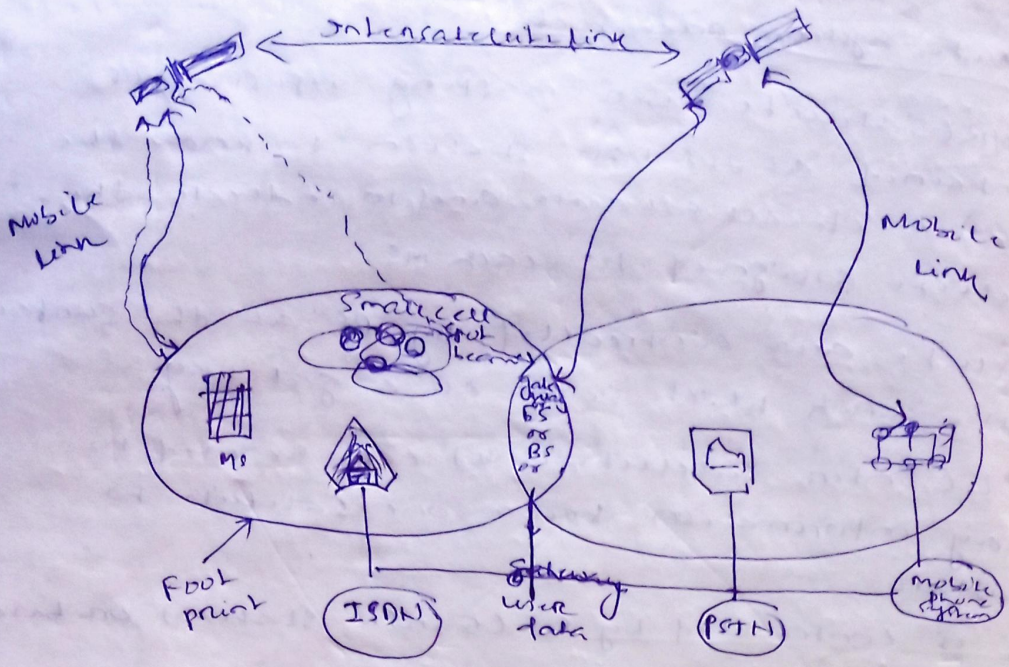
Global mobile satellite system:

Satellite system Architecture:

- SUMR (Satellite user mapping register) is maintained at the base station to know the location of all satellite and to indicate the satellite assigned to each MS.
- Satellite are controlled by BS at the surface of the earth which serve as a gateway.
- ISL (Inter satellite link) can be used to relay information from one satellite to another
- ISL is controlled by ES (Earth station) or base station
- Communication betn MS and satellite will be established by line of sight (LOS) beam called ML (Mobile link) and gateway link. ES used to establish link betn gateway and satellite
- Satellite are rotating constantly around the surface of the earth and a beam may be temporarily blocked either due to flying object rain absorption, fog. therefore a redundancy concept known as diversity is used to transmit the message through more than one satellite
- Once a contact has be established between a mobile system a satellite system using LOS beam, everyone in the world can be accessed, using underlying hardware backbone network on the surface of the earth
- To keep weight of each satellite to a reasonable level, a minimum amount of electronic circuit is kept in the satellite so that receiving incoming message come to another satellite and mobile user



Case ~~stu~~ studies of the IRRIDIUM:

It is a satellite based wireless personal communication network designed to permit any type of telephone transmission (voice or data)

