Step-by-Step Guide

How to Deploy BlueZ on Raspberry Pi3 and Use It

Part 1 - Deployment

BlueZ is the official Linux *Bluetooth*® protocol stack. As stated in the BlueZ v5.47 release notes, “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 tutorial guides you through the steps for installing BlueZ v5.50 on Raspberry Pi3 (R Pi3).

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Version: 1.1

Revision Date: 29 Augus 2018

Revision History

Version	Date	Author	Changes
1.0	31st May 2018	Kai Ren	Initial Version
1.1	29th August 2018	Kai Ren	Upgrade BlueZ installation to v5.50

Bluetooth®

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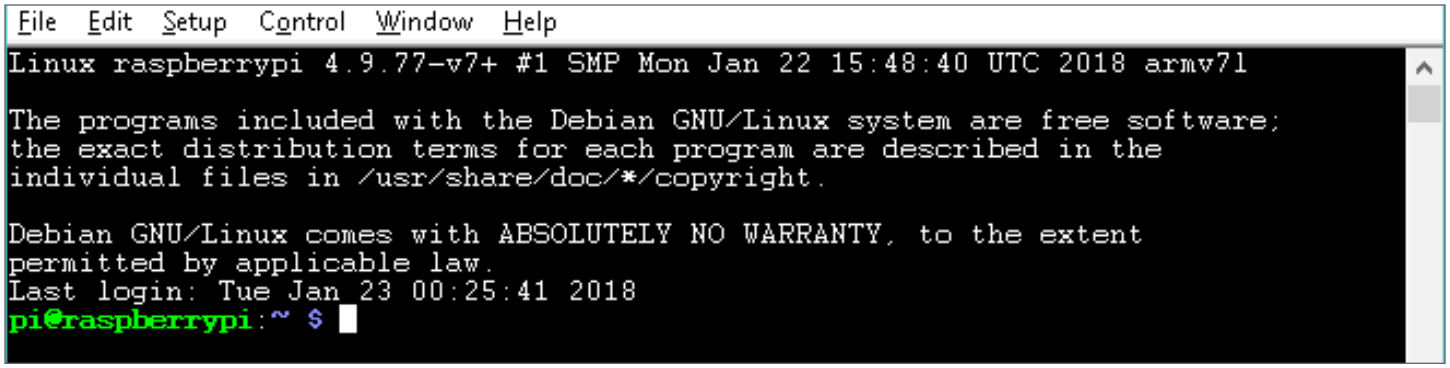
1.0 Prerequisite

Before deploying BlueZ, you should have performed the following to setup your R Pi3 board.

- The R Pi3 is powered by a USB Micro power supply which can supply at least 2A at 5V
- The TF card should be > 16GB, at least class 4
- The Raspbian is used in this tutorial:
  - RASPBIAN STRETCH WITH DESKTOP Image with desktop based on Debian Stretch
  - Version: March 2018
  - Release date: 2018-03-13
  - Kernel version: 4.9
- Flash the correct Raspbian, this link will show you how
- Change the login username and password, or remember the default one:
  Username: ***pi***
  Password: ***raspberry***
  It's important because we will use them to login to R Pi3 remotely through SSH.
- Please follow this guide to enable SSH. After that, R Pi3 can be remote accessed through SSH. The image below shows that I use Tera Term on my Windows10 laptop to access R Pi3 remotely



- It's already being "apt-get update" and "apt-get upgrade"

2.0 Install BlueZ v5.50

Once R Pi3 is setup correctly, you can start to install BlueZ v5.50.

2.1 Remote Access R Pi3 Through SSH

As mentioned in the Prerequisite section, you should remote login to R Pi3 through SSH. You need to make sure that your Windows computer is in the same LAN with R Pi3 and you know the IP address of R Pi3.

