

Q-1 What is Simulcast Paging system ?

Ans-1 A Simulcast Paging system refers to a system where coverage is continuous over a geographic area serviced by more than one paging transmitter. In this type of system the pager can be receiving signals from two or more paging transmitters when in the overlap area of the two or more paging transmitter.

Q-2 Define page.

Ans-2 A message is sent to a paging subscriber via the paging system access number which is usually a toll free telephone number with a telephone keypad or modem. The issued message is called a **page**.

Q-3 What are the functions of Forward control channels?

Ans-3 Forward control channels are responsible for initiating mobile calls and they also serve as beacons which continually broadcast all of the traffic requests for all mobiles in the system.

Q-4 What is Station Class Mark?

Ans-4 The Station Class Mark (SCM) is a 4 bit number which holds three different pieces of information. Your cellular telephone transmits this information to the cell tower.

- a. Bit 1 of the SCM tells the cell tower whether your cellphone uses the older 666 channel cellular system, or the newer 832 channel cellular system. The expansion to 832 channels occurred in 1988.

Bit 1:

0 = 666 channels

1 = 832 channels

- b. Bit 2 tells the cellular system whether your cellular telephone is a mobile unit or a voice activated cellular telephone.

Bit 2:

0 = Mobile cellular telephone

1 = Voice activated cellular telephone

- c. Bit's 3 and 4 tell the cell tower what power your cellular telephone should be transmitting on.

Bit 3/4:

00 = 3.0 watts (Mobiles)

01 = 1.2 watts (Transportables)

10 = 0.6 watts (Portables)

11 = Reserved for future use

Q-5 What is MIN?

Ans-5 A MIN (mobile identification number) is a serial number that uniquely identifies a cell phone services subscriber within a mobile carrier network. It is used by mobile phone services providers to identify subscribers within its database, specifically when routing calls. MIN can also be called a mobile subscriber identification number (MSIN). MIN is a 10-digit number that is derived from the mobile's phone number. It consists of two different parts MIN 1 and MIN 2. The **MIN 1** is usually the 24-bit number after the area code. **MIN 2** is the area/mobile subscriber code. The mobile number identifies the subscriber directory number, an electronic serial number for identifying the phone number, whereas the MIN is used to identify the subscriber.

Q-6 What does Electronic Serial Number (ESN) mean?

Ans-6 An Electronic Serial Number (ESN) is a unique identification number embedded by manufacturers on a microchip in wireless phones. The ESN is automatically transmitted to a base station when a call is made. The carrier's mobile switching office then detects the ESN and checks the validity of the call to prevent fraud. The electronic serial numbers are used in devices using code division multiple access (CDMA) technology. A 32-bit ESN has 8 bits representing a manufacturer code, 18 bits for a unique serial number and 6 bits reserved for future applications. The numbers are also used for time attendance and registration tracking.

Q-7 What is Handoff ?

Ans-7 When a mobile user is engaged in conversation, the mobile station (MS) is connected to Base station (BS) via radio link. If the user moves to the coverage area of the another BS, the radio link to the old BS is disconnected and radio link to new BS is established to continue conversation. This process is called **automatic link transfer or handoff**.

Q-8 What is Roaming?

Ans-8 Roaming refers to the ability for a cellular customer to automatically make and receive voice calls, send and receive data, or access other services, including home data services, when travelling outside the geographical coverage area of the home network, by means of using a visited network.

Q-9 What is cell splitting and why it is used?

Ans-9 Cell splitting is the process of subdividing a congested cell into smaller cells such that each smaller cell has its own base station with reduced antenna height and reduced transmitter power. It increases the capacity of a cellular system since number of times channels are reused increases.

Q-10 What is Cell Sectoring and why it is used?

Ans-10 Cell Sectoring involves replacing an omni directional antenna at the base station by several directional antennas. **Cell sectoring** is done mainly to reduce factors such as co-channel interference.

Q-11 What is umbrella cell pattern and why it is used?

Ans-11 Different antenna heights and different power levels can be used to provide small and large cells located at single site. This technique is called as **umbrella cell pattern**. It is used to provide large area coverage to high speed users while small area coverage to low speed users. It also ensures additional microcell channels for pedestrian users. The speed of each user is estimated by base station or MSC by evaluating how rapidly the short term average signal strength on RVC changes over time or with sophisticated algorithms. If high speed user in the large umbrella cell is approaching the base station, and its velocity is rapidly decreasing, the base station may decide to hand the user into the co-located microcell without MSC permission. This approach is basically used to reduce number of hand off for high speed users.

Q-12 What is cellular frequency reuse?

Ans-12 In the cellular concept, frequencies allocated to the service are re-used in a regular pattern of areas, called 'cells', each covered by one base station. In mobile-telephone nets these cells are usually hexagonal. In radio broadcasting, a similar concept has been developed based on rhombic cells.

Q-13 What is meant by handover technique?

Ans-13 In a cellular radio system having a two layer cell structure comprised by macro cells Overlaying microcells, Handover occurs only via the macro cell layer. Thus when the quality of a call handled by a microcell deteriorates below predetermined criteria the call is handed up rapidly to the umbrella macro cell and is only handed back down to a microcell when the handset has been in that microcell for a predetermined time and the quality of the link thereto exceeds predefined criteria.

