Developer Study Guide:

Deploying BlueZ v5.50 on Raspberry Pi Board

Part 1 - Deployment

BlueZ is the official Linux *Bluetooth*® protocol stack. From the release notes of BlueZ v5.47, "this release comes with initial support for it in the form of a new *meshctl* tool. Using this tool, it's possible to provision mesh devices through the GATT Provisioning Bearer (PB-GATT), as well as communicate with them (e.g. configure them) using the GATT Proxy protocol." This Developer Study Guide, explains how to install the latest release, BlueZ v5.50 on Raspberry Pi.

Author: Kai Ren

Version: 1.3

Revision Date: 26 July 2019

Revision History

Version	Date	Author	Changes
1.0	31 May 2018	Kai Ren	Initial Version
1.1	29 August 2018	Kai Ren	Upgrade BlueZ installation to v5.50
1.2	19 March 2019	Kai Ren	Updated the name to Developer Study Guide. Use latest Raspberry Pi release instead of master tree.
1.3	26 July 2019	Kai Ren	Add the support for Raspberry Pi 4 and update the kernel to raspberrypi-kernel_1.20190709-1.

Bluetooth®

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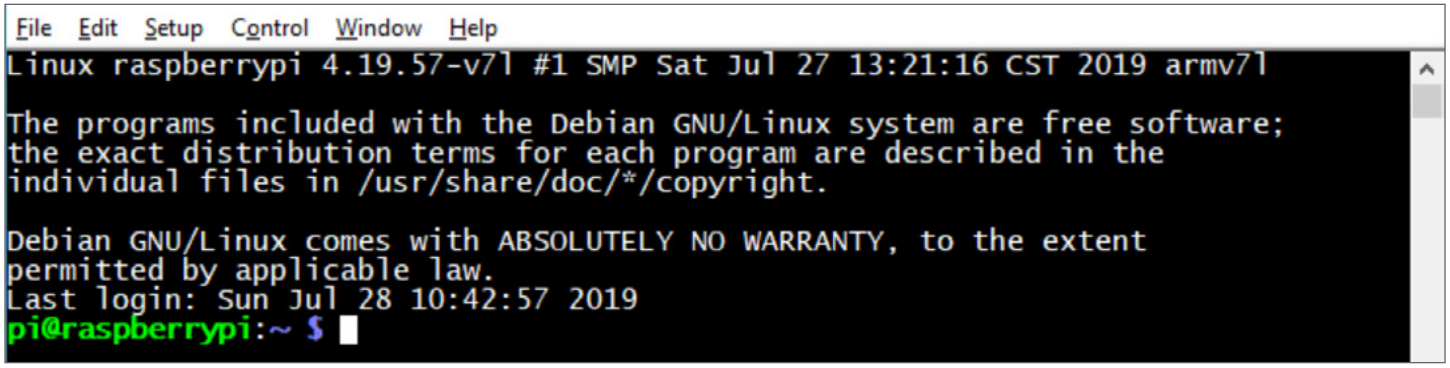
1.0 Prerequisite

This study guide has been tested on the following boards, calling them verified boards in this document:

- Raspberry Pi 2B
- Raspberry Pi 3B
- Raspberry Pi 3B+
- Raspberry Pi 4B

If you have one of above verified boards, please make sure that you:

- Follow this guide to setup your Raspberry Pi.
- Check if the operating system on your verified board is ready, and, if not, follow this guide to set up the software on your Raspberry Pi.
- Follow this guide to enable SSH to access the board remotely. The picture below shows the use of Tera Term on a Windows10 laptop through SSH to access the board remotely.



- The board has been issued “apt-get update” and “apt-get upgrade” successfully, these two commands will ensure your board has the latest updates.

2.0 Install BlueZ v5.50

Once the board is setup correctly, you can start to install BlueZ v5.50.

2.1 Remote Access Board Through SSH

As mentioned in the Prerequisite, you should remote login into the board through SSH. You need to make sure that your Windows computer is in the same LAN with the board and you know the IP address of the board.