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 for BlueZ v5.50

```
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/
```

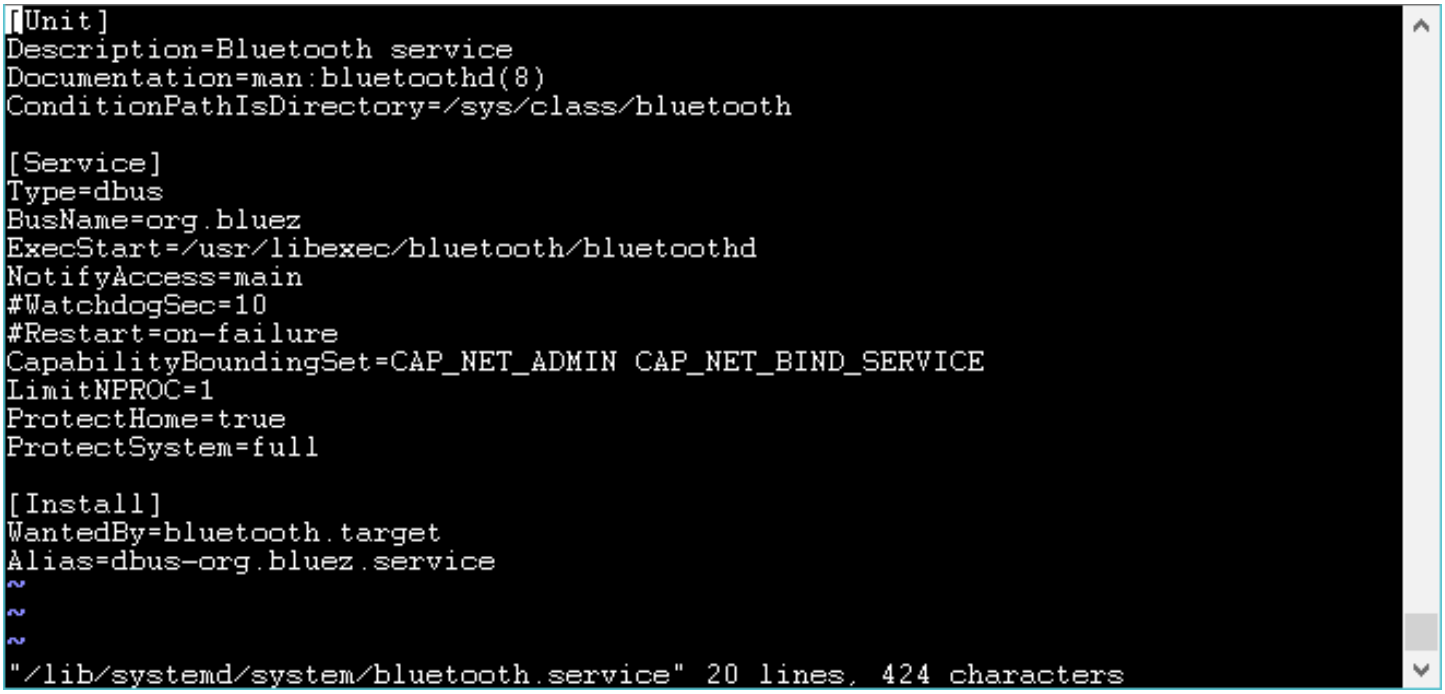
2.6 Compile and Install BlueZ

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

To make sure the upgrade you 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, as shown in the screenshot below.



Now, you 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
```

```
pi@raspberrypi:/usr/lib/bluetooth $ sudo cp /usr/lib/bluetooth/bluetoothd /usr/l
ib/bluetooth/bluetoothd-543.orig
pi@raspberrypi:/usr/lib/bluetooth $ ls -l
total 1600
-rwxr-xr-x 1 root root 816996 Oct 20 09:38 bluetoothd
-rwxr-xr-x 1 root root 816996 Jan 29 03:06 bluetoothd-543.orig
pi@raspberrypi:/usr/lib/bluetooth $
```

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]

```
pi@raspberrypi:~ $ cd ~
pi@raspberrypi:~ $ bluetoothd -v
5.50
pi@raspberrypi:~ $ meshctl -v
meshctl: 5.50
pi@raspberrypi:~ $
```

[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 takes a long time, or you can cross-compile, which is much quicker but requires more setup. This tutorial shows you the local building method.

3.1 Install Kernel Building Dependencies

```
sudo apt-get install -y git bc libncurses5-dev
```

3.2 Checking Out Building Tool and R Pi3 Source Code

```
cd ~
git clone --depth=1 https://github.com/raspberrypi/linux
```

3.3 Configuring the Kernel

```
cd ~
cd ./linux
KERNEL=kernel7
make bcm2709_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'll 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.

