



# **ZigBee Green Power User Guide**

ZB3GPUG  
Revision 0.2  
28 September 2017





# Contents

<b>Preface</b>	<b>7</b>
Organisation	7
Conventions	8
Acronyms and Abbreviations	8
Related Documents	9
Support Resources	9
Trademarks	9
Chip Compatibility	9
<b>1. Green Power Cluster</b>	<b>11</b>
1.1 Overview	11
1.2 Green Power Components	13
1.2.1 Hardware and Software Components	13
1.2.2 Green Power Infrastructure Devices	15
1.3 Green Power Structure and Attributes	16
1.4 Green Power Concepts	24
1.4.1 Green Power Tables	24
1.4.2 Commands and Transmission Modes	27
1.4.3 Green Power Addresses	28
1.5 Initialisation	30
1.6 Commissioning	31
1.6.1 GP Device in Auto-Commissioning Mode	32
1.6.2 GP Device in Uni-directional Commissioning Mode	36
1.6.3 GP Device in Bi-directional Commissioning Mode	39
1.6.4 Decommissioning	45
1.7 Operation	46
1.8 Useful Commissioning and Operational Topics	48
1.8.1 De-duplication	48
1.8.2 Pairing a GP Device with Multiple Sink Nodes	49
1.8.3 Creating a Translation Table	49
1.8.4 Persistent Data Management	54
1.9 Green Power Events	55
1.10 Green Power Functions	63
eGP_RegisterComboBasicEndPoint	64
eGP_RegisterProxyBasicEndPoint	66
eGP_ProxyCommissioningMode	67
bGP_IsSinkTableEntryPresent	68
bGP_GetFreeProxySinkTableEntry	69
vGP_RemoveGPDFFromProxySinkTable	70

## Contents

bGP_IsProxyTableEntryPresent	71
eGP_SinkTableRequestSend	72
eGP_ProxyTableRequestSend	73
eGP_ZgpTranslationTableUpdateSend	74
eGP_ZgpTranslationTableRequestSend	75
eGP_ZgpPairingConfigSend	76
bGP_CheckGPDAddressMatch	77
vGP_RestorePersistedData	78
1.11 Return Codes	79
1.12 Green Power Structures	79
1.12.1 tsGP_GreenPowerDevice	79
1.12.2 tsGP_GreenPowerClusterInstances	80
1.12.3 tsGP_GreenPowerCallBackMessage	80
1.12.4 tsGP_ZgppProxySinkTable	83
1.12.5 tsGP_ZgpsSinkAddrList	86
1.12.6 tuGP_ZgpdDeviceAddr	87
1.12.7 tsGP_ZgpdDeviceAddrAppId2	87
1.12.8 tsGP_ZgpCommissionIndication	88
1.12.9 tsGP_ZgpsGroupList	89
1.12.10 tsGP_GpToZclCommandInfo	89
1.12.11 tsGP_TranslationTableEntry	90
1.12.12 tsGP_ZgpCommissionCmdPayload	91
1.12.13 tsGP_ZgpCommissioningNotificationCmdPayload	94
1.12.14 tsGP_ZgpDecommissionIndication	96
1.12.15 tsGP_ZgpDataCmdWithAutoCommPayload	96
1.12.16 tsGP_ZgpsTranslationUpdateEntry	97
1.12.17 tsGP_ZgpTranslationUpdateCmdPayload	98
1.12.18 tsGP_ZgpTransTableResponseCmdPayload	99
1.12.19 tsGP_ZgpsTranslationTableUpdate	100
1.12.20 tsGP_ZgpPairingConfigCmdPayload	101
1.12.21 tsGP_ZgpSinkTableRequestCmdPayload	104
1.12.22 tsGP_ZgpProxyTableRequestCmdPayload	105
1.12.23 tsGP_ZgpsPairingConfigCmdRcvd	106
1.12.24 tsGP_ZgpsTransTblRspEntry	107
1.12.25 tsGP_SinkTableRespCmdPayload	108
1.12.26 tsGP_ProxyTableRespCmdPayload	109
1.12.27 tsGP_ZgpResponseCmdPayload	109
1.12.28 tsGP_ZgpNotificationCmdPayload	111
1.12.29 tsGP_ZgpCommissioningNotificationCmdPayload	113
1.12.30 tsGP_ZgpPairingCmdPayload	115

