



WINTER- 17 EXAMINATION

Subject Name: Mobile Communication

Model Answer

Subject Code:

17657

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 the following:

12 Marks

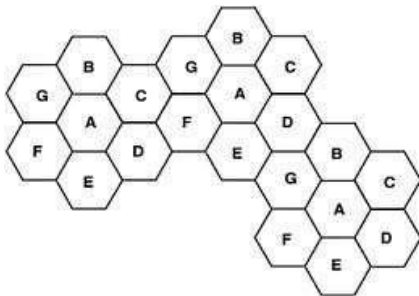
(a) What is frequency planning in cellular system .Draw Frequency reuse pattern for $N=4$ and $N=7$.

Ans:- (concept of frequency planning- 2 mks, each pattern 1 mks)

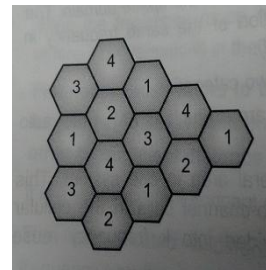
Each cellular base station is allocated group of radio channels to be used within a small geographic area called “cell” .Base stations in adjacent cells are assigned channel group which contains completely different channels than neighbouring cell. By limiting coverage area to within the boundaries of 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.

Frequency pattern for $N=7$



Frequency pattern for $N=4$



(b) List out features of HSCSD for 2.5G GSM system.

Ans:- (Any 4 features- 4 mks)

- 1) As the name implies, High Speed Circuit Switched Data is a circuit switched technique that allows a single mobile subscriber to use consecutive user time slots in the GSM standard.
- 2) That is, instead of limiting each user to only one specific time slot in the GSM TDMA standard, HSCSD allows individual data users to commandeer (officially take possession or control) consecutive time slots in order to offer higher speed data access to the GSM network.
- 3) HSCSD relaxes the error control coding algorithms originally specified in the GSM standard for data transmissions, and increases the available application data rate to 14,400 bps, as compared to the original 9,600 bps in the GSM specification.
- 4) By using up to 4 consecutive time slots, HSCSD is able to provide a raw transmission rate of up to 57.6 kbps to individual users, and this enhanced data offering can be billed as a premium service by the carrier.
- 5) HSCSD is ideal for dedicated streaming internet access or real-time interactive



web sessions, and simply requires the service provider to implement a software change at existing GSM base stations.

(c) For EDGE 2.5G and GPRS state following specifications

(i) Data rate

(ii) Channel bandwidth

(iii) Modulation technique

(iv) Number of voice channel.

Ans: (1 M for each parameter)

Parameters	EDGE 2.5G	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

(d) Write a short note on evolution of radio mobile communications.

Ans:- (relevant contents 4 mks)

In the last few decades, Mobile Wireless Communication networks have experienced a tremendous change.

The cellular wireless Generation(G) generally refers to a change in the nature of the system, speed, technology and frequency. Each generation have some standards, capacities, techniques and new features which differentiate it from the previous one.

The first handheld mobile cell phone was demonstrated by Motorola in1973.The 1st commercial automated cellular network was launched by NTT in Japan in 1979, followed by the launch of Nordic Mobile Telephone(NMT) system in Denmark, Finland, Norway and Sweden, in 1981.After this begins the development in generations for mobile wireless communication.



The first generation(1G) mobile wireless communication network was analog used for voice calls only. The second generation(2G) is a digital technology and supports text messaging.

After this was 3G which provided multimedia support along with higher data transmission rates and increased capacity. The fourth generation(4G) integrates 3G with fixed internet to support wireless mobile internet, which is an evolution to overcome the limitations of 3G and also raises the QoS, increases the bandwidth and reduces the cost of resources.

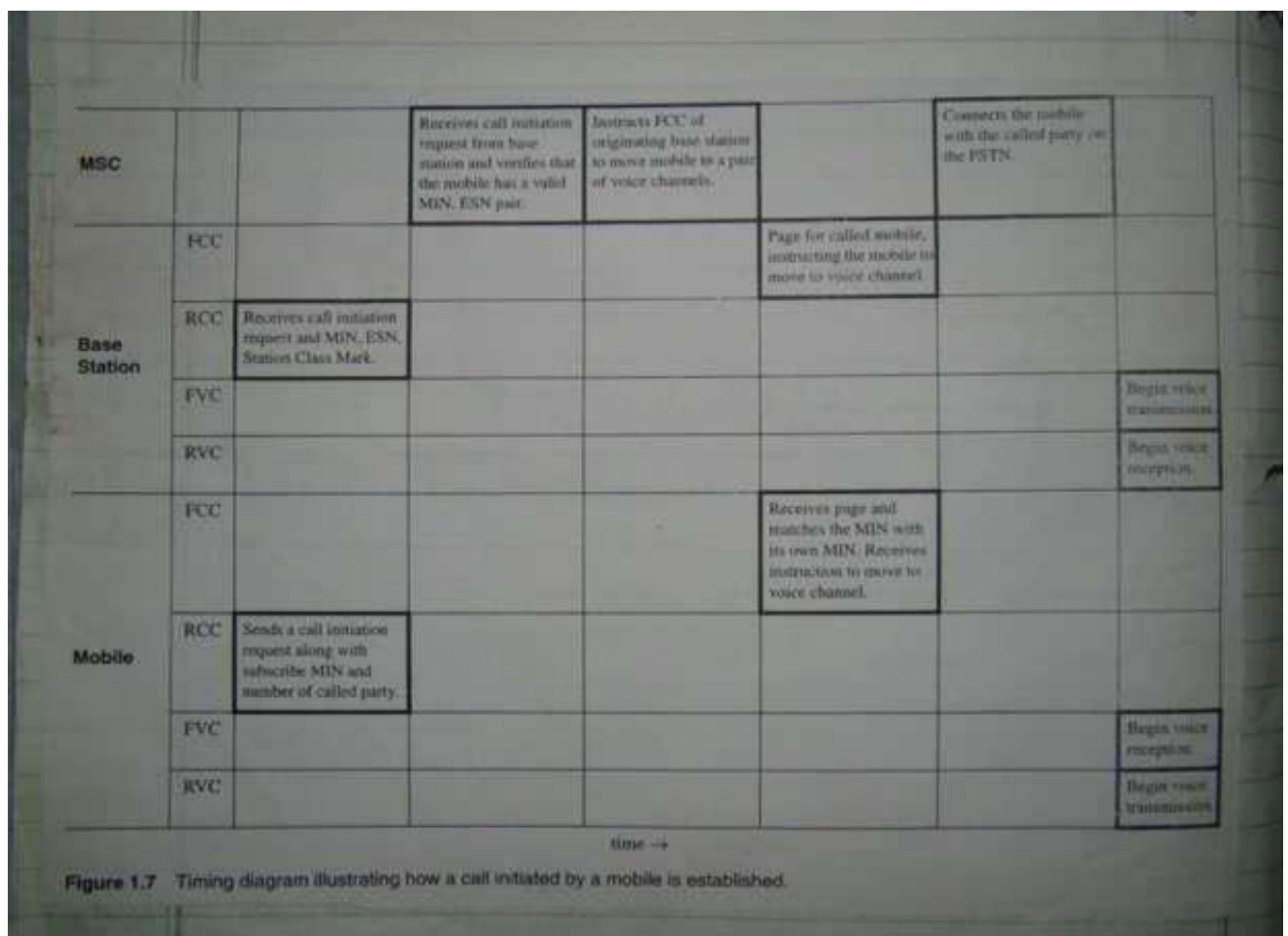
The 5G brings forward a real wireless world-Wireless World Wide Web (www) while 6G is proposed to integrate 5G with satellite networks for global coverage. 7G deals with space roaming.

(B) Attempt any one of the following:

6

(a) Describe call making procedure from mobile handset to a landline phone (PSTN) with neat timing diagram.

