



# UG131: ZigBee<sup>®</sup> Wi-Fi/Ethernet Gateway Reference Design (RD-0001-0201) User's Guide

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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 1.1.0.

## KEY POINTS

- Describes ZigBee Wi-Fi/Ethernet Gateway Reference Design.
- Provides step-by-step instructions for the installation and configuration process.
- Explains the ZigBee Gateway tabs.
- Offers troubleshooting solutions and references for common issues.
- Explains some utilities of the ZigBee Wi-Fi/Ethernet Gateway Reference Design.

## 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 a Raspberry Pi 2 computer with 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.

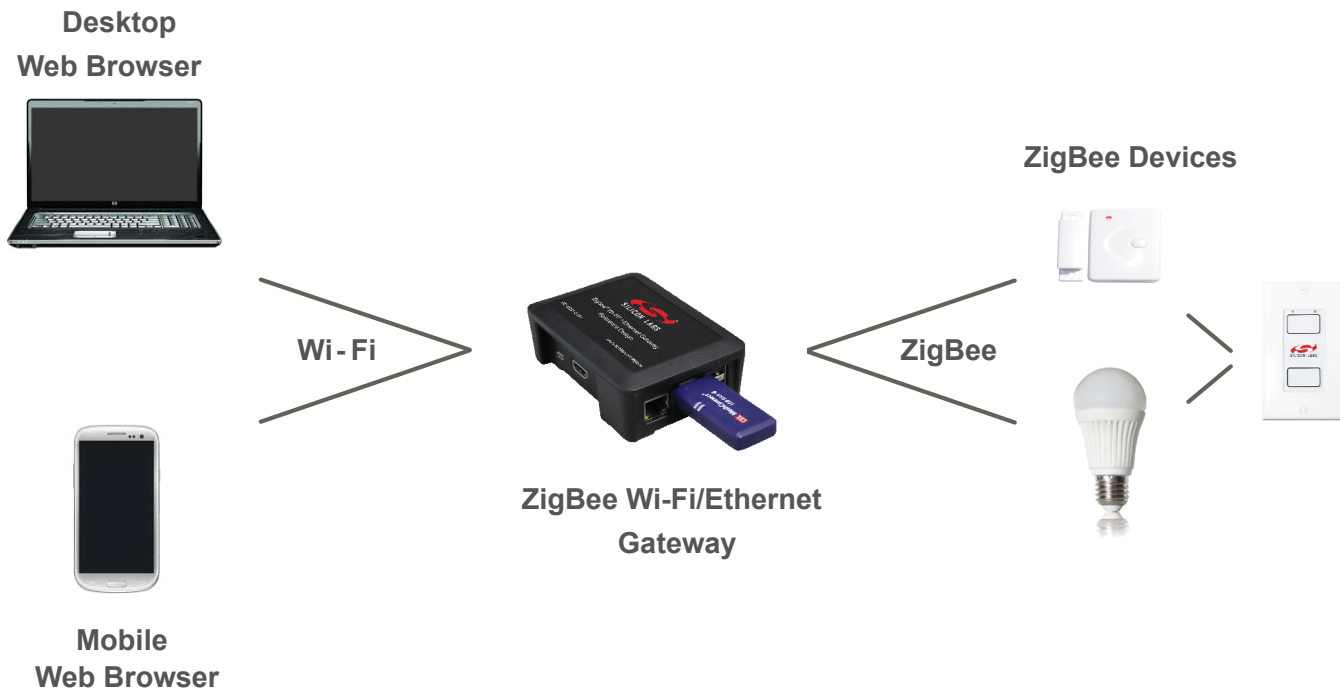


Figure 1.1. Typical ZigBee Wi-Fi/Ethernet Gateway Configuration

## 2. Installation and Configuration

### 2.1 Install the Silicon Labs EM3588 ZigBee USB Stick



Figure 2.1. ZigBee Wi-Fi/Ethernet Gateway

### 2.2 Supply Power to the Gateway

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

### 2.3 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.

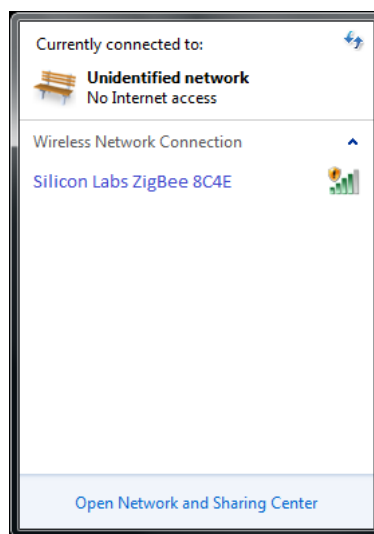


Figure 2.2. Wireless Network Connections (Windows)

