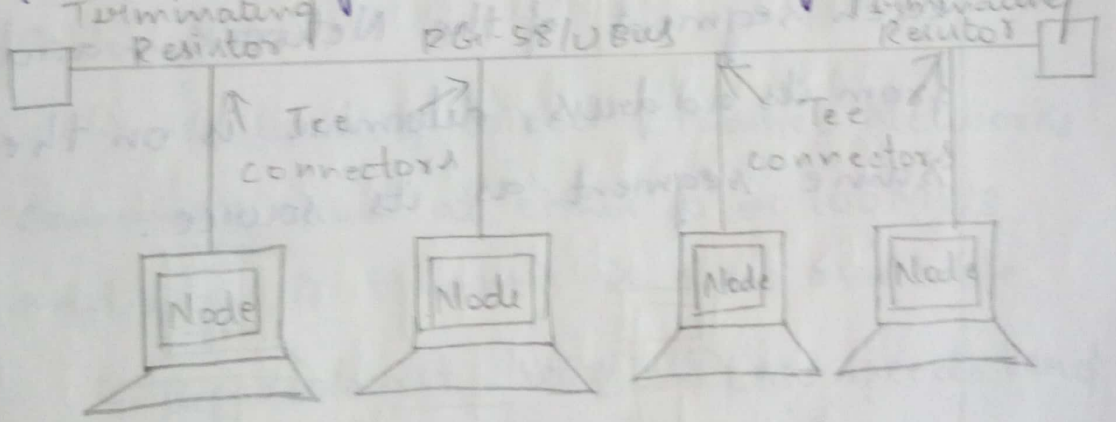
↳ The physical layout of an Ethernet LAN using twisted pair wiring usually looks more like a star than a bus.

↳ All the computers are connected to a central hub using two pair of wire in a single cable.



↳ The packet sent only to node which is addressed, eliminating the possibility of a collision.

↳ It has dis-advantages co-axial cable is more expensive than twisted pair wiring and connecting a station.



↳ This is a third type of Ethernet which uses thicker RG-8/U co-axial cable.

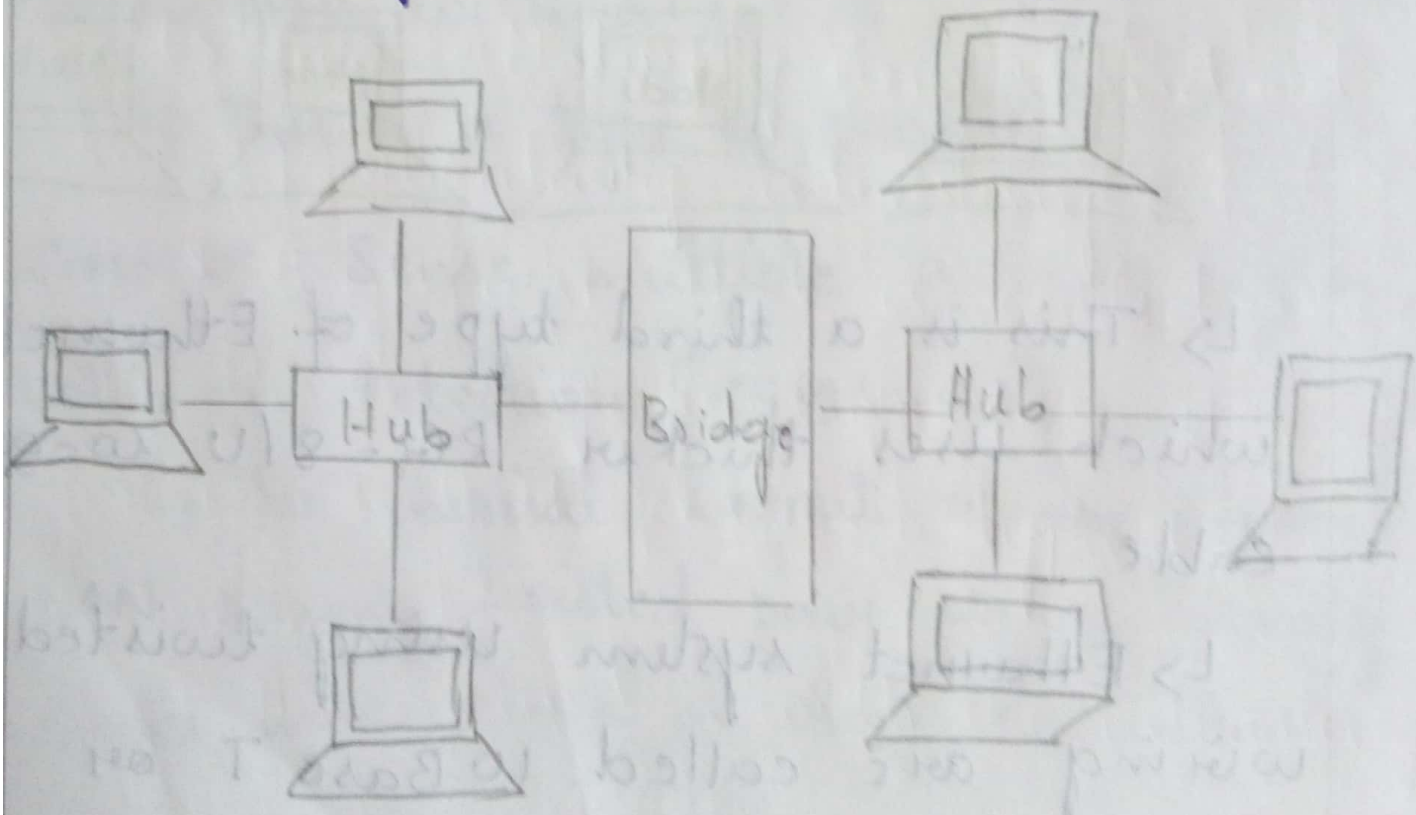
↳ Ethernet system using twisted pair wiring are called 10 Base T or 100 Base T for the 100 Mb/s Version.