Ans:- (Description – 3 mks, diagram -3 mks)

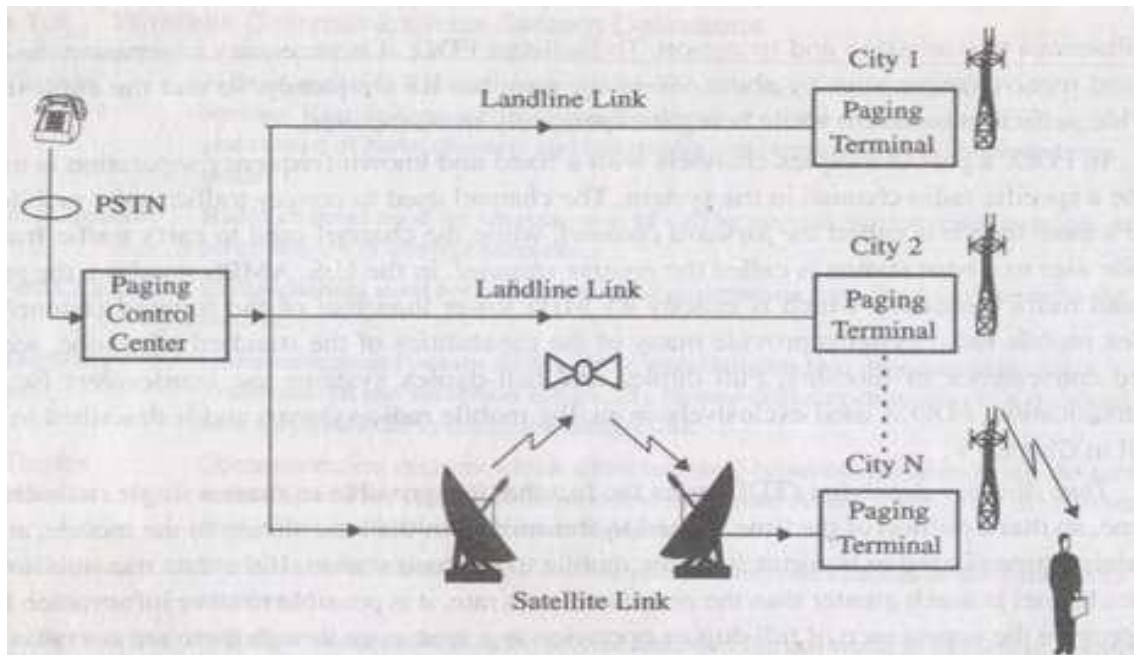




A call initiation request is sent on the reverse control channel (RCC). Mobile unit transmits its telephone number (MIN), Electronic Serial Number (ESN), Station Class Mark (SCM) which indicates power level and telephone number of called party. The cell BS receives this information and sends it to MSC. 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

b) Describe working principle of paging system with neat block diagram. Compare paging system with cellular phone system.

Ans: (Paging diagram- 1 ½ mks, explanation – 1 ½ mks, 3 comparison points- 3 mks)



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 centre 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 receivers 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.

Parameters	Cellular phone system	Paging system
Definition and basic function	A cell phone is an electronic device used for full duplex two-way radio telecommunications over a cellular of stations known as cell sites	A pager, also known as a beeper is a simple personal telecommunications device for sending and receiving short messages
Types	Basic phones, touchscreen phones, smartphones	Voice/Tone pagers, Numeric, Alphanumeric and two way alphanumeric pagers.
Handset Features and software	Uses built-in software to make and receive calls	Features may include GPRS, GPS, camera, games, compass and accelerometer. No additional features
Areas of use	Anywhere except where specifically disallowed. e.g. gas stations, hospitals, movie halls, air planes	Hospitals, fire stations, hospitality industry etc
Power supply	Rechargeable battery, car chargers, USB	Rechargeable batteries only
Privacy	Can be traced	Cannot be traced

Q2. Attempt any FOUR of the following:

16 marks

a) State four ways to improve capacity and coverage in cellular system. How repeater are used for range extension.

Ans:- (four methods – 2 mks, use of repeaters -2 mks)



Four ways to improve capacity and coverage are:

1. Micro-zone cell concept
2. Cell sectoring
3. Cell splitting
4. Repeaters

Use of Repeater for range extension.

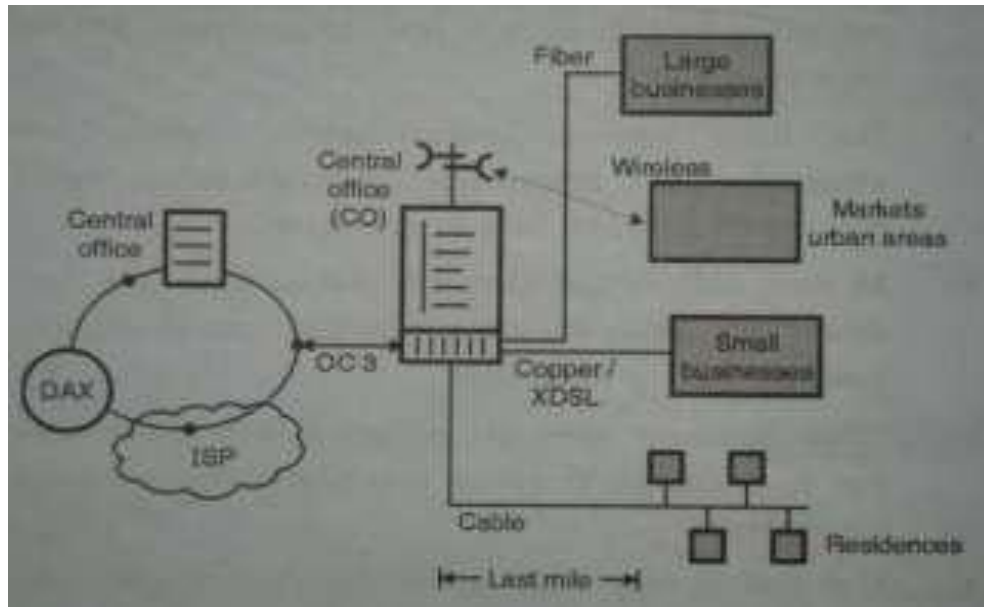
- It is often necessary to provide the dedicated coverage of the cellular mobile radio system, for *hard-to-reach* areas, such as within building or in valleys or in tunnels.
- The radio retransmitters known as repeaters, are often used to provide such range extension capabilities. The repeaters are 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 noise and interference are also reradiated by the repeater on both the forward and reverse links.
- Therefore we must take 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.

b) Describe wireless local loop with neat diagram.

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

WLL stands for Wireless Local Loop.

Microwave wireless links can be used to create a wireless local loop such as shown in figure below.



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.

c) Define blockage, call drops, word error rate and voice quality.

Ans:- (Each definition – 1 mks)

(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) State features of IS-95 B and IS-136.

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

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 -

- a. Each IS-95 CDMA radio channel supports up to 64 different user channels.
- b. 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.
- c. 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 (8×14.4 kbps)
- d. 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.
- e. 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)

- 1) Time Slots per Channel: 6
- 2) Users per Channel: 3 (full rate), 6 (half rate), 9 (future)
- 3) Modulation: Digital: $\pi/4$ DQPSK, Nyquist Filter factor = 0.35
- 4) Analog: FM
- 5) Data Structure: TDMA
- 6) Speech Coding: VSELP (vector sum excited linear predictive) 8 kbps
- 7) Modulation Data Rate: 24,300 symbols per second (1 symbol = 2 bits)
- 8) EIA/TIA Standards: IS-136.1 and IS-136.2 for system

e) State any four features of MANET.