### 2.4 Connect the Gateway to the Internet with Ethernet

**Note:** The Internet connection with Ethernet is only required when installing or updating software, as described in the step below.

### 2.5 Install or Update Gateway Software

Launch a browser and navigate to <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. After the gateway software installs, the gateway will reboot and it will be necessary to repeat step 2.3.

**Note:** Internet connection with Ethernet is only required when installing or updating software.

### 3. Run the ZigBee Gateway

After performing the steps 2.1 – 2.5 described in Section 2. [Installation and Configuration](#), launch a web browser and navigate to <http://192.168.42.1> to access the gateway functions. To power off the gateway, remove the USB power adapter.

To power on the gateway, repeat steps 2.1 – 2.3 as described in Section 2. [Installation and Configuration](#), then launch a web browser and navigate to <http://192.168.42.1> to access the gateway functions.

#### 3.1 Setup

In the Network Maintenance section of the Setup tab, confirm that “ZigBee Network: Up” is shown. On first boot the PAN ID is randomly assigned, the channel is set to 14, and the power is set to 20 dBm. This configuration can be changed by selecting the "Reform Network" configuration icon, 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.



Figure 3.1. Network Maintenance

Select the “+ Device” gateway button and initiate the network join procedure for the desired devices. The ZigBee Contact Sensor Reference Design (RD-0030-0201) enters network join mode by pressing physical switch S1 for more than one second. The ZigBee Lighting Demo Board Reference Designs (RD-0020-0601 and RD-0035-0601) enter network join mode by pressing physical switch S1 ten times rapidly. The ZigBee Capacitive Sense Dimmer Switch Reference Design (RD-0039-0201) enters network join mode by pressing physical switch S3 for more than one second. 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 contact sensor 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 lighting demo board will present a "Toggle Light" gateway button to toggle the state of the light and indicate the join/leave-sent/unresponsive state. The toggle button sends the ZCL (ZigBee Cluster Library) light toggle command.

The dimmer switch will show the joined/leave sent/unresponsive state.

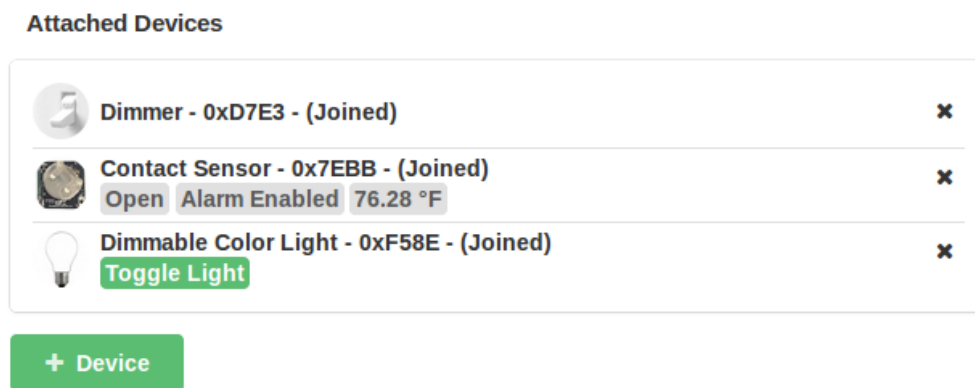


Figure 3.2. Attached Devices

The Gateway Reference Design allows the user to create rules to bind one device to another. To create a rule, select the “+ Set Rule” gateway 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.

