



**SUMMER– 15 EXAMINATION**

Subject Code: **17657**

**Model Answer**

**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 judgement 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 of following:**

**12 marks**

- (i) State the significance of frequency reuse in cellular system. Write procedure to select cell for frequency reuse.

Ans: (**Significance - 2 marks and procedure - 2 marks**)

**Significance:** 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.**

**Procedure:**

**Procedure to locate co channel cell:**

N is cluster size which should satisfy equation  $N = i^2 + ij + j^2$

where i and j are non-negative integers.

I) Move i cells along any chain of hexagons and then

II) Turn 60 degrees counter clockwise and move j cells.

- (ii) List out specifications of 2.5 G GSM (any four features)

Ans: (**Any four correct specifications – 4 marks**)

\*2.5 G GSM systems are **HSCSD, GPRS, and EDGE**

**Specifications of EDGE:**

The name EDGE stands for Enhanced Data rates for GSM Evolution and it enables data to be sent over a GSM TDMA system at speeds up to 384 kbps.

Multiple Access Technology	FDMA / TDMA
Duplex Technique	FDD
Channel Spacing	200 kHz
Modulation	GMSK, 8PSK
Slots per channel	8
Frame duration	4.615 ms
Latency	Below 100 ms

Overall symbol rate	270 k symbols / s
Overall modulation bit rate	810 kbps
Radio data rate per time slot	69.2 kbps
Max user data rate per time slot	59.2 kbps (MCS-9)
Max user data rate when using 8 time slots	473.6 kbps **

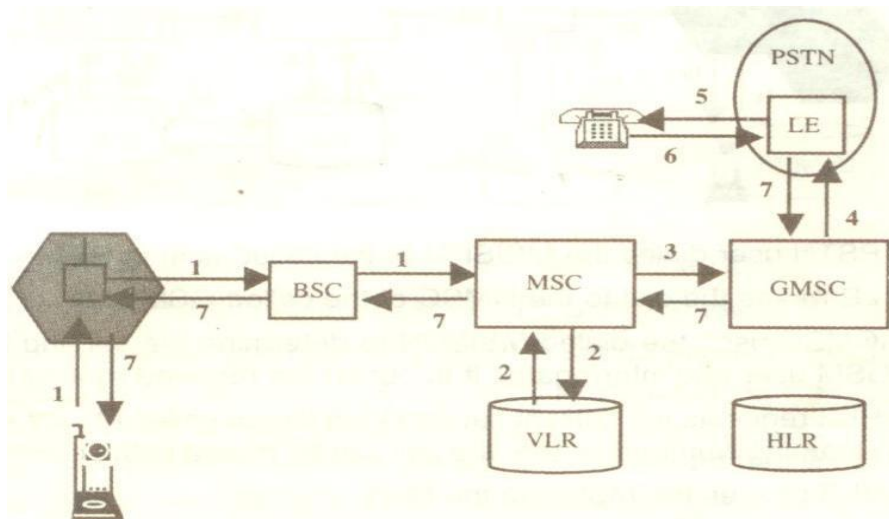
(iii) Compare IS 95 with IS 136 with respect to any four technical specifications.

Ans:- (Any four correct points – 4 marks)

Parameter	IS-95	IS-136
Uplink frequency	824-849 MHz	800MHz,1500MHz
Downlink frequency	869-894MHz	869-894MHz
Duplexing	FDD	FDD
Multiple access technique	CDMA	TDMA
Modulation	BPSK with quadrature spreading	$\pi/4$ DQPSK
Carrier separation	1025MHz	30KHz.
Voice channels per carrier	64	3

(iv) Write call processing in cellular telephone system.

Ans: (2 marks diagram and 2 marks procedure-any one)

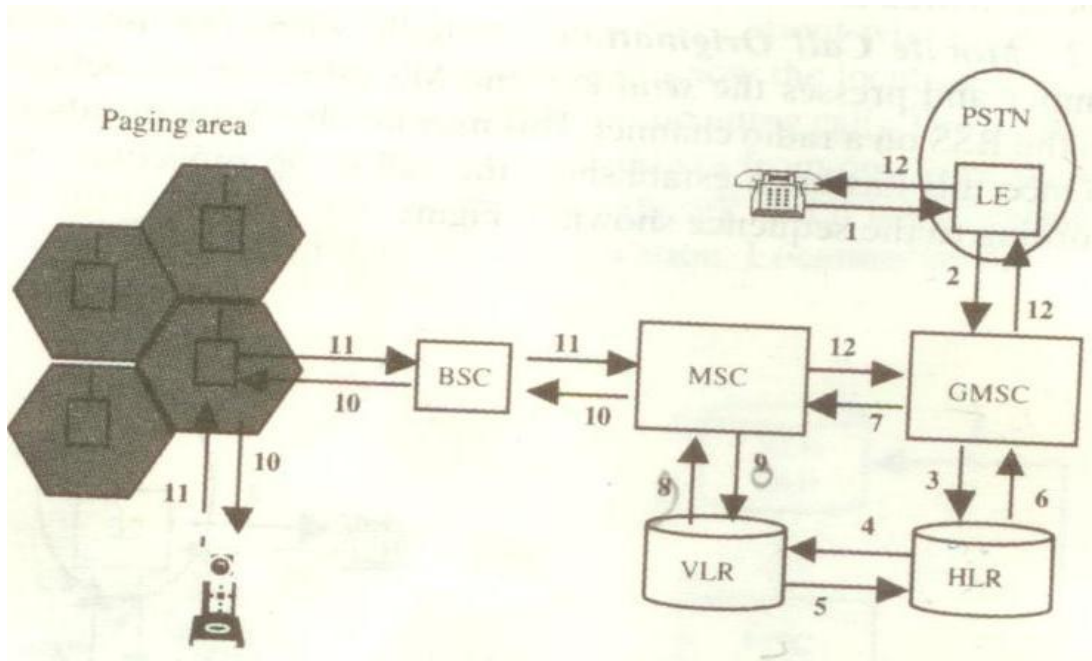


### Mobile call origination in GSM

1. The MS sends the dialed number indicating service requested to the MSC (via BSS).
2. The MSC checks from the VLR if the MS is allowed the requested service. If so, MSC asks BSS to allocate necessary resources for the call.
3. If the call is allowed, the MSC routes the call to GMSC.
4. The GMSC routes the call to the local exchange of called user.
5. The LE alerts (applies ringing) the called terminal.

6. Answer back (ring back tone) from the called terminal to LE.
7. Answer back signal is routed back to the MS through the serving MSC which also completes the speech path to the MS.

(OR)



**Mobile call termination:**

1. The PSTN user dials the MSISDN of the called user in GSM.
2. The LE routes the call to the GMSC of the called GSM user.
3. The GMSC uses the dialed MSISDN to determine the serving HLR for the GSM user and interrogates it to obtain the required routing number.
4. The HLR requests the current serving VLR for the called MS for a MSRN(MS roaming number).so that the call can be routed to the correct MSC.
5. The VLR passes the MSRN to the HLR
6. The HLR passes the MSRN to the GMSC.
7. Using the MSRN, the GMSC routes the call to the serving MSC.
8. The MSC interrogates the VLR for the current location area identity (LAI) for the MS.
9. The VLR provides the current location for the MS.
10. The MSC pages MS via the appropriate BSS. The MS responds to the page and sets up the necessary signaling links.
11. When the BSS has established the necessary radio links, the MSC is informed an the call is delivered to the MS.
12. When the MS answers the call, the connection is completed to the calling PSTN user.



