J. Ch. N. V. S. S. L. Sai Sruti

22PAIA0471

ECE-B

ASSIGNMENT-1

1. Draw and explain the basic cellular system architecture.

Ans:

Basic cellular system:-

A basic cellular system consists of three parts: a mobile unit, a cell site and a mobile telephone switching office (MTSO) with connections to the link the three sub systems.

1. Mobile units:

A mobile telephone contains a control unit, a trans-receiver and an antenna system.

2. Cell site:

The cell site provides interface between the MTSO and the mobile units, it has a control unit, radio cabinets, antennas, a power plant and data terminals.

3. MTSO:-

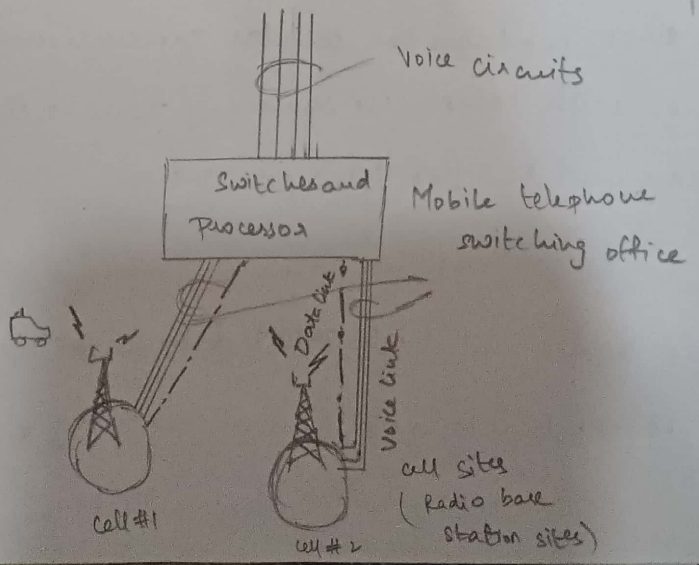
The switching office, the central co-ordinating elements for all cell sites, contains the cellular processor and cellular switch. It interfaces with telephone company zone offices, controls call processing and handles billing activities.

4. Connections:-

The radio and high-speed data links connect the three subsystems. Each mobile unit can only use one channel at a time for its communication link. But the

fixed : It can be anyone in the entire band assigned by the serving area, with each site having multichannel capabilities that can connect simultaneously to many mobile units.

The MTSO is the heart of the cellular mobile system. Its processor provides central coordination and cellular administration. The cellular switch, which can be either analog or digital, switches calls to connect mobile subscribers to other mobile subscribers and to the nationwide telephone network. It uses voice trunks similar to telephone company interoffice voice trunks. It also contains data links providing supervision links between the processor and the switch and between the cell sites and the processor. The radio link carries the voice and signaling between the mobile unit and the cell site. The high-speed data links cannot be transmitted over the standard telephone trunks and therefore must use either microwave links or T-carriers (wire lines). Microwave radio links or T-carriers carry both voice and data between the cell site and the MTSO.

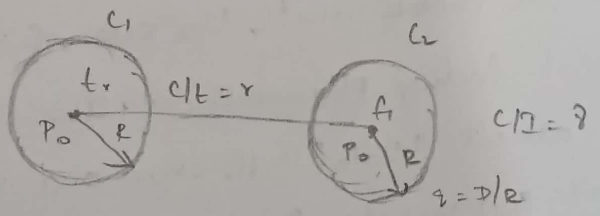


2. Define frequency reuse and explain reuse patterns.

Ans: Concept of Frequency Reuse Channels:

A radio channel consists of a pair of frequencies one for each direction of transmission that is used for full-duplex operation. Particular radio channels, say $f1$, used in one geographic zone to call a cell, say C1, with a coverage radius R can be used in another cell with the same coverage radius at a distance D away.

Frequency reuse is the core concept of the cellular mobile radio system. In this frequency reuse system users in different geographic locations (different cells) may simultaneously use the same frequency channel. The frequency reuse system can drastically increase the spectrum efficiency, but if the system is not properly designed, serious interference may occur. Interference due to the common use of the same channel is called co-channel interference and is our major concern is the concept of frequency reuse.



