BeagleBone Tutorial: WiFi, SSH and SFTP

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Introduction

This tutorial will guide users through the following tasks:

1. Connecting a BeagleBone to a WiFi network
2. Learning how to access the Linux Operating System Shell of a BeagleBone through Wi-Fi SSH connection
3. Transferring files between a BeagleBone and a personal computer using a graphical SFTP application

Prerequisite Tutorials

Users should ensure they are familiar with the document labelled ***BeagleBone Tutorial – Introduction*** before proceeding.

List of Required Equipment and Materials

1. 1x BeagleBone Green Wireless
2. 1x USB 2.0 A-Male to Micro B Cable (micro USB cable)
3. 1x Personal Computer with
    1. At least 1x USB 2.0 or 3.0 port
    2. Windows (Windows 8 or newer) **OR**
    3. Mac OS X (Mountain Lion or newer) **OR**
    4. Linux
4. Access to a network with an Internet connection

Establishing Wireless Network Access – WiFi

Most modern operating systems, such as Windows or Mac, provide some graphical method to configure Wi-Fi network access. However, a graphical tool is not easily accessible on the BeagleBone's operating system, Debian.

However, the Debian image for the BeagleBone provides a convenient command-line network manager, ConnMan, to configure network access over Wi-Fi. Follow the below steps to establish a data transport channel between your BeagleBone board and a Wi-Fi network.

1. WPA2 Enterprise networks such as ***eduroam*** require a separate configuration file, and the steps below are not sufficient for enabling ***eduroam*** connection. For more information about how to connect to ***eduroam***, please refer to the document labelled ***A Troubleshooting Guide for BeagleBone Network Access and Firmware Update*** on the BeagleBone wiki for more details.

2. Log into your BeagleBone. For more information, refer the document labelled ***BeagleBone Tutorial – Introduction***.

3. Issue the following command:

   $ connmanctl

   This command enables the interactive mode of ConnMan.

4. The shell prompt now becomes **connmanctl>** as shown below. Issue the following command.

   connmanctl> enable wifi

   Do not worry about the error message. This means WiFi is already enabled on your BeagleBone.

```
root@beaglebone:~# connmanctl
connmanctl> enable wifi
Error wifi: Already enabled
```

Figure 1. ConnMan

5. Issue the following command.

   connmanctl> scan wifi

   This scans for all WiFi hardware interfaces. Wait for "Scan completed for wifi" message.

```
connmanctl> scan wifi
Scan completed for wifi
```

Figure 2. Scanning WiFi hardware interfaces.

6. Issue the following commands.

   connmanctl> services

   This command lists all available WiFi networks.

```
connmanctl> services
    WHI_6               wifi_2cf7f106098e_5748495f36_managed_psk
    CHFE_EXT            wifi_2cf7f106098e_434846455f455854_managed_psk
    Mysticeti           wifi_2cf7f106098e_4d7973746963657469_managed_psk
    OceanChromecast     wifi_2cf7f106098e_4f6365616e4368726f6d6563617374_managed_none
    UCLA_WEB            wifi_2cf7f106098e_55434c415f574542_managed_none
    UCLA_WIFI           wifi_2cf7f106098e_55434c415f57494649_managed_none
    eduroam             wifi_2cf7f106098e_656475726f616d_managed_ieee8021x
    OCEAN-MEMBERS       wifi_2cf7f106098e_4f4345414e2d4d454d42455253_managed_psk
    OMS_ChemLab         wifi_2cf7f106098e_4f4d535f4368656d4c6162_managed_psk
    OCEAN-GUESTS        wifi_2cf7f106098e_4f4345414e2d475545535453_managed_psk
```

Figure 3. List of available WiFi networks.

7. Issue the following command to register an agent, which handles user requests.

```
connmanctl> agent on
Agent registered
```

Figure 4. Registering an agent.

