Application Note：
Telink Zigbee Demo
User Guide

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Brief：

This document is the user guide for Telink Zigbee Demo.

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Revision History

Version	Major Changes	Date	Author
1.0.0	Initial release	2018/11	YB, WJZ, Cynthia
1.1.0	Updated the sections below: 3.4 Establish network, 4 OTA Firmware Upgrade, 5.2.2 ZGC usage	2019/5	YB, Cynthia

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1 Overview

This document presents the guide on how to use Telink Zigbee Demo.

Telink Zigbee Demo is a set of Telink-supplied application samples based on Zigbee PRO (R21) specification and Zigbee 3.0 standard, including sampleGW (Coordinator), sampleLight (Router) and sampleSwitch (End-Device).

| Apps	EndPoint	In Cluster	Out Cluster
sampleGW	1	OTA	Basic, Identify , Groups, Scenes On/Off, Level Control
sampleLight	1	Basic, Identify , Groups, Scenes On/Off, Level Control	OTA
sampleSwitch	1	Basic	Identify , Groups, Scenes On/Off, Level Control

2 Software and Hardware List

2.1 Software list

1) Telink supplies necessary software tools on PC side:

 ✧ Integrated Development Environment: Telink IDE

 ✧ Firmware burning and debugging tool: Telink Burning and Debugging Tool (BDT)

 ✧ OTA encoding conversion tool: tl_ota_tool

2) Software tool to capture packets for analysis: E.g. TI Packet Sniffer, or Ubiqua. Users can select and install sniffer tool as needed for further debugging.

2.2 Hardware list

Telink Zigbee Demo currently supports two hardware platforms, including TLSR8269 kit and TLSR8258 kit.
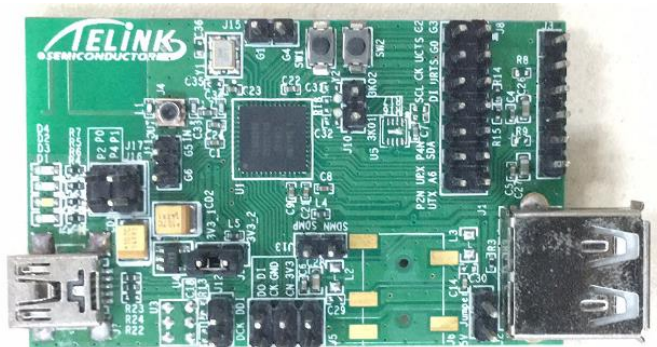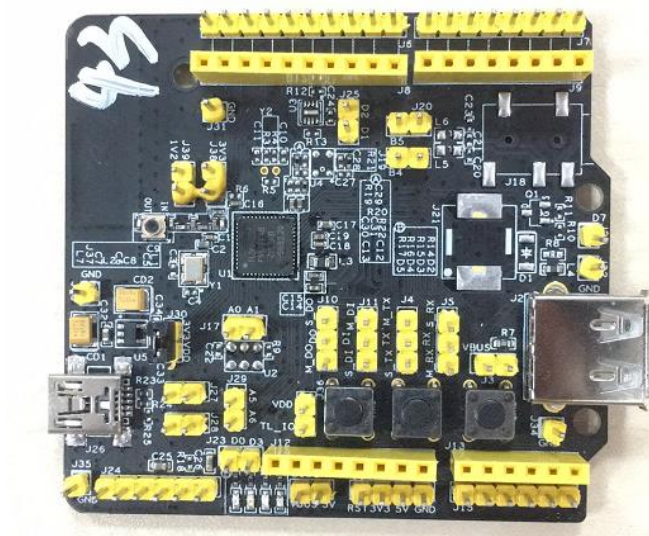

