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 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 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
- 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. 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/. 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:

- Green Power Device (GPD)
- A Z3 Proxy or Green Power Proxy (GPP)
- A Green Power Sink (GPS)

Green Power Device Frames (GPDF) are specialized frames, unique to GP (abbreviated to Frames in this document). The Frames are encapsulated within a ZCL packet for transmission across a Zigbee network. Frames 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 Frame within a standard Zigbee frame and forward the Frame 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 Frame packets. The following figure illustrates the data flow from the GPD to the GPP and finally to the GPS.

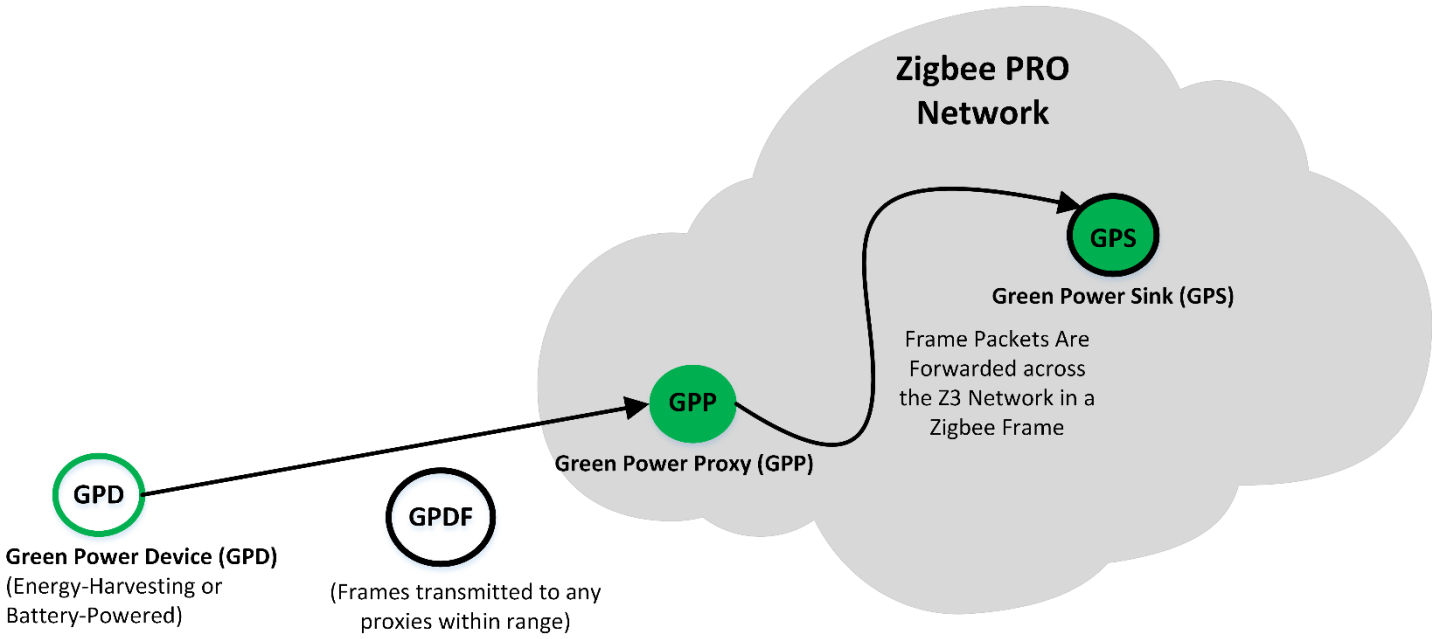


Figure 2-1. Basic Green Power Message Transmission

The Frame is shorter than a standard Zigbee frame which allows a GPD to transmit a Frame using less power than a standard Zigbee frame because the radio transmitter is active for less time.