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'll 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. [2]

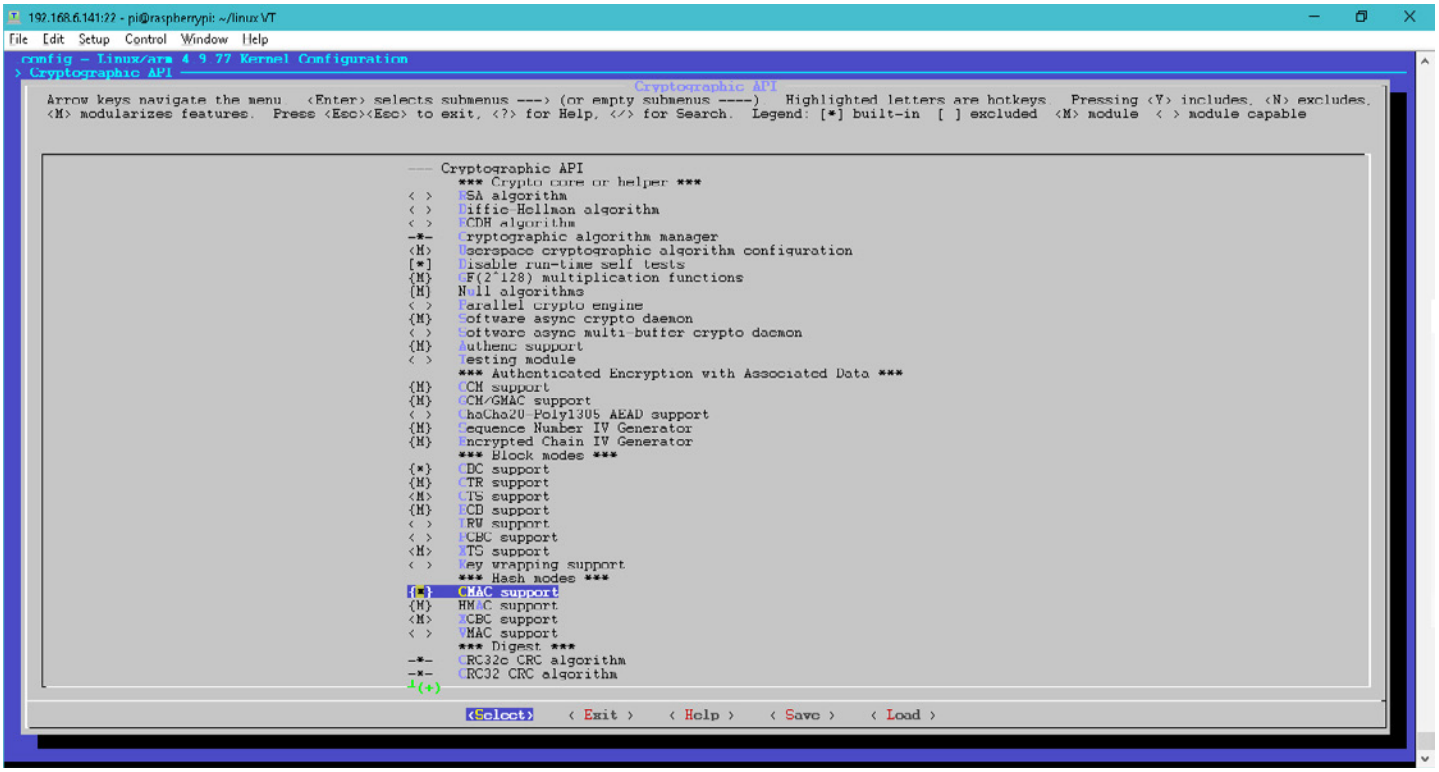
Please include the three modules below:

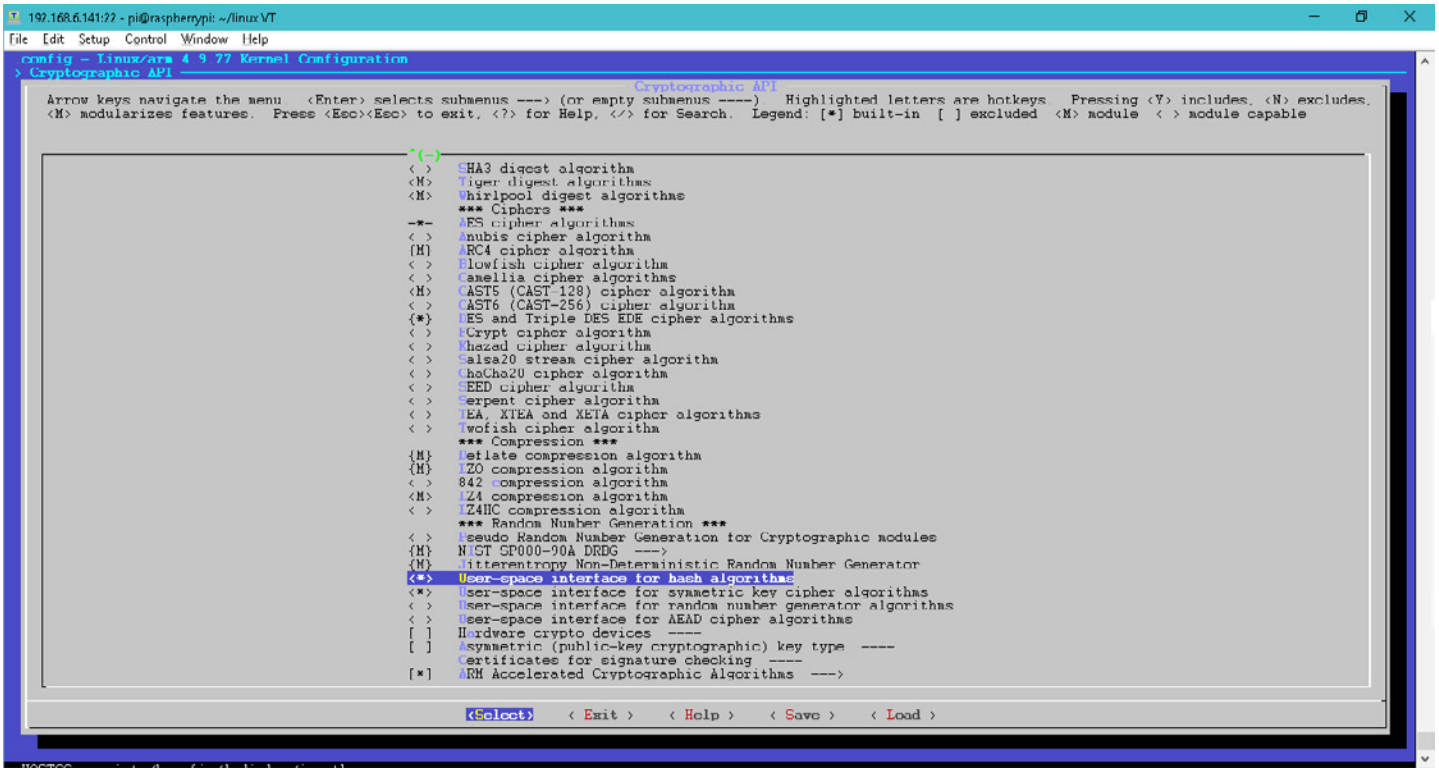
Select Cryptographic API → CMAC support

Select Cryptographic API → User-space interface for hash algorithms

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

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


192.168.6.141:22 - pi@raspberrypi: ~/linux VT
File Edit Setup Control Window Help
config - Linux/arm 4 9 77 Kernel Configuration
> Cryptographic API
Cryptographic API
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded <M> module < > module capable
--- Cryptographic API
*** Crypto core or helper ***
< > RSA algorithm
< > Diffie-Hellman algorithm
< > ECDH algorithm
-*- Cryptographic algorithm manager
<M> Userspace cryptographic algorithm configuration
[*] Disable run-time self tests
{M} GF(2^128) multiplication functions
{M} Null algorithms
< > Parallel crypto engine
{M} Software async crypto daemon
< > Software async multi-buffer crypto daemon
{M} Authenc support
< > Testing module
*** Authenticated Encryption with Associated Data ***
{M} CCM support
{M} GCM/GMAC support
< > ChaCha20-Poly1305 AEAD support
{M} Sequence Number IV Generator
{M} Encrypted Chain IV Generator
*** Block modes ***
{*} CBC support
{M} CTR support
<M> CTS support
{M} ECB support
< > LRW support
< > PCBC support
<M> XTS support
< > Key wrapping support
*** Hash modes ***
[*] CMAC support
{M} HMAC support
<M> XCBC support
< > VMAC support
*** Digest ***
-*- CRC32c CRC algorithm
-*- CRC32 CRC algorithm
v(+)
<Select> < Exit > < Help > < Save > < Load >


192.168.6.141:22 - pi@raspberrypi: ~/linux VT