**Q 1 b) Attempt any ONE of the following:**

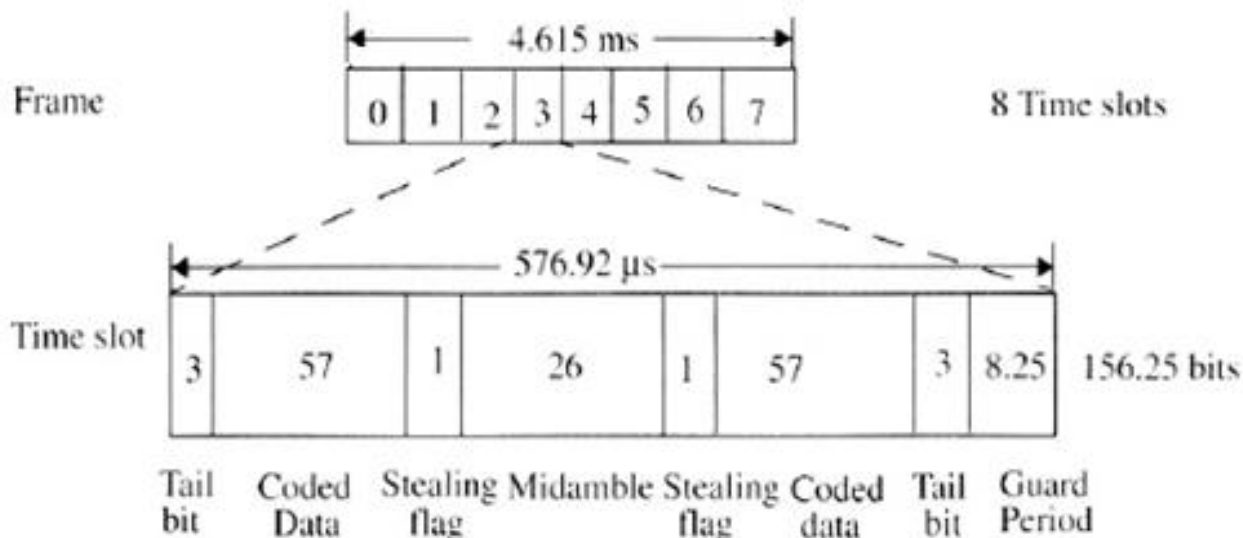
**6 Marks**

- (i) State the frequency band, channel bandwidth, access method and type of modulation used in GSM. Sketch GSM TDM structure.

Ans: (Specifications – 4 marks and structure diagram -2 Marks)

Parameter	Values
Frequency Band: Forward	935 – 960 MHz
Reverse	890 – 915 MHz
Channel bandwidth	200 KHz
Access method	TDMA
Type of modulation	GMSK

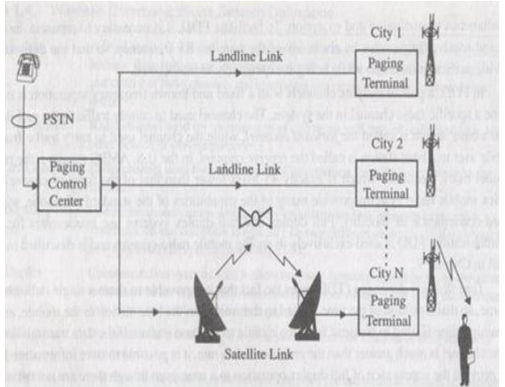
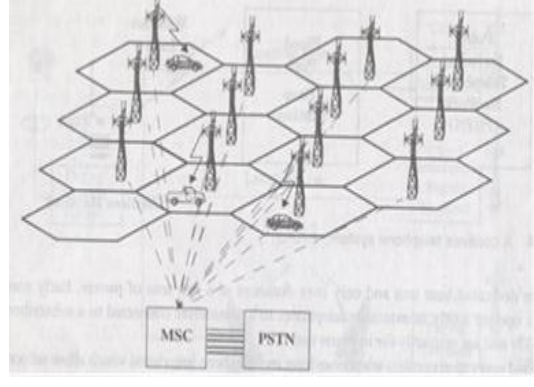
**GSM TDM Frame Structure**



- (ii) How paging system differs from cellular phone system? Compare w.r.t. capacity, operation, applications and system requirement.

Ans;- (4 marks for Four points and 1 mark each for both diagrams)

Parameter	Paging system	Cellular phone system
Capacity	Since paging covers a limited range of 2 to 5 km, the capacity is less	Since it covers a large geographic area so the capacity is more. It is normally more than 10000 subscribers per MSC.
Operation	Paging system transmits the message known as page along with paging system access number throughout the service area using base station on a radio link.	In a cellular system the area is divided into cells which are served by a base station. The base stations are linked to the MSC/MTSO. The MTSO interacts with the PSTN and the other MSCs through wired link. The MTSO provides necessary resources for the communication between the base station

		<p>and cellular phone.</p> 
<p>Applications</p>	<p>Pager is most useful option of one way communication and provides value added services such as sports line, news line, helpline, bilingual paging and intercity paging.</p>	<ol style="list-style-type: none"> <li>1. High-quality voice transmission.</li> <li>2. Messaging</li> <li>3. Internet access (Web surfing, including pages with audio and video).</li> </ol> <p>Additional services might be video conferencing etc.</p>
<p>System requirement</p>	<p>PSTN, paging control center satellite links and paging receivers. Though paging receivers are simple and inexpensive, the transmission system required is quite sophisticated.</p>	<p>Mobile station, base station, mobile switching center. The base station contains several transmitters and receivers to handle full duplex communication and can support several transmitting and receiving antennas.</p>

**Q2. Attempt any FOUR of the following**

**16 marks**

a) Define the term co-channel. State cause and effect of co-channel interference on system capacity.

**Ans: (Definition 1 mark, 1 ½ marks for causes and 1 ½ marks for effects)**

**Co-channel cells:** 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.

**Causes:**

- i) Reduction of D/R ratio, which reduces distance between two co-channels.
- ii) Use of omnidirectional antennas at the base station.
- iii) Increasing the antenna height at the base station.

Effects of co-channel interference on system capacity:

The parameter Q, called the co-channel reuse ratio, is related to cluster size N,

$$Q = D/R = \sqrt{3N}$$

A small value of Q provides larger capacity since the cluster size N is small, whereas a large value of Q implies smaller level of co-channel interference.

Thus with reduction in co-channel interference there will reduction in system capacity.

b) State any four features of UMTS.

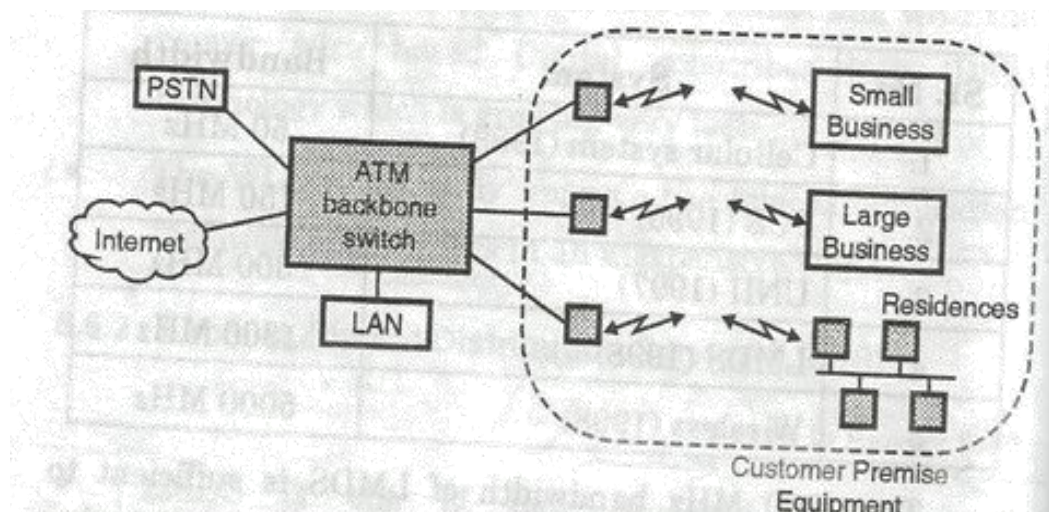
**Ans: (Any four features - 4 marks)**

- It is more robust for multipath delays.
- It has very high packet data rates of 2.048 Mbps.
- It has very high channel bandwidth of 5 MHz
- It has backward compatibility with GSM systems.
- It has high frame structure of 16 slots per frame.
- It gives signals of higher voice and data quality and also small bit error rates.
- It has a common world-wide spectrum band.
- It has global seamless connectivity (roaming).

c) LMDS is suitable local exchange carrier application. Justify and sketch its network diagram.

**Ans: (2 marks diagram and 2 marks explanation)**

The most important application of LMDS is the Local Exchange Carrier (LEC) network. It is shown in the figure.



LMDS is suitable for LEC because of following reasons.

The 1300MHz bandwidth of LMDS is sufficient to provide more than 200TV channels or 65000 full duplex voice channels.

The US LMDS band is 27.5 - 28.35 GHz, 29.1 – 29.25 GHz and 31.075 – 31.225 GHz. In this network the LEC uses a very wide bandwidth ATM (asynchronous transfer mode) or SONET (synchronous optical network) backbone switch. Such a switch can connect hundreds of megabits per second traffic to the internet, PSTN, or to its own private network.

