The ZigBee Wi-Fi/Ethernet Gateway Reference Design (RD-0001-0201) is designed to demonstrate ZigBee gateway functionality with the following Silicon Labs ZigBee reference designs:

- Lighting Reference Designs (RD-0020-0601 and RD-0035-0601)
- ZigBee Contact Sensor Reference Design (RD-0030-0201)
- ZigBee Capacitive Sense Dimmer Switch Reference Design (RD-0039-0201)

This user's guide refers to software release version 1.0.0.
1. Introduction

The ZigBee Wi-Fi/Ethernet Gateway Reference Design (RD-0001-0201) is designed to demonstrate ZigBee gateway functionality with Silicon Labs ZigBee reference designs, such as Lighting Reference Designs (RD-0020-0601 and RD-0035-0601), ZigBee Contact Sensor Reference Design (RD-0030-0201), and ZigBee Capacitive Sense Dimmer Switch Reference Design (RD-0039-0201). The Gateway runs on Debian Linux. The Gateway includes a web server that presents a user interface to a desktop or mobile web browser. The web browser can run on a device on the local area network (LAN). A typical ZigBee system configuration with the ZigBee Wi-Fi/Ethernet Gateway is shown in the figure below.

![ZigBee Wi-Fi/Ethernet Gateway](image)

Figure 1.1. Typical ZigBee Wi-Fi/Ethernet Gateway Configuration
2. Installation and Configuration

1. Install the Silicon Labs EM3588 ZigBee USB Stick.

![ZigBee Wi-Fi/Ethernet Gateway](image1)

**Figure 2.1. ZigBee Wi-Fi/Ethernet Gateway**

2. Supply power to the Gateway.

   Connect power with the included micro-USB power adapter. The green power LED will illuminate on the Gateway and the red activity LED will blink until the boot process has completed.

3. Connect to the Gateway Wi-Fi access point from a handset, tablet, or PC.

   Select the SSID “Silicon Labs ZigBee ABCD” where "ABCD" is an arbitrary hex number. Enter the passphrase “solutions” when prompted.

![Wireless Network Connections (Windows)](image2)

**Figure 2.2. Wireless Network Connections (Windows)**

4. Launch a web browser and navigate to the gateway software update page.

   Navigate to [http://192.168.42.1:3001/update](http://192.168.42.1:3001/update) to review the license agreement and download gateway software. You can return to this page to check for periodic updates.

   **Note:** An Ethernet connection is required.
3. Run the ZigBee Gateway


3.1 Setup

In the Network Maintenance section of the Setup tab, confirm that “ZigBee Network: Up” is shown, and if not, refer to Section 5. Troubleshooting for possible solutions. On first boot the PAN ID is randomly assigned, the channel is set to 11, and the power is set to 20 dBm. This configuration can be changed in the “Extended Network Form Settings” section, and on subsequent boots the settings are restored. The PAN ID is a 16-bit number expressed in hexadecimal format, the channel can be set to any valid ZigBee channel (11-26), and the valid power level range is –20 dBm to 20 dBm. Note that range checking is enforced.

![Network Maintenance](image)

**Figure 3.1. Network Maintenance**
Select the “+ Device” button and initiate the network join procedure for the desired devices. The lighting demo board enters join mode by pressing S1 ten times rapidly, the contact sensor by pressing S1 for more than two seconds, and the dimmer switch by pressing S3 for more than two seconds. Additional information can be found in the user’s guide for each device. Devices will appear in the list with their name, unique device ID, and state. The name is reported by each device and the unique device ID is assigned each time the device joins a ZigBee network.

If a device is on a network and communicating with the gateway, its state will be labeled as “joined”. A device failing to respond will be labeled “unresponsive”. The request to leave the network is sent by selecting the “X” next to the device, and will be labeled “leave sent” if there is no response from the device. Devices may become unresponsive or indicate leave sent because they are asleep, turned off, or out of range. When the device wakes, turns on, or comes back into range, the unresponsive device will be labeled as “joined” and a device labeled “leave sent” will be removed from the device list.

The ZigBee Contact Sensor Reference Design (RD-0030-0201) will indicate open/close state, active/alarm state, temperature, and the join/leave-sent/unresponsive state. The open/close state is sent by the contact sensor immediately upon change of state to indicate the magnet away (open) or near (closed) the reed switch. The alarm state is sent by the contact sensor immediately upon change of state when the tamper alarm is activated by pressing button S1 for more than four seconds and then releasing.

The ZigBee Lighting Demo Board Reference Design (RD-0020-0601 and RD-0035-0601) will present a toggle button to toggle the state of the light and indicate the join/leave-sent/unresponsive state. The toggle button sends the ZCL light toggle command.

The ZigBee Capacitive Sense Dimmer Switch Reference Design (RD-0039-0201) will show the joined/leave sent/unresponsive state.

The Gateway Reference Design allows the user to create rules to bind one device to another. To create a rule, select the “+ Set Rule” button, choose the desired input node and output node, and select “Bind”. Multiple rules can be set for both Input Nodes and Output Nodes. For example, both the contact sensor and dimmer switch input nodes can bind to the dimmable color light, shown below. If two input nodes send a command to an output node, the commands are executed in the order received.