Ans: (any four features – 1 mark each)

- 1) Mobile Adhoc Network (MANET) is an autonomous collection of mobile devices such as laptops, smart phone etc. that communicate with each other over wireless link and cooperate in a distributed manner to provide necessary network functionality in the absence of a fixed infrastructure.
- 2) This type of network operating as a standalone network or multiple point of attachment to the cellular networks paves the way for numerous new and exciting applications
- 3) MANET can be categorized into first, second and third generation.
- 4) It has evolved to be a robust, reliable, operational experimental network.
- 5) MANET allows users to access and exchange information regardless of their geographic position or proximity to infrastructure
- 6) All nodes in MANET are mobile and their connections are dynamic
- 7) It offers an advantageous decentralized character to the network

f) Draw basic cellular system and define :

- I. Frequency reuse

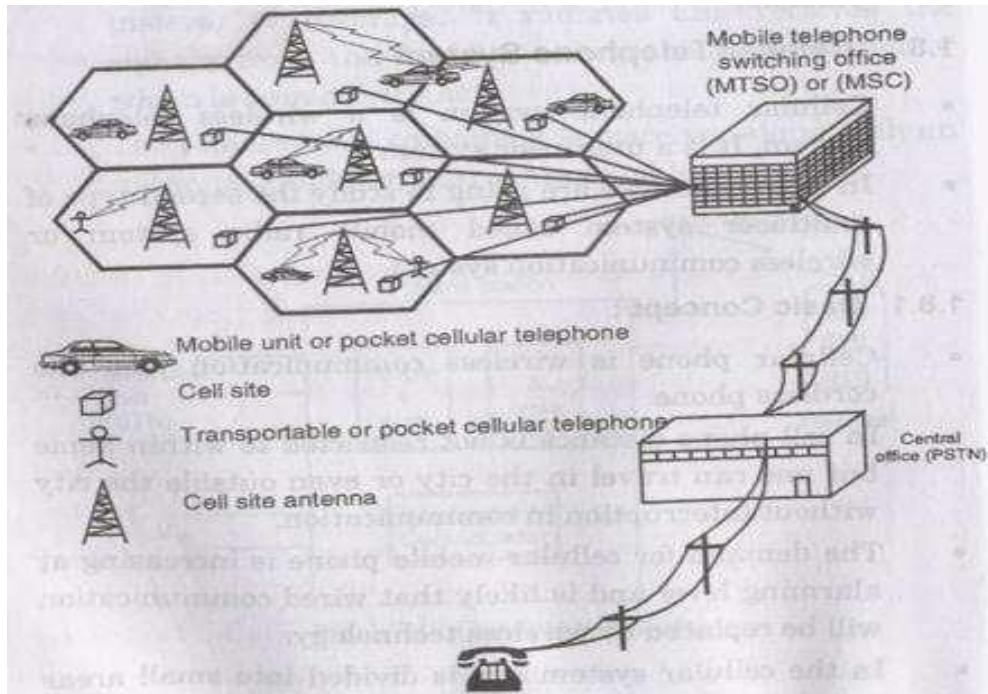


II. Frequency reuse ratio.

Ans:- (each definition- 1 mks diagram- 2 mks)

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.

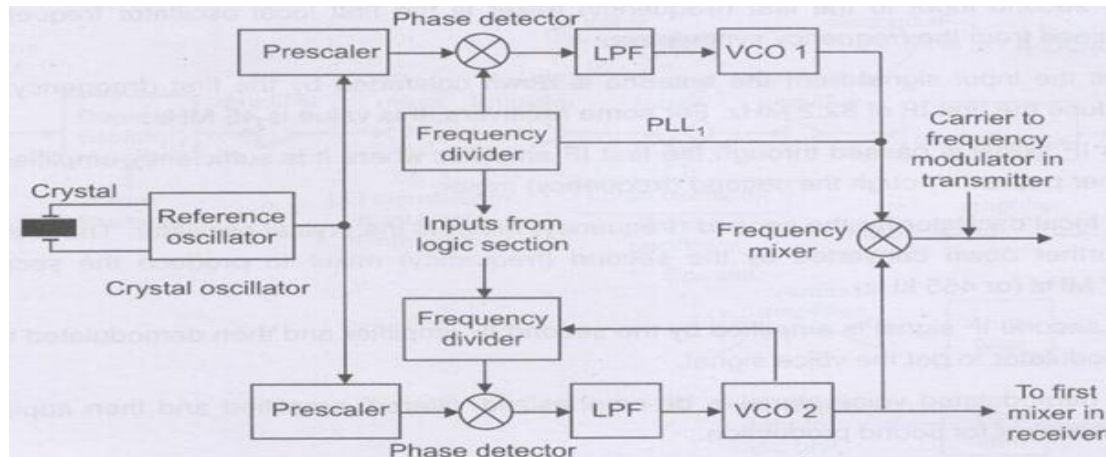


3. Attempt any four of the following

16 Marks

a) Describe working of frequency synthesizer used in mobile handset.

Ans:- (2M for Diagram & 2M for Explanation)



- 1) The synthesizer is used for developing all the signals used by the transmitter and Receiver.
- 2) It uses PLL circuits and mixer.
- 3) The crystal oscillator provides a reference for two PLL.
- 4) The function of PLL is to lock or synchronize frequency of VCO to that of input signal.
- 5) The output of VCO 2 is used as local oscillator frequency for the first mixer in the oscillator
- 6) The output of the two VCO are mixed together to produce the transmitter output frequency.
- 7) The frequency divider block receive divide by number from the logic section. These numbers are given by MTSC computer.
- 8) The divide by number will set Transmit and receive channel frequencies.
- 9) The two output produced by frequency synthesizer are applied to the modulator box in the transmitter and the first mixer in receiver respectively.
- 10) The frequency synthesizer thus act as local oscillator which can produce a wide range of frequencies with high stability.

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

Ans: (2M for GSM architecture & 1M each for function of HLR and OMC units.)

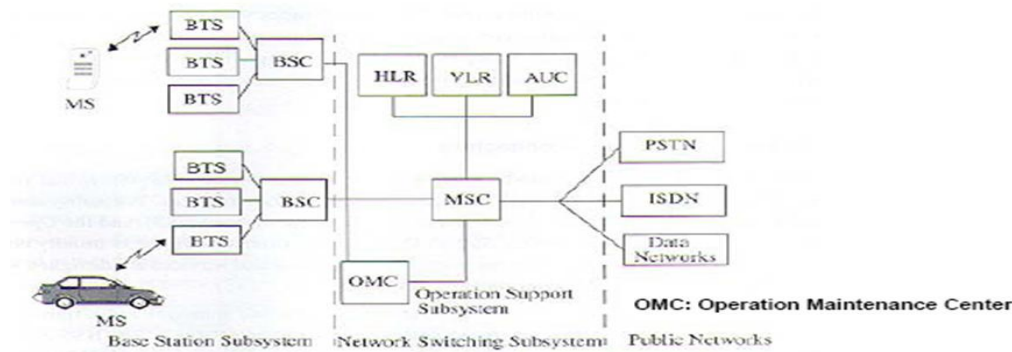
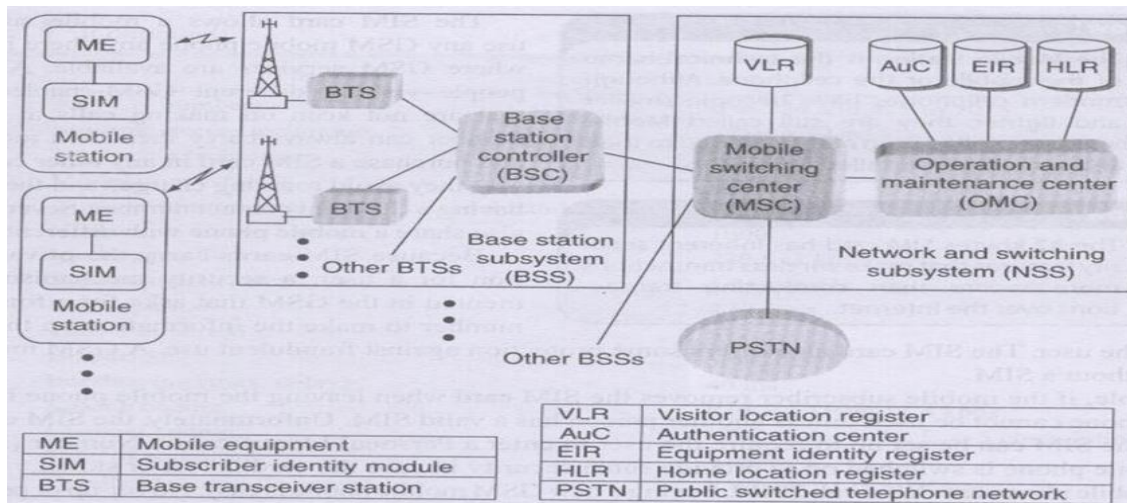


Fig. GSM system architecture

OR



Home Location Register (HLR):

- 1) This database contains all the administrative information about each subscriber along with their last known location.
- 2) In this way the GSM network is able to route calls to the relevant base station for the MS.
- 3) When a user switches on their phone, the phone registers with the network and from this it is possible to determine which BTS it communicates with so that incoming calls can be routed appropriately.
- 4) Even when the phone is not active (but switched on) it re-registers periodically to ensure that the network (HLR) is aware of its latest position.
- 5) There is one HLR per network, although it may be distributed across various sub-centers to for operational reasons.

