CELL (5I050)
TD 1

Exercise 1:

Consider a base station transmitting at 1 W. The attenuation of the signal follows the free space propagation model. For a correct reception of the signal, the received signal power must be at least -105 dBm. Calculate the cell size for the following frequencies:

    a) 900 MHz
    b) 1800 MHz

Exercise 2:

The cell size is limited by a maximum attenuation of 140 dB. The height of the base station's antenna is 30 m and the mobile antenna's height is 1.5 m.

    a) Calculate the maximum cell size for f = 900 MHz in an urban environment using the Okumura-Hata propagation model.
    b) Calculate the maximum cell size for f = 1800 MHz in an urban environment using the COST 231 - Hata propagation model.

Exercise 3:

The GSM system uses FDD (Frequency Division Duplexing) to provide duplex channels.
    a) What are the uplink and downlink frequency bands?
    b) These frequency bands are divided into sub-bands of 200 kHz. These sub-bands are also known as "frequencies" or "carriers". How many pairs of carriers are there in GSM?
    c) What is the duplex spacing in GSM?
    d) If the downlink frequency allocated to a mobile is 935.2 MHz, what is the uplink frequency of the communication?

Exercise 4:

The GSM system uses TDMA (Time Division Multiple Access) to share a frequency among users.

a) Each frequency is divided into time slots of 0.5769 ms. How many time slots are there in a TDMA frame? Calculate the duration of a TDMA frame?

b) A GSM network operator has 21 duplex frequencies. If the frequency reuse pattern has K = 7, what is the maximum number of communications that a cell can support simultaneously?

c) In the mobile terminal, what is the time spacing between transmission and reception time slots?

Exercise 5:

Let's consider a GSM network divided into 4 zones as shown in the following figure.
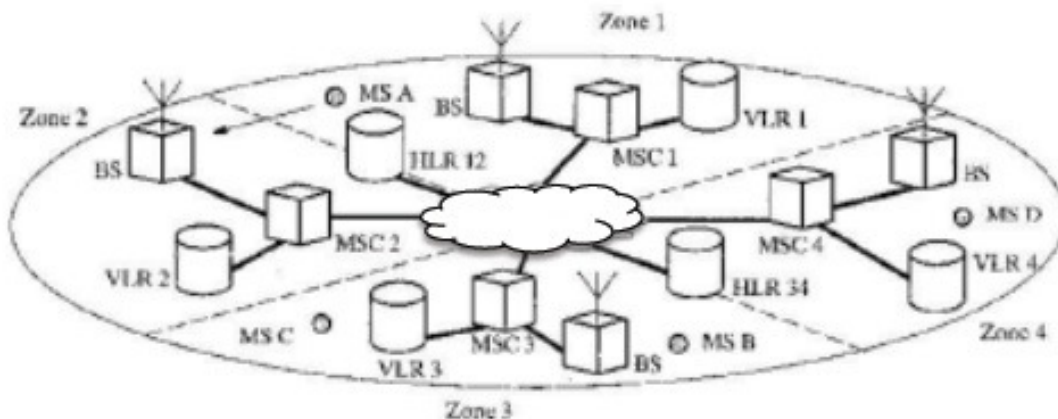
The identifier of the network (Network ID) is 171. Zones 1 and 2 use HLR12. Zones 3 and 4 use HLR34. The home zone and the mobile subscriber number of each are as follows:
- MS A : zone 2 : 0815
- MS B : zone 4 : 4711
- MS C : zone 1 : 0007
- MS D : zone 3 : 0218

Suppose that mobile terminals have already registered in their home zone since the beginning and their current location is shown in the figure.

a) For each mobile terminal, give the HLR which keeps the subscriber profile? Describe the entries of each HLR using the following format (Subscriber X: [MSISDN, MSRN])? (Note: The MSRN number follows the format [Network ID, MSC ID]. The MSISDN number follows the format [Network ID, HLR ID, subscriber number]).

b) For each mobile terminal, give the VLR containing the subscriber profile? Describe the entries of each VLR following the format (Subscriber X: [MSISDN, TMSI])?

c) Terminal A moves from zone 1 to zone 3 through zone 2. How do the VLR entries change? Describe the location update procedures performed by the network.

d) Terminal A is now in the zone 3 and wants to make a call to terminal D. Describe the call establishment procedure related to mobile terminals, MSCs, HLRs and VLRs?