IOT PROJECT

Preamble

You have to start your workstation using local hard disk. For this lab you may have to download a number of resources from the web site of the course , `https://icampus.esiee.fr`). You will also have to provide a report at the end of the second session that you should upload to the same web site.

Previous labs and lectures of this course are important input materials that you need to master for this IoT project.

1 Introduction

During this project that will last two sessions you will have to setup a complete IoT processing chain from real wireless sensors to storage in database and presentation of data using a dashboard.

For this goal you will have to reuse all the tools that have been presented and studied during the previous lectures and labs, so you have to refer to them when necessary.

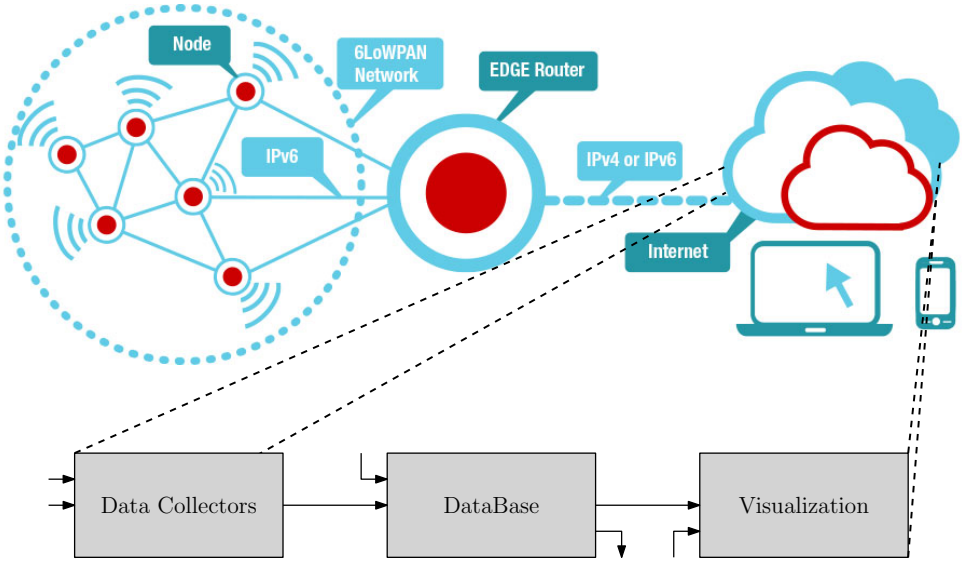

Figure 1
FUNCTIONALRESSOURCES OVERVIEW

The figure 1 illustrates the functional ressources required to implement this processing chain and figure 2 shows the hardware targets on which this functional resources have to be mapped.

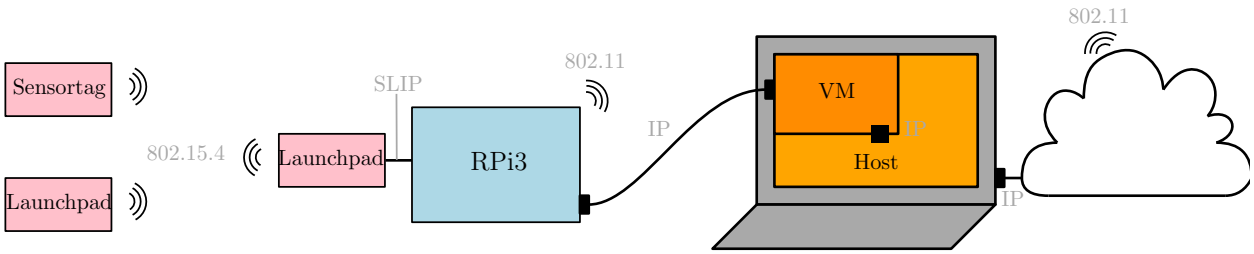

Figure 2
HARDWARE RESSOURCES OVERVIEW

2 Sensors network

The sensors network will be implemented using CC2650 sensortag and CC2650 launchpad boards. This last board will play the role of border/edge router and will expose an IPv6 interface in the host (either the RPi3 or the VM) on which it will be connected. Each group will work with its own sensors network having its own channel and PANID, such that you should not interfere each other.

2.1 Wireless Sensors Network

In this part, you will setup the wireless sensor network. First you need to launch the Virtual Machine instant-contiki in VMware, after login as user(login)/user(password):

- Plug in the launchpad
- Check the device name: dmesg|tail
- In contiki/tools run the command `sudo ./tunslip6 -s /dev/ttyACM0 -B 9600 fd00::1/64` if the device name is `/dev/ttyACM0`.

This will create the virtual IPv6 interface for the edge router connected on `/dev/ttyACM0` through USB.

