Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.

4) While assessing figures, examiner may give credit for principal components indicated in the Figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any Equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant Values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.

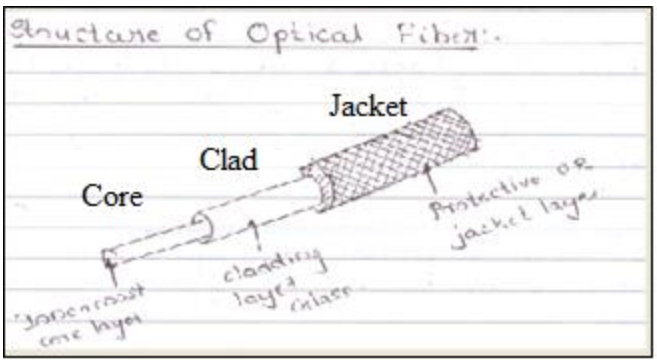
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q1

A) Attempt any Three **[12M]**

a) Draw and Explain the cross sectional diagram of fiber optical cable

Ans:- **[Diagram- 2M, Explanation: 2M]**



The optical fiber consists of three parts

1) Glass Core

2) Cladding Layer

3) Jacket Layer or Protective Layer

1) Glass Core:

The innermost layer of an optical fiber cable is the glass core. The light rays pass through this innermost core.

2) Cladding Layer:

The innermost glass layer is covered by the cladding layer is also made up of glass .But the refractive index of this layer is less than that of core layer.

The cladding layer performs the following Functions

i) It provides strength to the optical fiber cable.

ii) The cladding layer acts like a mirror. It will reflect the light rays and will not allow them to escape outside the fiber.

iii) When many optical fibers are packed in one cable the cladding layer avoids the interference between the light rays in the adjacent fibers.

3) Jacket Layer or Protective Layer:

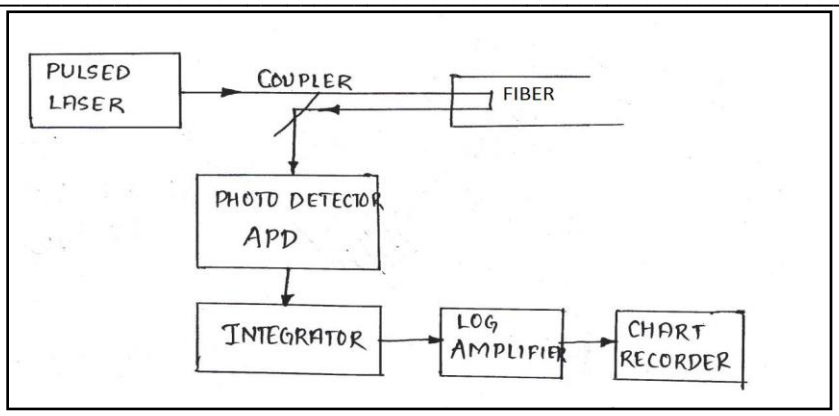
i) This is the outermost layer in an optical fiber.

ii) It provides mechanical strength to the optical fiber

iii) It provides the protection against the environmental factors

b) Explain the working of OTDR with block diagram.

Ans: **[Diagram- 2M, Explanation: 2M]**



i) OTDR is optical time domain reflect meter used for finding faults, splices and binds in fiber optic cables.

ii) OTDR consists of a light source and receiver, data acquisition and processing modules and an information storage unit for retaining data in external or internal memory disk and display.

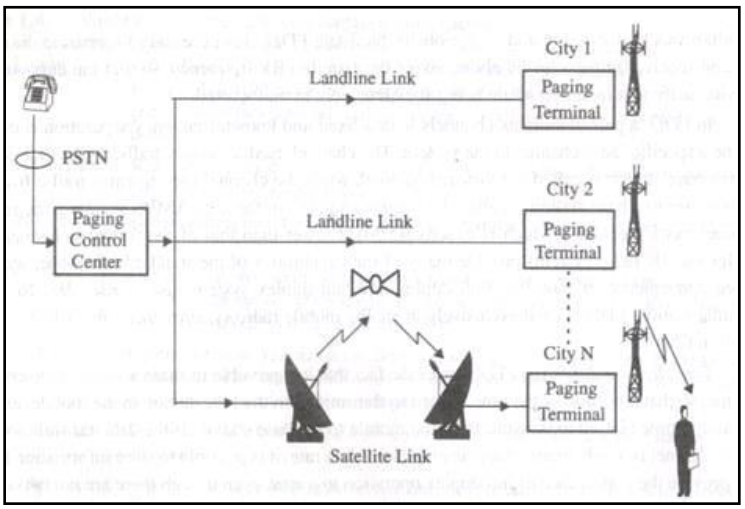
iii) A light pulsed is launched into the fiber in forward direction from an injection laser using coupler or beam splitter.

iv) Beam splitter or coupler makes possible to couple the optical excitation power impulse into the tested fiber and to deviate the backscattered power to the optical receiver.

v) The backscattered light is detected using an avalanche photodiode which drives integrator which is then fed to logarithmic amplifier and average measurements for successive points within the fibers are plotted as a chart recorder.

c) With neat diagram explain the working of paging system.

Ans: **[Diagram -2 M, Explanation-2 M]**



• **Paging System** Sends brief messages to Subscribers

• Messages may be numeric message, alpha numeric message, voice message.

In modern paging systems news headlines stock quotation, and faxes may be sent

A message is sent to a paging subscriber via the paging system access number (usually a toll-free telephone number) with a telephone keypad or modem.

• Page is transmitted throughout the service area by BS on radio carrier

• Covers a limited range of 2-5 km, or may even be confined to within individual buildings, wide area paging system can provide worldwide coverage

• Wide area paging system consist of a network of telephone lines many base station transmitters and a large radio tower that simultaneously broadcast a page from each base station

Types of messages are sent as following

1) Numeric message (containing numbers).
2) Alphanumeric message (containing numbers and text)
3) News headlines, stock information etc.

d) Explain intermodal dispersion.

Ans:- **[correct answer 4 M]**

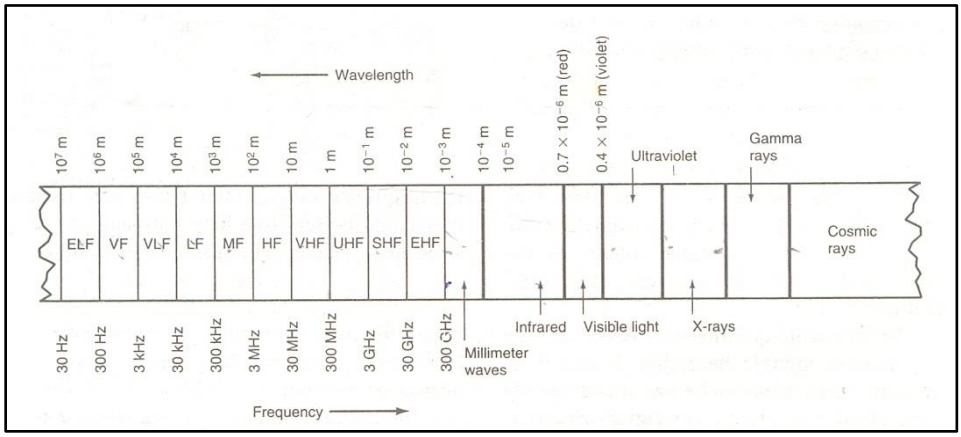
i) It is pulse broadening due to propagation delay difference between modes within multimode fiber.
ii) When an optical pulse is launched into a fiber, the optical power in the pulse is distributed over all of the modes of the fiber.
iii) Each of the mode that can propagate in a multimode fiber travels at a slightly different velocity.
iv) This means that modes in a given optical pulse arrive at the fiber end at slightly different times causing the pulse to spread out in times as it travels along the fiber.
v) Lower over modes travel almost parallel to the center line of the fiber cover
vi) the shortcut distance thus reaching the end of the fiber soon
vii) Higher order modes take loner route as they pass along the fiber and reach later

B) Attempt any ONE **[6M]**

a) Draw the frequency spectrum for communication and show the region for fiber optical communications. Write advantages and disadvantages of FOC.

Ans :

Frequency spectrum for communication **[2M]**



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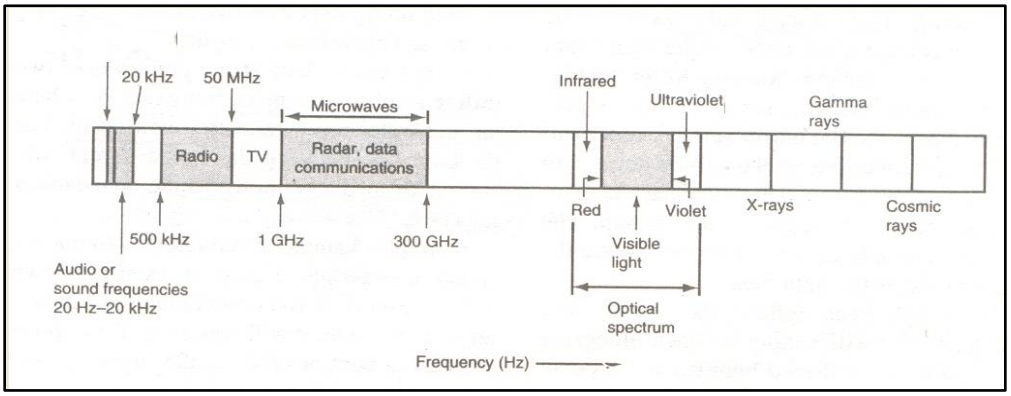


Optical spectrum in the above spectrum is used for optical communication

Advantages:- [Any 2] **[2M]**

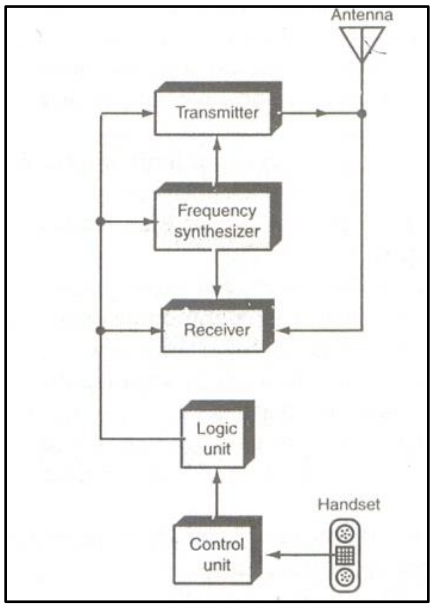
1. **High Bandwidth -** The higher the bandwidth, the greater the information carrying capacity. A higher bandwidth allows for higher data rates, more users and longer distances.
2. **Easy Upgrades** - Fiber optic cable allows for easy future upgrades. Because a variety of transmissions can use fiber optics, it is only necessary to change the electronics. The cable can stay in place. No need to pull new cable in the future.
3. **Low Attenuation** - This is a reduction of signal strength or loss of light power over the length of the fiber. Fiber optic cable usually has low attenuation characteristics which allow signals to travel over longer distances without re amplification. However, attenuation can be affected by extrinsic (environmental and physical bends), intrinsic (absorption and scattering) and wavelength. The longer the wavelength, the lower the attenuation.
4. **EMI/RFI Immunity** - Since fiber optic cable transmits light instead of electrical current, immunity to electromagnetic and radio frequency interference provides better signal quality, ensuring low bit error rates and/or low noise on the system.
5. **Security** - Again, since there is no electrical signal, fiber optic transmission is almost impossible to tap into without being detected.
6. **Lightweight**- Fiber optic cable is smaller and lighter than copper cable allowing for easier installation, especially when conduit and/or raceway space is at a premium
7. **Low Power Loss -** An optical fiber offers low power loss. This allows for longer transmission distances. In comparison to copper; in a network, the longest recommended copper distance is 100m while with fiber, it is 2000m.
8. **Interference** - Fiber optic cables are immune to electromagnetic interference. It can also be run in electrically noisy environments without concern as electrical noise will not affect fiber.
9. **Size** - In comparison to copper, a fiber optic cable has nearly 4.5 times as much capacity as the wire cable has and a cross sectional area that is 30 times less.
10. **Safety** - Since the fiber is a dielectric, it does not present a spark hazard.