1) TLSR8269 EVK
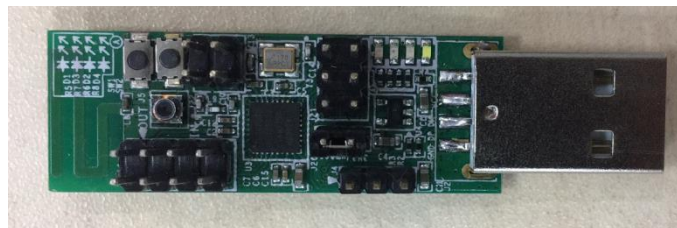
2) TLSR8269 USB dongle

Figure 1   TLSR8269 hardware kit

1) TLSR8258 EVK

2) TLSR8258 USB dongle

Figure 2   TLSR8258 hardware kit

3 Operation Guide

3.1 Import project

1) Place the mouse cursor on the "Project Explorer" window, click the right button of the mouse, and select the "Import…" to open the "Import" dialog window.
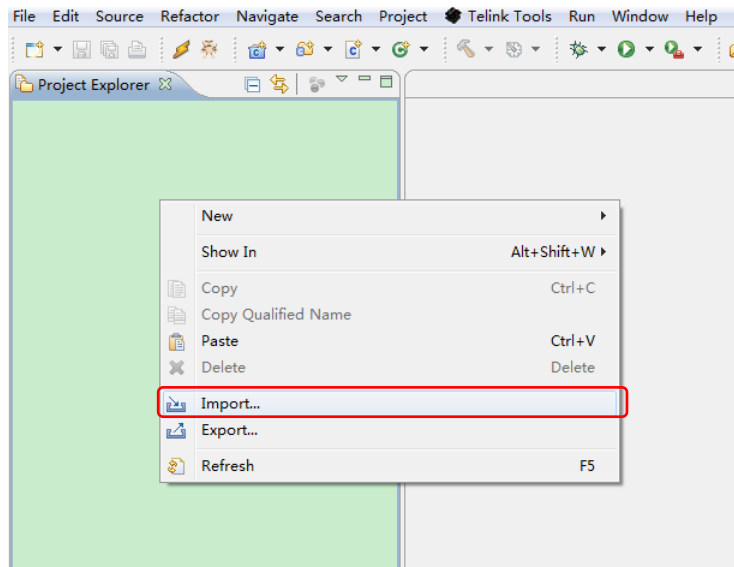
2) On the "Import" dialog window, select "General"->"Existing Projects into Workspace", and then click the "Next" button. The "Folder Browse" dialog window will pop up.
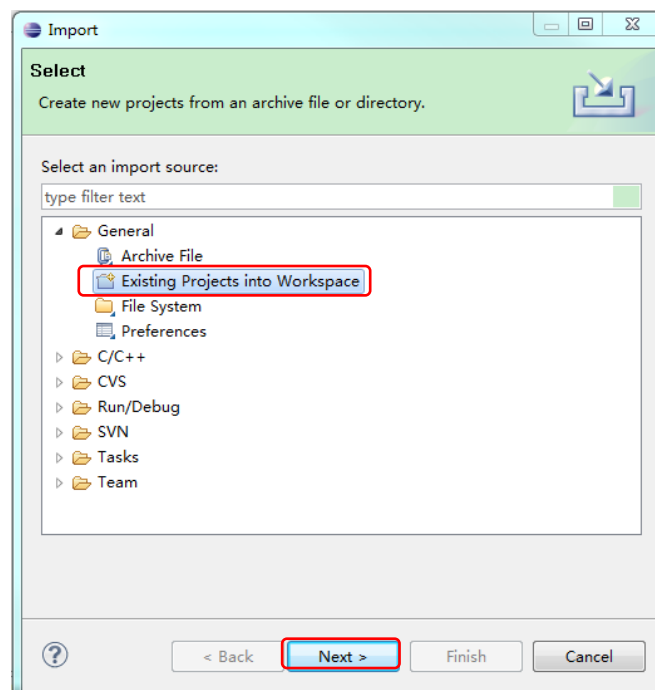
3) On the "Folder Browse" dialog window, click the "Browse…" button, select the target project file to be imported, and then click the "OK" button.
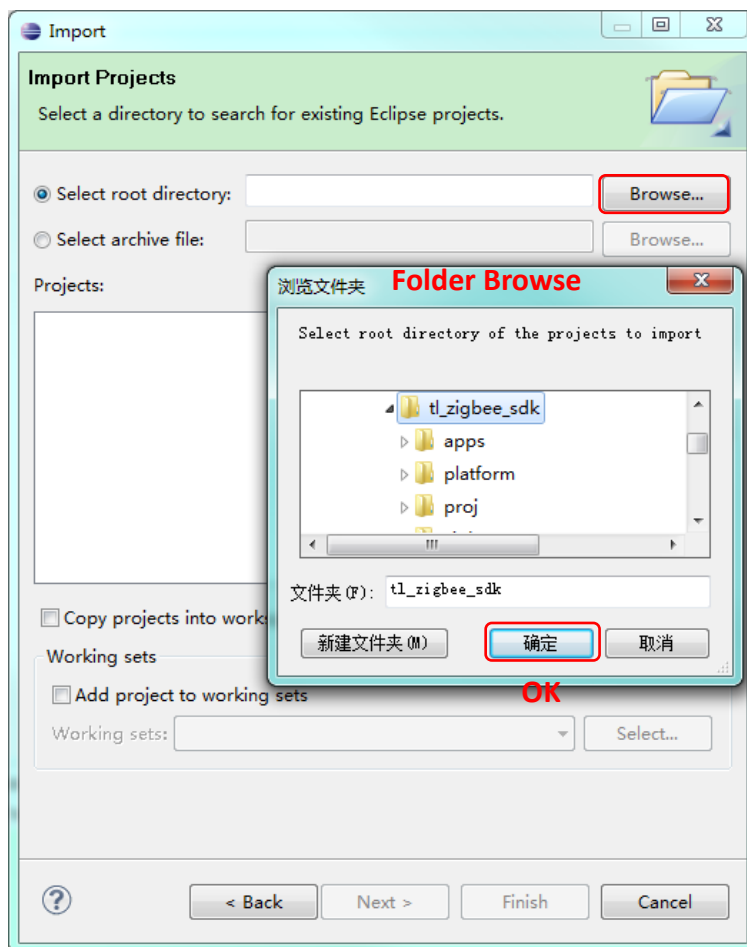
4) The file name and path of the selected project will be shown on the "Projects" window.

