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## MDM Assignment - 4

Q1. What do you understand by the term "Location Management"? ... central location

In cellular system, a mobile unit is free to move around within the entire range of coverage, and its movement is random making its geographical location unpredictable. Hence we need Location Management, which is identification of the current point geographical location or current point of attachment of a mobile unit which is required by the Mobile Switching Center to route a call to the receiver. Further it also performs transferring of session to next base station, to resume the session seamlessly. It kind of a directory management problem where locations are maintained continuously to minimize the communication overhead due to updates.

One of the several schemes regarding location management is the Location Search using forward Pointers.

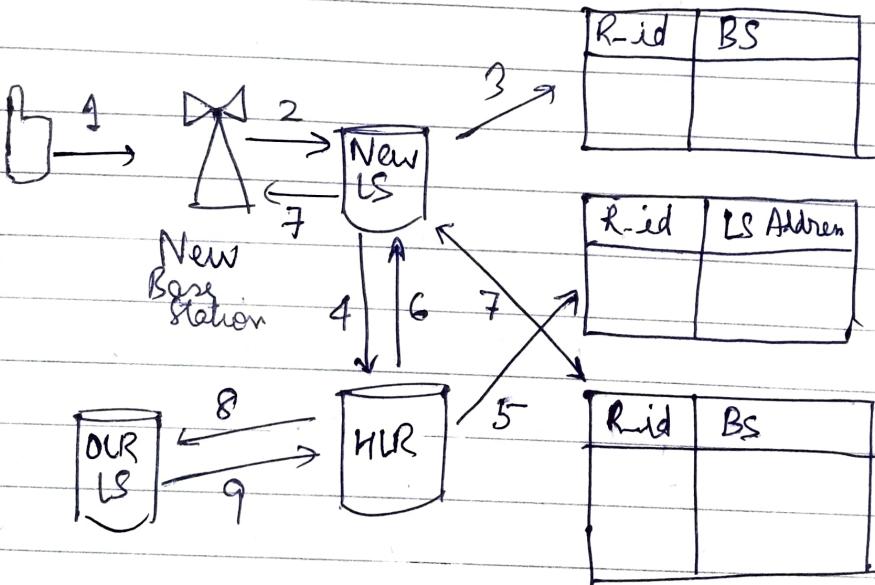
The steps are as follows :-

- 1) Caller sends a location query to the Source Base Station
- 2) Source Base Station forwards the query to Source Location Server
- 3) Source LS performs lookup in VLR, if found then location is known
- 4) If VLR fails then query is forwarded to HLR
- 5) Destination HLR finds Destination LS
- 6) Destination HLR sends Destination LS information to Source LS.
- 7) Destination Source LS finds first forward pointer and traverse to reach current LS.
- 8) The location of current base station is sent to Source LS.

The location update of Mobile unit on the other hand has the following steps :-

- 1) Mobile unit on movement to new location Server, informs new base station
- 2) New BS sends update query to New LS
- 3) New LS searches HLR in its database

- 4) New location of mobile unit is sent to the HLR
- 5) Old location is replaced by new location.
- 6) HLR sends information to New LS.
- 7) New LS stores the information and informs the new BS.
- 8) HLR also sends message about old LS to delete old location data
- 9) Old LS sends a confirmation to HLR



Location Update Steps

(Q2)

Investigate how data flows through wireless ... this model.

When a mobile unit or a broadcaster wants to send some data or broadcast a set of data it can follow two different approaches :-

i) Sends all the sets of data sequentially over a single channel, and the receivers can even receive them sequentially. Problem arises in case a selective tuning, where a receiver need only a part of data.

ii) The sender broadcasts each set of data over different channels, and each receiver can selectively tune over the channels as per their requirements.

Data streams on a wireless channel follow certain sets of rules, called protocols, through which they are transported over

the channel to desired location. Two popular protocols include TCP and UDP. In TCP protocol data is continuously sent sequentially over the same channel to the receivers, but is computationally expensive and has high communication overhead.