<b>1.13 Enumerations</b>	<b>118</b>
1.13.1 'Attribute ID' Enumerations	118
1.13.2 'Green Power Event' Enumerations	120
1.13.3 'Green Power Infrastructure Device' Enumerations	124
1.13.4 'Green Power Device Mode' Enumerations	125
1.13.5 'Communication Mode' Enumerations	126
1.13.6 'GPD Device ID' Enumerations	126
1.13.7 'GPD Command ID' Enumerations	127
1.13.8 'GPD Commissioning Command Type' Enumerations	128
1.13.9 'Proxy Commissioning Mode' Enumerations	129
1.13.10 'Sink Table Priority' Enumerations	129
1.13.11 'Translation Table Update Action' Enumerations	130
1.13.12 'Pairing Configuration Action' Enumerations	131
1.13.13 'Pairing Config Translation Table Action' Enumerations	131
1.13.14 'Reset-To-Default' Enumerations	132
1.13.15 'Data Restore/Initialise' Enumerations	133
1.13.16 'Security Level' Enumerations	133
1.13.17 'Security Key Type' Enumerations	134
<b>1.14 Compile-Time Options</b>	<b>135</b>
<b>1.15 Green Power Terminology</b>	<b>139</b>
 <b>2. ZigBee PRO Stack Features for Green Power</b>	 <b>141</b>
2.1 Stack Configuration	141
2.2 Stack Events	141
2.3 ZPS Structures	142
2.3.1 ZPS_tsAfZgpDataIndEvent	142
2.3.2 ZPS_tsAfZgpDataConfEvent	145
2.3.3 ZPS_tuGpAddress	145
2.3.4 ZPS_tuAfZgpGreenPowerId	146
2.3.5 ZPS_tsAfZgpGreenPowerReq	146
2.3.6 ZPS_tsAfZgpTxGpQueue	147
2.3.7 ZPS_tsAfZgpTxGpQueueEntry	148
2.3.8 ZPS_tsAfZgpGpst	148
2.3.9 ZPS_tsAfZgpGpstEntry	149
2.3.10 ZPS_tsAfZgpSecReq	150
2.3.11 ZPS_tsAfZgpGreenPowerContext	151



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## Preface

This manual provides an introduction to ZigBee Green Power (GP) and describes use of the NXP implementation of the Green Power feature for ZigBee 3.0 applications running on the NXP KW41Z wireless microcontroller. The manual contains both operational and reference information relating to the Green Power cluster, including descriptions of the supplied C functions and associated resources (e.g. structures and enumerations).

ZigBee Green Power is used in conjunction with the ZigBee PRO wireless network protocol. Use of the Green Power feature requires enhancements to the ZigBee PRO stack software, which are also described in this manual. These enhancements are supplied in the Kinetis Software Developer's Kit (KSDK), provided that the SDK was built to include ZigBee 3.0.

You must use this manual in conjunction with the documentation set for the ZigBee 3.0 software (see [“Related Documents” on page 9](#)). All the relevant resources are available via the NXP web site (see [“Support Resources” on page 9](#)).

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## Organisation

This manual consists of two chapters, as follows:

- [Chapter 1](#) describes the ZigBee Green Power cluster
- [Chapter 2](#) describes the ZigBee PRO stack enhancements for Green Power

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## Conventions

Files, folders, functions and parameter types are represented in **bold** type.

Function parameters are represented in *italics* type.

Code fragments are represented in the `Courier New` typeface.



This is a **Tip**. It indicates useful or practical information.