Click the "Finish" button to finish project importing.
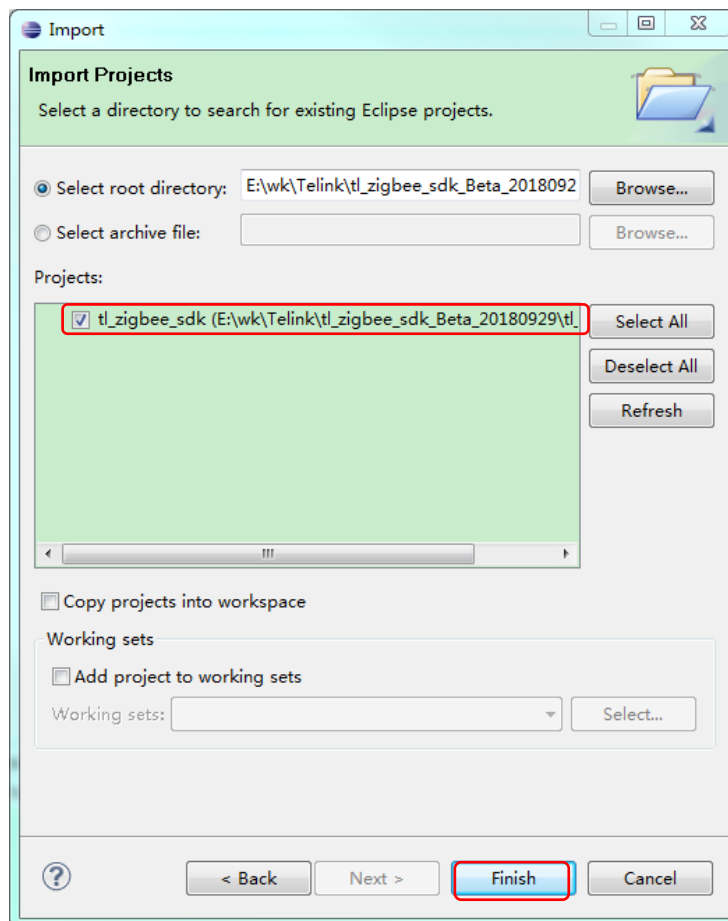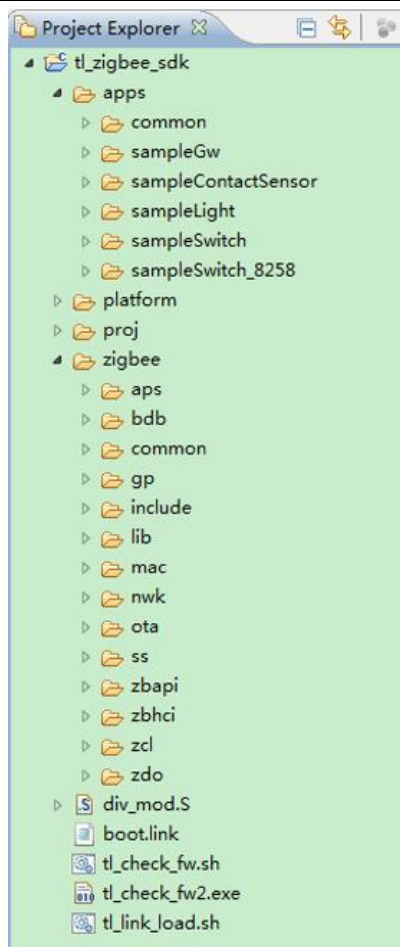
Figure 3   Directory structure for Telink Zigbee SDK Project

As shown in the Figure 3, the project "tl_zigbee_sdk" contains four directories:

✧   ../apps: user project directory

✧   ../platform: stack operation platform directory

✧   ../proj: driver-related directory

✧   ../zigbee: stack-related directory

3.2   Compile project samples

As shown in the Figure 4, click the drop-down icon , select the project sample to be compiled (e.g. sampleGw_8269), and wait for the end of compiling.
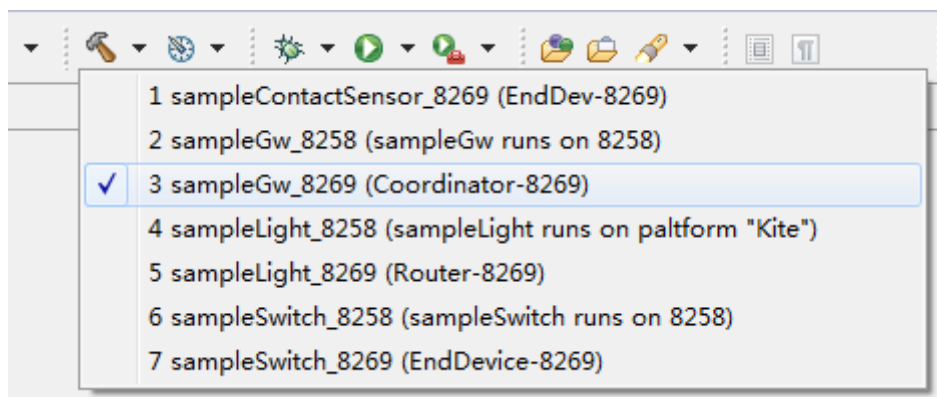
Figure 4   Compile project sample

After compiling is finished, the "Project Explorer" window will show folders including firmware binary file (e.g. "sampleGw_8269.bin").
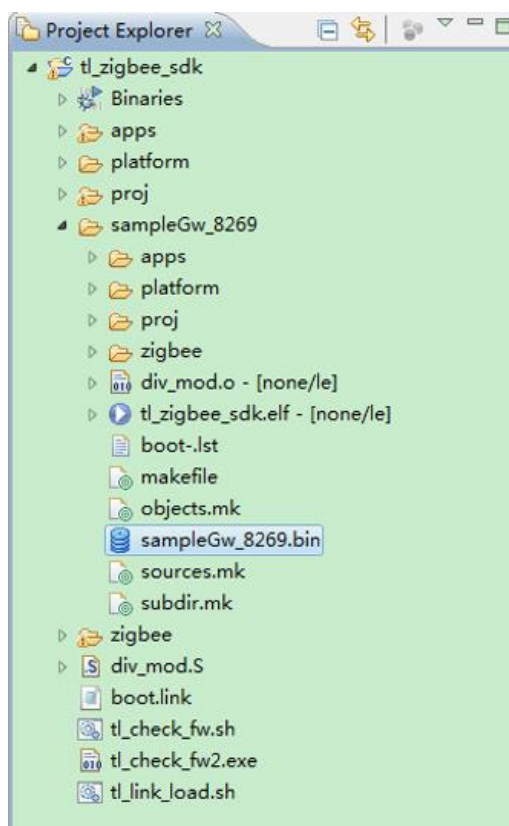
Figure 5   Firmware directory

3.3 Burn firmware

1) Connect hardware:

Use a mini USB cable to connect Telink burning EVK (TLSR8266BR56) with PC USB; the indicating lights on the EVK will blink once to indicate normal connection.