The LMDS thus provides wireless broadband connectivity to the customers without using the cables.



d) For EDGE 2.5 G and GPRS standard state following specification (2.5 G GSM)

- |                        |                               |
|------------------------|-------------------------------|
| (i) Data rate          | (iii) Modulation technique    |
| (ii) Channel bandwidth | (iv) Number of voice channels |

**Ans: (1 mark – each parameter)**

Parameter	EDGE 2.5 G	GPRS
Data rate	547.2 kbps	171.2kbps
Channel bandwidth	200kHz	200kHz
Modulation technique	GMSK and 8 PSK	GMSK and 8 PSK
Number of voice channels	8 per carrier	8 per carrier

e) Define the term blockage, call drops, word error rate and voice quality.

**Ans: (each definition – 1 mark)**

- **Blockage :** There are two types of blockage
  1. Set up blockage: To a mobile several calls can inter-collide simultaneously. If this no exceeds 10 then mobile is said to be blocked and this blockage is called as setup channel blockage.
  2. Voice channel blockage: Simultaneously when many calls come in, calls are rejected because there are no voice channels available, this is called voice channel blockage.
- **Call drops:** They are defined as the calls that are dropped because of factors after the voice channel is allocated to a mobile. Sometimes these are dropped because of weak signals. The drop call rate is dependent on hand off traffic model and signal coverage.
- **Word error rate:** Word error rate (WER) is a common metric of the performance of a speech recognition or machine translation system.  
 Word error rate can then be computed as:  $WER = S+D+I / N$   
 S is the number of substitutions, D is the number of deletions, I is the number of insertions, C is the number of the corrects, N is the number of words in the reference ( $N=S+D+C$ )
- **Voice quality:** Voice quality is signal to ratio and distortion ratio.  
 SINAD is usually expressed in dB and is quoted alongside the receiver RF sensitivity, to give a quantitative evaluation of the receiver sensitivity

f) Calculate system capacity if cluster size is 7 and per cell number of channels are 72. Calculate total system capacity if 14 such clusters are available.

**Ans: (2 marks- for correct formula, 2 marks - correct answer)**

**Given:** Cluster size  $N = 7$

No. of channels per cell,  $k = 72$

Total no of clusters  $M = 14$

**To find:** Capacity of cluster and total capacity

Solution: Total capacity, C is given by  $C = M \times k \times N$

Therefore,  $C = 14 \times 7 \times 72=7056$

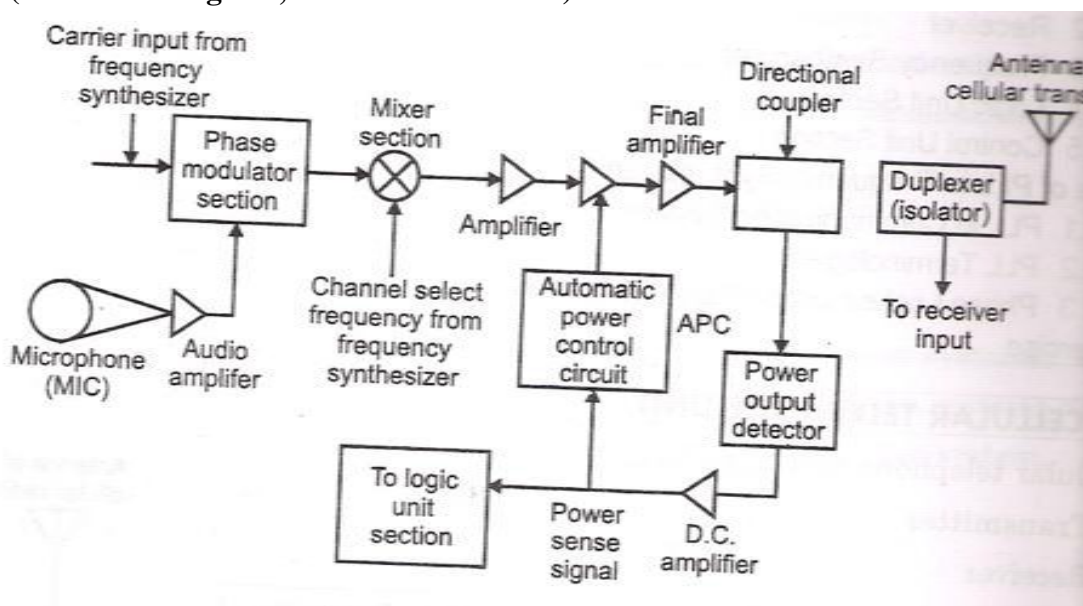


**Q.3) Attempt any FOUR of the following:**

**16 marks**

a) Draw block diagram of cellular transmitter and write the function of each block.

**Ans: (2Marks – Diagram, 2 Marks - functions)**



**Explanation:-**

**Phase modulator section and mixer:**

It is a low power FM unit operating in the frequency range of 824 to 849 MHz. The Carrier is obtained from frequency synthesizer and is applied to phase Modulator along with the amplified voice signal.

Modulator o/p converted using a mixer to final transmitter frequency.

Mixer o/p is applied to Class C amplifier.

**Final Amplifier:**

The final amplifier stage is designed to supply 3W to antenna.

**Automatic Power Control Circuit and DC amplifier:**

The automatic power control circuit controls the o/p power of the transmitter automatically, with the help of power o/p detector & DC amplifier.

Transmitter o/p is fed to duplexer. Carrier i/p for the phase modulator & the local oscillator frequency signal for mixer are produced by frequency synthesizer.

Transmitter o/p power is controlled by cell site & MTSO.

Receiver picks up the special control signals & sends to APC that sets transmitter o/p power level.



b) State functions of following blocks of GSM and using sketch show their interconnection:

- |          |           |         |
|----------|-----------|---------|
| (i) HLR  | (iii) AVC | (v) BSC |
| (ii) VLR | (iv) MSC  |         |

Ans:

1. **Home Location Registers (HLR)**

**(1/2 Mark)**

- Permanent database about mobile subscribers in a large service area (generally one per GSM Network operator)
- Database contains subscriber & location information.
- Database contains IMSI (International Mobile Subscriber Identity), prepaid/postpaid, roaming restrictions, supplementary services.
- Each Subscriber assigned IMSI to identify home user

2. **Visitor Location Registers (VLR)**

**(1/2Mark)**

- Temporary database which stores IMSI & customer information for each roaming subscriber visiting the coverage area of particular MSC.
- It updates whenever new MS enters its area, by HLR database.
- It controls the mobiles roaming in its area.

3. **Authentication Center (AUC)**

**(1/2 Mark)**

- A unit called the AUC provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each call.
- The AUC protects network operators from different types of fraud found in today's cellular world.

4. **Mobile Switching Center(MSC)**

**(1/2 Mark)**

- The MSC performs the telephony switching functions of the system.
- It controls calls to and from other telephone and data systems.
- It also performs such functions as toll ticketing, network interfacing, common channel signaling, and others.