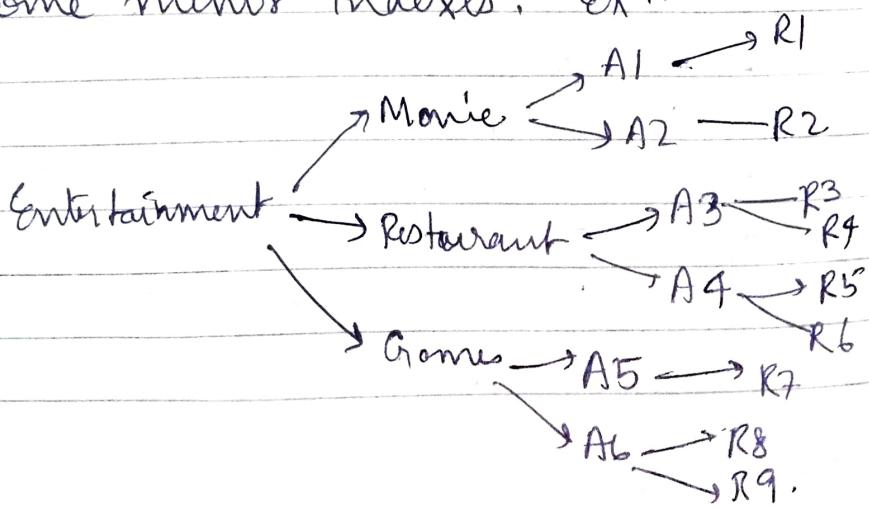
On the other hand UDP datagram protocol disseminates the data stream as packets where each packet may traverse a different optimal path as per the requirement and can be received at the receiver through different channels. This does not manage the sequence of packets and the data requirement of packets are higher as compared to the TCP.

In either case we can not eliminate the use of the broadcast disk. The broadcast disk enables more frequent pushing of data over a faster channel and than on a slower one. Several mobile unit receivers have varied capabilities and does not follow the same transmission rate as of the sender, hence broadcast disk will always be necessary for no loss of data.

Q3. How the use of major and minor index improves ... answer.

In date broadcast the problem of date search becomes a bottleneck which is handled by broadcast indexing. The indexing scheme for date broadcast is time-based and indicates to the user at what time data will be available from last tuning to the channel.

In Major and Minor indexing, the Major index provides information about the types of data broadcasted, where a major index does not directly point to the data, but points to the Minor sub-index. The minor indexes also called the location pointers point to the data which are associated with a location. Thus a date search includes accessing a major index and some minor indexes. Ex:-



Hence the use of Major and Minor indexes acts as a Divide and Conquer algorithm for a data search. Instead of searching a data item over the whole database, the use of Major indexes restrict the regions and hence divide the database, where only a certain regions may be searched. Then with the use of several minor indexes the search space is further divided, until a block is formed, where the data search is performed.

Creating more levels of indexing would evidently improve the data access because each indexing divides a search space to smaller regions, where it will be more relevant and easier to search for the data. But then as the number of levels will be bottlenecked by the attributes of the data items, like if the data items have  $n$  attributes, then it won't be possible to have more than  $n$  levels of indexing. Even each indexing require storage for storing relevant information of indexed items.

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As an example let's say there are data items categorised by three attributes A, B & C, where all are binary attributes and the number of data items in each set is equal and counts 100.

Hence,

Number of Items ( $A=0/1, B=0/1, C=0/1$ ) = 100

$\therefore n(A=0, B=0, C=0) = 100$

and similarly for all other combi-

If we use search for two level based index involving A and B Then for any item say 'i' we need to search for 200 items for both  $C=0$  and  $C=1$ .

On the other hand if we use three level of indexing involving A, B and C, we need to search only 100 items, as we will have information and distinct item set regarding all the attributes.

Q5

Clearly explain the diff. b/w a hard and a soft handoff. Explain ... a handoff.

When a cellular unit crosses its cell boundary and enters a neighbouring cell, due to fading, the signal strength decreases. Hence the system transfers the ongoing communication session to a new channel in the new base station, and this migration of unit from one cell to another is called handoff. It maintains that communication is maintained without interruptions.