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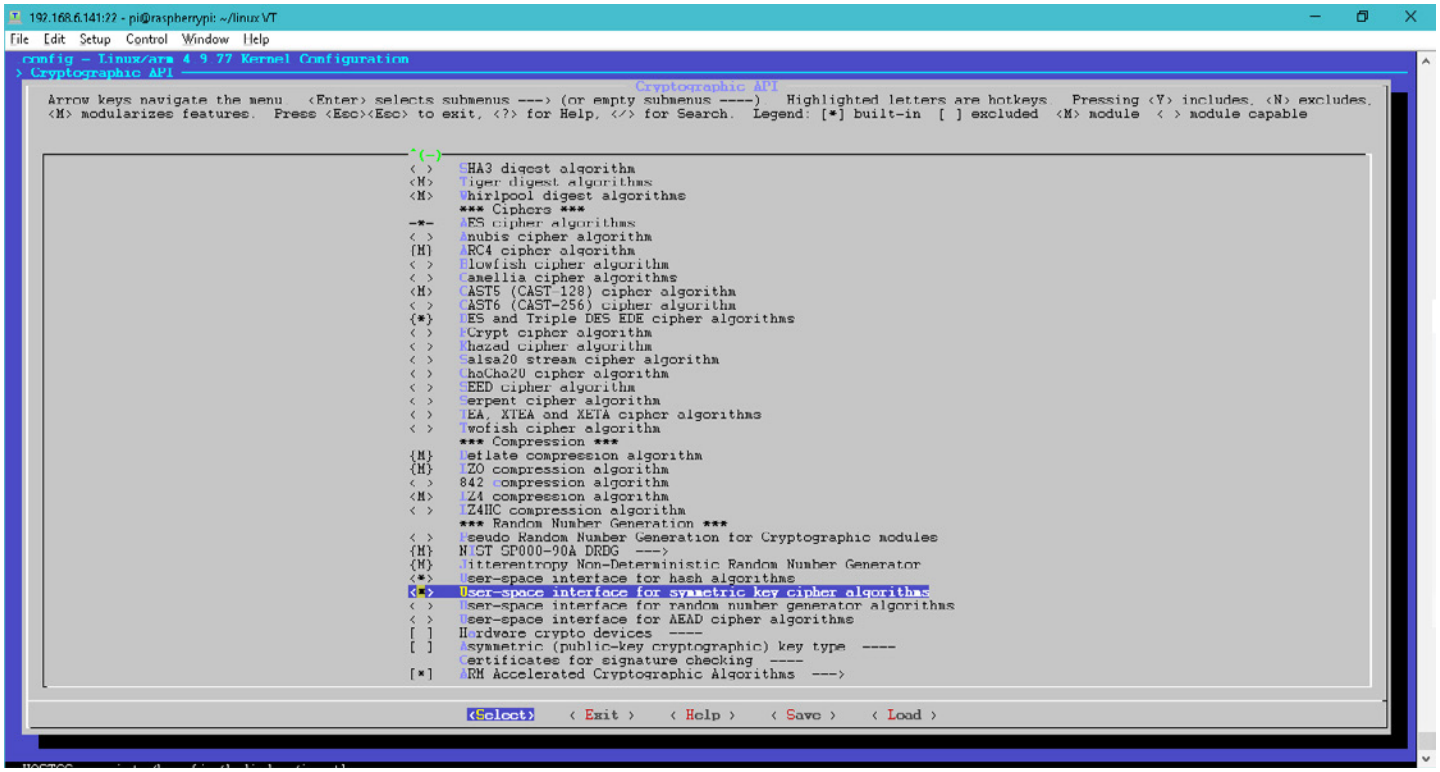
^(-)
< > SHA3 digest algorithm
<M> Tiger digest algorithms
<M> Whirlpool digest algorithms
*** Ciphers ***
-*- AES cipher algorithms
< > Anubis cipher algorithm
{M} ARC4 cipher algorithm
< > Blowfish cipher algorithm
< > Camellia cipher algorithms
<M> CAST5 (CAST-128) cipher algorithm
< > CAST6 (CAST-256) cipher algorithm
{*} DES and Triple DES EDE cipher algorithms
< > FCrypt cipher algorithm
< > Khazad cipher algorithm
< > Salsa20 stream cipher algorithm
< > ChaCha20 cipher algorithm
< > SEED cipher algorithm
< > Serpent cipher algorithm
< > TEA, XTEA and XETA cipher algorithms
< > Twofish cipher algorithm
*** Compression ***
{M} Deflate compression algorithm
{M} LZO compression algorithm
< > 842 compression algorithm
<M> LZ4 compression algorithm
< > LZ4HC compression algorithm
*** Random Number Generation ***
< > Pseudo Random Number Generation for Cryptographic modules
{M} NIST SP800-90A DRBG ---->
{M} Jitterentropy Non-Deterministic Random Number Generator
<*> User-space interface for hash algorithms
<*> User-space interface for symmetric key cipher algorithms
< > User-space interface for random number generator algorithms
< > User-space interface for AEAD cipher algorithms
[ ] Hardware crypto devices ----
[ ] Asymmetric (public-key cryptographic) key type ----
Certificates for signature checking ----
[*] ARM Accelerated Cryptographic Algorithms --->
<Select> < Exit > < Help > < Save > < Load >