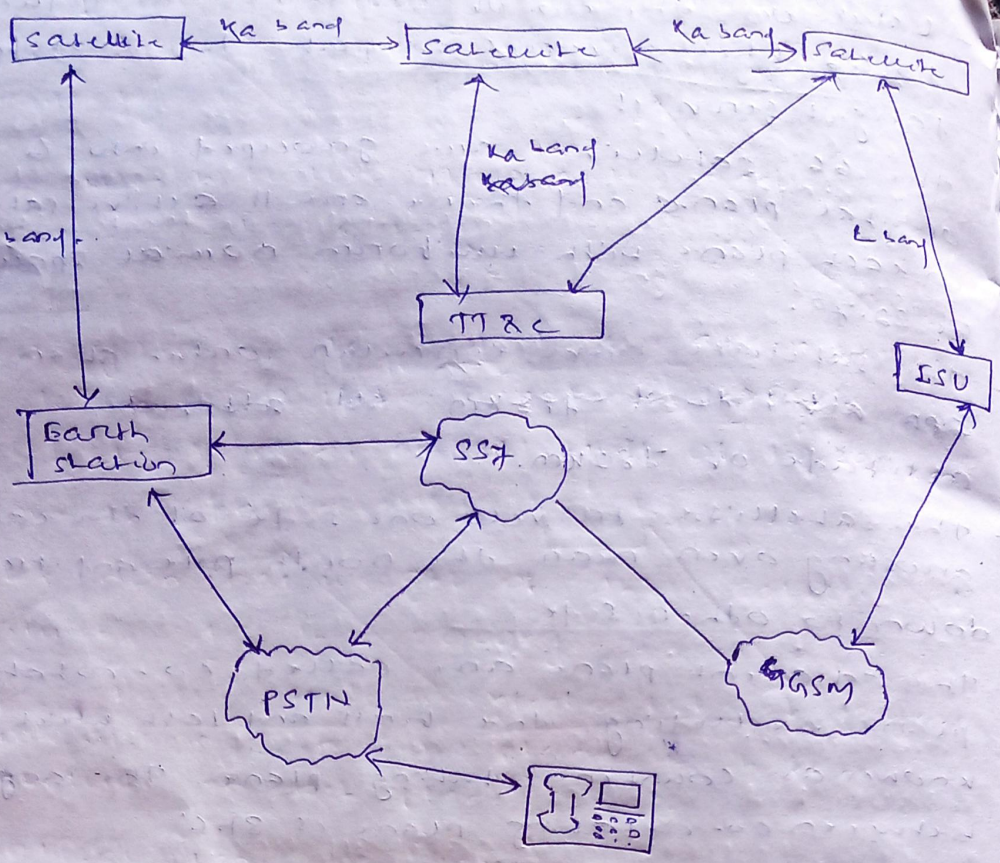
- It is an extension of existing wireless system to ~~telephone transmission~~ provide mobile service to remote areas that are not covered by terrestrial cellular service.

Concept:

The concept of using a constellation of LEO satellite to provide telecommunication service to mobile users was originated by motorola in 1987.

- the initial purposal was for 77 satellite in constellation and the system was called IRRIDIUM which has 77 elements in its orbit

- Later on the no. of satellite was reduced to 66 which were adequate to provide target services
The 66 satellites are grouped into 6 orbital planes and there are 11 active satellites on each plane with uniform nomial spacing of 32.70°.
- The satellite have circular orbit at an ~~approx altitude of 783 km and altitude~~ altitude of 782 km.
- The satellite travels one side of the earth crossing over near the north pole and travelling down to other side.
- The adjacent plane are called co-rotating plane excluding the first and last which is known as counter rotating plane. The angle between co-rotating plane is 31.6°
- The angle between counter rotating plane is 22°
- In IRRIDIUM system each satellite is equipped with 4 ~~way~~ two way communication, 1 with each neighbours in the same plane and those with in the adjacent plane.
- Each IRRIDIUM satellites has 48 beams antenna patterns and each beam has a minimum diameter of 600 km.
- The irridium support 3 types of link
i) up and down link from space vechile to gateway using Ka band.
ii) up and down link betn space vechile and ICU (irridium subscriber unit) using L band
iii) Two way intersatellite link betn space vechile and Ka band.



