UG103.15: Silicon Labs Green Power Fundamentals

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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 PRO 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 as a starting place for anyone needing an introduction to developing wireless networking applications, or who is new to the Silicon Labs development environment.

KEY POINTS

- Zigbee Green Power introduction
- Basic Green Power network
- Device types
- Commissioning process
- EmberZNet PRO 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. ZGP 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/. There are a number of valuable ZGP resources available for review and download.

2. Basic Green Power Network

A basic Green Power (GP) network consists of three separate devices:

1. Green Power Device (GPD)
2. A Z3 Proxy or Green Power Proxy (GPP)
3. A Green Power Sink (GPS)

GPD Frames (GPDF) are transmitted by the GPD devices and received by a Proxy or a Combination (Sink and Proxy) device. The GPP will then encapsulate the received GPDF within a standard Zigbee frame and forward the GPDF packets across the Zigbee PRO / Z3 network in the form of notifications to the Sink that that has been paired with the end device. In a Combination device, the Proxy side is responsible for forwarding the GPDF packets. The following figure illustrates the data flow from the GPD to the GPP and finally to the GPS.

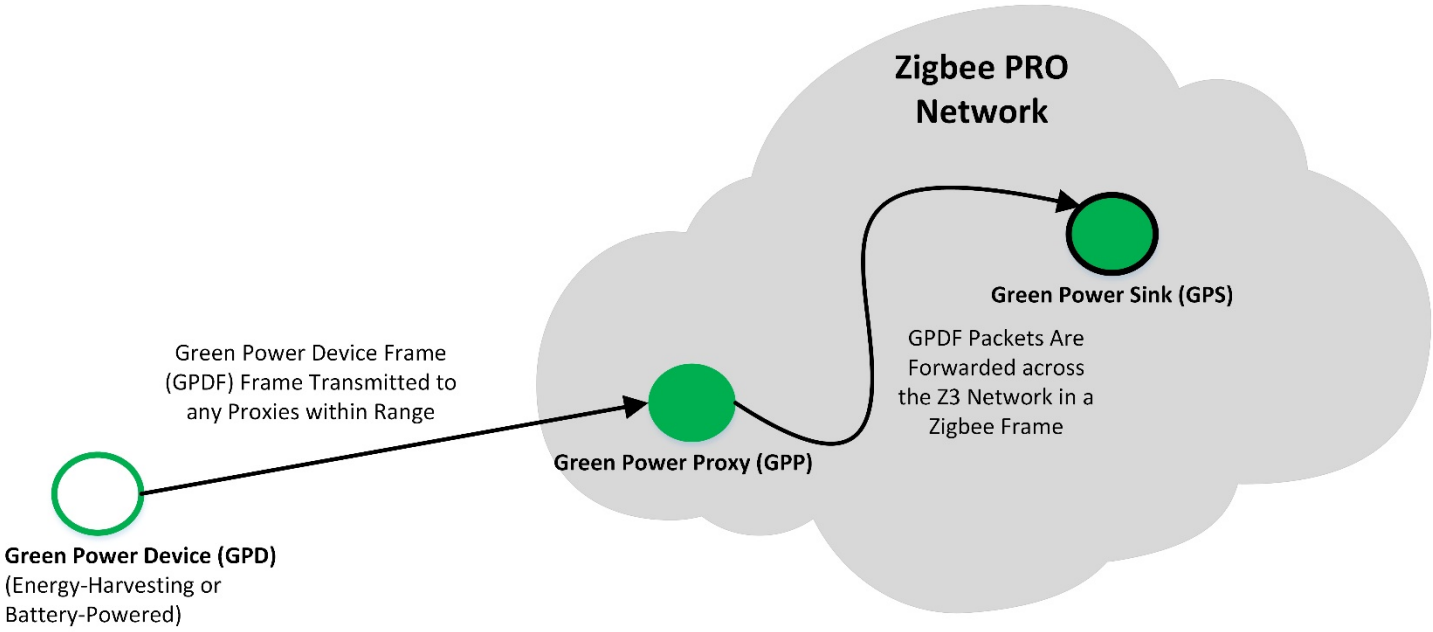


Figure 2.1. Basic Green Power Message Transmission

As indicated in the following figure, the GPDF 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.