Operation maintenance center (OMC)

- 1) Network operation and maintenance functions, subscription, management including charging and billing and also mobile equipment management.



2)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 equipments in the system.

c) A mobile communication system is allocated RF spectrum of 25 MHz with RF channel bandwidth of 25

KHz and if service area is divided in to 20 cells with cluster size of 4,compute system capacity.

Ans: (2M for calculation,1M for formula & 1M for correct answer)

One duplex channel = $2 \times 25 = 50$ kHz of spectrum.

Hence the total available duplex channels are = $25 \text{ MHz} / 50 \text{ kHz} = 500$ in number.

For $N = 4$, total channels per cell = $500/4 = 125$.

Cluster Size= 4

Assume clusters are replicated $M=3$ times

System capacity= $3 \times 500=1500$ total channels.

d) State any four specifications of UMTS.

Ans: (1M each for any four specification of UMTS)

1) Frequency spectrum: uplink 1920- 1980 MHz

Downlink:2110 – 2170 MHz

2) Channel Bandwidth:5 MHz

3) Chip rate:3.84 Mbps

4) Duplexing Technique: FDD and TDD modes

5) Modulation scheme: Direct sequence CDMA with QPSK

6) Frame length: 10 ms frame with 15 time slots

7) Coding Technique: Orthogonal variable spreading factor(OVSF)

8) Service type: Multi rate and multi service

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

Ans:- (2M for concept of signaling system No 7 & 2 M for SS7 Protocol Architecture
(Explanation if required).

SS7 is an architecture for performing out of band signaling in support of the call establishment ,billing, routing, and information exchange function of the Public switched Telephone network (PSTN).It identifies functions to be performed by a signaling system network and a protocol to enable their performance.

SS7 Protocol Model:



The message transfer part (MTP) provides OSI level protocol model as level-1 data service, level-2 link service and level-3 network service

- 1) The full level-3 service is provided by the signaling connection control part (SCCP)
- 2) The SCCP provides an enhanced addressing capability that may be considered as level 3+ or close to level-4

The layer 4-6 in the OSI model don't exist in SS7 protocol model

- 3) The transaction capability application part (TCAP) level and operations maintenance and administration (OMAP)

part level are considered the same as the Application level-7 in the OSI

- 4) The application service element ASE is at the same level as the OMAP .
- 5) The TCAP includes protocol and services to perform remote operations .
- 6) The primary use of TCAP in these networks is for invoicing remote procedures in supporting IN service like, 800 services .

- 7) The OMAP provides the application protocols and procedures to monitor coordinate and control all the network

resources which make communication based on SS7 possible

- 8) The ASE is for the MTP routing verification test (MRVT) which uses the connectionless services of TCAP
- 9) The MRVT is an important function on OMAP

4 (A) Attempt any three

12 Marks

a) List any four vision of IMT-2000

Ans: (1M each for any four points)

The capabilities and vision of an IMT 2000 system are as follows:

- 1) Common spectrum worldwide (1.8 – 2.2 GHz band)
- 2) Data rates of :9.6 Kbps or higher for global (mega cell),144 Kbps or higher for vehicular (macro cell),384 Kbps or higher for pedestrian (micro cell) and up to 2 Mbps for indoor environments (pico cell)
- 3) Global seamless roaming.
- 4) Multiple environments, that are not only confined to cellular, but also includes cellular, cordless, satellite, LANs, wireless Local loop (WLL)
- 5) Enhanced performance and security.
- 6) Wide range of telecommunications services (voice, data, multimedia etc)
- 7) Flexible radio bearers for increased spectrum efficiency
- 8) Full integration of wireless and wireline systems.

b) List and describe different types of Traffic channels (TCHS) provided in GSM.

Ans: (2M for list & 2M for Explanation)



1) GSM traffic channel (TCH)

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

(a) Full rate TCH:

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

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.

Full rate data channel for 4800bps(TCH/F4.8) This channel carries raw user data which is sent at 4800bps. With additional forward error correction coding applied by GSM standard the 4800bps data is sent at 22.8kbps.

Full rate data channel for 2400bps (TCH/F2.4) This channel carries raw user data which is sent at 2400bps. With additional forward error correction coding applied by GSM standard the 2400bps data is sent at 22.8kbps.

(b) Half rate TCH:

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 data at 11.4kbps.

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.

Half rate data channel for 2400bps (TCH/H2.4) : This channel carries raw user data which is sent at 2400bps. With additional forward error correction coding applied by GSM, this channel will carry data at 11.4kbps.

c) Compare GPRS standard with IS-95 B standard w.r.t

(1) Backward compatibility

(2) Channel Bandwidth

(3) Data rate

(4) Number of voice channels

Ans: (1M each for correct comparison point)

Parameter	GPRS	IS-95B
Backward compatibility	No	Yes
Channel Bandwidth	200 KHz	1.25 MHz



Data rate	9.6 Kbps	115 Kbps
Number of voice channels	No	53

d) With the help of neat sketch, explain the microcell zone concept.

Ans: (2 M for Diagram & 2M for Explanation)

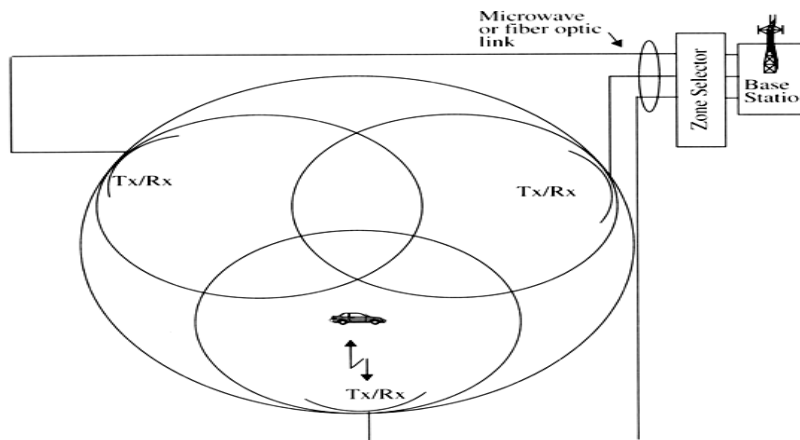


Figure The microcell concept

- 1) The problem associated with sectoring technique is the increase in number of handoffs. This puts an additional load on the switching and control link elements of the mobile system.
- 2) A solution to this problem is microcell concept.
- 3) In this scheme, all the three or more zone sites represents as Tx/ Rx are connected to the same base station and share the same radio equipment.
- 4) The transmission media used for connecting the zones to the base station are coaxial cable, fiber optics cable or a microwave link.
- 5) So each cell consists of a base station and multiple zones.
- 6) A mobile travelling within a cell, is served by the zone that has the strongest signal of all.
- 7) The antennas in zones are placed at the outer edges of the cell and any base station channel can be assigned to any zone by the base station.
- 8) As a mobile travels from one zone to the other within a cell, it uses the same channel . This will avoid hand-off. The base station will just switch the channel to the appropriate zone sit.
- 9) Thus a given channel is being used only in a particular zone in which the mobile is travelling.
- 10) So the base station radiation is localized. This will reduce interference.
- 11) The channels are distributed in time and space by all the zones are also reused in the co-channels cells. The microcell concept is very useful along highways or in the busy urban areas.