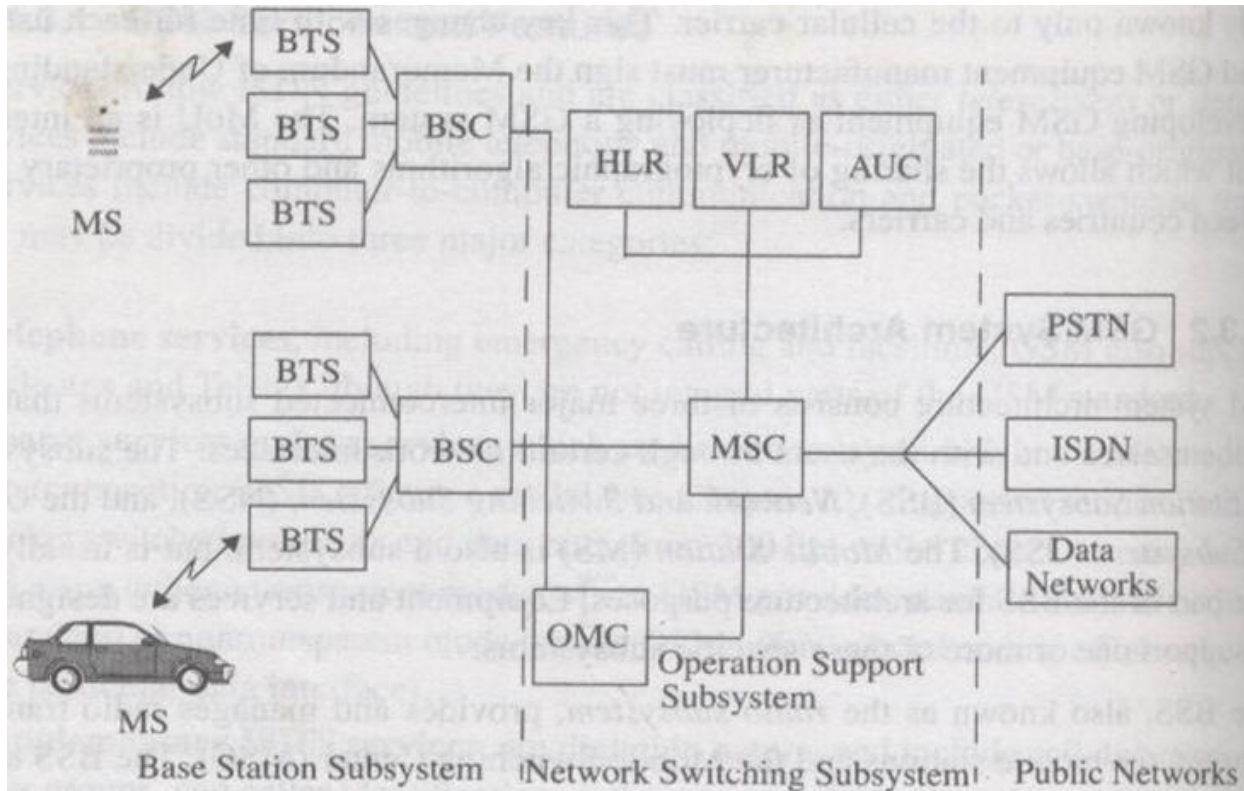
5. **Base Station Controller(BSC)**

**(1/2 Mark)**

- The Base Station Controller manages the radio resources for one or more BTS's.
- It handles radio-channel setup, frequency hopping, and handovers, as described below.
- The BSC is the connection between the mobile station and the Mobile service Switching Center (MSC).

Diagram to show interconnection of above blocks

(1 ½ Mark)



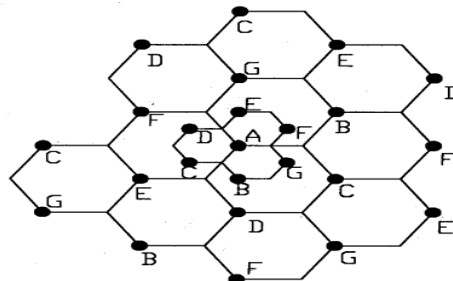
c) State capacity improvement methods for cellular system and their limitations (Any two methods).

Ans. Capacity improvement methods for cellular system are-

**1) Cell Splitting**

(1 Mark)

Cell splitting is the process of subdividing a congested cell in to smaller cells, each with its own base station and corresponding reduction in antenna height and transmitter power. Cell splitting increases the capacity of a system since it increases number of times that channels are reused. In cell splitting original cell is split in to smaller cells. New cell radius is half of the original radius. In this the cell boundaries need to be revised so that the local area which was earlier considered as a single cell can now contain number of smaller cell ,these new cells are called microcells. Cell splitting is divided into two types permanent and dynamic.

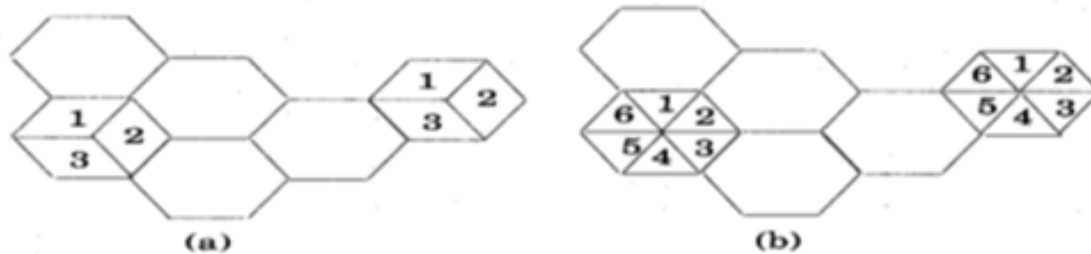


**Limitations of cell splitting (2 points) (1Mark)**

- The size of cell splitting is dependent on the following two factors:
- The radio aspect: the size of a small cell is dependent on how well the coverage pattern can be controlled and how accurately vehicle locations would be known.
- The capacity of the switching processor: The smaller the cells the more handoff will occur and the more cell splitting process is needed This factor of a switching processor is a larger factor than the handling of coverage areas of small cells.

**2) Sectoring (1Mark)**

Sectoring increase SNR using directional antennas and so capacity improvement is achieved by reducing the number of cells in a cluster, thus increasing frequency reuse. The co-channel interference in a cellular system may be decreased by replacing a single omnidirectional antenna at the BS by several directional antennas each radiating within a specified sector. The technique for decreasing co-channel interference and thus increasing system performance by using directional antennas is called sectoring. The factor by which the co-channel interference is reduced depends on the amount of sectoring used. A cell is normally portioned in to three 120 sectors or six 60 sectors as shown in figure below.



When sectoring is employed the channels used in a particular cell are broken down in to sectorized groups and are used only within a particular sector only. Sectoring improves Signal to interference (S/I) ratio and improves frequency reuse and thus system capacitive)

**Limitations of sectoring (2 points) (1 Mark)**

- It needs the use of a large number of directional antennas of each base station.
- It reduces the coverage area of the cellular system and hence increases the number of handoffs.

d) State four specifications of 3G CDMA – 2000.

**Ans: (Any four points - 1Mark each):**

Parameters	CDMA-2000
Carrier spacing	3.75 MHz
Chip rate	3.6864 MHz
Data modulation	FW-QPSK, RV-BPSK
Spreading	Complex (OQPSK)
Power control frequency	800 Hz



Variable data rate implement	Repeat, Puncturing multicode
Frame duration	20 ms (also 5, 30, 40)
Coding	Turbo and convolutional
Base station	Synchronous
Forward link pilot	CDM common pilot

e) State services offered by SS7 system (any four).

Ans: **SS7 Services – 1 mark each**

1. **Touch star** -It is also known as CLASS. It is a group of switch Controlled Services that provides its users with certain call management capabilities. It provides services such as call return, call forwarding, repeat dialing, call block, call tracing & caller ID.
2. **800 services** -It was introduced by bell System to provide toll-free access to the calling party to the services & database which is offered by private parties. Cost associated with the processing of calls is paid by the service subscriber.800 Service is offered under two plans :

- **800-NXX plan :**

The first 6 digits of an 800 call are used to select the interexchange carrier (IXC).

- **800 database plan :**

The call is looked up in the database to determine the appropriate carrier & routing information.

### 3. **Alternate Billing Service & Line Information Database (ADB/LIDB)**

These services use the CCS network to enable the calling party to bill a call to a personal number (third party number, calling card, or collect etc.) from any number

### 4. **Performance of SS7**

1) Performance of signaling network is studied by connection set-up time (response time) or the end-to-end Signaling information transfer time. The delays in the signaling point (SP) and the STP depend on the specific hardware configuration & switching software implementation.

### 2) **Congestion control in SS7 networks:**

With the increase in subscribers it is important to avoid congestion in the signaling network under heavy traffic conditions.SS7 networking protocols provide several congestion control schemes, allowing traffic to avoid failed links & nodes.

**Q.4) a) Attempt any THREE of the following:**

**12 marks**

(i) State any four features of IMT 2000.

Ans: **(1 Mark –each feature)**

- It supports multiple environments such as cellular, cordless satellite LAN's.
- It provides global seamless roaming and service delivery across the INT 2000 networks.
- It supports the VHE (Virtual Home Entertainment) and UPT (Universal Personal telecommunication). It provides security and enhances performances.
- It provides global coverage by integrating the terrestrial and satellite systems.
- It provides 2 Mbps data rates for indoor environments. It makes use of Intelligent Networks capabilities.



(ii) State specifications for following parameter of GSM air interface

- |                               |                          |
|-------------------------------|--------------------------|
| 1) Forward channel frequency, | 3) No. of user per frame |
| 2) Frequency spacing,         | 4) Modulation technique  |

**Ans: (1 Mark for each correct answer)**

- Forward channel specification: 935-960MHz
- Frequency spacing: 45MHz
- No. of user per frame: 8
- Modulation technique: 0.3GMSK

(iii) State features of IS – 136 and IS – 95B. (any four).

**Ans: (2 Marks for four correct features)**

**The features of IS - 95B are:**

The interim data solution of CDMA is called IS-95B. Like GPRS, IS-95B is already being deployed worldwide, and provides high speed packet and circuit switched data access on a common CDMA radio channel by dedicating multiple orthogonal user channels (Walsh functions) for specific users and specific purposes.

