Lab Exercise

Measuring the packet loss due to interference using Contiki-OS and Zolertia Z1 sensor nodes

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Objective The objective of this lab is to monitor the packet loss rate for different scenarios using the Contiki-OS and Zolertia Z1 sensor nodes. In order to perform the experiment, each group needs to setup a sender and receiver using Zolertia Z1 motes. The sender node will continuously measure the temperature, humidity and light values and will send them to the receiver node. Each group needs to perform following three experiments.

- First each group must use unique channel for communication and evaluate the packet loss rate (ContikiMAC).
- Second each group then use the same channel but unique node id for the receiver (again ContikiMAC).
- Atlast each group must repeat the previous configuration with No MAC and RDC technique (Receiver listening all the time).

Steps to follow Each group will be provided two Zolerta Z1 sensor nodes and one Raspberry pi. Raspberry Pi will be used for logging the data from receiving sender node. The following steps should be followed sequentially in order to perform the experiment successfully.

Log in to Raspberry Pi

- In order to start the experiment, you should first log in to the given Raspberry Pi.
- If you are using Windows operating system without ubuntu virtual machine then first download the PuTTY tool from www.putty.org.
- Then connect your laptop to the network with **SSID : CN-Students** and **Password : CnStudentsWiFiAccess123**. Once connected to this access point you will not be able to access internet.

- Install and open the putty tool. Enter the the name of your Raspberry Pi in Host Name field i.e. **pi@kalium** and select the connection type as **SSH** and click **Open**. A window will pop up asking for the password of your Raspberry Pi. Use the password written on the given paper.

- If you are using virtual machine for ubuntu then simply open the terminal and SSH to the given Raspberry Pi i.e. **ssh pi@kalium** and type the password written on the given paper.
- Now you need to setup the receiver Zolertia Z1 node.

Setting up Receiver

- To check the address of the connected Zolertia Z1 nodes, type **ls /dev/ttyUSB*** on the terminal. It will display the path of connected devices i.e. **/dev/ttyUSB0 /dev/ttyUSB1**
- Select the device connected to **/dev/ttyUSB0** as the transmitter node and **/dev/ttyUSB1** as the receiver node
- Now change the working directory to /home/pi/ComNets-contiki-master /examples/iotlab i.e. **cd /home/pi/ComNets-contiki-master/examp les/iotlab**

- Once you changed the directory, configure the address of the receiver node that will be required by the sender to send packets.

- The address of the receiver node can be configured by changing node id of the Zolertia Z1 node. Use **sudo make clean && sudo make TARGET=z1 MOTES=/dev/ttyUSB1 burn-nodeid.upload nodeid=3** to change the address of the receiver Zolertia Z1 node.

- Once the node id is changed, upload the receiver program on the Zolertia Z1 node using **sudo make clean && sudo make TARGET=z1 MOTES =/dev/ttyUSB1 receiver.upload**
- Once the program is successfully uploaded to the Zolertia Z1 node then follow the instructions below to setup the sender Zolertia Z1 node.

Setting up sender

- Change the working directory to /home/pi/ComNets-contiki-master/examp les/iotlab i.e. **cd /home/pi/ComNets-contiki-master/examples/iotlab**

- Once you changed the directory, configure the radio channel and receiver address for communication between sender and receiver node.

- A radio channel between 16-25 should be selected for communication between sender and receiver. In order to avoid interference, every group should select unique channel for communication.

- In order to configure the radio channel, open the Makefile using **sudo nano Makefile**. Once opened, set the channel by changing **DRF_CHANNEL** parameter. Use **CTRL+x** to exit and type Y to save the changes.
- Now use the same address or node id that you have used while setting up the receiver Zolertia Z1 node and update the address in sender.c file. Open the sender.c file using **sudo nano sender.c**. Once opened update the **addr.u8[0]** parameter by the node id that you used for the receiver Zolertia Z1 node. Use **CTRL+x** to exit and type Y to save the changes.
- Now upload the sender program to the Zolertia Z1 node using **sudo make clean && sudo make TARGET=z1 MOTES=/dev/ttyUSB0 sender.upload** .

Test your setup

- In order to test whether the receiver Zolertia Z1 node is receiving packets from the sender Zolertia Z1 node write **make TARGET=z1 MOTES=/dev/ttyUSB1 login** in terminal from the same working directory i.e /home/pi/ComNets-contiki-master/examples/iotlab and press enter.
- If everything is working properly then the receiver will print the received packets on terminal.
- In order to save the received packets from sender Zolertia Z1 node. Type **sudo python loging.py** on terminal and press enter.
- This will create a **rcvddata.csv** file in the current working director that can later be used for further analysis.
- Run the whole setup for atleast 5 minutes. After five minutes stop the python script by typing **CTRL+C** on the terminal and rename the rcvddata.csv file to exp1.csv using **mv rcvddata.csv exp1.csv** command on the terminal.

Then repeat the whole experiment using same channel i.e 20 by every group for communication but unique node ids for the receiver. Again run the experiment for at least five minutes and save the final file as exp2.csv

At last disable the ContikiMAC and radio duty cycling. To disable the ContikiMAC and radio duty cycling open the project_conf.h file in the same directory using **sudo nano project_conf.h** and add following two entries into the file.

#define NETSTACK_CONF_RDC nullrdc_driver

#define NETSTACK_CONF_MAC nullmac_driver

Then save and close the file. After configuring project-conf.h open Makefile using **sudo nano Makefile**, change the #**CFLAGS += -DPROJECT_CONF_H=¨project-conf.h¨** entry to **CFLAGS += -DPROJECT_CONF_H=¨project-conf.h¨** by removing the # from start. Again upload the receiver and transmitter codes on the Zolertia Z1 sensor nodes and store the results at the end in exp3.csv file.

Compare the results from three files and give logical reasoning on the behaviour of the received packets.