Q-14 What are the different types of Hand over?

Ans-14 The different types of Hand over are-

- Intra-satellite hand over
- Inter-satellite hand over
- Gateway hand over
- Inter-system hand over

Q-15 Why do paging systems need to provide low data rate?

Ans-15 Paging systems are designed to provide ultra-reliable coverage even inside buildings. Since buildings can attenuate radio signals by 20 or 30dB. To maximize the signal to noise ratio at each paging receiver, we need to reduce the noise level. This can be achieved by reducing the

RF bandwidth to which the noise level is proportional. The small RF bandwidth thus results in low data rate.

Q-16 How does a low data rate lead to better coverage?

Ans-16 In a paging system, the signal level in a receiver degrades when the distance between the receiver and the base station becomes large. If the coverage of paging system is defined by the coverage area at which the signal to ratio is above a certain threshold, for a lower data rate, the noise level in the receiver will be smaller, thus for a fixed threshold, the coverage will be larger.

Q-17 The GSM TDMA system uses a 270.833 kbps data rate to support eight users per frame.

- (a) What is the raw data rate provided for each user?
 (b) If guard time, ramp-up time and synchronization bits occupy 10.1 kbps, determine the traffic efficiency for each user.

Ans-17 (a) Raw data rate provided for each user = $270.833 / 8 = 33.85$ kbps.

(b) **Traffic efficiency for each user** = $(1 - 10.1 / 33.83) \times 100\% = 70\%$

Q-18 The US Digital Cellular TDMA system uses a 48.6 kbps data rate to support three users per frame. Each user occupies two of the six time slots per frame. What is the raw data rate provided for each user?

Ans-18 Raw data rate provided for each user = $48.6 / 3 = 16.2$ kbps.

Q-19 For a hexagonal geometry $Q = \sqrt{2D / R}$, calculate the worst case co-channel signal to interference ratio for 4 cell cluster. For sufficient voice quality, S / I should be greater than or equal to 18 Db. Hence, analyze which cell size offers the best spectrum utilization.

Ans-19 For $n = 2$, we need $q \geq (6(C / I))^{1/2} = (6 \times 25.12)^{1/2} = 12.28$

$N \geq Q^2 / 3 = 12.28^2 / 3 = 50.24$

$N = 52$

$M = B_T / B_C N = 20 \times 10^6 / 30 \times 10^3 \times 52 = 13$ channels / cell.

Q-20 The interference between the neighboring base stations is avoided by

- Assigning different group of channels
- Using transmitters with different power level
- Using different antennas
- All of the above

Ans-20 a. Assigning different group of channels

Q-21 Radio capacity may be increased in cellular concept by

- Increase in radio spectrum
- Increasing the number of base stations & reusing the channels

- c. Both a and b
- d. None of the above

Ans-21 b. Increasing the number of base stations & reusing the channels

Q-22 Hexagon shape is used for radio coverage for a cell because

- a. It uses the maximum area for coverage
- b. Fewer number of cells are required
- c. It approximates circular radiation pattern
- d. All of the above

Ans-22 d. All of the above

Q-23 Centre excited hexagonal cells use

- a. Sectorized directional antennas
- b. Omni directional antennas
- c. Yagi uda antennas
- d. None of the above

Ans-23 b. Omni directional antennas

Q-24 For the improving outage discuss following parameters

- a. Increase TX power
- b. Decrease the deterministic path loss
- c. Change the antennas

Ans-24 Possible solutions for improving outage:

- a. Increase TX power: YES, this will work, since it increases the fading margin. Spectrum regulations may, however, prevent us from doing so.
- b. Decrease the deterministic path loss: YES, this may be possible. It can be done by making a BS taller, for instance.
- c. Change the antennas: YES, this will also work. If the signal can be focused better the total loss will become smaller. The focusing of energy will, however, make the system more sensitive to the direction in which the TX/RX is in. Spectrum regulations, limiting EIRP may also prevent us from doing this.

Q-25 What is a diversity receiver?

Ans-25 Diversity receiver is the diversity scheme applied at the receiver end of the antenna in all effective technique for reducing interference, where selective combiner is used to combine two-correlated signal.

Q-26 What is CDMA digital cellular standard (IS 95)?

Ans-26 IS-95- interim standard, IS 95 allows each user within a cell to use the same radio channel and user in adjacent cell also use the same radio channel since this is a direct sequence spread spectrum CDMA system.

Q-27 Define the term dwell time.

Ans- 27 The time over which a call may be maintained within a cell without handoff.

Q-28 Define co channel cells.

Ans-28 The cells that operate with the same set of frequencies are referred as **co channel cells**.

Q-29 State the expression used to locate co channel cells.

Ans-29 $N = i^2 + ij + j^2$

Q-30 State the expression that relates co channel reuse ratio (Q) to radius (R) of a cell.

Ans-30 $Q = D/R$

Where D – Distance between center of co channel cells.