



Z-Stack Linux Gateway User's Guide – BeagleBone Addendum

Version 1.0

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1. Objective

The Z-Stack™ Linux Gateway is a complete application development suite that provides an abstracted API set and Linux-based servers, which can be used to develop a ZigBee gateway solution.

2. Scope

This document accompanies the Texas Instruments™ Z-Stack Linux Gateway User's Guide. This document provides an addendum to the User's Guide with BeagleBone specific information related to tool chains and platform hardware.

3. Definitions, Abbreviations, Acronyms

Term	Definition
NPI	Network Processor Interface
ZNP	ZigBee Network Processor
SBL	Serial Bootloader
SDK	Software development kit

4. Installation

The following sections provide details on supported hardware, host installation requirements and the steps necessary to install the Z-Stack Linux Gateway software.

4.1 Supported Devices

This release of Z-Stack Linux Gateway supports following devices:

Linux Gateway:

- BeagleBone Black
<http://beagleboard.org/>

ZigBee:

- [CC2531 USB Evaluation Module Kit](#)

4.2 Software Downloads and Board/Host Configuration

4.2.1 Beaglebone Black Setup

- Install the latest Beaglebone Black Debian software image. Instructions (follow all the steps):

<http://beagleboard.org/Getting%20Started>

The Beaglebone Black Debian Image is available for both SD card and eMMC:

<http://beagleboard.org/latest-images>

- After Beaglebone setup is complete, connect the board to Host PC using mini USB cable. Host PC should have network-over-USB access to the Beaglebone board. The IP address of the BeagleBone Black over this network interface is 192.168.7.2.

- Windows Host PC

After BeagleBone boots, new Ethernet interface is created on Host PC with the name “Linux USB Ethernet/RNDIS Gadget”. Host PC IP address 192.168.7.1 should get assigned to the new network interface. In case not, assign static IP address 192.168.7.1 and netmask 255.255.255.0 to the new network interface.

- Linux Host PC

IP address 192.168.7.1 should get automatically assigned to the new network interface (network over USB).

In case not, follow the instructions below to assign static IP address 192.168.7.1:

First you need to determine network device assigned to the network-over-USB. You can do this by examining /var/log/messages while logged into the BeagleBone Black, before and after the USB cable is plugged in. Right after the USB is plugged in you should see a line similar to the following appear:

```
Jun  2 13:35:48 a0873607local kernel: [12000.529197] eth2: register 'rndis_host' at usb-0000:00:06.0-2, RNDIS device, 90:59:af:68:85:be
```

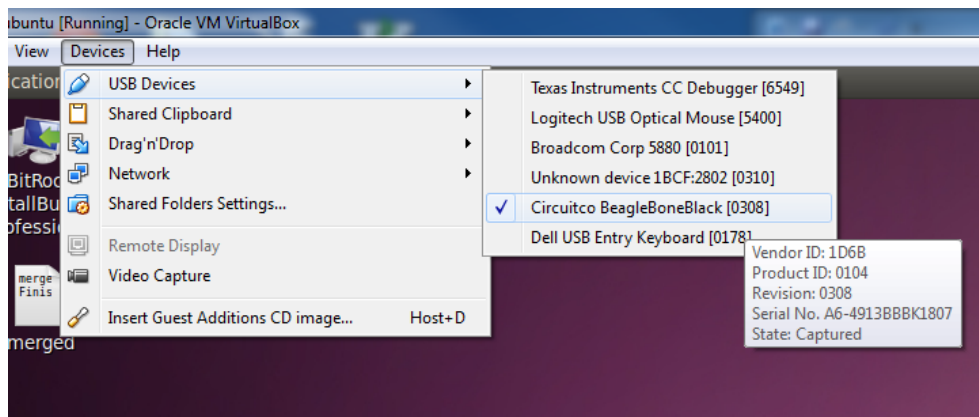
In the above example, the network-over-usb capability is assigned to “eth2”. With this information, you can issue the following command to statically assign the address:

```
sudo ifconfig eth2 192.168.7.1 netmask 255.255.255.0 up
```

For VirtualBox (or similar) hosted Linux Host OS's, make sure the guest Linux OS has access to the BeagleBone over the USB interface. In the VirtualBox menus, select

Devices->USB Devices->CircuitCo BeagleboneBlack

as shown below:



Gateway Installer comes with pre-built sample application executable. In case the user intends to modify/rebuild the sample application, or to develop a new end-user application the Linaro toolchain must be installed first.