- Each IS-95 CDMA radio channel supports up to 64 different user channels.
- The original IS-95 throughput rate specification of 9.6 kbps was not implemented in practice but was improved to the current rate of 14.4 kbps as specified in IS-95A.
- The 2.5G CDMA solution, IS-95B supports medium data rate (MDR) service by allowing a dedicated user to command up to 8 different user Walsh codes simultaneously and in parallel for an instantaneous throughput of 115.2 kbps per user ( $8 \times 14.4$  kbps)
- However, only about 64 kbps of practical throughput is available to a single user in IS-95B due to the slotting techniques of the air interface.
- IS-95B also specifies hard hand-off procedures that allow subscriber units to record different radio channels in the network without instructions from the switch so that the subscriber

**Features of IS-136: (2 Marks for four correct)**

- Time Slots per Channel: 6
- Users per Channel: 3 (full rate), 6 (half rate), 9 (future)
- Modulation: Digital: Pi/4 DQPSK, Nyquist Filter factor = 0.35
- Analog: FM
- Data Structure: TDMA
- Speech Coding: VSELP (vector sum excited linear predictive) 8 kbps
- Modulation Data Rate: 24,300 symbols per second (1 symbol = 2 bits)
- EIA/TIA Standards: IS-136.1 and IS-136.2 for system  
IS-137 for mobile stations  
IS-138 for base stations
- The Control Channels: IS-136 has both digital (DCCH) and analog (ACC) control channels. The ACC controls the analog transmissions and guarantees backward compatibility with systems such as AMPS and IS-54B.

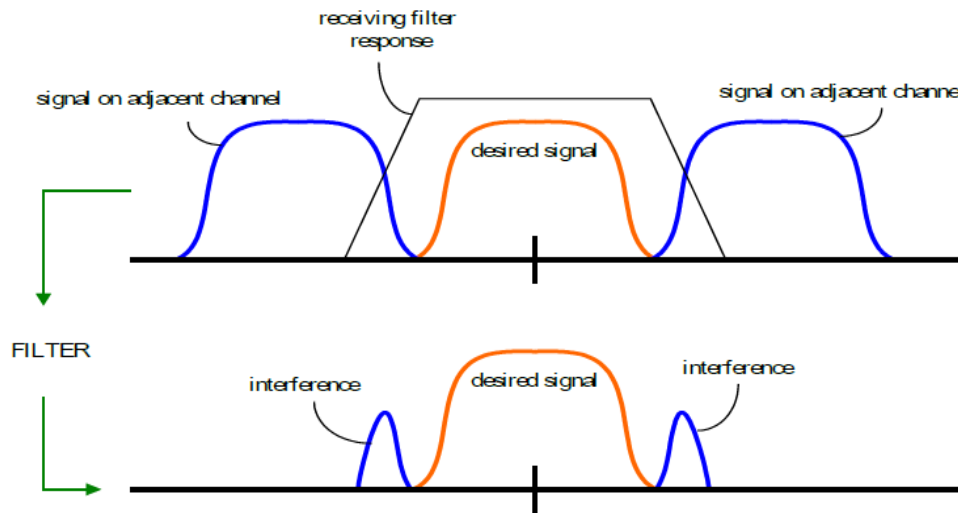
The DCCH controls digital transmissions and enables the specialized features of IS-136.

- Sleep mode for decreased battery usage during non-talk times.
- Short Message Service (SMS) for both point-to-point and broadcast information
- Greatly improved security (using DCCH and authentication)

(iv) Define the term adjacent channel interface. State methods to reduce it.

Ans: (2 Marks –Definition, 2 Marks –methods to reduce)

**Adjacent channel interference:** Interference resulting from signals which are close in frequency to the desired signal is called adjacent channel interference.



Adjacent channel interference results from imperfect receiver filters which allow nearby frequencies to leak in to pass band.

It is serious problem can be a particularly serious if an adjacent channel user is transmitting very close range to a subscribers receiver, while receiver attempts to receive a BS on the desired channel this is referred to as near far effect

**Next channel interference:**

Interference resulting from signal frequency which is immediately next to the desired signal frequency is called next channel interference.

Suppose the desired frequency of receiver is 90.3MHz. If it captures the frequency 91.3MHz transmitter then it results in next channel interference.

**To reduce the interference:** The adjacent channel interference can be reduced by

- 1) Careful filtering
  - 2) Careful channel assignment.
- There should be adequate frequency separation between the spectrums of the adjacent channels in a cell



- If the frequency reuse factor is large or cluster size is small the adjacent channel at the base station will be too close to each other in the frequency domain and this will increase the interference.

**Q 4 b) Attempt any ONE of the following:**

**6 marks**

(i) State the rule of Hand off Mechanism in cellular system. Compare hard hand off and soft hand off operational procedure. Define the term Delayed Handoff and Queued Handoff.

**Ans. Hand off Mechanism**

**(2 Marks)**

The mobile telephone switching office monitors the level of every signal in the cellular system.

If the strength of the signal diminishes then MTSO seeks new cell that can accommodate the better quality of communication.

MTSO makes this decision and transfer the call to a new frequency channel in a new cell site without either interrupting the call or altering the user.

In deciding when to hand off it is important to ensure that the drop in the measured signal level is not due to momentary fading and that the mobile is actually moving away from the serving base station.

In order to ensure this the Base station monitors the signal level for a certain period of time before a handoff is initiated.

**Hard Hand off (Operational Procedure)**

**(1 Mark)**

If a mobile station transmits between two base stations with different frequency assignments then it is called hard handoff. The handoff from one CDMA cell to another CDMA cell at different CDMA frequencies in a cellular system is called hard hand off

**Soft Hand off (Operational Procedure)**

**(1 Mark)**

The handoff from CDMA cell to CDMA cell at the same CDMA frequency is called soft hand off.

There is no need to change from one frequency to another frequency but change from one code to another code. The ability to select between the instantaneous received signals from a variety of base stations in a CDMA system is called soft hand off.

**Delayed Hand Off**

**(1 Mark)**

The hand off is necessary, when the level of the received signal becomes weak.

It is implemented with two level hand-off algorithms and the hand-off is requested after certain delay of time. This is called delayed hand-off. The main purpose of delaying in hand-off is to provide more opportunity for successful hand-off.

**Queued Hand off**

**(1 Mark)**

The MTSO will queue the requests of hand-off cells instead of rejecting them, if the new cell sites are busy or the call traffic is heavy. This operation is called as queuing or hand-off.

A queuing scheme becomes effective only when the requests for hand-off arrive at the MTSO in batches or bundles. If the hand off requests arrives at the MTSO uniformly, then the queuing system is not needed.





(ii) State characteristics of SS7. List out its features. State the meaning of signaling point, signal transfer point and signaling links of SS7.

**Ans. Characteristics of SS7 services: (2 points) (2 Marks)**

- 1) It is optimized for use in digital communication networks along with control exchanges that utilize 64kpbs digital channels.
- 2) It is designed for transfer of information reliably in a correct sequence without any loss or duplicate of information.
- 3) It is designed to satisfy the present and future requirements of information transfer for call control, management and maintenance.
- 4) It is suitable for operation over analog channels and at speed below 64kbps.
- 5) It is suitable for point terrestrial and satellite links.

**Features of SS7 (2 points) (2 Marks)**

- The control messages are routed through the network for different functions such as set up, maintenance management, termination etc.
- The control signaling is implemented using the packet switching technology network (PSTN).
- The mode used is associated channel mode but the use of disassociated mode is also possible.

**Important terms related to SS7 are explained below: (2Marks)**

**Signaling point:**

Any point in the signaling network which is capable of handling the SS7 control messages is called signaling point (SP)

It can be n end point for the control messages.

The circuit switching nodes of the network can be the end points.

**Signal transfer point:**

The signal transfer point is a type of signaling point.

It is capable of routing the control messages that means a message received on the signaling link is transferred to another unit.

It can be a purely routing node or it can also have functions of an end point.

**Signaling link:**

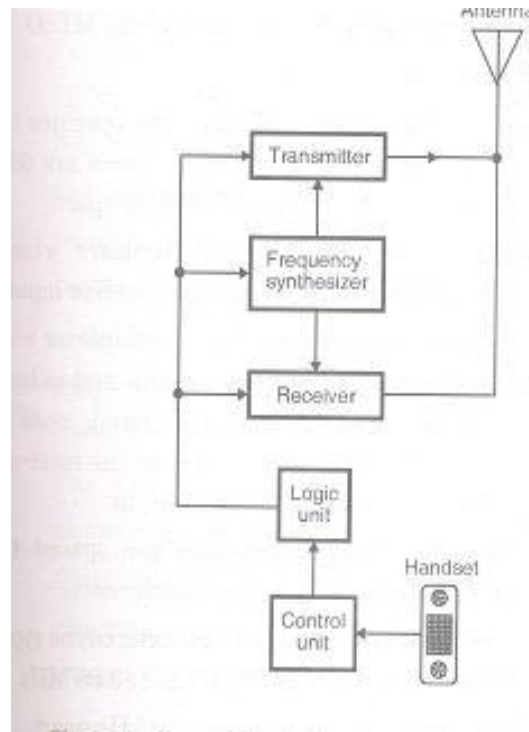
The signaling link is a data link that connects the signaling points.

