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Article

Appendix for

Raspberry Pi: An Effective Vehicle in Teaching Internet of Things in Computer Science and Engineering

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Appendix A

This tutorial teaches how to run a CoAP server on Raspberry Pi, and view the CoAP resources through Copper, the CoAP user-agent on Firefox.

A.1. Install Maven

Maven is used to manage the dependencies of complex projects, such as the CoAP implementation. Install Maven so that you don't need to manually deal with the dependencies of the library.

```
$ sudo apt-get install maven
```

After the installation, you will have two versions of java on your Raspberry Pi. Run the following command to set both the java JDK and java JRE to the same version:

```
$ update-java-alternatives –l
[jdk_name_1(openjdk-6)] ## [path]
[jdk_name_2(java-jdk-8)] ## [path]
```

This command list all java JDKs installed on the Raspberry Pi.

```
$ update-java-alternatives –s [jdk_name_2(java-jdk-8)]
```

This command set the jdk to java version 1.8, the same as the default java JRE version on Raspberry Pi.

A.2. Download CoAP Library

There are two ways to download CoAP core from github. First, download the .zip file directly from the github page [1]. Then unzip it, use FileZilla or similar ssh file management software to transfer the code to your Raspberry Pi. Second, download it directly from the Raspberry Pi. From the terminal, run the following command to get a copy of the files (a clone of the repository):

```
$ cd [your_destination_folder]
$ git clone https://github.com/eclipse/californium.git myCoAP
```

A.3. Compile the CoAP Library and Examples

This is the basic way of how you compile your CoAP projects. From the root of CoAP library:

```
$ cd myCoAP/demo-apps/cf-helloworld-server
```

```
$ sudo mvn clean install
```

All the CoAP projects will be compiled as .JAR file and locate in `myCoAP/demo-apps/run/`.

A.4. Run "Hello World"

Run the following command to start a CoAP server.

```
$ cd myCoAP/demo-apps/run
```

```
$ java –jar cf-helloworld-server-1.0.0-SNAPSHOT.jar
```

The source code of the "Hello World" is located at `myCoAP/demo-apps/cf-helloworld-server`. You can also check other examples from the Github repository [2].

A.5. Install CoAP Client on Firefox

Start the Firefox browser, and load the CoAP client's link from Firefox [3]. As shown in Figure A1. Then simply click the *Add to Firefox* button to install the client.
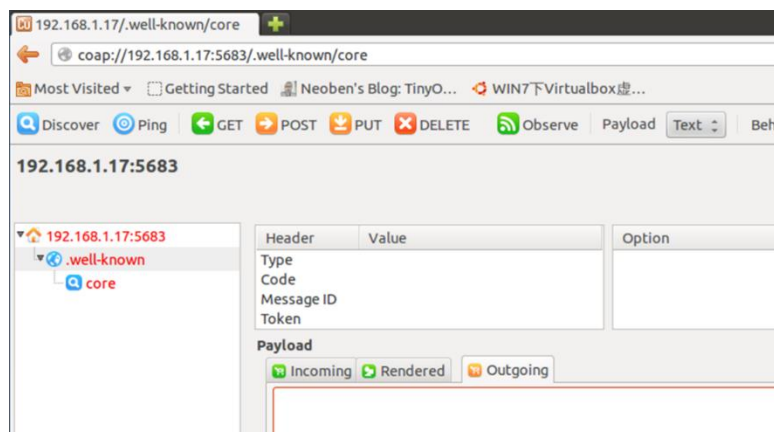

Figure A1. The CoAP client plugin on Firefox.

A.6. Use Copper

Suppose the IP address of your Raspberry Pi is 192.168.1.17, type the following CoAP address to access the "HelloWorld" server. The CoAP homepage will be shown as Figure A2.

```
coap://192.168.1.17:5683/
```


Figure A2. CoAP homepage with Copper.

Click *core*, then click *GET*, you will get all the resources available on the CoAP server. In this example server, the resource name is "helloWorld" (Figure A3).
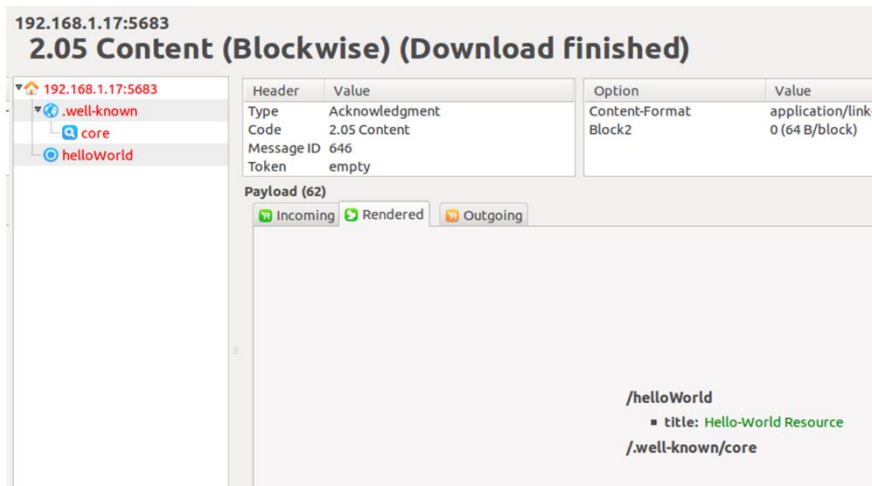
Figure A3. helloWorld resource on CoAP server.

