UG103.15: Silicon Labs Green Power Fundamentals

This document describes the main features and functions of Zigbee Green Power (ZGP) and a basic ZGP network, including its device types and commissioning process, and how EmberZNet supports the ZGP device types.

Silicon Labs' *Fundamentals* series covers topics that project managers, application designers, and developers should understand before beginning to work on an embedded networking solution using Silicon Labs chips, networking stacks such as EmberZNet PRO or Silicon Labs Bluetooth, and associated development tools. The documents can be used a starting place for anyone needing an introduction to developing wireless networking applications, or who is new to the Silicon Labs development environment.

KEY FEATURES

- Zigbee Green Power introduction
- Zigbee Green Power network
- Device types
- Commissioning process
- EmberZNet support for Zigbee Green Power

1 Introduction

Zigbee refers both to:

- An open standard for reliable, cost-effective, low power, wireless device-to-device communication of thousands of devices in a single network
- An alliance of over 400 companies who together are defining and using the standard to communicate in a variety of applications such as smart energy and commercial building automation.

For more information on Zigbee, see *UG103.2: Zigbee Fundamentals*.

Zigbee Green Power (ZGP) is included in the Zigbee 3.0 specification (Z3). ZGP enables battery less (energy-harvesting) or ultra-long battery devices to securely join Zigbee PRO networks. Common ZGP devices include switches, sensors, detectors, and buttons. It uses a new compact packet format that minimizes the amount of energy used to transmit data. This allows energy-harvesting devices to operate successfully and battery-powered devices to operate for periods in excess of what would be possible on a standard Zigbee network before requiring a replacement battery.

For more information on Zigbee Green Power, visit http://www.zigbee.org/zigbee-for-developers/zigbee-3-0/ and download the Zigbee Green Power white paper.

2 Basic Green Power Network

A basic Green Power network will consist of three separate devices:

- Green Power Device (GPD)
- A Z3 Proxy or Proxy with Green Power functionality
- A Green Power Sink

GPD Frames (GPDF) are transmitted by the GPD devices and received by a Proxy or Combo device. The Proxy or Combo will then encapsulate the received GPDF within a standard Zigbee frame and tunnel it across the Zigbee PRO / Z3 network to the Sink Device that that has been paired with the end device as shown in the following figure.

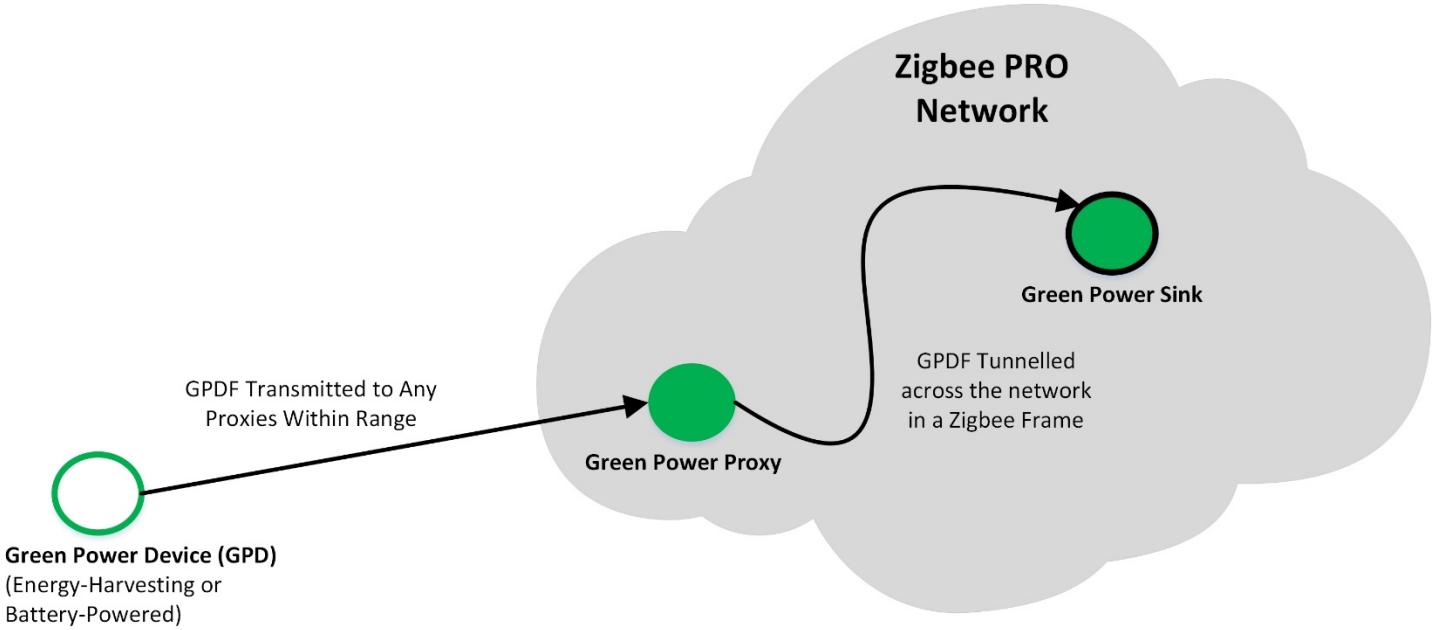


Figure 1. Basic Green Power Message Transmission

3 Device Types

ZGP includes the following device types:

Device type	Description
Green Power Device (GPD)	These devices either harvest or have ultra-long battery life. They communicate using a compact message format and **all messages are one-way (out only). GPDs are not end devices and cannot receive commands.**
Green Power Proxy (GP Proxy)	This router device translates ZGP frames to Zigbee Cluster Library (ZCL) frames. Per a requirement of the Zigbee 3.0 specification, all routers must support GP Proxy settings. For more information on ZCL, see *UG103.2: Application Development Fundamentals, Zigbee*.
Green Power Sink Target (GP Sink)	Any device that can be controlled by or receive data from a GPD (for example, a light or a server device). A GP Sink can only be implemented on a standalone Zigbee End Device (ZED).
Green Power Combo (GP Combo)	This is a combination of a GP Sink and a GP Proxy within a single device. This creates a device which is a ZP Proxy to route packets and at the same time a ZED.

3.1 GPD

3.1.1 GPDF

As indicated in the following figure, the Green Power Frame is shorter than a standard Zigbee frame (indicated by the dashed line). This allows a GPD to transmit a GPDF using less power than a standard Zigbee frame as the radio transmitter is active for less time.

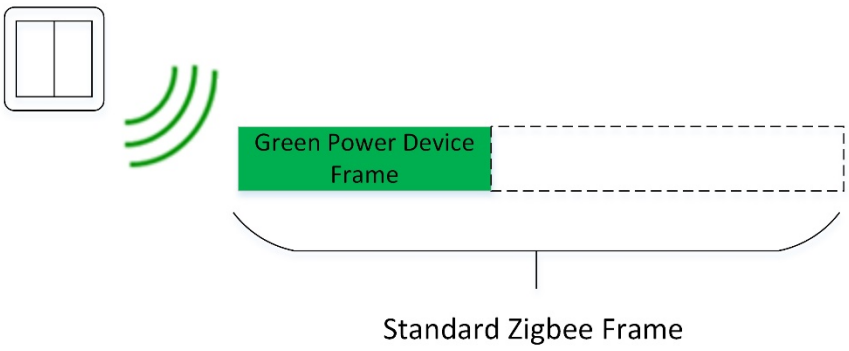


Figure 2. GPDF Size

GPDs are strictly one-way devices once in use, although they may optionally support bidirectional data exchange during pairing. GPDs should not be considered end devices and Zigbee considers them as less than ZEDs. For more information on ZEDs, see *UG103.2: Zigbee Fundamentals*.

3.2 Proxy

As GPDFs are specialized frames, unique to GP, they are encapsulated within a ZCL packet for transmission across a Zigbee network. To support this functionality, GP proxy basic functionality is a mandatory requirement in Z3 routers.

The Proxy acts as a conduit between the GPD and Sink. During the commissioning of a sink and GPD, an entry is added to the proxy table to act as a mapping between the GPD and Sink.

When a GPDF is received the Proxy may look up the sending GPD in its proxy table to determine the Sink or group to forward the GPDF to.

Note: Because the Proxy is merely forwarding the GPDF to its intended destination, it is agnostic about the GPDF data payload.

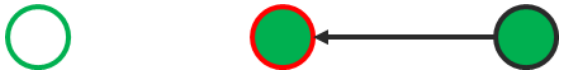
4 Commissioning Process

Before a Sink and GPD may be used within a Zigbee network, the Sink and GPD must be paired to inform the network which sink(s) will receive GPDFs sent by the GPD. Each GPD active in the network will be paired with one or more Sinks, and each Sink will be paired with one or more GPDs. Once commissioning is complete, the Proxy will store the pairing information in its proxy table and the Sink will store the pairing in its sink table.

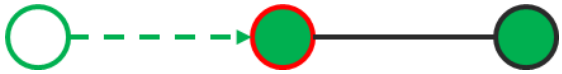
The following figure describes the steps in the basic ZGP commissioning process. See Figure 4 for the key.

1. The GP Sink and GP Proxy are joined to the same Private Area Network (PAN).

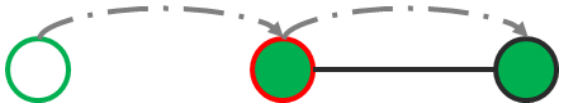
2. The GP Sink sends a ZCL message to listen for a joining GPD to commission (timeout in the notification, first successful connect, or a stop command).



3. GPD sends a GP join message that will be captured by a listening GP Proxy. Proxies will then be in watch mode – can only be in join for 1 sink at a time.



4. The GP Proxy creates a binding entry between the GPD and the GP Sink.



5. When the GP Proxy receives a message from the GPD, it will send the corresponding ZCL message to the GP Sink. The GPD can now send messages to the GP Sink via the GP Proxy.