4 B .Attempt any one

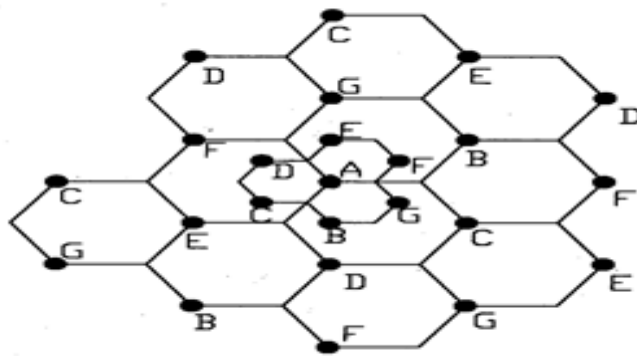
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a) Explain concept of cell splitting with neat diagram. Show that if cell radius is reduced by factor of $\frac{1}{2}$ then traffic load increases by factor of 4. Assume shape of cell is circular.

Ans: (3M for concept of cell splitting & 3M for Proof)

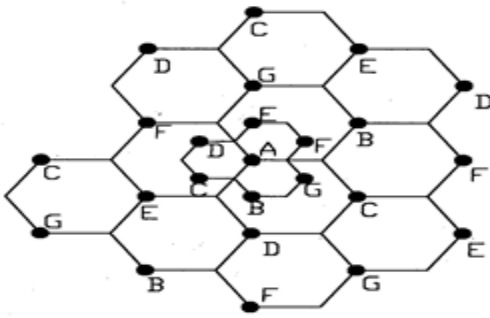
- 1) It is the process of subdividing a congested cell into smaller cell with its own base station having the corresponding reduction in the antenna heights & the transmitted power.
- 2) There are two cell splitting techniques,
 - a. Permanent splitting
 - b. Dynamic splitting
- 3) This technique utilizes the allocated spectrum efficiency in real time. In situations such as traffic jams, the ideal small cell sites may be rendered operative in order to increase the cell's traffic capacity



OR

Split congested cell into smaller cells.

- Preserve frequency reuse plan.
- Reduce transmission power.



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

Dynamic cell splitting:

This technique is based on utilizing the allocated spectrum efficiency in real time. In this of splitting techniques cells are not splitted permanently depending on requirement of traffic the splitting of the cells are carried out.

The algorithm for dynamically splitting cell sites is a tedious job since we cannot afford to have single cell unused during cell splitting at heavy traffic hours.

Proof:

When the cell radius is reduced by a factor, it is also desirable to reduce the transmitted power.

The transmit power of the new cells with radius half that of the old cells can be found by examining the received power P_R at the new and old cell boundaries and setting them equal.

This is necessary to maintain the same frequency re-use plan in the new cell layout as well.

Assume that P_{T1} and P_{T2} are the transmit powers of the larger and smaller base stations respectively. Then, assuming a path loss index $n=4$, we have power received at old cell boundary $= P_{T1}/R^4$ and the power received at new cell boundary $= P_{T2}/(R/2)^4$. On equating the two received powers, we get $P_{T2} = P_{T1} / 16$. In other words, the transmit power must be reduced by 12 dB in order to maintain the same S/I with the new system lay-out.

At the beginning of this channel splitting process, there would be fewer channels in the smaller power groups. As the demand increases, more and more channels need to be accommodated and hence the splitting process continues until all the larger cells have been replaced by the smaller cells, at which point splitting is complete within the region and the entire system is rescaled to have a smaller radius per cell. If a cellular layout is replaced entirely by a new layout with a smaller cell radius, the signal-to-interference ratio will not change, provided the cluster size does not change. Some special care must be taken, however, to avoid co-channel interference when



both large and small cell radii coexist. It turns out that the only way to avoid interference between the large-cell and small-cell systems is to assign entirely different sets of channels to the two systems. So, when two sizes of cells co-exist in a system, channels in the old cell must be broken down into two groups, one that corresponds to larger cell reuse requirements and the other which corresponds to the smaller cell reuse requirements. The larger cell is usually dedicated to high speed users as in the umbrella cell approach so as to minimize the number of hand-offs.

b) State and explain the various SS7 services .

Ans: (Any six services -1M each)

SS7 SERVICES

a) Touchstar

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.

b) 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 :

c) 800-NXX plan :

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

d) 800 database plan :

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

e) 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

f) 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 :

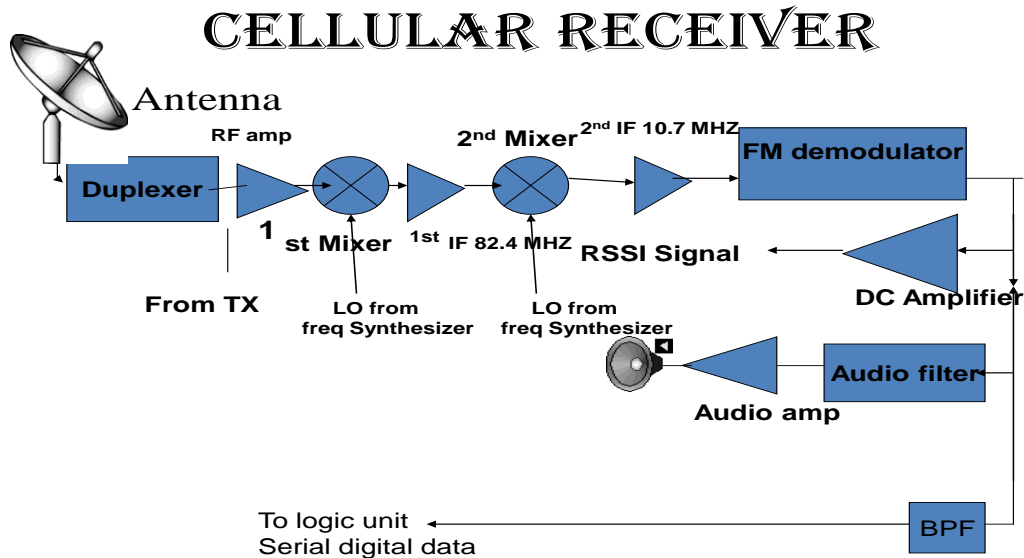
With the increase in subscribers it is important to avoid congestion in the signaling network under heavy traffic conditions. SS7 networking protocols provide several congestion control schemes, allowing traffic to avoid failed links & nodes.

Q5. Attempt any FOUR of the following:

16

(a) Draw block diagram of receiver unit of mobile handset and state its function.