Then use three DuPont cables to connect the VCC, GND and SWM of the EVK with the VCC, GND and SWS of the target board, respectively.

Figure 6   Connection chart for target board, burning EVK and PC

For the detailed guide of Telink burning EVK (TLSR8266BR56), please refer to the document "*AN_18010500_User Guide for Telink Burning EVK TLSR8266BR56*".

2) Use Telink Burning and Debugging Tool (BDT) on PC side to download target firmware files into target boards.

   a) Select chip part number: e.g. 8269.

   b) Click "File"->"Open", and select the firmware to be burned.

   c) Click the "Erase" button to erase the entire 512kB Flash of the target board by default.

   d) Click the "Download" button to start firmware burning.

Figure 7   Download firmware

For the detailed guide of Telink BDT, please refer to the document "*AN-18101200_Telink Burning and Debugging Tool (BDT) User Guide*"
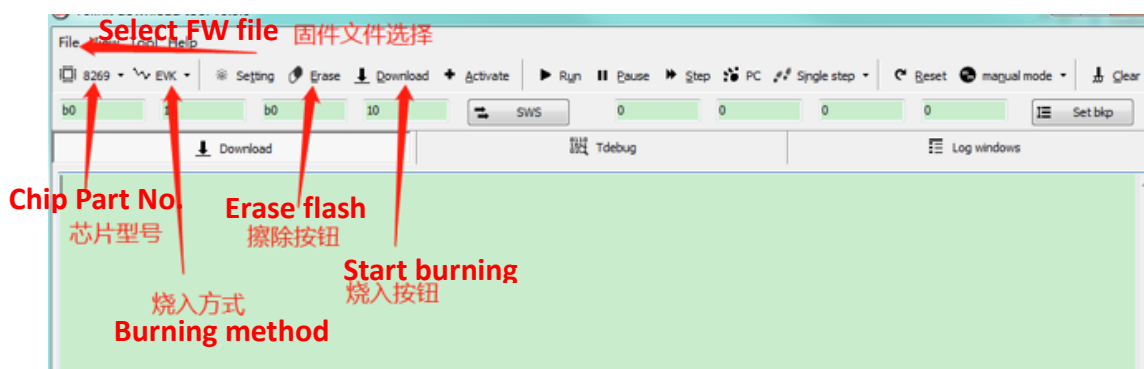
Take the USB Dongle based on 8269 platform as an example (for other platforms, please check out the configuration file in the SDK):

User should follow the steps in section **3.2 Compile project samples** to compile the project samples "sampleGw_8269", "sampleLight_8269" and "sampleSwitch_8269", so as to obtain three firmware binary files including "sampleGW.bin", "sampleLight.bin" and "sampleSwitch.bin".

Then user should follow the steps in section **3.3   Burn firmware** to download the three firmware files into the three target boards correspondingly, so that the target boards can act as Gateway (Coordinator), Light (Router) and Switch (EndDevice) in Telink Zigbee Demo.

*Notes:

1）MAC address: MAC address information is stored in the 8-byte location starting from flash address 0x76000. After booting, system will check MAC address info: If the detected info is 0xFFFFFFFFFFFFFFFF, it will randomly generate a MAC address.

2）Network information storage: After joining the network, Telink Zigbee Demo will store network info in two parts of the flash, including the 48-kB space starting from 0x34000 and 24-kB space starting from 0x7a000. Therefore, after firmware upgrade or after power cycle, the network info won't be lost.

3.4   Establish network

Power on the target board which is burned with the "sampleGW.bin". The white LED (POWER indicating light) on the sampleGW will be turned on.

When the blue LED ("Permit Join" indicating light) on the sampleGW is turned on, it indicates that the Personal Area Network (PAN ID) is successfully established and enabled to permit new device to join it. After 180 seconds expire, this network will be automatically disabled, and the blue LED on the sampleGW will be turned off.

User can use sniffer to capture and analyze packets during the procedure of joining the network.

3.4.1 Directly join network

Before the sampleGW disables its permission for new device to join the network, power on the sampleLight, so that the sampleLight can directly join the network.

After the sampleLight successfully joins the network, its green LED ("Permit Join" indicating light) will be turned on.

