MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

Summer 16 EXAMINATIONS

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 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.

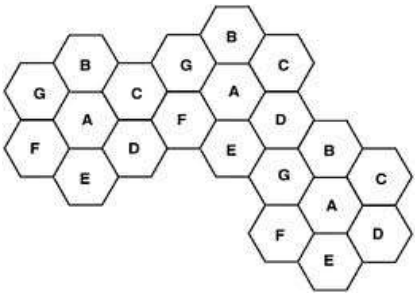
Q.1 a) Attempt any THREE of the following **12 marks**

1) Describe the concept of frequency reuse in cellular systems. Define cluster. Draw frequency reuse pattern for cluster size 7.

Ans. (1 mark concept, 1 mark definition, 2 marks diagram)
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 neighbouring 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.

Cluster: The number of cells that collectively use all the available frequencies is called a cluster. It is denoted by letter N.

Frequency Reuse pattern for cluster size 7



2) List following specifications of IS-95B 2.5 generation Standard.

i) channel bandwidth

ii) No of voice channels.

iii) Duplexing Tech.

iv) Data Rate.

Ans. **(1 mark each specification)**

Channel Bandwidth:1.25MHz

No. of voice channels: 64 user channels

Duplexing technique: FDD

Data Rate :115kbps

3) State Various 2.5 generations cellular standards based on TDMA and CDMA. State whether they are backward Compatible with second generation (2G) standard.

Ans: (2 marks list,2 marks state compatibility)

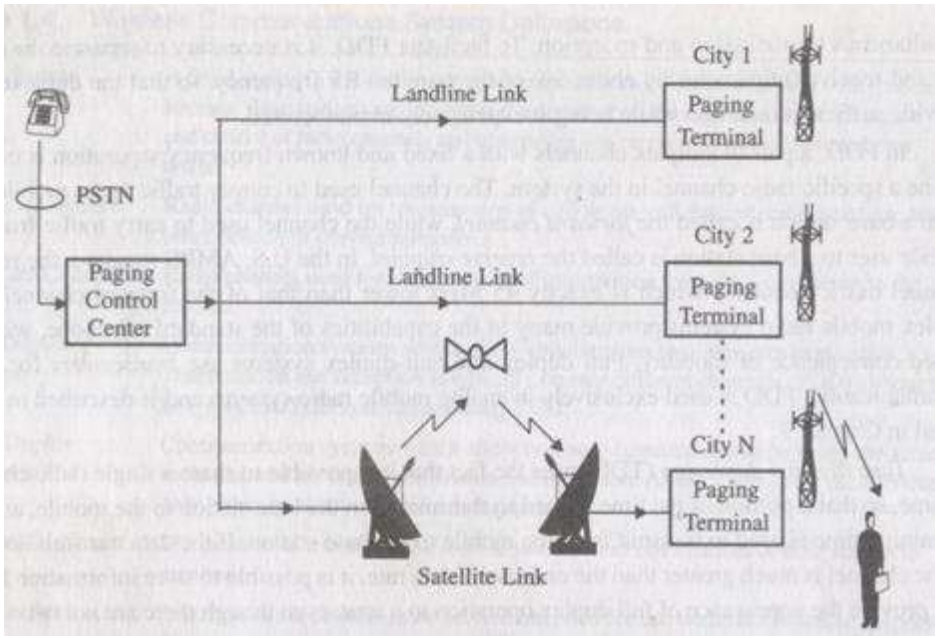
HSCSD FOR 2.5 G GSM -Backward compatible to GSM

GPRS FOR 2.5 G GSM and IS136-- Backward compatible to GSM

EDGE for 2.5G GSM and IS136-- Backward compatible to GSM

IS-95B for CDMA-- Backward compatible to IS-95A

4) **Ill**ustrate the operation of Radio paging system and state its main drawback.
Ans. (2 marks operation, 1 mark drawback, 1 mark diagram)



- 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.

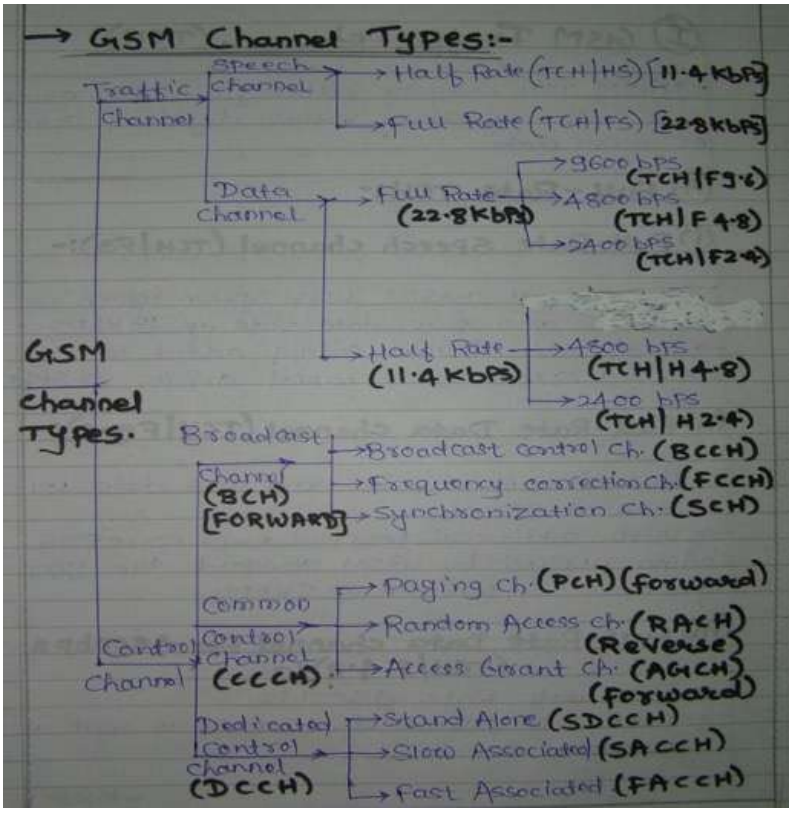
- Whenever a sender wants to send a message to a receiver he dials the 10 digit pager number of receiver through his telephone.
- Then this call is accepted by the operator present in the paging control center to whom the receiver pager number and the message to be sent has to be sent.
- Then the operator 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.

Drawbacks:
Since paging covers a limited range ,the capacity is less.
Paging is a simplex communication so are used for one way communication.

Q. 1 b) Attempt any ONE of the following **6 marks**

1) Draw GSM logical channel structure. Describe in detail GSM traffic channels .

Ans. (2 marks diagram, 4 marks explanation)



1) GSM traffic channel (TCH)

GSM TCH may be wither full rate or half rate and may carry either digitized speech or user data.

(a) Full rate TCH:

(I) **Full rate speech channel (TCH/FS):** This channel carries user speech which is digitized at a raw data rate if 13kbps. With GSM channel coding added to the digitized speech, this channel carries 22.8kbps.

(II) **Full rate data channel for 9600 bps(TCH/F9.6):** This channel carries raw user data which is sent at 9600bps. With additional forward error correction coding applied by GSM standard the 9600bps data is sent at 22.8kbps.

(III) Full rate data channel for 4800bps(TCH/F4.8)

(IV) Full rate data channel for 2400bps (TCH/F2.4)

(b) Half rate TCH:

(I) **Half rate speech channel (TCH/HS):** This channel has been designed to carry digitized speech which is sampled at half rate of 6.5kbps. with GSM channel coding added to the digitized speech the half rate speech channel will carry 11.4kbps.

