

OTA Upgrading Worksheet

In this worksheet we provide a step-by-step guide to create, build and run Z3GatewayHost sample and ZigbeeMinimal applications based on EmberZNet Stack 6.6.4. If you use a later release in the future, most of the instructions should still apply, although there could be minor differences not foreseen at the time of this document.

These exercises help you get familiar with ZigBee 3.0 in the EmberZNet Stack, Simplicity Studio v4 development environment, and the Wireless Start Kit (WSTK) with EFR32MG modules. We assume that you have a WSTK and the following software requirements:

- Simplicity Studio 4
- EmberZNet 6.6.4
- GCC 7.2

KEY FEATURES

- Step-by-step guide to creating, building and running ZigBee 3.0 applications based on EmberZNet 6.6.4
- Use Simplicity Studio v4 as the development tool
- ZigBee end device polling
- Zigbee end device keepalive and aging
- Zigbee end device rejoin

1 Pre-requisites

Make sure you have installed the EmberZnet 6.6.4 SDK and GCC toolchain on your PC.

1.1 Check EmberZnet SDK

- 1. Launch Simplicity Studio v4.
- 2. "Windows"→"Preference"→"Simplicity Studio"→"SDKs", make sure "EmberZnet 6.6.4" is installed

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Figure 1 Check SDK in Simplicity Studio

1.2 Check Toolchains

- 1. Launch Simplicity Studio v4.
- 2. "Windows"→"Preference"→"Simplicity Studio"→"Toolchains", make sure GCC toolchain is installed.

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Figure 2 Check Toolchain in Simplicity Studio

1.3 Install the software tools:

1. Cygwin;

Extract the package cygwinx86.rar and copy it to the root directory of disk C.

You can also extract the package cygwinx86.rar to other location as long as there is only ASCII characters in the path. In this case you will need to modify the file "cygwin_here.reg" and modify the path according to your location.



Double click "cygwin_here.reg" then select a folder and right click, check if there is a menu to start Cygwin in this folder.

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Figure 3 Right-click menu to start cygwin

1.4

- How to flash the programStart Simplicity Studio, then connect your device to PC;
- for "Flash Programmer", press it; 2. In the menu bar, find the icon
- 3. In the popup window, select the device;

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	Figure 4 Select device	

Figure 4 Select device

4. Then in the next window, click "browse" to select the generated image (.s37 or .hex) of your project, press "Program". You can also press "erase" if needed. Normally you just need to erase the device once before when you start the hands-on. The generated image is in the binary folder of your project. You can select it in "Project Explorer".

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		Flash to Device	
		Properties	Alt+Enter

Figure 5 Select image

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The unlock function only works using Silicon Labs Unlocking the chip will erase all data on flash and S	EFM32 and EFR32 boards. RAM.
	Unlock Debug Access Lock Debug Access
?	Close
Figure 6	Flash application

1.5 How to open console

Simplicity Studio has integrated a console so that it's convenient to debug through console. To use the console, you need:

Simplicity IDE

- 1. Change to "Simplicity IDE" perspective
- 2. Select your adapter in the "Debug Adapters" window, right click and select "connect";

3. Select your adapter in the "Debug Adapters" window, right click and select "Launch console";



Figure 7 Launch console

1.6 How to start Capture

1. Change to "Simplicity IDE" perspective

Simplicity IDE

- 2. Select your adapter in the "Debug Adapters" window, right click and select "connect";
- 3. Select your adapter in the "Debug Adapters" window, right click and select "Start Capture";

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Figure 8 Start Capture

2 Build the bootloader for OTA client

- 1. Go to File -> New -> Project. This will bring up the New Project Wizard
- 2. Select "Silicon Labs AppBuilder Project". Click Next.
- 3. Select "Gecko Bootloader". Click Next.
- 4. Select the latest version. (Gecko Bootloader 1.9.2). Click Next.
- 5. Select "SPI Flash Storage Bootloader (single image)". Click Next.
- 6. Name your project (Whatever name you want). Click Next.
- 7. Select board and compiler. Then finish.

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Figure 9 Select board and compiler

- 8. The new project should have been created now, with the project configuration file (an .isc file) open.
- 9. Click "Generate". Notice the project files appearing in Project Explorer. A window saying Generation successful will appear. Click OK.