Disadvantages of OFC: [Any 2] **[2M]**

1. **Cost** - Cables are expensive to install but last longer than copper cables.
2. **Transmission** - transmission on optical fiber requires repeating at distance intervals.
3. **Fragile** - Fibers can be broken or have transmission loses when wrapped around curves of only a few centimeters radius. However by encasing fibers in a plastic sheath, it is difficult to bend the cable into a small enough radius to break the fiber.
4. **Protection** - Optical fibers require more protection around the cable compared to copper.
5. **Affected by chemicals -** The glass can be affected by various chemicals including hydrogen gas (a problem in underwater cables.)
6. **Opaqueness -** Despite extensive military use it is known that most fibers become opaque when exposed to radiation.
7. **Requires special skills -** Optical fibers cannot be joined together as a easily as copper cable and requires additional training of personnel and expensive precision splicing and measurement equipment.
8. Brittleness and small size makes it difficult to work with.
9. Difficult to manufacture.
10. Expensive tools and techniques are required.

b) State function of Logic unit and control unit of mobile handset and draw diagram of mobile unit.

Ans: [Block Diagram of mobile Unit 2M,[Function of Logic unit(any 2)-2M, Function of control unit any 2 ,2M]



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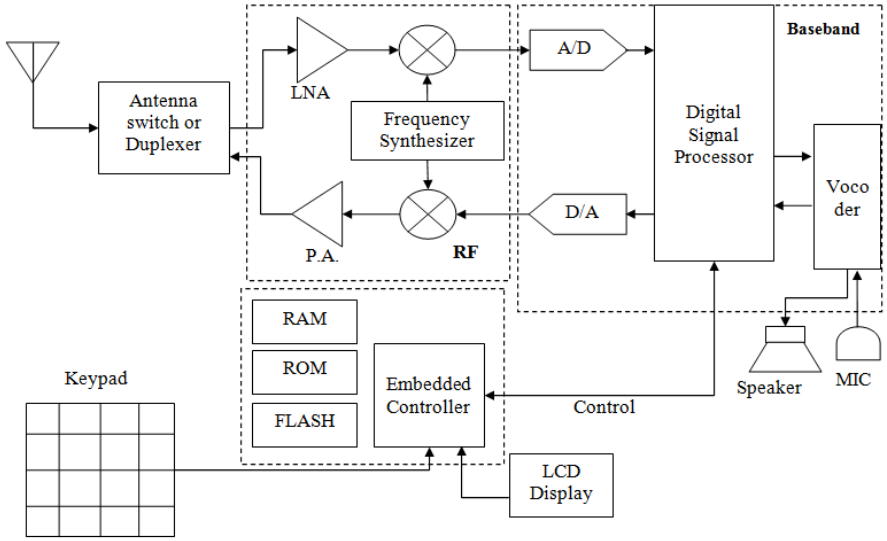


Logic Unit:

1. The logic unit contains the master control circuitry for the cellular radio .
2. It is made up of a microprocessor with both RAM and ROM plus additional circuitry used for interpreting signals from MTSO and generating control signals for the transmitter and receiver .All cellular radio contains a Programmable Read only Memory (PROM) chip called the Number Assignment Module(NAM) .
3. The NAM contains the mobile Identification Number(MIN) which is the telephone number assigned to the unit.
4. This chip allows the radio to identify itself when a call is initiated. All cellular mobiles radios are under control of MTSO through the cell site .
5. The MTSO sends a serial digital data stream at 10K bps through the cell site to the radio to control the transmit and receive frequencies and transmit power.

Control Unit:

1. The control unit contains the handset with speaker and microphone .
2. These circuits are built into the handheld unit
3. The main control unit contains a complete touch tone dialing circuit,
4. The control unit is controlled by a separate microprocessor that drives the LCD display and other indicators.
5. It also implements all manual control functions.
6. The microprocessor memory permits storage of often called numbers and an auto dial feature

Q2. Attempt any Four **[16M]**

a) Explain absorption losses.

Ans: **[Explanation-1M for each, Diagram- 1M]**

1. Absorption losses in optical fiber occur due to the presence of imperfections in atomic structure of fiber material, due to some inherent intrinsic material properties and due to some extrinsic material properties.
2. Absorption losses in optical fiber can be contributed due to ultraviolet absorption, infrared absorption and ion resonance absorption.

Ultra Violet Absorption:

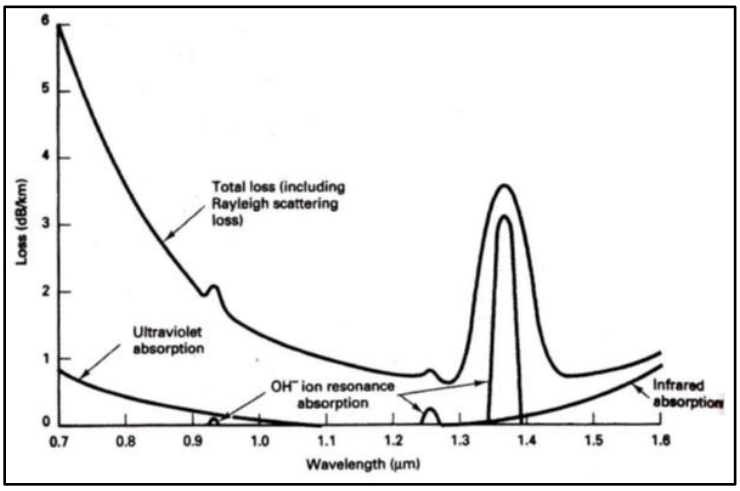
It is caused by the valance electrons in the silica material from which fibers are manufactured. Light ionizes valance electrons into conduction .The ionization is equivalent to a loss in the total light field and consequently contributes to the transmission losses of the fiber.

Infrared Absorption:

Infrared absorption is a result of photons of light that are absorbed by the atoms of the glass core molecules. The absorbed photons are converted to random mechanical vibrations typical of heating.

Ion resonance absorption:

It is caused by OH^- ions in the material. The source of OH^- ions is water molecules that have been trapped in the glass during the manufacturing process. Ion, Copper and Chromium molecules also cause ion absorption.



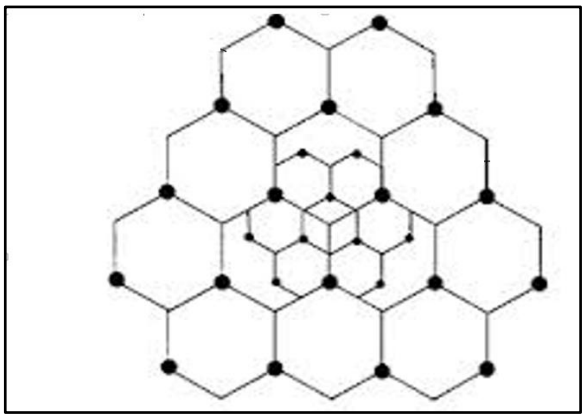
c) Draw and explain cell splitting and sectoring

Ans: **[Cell splitting- 2M, Cell sectoring - 2M]**

Cell splitting: **[Diagram 1M Explanation 1M [**

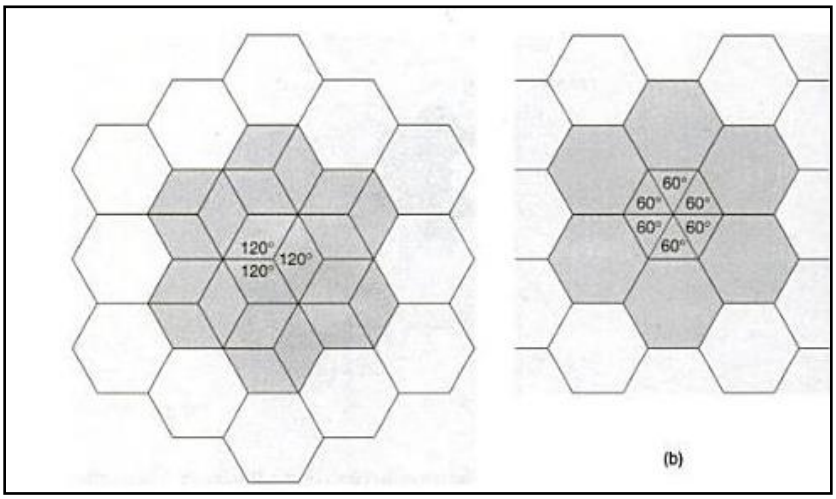
- Resizing or redistribution of cell areas is called cell splitting.
- Subdividing highly congested cells into smaller cells each with their own base station and set of channel frequencies.
- A large number of low power transmitters take over an area served by a single high powered transmitter.
- When the no. of subscribers wishing to make a call at any time = No. of channels in the cell, cell reaches maximum capacity (maximum traffic load of the cell). Then cell splitting creates new cells which can use frequency reuse.

- This increases the degree of frequency reuse and consequently increases the channel capacity of the cellular network.