Please click on the link [here](#), then select the “Download Linaro Toolchain” link. This will download only the toolchain which is all that is needed to rebuild the Sample Application.

- Your "PATH" variable needs to be modified to point to:
<LINARO INSTALL LOCATION>/bin

4.3 Package Contents

The installation package contains all of the documentation and software required to install, configure and develop ZigBee applications. The package employs a Linux-based installer which guides the installation process.

4.3.1 Binary Installation

The file name for the installer is: **ZStackGatewayRefDesignBeagleBone-1.0.1-linux-installer**

This installer will install the following:

Documents/

- Z-Stack Linux Gateway BeagleBone QuickStart Guide.pdf
- Z-Stack Linux Gateway User Guide.pdf
- Z-Stack Linux Gateway User Guide BeagleBone Addendum.pdf (This document)
- Z-Stack Linux Gateway - API document v1.1.pdf

Firmware/

- CC253x-GW-ZNP_<version>.hex
 - ZNP Hex file to be flashed on the C253x to convert it to a ZigBee Network Processor.
- SampleSwitchRouter_OTA.hex
 - Hex file to be flashed on a SmartRF05 + CC2530 to configure it as a Sample ZigBee HA Switch with OTA capabilities. This is useful to try out the OTA Upgrade feature supported by this release.

Precompiled_arm/

- servers/ Gateway Servers built for your target
 - NPI Server and configuration file: NPI_Inx_arm_server, NPI_Gateway.cfg
 - ZNP Server and configuration file: ZLSZNP_arm, config.ini
 - Network Manager Server and configuration file: NWKMGR_SRVR_arm

- Gateway Manager Server and configuration file: GATEWAY_SRVR_arm, gateway_config.ini, gateway_config.tlg
 - OTA Upgrade Server and configuration file: OTA_SRVR_arm
 - Scripts:
 - Servers' startup script: zigbeeHAgw
track_servers (used internally to monitor status of servers).
 - Script to fire up application: start_application
 - Sample OTA Upgrade configuration file: sample_app_ota.cfg
- app/ Sample Application built for the BeagleBone Black w/Debian.
 - main.bin Sample Application binary
- protobuf/ Pre-built Protobuf-C runtime support built for your target
 - libprotobuf-c.so.0
- tools/
 - Serial BootLoader Tool : sbl_tool.bin
 - Tool to query the version of CC2531 ZigBee SOC firmware : gw_soc_fw_version_query.bin
 - Tool to hardware reset CC2531 USB Dongle plugged into Beaglebone.: bbb_usbreset.bin
- misc/ Example binary image to test Serial Bootloader Tool
 - CC253x-GW-ZNP_<version>.bin
 - ota_sample_images/ Sample images to upgrade an example device that supports OTA upgrades.

Proto_files/

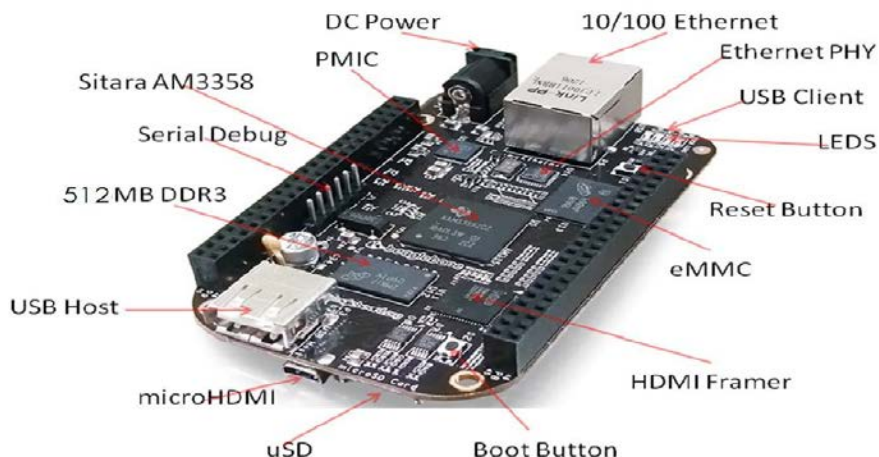
- Proto files that represent the APIs supported by the various servers that are part of this release. These are compiled by the proto-c compiler to create equivalent 'C' source and header files that are then included by the End-user application as well as the servers.
 - gateway.proto
 - nwkmgr.proto
 - otasrvr.proto