10. Select the project in Project Explorer window and compile your project by clicking on the Build icon ⁶. Ensure that the build completes with 0 errors.

3 Build the old version client image

- 1. Go to File -> New -> Project. This will bring up the New Project Wizard
- 2. Select "Silicon Labs AppBuilder Project". Click Next.
- 3. Select "Silicon Labs Zigbee". Click Next.
- 4. Select our latest EmberZNet stack for Soc (in this case EmberZNet 6.6.4 GA Soc). Click Next.
- 5. Select "ZigbeeMinimal". Click Next.
- 6. Name your project, such as "Client". Click Next.
- 7. In next window (Project Setup), select board to BRD4162A, and compiler to "GCC v7.2" (If you don't have it, please install any other). Click Finish.

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Figure 10 select board and compiler

- 8. In "ZCL Clusters" tab,
 - a. In "ZCL device type" field, set "ZCL device type" to "HA On/Off Switch"

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- 9. Turn to "plugins" tab, select the following plugins:
 - a. Install Code Library
 - b. OTA Bootload Cluster Client

general 👗 ZCL Clusters 🍰 Zigbee Stack 🍰 Printing and CLI 🌘 HAL 🗇 Plugins 🖉 Callbac	acks 👶 Includes 👶 Other options 🚯 Bluetooth GATT
Plugin configuration	
Use this section to select or unselect the plugins that you want to use in your application	
	Plugin: 🚸 OTA Bootload Cluster Client Policy
✓ 🕪 Strong Random, provides API: strong-random	Quality: V Production Ready (Certifiable)
Aprove the second secon	Description:
🗌 🕪 Xmodem Sender	This is a sumple implementation of how to define the policies of the Zinhee Over the six heatland cluster slight (a multi-heat application
ZCL Framework Core, provides API: command-interpreter2	host a sample implementation of now to define the pointers to the 2 goes over the an boottoac duster client (a multi-nop, application in boottoacto). It allows the implementor to decide what manufacturer ID image twe ID and file version information is used for when guerying the
🔲 🕪 Zigbee Event Logger Stub, provides API: zigbee-event-logger	server. It also defines a couple callbacks that are fired, such as download complete and ready to bootload.
✓ I when TLS, provides API: mbedtls	
→ mbed TLS Multiprotocol Configuration, provides API: mbedtls-config-multiprotocol	
🗸 🔳 🄽 ZigBee 3.0	
Find and Bind Initiator, provides API: find-and-bind-initiator	
Find and Bind Target, provides API: find-and-bind-target	
HA Device Trust Center Link Key Update	Options: Reset to defaults
Network Creator, provides API: network-creator	Image Type ID:[0-65535] 0
Network Creator Security, provides API: network-creator-security	Firmware Version: 100
✓ ♣ Network Steering, provides API: network-steering	
✓ ↓ Update TC Link Key, provides API: update-tc-link-key	Hardware Version:[0-65535] 0
✓ □ S ZigBee Light Link	Perform EBL Verification (SOC Only)
ZLL Commissioning Client	Include Hardware Version
□ � ZLL Commissioning Common, provides API: zll-profile	Delete Failed Downloads
ZLL Commissioning Network	
🗌 🌗 ZLL Commissioning Server	Details (double-click on files to show content):
ZLL Identify Server	Located at: C:\SiliconLabs\SimplicityStudio\v4\developer\sdks\pecko_sdk_suite\v2.6\protocol\zipbee\tool\appbuilder\\app\framework\pl:
ZLL Level Control Server Cluster Enhancements	Common source files (1)
ZLL On/Off Server Cluster Enhancements	S Implemented callbacks (4)
ZLL Scenes Client Cluster Enhancements	A sequired plugins (1)
ZLL Scenes Server Cluster Enhancements	کې Options (6) کلي (6)
ZLL Utility Client Cluster	Pluain extensions (1)
ZLL Utility Server Cluster	
🗸 🔳 🎥 ZigBee OTA Bootloading	
V 🕪 OTA Bootload Cluster Client, provides API: ota-client	
V N A Bootload Cluster Client Policy	
🔲 🌗 OTA Bootload Cluster Common Code	
🗌 🍁 OTA Bootload Cluster Server	
□ 🕪 OTA Bootload Cluster Server Policy	
🗹 🅪 OTA Bootload Cluster Storage Common Code	
🗹 🚸 OTA Cluster Platform Bootloader	
🗌 🅪 OTA POSIX Filesystem Storage Module	
🖂 🐢 OTA Simple Storage EEPROM Driver	
✓ ↓ OTA Simple Storage Module	
□ 🕪 OTA Simple Storage RAM Driver	