Figure 3. Basic Green Power Commissioning

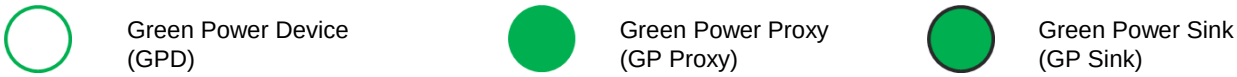


Figure 4. Basic Green Power Commissioning Key

5 EmberZNet Support for Zigbee Green Power

The following table summarizes how EmberZNet supports the ZGP device types.

Device type	Supported?	How Supported
GP Proxy Basic	Yes	Fully supported at the router level (requirement of the Zigbee 3.0 specification)
GP Proxy	Not currently supported by the stack	Not supported in the current Zigbee Green Power specification
GP Device	Not currently supported by the stack	N/A
GP Sink	Not currently supported by the stack	N/A
GP Combo	Not currently supported by the stack	N/A

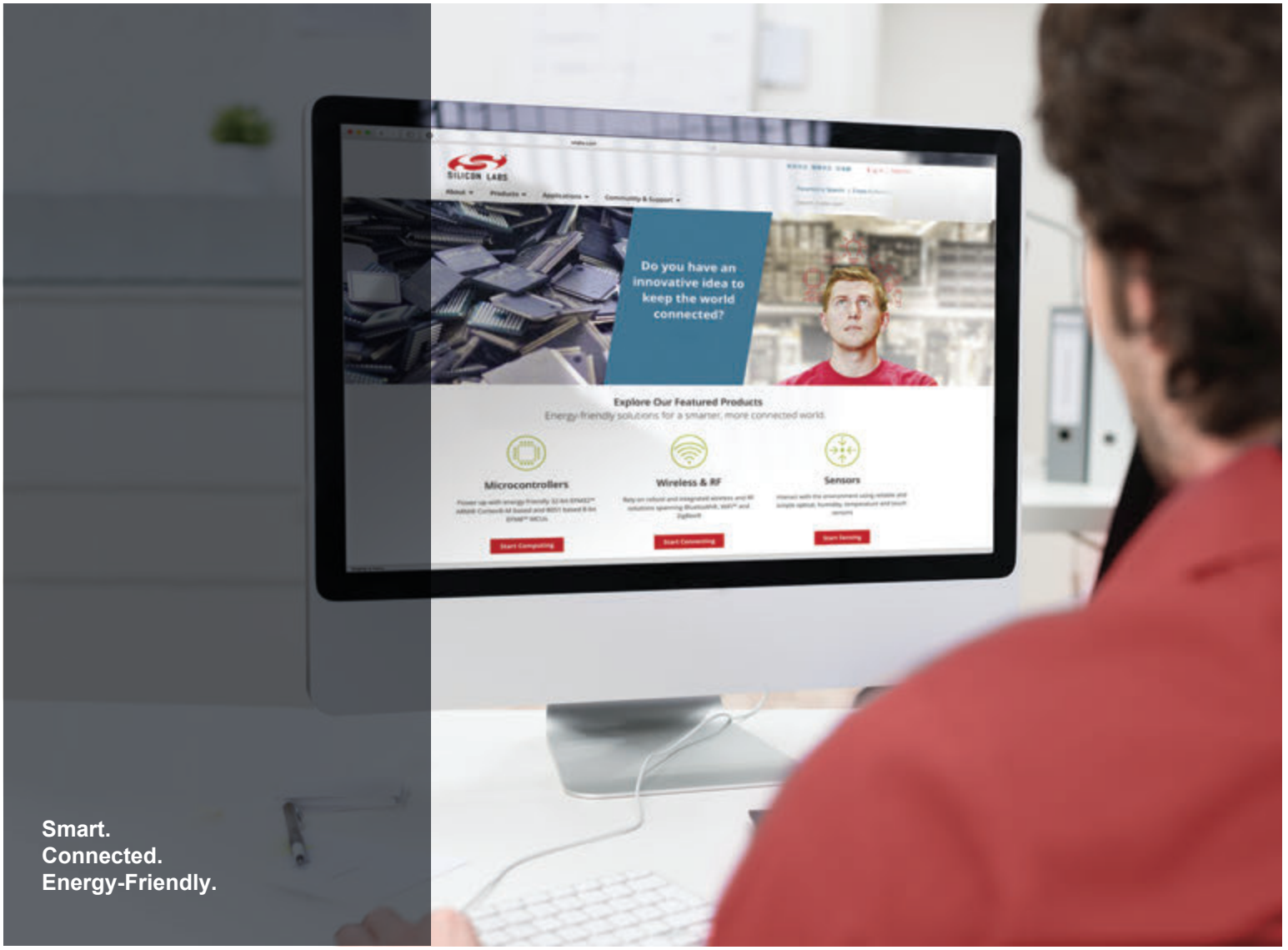
EmberZNet provides the following ZGP plug-in support with code and tools:

- Green Power Libraries: required stack side Proxy code
- Green Power Client: application side GP Proxy

6 Next Steps

For more information on Zigbee, see *UG103.2: Zigbee Fundamentals*.

For more information on ZGP, visit http://www.zigbee.org/zigbee-for-developers/zigbee-3-0/



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