Source/

- Script for building the sample app called *build_sample_app*
- Sources for the sample application itself at Projects/zstack/linux/demo
- Sources for Google's protobuf support, required to rebuild the sample application at google/protobuf-c.
- Google protobuf libraries at protobuf-c-arm/lib/
- Source and header files generated by compiling the .proto files that are required to build the sample application or create a new end-user application.
 - Projects/zstack/linux/otaserver/otasrvr.pb-c.c, otasrvr.pb-c.h
 - Projects/zstack/linux/nwkmgr/nwkmgr.pb-c.c, nwkmgr.pb-c.h
 - Projects/zstack/linux/hagateway/gateway.pb-c.c, gateway.pb-c.h

4.4 Product Installation Procedures

- Ensure Beaglebone Black is setup (as explained in 4.2.1).
- Connect Beaglebone black and Host PC using mini USB cable



Beaglebone Board

- Beaglebone Login credentials:

user: root
no password needed

- Insert the TI CC2531 USB dongle in the Beaglebone USB Host slot. In case the dongle is not pre-flashed with the correct image, use CC Debugger (<http://www.ti.com/tool/cc-debugger>) to flash Firmware/CC2531-GW-ZNP_<revision>.hex. The dongle should enumerate on the BeagleBone Black as a character device in /dev/ttyACMx, where x is usually 0.
- Install Z-Stack™ Linux Gateway binaries on Beaglebone

Installed package comes with pre built Z-Stack Gateway binaries for Beaglebone. Using 'scp' or similar protocol, transfer binaries to Beaglebone:

```
$ cd <INSTALL>/Z-Stack_Linux_Gateway-1.0.1/Precompiled_arm
$ scp z-stack_linux_gateway_arm_binaries_<version>.tar
  root@192.168.7.2:/root
```

- Open 2 SSH client shells (using putty etc., port 22) connected to BeagleBone board. Login as root
- Untar Z-Stack Gateway Binaries

```
$ cd ~
$ mkdir z-stack_linux_gateway_arm_binaries_<version>
$ tar xvf z-stack_linux_gateway_arm_binaries_<version>.tar -C z-
stack_linux_gateway_arm_binaries
```

- On one shell, run following commands to start Z-Stack Gateway servers

```
$ cd ~/z-stack_linux_gateway_arm_binaries_<version>
$ cp protobuf/libprotobuf-c.so.0 /usr/lib/
$ cd servers
$ chmod +x ./zigbeeHAgw
$ ./zigbeeHAgw beaglebone
```

This script will start and monitor following servers:

- NPI_Inx_arm_server
- ZLSZNP_arm
- NWKMGW_SRVR_arm
- GATEWAY_SRVR_arm
- OTA_SRVR_arm

- On second shell, run following commands to start Z-Stack Gateway application

```
$ cd ~/z-stack_linux_gateway_arm_binaries_<version>/servers
$ chmod +x ./start_application
$ ./start_application
```