This is a **Note**. It highlights important additional information.



*This is a **Caution**. It warns of situations that may result in equipment malfunction or damage.*

---

## Acronyms and Abbreviations

API	Application Programming Interface
CCA	Clear Channel Assessment
FCF	Frame Control Field
FCS	Frame Check Sequence
GP	Green Power
GPD	Green Power Device
IDE	Integrated Development Environment
MAC	Medium Access Control
PAN	Personal Area Network
PIB	PAN Information Base
SDK	Software Developer's Kit
ZGPD	ZigBee Green Power Device
ZGPP	ZigBee Green Power Proxy
ZGPS	ZigBee Green Power Sink



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## **Related Documents**

095499	ZigBee PRO Green Power Specification [from ZigBee Alliance]
ZB3QSG	ZigBee 3.0 Quick Start Guide
ZB3STAUG	ZigBee 3.0 Stack User Guide
ZB3DEVUG	ZigBee 3.0 Devices User Guide
ZB3ZCLUG	ZigBee Cluster Library User Guide
CONNFWKRM	Connectivity Framework Reference Manual

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## **Support Resources**

To access online support resources such as SDKs, Application Notes and User Guides, visit the Wireless Connectivity area of the NXP web site:

[www.nxp.com/products/wireless-connectivity](http://www.nxp.com/products/wireless-connectivity)

ZigBee resources can be accessed from the ZigBee page, which can be reached via the short-cut [www.nxp.com/zigbee](http://www.nxp.com/zigbee).

All NXP resources referred to in this manual can be found at the above address, unless otherwise stated.

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## **Trademarks**

All trademarks are the property of their respective owners.

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## **Chip Compatibility**

The Green Power software described in this manual can be used on the NXP KW41Z wireless microcontroller.



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# 1. Green Power Cluster

This chapter describes the ZigBee Green Power (GP) cluster and the NXP implementation of this cluster for ZigBee 3.0.

The Green Power cluster has a Cluster ID of 0x0021.

This cluster must be implemented on the reserved Green Power endpoint, 242, using a Profile ID of 0xA1E0.

---

## 1.1 Overview

ZigBee Green Power (GP) is an optional cluster with the aim of minimising the power demands on a network node in order to support:

- Nodes that are completely self-powered through energy harvesting
- Battery-powered nodes that require ultra-long battery life

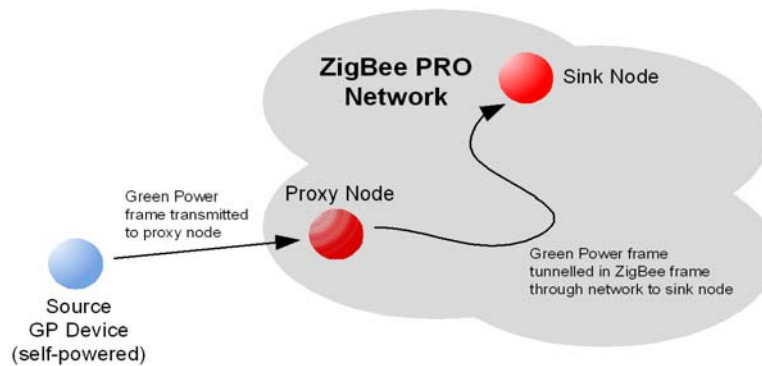
Typical nodes of this type are switches (e.g. light-switch), panic/emergency buttons, detectors and sensors. The energy harvesting nodes can be 'bursting energy harvesters' which generate and store energy in a very short time by electro-mechanical means (such as flipping a switch) or 'trickling energy harvesters' which generate and store energy over a long period of time (such as from solar cells).