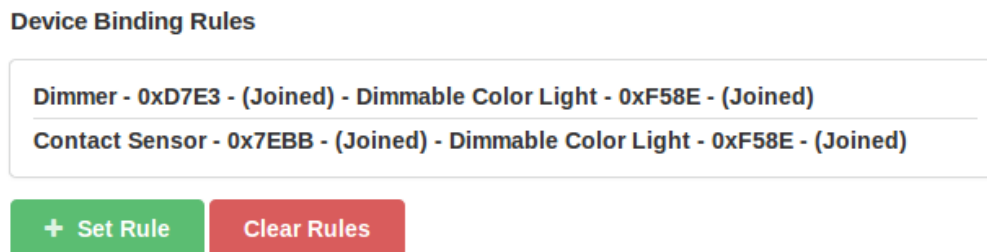


Figure 3.3. Device Binding Rules

### 3.2 Home

The Home tab duplicates the setup information and offers extended information with the "Show Extended Info" button. An HA (Home Automation) 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

**Note:** See Section 6.4 [OTA \(over-the-air\) Firmware Update](#) for more information about the "Available OTA images list."

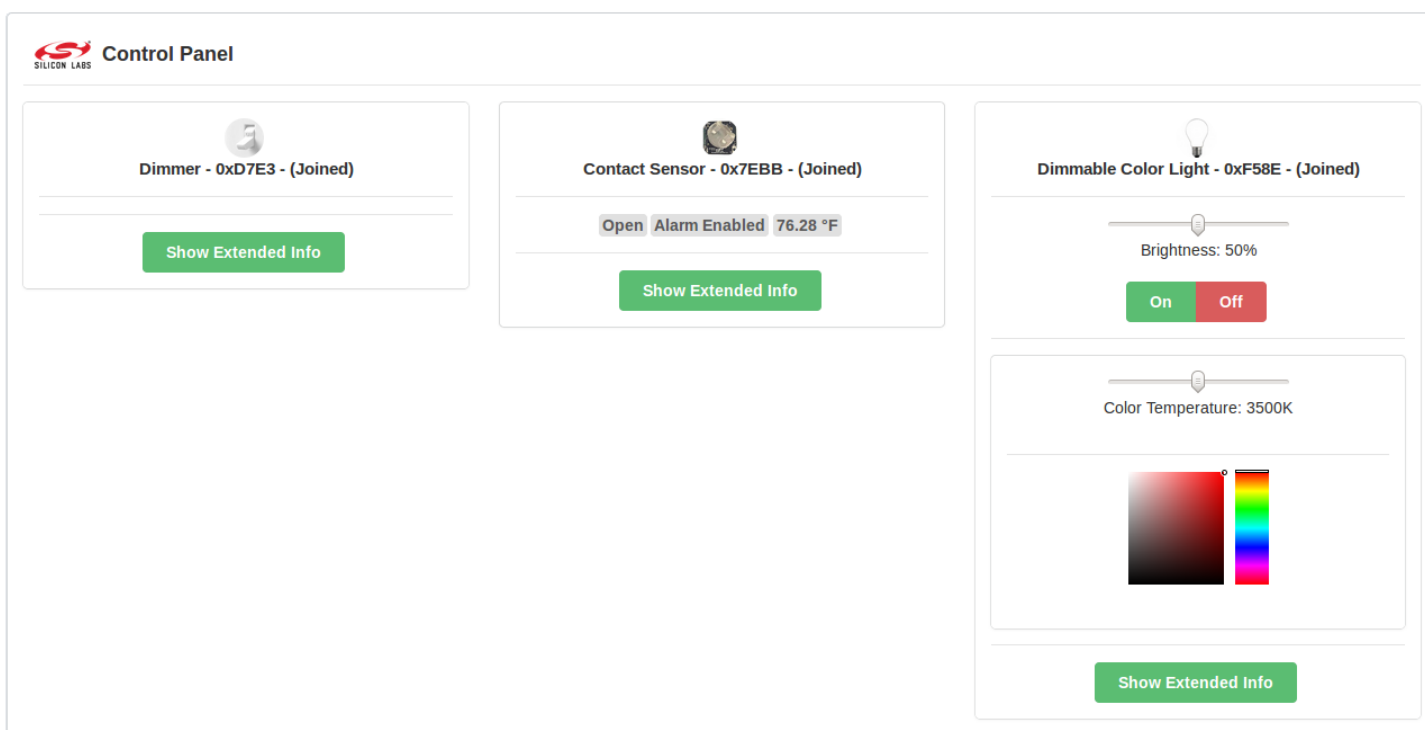


Figure 3.4. Home Tab

### 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`. For information about accessing this file, refer to Sections [6.1 Transfer Files to and from the Gateway](#) or [6.2 Remote Login to the Gateway](#).