(Network Architecture of iridium)

GLOBALSTAR:

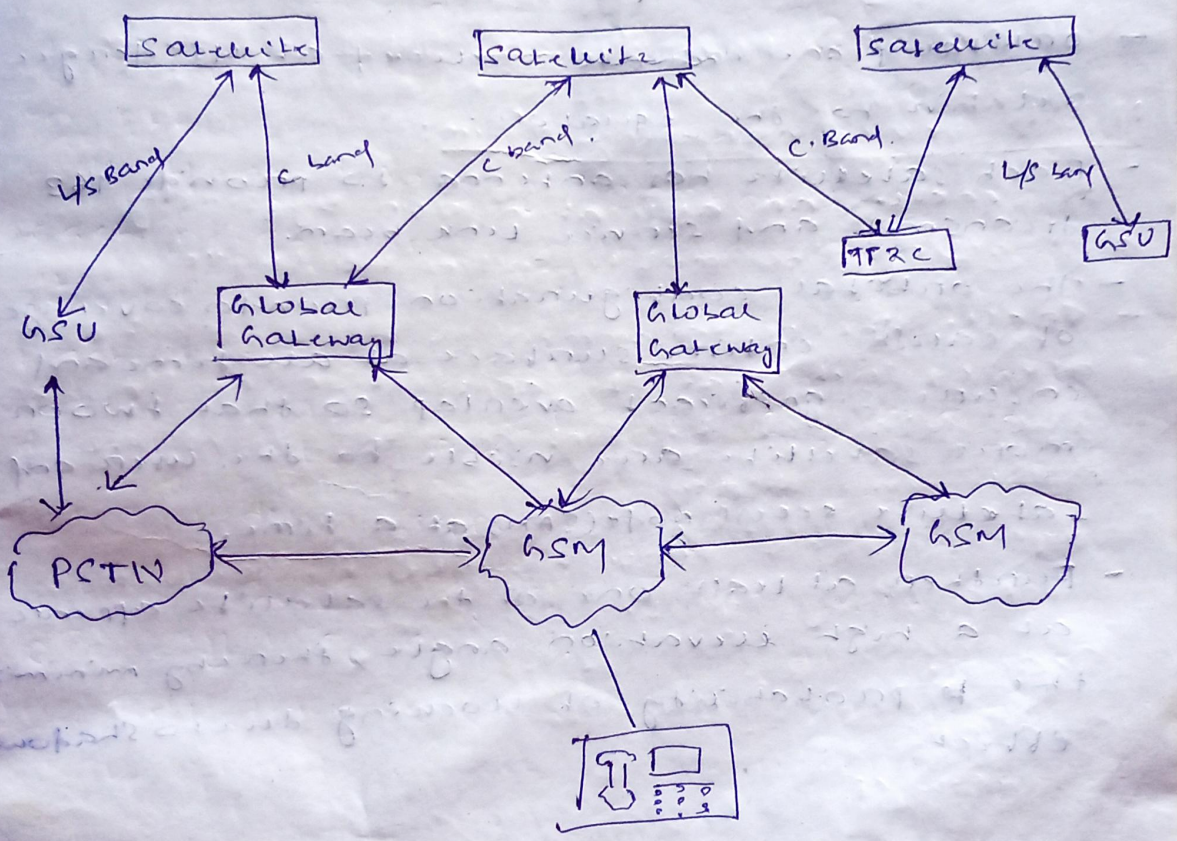
Globalstar is a low Earth orbit satellite constellation for satellite phone and low speed data communication.

- the Globalstar project was launched in 1991 as a joint venture of Loral communication and Qualcomm.
- It is a global satellite based system on 48 LEO satellite.

