SMART GRID FUNDAMENTALS
2021/2022

DEEC
DEPARTAMENTO DE ENGENHARIA
ELECTROTÉCNICA E DE COMPUTADORES
TÉCNICO LISBOA

ASSIGNMENT II
IEEE 802.15.4 (AND LORAWAN)

This assignment is to be done by a group of two students. The students are encouraged to prepare the assignment before the class considering the indicated parameter values. In the classroom, the professor will indicate the specific parameters to be used by each group, so the students should make themselves ready to easily adapt their calculations and software to the new parameters.

ATTENTION: Please, don't forget to show the exercises to the professor before leaving the classroom, since the progress will be evaluated.

1. Consider IEEE 802.15.4 example SGF/IEEE802154/Ex. 1. Obtain the maximum communication range both by simulation and compare with the calculated results. Don't forget that the path loss model corresponds to a log-distance path loss model, where the parameters can be obtaining by navigating into *radioMedium.pathLoss*. For distances greater than the breakpoint distance, the relevant parameters are *radioMedium.pathLoss.l02* and *radioMedium.pathLoss.alpha2*.

2. Create a copy of example SGF/IEEE802154/Ex. 1, and modify it so that both nodes run one instance of the *UdpBasicApp* application instead of the Ping application.
   a. Considering the application message size to be 40 bytes, configure the simulation to allow measuring the maximum throughput in bit/s. Suggestion: change the *UdpBasicApp.sendInterval* parameter so that the data rate is increased; when the received amount of data ceases to increase in the same proportion, it means that the network is saturated, i.e. the network is unable to carry more data per unit time.
   b. Repeat a). using a packet size of 100 bytes. How does the maximum throughput vary with packet size? Justify.
   c. Repeat a), but at this time with 20 nodes transmitting to another one. It may be advantageous to change the mobility model of the transmitting nodes to *CircleMobility*, so that the receiver node can be placed at the center of the circle formed by the transmitters. Consider a circle radius only a little bit smaller than maximum range. How does the maximum throughput vary with the number of transmitters? Justify.

3. Consider the example SGF/IEEE802154/Ex. 2 in *Static2* configuration.
   a. Run the example and obtain the average end-to-end delay.
   b. Create a copy of example SGF/IEEE802154/Ex. 2 and modify it so that the hosts and gateway belong to class *SensorNode* instead of *AodvRouter*, and the grid area of *Static2* configuration is reduced to 100mx100m. Measure the end-to-end delay and compare with that obtained in a). Justify.

4. **(Optional)** Run the LoRaWAN example. Answer the following questions:
    a. Which spreading factors (SFs) are being used?
    b. What is the pathloss model being used, and which are the values of the main parameters?
    c. Calculate the maximum communication range, taking into account an average shadowing effect.
    d. What is the Packet Error Rate in the LoRaWAN wireless interface?
    e. What are the reported causes of packet loss?