There are two types of handoffs:-

1) In hard handoff the mobile unit experience momentary silence in communication during migration, because at any time MU is attached to only one BS and hence a link channel must be terminated before acquisition of a new one.

2) In soft handoff since a mobile unit can simultaneously be connected to multiple channel links over different base stations, hence there is no silence in communication over migration, since the migration is a ~~also~~ software based channel switching over the unit.

There are five ways of processing a handoff :-

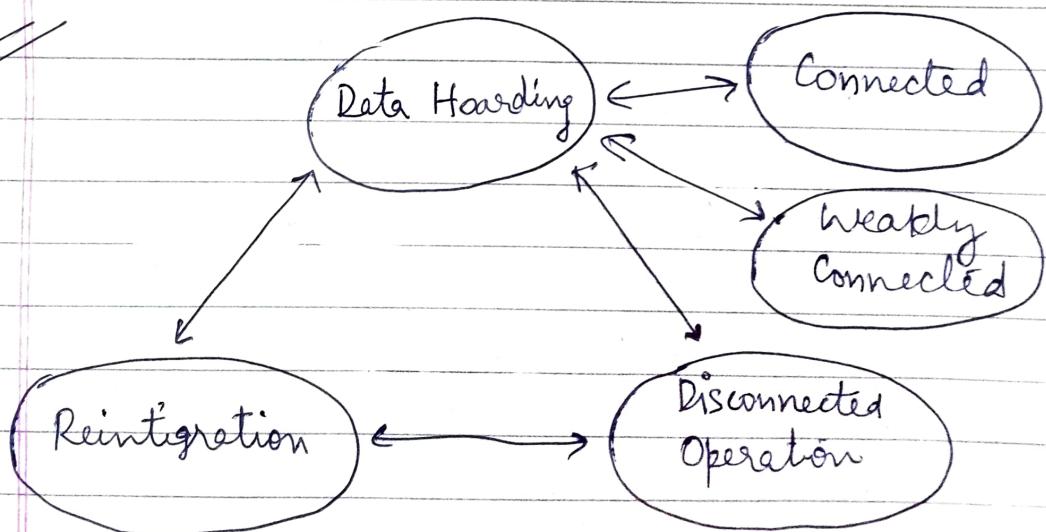
- i) Intra-cell handoff, in which transfer occurs <sup>for</sup> only one BS and MV only switches channel
- ii) Intercell handoff, in which transfer is over different BS connected over the same BSC
- iii) Inter-BSC handoff in which the two BS belong to different BSCs
- iv) Inter-MSO handoff, in which the transfer is b/w two BSs that belong to BSCs belonging to different MSO.

To manage, we may need either Soft or Hard Handoff. In soft handoff, as a MV comes closer to a BS, it acquires an optimal channel strength to store the channel over itself, so that <sup>internal</sup> switching can be performed according to strength.

In case of Hard Handoff management the MU first terminates the communication, upon which MS initiates a 'handoff request message' through new BS, upon which channel is transferred to new BS and communication is re-initiated. Then according to the type of handoff security key and location updation of the MU is performed.

Q6

In how many different modes a cell phone may enter? Explain ... modes.



The mobile unit may be operate under the following four modes according to the connectivity over the network.

i) In Connected Mode, the Mobile unit has enough channel strength such that any data transaction can be performed over the network and always the most recent data is read.

ii) In Weakly Connected Modes the network connectivity is either slow or expensive, and may be lost for short periods of time. Even there may be variation in signal strength. Here the cache misses of data query can be selectively serviced and different propagation of local updates are serviced.

iii) When a network disconnection is anticipated, the mobile unit moves to Data Hoarding state, where it caches most relevant data items to survive forthcoming disconnection. It here decides the induction of which data to hoard and stores them locally on a priority basis. It denotes the start of disconnected state.