Once you're 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 Mon Aug 6 14:31:38 HKT 2018. That time and date was exactly when I built the kernel and it means the kernel building and installation as successful.

```
pi@raspberrypi: ~
Linux raspberrypi 4.14.59-v7+ #1 SMP Mon Aug 6 14:31:38 HKT 2018 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu Aug  9 12:06:26 2018 from 192.168.6.147
pi@raspberrypi:~ $ uname -a
Linux raspberrypi 4.14.59-v7+ #1 SMP Mon Aug 6 14:31:38 HKT 2018 armv7l GNU/Linux
pi@raspberrypi:~ $
```

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

```
pi@raspberrypi: ~/bluez-5.50/mesh
pi@raspberrypi:~ $ cd ./bluez-5.50/mesh/
pi@raspberrypi:~/bluez-5.50/mesh $ meshctl
[meshctl]# help
Menu main:
Available commands:
-------------------
config                                  Configuration Model Submenu
onoff                                   On/Off Model Submenu
list                                    List available controllers
show [ctrl]                             Controller information
select <ctrl>                           Select default controller
security [0(low)/1(medium)/2(high)]     Display or change provision security level
info [dev]                              Device information
connect [net_idx] [dst]                 Connect to mesh network or node on network
discover-unprovisioned <on/off>         Look for devices to provision
provision <uuid>                        Initiate provisioning
power <on/off>                          Set controller power
disconnect [dev]                        Disconnect device
mesh-info                               Mesh networkinfo (provisioner)
local-info                              Local mesh node info
menu <name>                             Select submenu
version                                 Display version
quit                                    Quit program
exit                                    Quit program
help                                    Display help about this program
export                                  Print evironment variables
[meshctl]#
```

4.0 Summary

Once you complete all the steps listed above, you'll have a Raspberry Pi3 board which can work as a provisioner to provision any dev kits/boards that support PB-GATT. Future tutorials will show you how to use meshctl to provision and configure a real Bluetooth mesh device.