(II) **Half rate data channel for 4800bps (TCH/H4.8):** This channel carries raw user data which is sent at 4800bps. With additional forward error correction coding applied by GSM, this channel will carry data at 11.4kbps.

(III) Half rate data channel for 2400bps (TCH/H2.4)

2) **Illustrate with the help of neat timing diagram , the process of call initiation from mobile handset to a landline phone (PSTN) using timing diagram**.

Ans: (2 marks diagram, 4 marks explanation)

- A call initiation request is sent on the reverse control channel (RCC).
- Mobile unit transmits its telephone number (MIN), Electronic Serial Number (ESN), Station Class Mark (SCM) which indicates power level and telephone number of called party.
- The cell BS receives this information and sends it to MSC.
- The MSC validates the request, makes connection to called party through the PSTN.
- MSC instructs BS and mobile user to move to an unused voice channel pair to allow the conversation to begin.

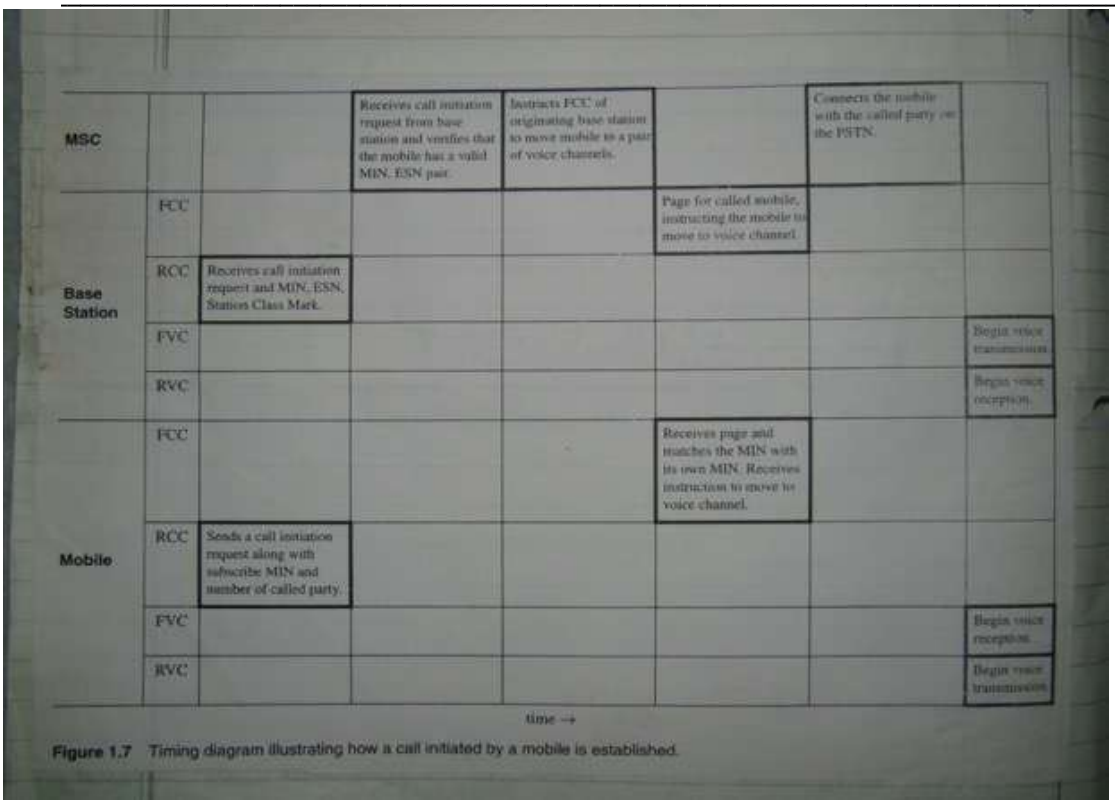
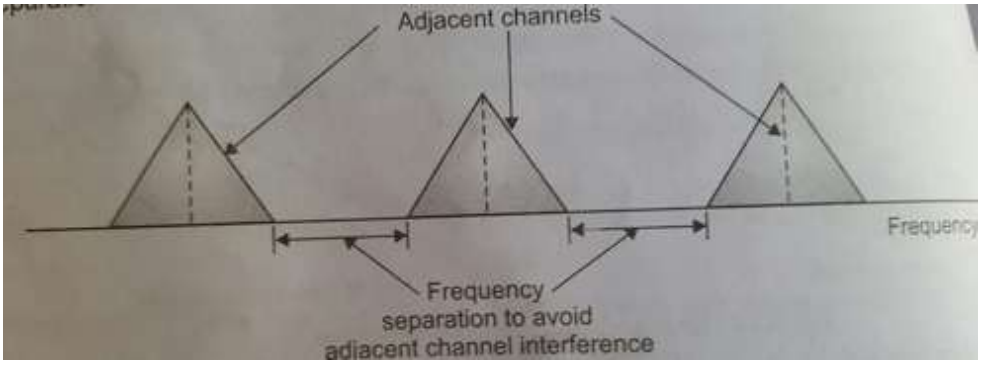


Figure 1.7 Timing diagram illustrating how a call initiated by a mobile is established.

Q.2 Attempt any four of the following **16 marks**

a) Describe adjacent channel interference in cellular system with the help of appropriate diagram. How it can be minimized ?

Ans: (1 mark diagram, 3 marks description)



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 adjacentchannels 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.

b) List the following parameters of 3G-TD-SCDMA system. (any four)

(1) Bandwidth

(2) Data Rate

(3) Multiple Access

(4) Backward Compatibility

(5) Developed by

Ans: (1 mark each parameter)

(1) Bandwidth: 1.6MHZ

(2) Data Rate: Up to 384kbps of packet data rate,

(3) Multiple Access: Time division synchronous code division multiple access technology.

(4) Backward Compatibility: GSM

(5) Developed by: China academy at telecomm (CATT) and seimens corporation jointly developed.

c) State any Four features of Third Generation (3G) Standard systems and list various 3G standards.

Ans: (½ mark each feature, ½ mark each 3G standard)

Features of Third generation (3G) standard system:

- Multi-megabit internet access.
- Voice activated cells.
- Unparalleled network capacity.
- Ubiquitous " always on" access.

- Communications using voice over internet protocol.

Various 3G standards are:

(1) W-CDMA

(2) IMT 2000

(3) CDMA 2000

(4) TDSCDMA

d) Compare GPRS Standard with IS-95-B Stand w.r.t.

(1) Backward Compatiblity

(2) Channel Bandwidth

(3) Data Rate

(4) Number of voice channels .

Ans: (1 mark each parameter)

Parameters	GPRS Standard	IS-95-B stand
Backward Compatiblity	GSM	IS95
Channel Bandwidth	200KHZ	1.25MHZ
Data Rate	171.2kbps	14.4kbps
Number of voice channels	8 per carrier	64 user channels

e) State any four specifications of Personal Area network (PAN).