Cell Sectoring: **[Diagram 1M, Explanation 1M]**

a) Sectoring is another method of increasing the channel capacity of cellular system. In this method we use directional antennas to decreases the co channel and adjacent channel interference and reuse the frequency within the cell.
b) Instead of using a single omnidirectional antenna (in case of cell splitting), sectoring uses several directional antennas each covering a small area (called a sector) of the cell.
c) Usually, cells are divided into six 60^0 sectors or three 120^0 sector.



a) When a three sector configuration is used, three antennas are installed in each 120^0 sector.
b) In these antennas, one is used for transmission and two for reception.
c) The process of using two receiving antenna is known as diversity.
d) It enhances the reception by providing more antennas.
e) Usually both the receive antennas are placed on the same tower, one at 30 meter height and other at 50 meter height.

d) Classify types of optical fiber with respect to index profile and mode of propagation of light.

Ans: **[Based on index profile -2M, Based on Modes - 2M]**

Classification Based on Index profile:

a) Step index fiber

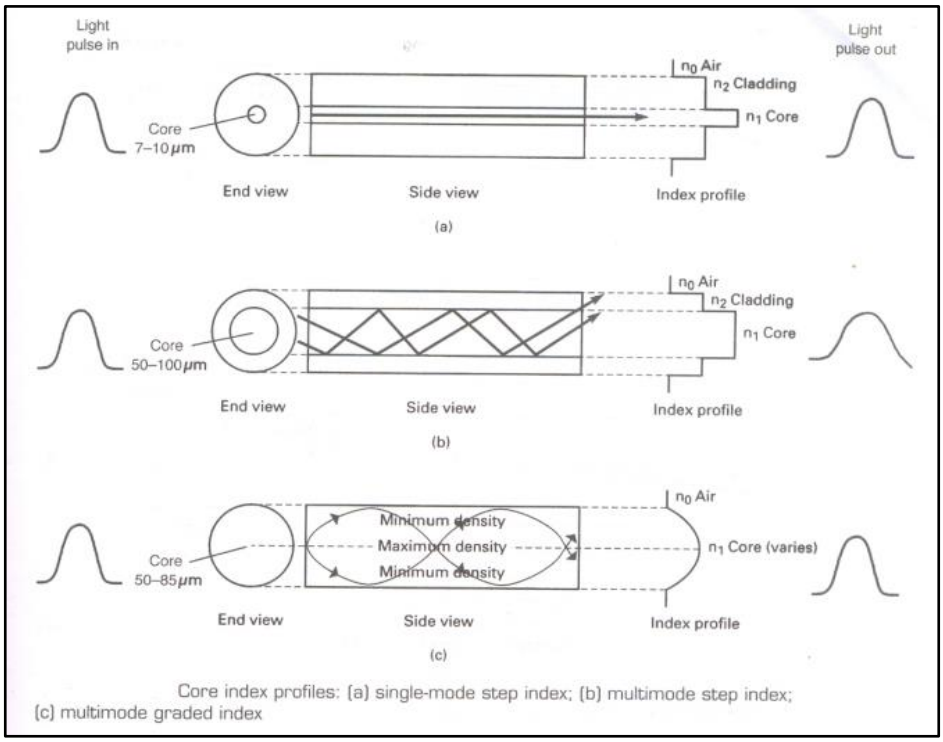
b) Graded Index fiber

Classification Based on Mode of propagation of light:

a) Single Mode step index Fiber

b) Multimode Step Index Fiber

c) Multimode graded Index Fiber



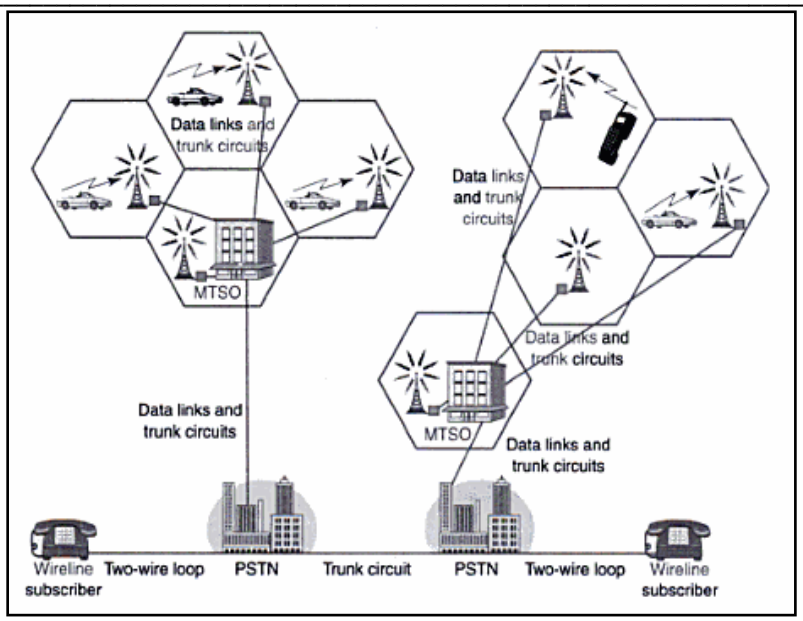
Core index profiles: (a) single-mode step index; (b) multimode step index; (c) multimode graded index

OR

e) Explain cellular telephone system with neat diagram.

Ans: **[Diagram - 2M , Explanation- 2M)**

Note:- ***Marks should be considered if any relevant diagram showing cellular telephone system concept is drawn***



- The mobile system has hexagonal shaped cells. Each cell has a base station situated at the center.
- Radio network is defined by a set of radiofrequency transceivers located within each of the cell.
- A base station serves as central control unit for all users in that cell.
- The base station of all the cells are connected to the switched center(MTSO). This interface is bidirectional. The exchange of information between the switched center and the base station is a two way.
- The communication area is divided into hexagonal cells. Hence the system is known as cellular radio system.

The switching center (MTSO) acts as the interface between the Public

Switched telephone Network and the base station

- Mobile units communicate directly with the base stations and the base stations communicate with the MTSO(Mobile Telephone Switching office)
- An MTSO controls channel assignment, call processing, call setup and call termination .and allocating radio frequency channels.
- MTSO provides the centralized administration and maintenance point for the entire network
- Due to this layout the communication can take place between two mobile subscribers or between a mobile subscriber and a landline telephone.
- If a mobile subscriber travels from one cell area to the other then it automatically connected to the base station of that cell. Thus the call will be continuing without any break.

e) Define radiation loss and coupling loss.

Ans: **[Radiation Loss-2M, Coupling Loss -2M]**

Radiation Loss:

a) Radiation losses are caused mainly by small bends and kinks in the fiber.
b) There are two types of bends. Micro bend and constant radius bend.

c) Micro bending occurs as the result of thermal contraction rates between the core and cladding material. Micro bend is a miniature bend or geometric imperfection along the axis of the fiber and represent the discontinuity in the fiber where Rayleigh scattering can take place.

d) Constant Radius bends are caused by excessive pressure and tension and generally occur when fiber are bent during handling or installation.

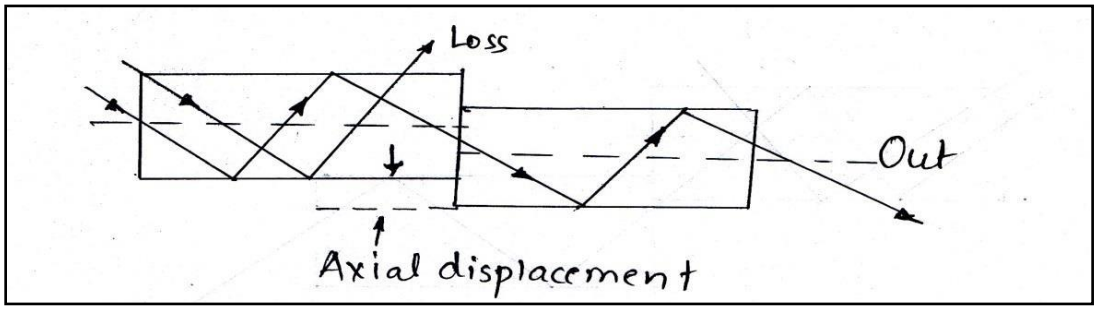
Coupling Loss :

a) Coupling losses are caused due to imperfect physical connections.

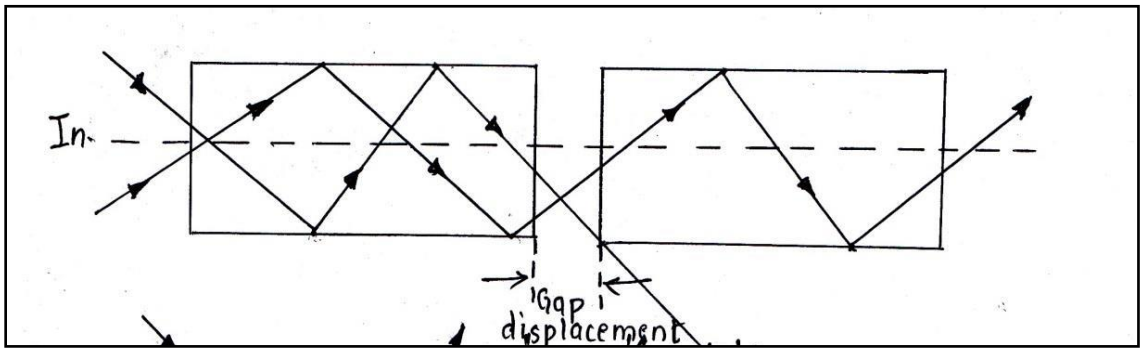
b) In fiber cables coupling losses can occur at any of the following three types of optical junctions, Light source to fiber connection, fiber to fiber connection, fiber to photo detector connection.

c) Junction losses can occur because of one of the following alignment problems.