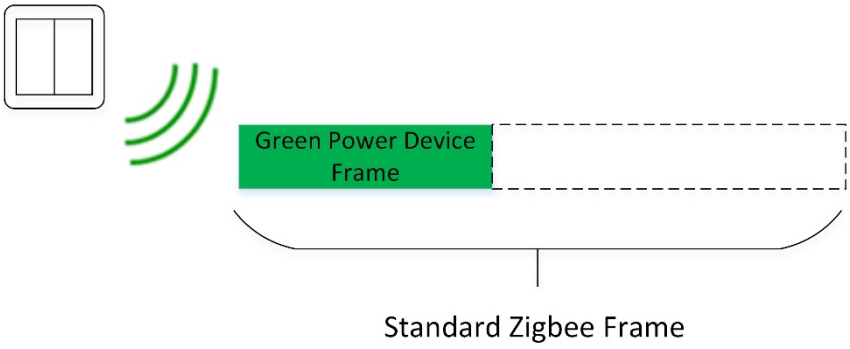


Figure 2.2. GPDF Size

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 Zigbee End Devices (ZEDs). For more information on ZEDs, see *UG103.2: Zigbee Fundamentals*.

3. Device Types

ZGP includes the following device types:

Device type	Description
Green Power Device	A self-powering, energy-harvesting device that implements the Green Power feature. These devices 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	A fully-compliant Zigbee device, which in addition to the core Zigbee specification also implements proxy functionality of the Green Power feature. The proxy translates ZGP frames to Zigbee Cluster Library (ZCL) frames and acts as an intermediate node between the GPD and sinks on the Zigbee network. For more information on ZCL, see UG103.2: Application Development Fundamentals, Zigbee.
Green Power Sink	Any device that can be controlled by or receive data from a GPD (for example, a light or a server device). A GPS can only be implemented on a standalone ZED.
Green Power Combo Basic (GPCB)	A combination device that only implements the basic GP combo functionality, for both sink and proxy within a single device.

3.1 Green Power Proxy

GPDFs are specialized frames, unique to GP. The frames are encapsulated within a ZCL packet for transmission across a Zigbee network. The proxy acts as a conduit between the GPD and the sink. During the commissioning of a GPS and GPD, an entry is added to the proxy table to act as a mapping between the GPD and the 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.

3.2 Green Power Sink

A Green Power Sink is a fully-compliant Zigbee device, which in addition to a core Zigbee specification also implements the sink functionality of the Green Power feature, basic or advanced. The sink is thus capable of receiving, processing, and executing GPD commands, tunneled and optionally also directly received. For more information, refer to *ZigBee PRO Green Power specification, Basic functionality, set Version 1.0* (ZigBee Document 16-02607-024).

3.3 Green Power Combo Basic

A Green Power Basic Combo implements the basic set of proxy and sink functionality, as well as selected server-side and client-side attributes per the *ZigBee PRO Green Power specification, Basic functionality set, Version 1.0* (ZigBee Document 16-02607-024).

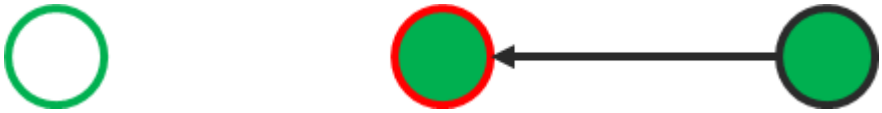
4. Commissioning Process

Before a GPS 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.

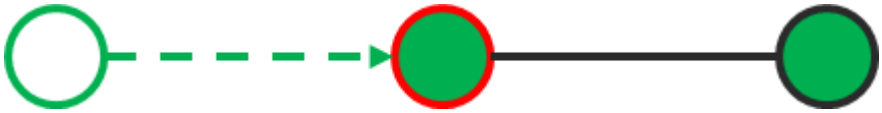
The steps in the basic ZGP commissioning process are as follows.

1. The GPS and GPP are joined to the same Zigbee Private Area Network (PAN).

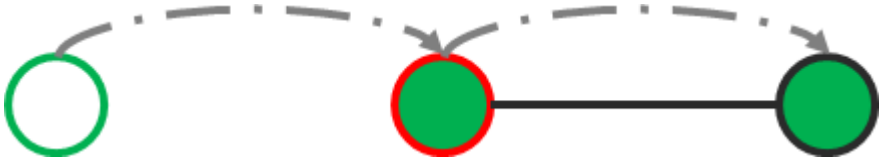
2. The GPS sends a ZCL message to listen for a joining GPD to commission (timeout in the notification, first successful connect, or a stop command).