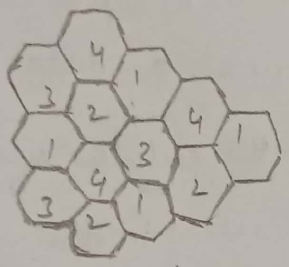
Frequency reuse scheme:-

The frequency reuse concept can be used in the time domain and the space domain. Frequency reuse in the time domain results in the occupation of the same frequency in different time slots. It is called time division multiplexing (TDM). Frequency reuse in the space domain can be divided into two categories.

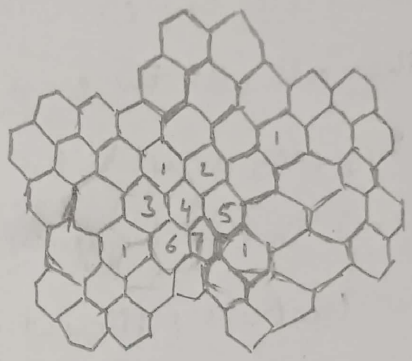
1. Same frequency assigned in two geographic areas, such as AM or FM radio stations using the same fre..., such as

different cities.

2. Same frequency repeatedly used in same general area in one system - the scheme is used in cellular systems. There are many co-channel cells in the system. The total frequency spectrum allocation is divided into k frequency reuse patterns, as illustrated.

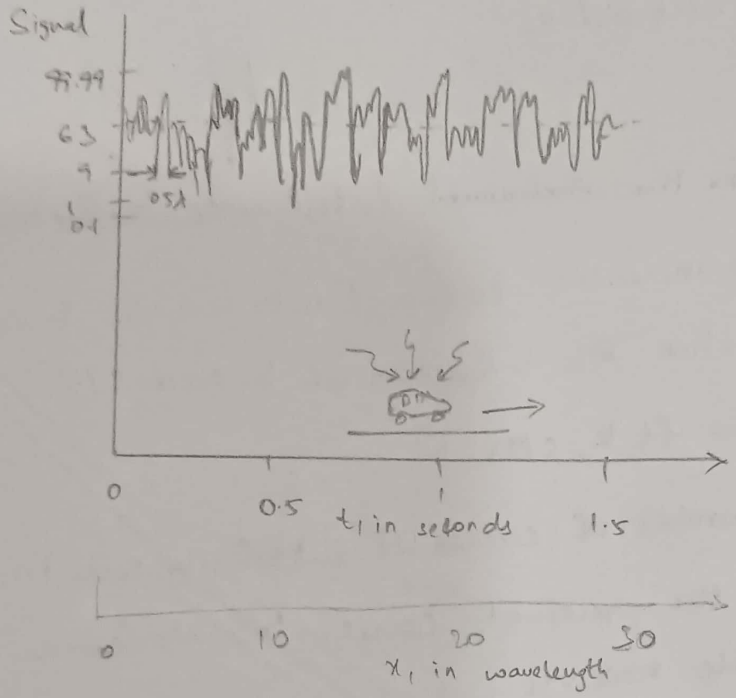


k = 4



3. Explain the phenomenon of severe fading in mobile communication.

Ans: If the antenna height of the mobile unit is lower than its typical surroundings, and the carrier frequency wavelength is much less than sizes of the surrounding structures, multipath waves are generated. At the mobile unit, the sum of the multipath waves causes a signal-fading phenomenon. The signal fluctuates in the range of about 40dB (10dB above and 30dB below the average signal). We can visualize the nulls of the fluctuation at the baseband at about every half wavelength in space, but all nulls do not occur at the same level. If the mobile unit moves fast, the rate of fluctuation is fast. For instance, at 850MHz, the wavelength is roughly 0.35m (1ft). If the speed of the mobile unit is 24 km/h (15 mi/h) or 6.7 m/s, the rate of fluctuation of the signal reception at a 10-dB level below the average power of a fading signal is 15 nulls per second.



R level dB	$\bar{n}_R$	$\bar{t}_R$	CDF
	0.00014	714.14	0.999
10		1.71	0.629
0	0.36788		
−10	0.28593	0.31426	0.09
−20	0.1	0.1	0.01
−30	0.0315	0.03168	0.001

$$P(r \le R) = \int_0^R P(r)\,dr$$ cummulative probability distribution (CDF)

$$\bar{n}(R) = \frac{\beta V}{\sqrt{2\pi}} \times n_R$$ level crossing rate

$$\bar{t}(R) = \frac{\sqrt{2\pi}}{\beta V} \times \bar{t}_R$$ average duration of fades

$$P(r) = re^{-r^2}$$ Rayleigt distribution

4. What is the concept of co-channel interference reduction factor.

Ans: Reusing an identical frequency channel in different cells is limi-ted by cochannel interference between cells, and the cochannel interference can become a major problem.