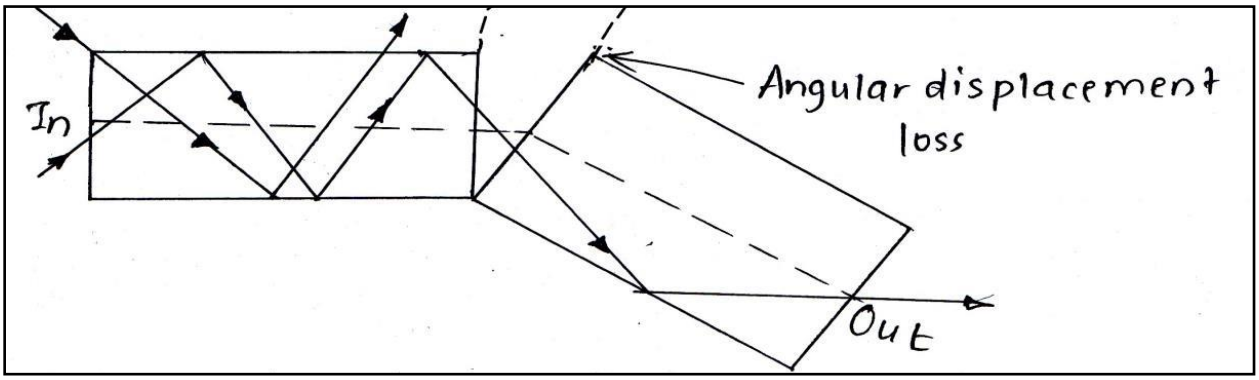
i) Lateral displacement of OFC (Optical fiber cable):



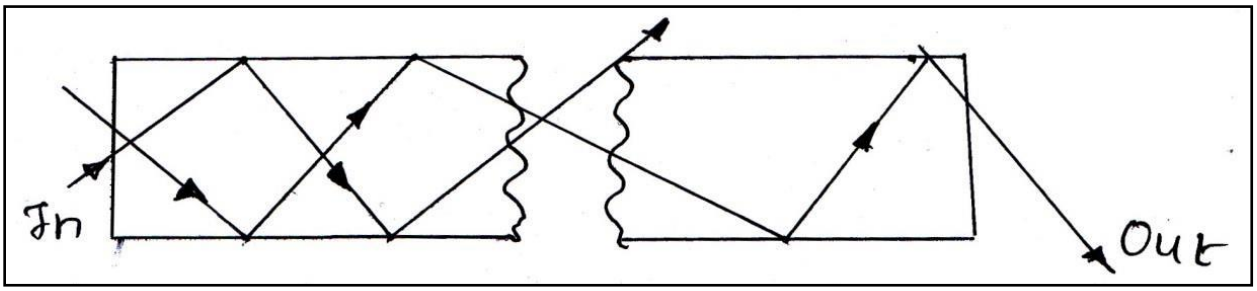
ii) Gap displacement of OFC:



iii) Angular misalignment of OFC:



iv) Surface finish or Rough surface:



Q 3. Attempt any TWO: [16M]

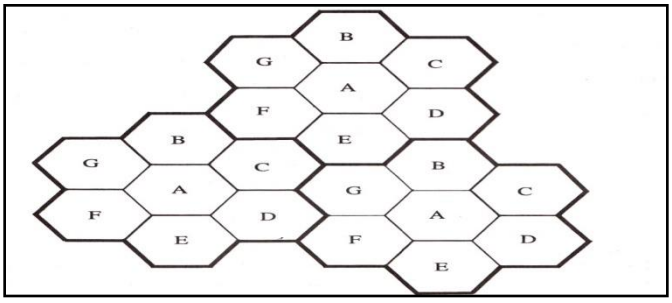
a) Define frequency reuse. Draw frequency reuse pattern with cluster size 7.

Ans: (Definition –4M, Diagram-4M)

Frequency Reuse:-

Each cellular base station is allocated group of radio channels to be used within a small geographic area called "cell" Base stations in adjacent cells are assigned channel group which contains completely different channels than neighboring cell. By limiting coverage area to within the boundaries of cell, the same group of channels may be used to cover different cells that are separated from one another by distance large enough to keep interference level within tolerable limits. The design process of selecting and allocating channel groups for all the cellular base station within a system is called frequency reuse or frequency planning.

Frequency reuse is important as the spectrum allocated for cellular transmission is limited and demand is increasing rapidly.



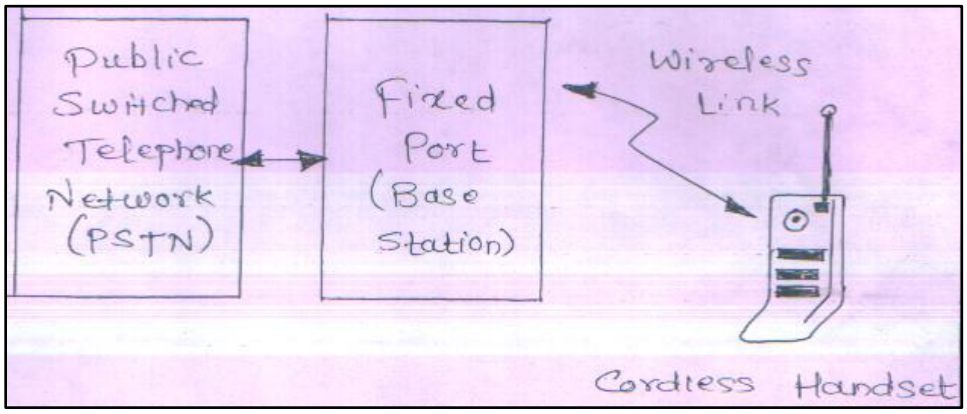
In the diagram there are 7cell A,B,C,D,E and F with unique frequency set in each cluster.A cluster is having 7 cell,there are such 3 clusters.

Cells with same set of frequency is called co-channel cell.Thus in above diagram there is frequency reuse Each set of frequency is repeated ,the co-channel cells are separated by sufficient distance so that there should not be any interference.

b) Draw cordless telephone system and explain it.

Ans: **[Diagram – 4M, Explanation- 4M]**

Cordless telephone system:

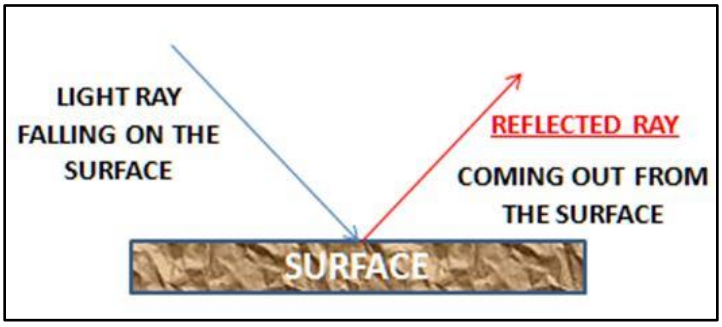


- Cordless telephone system is full duplex communication system that uses radio to connect a portable handset to a dedicated base station. which is then a specific telephone line with a specific telephone no. on the Public Switched Telephone No. (PSTN).
- In 1G portable unit communication only to the dedicated base unit and only over a distance of a few tens of meter .
- In 2G It allow subscribers to use handsets at many outdoor locations within the urban centers such as london or Hong-Kong
- Modern cordless telephones are sometimes combined with paging receivers so that the subscriber may first be paged and responded to page using the cordless telephones.
- It provides the user with limited range and mobility and it provide coverage range up to a few hundred meter.

c) Define: (i) reflection, (ii) Diffraction, (iii) Absorption, (iv) Dispersion with the help of light theory.

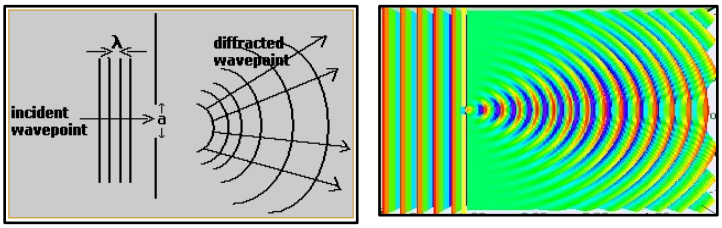
Ans: **[Definition- 2M Each]**

i. **Reflection:** Bouncing back of a light ray after hitting any surface is known as reflection.

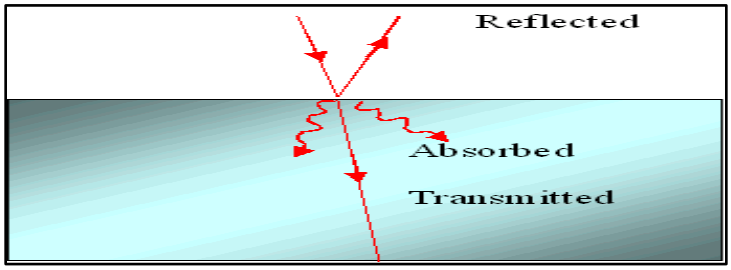


The reflection of light from a mirror follows the law of reflection i.e. the direction of the reflected light wave is easily predicted if the angle of incident light beam is known as the angle of incident is equal to angle of reflection.

ii. **Diffraction** is **defined** as a process by which **light** waves break up into dark and **light** bands or into the colors of the spectrum.

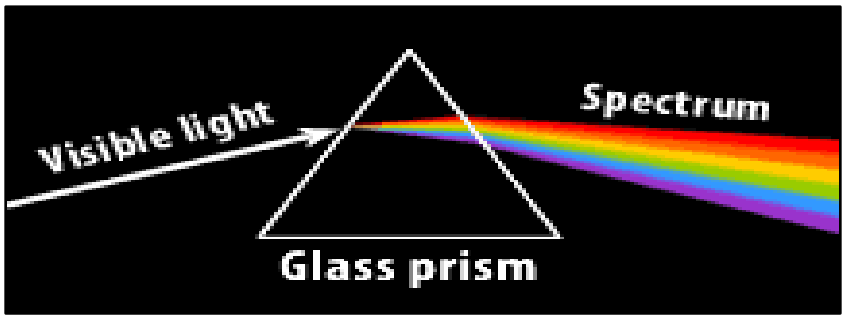


iii. **Absorption:** Matter can capture electromagnetic radiation and convert the energy of a photon to internal energy. This process is called **absorption**



iv. **Dispersion:**

The process of splitting of white light into seven colors is called dispersion of light.



Q4.

A) Attempt any THREE: **[12M]**

i) State type of interferences in mobile communication. Explain any one with diagram.

