Module: Internet of Things **2019/2020**

Lab Session 1: Preparation

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1.1 Introduction

In the first lab session, we are going to prepare our working environment to be able to run, develop, modify and debug software for wireless sensors. In this lab we use the Contiki operating system that is designed to run on small low-power embedded devices.

Contiki provides a fully configured development environment that runs as a virtual machine. In this session we install and configure the free VMware Player, run the Contiki Image on it and connect sensor nodes to the Contiki environment to be able to deploy programs.

Note: **The lab computers already have the software installed and you should not redo the installation in the Lab.**

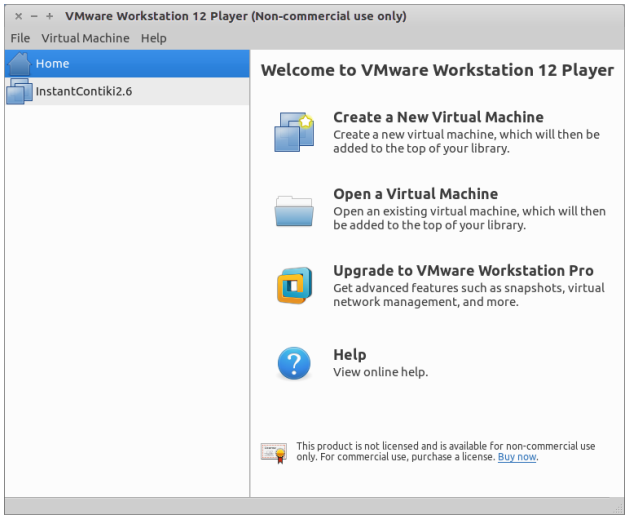
1.2 Running Contiki in the Lab

To run Contiki on the lab computer, you do the following:

1) Go to Applications - Accessories – Terminal.
2) On terminal window, type "vmplayer"; Wait for Virtual Machine window to open up.

   The application may request an email and an update.

   - For the email, you may just type: 'abc@abc.com'
   - For the additional pop-up window, select "Remind Me Later"
3) You should now reach the main screen of VM Player (see below):



If you see "InstantContiki2.6" under "Home" on the left pane, you may goto step 7. Otherwise, you need to tell VM Player where to find the image (Steps 4 to 6).

4) Double click "Open a Virtual Machine" on main window.
5) Click “+other locations” on the left pane, then click “Computer”. On the search bar, type “contiki”. In the search result, you should see “contikivm-feps” folder. Click to go into the folder.
6) Double click on the file with extension “.vmx”. VM Player will now remember where to find the image.
7) Select “InstantContiki2.6” image and click “Play Virtual Machine” or “Power On” at the bottom of main window.
8) If asked, select "I copied it" on pop-up window and wait for few seconds.
9) On the next pop-up window, select "Remind Me Later".
10) On the login screen, type the password: “user”.

1.3 Testing Your Contiki Environment

You can now test your development environment by running “Hello World” in InstantContiki. Note that in our lab computers, we install XM1000 under “contiki-2.6” folder in InstantContiki.

1) Open a terminal. Change the working directory to Hello World example. Type the following command:
```
$ cd /home/user/contiki-2.6/examples/hello-world
```

2) Touch the source code to make sure that the code will be compiled next time.
```
$ touch hello-world.c
```

3) Compile hello-world and make sure it is successful.
```
$ make TARGET=xm1000 hello-world
```

> **Note**: If you face a compilation error related to missing gcc-msp430, you may download it by using the following command:
> ```
> $ sudo apt-get install gcc-msp430
> ```

4) Upload your binary code to the mote. When it is successful, you should see “Mass Erase…” and then “19408 bytes programmed” on the screen.
```
$ make TARGET=xm1000 hello-world.upload
```

> **Note**: If the above step returns a “Permission denied” error, you can execute the command via super user to gain permission. The password for super user is ‘user’.
> ```
> $ sudo make TARGET=xm1000 hello-world.upload
> ```

> **Note**: If the above step returns quickly without showing the number of bytes programmed, then there may be a connection problem between your VM and the mote. Please make sure:
> - Your mote is properly inserted into a USB port of the computer (in some occasion, you may need to remove and reinsert the mote, or try another USB port);
> - Your mote is logically connected to your guest OS. In other words, the guest OS (or the VM) has captured the mote “MTM-XM1000MSP”;

5) Login to the mote to see the result. First, type the following command:

```
$ make TARGET=xm1000 login
```

or use the following if permission is needed

```
$ sudo make TARGET=xm1000 login
```

Now you should see some random characters. Press the red button on the mote to reset the mote. Your code will be rerun.