Assume that the size of all cells is roughly the same. The cell size is determined by the coverage area of the signal strength in each cell. As long as the cell size is fixed, cochannel interference is independent of the transmitted power of each cell. It means that the received threshold level at the mobile unit is adjusted to the size of the cell. Actually, cochannel interference is a function of

a parameter q is defined as

$$q = D/R$$

The parameter q is the cochannel interference reduction factor. w
-en the ratio of q increases, cochannel interference decreases. Further
-more, the separation D is a function of k and C/I.

$$D = f(k, C/I).$$

where k_1 is the number of cochannel interfering cells in the first tier and C/I is the received carrier-to-interference ratio at the desired mobile receiver.

$$\frac{C}{I} = \frac{C}{\sum_{k=1}^{k_1} I_k}$$

In a fully equipped hexagonal-shaped cellular system, there are alwa
-ys six cochannel interfering cells in the first tier, as shown; the
is $k_1 = 6$. The maximum number of k, in the first tier can be
shown as 6.

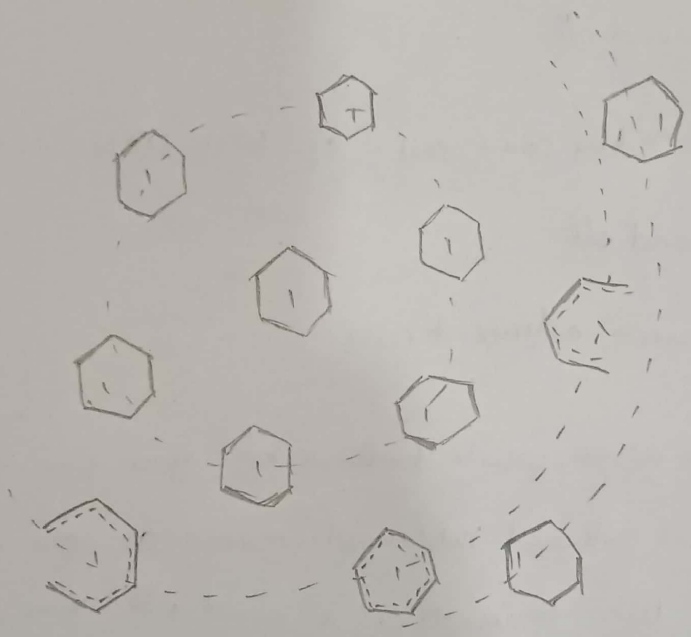
$$\frac{C}{I} = \frac{R^{-\gamma}}{\sum_{k=1}^{k_1} D_k^{-\gamma}}$$

where γ is a propagation path-loss slope determined by the actual terrain environment. In a mobile radius medium, γ usually is assumed to be 4. k is the number of cochannel interfering cells and is equal to 6 in a fully developed system, as shown in fig. The six cochannel interfering cells in the second tier cause weaker interference than those in the first tier. Therefore, the cochannel interference from the second tier of interfering cells is negligible.

$$\frac{C}{I} = \frac{1}{\sum_{k=1}^{k_t} \left(\frac{D_k}{R}\right)^{-\gamma}} = \frac{1}{\sum_{k=1}^{k_t} (q_k)^{-\gamma}}$$

where q_k is the cochannel interference reduction factor with kth cochannel interfering cell

$$q_k = \frac{D_k}{R}$$



5. What is hand off? Explain different types of hand offs with suitable examples?

Ans. Hand off is the process of transferring an ongoing call (or) data session from one cell/base station to another as a mobile user moves across cell boundaries.

Types:

1) Hard hand off;

* Break before make connection.
* old link is broken before new link is established.
* Eg: Traditional GSM networks.

2) Soft hand off:

* 'Make-before-break' connection.

* mobile connects to two base stations simultaneously during transition.

Eg: CDMA networks.

3) Intra-cell hand off:

* Occurs within the same cell · eg: b/w sector antennas.

4) Inter-cell hand off:

* occurs between adjacent cells.

Eg: When you move while talking on your phone, and your call continues without interruption even as you move from one coverage area to another, a hand off has occurred.