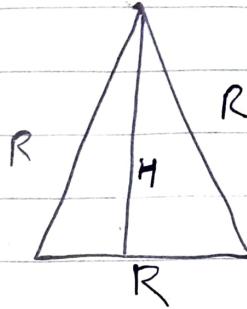
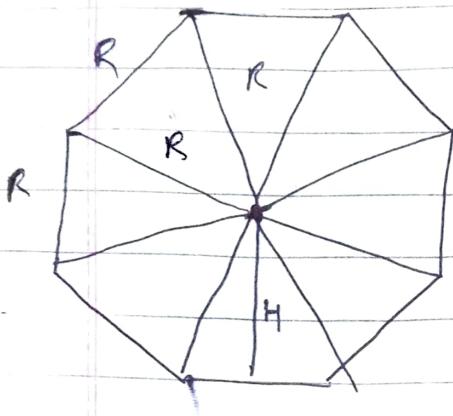
iv) In disconnected modes, the mobile unit has no connectivity over the network and hence all the cache miss over data query are handled as exception, if data is not hoarded. The unit logs all the locally made updates and performs optimisation of the log, so that it may help in reintegration mode.

v) Upon attaining connection after the disconnected mode, the Mobile unit enters reintegration mode, where updates performed locally as reflected in the log are re-integrated with updates performed at other sites. Operations performed at disconnected mode are accepted depending on the concurrency semantics adopted by the system.

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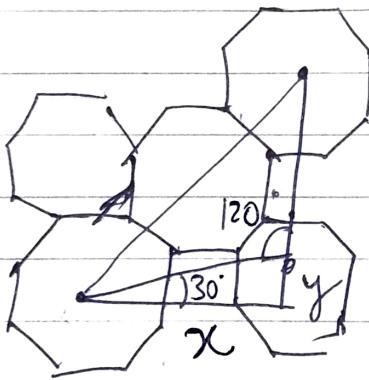
Q4

Prove the  $N = i^2 + ij + j^2$ , where N is the cell cluster size, i...j coordinate is  $60^\circ$  from i coordinate.



Here  
 $H = \sqrt{3}R/2.$

Now for  $D$  = Minimum Handoff distance



$$n = i\sqrt{3} R \cos 30 = \frac{3}{2} iR$$

$$y = i\sqrt{3} R \sin 30 = \frac{\sqrt{3}}{2} iR$$

where  $i, j$  represent the cell upto which we need to travel on  $i$  coordinate to some number of cells and turn clockwise or counterclockwise on  $j$  coordinate.

$$\therefore D^2 = \left(\frac{3}{2}iR\right)^2 + \left(\frac{\sqrt{3}}{2} + \sqrt{3}jR\right)^2$$

$$= 3R^2(i^2 + j^2 + ij)$$

$$\therefore D = R \sqrt{3(i^2 + j^2 + ij)}$$

$$= R \sqrt{3((i+j)^2 - ij)}$$

Now  $N$  = Number of cells in cluster

Now letting

$$R_1 = \frac{\sqrt{3}}{2} R$$

$$\therefore D^2 = (2R_1)^2 (i^2 + j^2 + ij)$$

Hence

$$3N \cdot R^2 = (2R_1)^2 (i^2 + j^2 + ij)$$

However

$$N \cdot 3 \cdot R^2 = 3 \cdot R^2 (i^2 + j^2 + ij)$$

$$\therefore N = (i^2 + j^2 + ij)$$

Here we have used the relation  
that  $3N \cdot R^2 = D^2$  where  $R$  is the  
radius of the hexagon.

(Q6)

continued—

When we talk about the modes in which a mobile unit can freely move around, then they are of three types:-

- 1) Active Mode
- 2) Doze Mode
- 3) Power Down Mode

In active mode the mobile actively communicates with other subscriber, and may move within a cell or encounter a handoff. In doze mode a mobile unit does not actively communicate with other subscribers but continues to listen to the base station and monitors the signal level around it, and in power down mode the unit is not functional at all. When it moves to a different cell in doze or power down modes, then it is neither possible nor necessary for the location manager to find the new location.