CONCEPT:

- Global star constellation of 48 LEO satellite is designed to orbit an altitude of 141km. above the earth surface in 8 orbit plane inclined at 52°

- Each plane is occupied by 6 satellites and nominal weight of each satellite is 450 kg and working life is 7.5 years. Each satellite supports a 16 beam antenna ~~pattern~~ pattern with an average beam diameter of 2250km.
- In the absence of ISL Globalstar makes the maximum use of International terrestrial network.
- A globalstar gateway is designed to serve an area of 3000km in diameter.
- Globalstar use CDMA technology for service link and FDMA/FDD for gateway link.
- Call from the subscriber are routed via a satellite to the nearest ~~satellites~~ earth station and from there they'll be routed over the existing network.



(Network architecture of Globalstar)

ICO ICO is a medium earth orbit (MEO) mobile satellite system which is designed primarily to provide service to handheld phone.

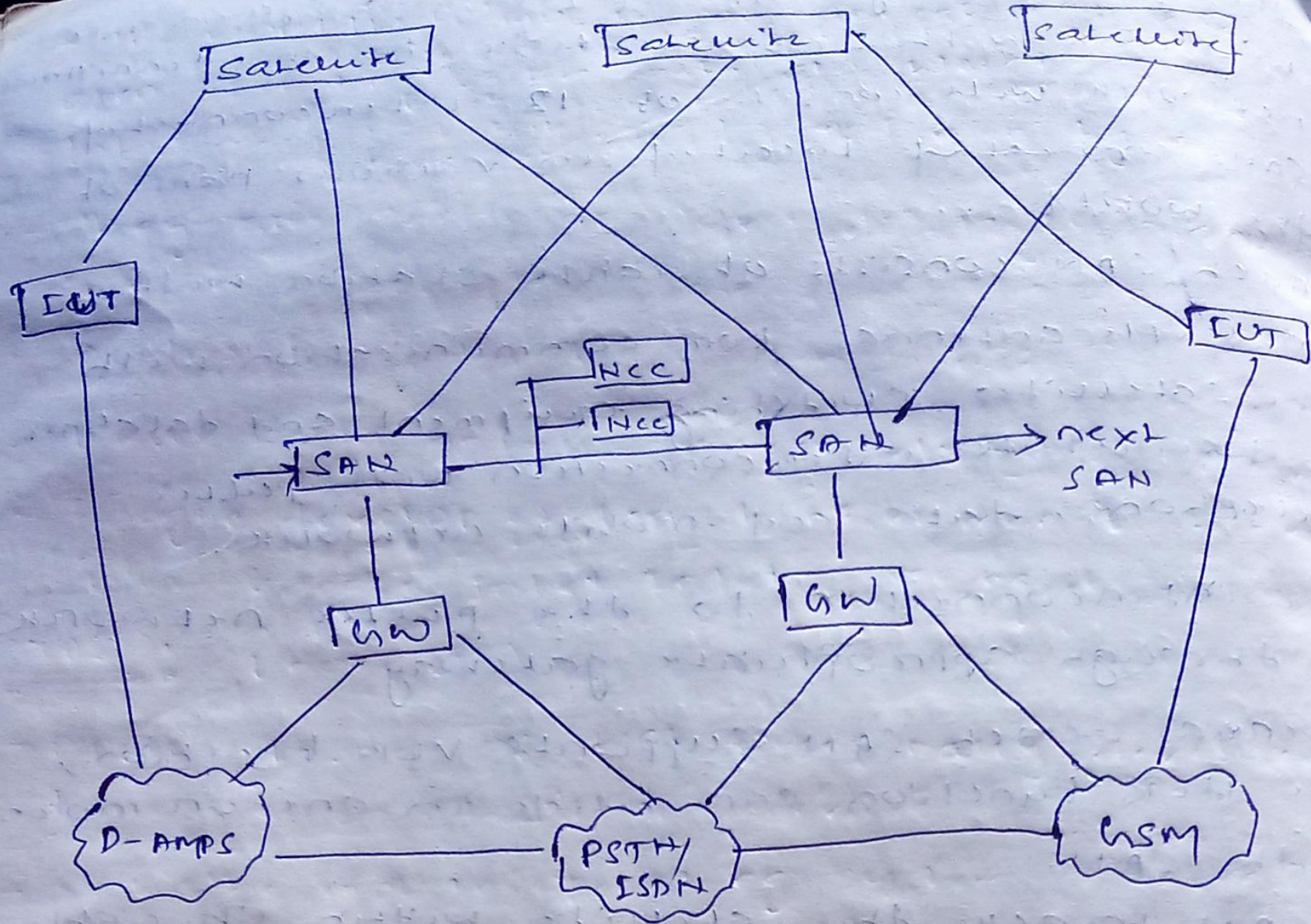
- ICO ~~uses~~ will use TDMA as the radio transmission technology.