Ans: (1 mark each specification)

Parameter	Specification
speed	720 kbps
Frequency range	2.4 GHz ISM band
Duplexing method	TDD
Modulation Technique	GFSK
Channel B.W	1 MHz

Ans: (1 mark each specification)

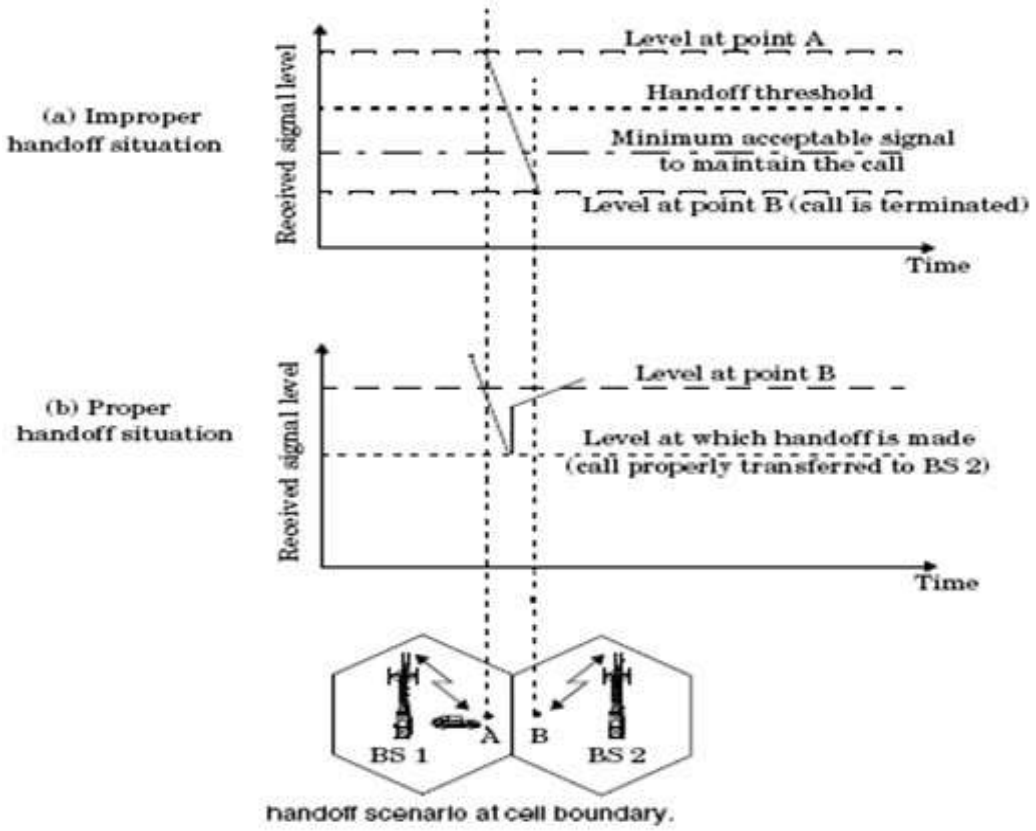
f) Illustrate with the help of neat figure proper and improper hand-off procedure.

Ans: (2 mark diagram, 2 marks explanation)

Handoff -When a mobile moves into a different cell while a conversation is in progress, the MSC automatically transfers the call to a new channel belonging to the new base station. This process of transferring call to a new base station is called as Hand off.

Explanation

- The term hand-off does not mean a physical change in the assigned channel but rather than a different base station handles the radio communication task.
- Hand-off is a process of automatically transferring the call to a new frequency channel belonging to a new base station, when the cellular mobile phone moves into a different frequency zone so that the conversation can be continued in a new frequency zone without dialing.
- The processing of hand-off is an important task in a cellular telephone system.
- In the hand-off strategies higher priority is given to the hand-off request than the call initiation request in the cellular system.
- The procedure of hand-off should be performed successfully and it should not be repeated frequently.
- The system designers must specify the optimum signal level at which the hand-off is to be initiated.
- The minimum signal level Pr, minimum is first decided for maintaining the call. Then the slightly stronger signal levels used as a hand-off Pr, threshold for maintaining the call.
- The difference between these two levels of the signal is denoted by a symbol delta, Δ and it is given by: Δ= Pr, threshold- Pr, minimum
- As the value of delta is very critical, it should not be too small or too large.
- If the value of delta is too small, then the call may lost due to weak signal and if the value of delta is too large ,then unnecessary hand-off may take place at any time.
- Before initiating the hand-off, it is always necessary to ensure that the reduction in the measured signal level is not due to the momentary signal fading and that the mobile is actually moving.
- Hence from above explanation, the value of Δ should not be too small or too large because only then handoff will be done at proper signal level.



handoff scenario at cell boundary.

Q.3) Attempt any four of the following **16 marks**

a) Define the following terms with respect to cellular system.

(1) Mobile station

(2) Base station

(3) Forward Channel

(4) Control Channel

Ans: (1 mark each definition)

1) Mobile station: It is defined as a station in the cellular radio service which is used when in motion at an unspecified location. Mobile stations may be held- held personal units (portables) or installed in vehicles (mobiles).

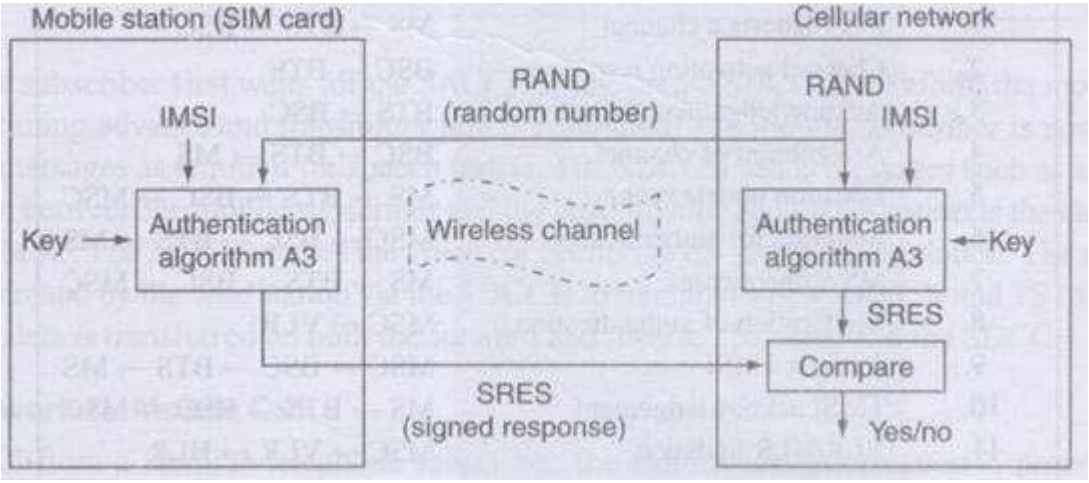
2) Base station: A fixed station in a mobile radio system used for radio communication with mobile stations. Stations are located at the center or on the edge of a coverage region and consists of radio and transmitter and receiver antennas mounted on a tower.

3) Forward Channel – Radio channel used for transmission of information from the base station to the mobile.

4) Control channel :It is defined as the radio channel used for the transmission of beacons such as call set up, call request, call initiation etc.

b) Explain authentication process in GSM system with help of appropriate sketch.