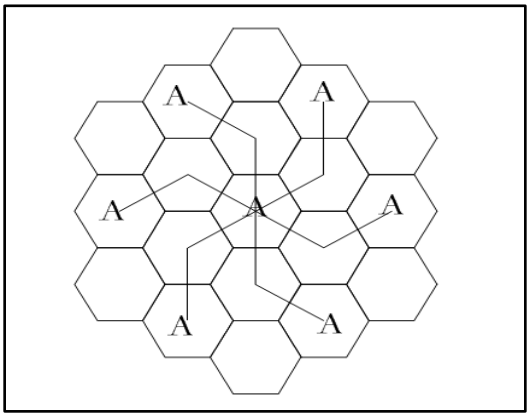
Ans: **[Types of Interference-1M, Explanation of any one-3M]**

The two major kinds of interferences produced within mobile communication

1. Co-channel interference
2. Adjacent channel interference.

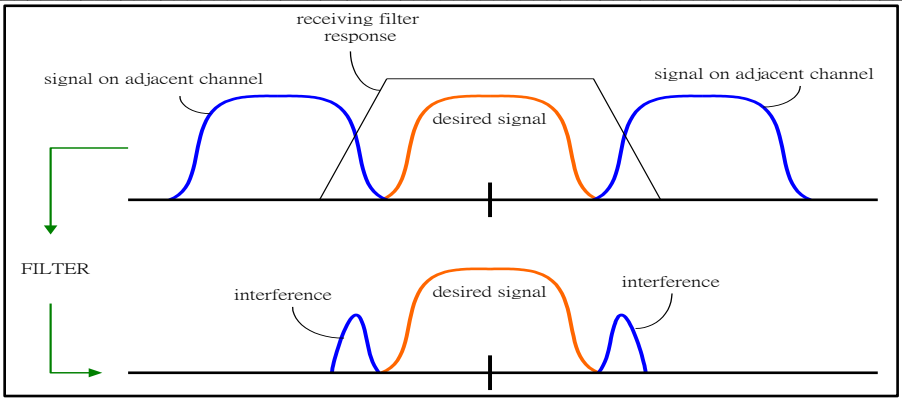
1. Co-channel interference:

- Frequency reuse implies that in a given coverage area. There are several cells that use the same set of frequencies.
- These cells are called co-channel cells and interference between signals from these cells is called co-channel interference.
- To reduce co-channel interference, co-channel cells must be physically separated by a minimum distance to provide sufficient isolation due to propagation.
- If the radius of the cell is (R) and the distance between the centers of the nearest co-channel cells (D).
- The parameter Q is called the co-channel reuse ratio is related to the cluster size.
- For a hexagonal geometry $Q=D/R=\sqrt{(3N)}$
- A small value of Q provides larger capacity since the cluster size is small whereas a large value of Q improves the transmission quality, due to smaller level of co-channel interference.



Adjacent Channel Interference:

- Adjacent channel interference: interference from adjacent in frequency to the desired signal.
  - i) Imperfect receiver filters allow nearby frequencies to leak into the pass band
  - ii) Performance degrade seriously due to *near-far* effect.



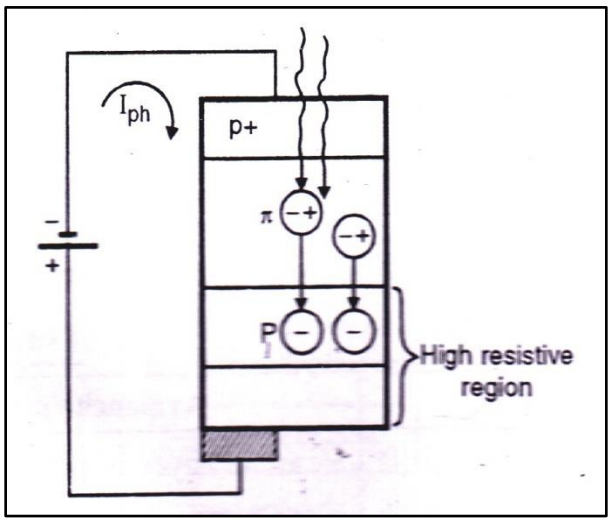
- Adjacent channel interference can be minimized through careful filtering and *channel assignment*.
- Keep the frequency separation between each channel in a given cell as large as possible
- A channel separation greater than six is needed to bring the adjacent channel interference to an acceptable level.

ii) Draw and explain construction and working principle of avalanche photodiode.

Ans: **[Diagram-2M, Working-2M]**

Avalanche photodiode are used to obtain the large gain, i.e. large output because conventional photodiodes and PIN photodiodes obtain the limited gain.

Diagram:



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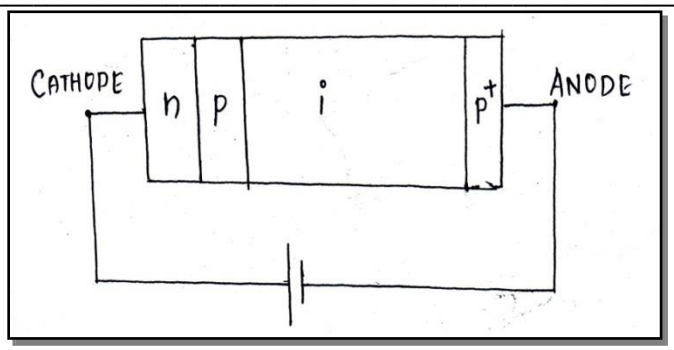


Fig. Avalanche photodiode

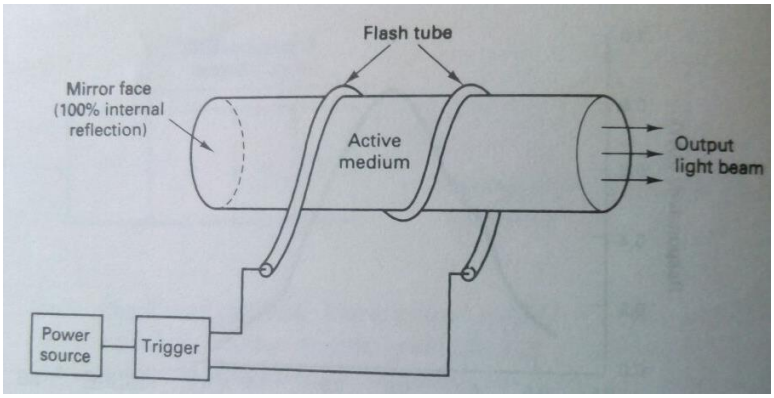
Working:

- Light enters the diode & absorbed by the P^+ material.
- This causes high electric field intensity developed across the i-p-n junction.
- This provides reverse biased & causes impact ionization.
- During ionization carrier can gain sufficient energy to ionize other electrons.
- This process is continues like an avalanche.
- It is effectively equivalent to an internal gain or carrier multiplication.
- APD's are more sensitive than PIN diodes.
- And requires less additional amplification.

iii) Explain construction and working principle of LASER.

Ans: **[Constructional diagram 2M, Working-2M]**

Fig shows the basic construction of LASER.



Working:

- The power source is connected to a flashtube that is coiled around a glass tube that holds the active medium.
- One end of the glass tube is a polished mirror face for 100% internal reflection.
- The flashtube is energized by a trigger pulse and produces a high level burst of light. The flash causes the chromium atoms within the active crystalline structure to become excited.
- The force of pumping raises the level of the chromium atoms from ground state to an excited energy state.
- The ions then decay, falling to an intermediate energy level. When the population of ions in the intermediate level is greater than the ground state, a population inversion occurs.
- The population inversion causes laser action to occur. After a period of time, the excited chromium atoms will fall to the ground energy level. At this time, photons are emitted.
- The emitted photons strike atoms and two other photons are emitted. The higher frequency of the energy causes greater strength photons.

iv) Compare GSM with IS-95 with respect to:

i) Modulation technique used

ii) Multiple access technology used

iii) Uplink frequency.

iv) Downlink frequency.

Ans: **[1M for each point]**

Sr. No.	Parameter	GSM	IS-95
1)	**Modulation technique used.**	GMSK	QPSK with DSSS
2)	**Multiple access technology used**	TDMA	CDMA
3)	**Uplink frequency**	890MHz. to 915MHz.	824MHz to 849MHz.
4)	**Downlink frequency**	935MHz to 960MHz.	869MHz to 894MHz.

B) Attempt any ONE: [6M]

a) State IMT 2000 services.

Ans: [Any 6 services -1M for each service]

IMT-2000 Service:

Circuit and packet bearer capability up to 144 kb/s in vehicular radio environment circuit and packet bearer capability up to 384 kb/s for pedestrian radio environment.

Circuit and packet bearer capability up to 2048 kb/s in indoor office radio environment

Interoperability and roaming among the IMT-2000 family of systems

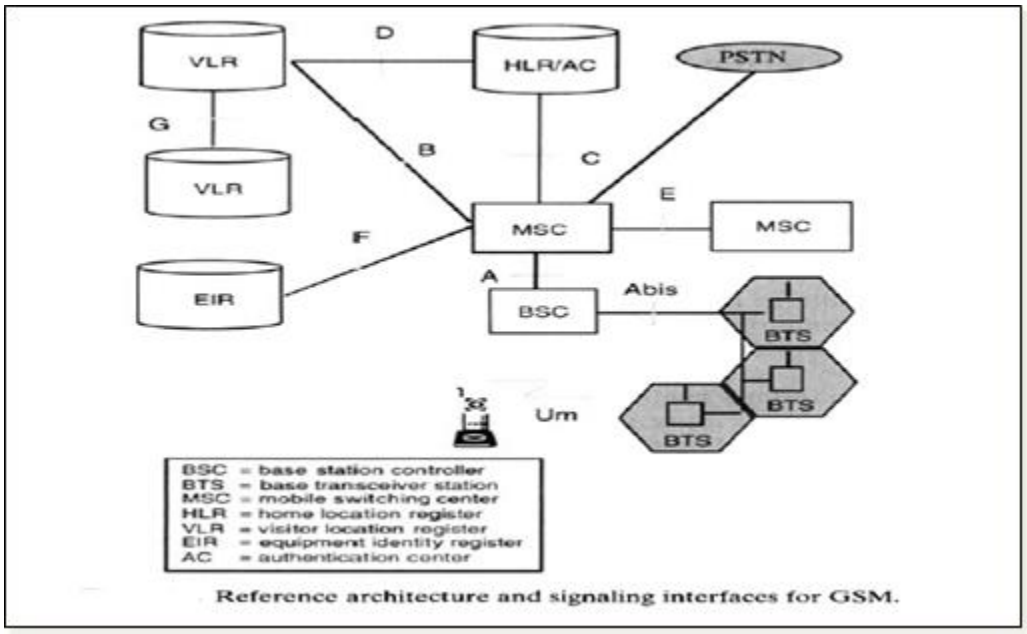
- Service portability and support of virtual home environment
- Multimedia terminals and services
- Separation of call and bearer channel/connection control
- Emergency and priority calls
- Geographic position/location service
- User authentication and ciphering
- User-network and network-network (mutual) authentication
- Lawfully authorized electronic surveillance

- Support higher data rates that can support multimedia applications, provide a high spectral efficiency, makes as many of the interfaces standard as possible, and provide compatibility to services within the IMT-2000.
- Although voice traffic will continue to be the main source of revenue, packet data for internet access, advanced messaging services such as multimedia email, and real-time multimedia for applications such as telemedicine and remote security are envisaged in IMT-2000.
- Services available over IMT2000 are

i) Speech
ii) Switched Data
iii) Interactive Multimedia
iv) Simple Messaging
v) Medium Multimedia
vi) High Multimedia

b) Draw GSM architecture and state function of any three blocks.

Ans: **[Diagram: 3M, function of any three blocks-1M each]**



Reference architecture and signaling interfaces for GSM.