concept:

- ICO system is designed to use a constellation of 10 MEO satellites in intermediate circular orbit (ICO) ~~an~~ at an altitude of 10,335 km. above the earth surface.
- The nominal weight of their satellite at launch is less than 2000kg.
- The satellite with an expected life of 12 years are arrange on two planes with five satellite in each plane
- orbital plane ~~indicate~~ inclined at 45 degree relative to the equator.
- Each satellite has antenna to provide 163 transmit and service link beam.
- The orbital configuration provides coverage of earth entire surface at all time and ensure significant overlap so that two or more satellite are visible to the user and satellite access node (SAN) at a time.
- Further at least one of the satellite appear at a high elevation angle, thereby minimizing the ~~to~~ probability of blocking due to shadowing effect.

The ground segement in the LEO system which will link with LEO satellite to the terrestrial network will consist of 12 interconnected SANs located in various part of the world.

- Each SAN consists of earth station with multiple antennas for communication with the satellites switching equipment and database to facilitate interconnection with public telephone, data and mobile network.
- The interconnection to the public network is through appropriate gateway.
- Whereas each SAN supports VLR function, the HLR function can reside on one or more of the SAN.
- A SAN track the satellite within its sight and will direct communication traffic to the satellite which can provide reliable, uninterrupted link for a given call, in term of angle elevation and duration of satellite visibility.
- SAN also have the capability to execute hand off from an area covered by one satellite to another satellite coverage.
- Such hand-off are expected to be very infrequent in LEO, MEO based system.
- The TTRC function are associated with 6 of the 12 interconnected SAN.



Network Architecture of ICO system

Mobile

→ Working of VPN —

→ Routers with VPN software works like normal router, filtering packets.

→ VPN performs the following functions:

* A router implementing VPN software is configured such that
  1. It rejects all incoming packets except those that arrive from a router which belongs to the authorized network.
  2. It rejects all outgoing packets except those which belong to the authorized network.
* VPN software encrypts each outgoing packet before transmission. Received packets are decrypted.

→ Goals of VPN —

1. Confidentiality —
   → protects the privacy information being exchanged between communicating parties.
2. Integrity —
   → ensures that information being transmitted over the public Internet is not altered in any way during transit.

→ It uses 3 technologies.

* One-way hash functions:
  → fixed length output based on arbitrary length input.
* Message-authentication codes:
  → simply adds a key to hash functions