ZigBee Green Power minimises the power demands on a node that participates in a ZigBee PRO network by:

- Employing shorter data frames that take less time to transmit, thus reducing the amount of energy needed for each transmission - these GP frames are simple IEEE 802.15.4 frames that are shorter than ZigBee-format frames
- Not requiring these nodes to be full, permanent members of the network and allowing them to only transmit data when they need to (e.g. when a button on the node is pressed)

A Green Power frame is sent to a 'proxy' node, which is a normal network node and which embeds or 'tunnels' the Green Power frame within a normal ZigBee frame for re-transmission through the network. The Green Power cluster is not needed on the source 'GP device' but must be used on the proxy nodes, as well as the 'sink' nodes that need to receive and interpret the tunnelled Green Power frames. The basic Green Power mechanism for sending a frame of data is illustrated in [Figure 1](#) below.

Further operational details of Green Power are provided in [Section 1.4](#).



**Figure 1: Basic Green Power Mechanism**

The advantages of using ZigBee Green Power are:

- Allows the use of nodes for which mains power or batteries are not practical, safe or available, e.g. nodes in isolated or hazardous locations
- Can eliminate the need for batteries in nodes, and the associated maintenance, waste and environmental concerns
- Eco-friendly nodes
- Low-cost, quick and easy installation of nodes
- Suitable for nodes in locations where maintenance would be difficult

An application that uses the Green Power cluster (on a proxy node or sink node) must include the header files **GreenPower.h** and **zcl\_options.h**. The Green Power software is compiled into a built application by defining **CLD\_GREENPOWER** in the **zcl\_options.h** file. Further compile-time options for the Green Power cluster are detailed in [Section 1.14](#). Green Power must also be enabled in the ZPS configuration, as indicated in the description of Green Power initialisation in [Section 1.5](#).

## 1.2 Green Power Components

This section describes the main components used in ZigBee Green Power. For a general introduction to Green Power, first refer to [Section 1.1](#).

### 1.2.1 Hardware and Software Components

As introduced in [Section 1.1](#), the use of the ZigBee Green Power feature requires three types of node:

- **ZigBee Green Power Device (ZGPD):** This is a source node that sends Green Power frames into the network via a proxy node (see below)
- **ZigBee Green Power Proxy (ZGPP):** This is a network node which is capable of receiving a Green Power frame from a ZGPD, embedding (tunnelling) the GP frame within a normal ZigBee frame and passing this frame into the ZigBee PRO network
- **ZigBee Green Power Sink (ZGPS):** This is a sink (target) node which is paired with a ZGPD, and is capable of receiving and interpreting tunnelled GP frames as well as direct GP frames from the ZGPD

A network node can be both a ZGPP (proxy) and a ZGPS (sink). This combined node is referred to as a 'combo' node.



**Note 1:** For clarity, the acronyms ZGPD, ZGPP and ZGPS will not always be used in this manual - these nodes will usually be referred to as the GP device, proxy node and sink node, respectively.

**Note 2:** The functionality of a Green Power node (except the source 'GP device') is determined by the GP 'infrastructure devices' that are resident on the node. The GP infrastructure devices are listed and described in [Section 1.2.2](#).

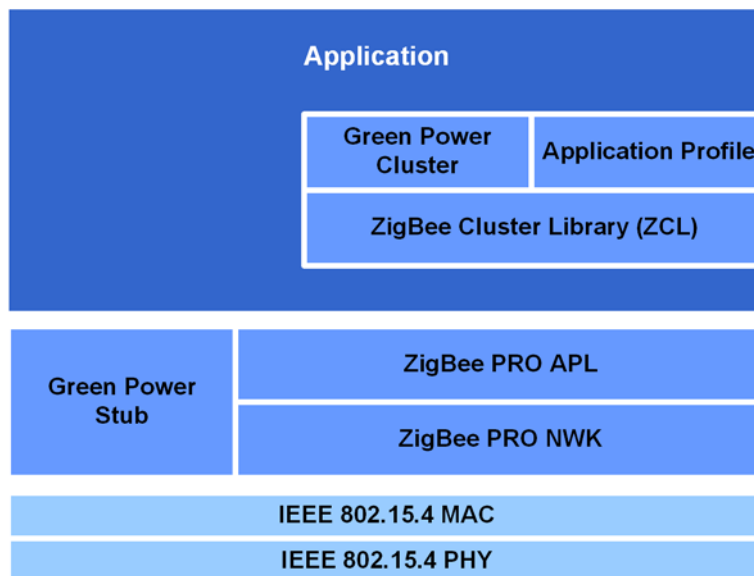
### Proxy and Sink Nodes

A proxy node and sink node each requires the following software components:

- Application
- ZigBee Green Power cluster
- ZigBee Cluster Library (ZCL)
- ZigBee PRO stack with Green Power stub

The software stack architecture for a proxy node and sink node is illustrated in [Figure 2](#) below. The IEEE 802.15.4 MAC layer incorporates an additional 'MAC shim' (not shown in the diagram) which filters GP frames that have been received directly from the source GP device and passes them to the Green Power stub.

Raw GP frames that arrive directly from the source GP device are routed up to the GP cluster via the GP stub, while tunnelled GP frames that arrive from a proxy node (in ZigBee frames) are routed up to the GP cluster via the ZigBee PRO stack layers.



**Figure 2: ZigBee Green Power Software Stack**

The GP cluster also requires a 1-ms software timer to be set up and needs to be notified by the application every time the software timer expires (see [Section 1.5](#)).

### **GP Device (Source)**

A source GP device requires the following software components:

- Application
- IEEE 802.15.4 stack

The GP device does not require any ZigBee software components, as the GP frames that it transmits are not ZigBee-format frames.

## 1.2.2 Green Power Infrastructure Devices

ZigBee define a number of Green Power 'infrastructure devices', which are software entities that reside on the ZGPP and ZGPS nodes described in [Section 1.2.1](#) (but not the ZGPD), and provide their GP functionality. Each of these devices hosts the GP cluster. The GP infrastructure devices are listed and described in [Table 1](#) below (for full details of these devices, refer to the ZigBee Green Power Specification). Enumerations are provided for these devices and are listed in [Section 1.13.3](#).

GP Infrastructure Device	Description
Proxy	GP proxy functionality, supporting a GP cluster server and client
Proxy Basic	GP proxy basic functionality, supporting only a GP cluster client
Target	GP sink functionality, supporting a GP cluster server and client, with restricted receive capability as a client (does not support the GP stub in the stack, so is not capable of directly receiving GP frames from a GP device)
Target Plus	GP sink enhanced functionality, supporting a GP cluster server and client, with full receive capability as a client and optionally a transmit capability as a server
Commissioning Tool	GP commissioning tool functionality, supporting only a GP cluster server with both transmit and receive capabilities
Combo	GP combo (proxy and sink) functionality, supporting a GP cluster server and client, with a receive capability as a client and a transmit capability as a server
Combo Basic	GP combo (proxy and sink) basic functionality, supporting a GP cluster server and client, with a receive capability as a client and optionally a transmit capability as a server

**Table 1: Green Power Infrastructure Devices**



**Note 1:** The current ZigBee Green Power release from NXP supports only the Proxy Basic and Combo Basic devices. You should use the Proxy Basic device on nodes that need to support only the proxy functionality. You should use the Combo Basic device on nodes that need to support only the sink functionality or both the sink functionality and proxy functionality.

**Note 2:** In the current software release, the features of the Proxy Basic device are limited and do not include unicasts and Proxy table maintenance.

## 1.3 Green Power Structure and Attributes

The attributes of the Green Power cluster are contained in the following structure.



**Note 1:** The Green Power terminology used in the attribute descriptions below is listed and detailed in [Section 1.15](#).