OR

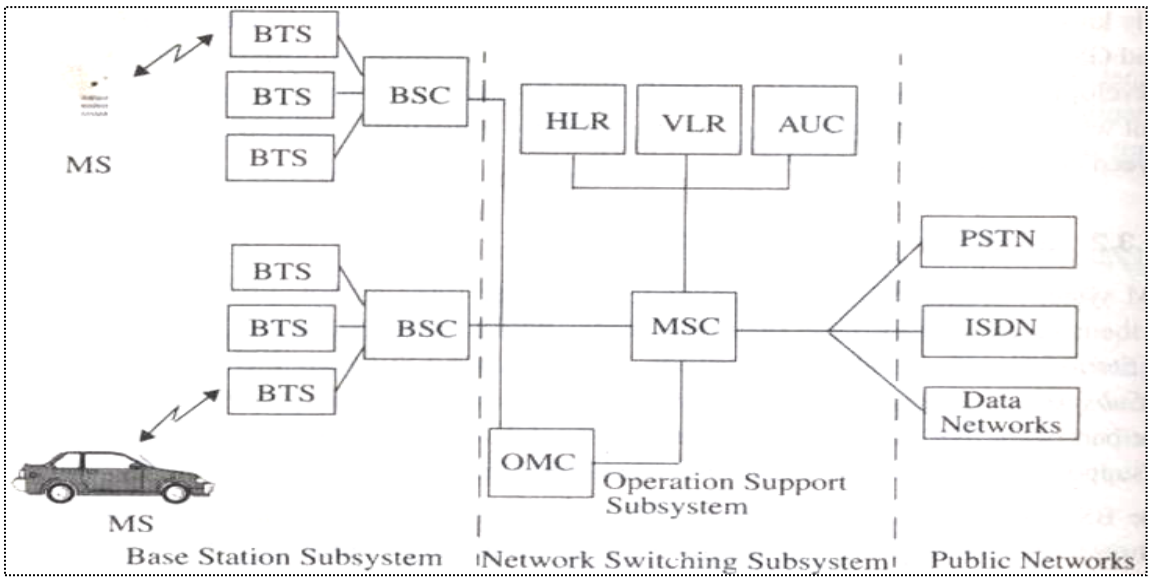
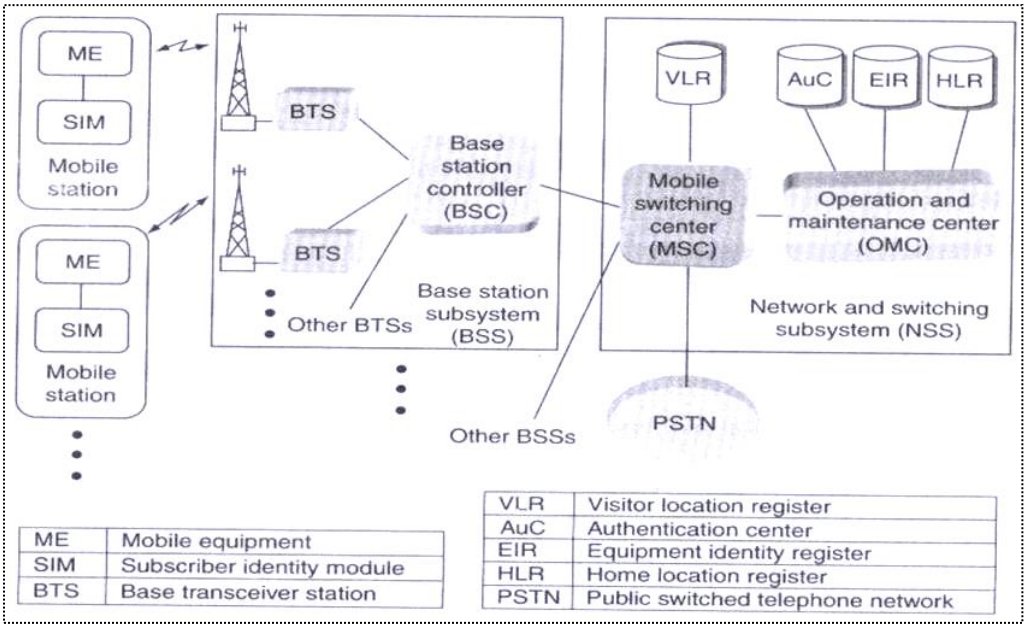


Fig. GSM architecture

OR



1. BSS:

a) Radio resource control

b) Frequency hopping and power control

c) Handoff management

d) Digital signal processing

2. Home Location Registers (HLR):

a) Permanent database about mobile subscribers in a large service area (generally one per GSM network operator)

b) Database contains subscriber & location information

c) Database contains IMSI (International Mobile Subscriber Identity), prepaid/postpaid, roaming restrictions, supplementary services

d) Each Subscriber assigned IMSI to identify home user

3. Visitor Location Registers (VLR)

a) Temporary database which stores IMSI & customer information for each roaming subscriber visiting the coverage area of particular MSC.

b) It updates whenever new MS enters its area, by HLR database. It controls the mobiles roaming in its area.

4. MSC performs the following major functions:

a) Call setup, supervision, and release
b) Digit collection and translation
c) Call routing
d) Billing information collection
e) Mobility management: Registration, location updating ,inter-BSS and inter-MSC call handoffs
f) Paging and alerting
g) Management of radio resources during a call
h) Echo cancellation
i) Manage connections to BSS, other MSCs, and PSTN/ISDN
j) Interrogation of appropriate registers (V/HLRs)

5. Authentication Center AC

a) AC associated with the HLR, the authentication center contains authentication parameters that are used on initial location registration, subsequent location updates, and on each call setup request from the MS.
b) AC maintains the authentication keys and algorithms, and provides the security triplets (RAND,SRES, and Kc) to the VLR so that the user authentication and radio channel encryption procedures may be carried out within the visited network.
c) The authentication center for GSM contains the security modules for the authentication keys (Ki) and the authentication and cipher key generation algorithms A3 and A8, respectively.

6. Equipment Identity Register (EIR)

a) EIR maintains information to authenticate terminal equipment so that fraudulent, stolen, or nontype-approved terminals can be identified and denied service.
b) The information is in the form of white, gray, and black lists that may be consulted by the network when it wishes to confirm the authenticity of the terminal requesting service.

Q 5 Attempt any Two: [16M]

a) List the important features of 3G-CDMA 2000.

Ans: [Each feature-1M, Any Eight]

Important features of 3G-CDMA 2000:

Multiple Access Method	DS-CDMA
Duplexing Method	FDD/TDD
Base Station Synchronization	Asychronous Operation
Channel Separation	5MHz
Chip Rate	3.84 Mcps multiple carrier pers ec
Frame Length	10 ms
Service Multiplexing	Multiple Services with different QoS Requirements Multiplexed on one Connection
Multirate Concept	Variable Spreading Factor and Multicode
Detection	Coherent, using Pilot Symbols or Common Pilot
Multiuser Detection, Smart Antennas	Supported by Standard, Optional in Implementation

OR

Important features of 3G-CDMA 2000:

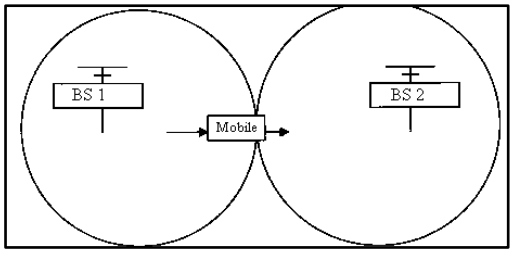
- High level of flexibility
- Cost-effectiveness in all operating environments
- Commonalty of design worldwide
- Operation within the designated -2000 frequency bands
- Common spectrum worldwide (1.8-2.2 GHz band)
- Multiple radio environments (cellular, cordless, satellite, LANs)
- Wide range of telecommunications services (voice, data, multimedia, internet)
- Flexible radio bearers for increased spectrum efficiency
- Data rates up to 2 Mb/s (phase 1)—for indoor environments
- Maximum use of IN capabilities (for service provision and transport)
- Global seamless roaming
- Enhanced security and performance
- Integration of satellite and terrestrial systems

b) Explain the meaning of Hand-off. List the different types of Hand-off and explain any two.

Ans: [Meaning of Hand-off -2M,List the different types of Hand-off -1M,[Explanation of any two handoff -2M each]

Note: Marks should be credited to any different diagram also showing handoff concept.

Meaning of Handoff:



Handoff: When a mobile unit moves from one cell to another while a call is in progress, the MSC must transfer (handoff) the call to a new channel belonging to a new base station. This process is called hand-off.

List the different types of Hand-off:

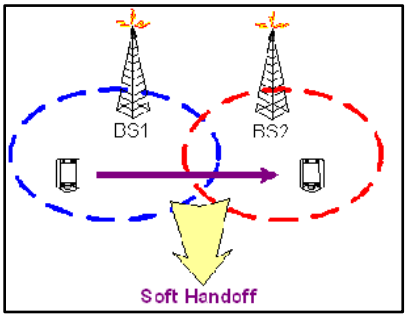
- Soft Hand-off
- Hard Hand-off
- Intersystem handoff
- Mobile Assisted Handoff (MAHO)

Handoff can be classified on different bases:

1] Type of connection

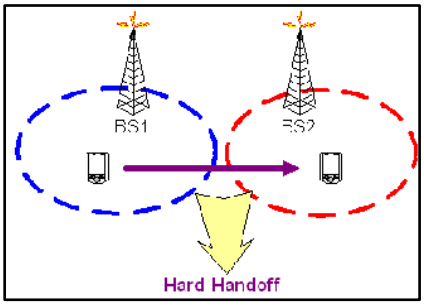
- **Soft Hand-off:** *"make-before-break".*

When the user moves from one cell to another and the channels change from old base station to channels of new base station, before the connection brakes is called as Soft Hand-off.

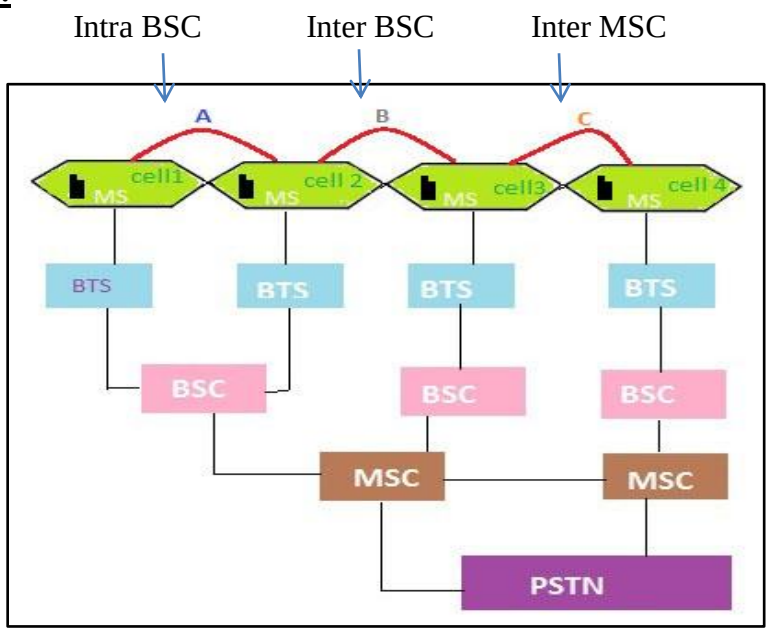


- **Hard Hand-off:** "*break before make*"

When the user moves from one cell to another and the channels change from old base station to channels of new base station after the connection brakes is called as hard Hand-off.