3. Digital signatures –
— public key cryptography.

3: Authentication —

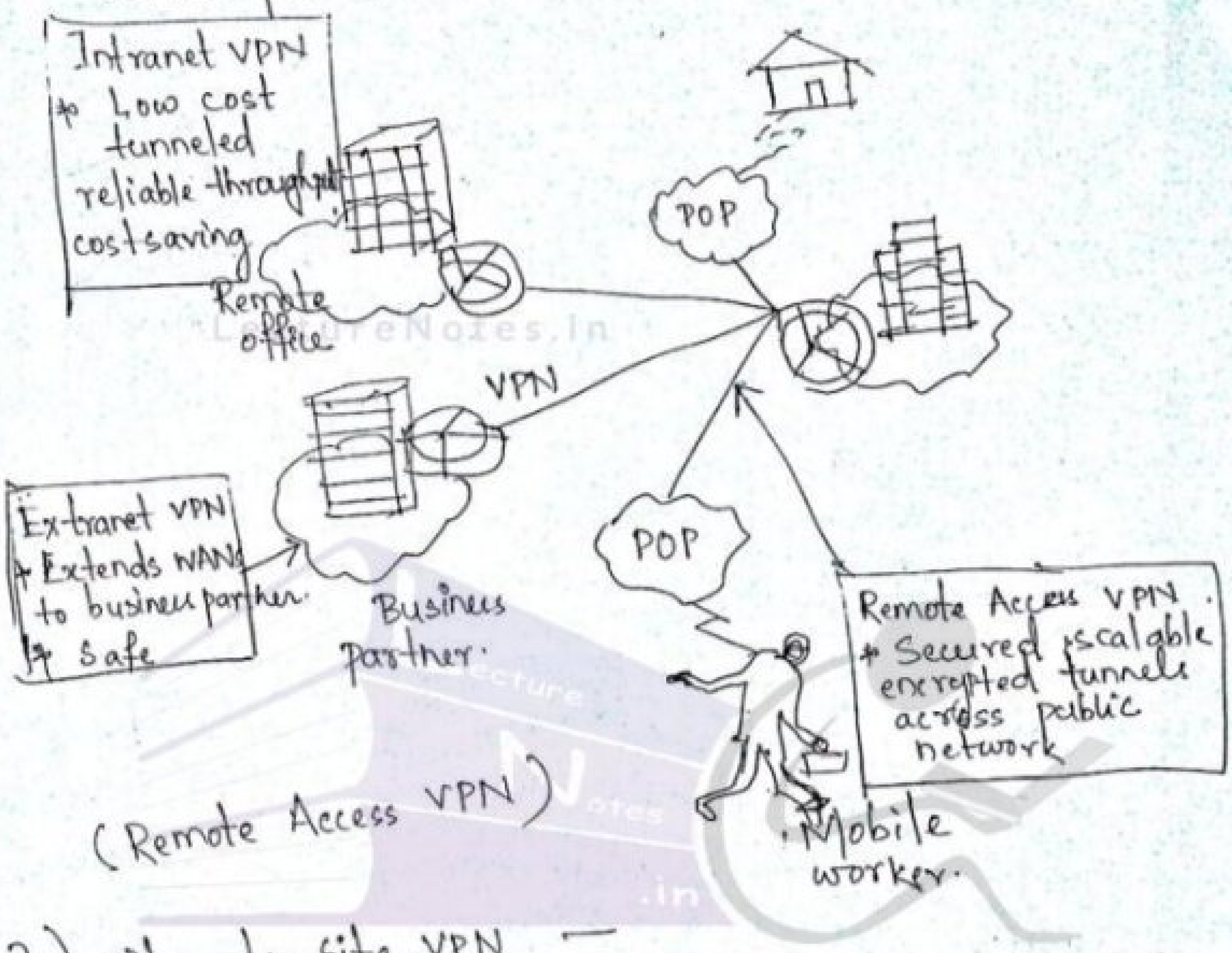
→ It ensures the identity of all communicating parties.
→ VPN use one or more forms of authentication.
① Password authentication or Digital certificates.
②.

→ Types of VPN —

(1) Remote Access VPN —

→ Also called a virtual private dial up network (VPDN).
→ It is a used to LAN connection used by a company that has employees who need to connect to the private network from various remote locations.
→ A corporation that wishes to set up a large remote access VPN will outsource to an enterprise service provider (ESP).
→ The ESP sets up a network access server (NAS) and provides the remote users with desktop client software for their computers.
→ The telecommuters can then dial a toll-free number to reach the NAS and use their VPN client software to access the corporate network.
e.g.→ Remote access VPNs permit secure, encrypted connections between a company's private network

and remote users through a third-party service provider.