Ans:- (block diagram-2 mks, functions- 2 mks)



- The main function of receiver is to capture the signal of the desired frequency by filtering other adjacent frequency and demodulate signal and give to loudspeaker, apart from that mobile receiver also able to detect RSSI signal and other usable signals transmitted by BS and MSC
- The receiver is a dual conversion super heterodyne radio receiver.
- An RF amplifier boosts the level of received cell site signal.
- The first mixer translates the incoming signal down to a first IF of 82.2MHz.
- The signal passes through IF amplifier and filters to the second mixer. The second IF is usually either 10.7MHz or 455KHz
- The signal is then demodulated, de-emphasized, filtered and amplified before being applied to the output speaker in the handset.

b) **State examples of wireless communication systems and explain cordless telephone system with block diagram.**

Ans:- (Examples of wireless communication systems are- any 2- 1 mks)

Pager

Cordless telephone system

Cellular telephone

AC remote control

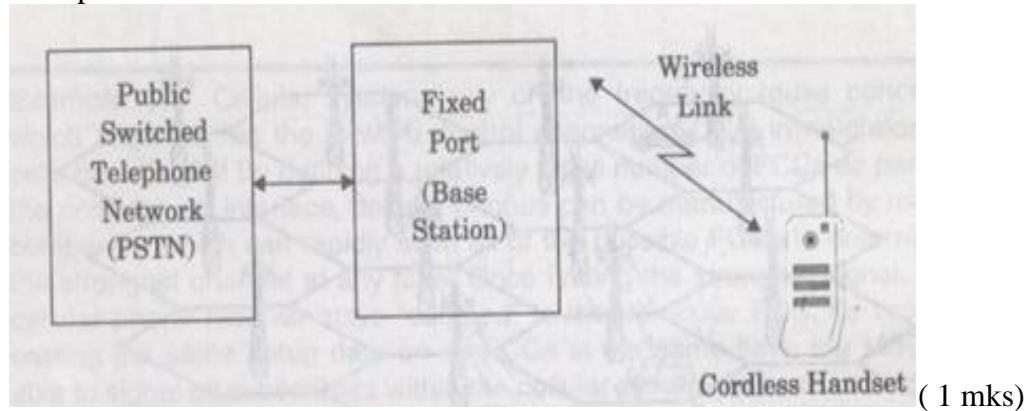
Hand held walky-talky

TV remote control

Cordless telephone system



Cordless Telephone Systems are full duplex communication systems that use radio to connect a portable handset to a dedicated base station, which is also connected to a dedicated telephone line with a specific telephone number on PSTN.



The fixed port of a cordless telephone is nothing but the base unit on which cordless handset is placed, is connected to a telephone line and an adapter to produce a dc supply for various electronic circuits inside the base unit.

The communication between the base unit and the handset is wireless and the range is limited to 50 meters.

In the base unit all call processing circuits like amplifiers and also ring circuit is present. In addition a transceiver is also present which is used for communication with the handset.

In handset also the transceiver along with an antenna, amplifier, microphone and loud speaker are present.

1st generation cordless telephone systems could cover only distance of a few ten meters(approximately 50m)and can be operated solely as extension telephones to a transceiver connected to a subscriber line on the PSTN and are primarily for in-home use.

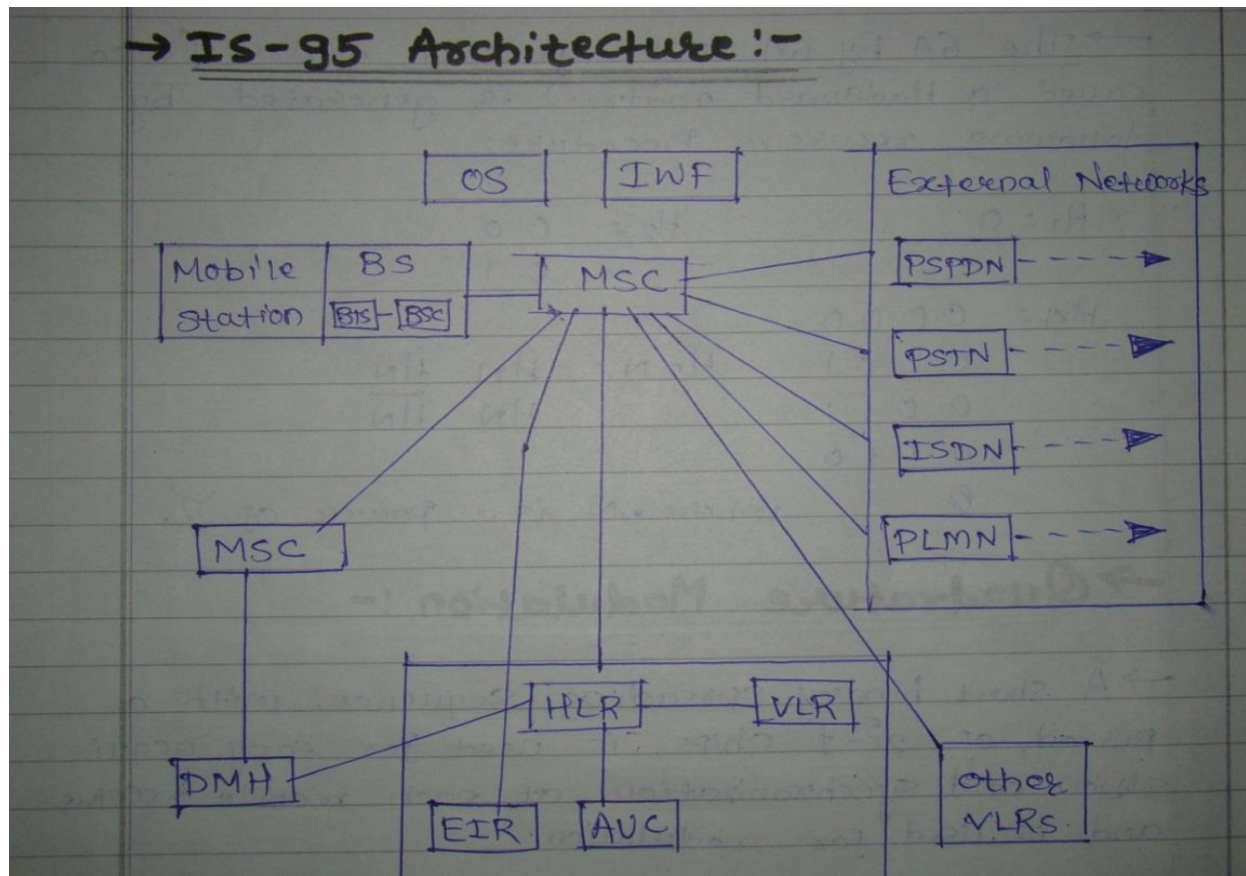
2nd generation cordless telephone systems could cover distance of a few hundred meters which allows subscribers to use their handsets at many outdoor locations within urban centers.

Cordless telephone systems provide the user with limited range and mobility, as it is not possible to maintain a call if the user travels outside the range of the base station.

(2 mks)

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

Ans : (Architecture – 2 mks, functions of any two blocks- 2 mks)



BS-Base station

Mobile switching center

HLR-Home location registers
register

VLR- Visiting location registers

DMH-Data message handler

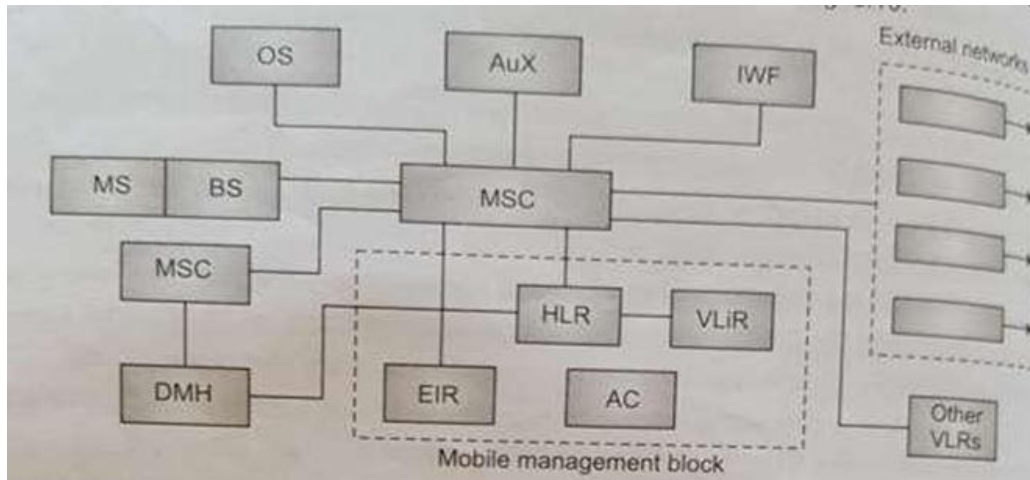
AUC- Authentication center

OR

OS-Operating system MSC-

IWF-Interworking function

EIR-Equipment identity



(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) Compare 3G W-CDMA (UMTS) and 3G CDMA 2000.