Figure 13 firmware version

- d. OTA Bootload Cluster Common Code
- e. OTA Bootload Cluster Storage Common Code
- f. OTA Cluster Platform Bootloader
- g. OTA Simple Storage Module
- h. OTA Simple Storage EEPROM Driver, in the properties, set the "read-modify-write" option to "false"

gin configuration e this section to select or unselect the plugins that you want to use in your application			
	***	Plugin: Plugin:	
🗸 📣 Strong Random, provides API: strong-random	^	Quality: 🖋 Production Ready	
Ap Throughput		Description:	
Amodem Sender		This is a define facetor Orac alta air simple standard and	alunia la una a EERROM es ales un destrino alestano de úna la analidade e monesta
ZCL Framework Core, provides API: command-interpreter2		record the actual data being read or written as well as met	a-data with information about how far along a client download is. It can be used either
🗌 🚸 Zigbee Event Logger Stub, provides API: zigbee-event-logger		by an OTA Client or an OTA Server.	
🗹 🚸 mbed TLS, provides API: mbedtls			
🗌 🚸 mbed TLS Multiprotocol Configuration, provides API: mbedtls-config-multiprotocol			
✓ ■ SigBee 3.0			
🗖 🚸 Find and Bind Initiator, provides API: find-and-bind-initiator			
🗌 🚸 Find and Bind Target, provides API: find-and-bind-target		0.0	
🗌 🚸 HA Device Trust Center Link Key Update		Options:	Reset to defaults
Network Creator, provides API: network-creator		SOC Bootloading Support	
Network Creator Security, provides API: network-creator-security		EM35x SOC Only: Enable 4.2 Application Bootloader Co	ompatibility Mode
✓ ↓ Network Steering, provides API: network-steering		Gecko Bootloader Storage Support:	Do not use slots 🗸
✓ ↓ Update TC Link Key, provides API: update-tc-link-key		3 11	
🗸 🗌 🏂 ZigBee Light Link		Storage Slot To Save Images To:	0
🗌 🚸 ZLL Commissioning Client		OTA Storage Start Offset:	0
🗌 🐢 ZLL Commissioning Common, provides API: zll-profile		074 0	202144
🗌 🚸 ZLL Commissioning Network		OTA Storage End Offset:	202144
🗌 🚸 ZLL Commissioning Server		EEPROM Device Read-modify-write Support:	unspecified 🗸
🗌 📣 ZLL Identify Server			true
ZLL Level Control Server Cluster Enhancements		Frequency for Saving Download Offset to EEPROIVI (bytes):	false
ZLL On/Off Server Cluster Enhancements		Details (double-click on files to show content):	unspecified
ZLL Scenes Client Cluster Enhancements			
ZLL Scenes Server Cluster Enhancements		Located at: C:\SiliconLabs\SimplicityStudio\v4\deve	eioper\sdks\gecko_sdk_suite\v2.6\protocoi\zigbee\tooi\appbuilder\\\app\framework\p
🗌 🚸 ZLL Utility Client Cluster		Common source files (3)	
🗌 🚸 ZLL Utility Server Cluster		> (S) Implemented calibacks (7)	
🗸 🔳 🏂 ZigBee OTA Bootloading		S alle Required plugins (2)	
🗹 🚸 OTA Bootload Cluster Client, provides API: ota-client		> S Defined calibacks (1)	
🗹 🚸 OTA Bootload Cluster Client Policy		> Setup contributions (1)	
🗌 🚸 OTA Bootload Cluster Common Code		> ve Options (8)	
🗌 🚸 OTA Bootload Cluster Server		> V Conditions (2)	
OTA Bootload Cluster Server Policy		> 😿 Plugin extensions (1)	
🗹 🧄 OTA Bootload Cluster Storage Common Code			
🗹 🍁 OTA Cluster Platform Bootloader			
OTA POSIX Filesystem Storage Module		<	
🖂 🕸 OTA Simple Storage EEPROM Driver			
🗹 🕸 OTA Simple Storage Module			
OTA Simple Storage RAM Driver	~		