Ans: (2 marks diagram, 2 marks explanation)



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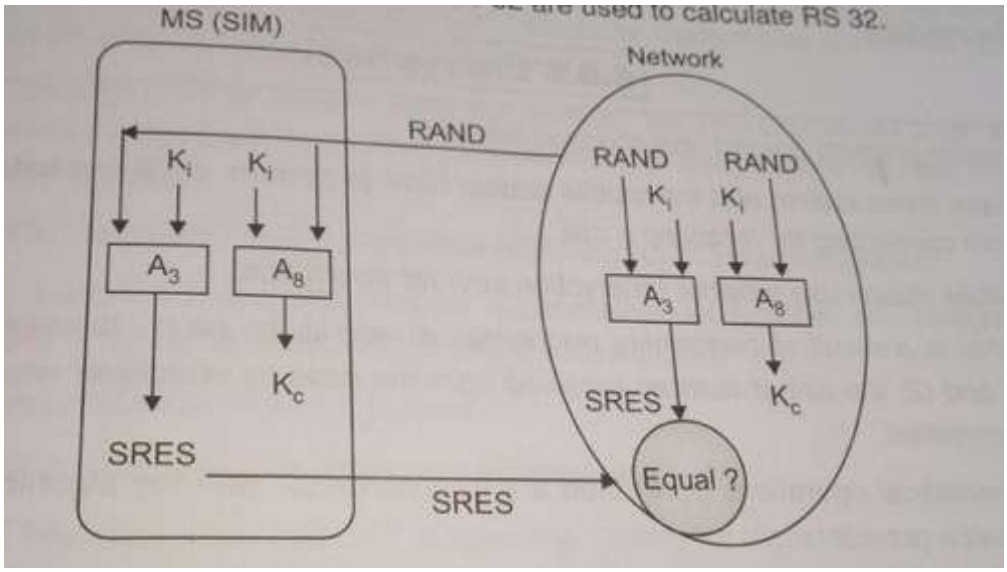


Explanation

Authentication refers to process by which station confirms the identity of mobile station. It protects GSM network against unauthorized access.

The Authentication Centre is responsible for all security aspects. The AUC generates the Ki"s associates them with IMSI and provides for each IMSI a set of triplets consisting of **RAND (Random Number), SERS (signed Response), Kc (Cipher key)**

Authentication center first authenticate the subscriber mobile station and only then MSC provides service.

At MS- SIM contains the entire authentication data along with A3 and A8 algorithm and signed response is generated using this.

At network side signed response is generated using same algorithm and random number and if both the signed response matches then mobile phone authenticated.

c) State four ways to improve capacity and coverage in cellular system . Describe how repeaters are used for range extension.

Ans: (1 mark 4 methods, 3 marks explanation)

Four ways to improve capacity and coverage are:

1.Microzone cell concept

2.Cell sectoring

3.Cell spltting

4.Repeaters

Repeaters are used for range extension.

- It is often necessary to provide the dedicated coverage of the cellular mobile radio system. for *hard-to-reach* areas, such as within building or in valleys or in tunnels.
- The radio retransmitters known as repeaters, are often used to provide such range extension capabilities. The repeaters are bidirectional in nature.
- They simultaneously send signals to and receive signals from a base station.
- The repeaters work using over the air-signals so that they may be installed anywhere and are capable of repeating an entire Cellular or Personal Communication (PCS) band.
- The repeater amplifier's and reradiates the base signal, signals to the specific coverage region after receiving signals from a base station forward link.
- At the same time, the received nose and interference are also reradiated by the repeater on both the forward and reverse links.
- Therefore we must takes proper care to place the repeaters properly and to adjust the various forward and reverse link amplifier levels and antenna patterns properly.
- In practice, the directional antennas or Distributed Antenna Systems (DAS) are connected to the inputs or outputs of repeaters for localized spot coverage, particularly in tunnels or buildings.
- The repeater does not add capacity to the cellular system, but it simply serves to reradiate the base station signal into specific locations.
- The repeaters are increasingly used to provide coverage into and around buildings, where coverage has been traditionally weak.

d) State any four specifications of UMTS .

Ans: (1 mark each specification) (any 4 specifications)

Specifications of UMTS are:

1. It is more robust for multipath delays.
2. It provides higher immunity towards frequency selective fading.
3. It has very high packet data rates of 2.048Mbps.
4. It has very high channel bandwidth of 5 MHz.
5. It has backward compatibility with the GSM systems.
6. It has high frame structure of 16 slots per frame.
7. It gives signals of higher voice and data quality and also small bit-error rates.
8. It has a common world-wide spectrum band.
9. It can operate in multiple radio environments such as cellular, cordless, satellite, LAN etc.
10. It has a wide range of telecommunication services such as voice, data, multimedia, internet etc.
11. It has global seamless connectivity (roaming).

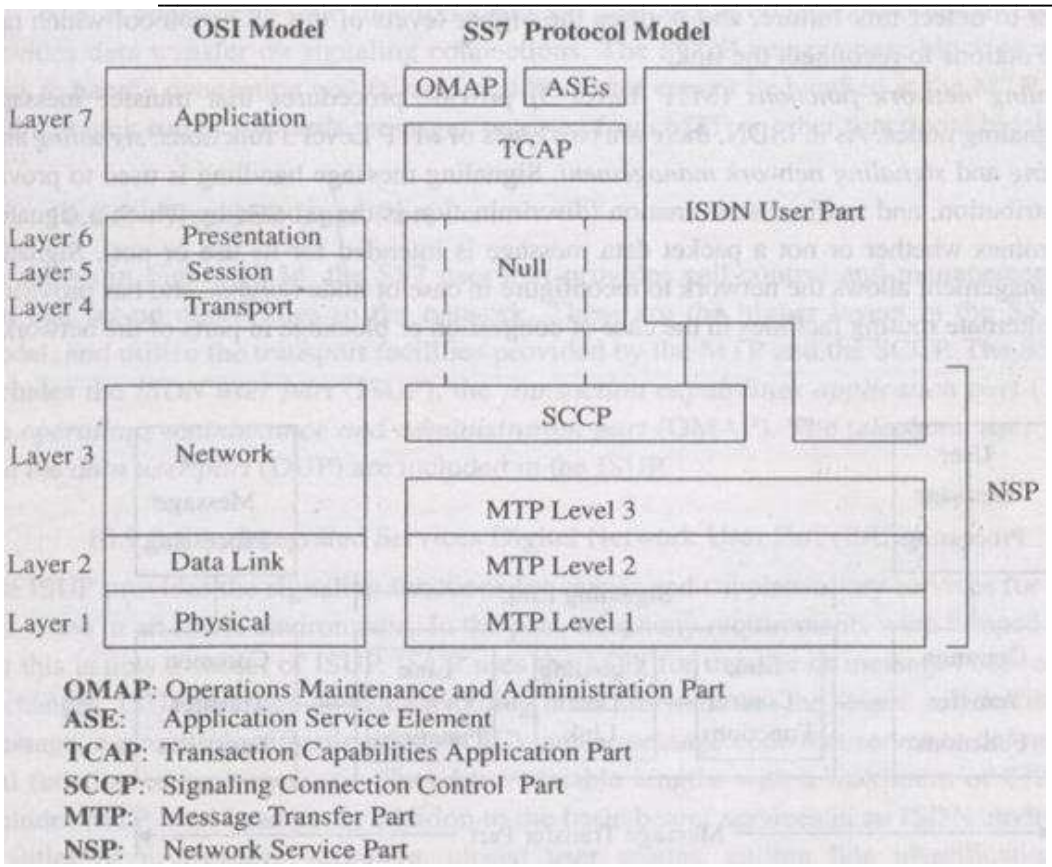
e) State the concept of signaling system No. 7 (SS7).Draw architecture of SS7 for NSP of the protocol. (Only lower three layers of OSI model).

Ans: The signaling system SS7 is an out of band signaling method in which the common data channel is used to convey signaling information related to a large number of trunks(voice and data).

The signaling has traditionally supported the following functions:

1. Supervisory functions eg. On hook/off hook to indicate idle or busy status.
2. Addressing function eg. Called number.
3. Calling information eg. Dial tone and busy signals.

The introduction of electronic processors in switching systems made it possible to provide common channel signaling.



Q.4a) Attempt any three of the following: 12 marks

(1) State the significance of IMT-2000. State vision of IMT-2000. (four points).