Click *helloWorld* then *GET*, you will get the response from the server, which is the string "Hello World!", as shown in Figure A4. To this point, you have successfully ran the first CoAP application.
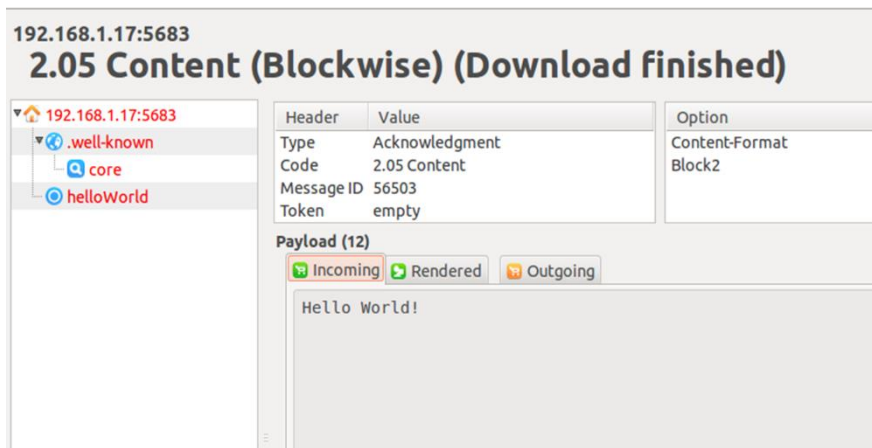

Figure A4. Response from the CoAP server for helloWorld resource.

Appendix B

This tutorial describes how to work with Raspberry Pi using your laptop's screen and keyboard. The basic idea is to connect the Raspberry Pi to your laptop through the Ethernet port, then play with it using remote desktop. For initial setup, you will need the monitor, keyboard, mouse, and WiFi adapter for Raspberry Pi. Afterwards you will only need the Raspberry Pi, Ethernet cable, and a Laptop.

B.1. Install XRDP on Raspberry Pi

XRDP is the remote desktop on Linux-based systems. Run the following command to install XRDP on Raspberry Pi.

```
~$ sudo apt-get install xrdp
```

B.2. Connect Raspberry Pi to Laptop

Raspberry Pi and the laptop will be connected through an Ethernet cable. Wait for several minutes for the Raspberry Pi and Laptop to assign IP addresses by themselves. Then run the following command in Raspberry Pi to get the IP address.

```
~$ ifconfig
```

The IP address is similar as in Figure B1. Remember this address for future use.

Figure B1. IP address of the Raspberry Pi.

B.3. Remote to the Raspberry Pi

In Windows system, open the Remote Desktop Connection, and use the IP address obtained above to connect to the Raspberry Pi. The window asking for the Raspbian user name and password will show up as in Figure B2. Type in the user name and password, you will see the Raspberry Pi desktop as an application window in Windows system. To this point, you can discard the external monitor, keyboard, and mouse, and work with Raspberry Pi using the laptop screen and keyboard.
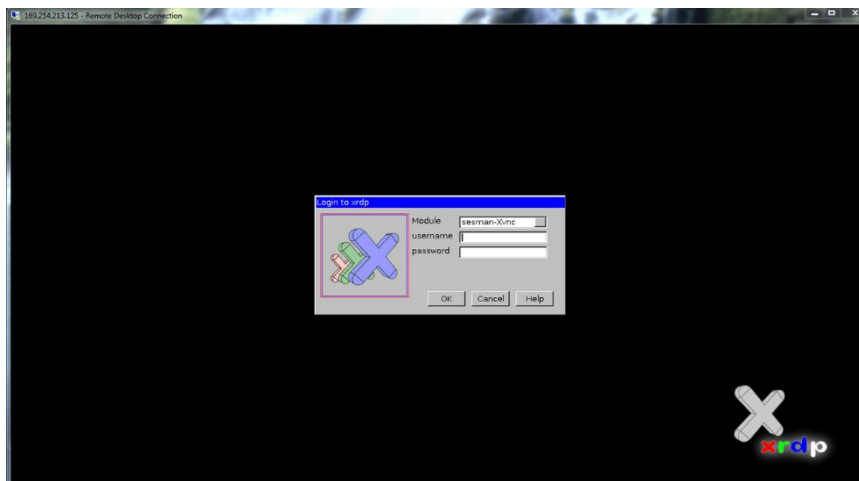

Figure B2. Remote login window for Raspbian.

B.5. Working with WiFi Adapter

It turns out that sometimes Raspberry Pi cannot work well when both the Ethernet and WiFi adapter are attached at the system boot time. In order to use the above method smoothly, especially when you are trying to connect to the network on campus, the following tips may help.

First, the Ethernet IP addresses of your laptop and Raspberry Pi usually do not change after the first connection. For example, at the first connection, your laptop's Ethernet IP address is 169.254.22.33, Raspberry Pi's Ethernet IP address is 169.254.44.55. Then after you disconnect them, and reconnect them in the future, the IP addresses usually do not change. So you don't need to setup the static IP addresses for them. In case the IP address changes, repeat Section B.2 to find the new IP address.

Second, before the Raspberry Pi start, connect the Ethernet cable, detach the WiFi adapter. After you remotely connect to it, attach the WiFi adapter. In this way both the network connection work smoothly. If the WiFi adapter is attached earlier, there may be some problem with the Ethernet connection.

References

1. Californium. Available online: https://github.com/eclipse/californium (accessed on 23 August 2016).
2. hands-on-coap. Available online: https://github.com/jvermillard/hands-on-coap (accessed on 23 August 2016).
3. Copper (Cu) CoAP user-agent for Firefox. Available online: https://addons.mozilla.org/en-US/firefox/addon/copper-270430/ (accessed on 23 August 2016).