2.2 Install Dependencies for BlueZ

```
sudo apt-get install -y git bc libusb-dev libdbus-1-dev libglib2.0-dev libudev-dev libical-dev libreadline-dev autoconf
```

2.3 Install json-c

```
cd ~
wget https://s3.amazonaws.com/json-c_releases/releases/json-c-0.13.tar.gz
tar -xvf json-c-0.13.tar.gz
cd json-c-0.13/
./configure --prefix=/usr --disable-static && make
sudo make install
```

2.4 Install *ell* for BlueZ v5.50

```
cd ~
wget https://mirrors.edge.kernel.org/pub/linux/libs/ell/ell-0.6.tar.xz
tar -xvf ell-0.6.tar.xz
cd ell-0.6/
sudo ./configure --prefix=/usr
sudo make
sudo make install
```

2.5 Get BlueZ v5.50 Source Code

```
cd ~
wget http://www.kernel.org/pub/linux/bluetooth/bluez-5.50.tar.xz
tar -xvf bluez-5.50.tar.xz
cd bluez-5.50/
```

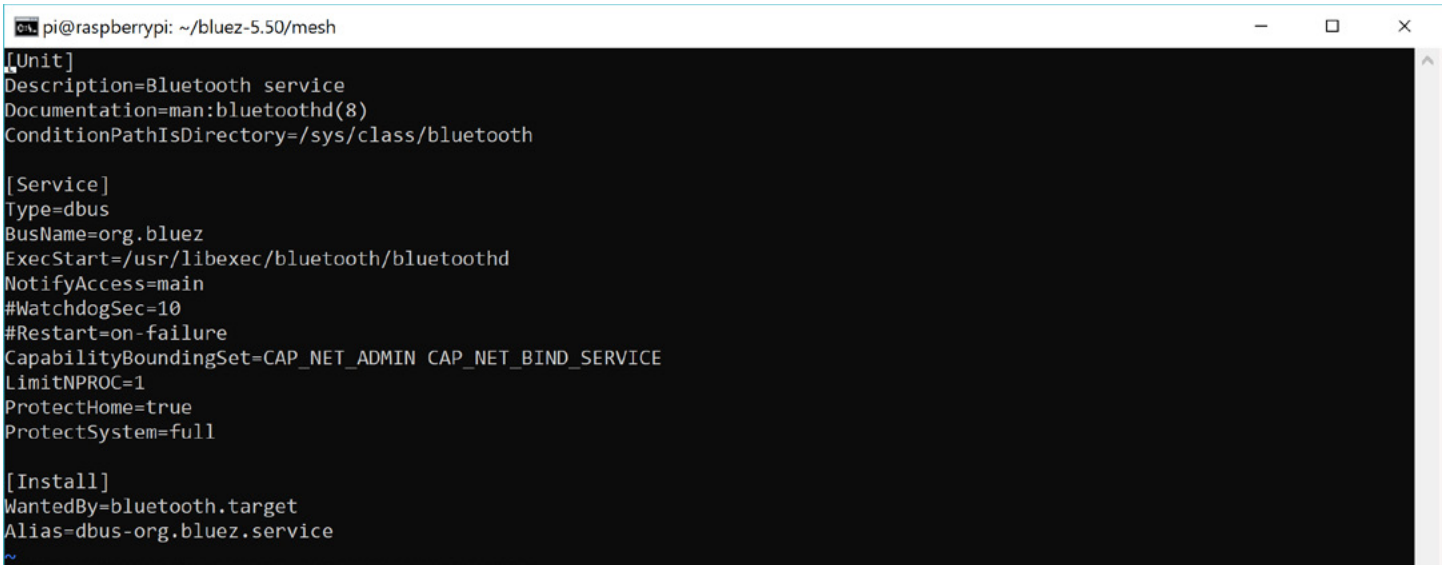
2.6 Compile and Install BlueZ

```
./configure --enable-mesh --prefix=/usr --mandir=/usr/share/man --sysconfdir=/etc --localstatedir=/var

make

sudo make install
```

To make sure the upgrade we you want to install is BlueZ to v5.50, tell systemd to use the new bluetooth daemon:

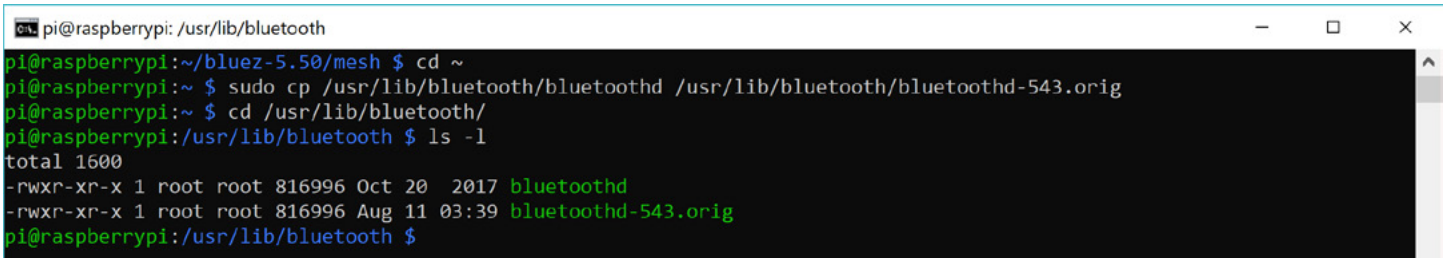
```
sudo vi /lib/systemd/system/bluetooth.service
```

After opening this file, bluetooth.service, make sure the ExecStart line points to your new daemon in /usr/libexec/bluetooth/bluetoothd, as shown in the screenshot below.



Up till now, that wasn't enough. You still need to create a symlink from the old *bluetoothd* to the new one. First, rename the old file for backup, type below command and you will find the backup file as below screenshot shown.

```
sudo cp /usr/lib/bluetooth/bluetoothd /usr/lib/bluetooth/bluetoothd-543.orig
```



Create the symlink using the command below and double check the version of *bluetoothd* and *meshctl*.

```
sudo ln -sf /usr/libexec/bluetooth/bluetoothd /usr/lib/bluetooth/bluetoothd

sudo systemctl daemon-reload

bluetoothd -v

meshctl -v
```

As shown in the screenshot below, *bluetoothd* and *meshctl* are all v5.50. This means that BlueZ v5.50 installation is successful.[1]

But if you type *meshctl* and click the *Enter* key to start the service, an error message, “Failed to parse provisioning database file prov_db.json”, will pop-up as below:

The next section will tell you how to solve this problem in order to initiate meshctl service.

[1] *About upgrading bluetoothd, reference this article*
https://raspberrypi.stackexchange.com/questions/66540/installing-bluez-5-44-onto-raspbian

3.0 Rebuilding the Kernel for BlueZ v5.50

There are two main methods for building the kernel. You can build locally on a Raspberry Pi, which will take a long time, or you can cross compile, which is much quicker but requires more setup. This article outlines the local building method.

3.1 Install Kernel Building Dependencies

```
sudo apt-get install -y git bc bison flex libssl-dev
```

3.2 Check Out Building Tool and Source Code

```
cd ~
wget https://github.com/raspberrypi/linux/archive/raspberrypi-kernel_1.20190709-1.tar.gz
tar -xvf raspberrypi-kernel_1.20190709-1.tar.gz
```

3.3 Configuring the Kernel

```
cd ~
cd ./linux-raspberrypi-kernel_1.20190709-1/
```

Depending on your Raspberry Pi board version, run the following commands alternatively.

- Raspberry Pi 2, Pi 3, Pi 3+, and Compute Module 3[2] default build configuration

```
KERNEL=kernel7
make bcm2709_defconfig
make menuconfig
```

- Raspberry Pi 4

```
KERNEL=kernel7l
make bcm2711_defconfig
make menuconfig
```

After typing *menuconfig*, the kernel configuration menu will pop up. The *menuconfig* utility has simple keyboard navigation. After a brief compilation, you will be presented with a list of submenus containing all the options you can configure; there's a lot, so take your time to read through them and get acquainted.

[2] Compute Module 3 haven't been verified on this document, but theoretically, it shall works.