Q5. Attempt any FOUR of following:

16 marks

a) Draw block diagram of mobile unit and state functions of each block.

Ans: (2 marks diagram and 2 marks function)



**Transmitter:** It is low power FM unit operating in the frequency range of 825 to 845MHz. There are 666, 30 KHz transmit channel. The carrier is furnished by a frequency synthesizer is a phase modulated by voice signal.

**Receiver:** The receiver is a dual conversion super heterodyne. The incoming signal frequency is down converted twice to frequency of 455KHz or 10.7MHz with the help of mixer and IF amplifier stages. The signal is then demodulated deemphasized and filtered and given to loud speaker.

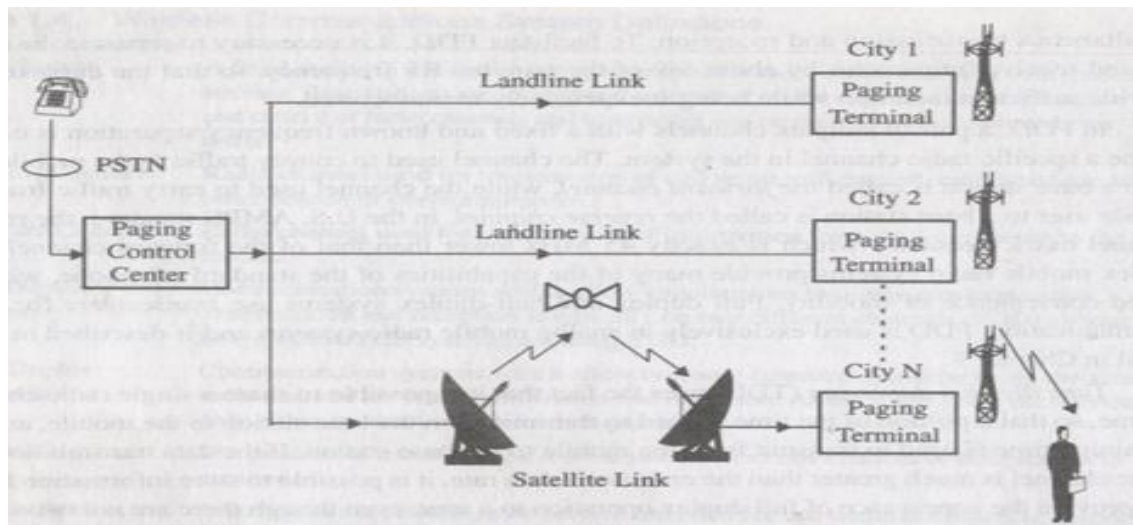
**Frequency Synthesizer:** This block generates all the signals used by transmitter and receivers. It uses standard PLL circuits and a mixer.

**Logic Unit:** This unit contains master control circuit for a cellular radio. It is made up of microprocessor with RAM and ROM and additional circuit used for interpreting signals from MSC and BS and generates control signal for the transmitter and receiver.

**Control unit:** The control unit contains the handset with speaker and microphone. The control unit is operated by a separate microprocessor that drives the LCD display and other indicators.

b) With block diagram write operation of paging system.

Ans: (diagram- 2 marks, operation- 2 marks)



- Pager is a Simplex Communication Device.
- Paging Systems are communication systems that send messages to a subscriber.
- Message can be numeric or alphanumeric.
- Paging Systems are used to notify a subscriber of the need to call a particular telephone number or to travel to a location to receive further instructions.
- In modern paging systems, news headlines, faxes can also be sent.
- A message is sent to a paging subscriber via the paging system access number with a telephone keypad or modem. The issued message is called a 'Page'.
- The paging system then transmits the page throughout the service area using base stations which broadcast the page on a radio carrier.
- The coverage area of a simple paging system ranges from 2 to 5 km while a wide paging system can have a worldwide coverage area.
- Whenever a sender wants to send a message to a receiver he dials the 10 digit pager number of receiver through his telephone.
- Then this call is accepted by the operator present in the paging control center to whom the receiver pager number and the message to be sent has to be sent.
- Then the operator will broadcast the message and the receiver paging number to all the paging terminals or the base stations.
- Then a particular base station under the area where the receiver is present will transmit the message to the receiver pager.
- Then the receiver's pager device will receive all messages and will verify whether the sender number is stored in its memory or not.
- If it is stored then the pager device will give beep which indicates the receiver that a message is sent by sender to his pager and the message will be displayed in the LCD.



c) List out any four features of IS- 95 CDMA system.

**Ans;- 1 mark –each feature (any four features)**

1. Diversity
2. Power control
3. Soft handoff
4. IS-95 system capacity
5. Soft capacity
6. Quality of service

**1. Diversity**

- The cellular system are having tendency to multipath fading and diversity methods of some are required to mitigate the effect of fading.
- Type of diversity in CDMA is:
  - Time diversity: - Provided by symbol interleaving, error detection& correction coding
  - Frequency diversity: - provided by 1.25MHz
  - Space (path) diversity: - Multipath signals accepted by Receiver

**2. Power control**

- For the CDMA system to work efficiently the RF power in the system need to be controlled.
- All the transmission from mobile must receive at base station receiver at approximately the same strength (within 1dB).
- To maximize the no. of users sharing a cell, only minimum RF power required for reliable communication.

**3. Soft handoff**

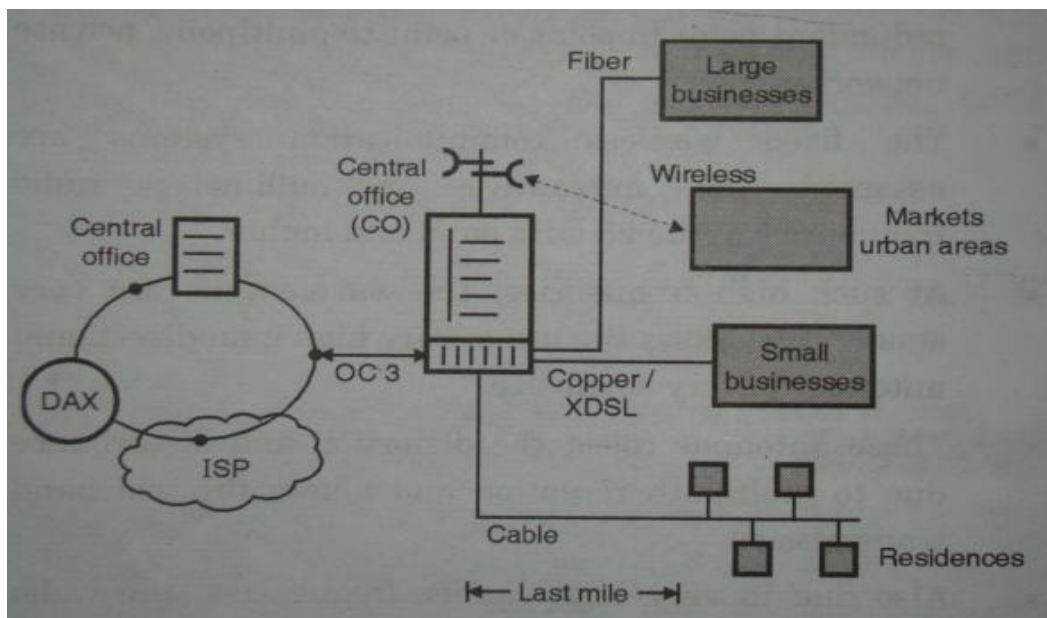
- The soft handoff in a CDMA system results from system capability to simultaneously deliver signal to mobile through more than one cell.

**4. System capacity**

- Key parameters that determine capacity of CDMA are as follow:
  - Processing gain ratio of spreading code information data rate (W/R).
  - Ratio of energy per bit to noise power (Eb/No)
  - Voice activity factor

d) Sketch architecture of WLL system and list its advantages.

Ans: (architecture -2 marks, advantages -2 marks)



**Advantages of WLL: (any two)**

1. High bandwidth is available
2. Faster deployment
3. Lower deployment costs
4. Lower network maintenance, management and operating cost.

e) Write the concept of Ad-hoc mobile communication for 4G.