- Stopping Gateway Servers

Aborting the script “zigbeeHAgw” (Ctrl + C) will kill all the Gateway servers

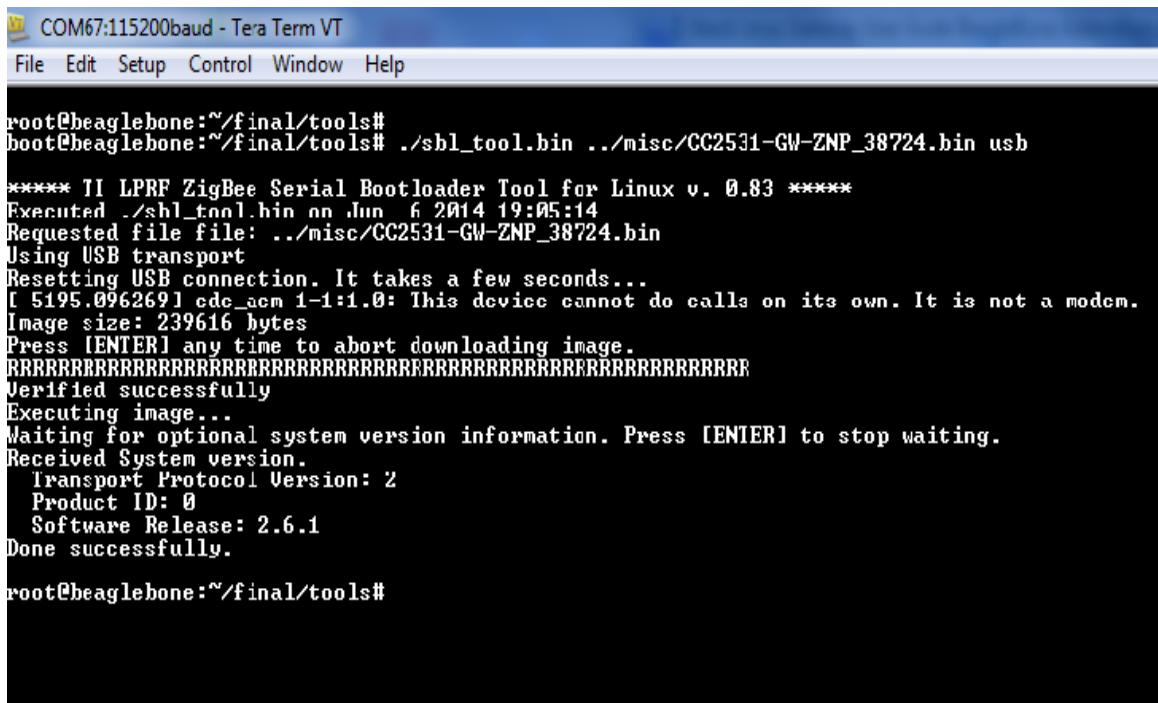
- Stopping Gateway Application

Use “Quit”/”q” to quit the sample application

- Running Serial Bootloader Tool to update CC2531 ZigBee SOC image on USB Dongle

NOTE: make sure no servers are running.

```
$ cd ~/z-stack_linux_gateway_arm_binaries_<version>/tools
$ ./sbl_tool.bin ../misc/CC2531-GW-ZNP_<version>.bin usb
```



```
COM67:115200baud - Tera Term VT
File Edit Setup Control Window Help

root@beaglebone:~/final/tools#
root@beaglebone:~/final/tools# ./sbl_tool.bin ../misc/CC2531-GW-ZNP_38724.bin usb

***** TI LPRF ZigBee Serial Bootloader Tool for Linux v. 0.83 *****
Executed ./sbl_tool.bin on Jun 6 2014 19:05:14
Requested file file: ../misc/CC2531-GW-ZNP_38724.bin
Using USB transport
Resetting USB connection. It takes a few seconds...
[ 5195.096269] cdc_acm 1-1:1.0: This device cannot do calls on its own. It is not a modem.
Image size: 239616 bytes
Press [ENTER] any time to abort downloading image.
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Verified successfully
Executing image...
Waiting for optional system version information. Press [ENTER] to stop waiting.
Received System version.
  Transport Protocol Version: 2
  Product ID: 0
  Software Release: 2.6.1
Done successfully.

root@beaglebone:~/final/tools#
```