Once the green LED on the sampleLight is turned on, the entire network will be automatically disabled after 180 seconds expire.
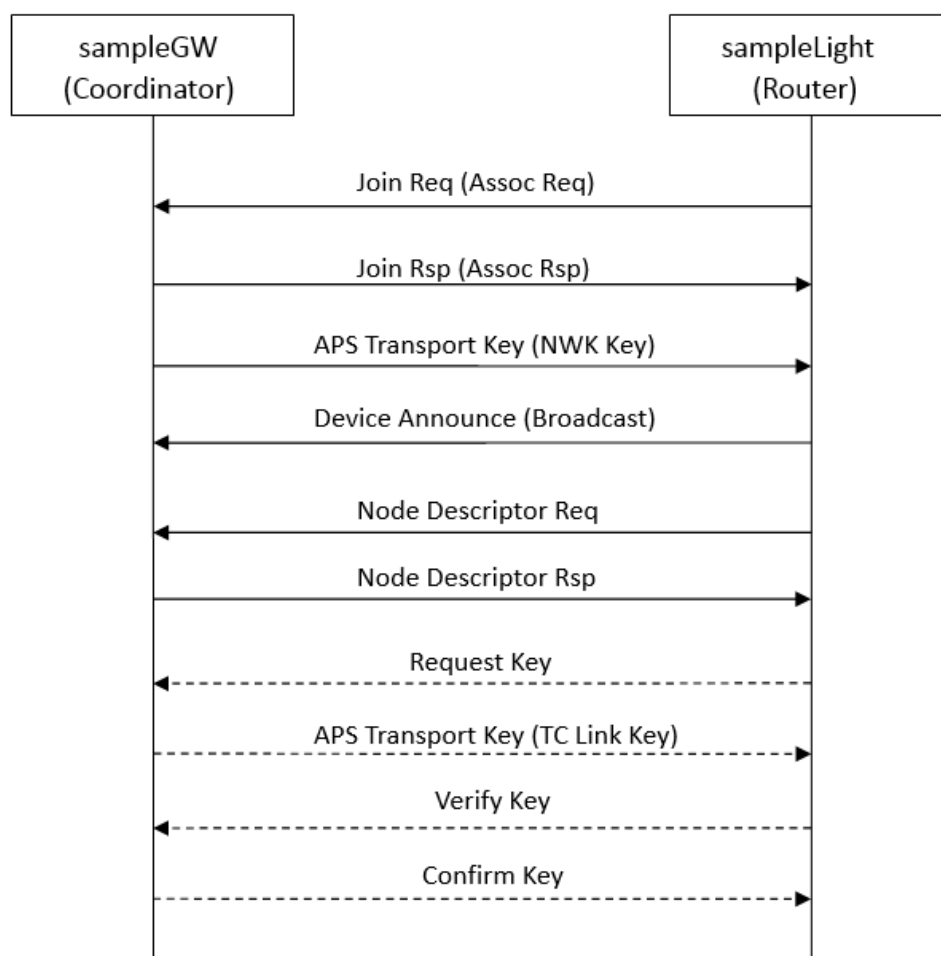

Figure 8   Join network directly

3.4.2 Join network via intermediate device

By pressing the "SW2" button on the sampleGW, the sampleGW can disable/enable its permission for new device to join the network.

Similarly, by pressing the "SW2" button on the sampleLight, the sampleLight can enable/disable its permission for new device to join the network. When the permission is enabled, power on the sampleSwitch, so that the sampleSwitch can indirectly join the network via the intermediate device (i.e. sampleLight).
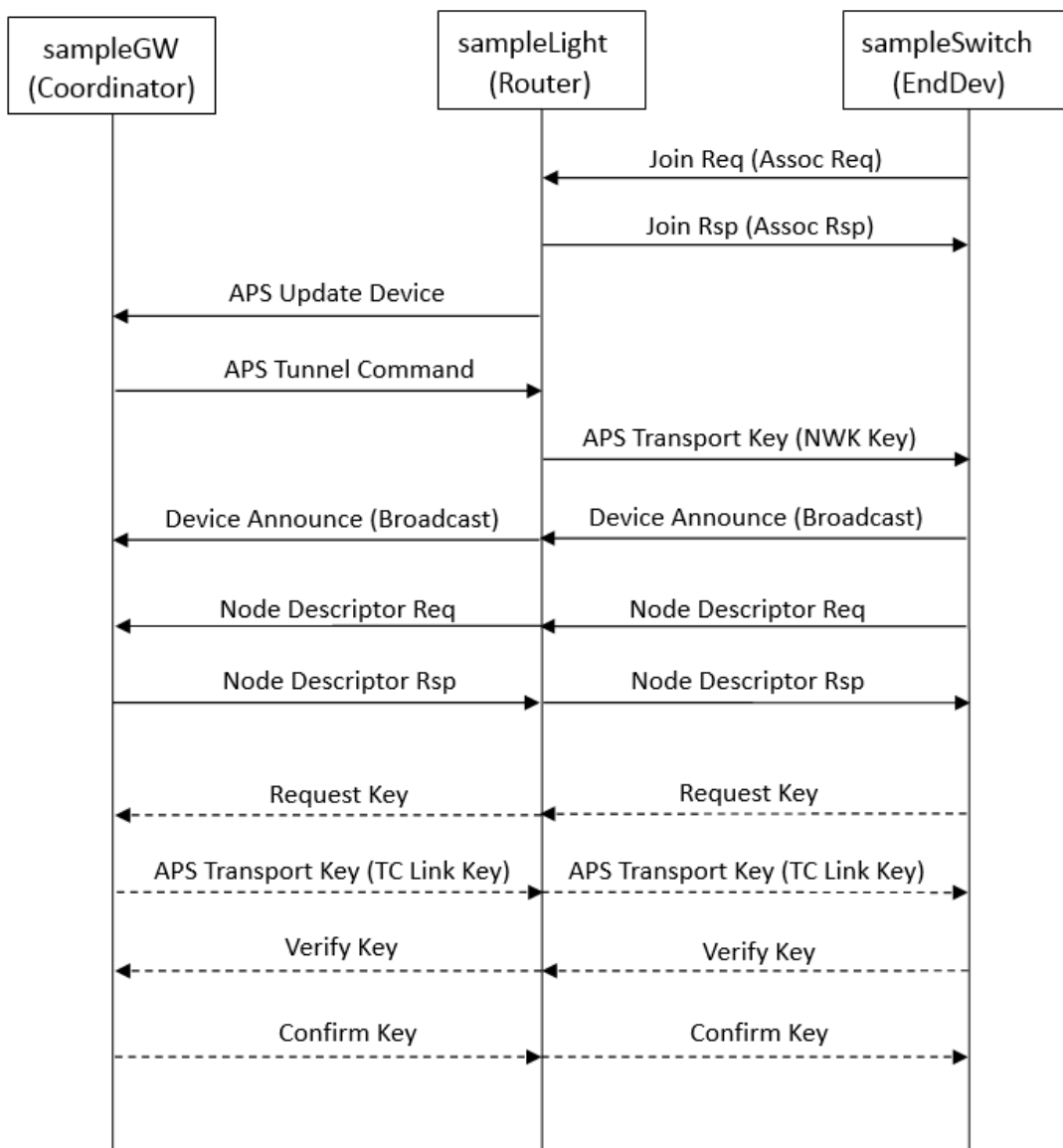
The Figure 9 shows this flow.