You should now see "Hello, world" on the screen. Congratulation, you have a working environment.

6) Use [CTRL]+[Z] to logout from the mote. You should return back to your command prompt.

1.4 Download links

If you wish to use Contiki outside the labs, you can install Contiki on your own computer. You can find links to necessary files for the setup. The following two sections show the steps.

- VMware Workstation Player:
  Get it from http://www.vmware.com/products/player/
- InstantContiki 2.6 with XM1000 platform files:
  Get it from https://drive.google.com/drive/folders/0B-JRsN5_XprcOW5FS04yQ01FaWM?usp=sharing
- Official InstantContiki 3.0
  Get it from http://sourceforge.net/projects/contiki/files/Instant%20Contiki/
- XM1000 Platform Files for InstantContiki 3.0
  Get it from http://www.advanticsys.com/shop/asxm1000-p-24.html
  or get a copy here: https://drive.google.com/file/d/0B9L9Cq60PBMNRkVvdVZPZEhhV0k/view?usp=sharing

1.5 (Optional) Installation on Your Own Computer – Contiki 2.6

If you wish to use Contiki outside the labs, you can install Contiki on your own computer. You may follow the following instruction to install Contiki onto your computer:

- Install a VM player
- Download a copy of InstantContiki version 2.6 from this link[1](all files). We have already preinstalled all necessary XM1000 platform files in this image. It is ready to use.
- Place all downloaded files in a single folder.
- Run VM player, and then open the downloaded vmx file.

You should now see your VM loading up Ubuntu OS in the virtual machine. When asked for a password, type 'user'.

You should first identify your contiki folder. It may be located at "/home/user/contiki-2.6/"

You may now test your environment with the procedure given in the section earlier.

[1] https://drive.google.com/drive/folders/0B-JRsN5_XprcOW5FS04yQ01FaWM?usp=sharing
https://surreyac-my.sharepoint.com/:f:/g/personal/cf0014_surrey_ac_uk/Ei6HKR08cupLtHfh7EHz0VEBlvOBf-NZK2hkOaAB1fvPKg?e=XvXWhd
If you download Contiki 2.6 from other sites, you may need to install XM1000 platform files. See the next section for details.

1.6 (Optional) Installation on Your Own Computer – Contiki 3.0

Contiki 3.0 is the latest version. You can install Contiki 3.0 on your own computer by the following instructions.

1.6.1 STEP 1: Setting up and running InstantContiki

This step is about setting up and running InstantContiki. To do so, please follow the instruction below:

- Install a VM player
- Download a copy of InstantContiki 3.0.

  You can download a "clean" version of InstantContiki from the official website. The official website should direct you to sourceforge website where all InstantContiki versions are stored (see here[2]). Please download version 3.0.
- Extract the InstantContiki image files to your hard drive.
- Run VM player, and then open the downloaded vmx file.

You should now see your VM loading up Ubuntu OS in the virtual machine. When asked for a password, type 'user'.

If you have problems installing the player and the software have a look at this tutorial explaining the installation process step-by-step (http://www.contiki-os.org).

NOTE: Optionally (but not recommended at this stage), you may further update your Contiki to the latest version. You can do that in the Ubuntu OS by typing the following command:

```
$ git clone https://github.com/contiki-os/contiki.git
```

The above command will copy the latest Contiki files to your current path and store them in a folder named "contiki". You may rename this folder after the download.

We **DO NOT** recommend you to further update Contiki at this stage as the latest Contiki may not be compatible with the platform files.

1.6.2 STEP 2: Installing XM1000 Platform Files

In order to be able to run the programs that we are going to develop on the hardware nodes, we need the toolchain for the MTM-XM1000 Sensor Nodes. Since the official InstanContiki does not contain XM1000 platform files, you need to install the platform files manually.

- Download XM1000 Platform Files into Ubuntu. The platform files are stored in a single zipped file named "xm1000.tar.gz".
- Extract the file to Contiki folder (see the following for guidance):

```
$ mkdir xm1000
$ tar xzvf xm1000.tar.gz -C xm1000
$ cd xm1000                ← here you should see two folders
$ cp -R * /home/user/contiki-2.6/   ← replace with your contiki folder
```

- Open a terminal console and enter the following command:

```
$ make TARGET=xm1000 savetarget
```

You should now have the development environment for XM1000 mote. You may now test your environment with the procedure given in the section earlier.

[2] https://sourceforge.net/projects/contiki/files/Instant%20Contiki/