Ans:(2 mark significance,1/2 mark each vision- 4 points)

Significance:

The rapidly growing internet enviorment and the service requirement in telecommunication services requires support for assymetric ,interactive ,multimedia traffic based on high speed packet data transport. It is therefore necessary to recognize international or global standards for mobile telecommunication to ensure seamless global mobility and service delivery as well as integrating the wireline and wireless network to provide telecomm. Services transparent to the users.

IMT 2000 is that global standard to satisfy market demand for mobile services in the ewnty first century.

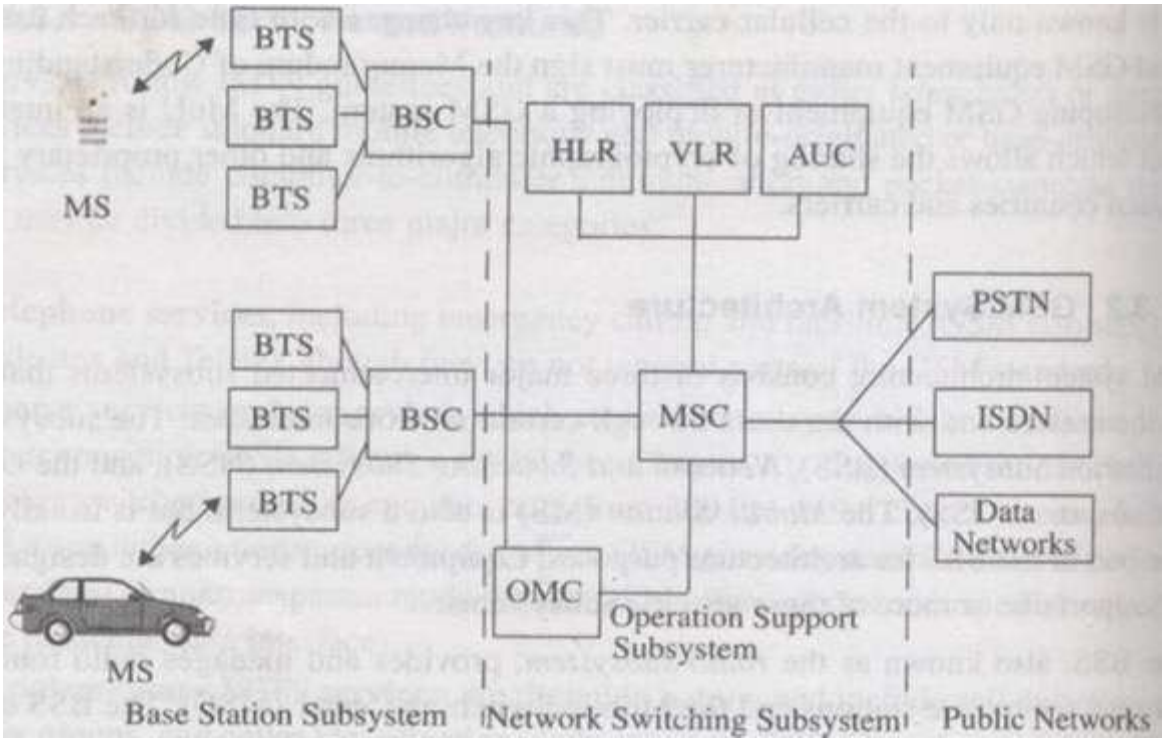
The vision of IMT 2000 are as follows:

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.

3) Draw GSM system architecture and explain function of HLR and OMC units .



Function of Operation maintenance center (OMC)

- Network operation and maintenance functions, subscription, management including charging and billing and also mobile equipment management.
- The OMC also has provision for adjusting all base station parameter and billing procedure as well as providing system operators with the ability to determine the performance and integrity of all equipment's in the system.

Function of Home Location Register:

- Each subscriber assigned IMSI to identify home user.
- Database contains IMSI ,prepaid/postpaid, roaming restrictions, supplementary services.
- Database contain subscriber and location information.
- Permanent database about mobile subscription in a large service area.

(3) List the following specifications of IS-136 standard .

1) Frequency Spectrum
2) Channel Bandwidth

3) Data Rate

4) Modulation Technique

Ans: (1 mark each specification)

1) Frequency Spectrum :Uplink 800 MHz,1500MHz

Downlink 869-894MHz

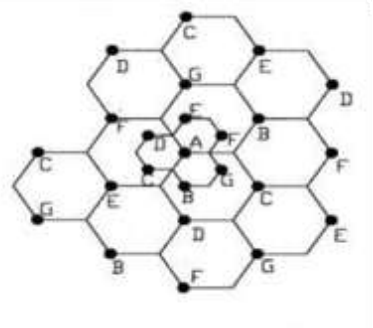
2) Channel Bandwidth :30KHz

3) Data Rate :24,300 symbols per second.

4) Modulation Technique : Π/4 DQPSK

(4) Describe cell Splitting technique with help of neat sketch . How it increases system capacity ?

Ans: (1 mark diagram,3 marks explanation)



Concept:

- The cell splitting achieve the capacity improvement by essentially rescaling the cellular system
- By decreasing the cell radius R and keeping the co-channel reuse ratio D/R unchanged, cell splitting increases the number of channels per unit area
- The cell splitting is the process of subdividing a congested cell into small cells with its own base station having the corresponding reduction in the antenna heights and the transmitted power

Cell splitting helps in increasing system capacity:

- 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.

b) Attempt any one of the following 6 marks

(1) Draw basic cellular system . State advantages of Cellular system and define :

1) frequency reuse and
2) frequency reuse ratio

Ans: (1 mark diagram,1mark advantages,1 mark each definition)

Advantages of cellular system:

It covers a large geographic area so the capacity is more.

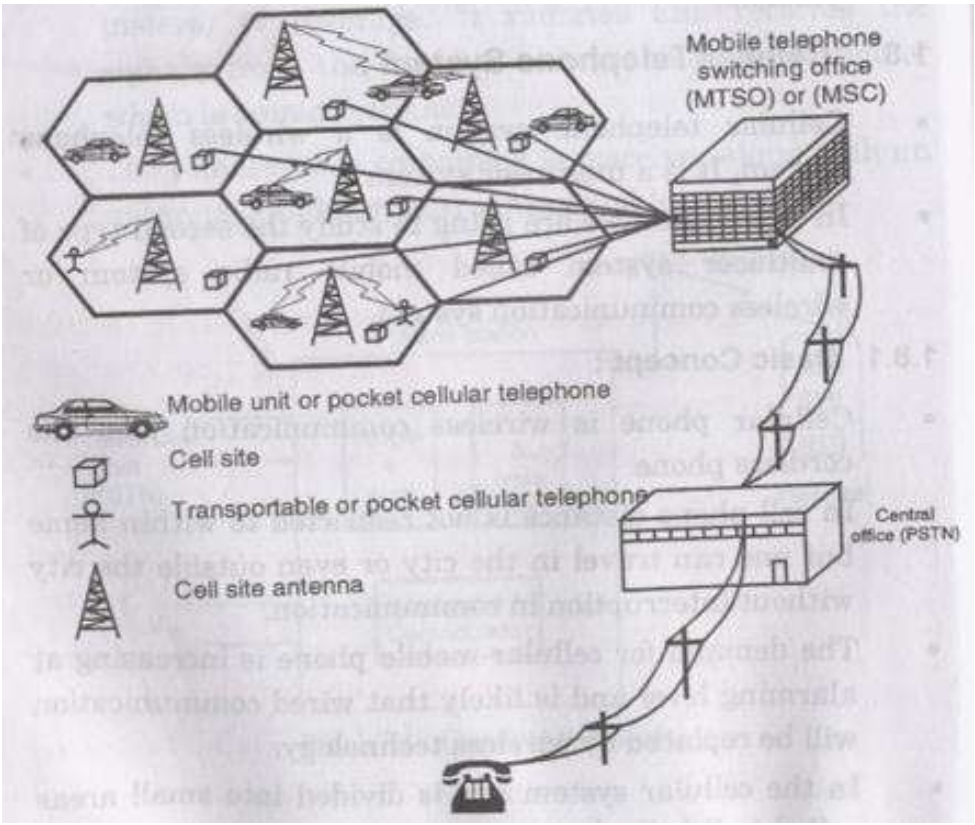
It has large number of users in limited frequency spectrum.