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 Device Types

ZGP includes the following device types:

Device type	Description
Green Power Device (GPD)	The device that generates commands and events (for example, light switches) to be used by the GP Sinks (for example, lights).
Green Power Proxy Basic (GPPB)	A mandatory subset of the GP Proxy features to achieve Zigbee 3.0 certification. This subset is basically assuring that router devices can receive Green Power packets and forward it to the destination (that is, GP Sink Basic). **Note:** Because the proxy is merely forwarding the Frame to its intended destination, it is agnostic about the Frame data payload.
Green Power Sink Basic (GPSB)	A Green Power Sink Basic is a fully-compliant Zigbee device, which in addition to a core Zigbee specification also implements the sink functionality of the GP 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).
Green Power Combo Basic (GPCB)	A Green Power Combo Basic 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).

3.1 Zigbee Green Power and EmberZNet Pro Support

The following table summarizes lists each ZGP feature from the Zigbee standard, whether EmberZNet supports it, and any limitations in the EmberZNet PRO support.

Key

- GPDF Support: If the device supports Green Power Device Frames sending out or receiving from the Zigbee network layer.
- Yes: Both the standard Zigbee device and EmberZNet PRO support.
- No: The standard Zigbee device supports but EmberZNet PRO does not support.
- N/A: The feature is not applicable to the standard Zigbee device.

	EmberZNet PRO Support			
Zigbee Green Power Feature	GPD	GPPB	GPSB	GPCB
GPDF Support: Auto Commissioning GPDF handling	No	No	No	No
GPDF Support: Direct Reception of GPD frames (ability to receive the GPDF GPD commands from a GPD device)	Yes, bidirectional	Yes	No	Yes
GPDF Support: Sending out GPD frames (GPD Commands)	Yes	Yes	No	Yes
GPDF Support: Immediate bidirectional responses (getting back a channel configuration or commissioning reply with in 20 - 30 msec of request window)	Yes	No	No	No
GPDF Support: Buffered bidirectional responses (using GP data transmit queue mechanism to respond, such as channel configuration or commissioning reply)	Yes	Yes	No	Yes
GP Notification: Forwarding of GPD commands to Sink LW UCAST/Derived GCAST	N/A	Yes	No	Yes
GP Notification: Forwarding Full Unicast GPD commands	N/A	No	No	No
GP Notification: GPDF Security Level b10 (4 Byte MIC Authentication)	Yes	Yes	No	Yes
GP Notification: GPDF Security Level b11 (protected with shared key)	Yes	Yes	No	Yes
GP Commissioning: Commissioning Tool (CT) command (GP Pairing Configuration) forwarding to Sink Group (Pre-Commissioned GCAST)	N/A	No	Yes	Yes

	EmberZNet PRO Support			
Zigbee Green Power Feature	**GPD**	**GPPB**	**GPSB**	**GPCB**
GP Commissioning : GPDF Security Level b10 for key request (4 Byte MIC Authentication)	Yes	Yes	No	Yes
GP Commissioning: GPDF Security Level b11 for key request (protected with shared key)	Yes	No (reception)	Yes	Yes
GP Commissioning: Application Description Command handling for sink functionality match in commissioning for Multisensor / Compact Attribute reporting	Yes	N/A	Yes	Yes
GP Commissioning: Generic Switch Commissioning	Yes	N/A	Yes	Yes
GP Pairing Maintenance : Pairing Search / Handling, Proxy Table update, Sink table update	N/A	No	N/A	No
Translation Table Support : Translation table add/update/replace	N/A	N/A	Yes	Yes

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

- Green Power Libraries: required stack-side Proxy Basic and Sink Basic 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

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.

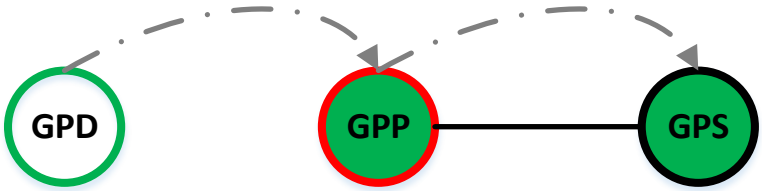
Figure 4-1 describes the steps in the basic ZGP commissioning process.

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 ZGP Commissioning Process

5 Next Steps

For more information on ZGP, visit https://www.zigbee.org/zigbee-for-developers/greenpower/

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

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