**Note 2:** For full details of the attributes, refer to the ZigBee Green Power Specification.

```
typedef struct
{
#ifdef GP_COMBO_BASIC_DEVICE
    /* Client Attributes */
    uint8          u8ZgppMaxProxyTableEntries;
    tsZCL_LongOctetString  sProxyTable;

    /* Server Attributes */
    uint8          u8ZgpsMaxSinkTableEntries;
    tsZCL_LongOctetString  sSinkTable;
    zbmap8         b8ZgpsCommunicationMode;
    zbmap8         b8ZgpsCommissioningExitMode;

#ifdef CLD_GP_ATTR_ZGPS_COMMISSIONING_WINDOW
    uint16         u16ZgpsCommissioningWindow;
#endif

    zbmap8         b8ZgpsSecLevel;
    zbmap24        b24ZgpsFeatures;
    zbmap24        b24ZgpsActiveFeatures;
#endif

#ifdef GP_PROXY_BASIC_DEVICE
    /* Client Attributes */
    uint8          u8ZgppMaxProxyTableEntries;
    tsZCL_LongOctetString  sProxyTable;

#ifdef CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_NUMBER
    uint8          u8ZgppNotificationRetryNumber;
#endif

#ifdef CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_TIMER
```



```

        uint8                                u8ZgppNotificationRetryTimer;
    #endif

    #ifdef CLD_GP_ATTR_ZGPP_MAX_SEARCH_COUNTER
        uint8                                u8ZgppMaxSearchCounter;
    #endif

    #ifdef CLD_GP_ATTR_ZGPP_BLOCKED_GPD_ID
        tsZCL_LongOctetString                sZgppBlockedGpdID;
    #endif

        zbmap24                                b24ZgppFunctionality;
        zbmap24                                b24ZgppActiveFunctionality;
    #endif

    /* Shared Attributes b/w server and client */

    #ifdef CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY_TYPE
        zbmap8                                b8ZgpSharedSecKeyType;
    #endif

    #ifdef CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY
        tsZCL_Key                            sZgpSharedSecKey;
    #endif

    #ifdef CLD_GP_ATTR_ZGP_LINK_KEY
        tsZCL_Key                            sZgpLinkKey;
    #endif

    uint16                                    ul6ClusterRevision;

}tsCLD_GreenPower;

```

where use of all the attributes, except the security attributes, is dependent on the Green Power infrastructure device type (see [Section 1.2.2](#)) enabled using macros defined in the compile-time options (see [Section 1.14](#)).

### 'Combo Basic' Device Client Attributes

The following attributes are used only if GP\_COMBO\_BASIC\_DEVICE is defined:

- `u8ZgppMaxProxyTableEntries` is the maximum number of proxy table entries (see below) that can be stored by the local node (client). This attribute is always equal to the value of the compile-time macro `GP_NUMBER_OF_PROXY_SINK_TABLE_ENTRIES`. The application should therefore use this macro to configure the number of sink table entries. The default value is 10.
- `sProxyTable` is a structure representing the proxy table, which indicates the pairings between source GP devices (within direct range of the proxy node) and sink nodes in the network. This structure is used for the over-air transmission of a proxy table, as explained in the ZigBee Green Power Specification, and the application should not modify the structure. The application can modify the local proxy table using supplied API functions, as described in [Section 1.4.1.3](#) and [Section 1.10](#).

### 'Combo Basic' Device Server Attributes

The following attributes are used only if GP\_COMBO\_BASIC\_DEVICE is defined:

- `u8ZgpsMaxSinkTableEntries` contains the maximum number of sink table entries (see below) that can be stored by the local sink node (server). This attribute is always equal to the value of the compile-time macro `GP_NUMBER_OF_PROXY_SINK_TABLE_ENTRIES`. The application should therefore use this macro to configure the number of sink table entries. 0xFF indicates unspecified and 0x00 indicates that a sink table is not supported.
- `sSinkTable` is a structure representing the sink table, which indicates the pairings between the local sink node (server) and source GP devices. This structure is used for the over-air transmission of a sink table, as explained in the ZigBee Green Power Specification, and the application should not modify the structure. The application can modify the local sink table using supplied API functions, as described in [Section 1.4.1.2](#) and [Section 1.10](#).
- `b8ZgpsCommunicationMode` is a value indicating the communication mode required by the local server (for enumerations, see [Section 1.13.9](#)):