I t provides a very high quality service that is often comparable to that of load line telephone systems

It provides internet services .additional services like video conferencing etc.

Frequency Reuse: The design process of selecting and allocating RF channel group for all of the cellular base station within a cellular system is known as frequency reuse.

Frequency Reuse Ratio: The reciprocal of the cluster size (N) in a cellular system is called as Frequency reuse ratio.Frequency reuse ratio=1. It should be as large as possible.



2) State and explain the three services offered by GSM system.

Ans: (1 mark state,3marks –explain)

The three services offered by GSM systems are;

Telephone services

Bearer services

Supplementary ISDN services

Telephone Services:

Teleservices include

- Standard mobile telephone
- Mobile-originated
- Base-originated traffic.
- emergency calling
- Fax
- Videotext
- Tele text,
- SMS
- MMS.

Supplementary ISDN services:

This service are digital in nature and include

- Call diversion
- Caller line ID
- Closed user group
- Call barring
- Call waiting
- Call hold
- Connected line ID
- Multiparty (Teleconferencing)
- Call charge advice
- This service also include the Short Messaging Service (SMS) which allow GSM subscriber and BS to transmit alphanumeric pages of limited length (160 -7 ASCII characters) while simultaneously carrying normal voice traffic.

Bearer services :
The data services include the communication between computers and packet switched traffic These services are limited to the first three layers of the OSI reference model.

5. Attempt any FOUR of the following : (16 marks)

a) Identify the given block diagram and name the blocks. A,B, and C. State the function of

Identified block diagram.(Refer Figure No .1)

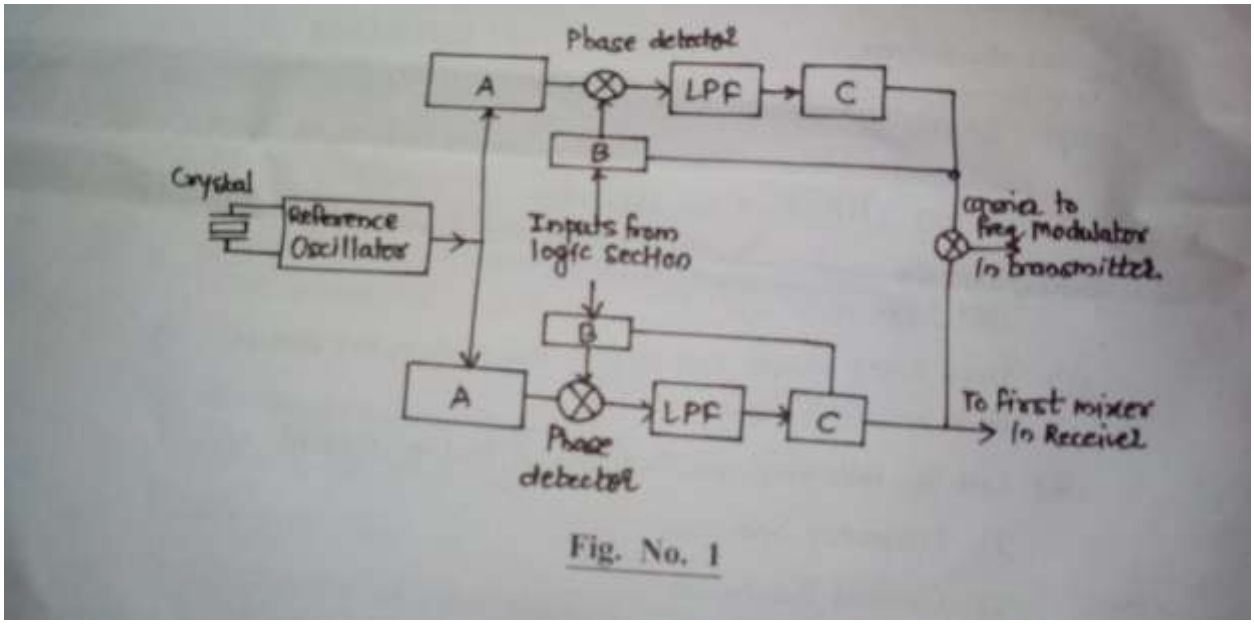


Fig. No. 1

Ans:- (1 mks each correct answer)

The above block diagram is – Frequency Synthesizer- 1/2 mks

A- Prescalar- ½ mks

B-Frequency Divider- 1/2 mks

C- VCO-Voltage controlled Oscillator- 1/2 mks

Function- (2 mks)

The synthesizer is used for developing all the signals used by the transmitter and receiver. It uses the PLL circuits and a mixer. The crystal oscillator provides a reference for the two PLLs. The output of VCO-2 is used as a local oscillator frequency for the first mixer in the receiver. The outputs of the two VCOs are mixed together to produce the transmitter output frequency. The frequency divider block receives the divide by numbers from the logic section.
These numbers are given by the MTSO computer. The divide by numbers will set the transmitting and receiving channel frequencies. The two outputs produced by the frequency synthesizer are applied to the modulator box in the transmitter and the first mixer in receiver respectively. Thus the frequency synthesizer acts a local oscillator which can produce a wide range of frequencies with high stability.

b) Compare IS-95 system with GSM system with respect to following points .(any four points).

(1) frequency spectrum (2) multiple access (3) channel bandwidth (4) SMS length

(5) type of hand-off.

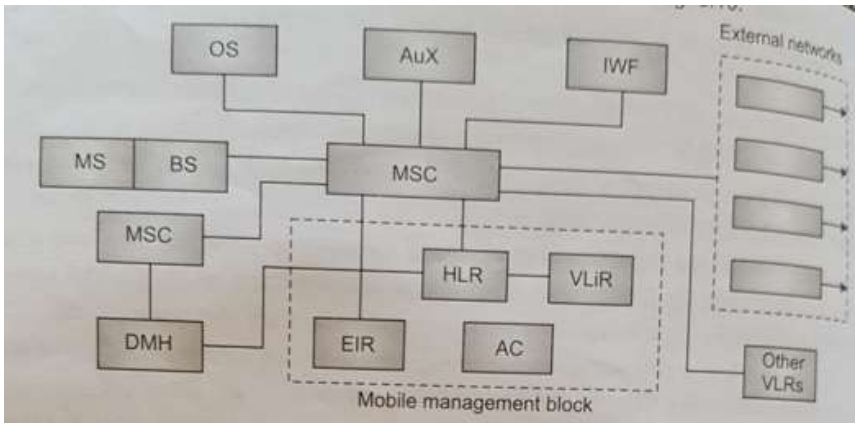
Ans:-

Parameters	IS-95 system	GSM system

frequency spectrum	800 or 1900 MHz	880-915 MHz 935-960MHz
multiple access	CDMA	TDMA
channel bandwidth	1250KHz	200KHz
SMS length	120	160
type of hand-off	Soft	Hard

c) Draw architecture of IS-95 system and state function of any two blocks .