Figure 14 OTA Storage setting

- 10. Turn to "Printing and CLI" tab, enable the following debug options.
 - a. Unfold "Individual plugin debug printing"
 - i. enable "OTA Simple Storage EEPROM Driver", both "compiled in" and "Enabled at start up";
 - ii. enable "OTA Bootload Cluster Storage Common Code", both "compiled in" and "Enabled at start up";
 - iii. enable "OTA Cluster Platform Bootloader", both "compiled in" and "Enabled at start up";
 - iv. enable "OTA Bootloader Cluster Client", both "compiled in" and "Enabled at start up";
 - v. enable "OTA Bootloader Cluster Client Policy", both "compiled in" and "Enabled at start up";
 - vi. enable "OTA Simple Storage Module", both "compiled in" and "Enabled at start up";
 - b. Unfold "Application specific debug printing"
 - i. enable "OTA Bootloader Cluster", both "compiled in" and "Enabled at start up";
- 11. Click "Generate". Notice the project files appearing in Project Explorer. A window saying "generating successfully" will appear. Click OK.
- 12.Select the project in Project Explorer window and compile your project by clicking on the Build icon ⁵. Ensure that the build completes with 0 errors.
- 13.In the build directory, backup the following file to a new folder "V100":
 - a. Client.ota
 - b. Client.s37

4 Build the new version client image

- 1. Open the isc file of the client project, turn to "plugins" tab, select the plugins "OTA Bootload Cluster Client Policy", in the properties page, set the firmware version to 200.
- 2. Save and generate the project, then build.
- 3. In the build directory, backup the following file to a new folder "V200":
 - a. Client.ota
 - b. Client.s37

5 Build the server

We will still use the Z3GatewayHost + NCP as the OTA server.

The OTA server is already configured. If you have run the last hands-on successfully, then you can skip this step.

You can check it with the following steps:

1. Open the isc file of the host project, turn to "ZCL Cluster" tab, make sure the server side of "Over the Air Bootloading" is enabled.

eneral 🚺	ZCL Clu	sters	🚴 Zigbee	Stack 🛛 🚓 Pri	nting and	CLI 🔘	HAL 🗣	Plugins	S Call	acks	🚴 Incl	udes 🛛 🤞	🖕 Other options 🛛 🚯 🛛 Blu	etooth GATT								
ters																						
/lanufactur	er (name o	r code):	Ember [0x1	1002]						~	Default	t respons	e policy: Conditional 🗸									
Multiple e	ndpoint co	onfiguratio	n							Sele	ected clus	ster descr	iption:									
Endpo	Profile	Devic	Version	Configuration	Netw	/ork			New													
411	Hom	0×00	1	Primary	Prim	arv																
=1242	Green	0x0061	1	GreenPower	Prim	arv			Delete													
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• Over the Air Bootloading					0x0019	H				- []												
	Power P	rofile	ouonig		0x001A	H				- []												
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2. Turn to "Plugins" tab, make sure the following plugins are enabled:

- a. OTA Bootload Cluster Common Code
- b. OTA Bootload Cluster Server
- c. OTA Bootload Cluster Server Policy
- d. OTA Bootload Cluster Storage Common Code
- e. OTA POSIX Filesystem Storage Module

6 Test

- 1. Flash the bootloader (xxx-combined.s37) and ncp (ncp.s37) image to WSTK (NCP);
- 2. Flash the bootloader (bootloader-storage-spiflash-single_xxx-combined.s37) and old version image (Client.s37) to your client.
- 3. In the "build/exe" folder under the host project, there should be a directory named "ota-files" (If it doesn't exist, create one). Copy the **new version** of the Client.ota to this directory.
- 4. Find the COM port number of your NCP board.
 - a. Start a cmd window:

	m D 袋 …
仚	Best match
	Command Prompt App
	Apps
	Visual C++ 2008 64-bit Command Prompt
	Visual C++ 2008 32-bit Command Prompt
	Visual C++ 2008 64-bit Cross Tools Command Prompt
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
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	بر cmd
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Figure 15 start cmd window

b. Change to C:\SiliconLabs\SimplicityStudio\v4\developer\adapter_packs\serial. Then run command:

serial.exe -ports



Figure 16 get COM port of the WSTK

- 5. Make sure your WSTK for NCP is disconnected in Simplicity Studio.
- 6. Start Cygwin, and switch to the directory of the Z3GatewayHost project, then switch to "build/exe" directory. Run the following command to start the host:

//COM17 is the COM port of the NCP ./Z3GatewayHost.exe -p COM17 /cygdrive/c/Users /Documents/v4_workspace_2.6/Z3GatewayHost \$ cd build/exe /cygdrive/c/Users /Documents/v4_workspace_2.6/Z3GatewayHost/build/exe \$ ./Z3GatewayHost.exe -p COM17 Reset info: 11 (SOFTWARE) ezsp ver 0x07 stack type 0x02 stack ver. [6.6.4 GA build 180] Ezsp Config: set source route table size to 0x0064:Success: set Ezsp Config: set security level to 0x0005:Success: set Ezsp Config: set address table size to 0x0002:Success: set Ezsp Config: set TC addr cache to 0x0002:Success: set Ezsp Config: set stack profile to 0x0002:Success: set Ezsp Config: set MAC indirect TX timeout to 0x1E00:Success: set Ezsp Config: set max hops to 0x001E:Success: set Ezsp Config: set tx power mode to 0x8000:Success: set Ezsp Config: set supported networks to 0x0001:Success: set Ezsp Value : set end device keep alive support mode to 0x00000003:Success: set Ezsp Policy: set binding modify to "allow for valid endpoints & clusters only":Success: set Ezsp Policy: set message content in msgSent to "return":Success: set Ezsp Value : set maximum incoming transfer size to 0x00000052:Success: set Ezsp Value : set maximum outgoing transfer size to 0x00000052:Success: set Ezsp Config: set binding table size to 0x0010:Success: set Ezsp Config: set key table size to 0x0040:Success: set Ezsp Config: set max end device children to 0x0020:Success: set Ezsp Config: set aps unicast message count to 0x000A:Success: set Ezsp Config: set broadcast table size to 0x000F:Success: set Ezsp Config: set neighbor table size to 0x0010:Success: set NCP supports maxing out packet buffers Ezsp Config: set packet buffers to 179 Ezsp Config: set end device poll timeout to 0x0001:Success: set Ezsp Config: set zll group addresses to 0x0000:Success: set Ezsp Config: set zll rssi threshold to OxFFD8:Success: set Ezsp Config: set transient key timeout to 0x00B4:Success: set Ezsp Endpoint 1 added, profile 0x0104, in clusters: 8, out clusters 20 Ezsp Endpoint 242 added, profile 0xA1E0, in clusters: 0, out clusters 1 MOTT Client Init

Figure 17 Start host

You should be able to see the detail info of the OTA image:

```
Found OTA file 'Z3SwitchSoc_Ota_4167A.ota'
Manufacturer ID: 0x1002
Image Type ID: 0x0000
Version: 0x0000064
Header String: EBL Z3SwitchSoc_Ota_4167A
Found 1 files
```

7. On the console of the host, run the following command to create a network.

```
plugin network-creator start 1
```

Program a install code string following the steps in section 7.1 of <u>https://github.com/MarkDing/IoT-Developer-Boot-Camp/wiki/Zigbee-Hands-on-Forming-and-Joining</u>. After that, derive a link key from the install code with the provided tool HashingTool.exe.

🔒 InstallCode Hashing To	ol	$\times$
InstallCode (>=6 Bytes)	1122334455667788	
Derived Link Key	41618FC0C83B0E14A589954B16E31466	
	Derive	

Figure 18 Derive link key from install code

9. On the console of the host, use the following command to open the network for the device:

```
//000B57FFFEA8EF42 is the Eui64 of the client
//41618FC0C83B0E14A589954B16E31466 is the install code derived link key
plugin network-creator-security open-with-key {000B57FFFEA8EF42}
{41618FC0C83B0E14A589954B16E31466}
```

10. Open console of the client, then run the following command to start joining.

plugin network-steering start 0

Add the NWK key to Simplicity Studio, then start to capture.
 On the console of the client, use the following command to start OTA upgrading.

```
plugin ota-client start
```

13. On the console of the client, use the following command to check the firmware version.

plugin ota-client info