The Gateway Reference Design allows the user to create rules to bind one device to another.
3.2 Home

The home tab duplicates the setup information and offers extended information with the "Show Extended Info" button. An HA Color Light also shows on/off and dimming, color temperature, and hue/saturation controls. The extended information includes:

- Node EUI
- Gateway EUI
- Node State (joined, leave sent, unresponsive)
- Firmware version
- Firmware Image type
- Manufacturer ID
- OTA bytes sent
- Updating indicator (via OTA)
- Endpoint 1 device ID
- Available OTA images list

Available OTA update images are located here: /opt/SiliconLabsGateway/webserver/ota_avail_files

**Note:** The OTA update process will take approximately ten minutes for non-sleepy devices and up to several hours for sleepy devices.

**Note:** Only one device should be in the "Attached Device" list prior to beginning the OTA update process.

![Control Panel](image)

**Figure 3.4. Home Tab**
3.3 Diagnostics

The diagnostics tab offers a network test and logging options.

The network test sends rapid on/off commands to a selected light in order to determine several key performance metrics of the ZigBee network. It is configured by selecting the desired light, setting the period (ms) and iterations, and selecting “Run Network Test”. The test measures network throughput and RF conditions. The “Refresh Log” button will update the test output tab.

The result is shown in the Test Output log tab, and the log file is located here: /opt/SiliconLabsGateway/webserver/logs/CustomerTest.log

The backend output tab displays all web server command routing. The “Console Log Streaming” option enables log updates to the backend output tab. The “Advanced Callback Logging” option enables extra statistic logging such as: message time stamps, acknowledgement errors, link quality (LQI), and receive signal strength (RSSI). In typical use, logging this information is not necessary, and disabling this option reduces gateway overhead.

The backend output log file is located here: /opt/SiliconLabsGateway/webserver/logs/GatewayTransport.log

The gateway output tab shows all ZigBee gateway commands and data. The “Console Log Streaming” option enables log updates to the gateway output tab. In typical use, logging this information is not necessary, and disabling this option reduces gateway traffic and overhead. The gateway output tab can also be used to send command line interface (CLI) commands.

The gateway output log file is located here: /opt/SiliconLabsGateway/logs/gateway.log

3.4 About

The About tab shows all versions and displays the web server IPv4 address for the purpose of connecting a mobile handset, tablet, or another computer to the gateway.

Note: The “Running on IP” address is updated when refreshing the browser window.
4. Next Steps

The ZigBee Wi-Fi/Ethernet Gateway Reference Design (RD-0001-0201) is designed to demonstrate ZigBee gateway functionality with Silicon Labs ZigBee reference designs, such as Lighting Reference Designs (RD-0020-0601 and RD-0035-0601), ZigBee Contact Sensor Reference Design (RD-0030-0201), and ZigBee Capacitive Sense Dimmer Switch Reference Design (RD-0039-0201). For next steps, refer to the user's guides for each of these reference designs. The ZigBee Wi-Fi/Ethernet Gateway Reference Design is also designed as a reference to demonstrate the software functions and can be used as a baseline for further development and porting to a Linux platform. To aid in the understanding of the software architecture, refer to the figure below.

![Software Architecture Diagram]

The Gateway includes the EmberZNet Pro ZigBee stack binaries and server software source code. To modify the binaries it is necessary to acquire a ZigBee development kit EM35x-DEV. To learn more about purchasing and using a ZigBee development kit, go to: [https://www.silabs.com/products/wireless/zigbee/Pages/zigbee-getting-started.aspx](https://www.silabs.com/products/wireless/zigbee/Pages/zigbee-getting-started.aspx). The webserver JavaScript source code is available for study and modification within Gateway. The directory structure is as follows:

```
/opt/SiliconLabsGateway/bin/siliconlabsgateway
  ZigBee gateway manager executable (source available from Silicon Labs)
/opt/SiliconLabsGateway/webserver
  Backend node.js source files, interpreted by npm
/var/www
  Webserver react.js source files, served by Apache
```
5. Troubleshooting

5.1 Unable to Add Devices

The ZigBee end node may not be in the active network search state. Refer to the user’s guide for each device and verify network search mode.

5.2 Unable to Remove Devices

When attempting to remove ZigBee end nodes by selecting the “X” next to the device name, the message “leave sent” may appear but the device remains in the device list. The device may be powered down or out of range, and unable to acknowledge the request. Once powered up and in range, the end node will acknowledge the request to leave and disappear from the device list.
6. Utilities

6.1 Transfer Files to the Gateway

Once connected to the Gateway Wi-Fi access point, it is possible to transfer files to the Gateway:
1. Open WinSCP.
2. Connect to the Gateway at 192.168.42.1, port 22.
3. Login = pi; Password = raspberry

6.2 Remote Login to the Gateway

Once connected to the Gateway Wi-Fi access point, it is possible to login remotely.
1. Open an SSH session using PuTTY.
2. Connect to the Gateway at 192.168.42.1, port 22.
3. Login = pi; Password = raspberry

6.3 Change Wi-Fi Parameters

The Wi-Fi parameters can be changed by modifying the "hostapd.conf" file.

```
cd/etc/hostapd
sudo nano hostapd.conf
```

1. Change the Wi-Fi parameters such as SSID and/or wpa_passphrase.
2. Press CTRL+X to exit.
3. Press "Y" to write changes.
4. Type "Enter" to accept.

```
sudo reboot
```
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