3. GPD sends a GP join Commissioning message that will be captured by a listening GPP. Proxies will then be in watch mode; they can only be in Commissioning mode for one sink at a time.



4. The GPP creates a Pairing entry in its Proxy Table between the GPD and the GPS.



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

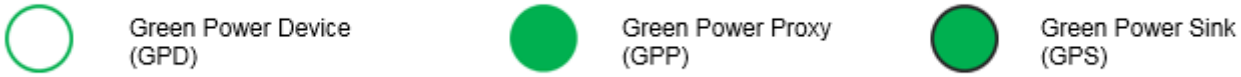


Figure 4.1. Basic Green Power Commissioning Key

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 Ember ZNet PRO stack	Not entirely certifiable in the current Zigbee Green Power specification
GP Device	Not currently supported by the Ember ZNet PRO stack	Fully supported as Zigbee Green Power Device
GP Sink	Yes, but without the Direct GPDF handling feature	Not entirely certifiable in the current Zigbee Green Power specification
GP Combo Basic	Yes	Fully supported at the router level (requirement of the Zigbee 3.0 specification)

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

- Green Power Libraries: required stack-side Proxy and Sink code
- Green Power Client: application-side GPP
- Green Power Server: application-side GPS
- Green Power Common: common application code between the GPP and the GPS

6. Next Steps

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

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

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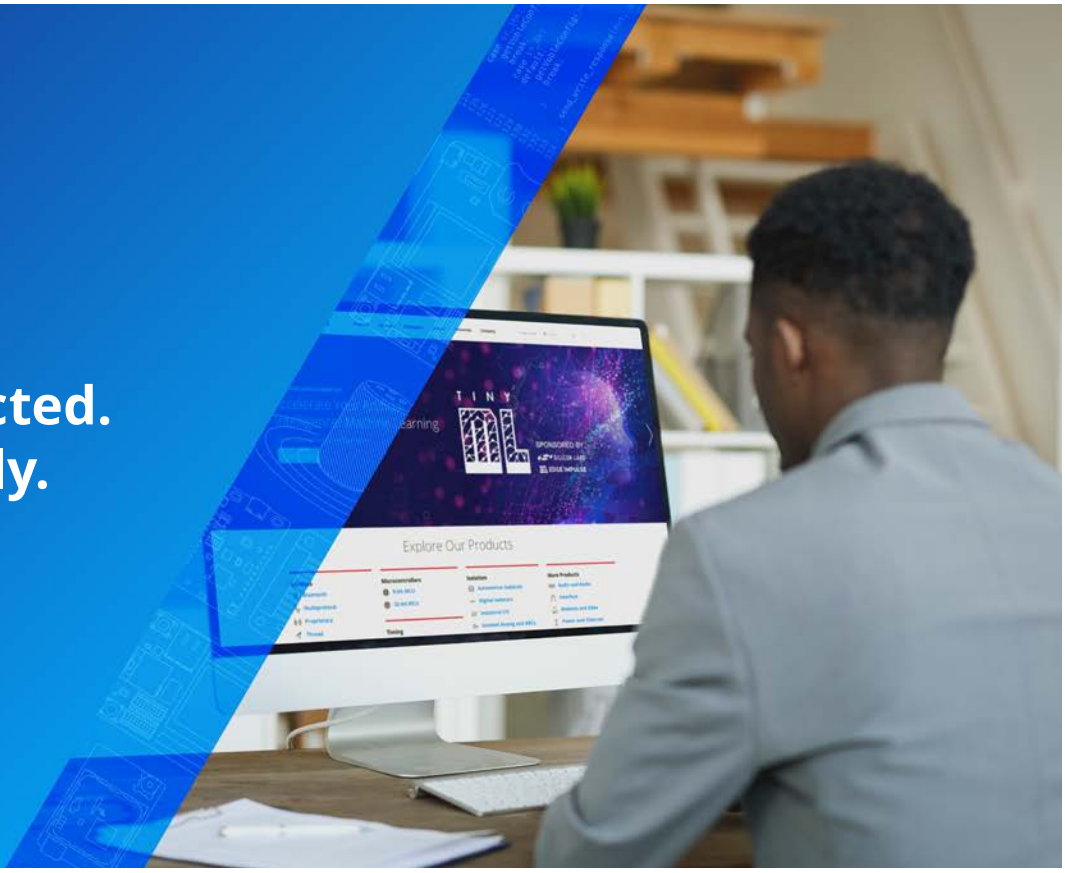

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