1 – Exercise (6 points)

A personal Area Network based on IEEE 802.15.4 beacon enabled mode (only CFP) is deployed to collect temperature samples out of 20 sensor nodes. 5 sensor nodes are characterized by the following traffic requirements: $P(r=32[bit/s])=0.3$, $P(r=160[bit/s])=0.5$, $P(r=0)=0.2$. The remaining 15 sensor nodes have deterministic traffic with rate $r= 32[bit/s]$.

Assuming that the nominal rate is $R=250[kb/s]$, that the temperature samples are $L==25[byte]$ long and fit exactly in one slot of the CFP, design the Beacon Interval structure (slot duration, BI duration, number of slots in the BI) which minimizes the duty cycle under the requirement that all sensor nodes have the required average channel rate towards the sink/PAN coordinator.

2 – Exercise (6 points)

A Dynamic Frame ALOHA system is used to arbitrate 4 tags. Find out the collision arbitration efficiency knowing that the first frame has size $r_1=2$ (all the length of the following frames is optimally set to the current real backlog).

3 – Exercise (6 points)

A LoraWAN network is composed of one gateway and two sets of clients. Set 1 contains $N_1= 200$ clients which generate uplink packets according to Poisson process with parameter $\lambda_1=0.5$ [messages/minute] and using a Spreading Factor $SF_1=7$ with related transmission time $T_1= 10[ms]$. Set 2 is composed of $N_2=100$ clients which generate uplink packets according to Poisson process with parameter $\lambda_2=0.2$ [messages/minute] and using a Spreading Factor $SF_2=12$ with related transmission time $T_2= 100[ms]$. Write the expressions of the collision probability for a client of type 1 and 2 and the collision probability of a generic client.

3 – Questions (8 points)

1. What is the predicted frame size by Schoute's estimate if the previous frame was composed of: 2 slots with successful transmissions, 5 empty slots, 6 slots with collisions?
2. A mote runs the IEEE 802.15.4 Carrier Sense Multiple Access procedure. The current parameter are CW=2, NB=1, BE= 4. Briefly explain what is the use of these parameters. In which range the mote will choose the next slot for sensing the channel?
3. Briefly explain the use of the *Block Transfer mode* in the COAP