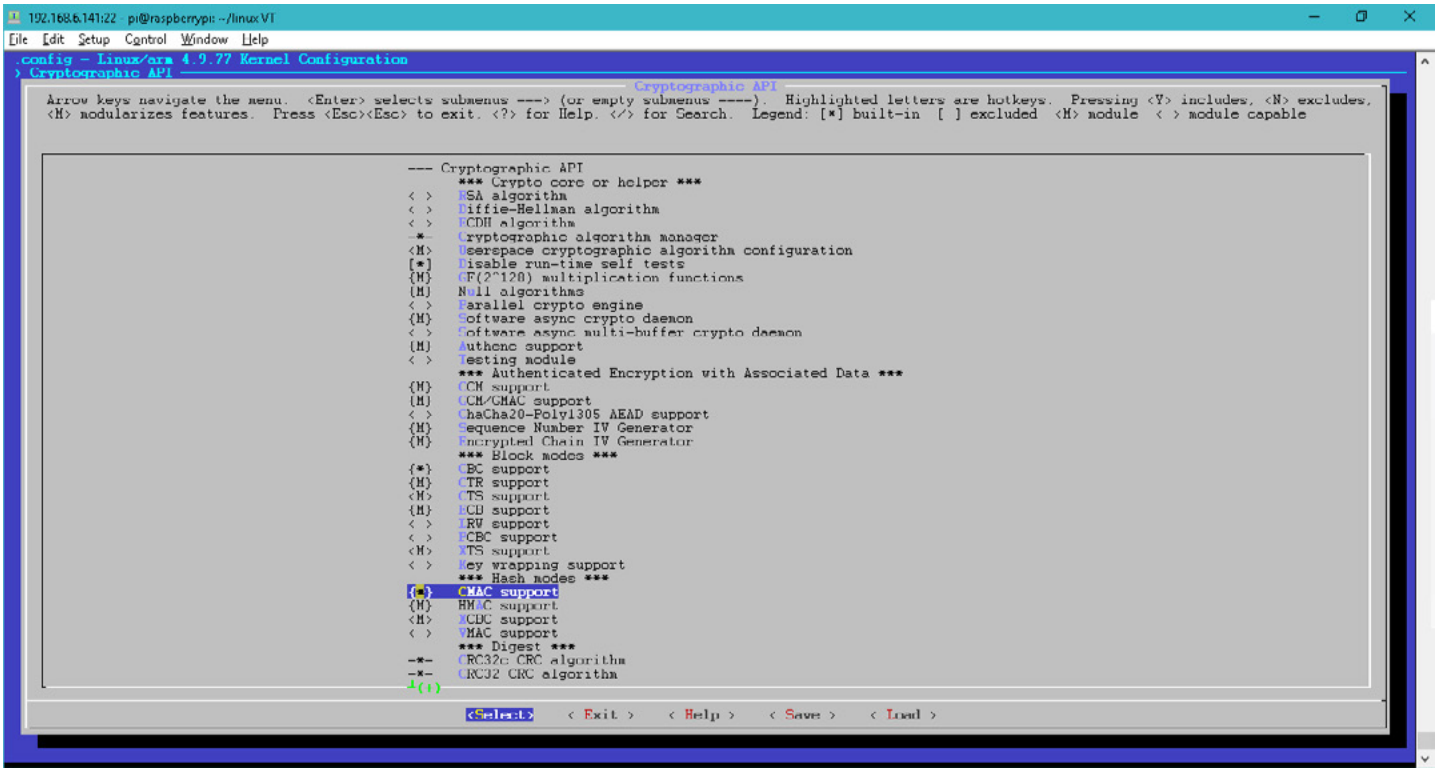
Use the arrow keys to navigate, the *Enter* key to enter a submenu (indicated by --->), *Escape* twice to go up a level or exit, and the space bar to cycle the state of an option. Some options have multiple choices, in which case they will appear as a submenu and the Enter key will select an option. You can press h on most entries to get help about that specific option or menu[3].

Please include the three modules below:

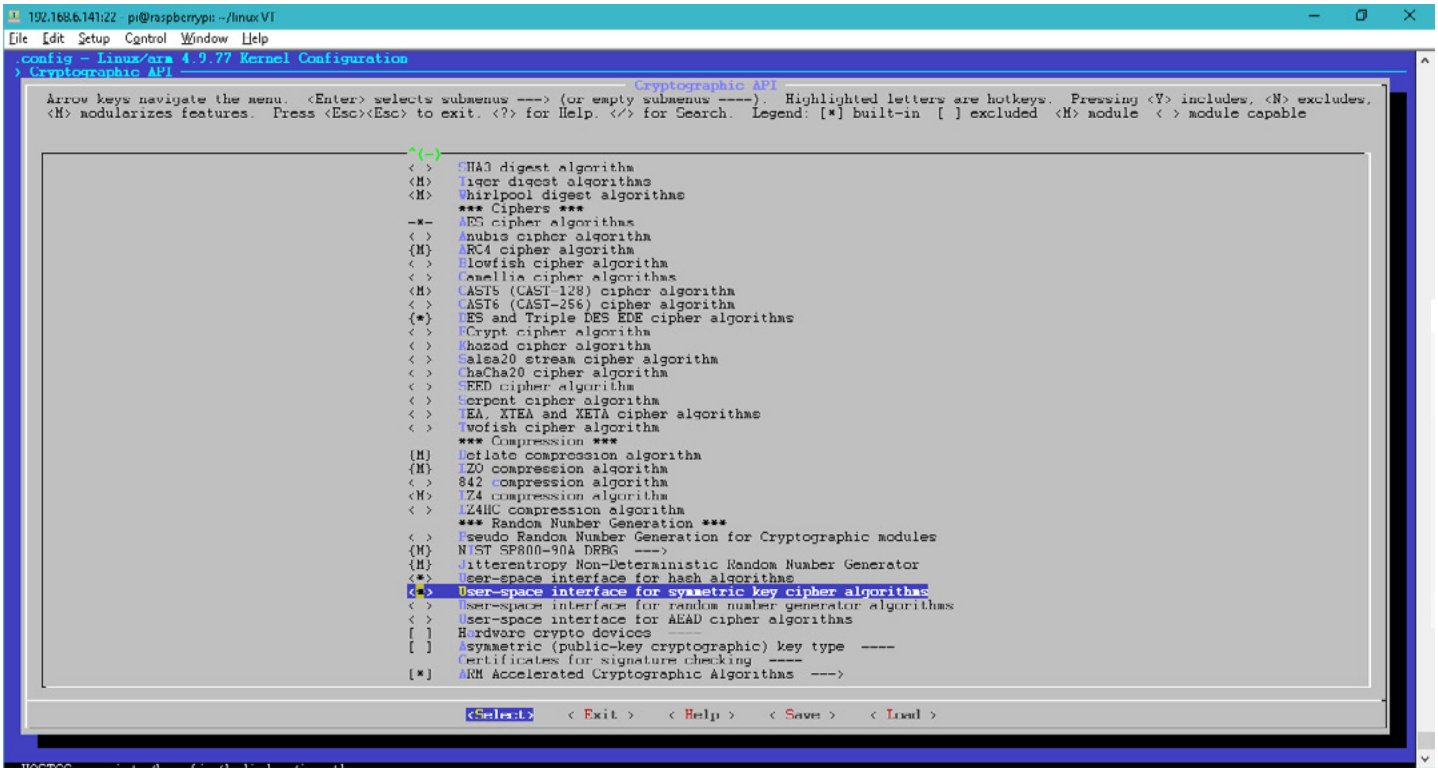
Select *Cryptographic API → CMAC support*