(Remote Access VPN)

(2.) site-to-site VPN —

→ Through the use of dedicated equipment and large scale encryption, a company can connect multiple fixed sites over a public network such as the Internet.

→ Site-to-site VPNs can be one of two types:

* Intranet-based —

→ If a company has one or more remote locations that it wishes to join in a single private network, it can create an intranet VPN to connect LAN to LAN.

→ Virtual Private Network (VPN) :—

→ It is a private data network that makes use of the public telecommunication infrastructure, maintaining privacy through the use of a tunneling protocol and security procedures.

→ VPN can be contrasted with a system of owned or leased lines that can only be used by one company.

→ Main purpose of VPN is to ~~provide~~ give the company the same capabilities as private leased lines at much lower cost by using the shared public infrastructure.

→ VPN makes it possible to have the same protected sharing of public resources for data.

→ VPN works by using the shared public infrastructure while maintaining privacy through security procedures and tunneling protocols such as the Layer Two Tunneling Protocol (L2TP).

→ Features in a well designed VPN —

→ Security
→ Reliability
→ Scalability
→ Network Management
→ Policy Management

→ Implementation of VPN —

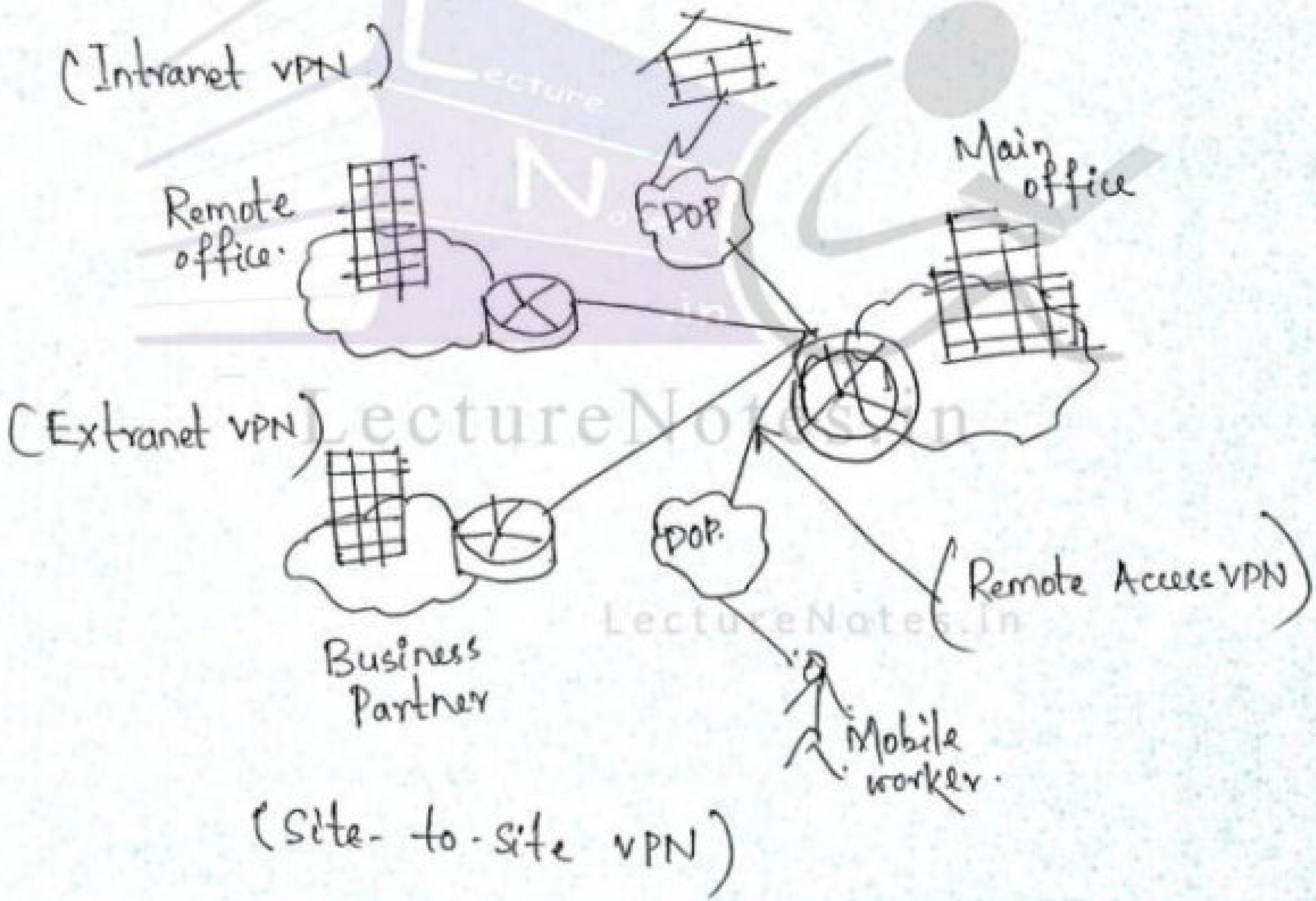
→ VPN is usually implemented in software. It includes