Ans:- (Architecture- 2 mks)



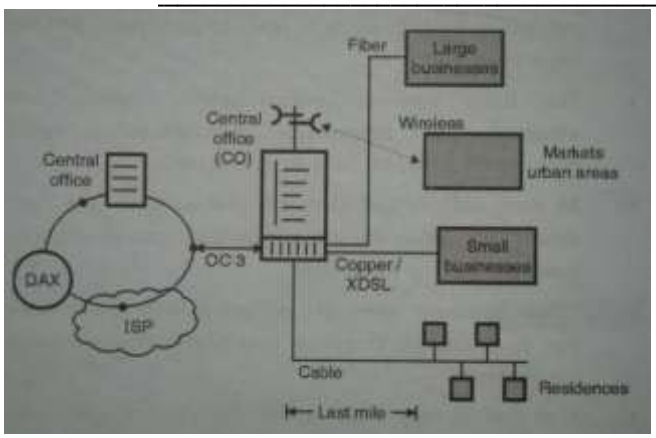
(Any two functions can be explained- 1 mks each)

Mobile Switching Centre- (MSC): The MSC co-ordinates the activities of all the base stations and connects the entire cellular system to the PSTN. A typical MSC handles 100,000 cellular subscribers and 5,000 simultaneous conversations at a time, and accommodates all billing and system maintenance functions as well. Communication between the BS and mobiles is defined by a standard Common Air Interface (CAI) that specifies four different channels.

Base Station-BS- The base station is installed for every cell. It communicates with all the mobile stations existing in its cell. The BS Communicates with the mobile switching center (MSC)

d) Draw neat figure of wireless local loop and state its importance.

Ans:- (Diagram- 2 mks, importance 2 mks)



Importance-Local Loop is a network that resides between the central office (CO) and the individual homes and business in close proximity to the central office (CO) as shown in figure above.
In most developed countries, copper or optical fiber cable already has been installed to residence and business. One more advantage of WLL is that we have to pay only once for that wireless equipment, after there is no additional costs involved. System WLL is based on Cellular, satellite, microcellular The WLL can greatly improve the telecommunication facilities and services in an inexpensive way.
It provides-

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

e) State the concept of following terms

(1) Voice channel blockage (2) Call drops
(3) Voice quality (4) Word error rate
Ans:-

(1) Voice channel blockage - Simultaneously when many calls come in , calls are rejected because there are no voice channels available and this blockage is called as voice channel blockage.

(2) Call drops- Defined as the calls that are dropped because of factors after the voice channel is allocated to a mobile because of weak signals. It depends on hand off traffic model and signal coverage.

(3) Voice quality- It is the ratio of signal to distortion (SINAD), usually expressed in dB and quoted alongside the receiver RF sensitivity, to give a quantitative evaluation of the receiver sensitivity.

(4) Word error rate- WER is a common metric of the performance of a speech recognition or machine translation system and given as

WER= (S+D+I)/N

Where, S= ni of substitutes
D= no of deletions

I= no of insertions
N= no of words in the reference.

f) Define the following terms

(1) MSC (2) Co- channel interference (3) system capacity (4) frequency Reuse distance

Ans:- (1 mks each definition)

1) MSC-**Mobile Switching Centre (MSC):** The MSC co-ordinates the activities of all the base stations and connects the entire cellular system to the PSTN. A typical MSC handles 100,000 cellular subscribers and 5,000 simultaneous conversations at a time, and accommodates all billing and system maintenance functions as well. Communication between the BS and mobiles is defined by a standard Common Air Interface (CAI) that specifies four different channels.

2) **Co channel interference**-In the frequency reuse concept, there are no. of cells using the same set of frequencies. Such cells are called as the co channel cells. The interference taking place between the signals from these cells is called as the co channel interference.

3) **System Capacity**- The total no. of duplex channels in a cellular system is called capacity of a cellular system .It is given by-

C= MGN=MF

Where M= No. of times the cluster is replicated in a fixed service area
G= No of channels per cell
N= No. of cells in a cellular system
F= Total no. of channel in a system.

The system capacity of a cellular system is directly proportional to the no. of times a cluster is replicated in a fixed service area. It depends on the value of Q (Co-channel reuse ratio)

4) **Frequency Reuse Distance-D**- The distance between two cells using the frequency reuse concept and is depends on

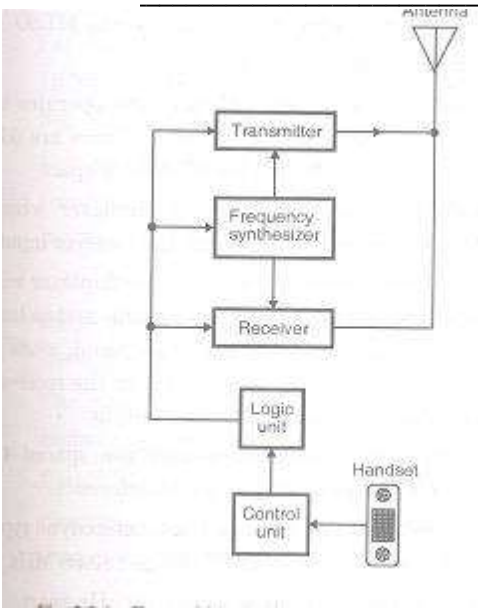
R= radius of one cell
N= No of cells in one cluster
And given as-

$$D= R * N *\sqrt{3}$$

6. Attempt any FOUR of the following : (16 m)

a) Draw block diagram of mobile unit and state function of each block. State two features of mobile handset .

Ans:-



(1 mks)

Function of each block (2 mks)

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 455 KHz or 10.7MHMz 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.

Features- (any 2 – 1mks)

1. The transmitter and receiver share the same antenna

2 . O/p power is controlled by cell site and MTSO

3. Typical o/p power is 3 W

4. The transmitter and receiver are spaced 45 MHz apart to minimize the interference.

b) Describe Radio aspect and Security aspects of IS-95 system.

Ans:- **(Proper explanation – 2 mks for each)**
RADIO ASPECTS OF IS-95- The IS-95 is specified for reverse link operation in the 824 to 894 MHz band and 869 to 894 MHz for the forward link. A forward and reverse channel pair is separated by frequency spectrum of 45 MHz for cellular band operation. Many users share a common channel for transmission. The maximum user data rate is 9.6 kbps. The IS-95 uses spread spectrum technology. The spreading process is different for the forward and reverse links in the original

CDMA specification. On the forward link, the user data is encoded using a rate 1/2 convolution code, interleaved, and spread by one of 64 orthogonal spreading sequences .Each mobile in a given cell is assigned a different spreading sequence, providing perfect separation among the different users.

