Satellite Communication: Exercises

1- The TLE of three telecommunication satellites are given below:

1 41918U 17003B 19309.62692705 .00000074 00000-0 19434-4 0 9999

2 41918 86.4012 17.8452 0002345 83.7614 276.3849 14.34217262147010

1 43233U 18024C 19309.50863641 -.00000029 00000-0 00000-0 0 9997

2 43233 0.0547 13.9394 0002581 211.3171 134.7277 5.00116407 30327

1 28884U 05041A 19310.14771662 .00000075 00000-0 00000+0 0 9999

2 28884 0.0316 278.6061 0001643 300.7953 105.8805 1.00271913 51404

a- One of these satellites is a geostationary satellite. Could you explain which parameters allow you to find the geostationary satellite?

b- Compute the semi-major axis and the altitude of each satellite.

2- Provide the expression of the spectral efficiency in terms of:

a. Data rate and Nyquist bandwidth.

b. Data rate and symbol rate.

3- Discuss the relationship between:

a. E_s/N_0 and E_b/N_0,

b. E_s/N_0 and C/N,

c. C/N_0 and C/N.

4- Consider DVB-S2 16APSK4/5 of roll-off 0.2 for a carrier occupying of full transponder of 36MHz,

a. Compute the symbol rate

b. Compute the spectral efficiency

c. Compute the data rate

d. From the DVB-S vs DVB-S2 graphic, determine the required E_s/N_0 [dB](operating point). Compute the corresponding E_b/N_0 [dB]

5- A gateway is communicating with a terminal through a geostationary satellite in Ku. The uplink C/N_0 is 13dB higher than the downlink C/N_0. The satellite EIRP is 48 dBW and the terminal G/T is 16 dB/K

a. Give the expression of the total C/N_0 in function of the downlink C/N_0. Comment the result.

b. Give a typical frequency for the downlink in Ku.

c. Compute the downlink free space losses

d. Compute the total C/N_0 with clear sky.

e. Compute the global C/N

i. on 36MHz with a roll-off of 0.2.

ii. on 48MHz with a roll-off of 0.2.

f. For each case, determine in dB E_s/N_0. Propose a DVB scheme (S, S2 or S2X). Compute in dB the corresponding E_b/N_0.