Ans: (4 differences - Each 1 Mark)

Parameters	3G WCDMA	3G CDMA 2000
Carrier spacing	5 MHz	3.75 MHz
Chip rate	4.096MHz	3.6864MHz
Power control frequency	1.5MHz	800 Hz
Coding	Turbo and conventional	Turbo and convolution

(e) State the features of Bluetooth and PAN (Personal Area Network)

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.

(f) Define handoff. Explain basic process of handoff with neat diagram. List types of handoff.

Ans:- (Definition- 1 mks, any two types- 1 mks, diagram- 1 mks, explanation- 1 mks)

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.

Types of Hand off

1. Mobile Assisted Hand off
2. Intersystem Hand off
3. Delayed Handoff (Two level Hand off)
4. Queued Handoff
5. Hard hand off
6. Soft hand off
7. Inter system handoff

Hand off Process:

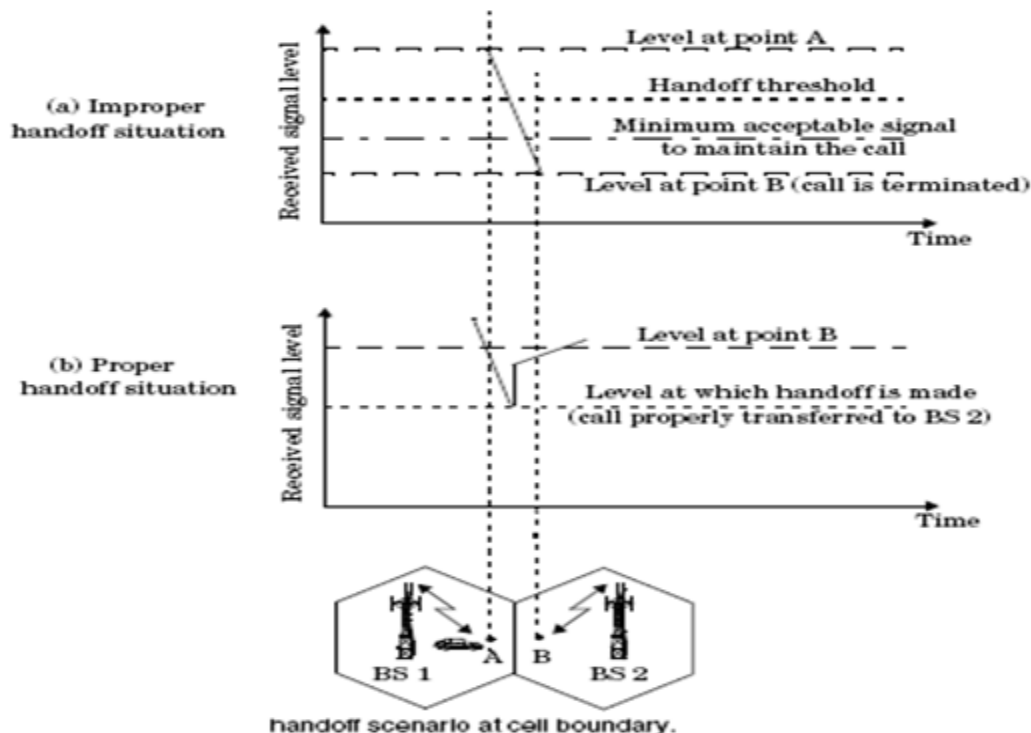
- The term hand-off does not mean a physical change in the assigned channel but rather than a different base station handles the radio communication task.
- Hand-off is a process of automatically transferring the call to a new frequency channel belonging to a new base station, when the cellular mobile 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 $P_{r, \text{minimum}}$ is first decided for maintaining the call. Then the slightly stronger signal levels used as a hand-off $P_{r, \text{threshold}}$ 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,

$$\Delta = P_{r, \text{threshold}} - P_{r, \text{minimum}}$$

- 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.

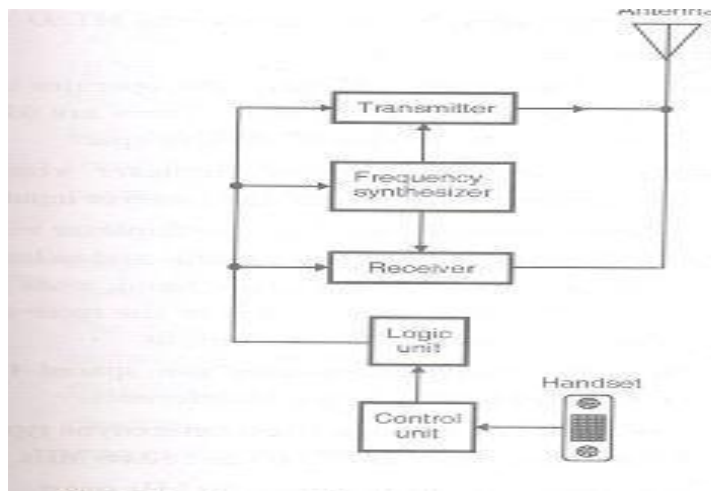


Q6. Attempt any FOUR of the following:

16

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

Ans:- (Block diagram- 2 mks, function-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 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) List any four features of IS-95 CDMA.

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

(c) 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

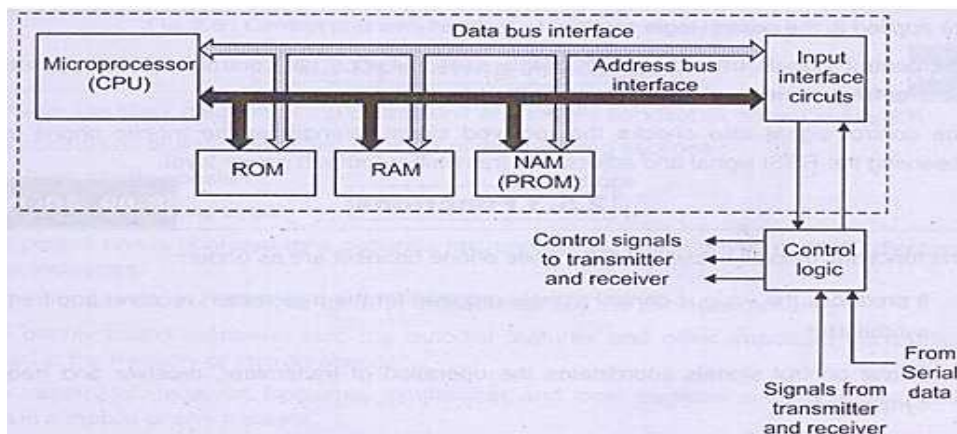


that is immediately within their radio range or one that is outside their radio range.

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.

d) Draw the block diagram of logic unit and write function of each block.

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The logical unit contains the main control circuitry for the cellphone unit. The logical unit consists of a CPU, RAM, ROM, I/O interface circuit and control logic. NAM (Number Assignment Module) is a programmable read only memory (PROM). The NAM holds the Mobile Identification

Number (MIN) i.e. the telephone number of the mobile phone.

The serial data comes from the MTSSO. The bit rate of this signal is 10kbps. The MTSSO keeps a full control over all the cell phones using this serial data. This signal controls the transmitting and receiving frequencies and transmitted power. The MTSSO checks the received signal strength at the mobile by observing the RSSI signal and adjust the transmitted power level. Control signals from control logic section are applied to transmitter and receiver section of mobile unit.

(e) Describe Ratio aspect and security aspect of IS-95 system.