8. From the list of available WiFi networks, choose the network you want to join. Issue the following command.

   connmanctl> connect <wifi service>

   Replace <wifi service> with the service you chose. You may use the **Tab** key to autocomplete. In the example below, the service for "WHI_6" network is used.

```
connmanctl> connect wifi_2cf7f106098e_5748495f36_managed_psk
Agent RequestInput wifi_2cf7f106098e_5748495f36_managed_psk
  Passphrase = [ Type=psk, Requirement=mandatory ]
```

Figure 5. Registering an agent.

9. When the passphrase is asked, enter the passphrase of the chosen WiFi network.

10. Issue the following command to quit ConnMan.

```
connmanctl> quit
root@beaglebone:~# $
```

Figure 6. Registering an agent.

11. Issue the following command in order to verify that the Intel Edison has internet access:

    $ ping google.com

```
root@beaglebone:~# ping google.com
PING google.com (172.217.11.78) 56(84) bytes of data.
64 bytes from lax17s34-in-f14.1e100.net (172.217.11.78): icmp_seq=1 ttl=54 time=13.9 ms
64 bytes from lax17s34-in-f14.1e100.net (172.217.11.78): icmp_seq=2 ttl=54 time=102 ms
64 bytes from lax17s34-in-f14.1e100.net (172.217.11.78): icmp_seq=3 ttl=54 time=490 ms
64 bytes from lax17s34-in-f14.1e100.net (172.217.11.78): icmp_seq=4 ttl=54 time=43.2 ms
```

Figure 7. Verifying WiFi connectivity.

If the ping command is successful, press **Ctrl-C** to quit and proceed to the next section labelled Shell Access – SSH. If the **ping google.com** command returns an error such as

ping: bad address 'google.com'

Verify that Google is accessible by visiting www.google.com on a web browser on your personal computer. If www.google.com is not accessible, attempt to access another website on your web browser. If no websites are loading on your personal browser, please contact the course instructor or IT system administrator.

If a website is through a web browser on your personal computer, attempt to ping it from the Intel Edison by issuing the following command:

ping <other_website>

If this command returns the same error as above (**bad address**), please attempt to re-establish network access by following the steps in the section labelled Establishing Wireless Network Access – WiFi.

Shell Access – SSH

SSH stands for "**S**ecure **SH**ell". It is used to communicate in a secure manner over an unsecure network. We have already used SSH to log into the BeagleBone in ***BeagleBone Tutorial – Introduction***. Such SSH connection was via Ethernet-over-USB. This means that the micro USB cable connecting your BeagleBone and your personal computer is the medium used for the SSH communication. Thus, the BeagleBone must remain connected to your personal computer.

Now, your BeagleBone is connected to a WiFi network, you can access your BeagleBone via WiFi as long as both your BeagleBone and your personal computer are connected to the same WiFi network. In this case, your BeagleBone does not need to be connected to your personal computer.

Follow the steps below to use SSH to access the shell on your BeagleBone via WiFi.

1. Log into your BeagleBone using SSH via Ethernet-over-USB.

2. Your BeagleBone must be secured by a password to use SSH via WiFi. Issue the following command to set up a password.

   $ passwd

   Pick a simple password (such as "password123") that can be shared with group members or course instructors. **Record this password in a secure location**. If the password for the root account is lost, the user will be required to reinstall the latest Debian Linux Operating System. This process requires writing digital contents to the nonvolatile (flash) memory of a computing device. It is a is time consuming process that will result in the loss of all files and data present in the flash memory of the BeagleBone.

   If you want to change the password later, you can use the same command.

```
root@beaglebone:~# passwd
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
```

Figure 8. Setting up password.