2] Intersystem handoff:



Intra BSC handoff: When the handoff takes place within BSC .
Inter BSC handoff: When the handoff takes place within different BSC .
Inter MSC handoff: When the handoff takes place within different MSC.

3] Mobile Assisted Handoff (MAHO):

A mobile assisted handoff (MAHO) is a process used GSM cellular networks where a mobile phone assists/helps the cellular base station to transfer a call to another base station. It is a technique used in mobile telecom to transfer a mobile phone to a new radio channel with stronger signal strength and improved channel quality. Mobile assisted handoff can also be referred to as mobile assisted handover.

MAHO is based on a mobile phone's capabilities in detecting and identifying better radio channels to be used within a call. MAHO works when a mobile phone can scan, review and monitor nearby radio channels. The mobile collects the measurements, usually in the form of RF signal quality, received signal strength indication (RSSI).These measurements are then sent to the base station, which evaluates them and transfers the call to the best available channel.

c) Describe operation of WLL with suitable diagram and state any two features of WLL.

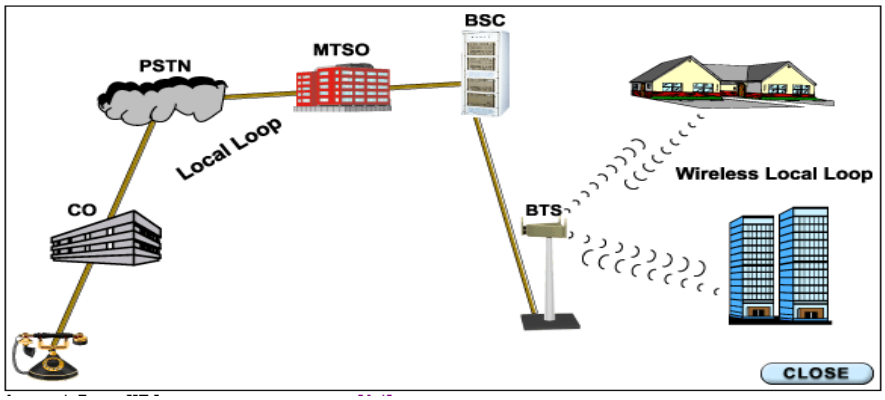
Ans: **[Suitable Diagram -2M, Operation of WLL-2M, Any two features of WLL- 2M each]**

***Note:* Marks should be credited to any different diagram for WLL**

Wireless local loop system[WLL]:

- WLL is a system that connects subscribers to the local telephone station wirelessly.

A general WLL setup:



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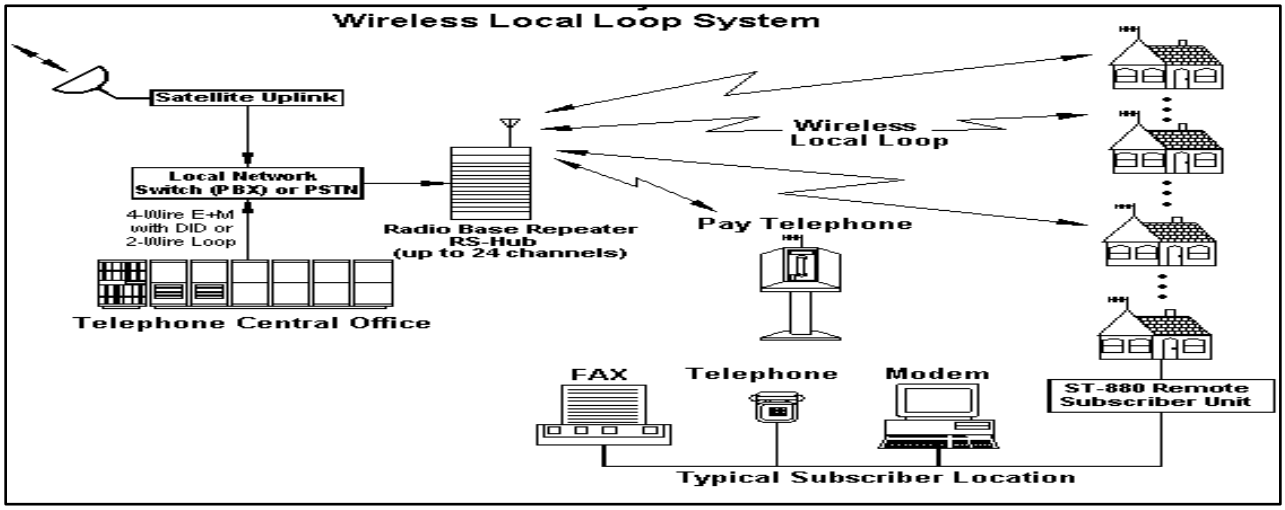

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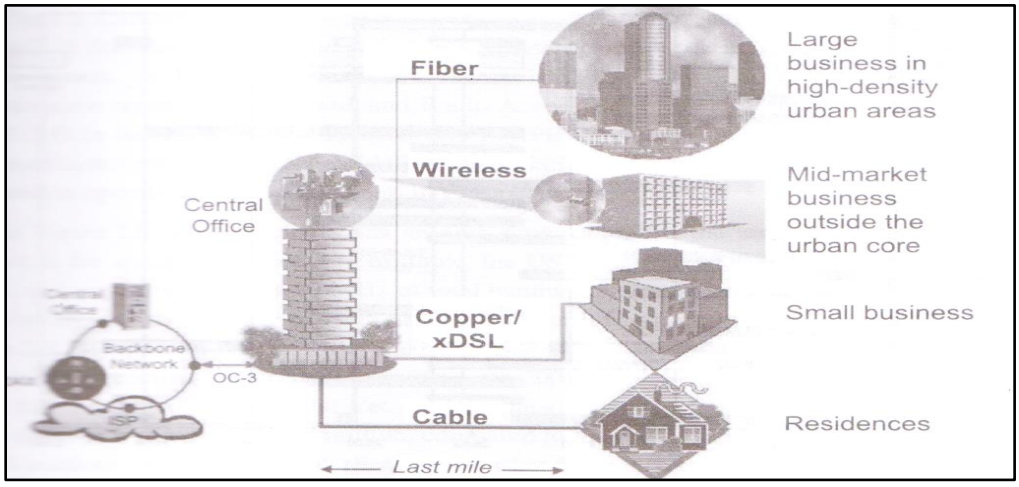
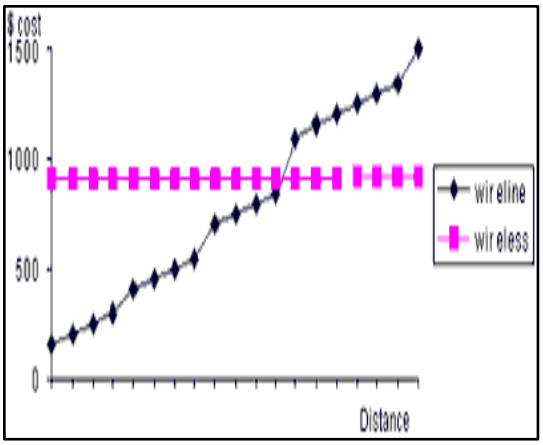


Explanation of WLL:

- Microwave wireless links can be used to create WLL .
- WLL is a telecommunication network between central office CO and individual homes and business in close proximity to the CO.
- All the connections from CO are connected to MTSO and in turn to BSC and BTS and then wirelessly to homes or business place.
- Copper wire and fibre optic cable takes years for installation and is costly whereas WLL equipment can be deployed just in few hours.

Features of WLL:

a) Wireless cost is constant over distance for WLL :



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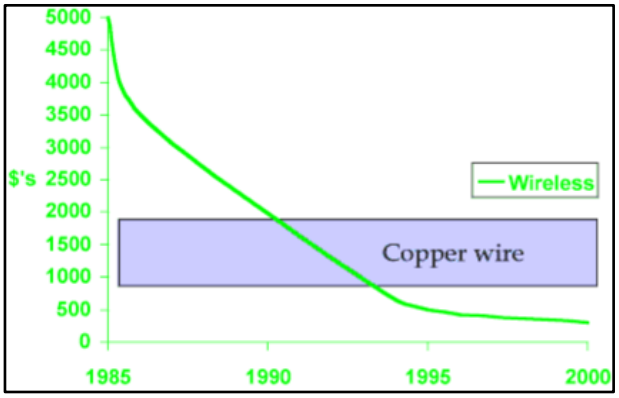


b) Systems WLL is based on:

- Cellular
- Satellite (specific and adjunct)
- Microcellular

c) Other names of WLL:

- Radio In The Loop (RITL)
- Fixed-Radio Access (FRA).

d) Wire-line depends on distance AND terrain

e)WLL:
Depends on economic development, existing infrastructure of a region

f)WLL :
Offers market competition, quick deployment and relatively reliable service at low costs

g)Toll-quality service:

h)Expand from a central office to about 5 miles

i)Low license cost

j)Subscriber costs equivalent or better than copper

Q6) Attempt any four: [16M]