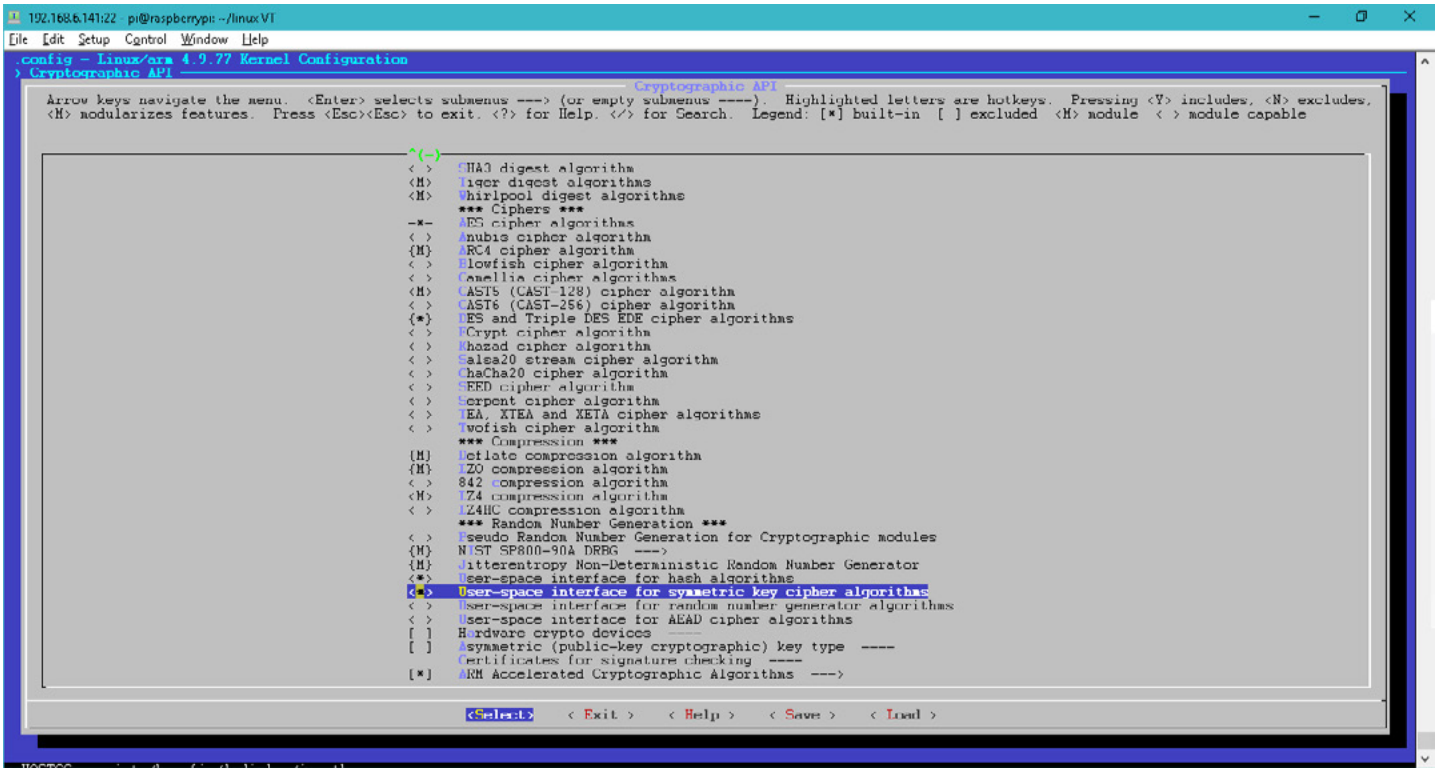
Select *Cryptographic API → User-space interface for hash algorithms*

Select *Cryptographic API → User-space interface for symmetric key cipher algorithms*



[3] About this part, reference this article, https://www.raspberrypi.org/documentation/linux/kernel/configuring.md





Once you are done making the changes you want, press *Escape* until you're prompted to save your new configuration. By default, this will save to the .config file. You can save and load configurations by copying this file around.

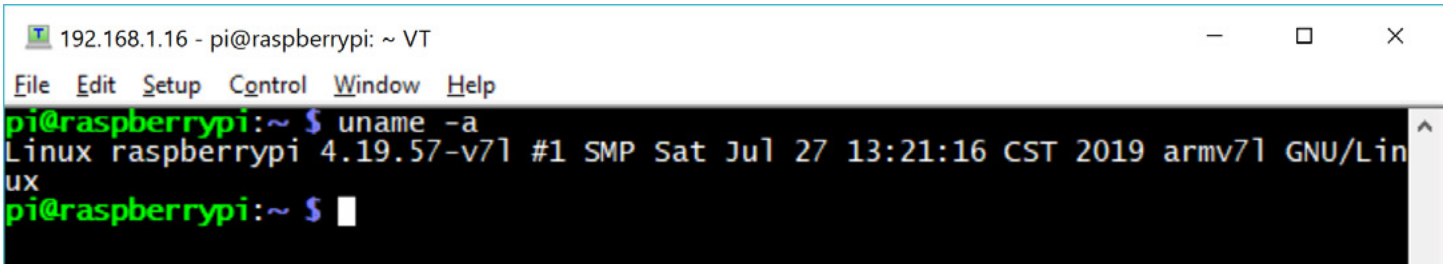
3.4 Build and Install the Kernel, Modules, and Device Tree blobs

```
make -j4 zImage modules dtbs
sudo make modules_install
sudo cp arch/arm/boot/dts/*.dtb /boot/
sudo cp arch/arm/boot/dts/overlays/*.dtb* /boot/overlays/
sudo cp arch/arm/boot/dts/overlays/README /boot/overlays/
sudo cp arch/arm/boot/zImage /boot/$KERNEL.img
sudo reboot
```