3. Issue the following command to reboot your BeagleBone

   $ reboot

4. Log into your BeagleBone again using SSH via Ethernet-over-USB.

5. Issue the following command to find the IP address of the board.

   $ ifconfig

Look for the IP address for the wlan0 (Wireless LAN) connection. In this example, the IP address is 10.0.1.13. Your BeagleBone may have a different IP. Notice the IP address for usb0 (Ethernet-over-USB) is also shown.

```
root@beaglebone:~# ifconfig
SoftAp0   Link encap:Ethernet  HWaddr b0:d5:cc:71:d1:7e
          inet addr:192.168.8.1  Bcast:192.168.8.255  Mask:255.255.255.0
          inet6 addr: fe80::b2d5:ccff:fe71:d17e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:33 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:7873 (7.6 KiB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:333 errors:0 dropped:0 overruns:0 frame:0
          TX packets:333 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:27617 (26.9 KiB)  TX bytes:27617 (26.9 KiB)

usb0      Link encap:Ethernet  HWaddr b0:d5:cc:71:d1:71
          inet addr:192.168.7.2  Bcast:192.168.7.255  Mask:255.255.255.0
          inet6 addr: fe80::b2d5:ccff:fe71:d171/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:3676 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7285 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:284015 (277.3 KiB)  TX bytes:10401905 (9.9 MiB)

wlan0     Link encap:Ethernet  HWaddr 2c:f7:f1:06:09:8e
          inet addr:10.0.1.13  Bcast:10.0.1.255  Mask:255.255.255.0
          inet6 addr: fe80::2ef7:f1ff:fe06:98e/64 Scope:Link
          inet6 addr: 2606:6000:629a:92f0:2ef7:f1ff:fe06:98e/64 Scope:Global
          UP BROADCAST RUNNING MULTICAST DYNAMIC  MTU:1500  Metric:1
          RX packets:361 errors:0 dropped:0 overruns:0 frame:0
          TX packets:120 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:117559 (114.8 KiB)  TX bytes:23714 (23.1 KiB)
```

Figure 9. Output of ifconfig.

6. If you use the wlan0 IP address instead of the usb0 IP address when logging into your BeagleBone, you are establishing SSH connection via WiFi.

   In other words, if you are a Windows user, enter this IP address to Host Name box in PuTTy, or if you are a Mac or Linux user, enter root@<wlan0 IP address> on Terminal.

File Transfer – SFTP

SFTP stands for "**SSH File Transfer Protocol**". It is a network protocol that provides file access, file transfer, and file management over a potentially insecure network. This section describes how to use a GUI-based SFTP software called FileZilla to transfer files between your BeagleBone and your personal computer utilizing SFTP. There are alternative SFTP clients such as Cyberduck.

1. Download the FileZilla Client from the following link, as shown in Figure 10.

   https://filezilla-project.org

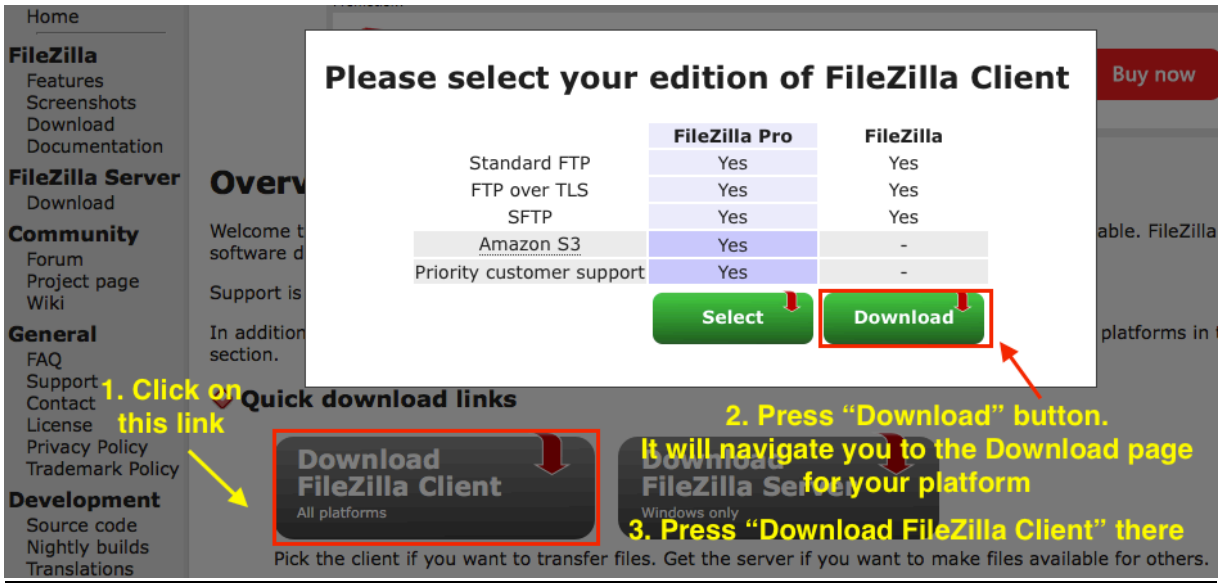

Figure 10. Downloading FileZilla.