ETHERNET BRIDGE:

↳ When a Network becomes too large to satisfy the distance constraints just described, it can be broken into two Sections connected by a bridge.

↳ A bridge connects to both Network Segments.

↳ It looks at each packet of data on each segment of the Network, and from its address, determine is on the same segment as its source.



↳ If the Source and destination are on the same segment, it does nothing.

↳ If they are on different segments, it places the packet on the segment holding the destination.

↳ This is called selective forwarding.

WIRELESS LAN'S:

↳ Wireless local area Networks are slower and more expensive than wired LANs.

↳ Therefore, the use of wireless LANs is indicated only where there are compelling advantages to being free of cabling.

↳ Ordinary wired Ethernet Networks commonly run at either 10 or 100 Mb/s and gigabit Ethernet is Now available.

↳ By Contrast, wireless LAN speeds tend to be in the 1 to 2 Mb/s range.

↳ This is fast enough for many applications.

↳ For instance, a Spreadsheet program running on a Notebook computer can usually share files with others on the network without requiring a great deal of bandwidth.

01.05.2020

RADIO LAN'S:

↳ There has been a proliferation of proprietary radio standards for LAN's.

↳ Most have used unlicensed frequency bands in the 900 MHz range and more recently the 2.4 GHz range.

↳ Wired ethernet, by contrast, has quite rigid standards, any Network adapter designed for a 10BaseT system.

↳ Recently, there has been some improvement in this chaotic situation.

↳ Two relatively new standard are particularly intersting.

* The first that is called IEEE 802.11, is a general purpose standard for LANs that cover a typical environment.

* The second, with the intersting name of bluetooth, is intended for

much shorter range, up to 10m and is intended to provide a low cost cost, built in capability for devices such as cellular phones and personal digital assistants [PDAs).

BLUETOOTH:

↳ It is designed to be an open standard for short range systems, the usable operating range is specified as 10cm to 10m and can be extended to 100m using RF amplifiers for the transmitters.

↳ Bluetooth devices can be built upto many types of equipments; cellular phones, Notebook computers and personal digital assistants and computer peripherals such as printers, modem and loudspeackers.

↳ Technically, the Bluetooth standard resembles the frequency hoping version of the IEEE 802.11 wireless Ethernet standard. The reason is the same as cited by the IEEE.

↳ Bluetooth radios employ a rather simple Spread-Spectrum technique frequency hopping. channels are 1MHz apart, giving room for 79 channels in North America and most of Europe.

↳ The channel bit rate is 1Mb/s.

↳ Bluetooth systems divide data into packets and sent one packet per hop. The length of packet can be from one to five slots; the

↳ The length of a slot is 625 μs.

WIRELESS BRIDGES:

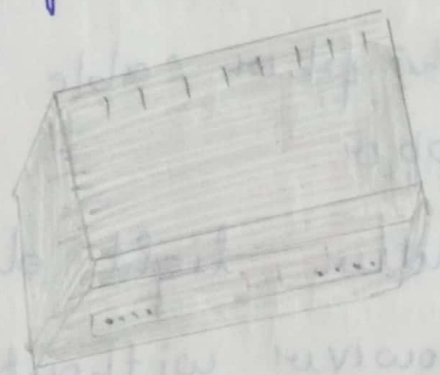
↳ Wireless Bridges connect LAN segments

↳ Often these are in different building so it is necessary to use a system with more range than those described above.

↳ Some bridges use high-speed dedicated microwave links. These can be fast but they are expensive and require licensing.

↳ Lower-cost bridges using the 902-MHz or 2.4-GHz unlicensed bands are available from several vendors.

↳ A typical example is shown in fig.



↳ It can operate over a distance of about 10 km, under good line of sight conditions, at a data rate of about 2 Mb/s.

↳ Line-of-sight propagation conditions are more likely b/w building than within them.

↳ The built-in antenna shown can be replaced with a directional rooftop antenna for greater range.

CONNECTION USING INFRARED WIRELESS MODEMS:

Though the great majority of the wireless systems described in this book use radio communication, we should Note that light waves can also be employed, you are probably familiar with fiber optics is it really a wireless technology, because the fiber cable through contain copper.

Transmitter, light directly through the air however without benefits of the fiber.

The common television remote control is an example of it simple infrared communication system