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.

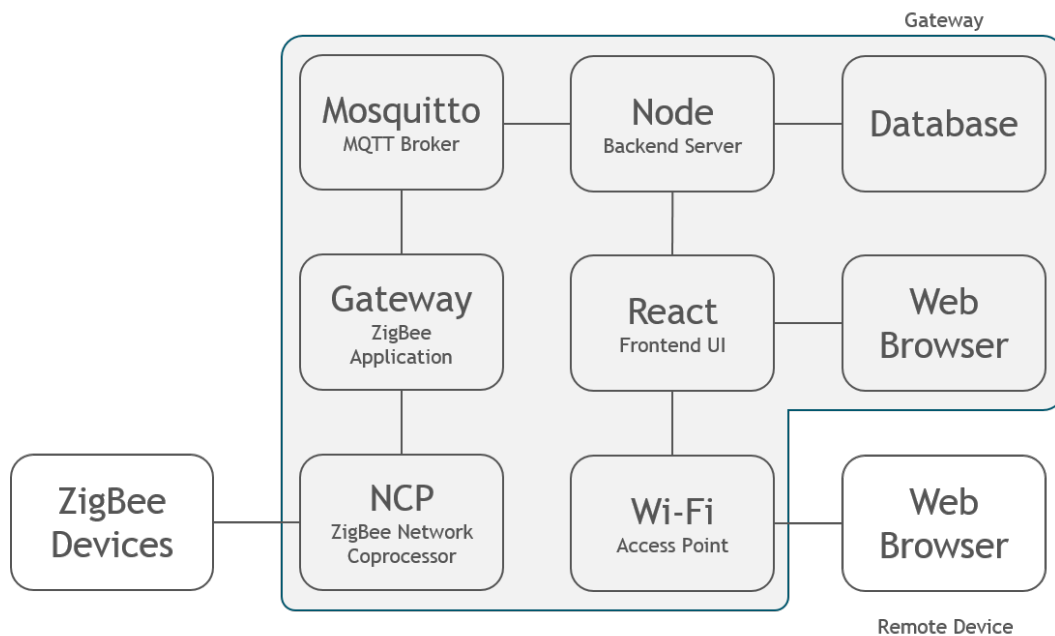
**Note:** The “Running on IP” address is updated when refreshing the browser window.

### 3.5 Shutdown

Remove power to shutdown the gateway.

## 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.



**Figure 4.1. Software Architecture**

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>. The webserver JavaScript source code is available for study and modification within the Gateway file system. The directory structure is as follows:

```
/opt/SiliconLabsGateway/bin/siliconlabsgateway
  ZigBee gateway application executable (source code available from Silicon Labs, See Section 7. Resources)
/opt/SiliconLabsGateway/webserver
  Backend server node.js source files, interpreted by npm
/var/www
  Frontend UI 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, asleep, 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 and from 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 = `raspberrypi`

### 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 = `raspberrypi`

### 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
```

### 6.4 OTA (over-the-air) Firmware Update

OTA firmware updates for the contact sensor, lighting demo board and dimmer switch is possible if update files are located here: [/opt/SiliconLabsGateway/webserver/ota\\_avail\\_files](#). OTA files in this location will appear in the "Available OTA images list" as described in [Section 3.2 Home](#). The OTA update process will take approximately ten minutes for non-sleepy devices and up to several hours for sleepy devices. Only one device should be in the "Attached Devices" list prior to beginning the OTA update process.

## 7. Resources

### Getting Started

Getting Started with ZigBee:

<http://www.silabs.com/products/wireless/zigbee/Pages/zigbee-getting-started.aspx>

Getting Started with Reference Designs:

<http://www.silabs.com/iot/Pages/zigbee-reference-design-getting-started.aspx>

### Training

Overview of ZigBee Connected Home Reference Designs:

<http://community.silabs.com/t5/Video-Tutorials/Overview-of-ZigBee-Connected-Home-Reference-Designs/td-p/157487>

### Community

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