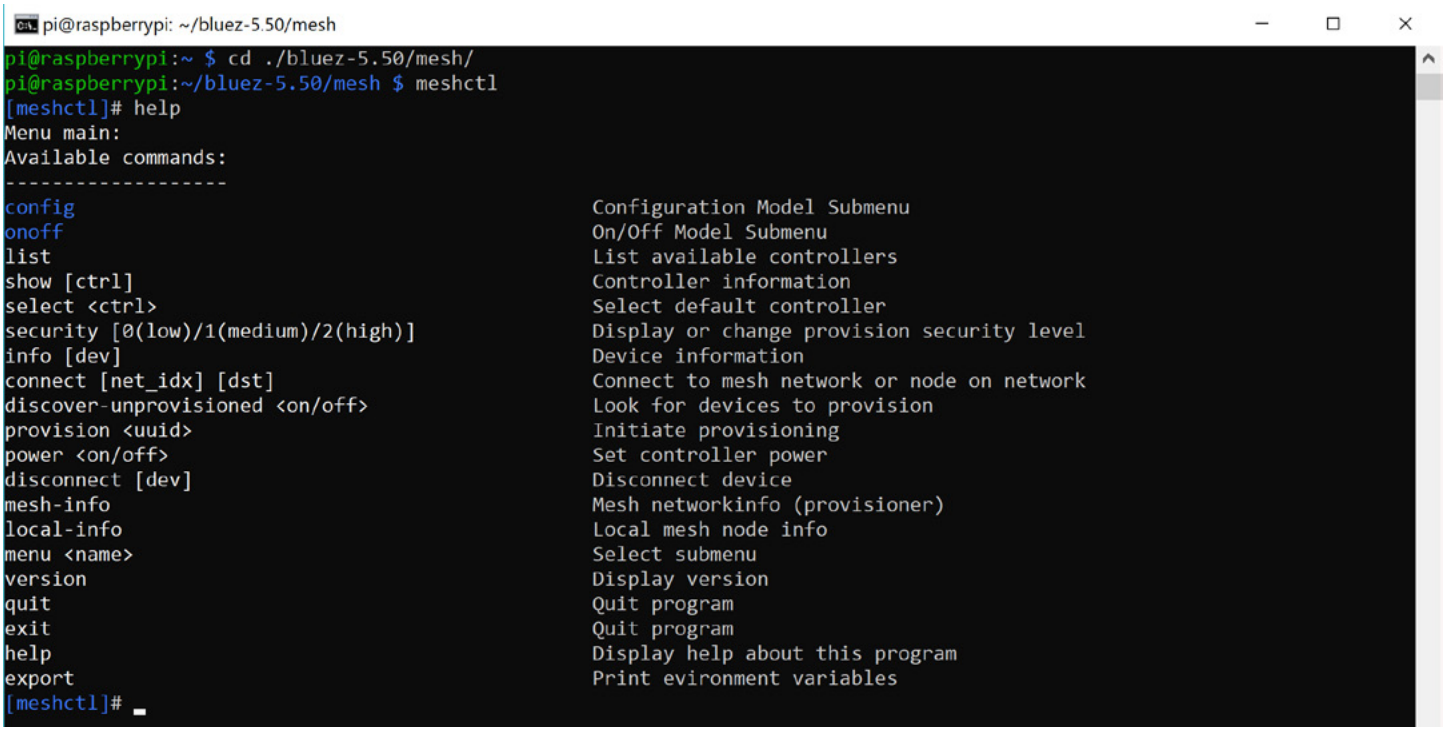
This process takes a longtime, maybe 2 to 3 hours.

3.5 Verifying Kernel Installation

After the board restart, issue command *uname -a* and a new build time will be shown. In the image below, you can see the build time is **Sat Jul 27 13:21:16 CST 2019**. That time and date was exactly when the kernel was built and it means the kernel building and installation was successful.



Type *meshctl* in folder *~/bluez-5.50/mesh* to ensure it will work correctly, as shown in the image below.



4.0 Summary

If you go through all the steps listed above, you will have a Raspberry Pi board that can work as a provisioner to provision any dev kits/boards that support PB-GATT. This guide, "Deploying BlueZ v5.50 on Raspberry Pi 3 and Use It, Part 2 — Provisioning", shows you how to use *meshctl* to provision and configure a real Bluetooth mesh device.