Figure 9   Join network indirectly

3.5   Zigbee Demo control

After successfully joining the network, by pressing the "SW1" or "SW2" button on the sampleGW/sampleLight/sampleSwitch, the following functions can be realized: switch on/off light, adjust luminance, enable/disable permission for new device to join network, and etc.

The table below shows button functions for the sampleGW, sampleLight and sampleSwitch.

	SW2	SW1
sampleGW	Enable/Disable permission for new device to join network.	Advertise toggle command once per second to switch on/off light.
sampleLight	Enable/Disable permission for new device to join network.	Short press: switch on/off its light Long press for 5 seconds: leave network
sampleSwitch	Advertise command to adjust luminance.	Short press: advertise toggle command Long press for 5 seconds: leave network

4 OTA Firmware Upgrade

In this section, the sampleLight is taken as an example to present how to upgrade firmware via the OTA (Over-The-Air) technology.

OTA device includes Server and Client. Herein the sampleGW is OTA Server, while the sampleLight is OTA Client.

Both the sampleGW and sampleLight enable OTA function by default. The macro "ZCL_OTA_SUPPORT" (see "app_cfg.h") is used to enable (1)/disable (0) OTA function.

4.1 Preparation before firmware upgrade

As per OTA protocol specification, firmware can upgrade but does not support degradation.

During OTA upgrade, the following three parameters will be checked: manufacturer code, firmware type and firmware version number. Only when both the manufacturer code and firmware type are consistent, and firmware to be updated is newer than the current version, will firmware upgrade be started.

4.1.1 Compile firmware

1) Modify parameters:

Open the file "sampleLight.c", and find the OTA parameter definition as shown below. The "CURRENT_FILE_VERSION" indicates current firmware version. User should modify firmware version from "0x01000200" to "0x01000300".

```
//running code firmware information
ota_preamble_t sampleLight_otaInfo = {
        .fileVer = CURRENT_FILE_VERSION,
        .imageType = IMAGE_TYPE,
        .manufaurerCode = TELINK_MANUFACTURER_CODE,
};
```

2) Recompile the sample project to generate new firmware "sampleLight.bin".

Please refer to section **3.2   Compile project samples**.

4.1.2   Encoding conversion

Copy the new firmware "sampleLight.bin" into the folder containing the "tl_ota_tool.exe", and rename the "sampleLight.bin" to "zbGitVersionCode.bin".

Double click the "tl_ota_tool.exe" to start the tl_ota_tool on the PC side. Input related parameters (see section 4.1.1) and press the "Enter" key, so as to generate the "ota.ota" file.
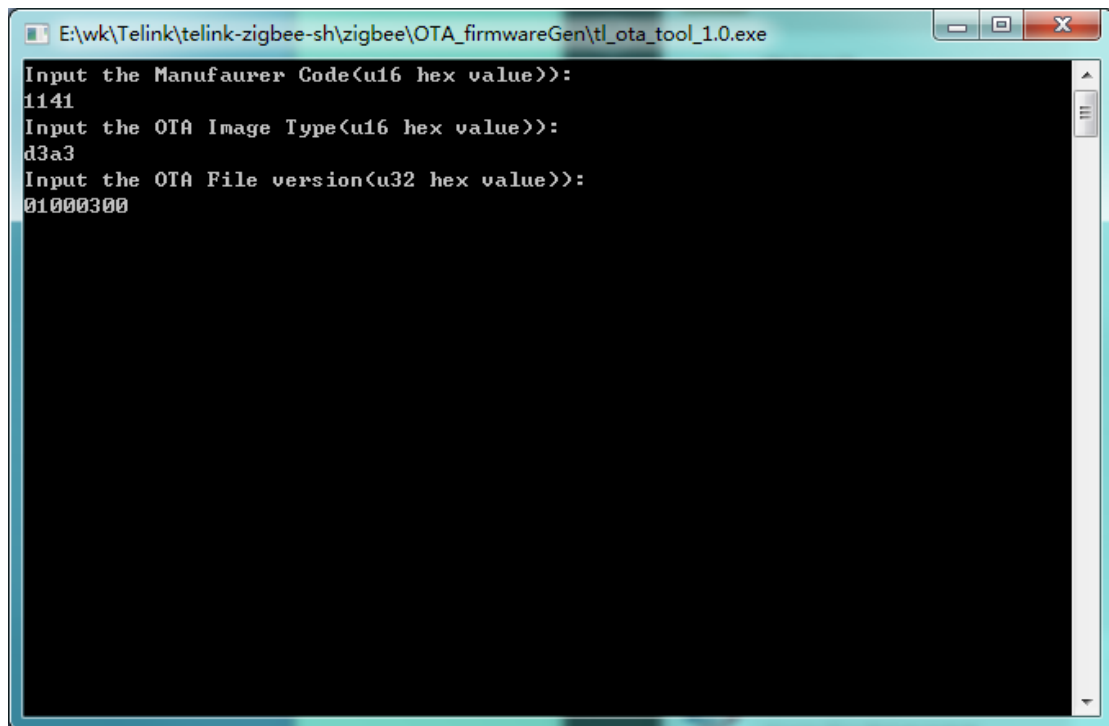