After resetting the Launchpad you should get the following log message in your command window:

```
Got configuration message of type P
Setting prefix fd00::
created a new RPL dag
Server IPv6 addresses:
fd00::212:4b00:7b1:a785
fe80::212:4b00:7b1:a785
Starting Contiki-3.x-3153-g263af6f
With DriverLib v0.47020
TI CC2650 LaunchPad
IEEE 802.15.4: Yes, Sub-GHz: No, BLE: Yes, Prop: Yes
Net: sicslowpan
MAC: CSMA
RDC: ContikiMAC, Channel Check Interval: 16 ticks
RF: Channel 25
Node ID: 42885
RPL-Border router started
*** Address:fd00::1 => fd00:0000:0000:0000
```

In the VM you can run firefox and connect to the address of the edge router: http://[fd00::212:4b00:7b1:a785] with the above example. It will provide you the list of its neighbors.

You can now run the sensortag powered only by battery or powered by the debug devpack. In this last case you can get log information from the sensortag thanks to the serial connection.

The easiest way to use this serial line is to use Tera-Term under windows (you should take care that the attached USB plug is linked to windows not to the VM). You should set the baud-rate to 115200 and in the terminal option the "New line" to auto for receive.

2.2 Sensortag IHM

- At startup green and red led blink alternatively quickly.
- After startup the sensortag look for its 802.15.4 network, the green led blinks quickly.
- Upon 802.15.4 association, the green led blinks slowly.
- After startup the sensortag try to connect to a MQTT broker at fd00::1-1883. If this connection is succesfull the green led is switched off, and blink only at each MQTT publication (*ie.* every 30*s*)
- One push on the left button stop the application, another press restart the application.
- One push on the right button trigger an asynchronous MQTT publication.

It should be emphasized that the sensortag also embeds a CoAP server providing the data for the same sensors than the MQTT client.

2.3 MQTT Broker

Normally a mosquitto MQTT broker is running as a service on the VM, so you should be able to check the published messages from the sensortag.

- The MQTT clients of the CC2650 sensortag will publish/subscribe to a broker located at the IPv6 address fd00::1
- The MQTT publisher client will publish the sensor values and other information in one JSON formated stringified object to the topic cc26xx/00124b9f0706/evt/status/fmt/json every 30*s* where 00124b9f0706 is the MAC address of the sensortag.Its IPv6 address in this case is fd00::212:4b00:69f:706.
- The MQTT subscriber client will subscribe to the topic cc26xx/00124b9f0706/cmd/leds/fmt/json. Writing a 1 to this topic will switch on the red led while writing a 0 will switch this led off.
- Another MQTT subscriber client will be able to subscribe to the sensors values published by the CC2650 sensortag by subscribing to the topic cc26xx/+/evt/status/fmt/json. Here it is more comfortable to use the one level wildcard "+" or the multilevel one "#", but you can also use the actual MAC address of the sensortag.

3 RPi3 or not RPi3

In fact you will be able to do exactly the same things, rather in the same way both with the VM and the RPi3. Even if this last one is the most appropriate hardware to implement this function. That is why it is suggested, for the sake of simplicity, to work

at first with VM to make the whole system run and then to shift the border/edge router and the according configurations from the VM to the RPi3 in a second step.

Further information about that will be provided in another lab statement.

4 Cloud processing

In this part you should setup the interface between the cloud processing pipe and the data coming from the sensors network.

4.1 Interface to the sensors network

For that you need check the IP address of the VM in the network between the VM and the host, you can get it using either one of the following commands on a terminal on the VM: ifconfig or ip addr.

If for any reasons you wish to make your MQTT broker available from any machine, you should either run this broker on the windows host or add NAT masquerade configuration to the VM which is out of the scope for this lab.

To use the broker on the windows host, you should first stop the one on the VM using the following command:

- sudo service mosquitto stop

Then you have to redirect the network trafic coming from the sensors network to FD00::1-1883 towards IPv4AddressOfTheHost:1883 with the command below:

- 6tunnel -6 1883 IPv4AddressOfTheHost 1883

You can get the IPv4 address of the host using the ipconfig command in a command window on the host.

Don't forget to launch the mosquitto broker on the host and restart the sensortag as indicated above.

4.2 IoT application

As stated above the sensortag will published a single stringyfied JSON to the broker. This should not be the most appropriate both for the database and the dashboard. You can try to imagine and implement a processing that will get the publication from the sensortag, parse it and re-publish it in separate topics more suitable for cloud processing.

Regarding the dashboard you should at least make use of all the functionalities that have been studied in a relevant manner depending on the data. The dashboard should offer informations both from the sensors but also by health data about the sensortag.