2. Install and open FileZilla.

3. Enter the IP address of your BeagleBone (either wireless LAN IP or Ethernet-over-USB IP), root as the username, password you chose, and **22** as the port number, as shown in Figure 11.

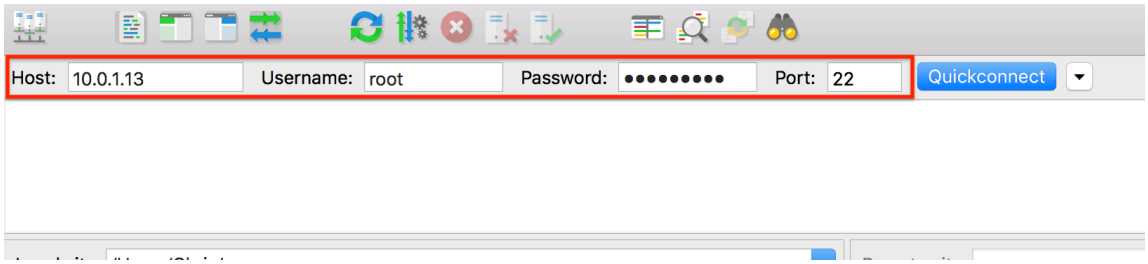

Figure 11. FileZilla.

4. Click **Quickconnect**.

5. The following popup appears. Check "Always trust this host, add this key to the cache" and click **Ok**.

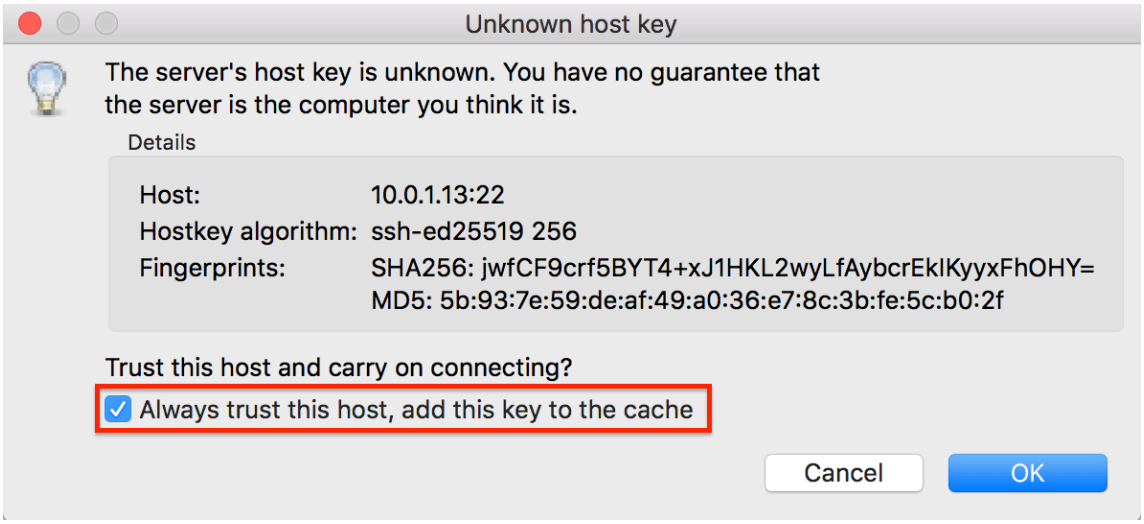

Figure 12. Adding host key

6. An SFTP connection has been successfully established between the BeagleBone and your personal computer. The FileZilla window includes two file explorers. The left one is for your personal computer (local machine) and the right one is for your BeagleBone (remote machine).