Figure 10   tl_ota_tool interface

4.2   Load FW to OTA Server

1) Follow the Figure 6 to connect the sampleGW (OTA Server) with PC USB via the burning EVK (TLSR8266BR56).

2) Select chip part number as "8269".

3) Click "File"->"Open", and select the file "ota.ota". If the "ota.ota" fails to be selected (Telink BDT tool does not support ota as suffix), change the suffix to ".bin", and then select the "ota.bin".

4) Click the "Setting" button on the main interface to open the "Setting" window. On the "Setting" window, select the "FLASH" and set the "Download Addr (H)" as "40000" via the drop-down box.
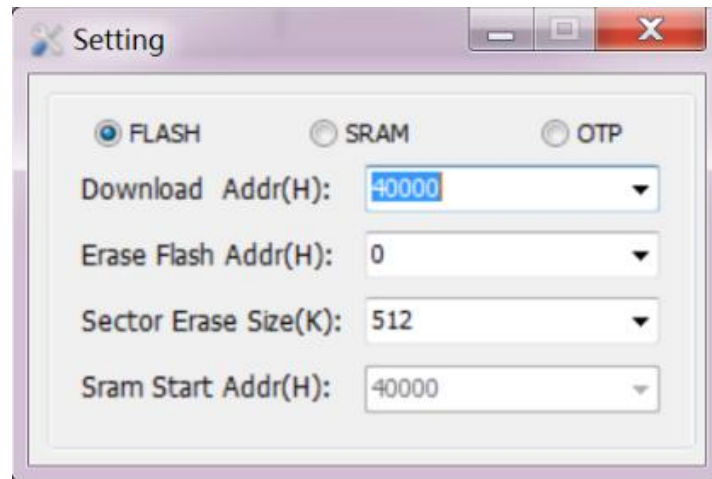
5) Click the "Download" button on the main interface to start loading firmware.

4.3   Auto FW check and upgrade on OTA Client

Power cycle the sampleGW. The sampleLight (OTA Client) will periodically check the sampleGW (OTA Server) with the interval of 30 minutes by default. When it detects there's suitable firmware to be upgraded, firmware upgrade will be started.

During the OTA firmware upgrade process, user can use sniffer to capture packets for further analysis.

5 ZGC Gateway Control Tool

5.1 System framework

Telink ZGC tool is a set of Gateway control tool based on ZBHCI serial-port self-defined command set (For detailed information, please refer to the document "**AN_17110600_Telink Zigbee 3.0 SDK Guide**").

All of ZCL commands supported by the ZGC are standard commands. For detailed command parameters, please refer to the document "07-5123-07-ZigbeeClusterLibrary_Revision_7.pdf".
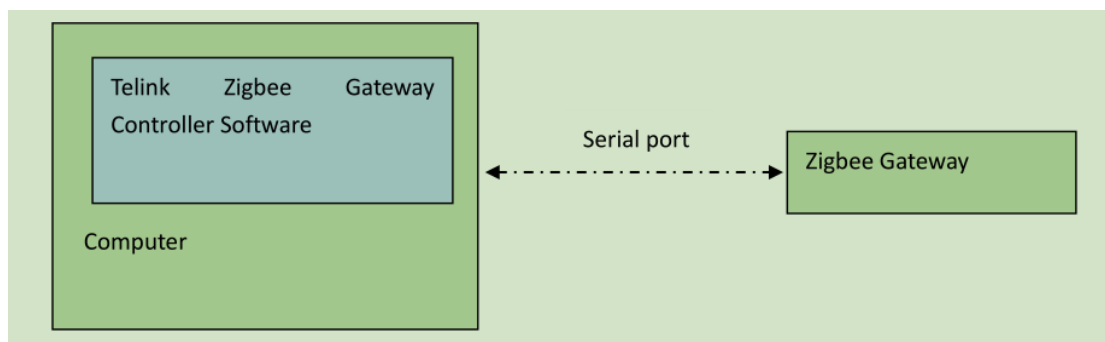

Figure 11   ZGC connection framework

5.2 Operation guide

In this section, a sampleGW and a sampleLight are taken as an example to present how to join a network, switch on/off light and adjust luminance.

5.2.1 Preparation before usage

1) Use the "Telink Burning and Debugging Tool (BDT)" on PC side to erase the entire 512kB Flash of the sampleGW and sampleLight.

2) Configure the "ZBHCI_UART" in the file "../apps/sampleGw/app_cfg.h" as 1 to enable the "ZBHCI_UART" function for the sampleGW. Recompile the sample project to generate "sampleGw.bin".

3) Follow the guide in section **3.3   Burn firmware** to download the firmware into the target board.