(a) List any four features of each:
(i) EDGE for 2.5G GSM
(ii) IS-136
Ans: [Any four features: 1/2 mark of each]

i) EDGE for 2.5G GSM:

a) Enhanced data rates for GSM (as Global) Evolution advanced upgrade to the GMS standard.
b) It requires the addition of new hardware and software at existing base station.
c) EDGE introduces new digital modulation format 8 – PSK (octal phase shift keying) when it is used in addition to GSM's standard GMSK.
d) EDGE allows for a different air interface format known as multiple modulation and coding scheme with varying degrees of errors control protection.
e) Coverage range is smaller in EDGE than in HSDRC or GPRS.
f) EDGE is also called as Enhanced GPRS.
g) In EDGE each MCS (Multiple modulation and system) state may use either GMSK (low data rate) or 8-PSK (high data rate) or 8-PSK (high data rate) modulation for network access depending on the instantaneous demands of network and the operation

ii) IS-136

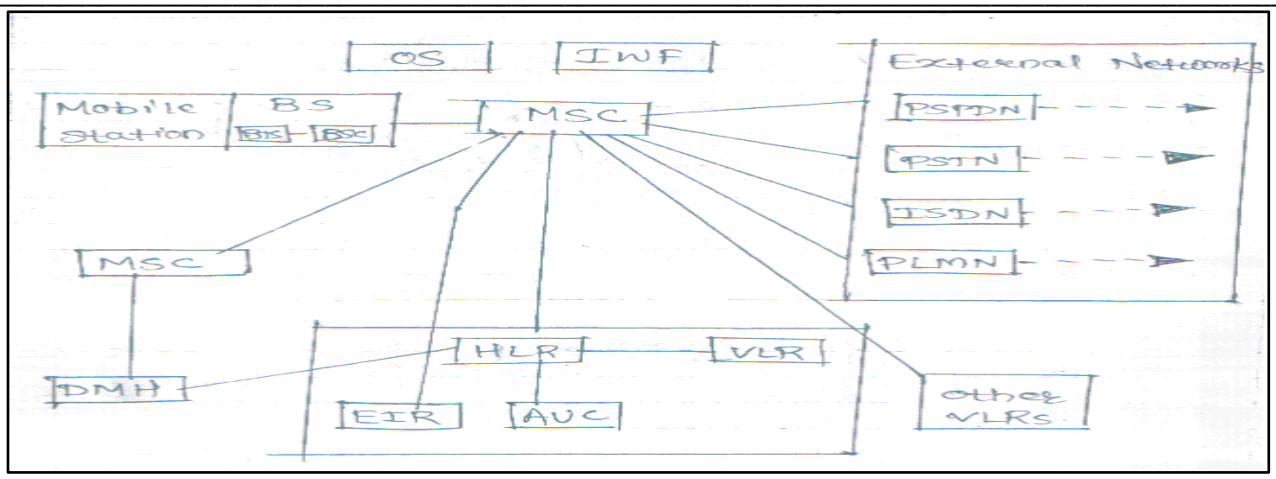
a) IS-136 is called Interim standard also called NADC north American digital cellular
b) IS 136 was developed to host new features and services to be competitive with IS95 and GSM 2G standards.
c) It specifies short messaging capabilities.
d) It provides user group features
e) It is suitable for paging applications
f) It is suitable for wireless PBX application

(b) Explain how call processing takes place IS-95 CDMA.

Ans: . [Diagram-2M,Explanation -2M]

Note: Marks should be credited even if students explain the answer with the help of forward/Reverse channel processing

:



Call processing takes place IS-95 CDMA:

When mobile phone unit user calls tries to gain access to service from the network.
The BSC is the control and management system for one or more BTS's.

a) The BSC exchanges the messages with both the BTS and MSC.
b) The MSC is an automatic system that interfaces the user traffic from wireless network with the wire line network or other wireless networks. MSC provides radio contact to a call.
c) Mobile station communicates with BSS for radio resources which in turn communicate with MSC for necessary channels.
d) When a roaming MS enters a new service area covered by the MSC, information is stored in VLR.
e) HLR maintains all subscriber-related information.
f) Data Message Handler (DMH) for collects the billing data.
g) Authentication Centre (AUC):The AUC manages the authentication associated with individual subscriber.
h) Inter working Function (IWF):The IWF enables the MSC to communicate with other networks.
(PSTN), (ISDN), (PLMN) and Public Switched Packet Data Network (PSPDN)

(c) State the function of following GSM Channels:
i) Broadcast channel
ii) Slow associated dedicated channel
iii) Fast associated dedicated channel
iv) Standalone dedicated channel

Ans: **[Function of each GSM Channels-1M each]**

i) Broadcast control channel (BCCH) : **(**Unidirectional (base-to- mobile) channel that is used to broadcast (continuous transmission) information regarding the mobile's serving cell as well as neighboring cells.

ii) Slow associated dedicated channel (SACCH): is deployed to transfer link quality and signal strength information in the uplink direction and for power control frame adjustment (timing) information in the downlink direction.

iii) Fast associated dedicated channel (FACCH): is assigned only to a traffic channel (TCH) and relies on frame stealing to transfer handoff information during an active call.

iv)The stand alone control channel(SDCCH): provides data transfer in both the uplink and downlink directions for call setup or short messages and is released at the completion of data transfer

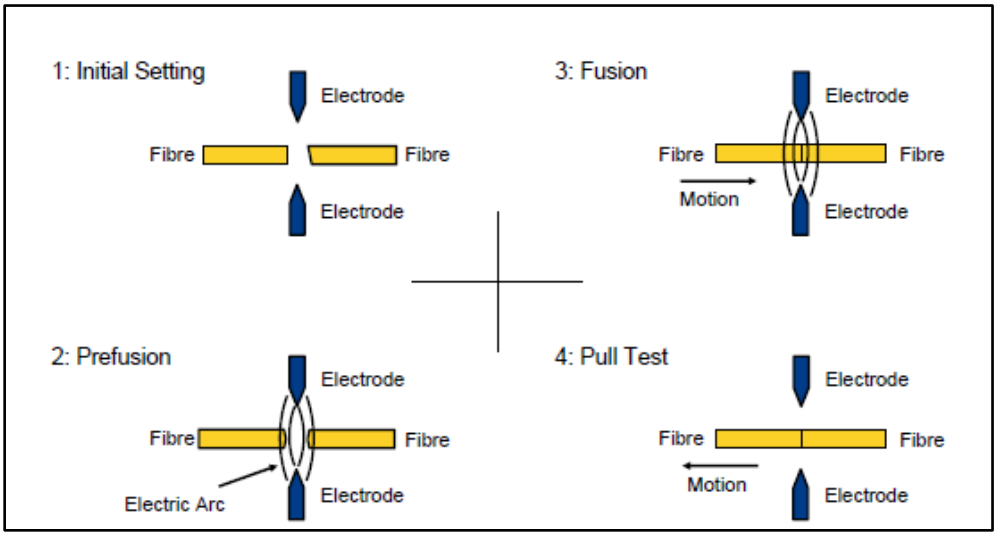
(d) Explain the following splicing techniques:

i) Fusion

ii) V-grooves

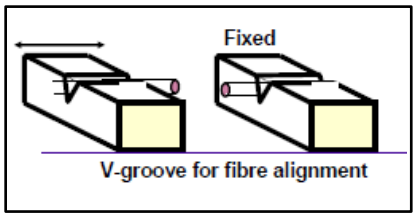
Ans: **[Diagram -2 M each, Explanation-2 M each]**

i) Pre-fusion splicing:



- Fusion splice are made by thermally bonding together the prepared fibers end.
- The prepared fibers ends are pre-aligned and butted together in order to achieve good continuity.
- The butt joint is then heated with an electric arc or a laser and hence bonded together
- It provides very low splice losses.
- For good joint they have to be properly positioned and aligned.

(i) V-grooves



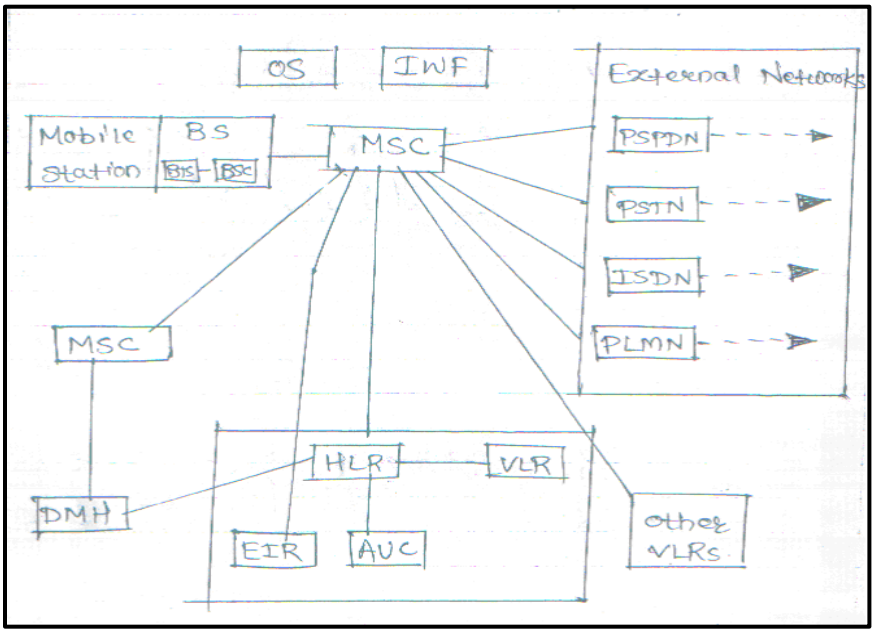
***Note:* Marks should be credited for any other diagram which show V groove**

(a) In this method the prepared fibre ends are first butted in a "V" shaped groove.
(b) In v shape groove two fibers are bonded with an adhesive.
(c) "V" shaped channel is either a grooved silicon, plastic ceramic or metal substrate.
(d) It provide splice losses of around 0.1 dB

(e) Draw system architecture of IS-95 and explain working of any two blocks.

Ans: **[diagram of system architecture of IS-95 -2 marks, working of any two blocks- 1 mark each]**

System architecture of IS-95:



Working of blocks:

Mobile Station (MS): This is the mobile phone unit with the user.

The MS terminates the radio path on the user side and enables the user to gain access to service from the network.

Base Station (BS):

The BS terminates the radio path and connects to the MSC.

Base Transceiver Station (BTS):

BTS consists of one or more transceivers placed at a single location and terminates the radio path on the network side.

Base Station Controller (BSC):

The BSC is the control and management system for one or more BTSs.

The BSC exchanges the messages with both the BTS and MSC.

Mobile Switching Centre (MSC):

The MSC is an automatic system that interfaces the user traffic from wireless network with the wire line network or other wireless networks.

MSC provides radio contact to a call. **Home Location Register (HLR):**

Manages mobile subscribers by maintaining all subscriber-related information.

Data Message Handler (DMH):
The DMH is responsible for collecting the billing data.

Visitor's Location Register (VLR):
When a roaming MS enters a new service area covered by the MSC, information is stored in VLR.

Authentication Centre (AUC):
The AUC manages the authentication associated with individual subscriber.

Equipment Identity Register (EIR):
The EIR provides the information about mobile device for record purpose.

Operation System (OS):
The OS is responsible for overall management of the wireless network.

Inter working Function (IWF):
The IWF enables the MSC to communicate with other networks.

External Networks:
These are other communication networks and can be :

- Public Switched Telephone Network (PSTN)
- Integrated Service Digital Network (ISDN)
- Public Land Mobile Network (PLMN)

Public Switched Packet Data Network (PSPDN)