→ Each site for VPN should be connected to internet.

→ The VPN software is run on a router on each site.

* Extranet based –

– when a company has a close relationship with another company (for example, a partner, supplier or customer) it can build an extranet VPN that connects LAN to LAN and that allows all of the various companies to work in a shared environment.



PCM,

BLUE TOOTH:

→ It is an open specification for radio system.

→ It provide the network infrastructure to enable short range wireless communication of data and voice

→ It comprises of a hardware component and a software component.

→ This technology allows user to make adhoc wireless connection between device like mobile phone, desktop and notebook computer without any cable

→ It can transfer data at a speed of 720kbps with 50 meter range

Bluetooth protocol:

→ It consists of → a radio unit

→ link control unit

→ a support unit for link management

→ Bluetooth radio is built into a small microchip and operates in a globally available frequency band ensuring interoperability worldwide.

→ It uses the unlicensed 2.4 GHz ISM (Industrial scientific and medical) frequency band.

→ Bluetooth protocol uses a combination of circuit and packet switching

→ The channel is slotted and slots can be reserved for synchronous packet

Piconet and Scatternet:

→ Bluetooth support both unicast (point-to-point) and multicast (point-to-multipoint) connection.

→ It uses the concept of master and slave

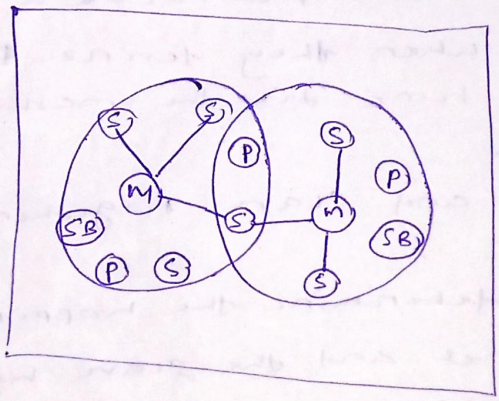
→ In a master slave protocol a device cannot talk as and when they desire. They need to wait till the time till the master allows them to talk.

→ The master and slave together form a piconet.

→ The master determine the hopping pattern in the piconet and the slave have to synchronize to this pattern.

→ 2 additional types of devices are also present. Parked (P) and Standby (SB)

→ Parked device cannot actively participate in the piconet but are known and can be reactivated within some millisecond.

→ Standby device donot participate in the piconet

- Each piconet has exactly one master and upto seven simultaneous slave
- more than 200 devices can be parked.
- Several of these piconet can be linked together to form a larger network in an adhoc manner.
- the topology can be thought as a flexible multiple piconet structure - this network of piconets are called scatternet.
- A scatternet is formed when a device from one piconet also act as a member of another piconet
- In this scheme a device being master in one piconet can simultaneously be a slave in another piconet.