Ans:- (Relevant description of each – 2 mks)

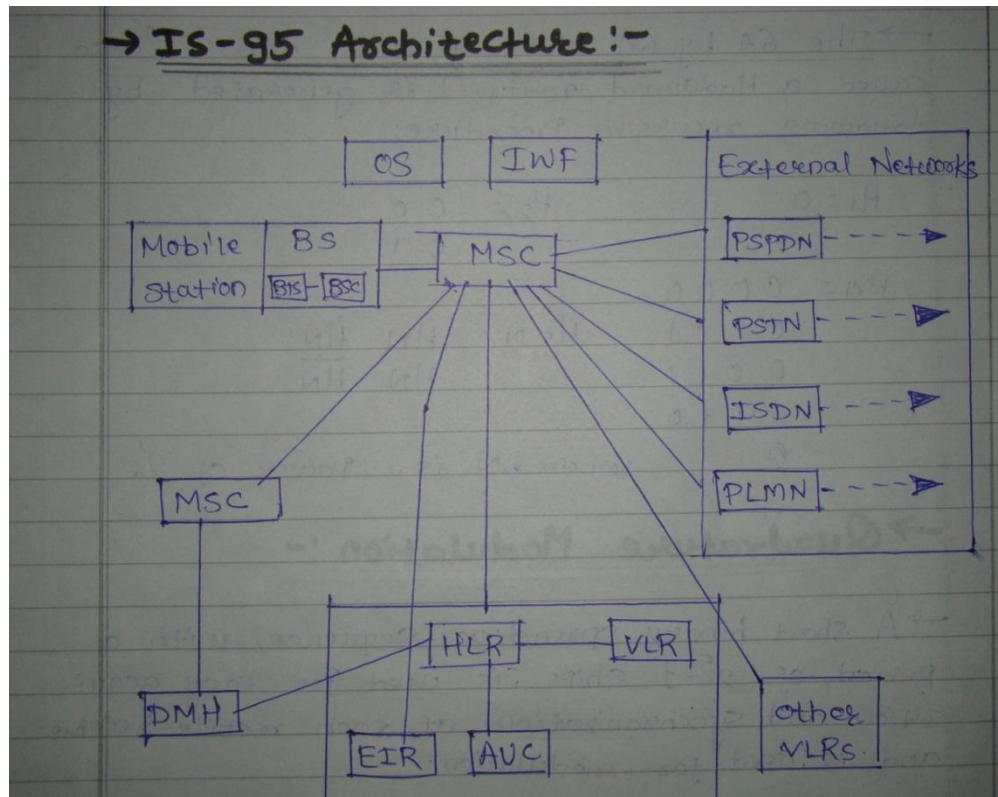
Radio aspects of IS 95system



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Nominal data rate (Rate Set 1)	9.6 kbps
Filtered bandwidth	1.23 MHz -> 1.25 MHz with guard band
Coding	Convolutional coding Constraint length = 9 Viterbi decoding
Interleaving	With 20 ms span

Security aspect of IS 95

1. CAVE (cellular authentication and voice encryption) algorithm is used .
2. Uses a 64 bit A-key along with ESN and Random number to generate 128 bit shared secret data (SSD) • SSD is divided into two 64 bit blocks – (A for authentication, B for encryption)
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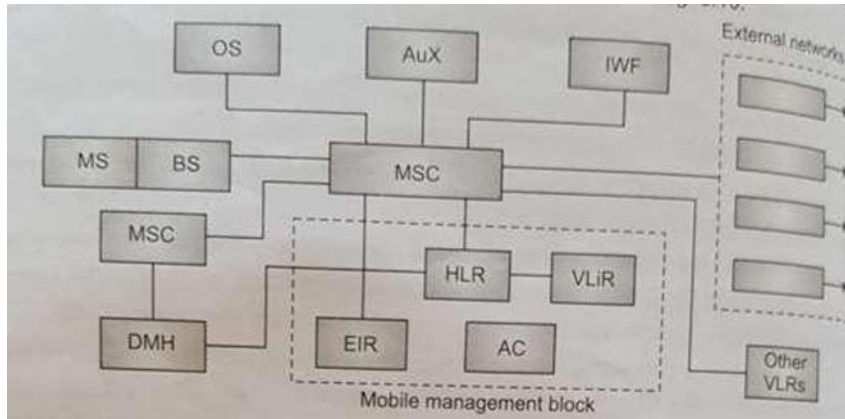
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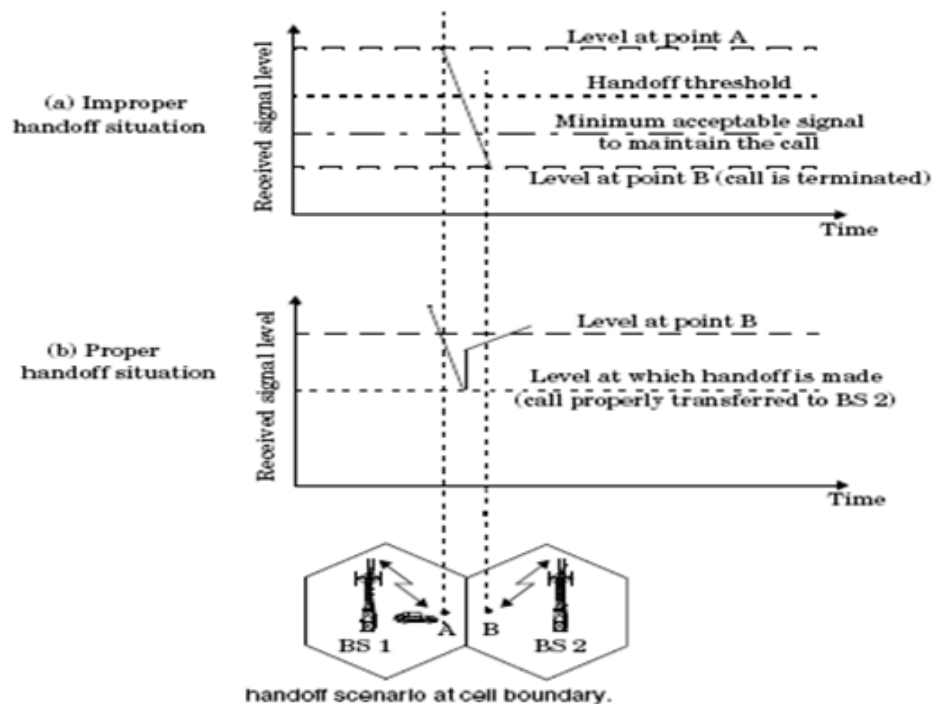
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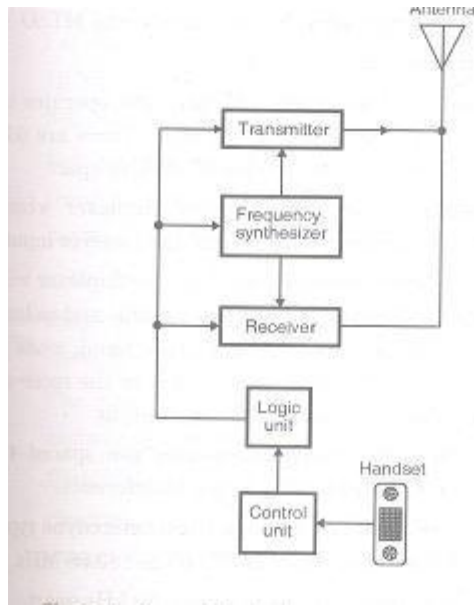


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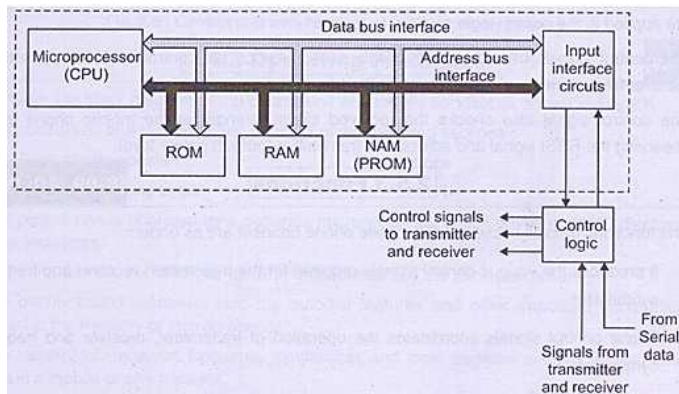
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