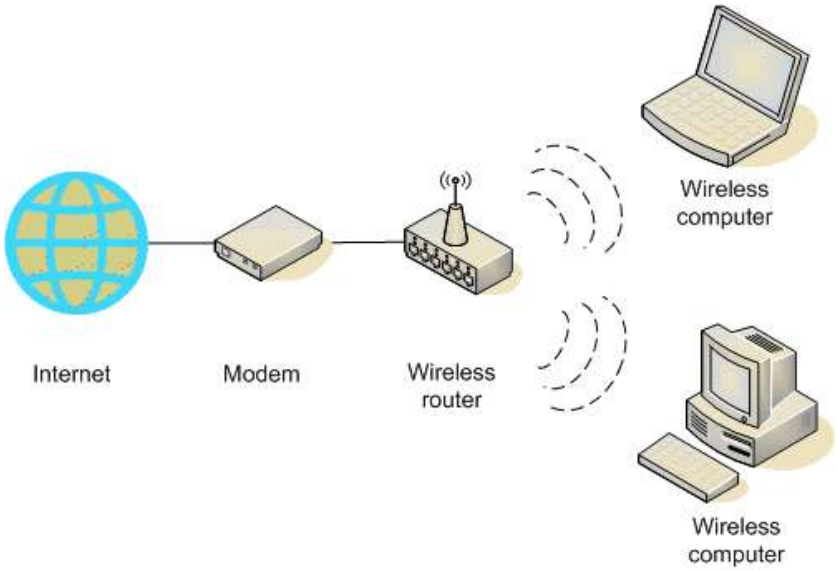
To reduce interference between mobiles that use the same spreading sequence in different cells and to provide the desired wide band special characteristics, all signals in a particular cell are scrambled. On the reverse link, a different spreading strategy is used since each received signal arrives at the base station via a different propagation path. The reverse channel user data stream is first convolution encoded with a rate of 1/3 code. After interleaving, each block of 6 encoded symbols is mapped. Another essential element of the reverse link is tight control of each subscriber's transmitter power, to avoid the *near end-far end* problem that arise from varying received powers of the users. A combination of open-loop and closed-loop power control is used to adjust the transmit power of each in-cell subscriber so that the base station receives each user with the same received power.

The commands for the closed-loop power control are send at a rate of 800 b/s and these bits are stolen from the speech frames. Without fast power control, the raid power changes due to fading would degrade the performance of all users in the system.

SECURITY aspects-The IS-95 CDMA systems also use the authentication and privacy procedures specified in IS-41.At the time of subscription, the mobile station is programmed with information specific to the subscriber or the terminal, such as Mobile Identification Number (MIN) and Electronic Serial Number (ESN), as well as the Cellular Authentication and Voice Encryption (CAVE) algorithm. Since it currently does not utilize a subscriber identity module (as in case of GSM), the private key (called the A key) is provided to the subscriber through a secure means (e.g., through registered mail).The subscriber then uses the terminal's keypad to enter the 64 bit 'A' key into the mobile station and its correct entry is verified by the security software within the mobile station. The A key also resides in the Home Location Register/Authentication Centre (HLR/AC) in the subscriber's home network. Once the subscriber specific data, the CAVE algorithm, and the A key have been successfully programmed into the mobile station, the HLR/AC asks the mobile station to generate the Secret Shared Data (SSD) by sending a random number for SSD generation (RANDSSD) parameters to the mobile station. This may take place when the mobile station makes the initial registration request. The mobile station utilizes RANDSSD, the A key and the ESM as input to the CAVE algorithm to generate the SSD. This SSD is then used for generating authentication results and cryptographic keys

c) Illustrate operation of wireless LAN in Ad-hoc mode with neat sketch and labeled diagram.

Ans:- (Labelled Diagram – 2mks, Explanation- 2 mks)



A **wireless ad hoc network (WANET)** is a decentralized type of wireless network The network is ad hoc because it does not rely on a pre- existing infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks. Instead, each node participates in routing by forwarding data for other nodes, so the determination of which nodes forward data is made dynamically on the basis of network connectivity. In addition to the classic routing, ad hoc networks can use flooding for forwarding data.

Wireless mobile ad hoc networks are self-configuring, dynamic networks in which nodes are free to move. Wireless networks lack the complexities of infrastructure setup and administration, enabling devices to create and join networks "on the fly" – anywhere, anytime.

OR

An adhoc network is a peer to peer network setup temporarily to meet some immediate need. For example , a group of employees each with laptop computer may convince in a conference room for business. The employees link their computers in a temporary network just for the duration of the meeting.

A wireless network can exhibit two different basic system architectures. Wireless LAN are of two types-

1. Infrastructure mode
2. Ad hoc mode

   WLAN Adhoc mode- In this mode, there is no access point. A no. of MS can communicate directly with each other. Nodes can communicate if they can reach each other physically.

   In case of wireless communication in adhoc mode, the communication is directly over wireless radio waves complain to 802.11 packets. The communication among different modes takes place either using FHSS or DSSS. For FHSS, we use Gaussian FSK modulation while for DSSS, we use Gaussian MSK modulation. The carrier frequency used is 2.4GHz and it provides data rate of either 2 Mbps or 1 Mbps.

d) Identify the given block diagram and state function of blocks A,B,C .(Refer Figure No .2)

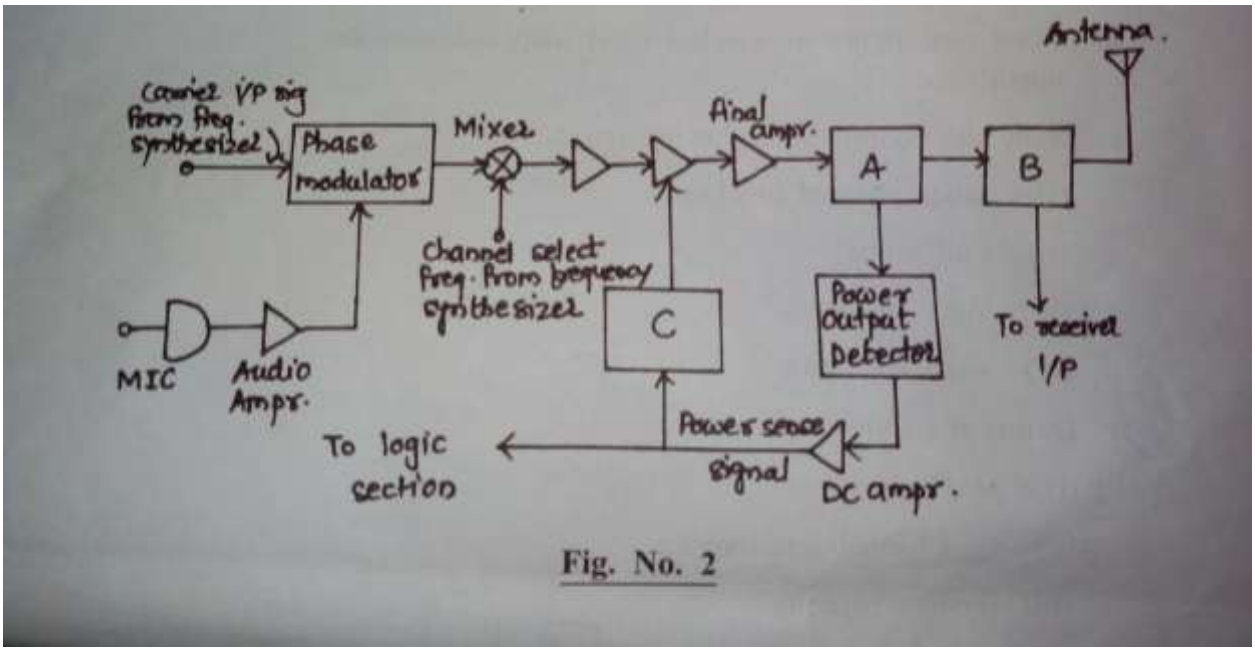


Fig. No. 2

Ans:- (Each answer 1 mks)

The block diagram is the **cellular transmitter**

A-Directional Coupler
A- Duplexer/Isolator
B- Automatic Power Control Unit

e) State any four features of IS-95 standard and describe them.

Ans:- (Any four can be listed and explained)

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