4) Connect the UART TX, UART RX and GND of the 232-to-TTL serial port tool with the UART RX (PC3), UART TX (PC2) and GND of the 8269 USB dongle, respectively.

5) Power on the 8269 USB dongle and serial port tool.

5.2.2 ZGC usage

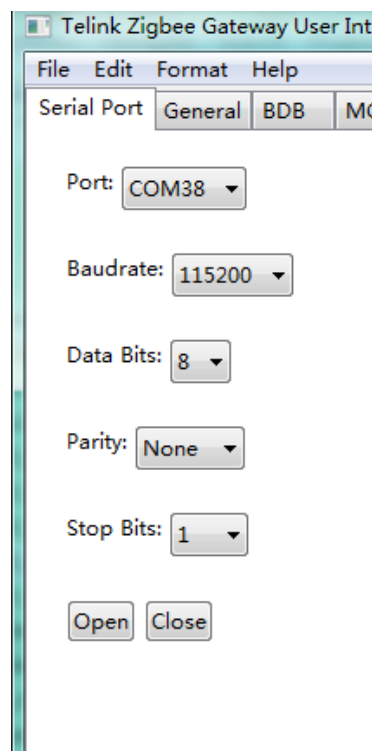1) Select the "Serial Port" page, and configure "Baudrate" as 115200 via the drop-down box.

Figure 12   Serial port configuration page

2) Select the "BDB" page -> Set channel via the drop-down box and click "Set Channel" -> Click "Start Network", so as to establish a network.
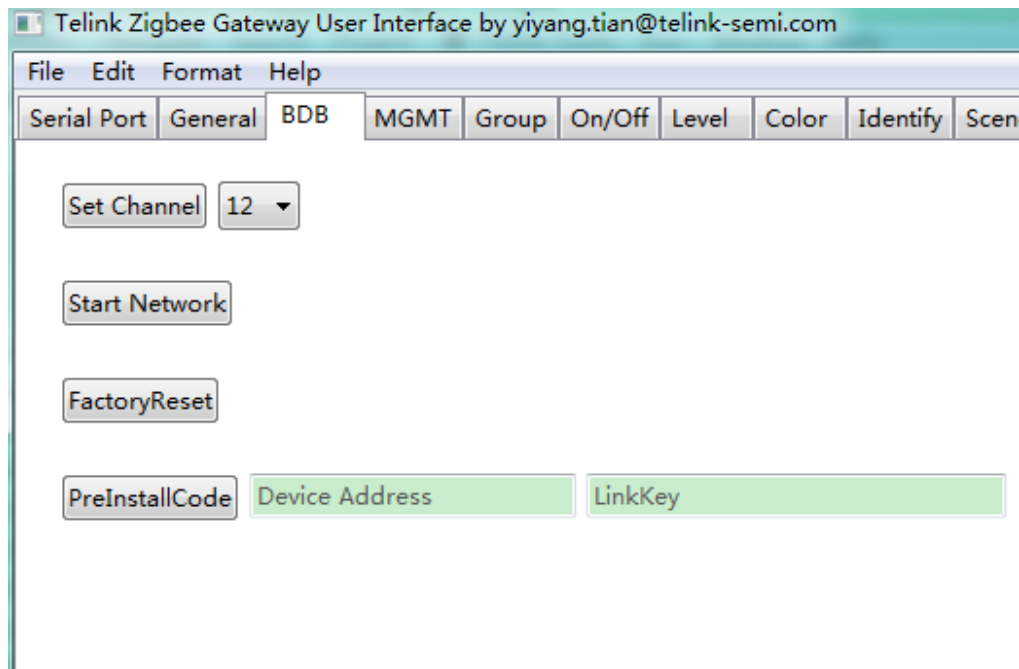

Figure 13   Establish network

Note: Once the network is established successfully, after power cycle of the sampleGW, the network will be restored automatically without the need to manual re-establishment the network.

3) Select the "MGMT", and use the "Permit Join" to enable/disable the permission for new device to join the network. As shown in the figure below, a "Mgmt Permit Join" command will be advertised, and the permission will be enabled for 10 seconds during which new device is allowed to join the network.
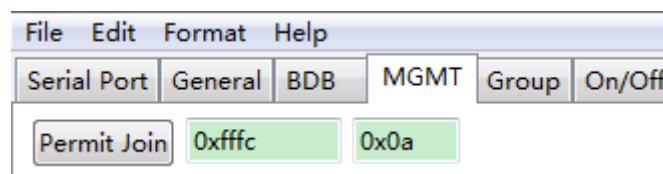

Figure 14   Permit Join

4) Power on the sampleLight and wait for the sampleLight to join the network. After the sampleLight successfully joins the network, user can use commands in the "On/Off" and "Level" to switch on/off light and adjust luminance for the sampleLight.
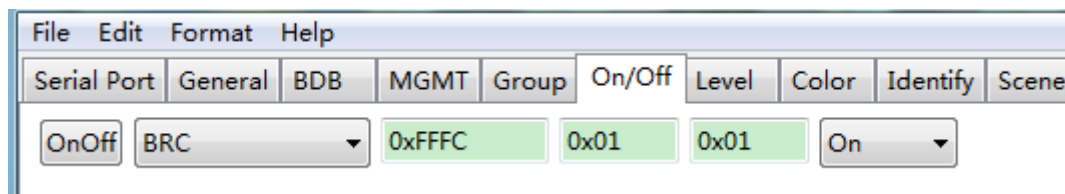
5) The input parameters should be hexadecimal 0xXXXX, as shown below.

Figure 15   Input parameters