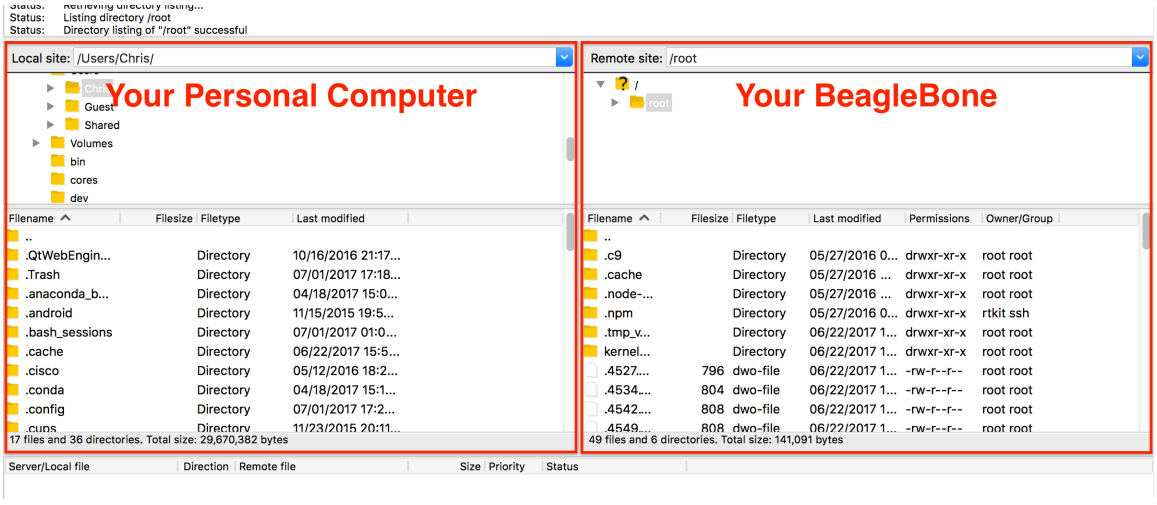

Figure 13. FileZilla Window

7. To transfer a file from your personal computer to your BeagleBone using SFTP, navigate to the location of the file in the file explorer on the left. Then, navigate to the location where you want to transfer the file to in the file explorer on the right. Next, drag and drop the file.

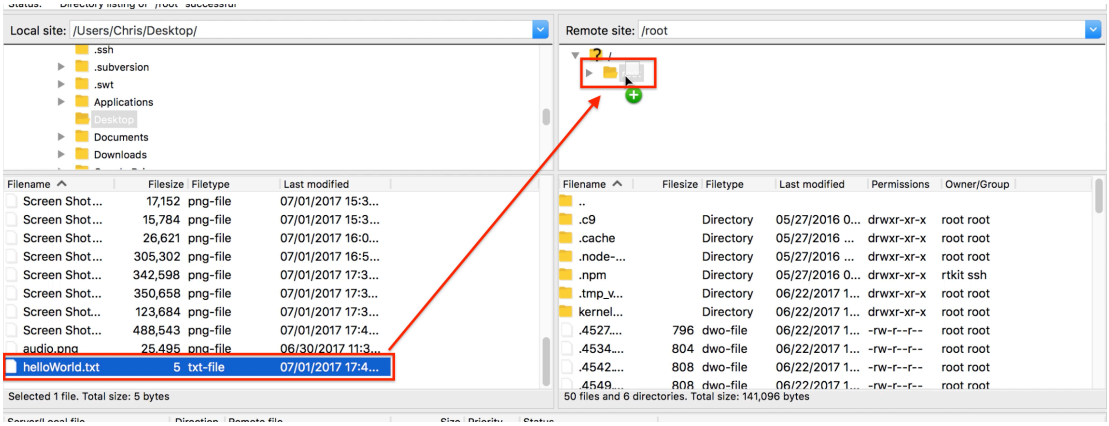

Figure 14. FileZilla Window

8. Issue the command **ls** on your BeagleBone. This will display the contents of the current working directory. Notice how the transferred file is now listed in the current directory.

9. Transfer the file back to your personal computer by dragging it from the right file explorer onto the left file explorer.