Ans: (concept - 4 marks)

1. Ad-hoc wireless network is a collection of two or more devices equipped with wireless communications and networking capability. Such devices can communicate with another node that is immediately within their radio range or one that is outside their radio range.
2. An ad hoc wireless network is self-organizing and adaptive. This means that a formed network can be de-formed on-the-fly without need for any system administration. The term “ad-hoc” tends to imply “can take different forms” and “can be mobile, standalone, or networked”.
3. As mobile devices can exist in many forms. There are great differences among these devices which can affect communication performance and design of communication protocols.
4. The ability of an ad hoc mobile device to act as a server or service provider will depend on its computation, memory, and storage and battery life capacity.
5. The presence of heterogeneity implies that some devices are more powerful than others, and some can be servers while others can only be clients.

f) Define forward voice channel, reverse voice channel, micro cell, and repeater.

Ans: (each correct definition – 1 mark)

**Forward Voice Channel** – Radio channel used for voice transmission from the base station to the mobile.

**Reverse Voice Channel** – Radio channel used for voice transmission from mobile to the base station.

**Micro cell** – A small geographic coverage area of a base station with the diameter less than 2 km each of which is allocated a number of RF channels is called a microcell.

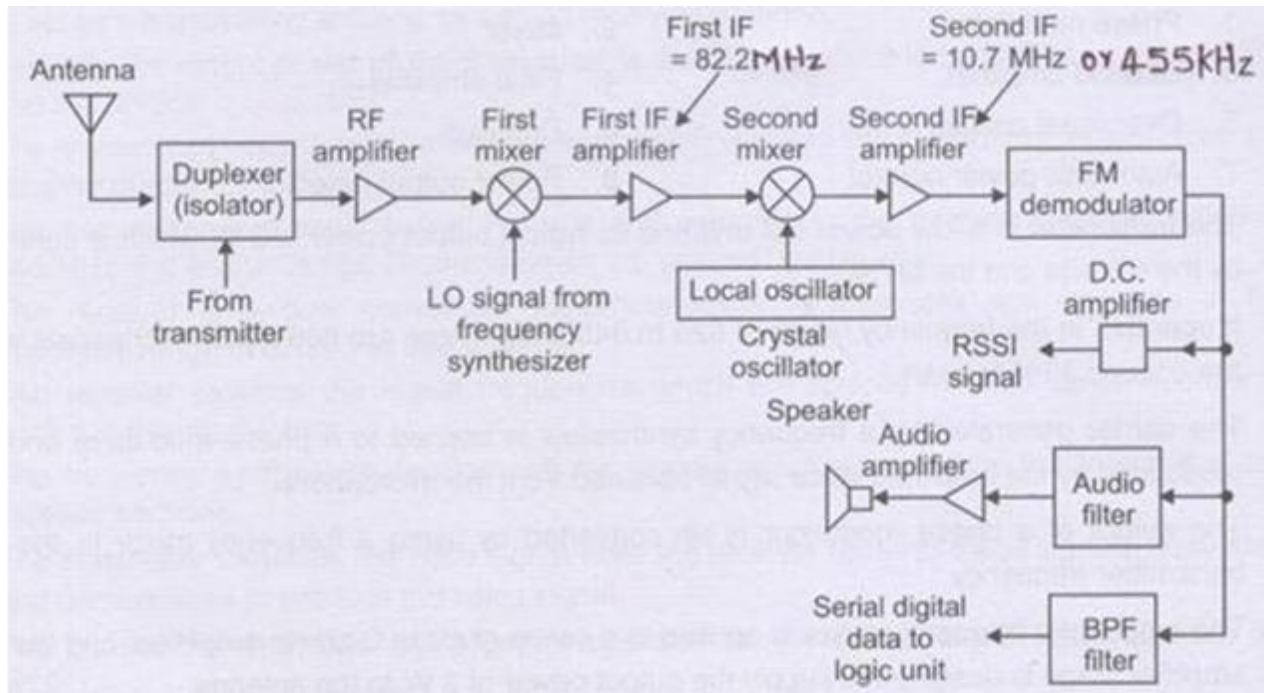
**Repeater** – The radio transmitter often used repeatedly to improve the extension of range in radio communication is called repeater.

**Q 6. Attempt any FOUR of the following:**

**16 marks**

a) State working principle of receiver of mobile unit. State significance of RSSI signal.

Ans: (diagram 2 mark, operation 1 mark, 1 mark significance)



The receiver unit of a mobile unit is a dual conversion super heterodyne receiver operated in the frequency range 870.03 to 889.98MHz, providing 666 receive channels space 30 kHz apart. The input signal from the antenna is isolated from the output stage of transmitter with the help of duplexer. The duplexer will connect the received signal only to the cellular receiver unit.

The output of duplexer is given to RF amplifier which boosts the level of input signal to a sufficient value, which is applied to first mixer.

The second input to mixer-1 is local oscillator-1 signal obtained from the frequency synthesizer.

The first mixer will down convert the incoming signal to produce the first IF which is equal to 82.2MHz. For some receivers this value is 45MHz.

This signal passes through the first IF amplifier where is sufficiently amplified and applied to second mixer.

The local oscillator for second mixer is a crystal oscillator. The second down conversion takes place at second mixer and produce IF of 10.7MHz or 455 kHz.

This signal is amplified by 2nd IF amplifier and demodulated by the FM demodulator to get the voice signal.

The demodulated voice signal is de-emphasized, filtered, amplified and then applied to the loud speaker for sound production.

**Significance of RSSI:** It is a measurement of the power present in a received radio signal. The RSSI signal is sent back to cell site so that MTSO can monitor the received signal from the cell and make decision about hand off.

b) For IS-95, list out channel specification, state information available on forward traffic channel.

Ans: (**Specification - 2 marks, information available - 2 marks**)

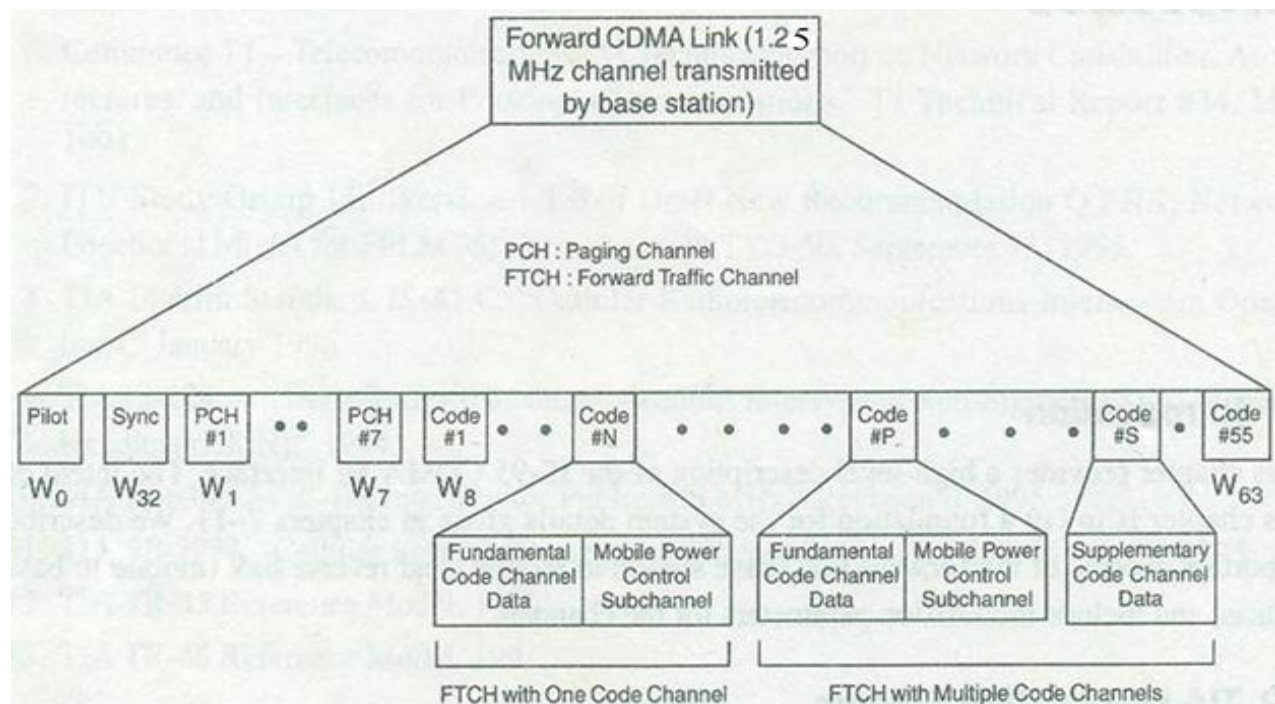
**Channel specifications:**

Forward link frequency - 869 to 894 MHz

Reverse link frequency - 824 to 894 MHz

The maximum user data rate is 9.6 kbps

It uses spread spectrum technology.



