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4. (a) A cellular service provide deploys 210 cells in an area of 2100 km$^2$, where it has 30% market penetration rate. The system uses a cluster size of 7 and a total of 420 simplex channels. The system uses a fixed channel assignment, blocked calls cleared scheme and omni-directional antennas at the base station. The population density of the service area is 73 per km$^2$ and the average traffic load needed by each user is 0.1 Er.

(i) Determine the number of trunk channels per cell.

Answer 4 (a) (i) There are total 420 simplex channels per cluster
which mean 210 duplex channels per cluster
The number of trunk channels in a cell is $21/7 = 30$

(ii) Determine the traffic load per cell that needs to be offered by the system.

Answer: (ii) The size of a single cell is $\frac{2100\ km^2}{210} = 10\ km^2$
The population per cell is $73 \times 10 = 730$
The subscribers per cell are $730 \times 30\% = 219$
The traffic load per cell is $219 \times 0.1 = 21.9$ Erlang

(iii) Determine the amount of traffic blocked (Erlangs) for the service area.

Answer: (iii) The traffic load of the service area is $21.9 \times 210 = 4599$ Erlangs

(iv) Suppose the service provider decides to use the block call delayed scheme instead of the block call cleared scheme. Explain one advantage and one disadvantage of this change from the user's perspective. Justify your answer.

Answer: (iv) Numbers of channels per cell is 30
Offered traffic per cell is 21.9 Erlangs
When applying the blocked call clear scheme, according to the Erlang B table, the $P_B = 2\%$
When applying the blocked call delay scheme, according to the Erlang C table, the $P_D = 7\%$

The advantage of this change is that there will barely no call be blocked after waiting for a certain amount of time

The disadvantage of this change is that the probability of successfully making a phone call without any delay or block is dropping from 98% to 93%.

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4 (b) Considering a typical cellular system with the service area partitioned into clusters with each cell having a BS serving the MS. There are four other basic components in a typical cellular network system besides the "MS" and the "BS". Explain the functions of these four components and sketch the block diagram to show how all these components function as a cellular network system.

Answer (b) 1. Gateway 2. Databases 3. Air interface standard 4. Security mechanism

1. Gateway: to connect the Radio access network with the wireline network, as well as connect the cellular system with the PTSD

2. Databases: store the necessary access data and user information.

3. Air Interface Standard: Define the protocols and rules how the Mobile station and base station communicate in the wireless channels.

4. Security mechanism: protect the integrity and privacy of the users' data as well as the security of the system.