- Information on the forward traffic channel includes
  - 1) the primary traffic (voice and data)
  - 2) secondary traffic (data) and
  - 3) signaling

c) State any four features of Bluetooth and PAN.

Ans: (Note PAN and Bluetooth will carry common features)

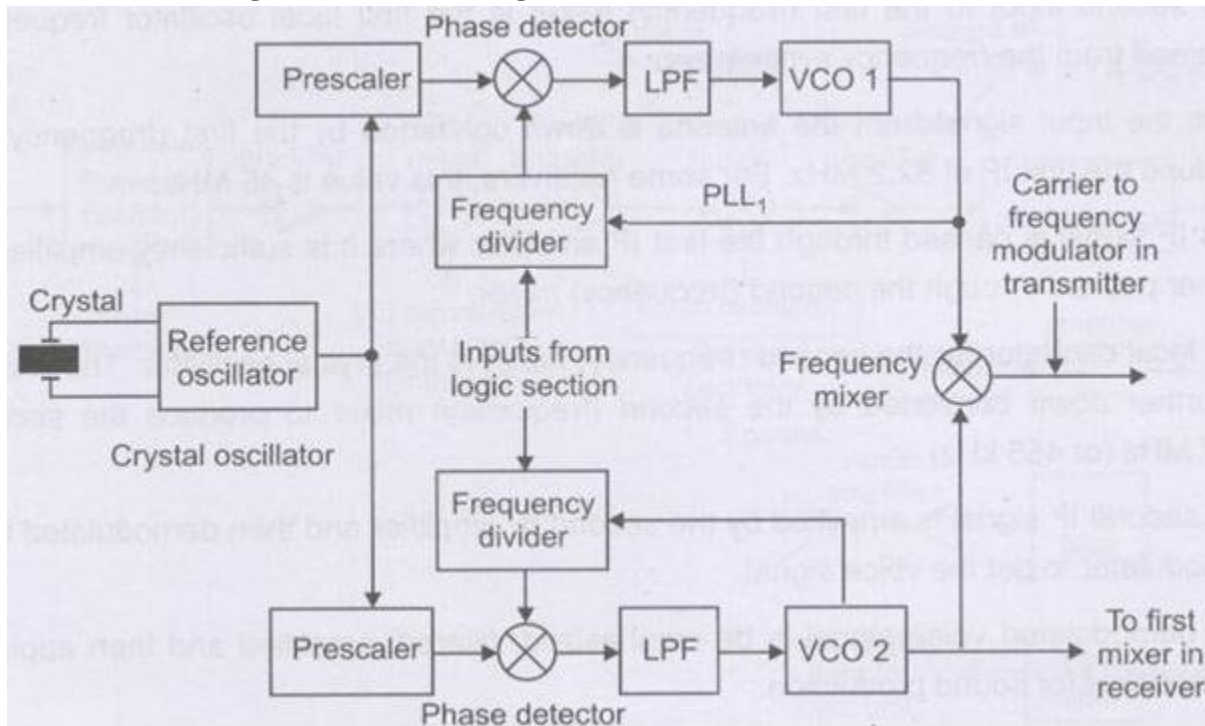
**(2 marks – Bluetooth, 2 marks – PAN)**

➤ PAN is a networking feature of Bluetooth-enabled devices.

1. Each Bluetooth device has the capability of sharing all of its features with other Bluetooth devices in the surrounding area.
2. For example, a Bluetooth phone can share information with a Bluetooth-enabled computer or printer, just like one Bluetooth-enabled computer can link to another
3. Bluetooth-enabled computer, sharing all the features, such as the Internet.
4. Bluetooth devices can communicate at ranges of up to 10 meters.
5. Bluetooth devices do not need to be in direct sight of each other.

d) For mobile unit, how many signals are obtained from frequency synthesizer? State the use of these signals. Why their frequency shall be different?

Ans: (2 marks diagram, 1 mark for signals, 1 mark for reason)



Two signals are obtained from frequency synthesizer.

1. Carrier to frequency modulator in transmitter
2. to first mixer in receiver.

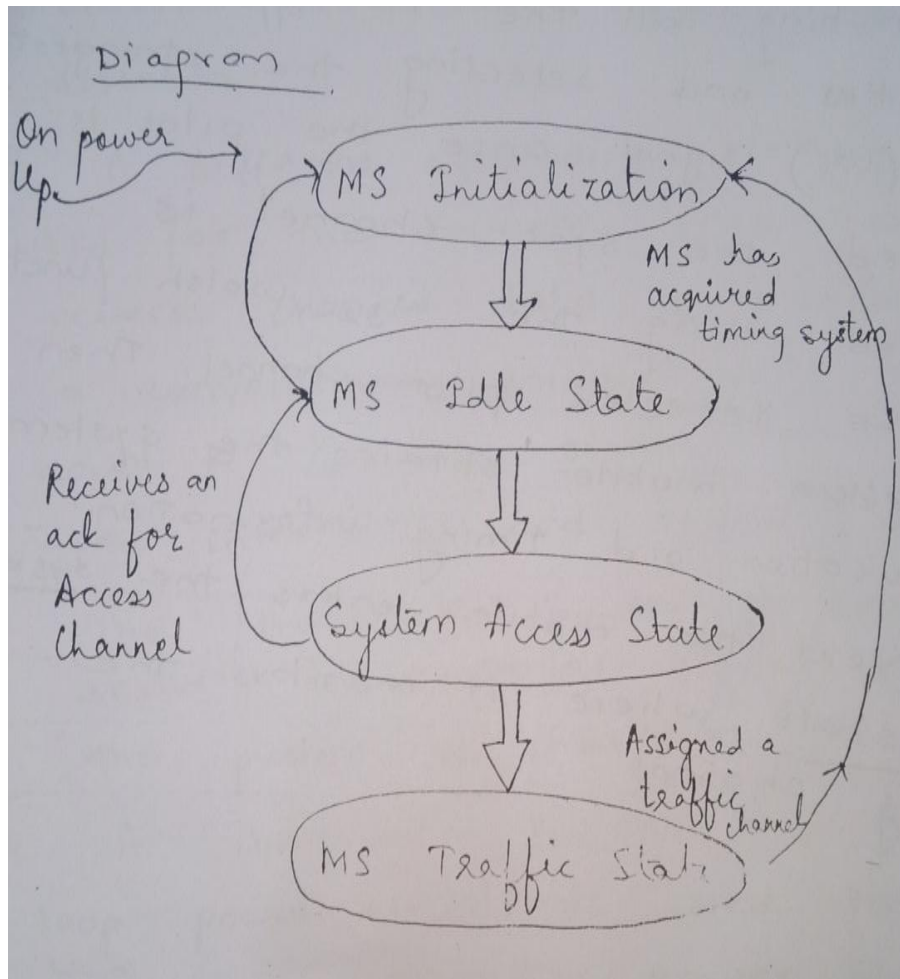
Frequencies should be different to ensure full duplex system and to avoid interference.

It is also useful to use single antenna in mobile handset.



e) For IS-95 write the meaning and their sequence of following: call processing state, system access state, system idle state, traffic channel state, system initialization state.

Ans: (1- mark diagram, 3 marks explanation)



**Call Processing Operation:**

The operation of call processing in IS-95 CDMA system is as follows:

d) System initialization state:

- The mobile acquires a pilot channel of a CDMA system.
- It searches all the PN offset possibilities and selects the strongest pilot signal.
- It acquires the synchronization channel and detects the pilot channels.
- It obtains the system configuration and timing information for the CDMA system.

ii) System idle state:

- The mobile performs the monitoring procedure of paging channel.
- It transmits an acknowledgement in the response to any message received that addressed to this mobile.
- It also maintains all active registration timers.



e) System access state:

- If cell is being placed or received by the mobile it enters into the access, it exchange the necessary parameters.
- The mobile transmit its response messages or request message to the base station on the access channel and receives the message from the base station on the paging channel.
- Similarly the base station transmits its messages to the mobile, the paging channel and receive message from the mobile on the access channel.
- The entire process of transmitting one message and receiving an acknowledgement for that message is called an access attempt .the access attempt ends after an acknowledgement is received.

f) Traffic channel state:

- If the access attempt is successful, then the mobile enters into the last state called as traffic state in which the transactions of voice and data take places.
- The mobile station communicates with the base station using forward and reverse traffic channels.