Values	Communication Mode
0x00	Unicast forwarding of GP notifications by (all) proxies
0x01	Groupcast forwarding of GP notifications to a 'derived' group
0x02	Groupcast forwarding of GP notifications to 'pre-commissioned' groups
0x03	Unicast forwarding of GP notifications by proxies supporting the lightweight unicast feature (without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command)
0x04-0xFF	Reserved

- `b8ZgpsCommissioningExitMode` is a bitmap indicating the conditions for exiting Commissioning Mode on the local server ('1' - supported, '0' - not supported):

Bits	Exit Condition
0	On expiration of the optional 'commissioning window' timeout (see below)
1	On the first successful pairing (not to be set with bit 2)
2	On receiving 'proxy commissioning mode (exit)' command (not to be set with bit 1)
3-7	Reserved

- `u16ZgpsCommissioningWindow` is an optional attribute representing the time-period, in seconds, during which the local server will accept pairing changes (additions and/or removals).
- `b8ZgpsSecLevel` indicates the minimum security level that the local server requires a paired Green Power node to support:

Values	Security Level
0x00	No security
0x01	Reserved
0x02	Full (4-byte) frame counter and full (4-byte) MIC only *
0x03	Encryption with full (4-byte) frame counter and full (4-byte) MIC *
0x04-0x07	Reserved

\* 0x02 and 0x03 are the only security levels supported in the current software release

- `b24ZgpsFeatures` is a bitmap indicating the Green Power features supported by the local server. Each bit corresponds to a GP feature and is set to '1' if the feature is supported or to '0' otherwise. The bitmap is detailed in [Table 2 on page 22](#).
- `b24ZgpsActiveFeatures` is a bitmap indicating the GP features that are currently enabled on the local server. Each bit corresponds to a GP feature and is set to '1' if the feature is enabled or to '0' otherwise. The bitmap is detailed in [Table 4 on page 23](#).

### **'Proxy' Device Client Attributes**

The following attributes are used only if `GP_PROXY_BASIC_DEVICE` is defined:

- `u8ZgppMaxProxyTableEntries` is the maximum number of proxy table entries (see below) that can be stored by the local proxy node (client). This attribute is always equal to the value of the compile-time macro `GP_NUMBER_OF_PROXY_SINK_TABLE_ENTRIES`. The application should therefore use this macro to configure the number of sink table entries. The default value is 10.

- `sProxyTable` is a structure representing the proxy table, which indicates the pairings between source GP devices (within direct range of the proxy node) and sink nodes in the network. This structure is used for the over-air transmission of a proxy table, as explained in the ZigBee Green Power Specification, and the application should not modify the structure. The application can modify the local proxy table using supplied API functions, as described in [Section 1.4.1.3](#) and [Section 1.10](#).
- `u8ZgppNotificationRetryNumber` is an optional attribute specifying the number of (unicast) GP notification retries to be performed on failing to receive a GP notification response from a particular sink node. The default value is 2.
- `u8ZgppNotificationRetryTimer` is an optional attribute specifying the time, in milliseconds, to wait for a response after sending a (unicast) GP notification to a particular sink node. The default value is 100.
- `u8ZgppMaxSearchCounter` is an optional attribute specifying the maximum value that the Search Counter for a proxy table entry can take before it rolls over to 0. The default value is 10.
- `sZgppBlockedGpdID` is an optional attribute containing information about source GP devices that are in direct range of the proxy node but are not members of the same GP system and should therefore be blocked/excluded by the proxy node. This attribute takes the form of a string with a format that is detailed in the ZigBee Green Power Specification.
- `b24ZgppFunctionality` is a bitmap which specifies the GP functionality supported by the proxy node. Each bit corresponds to a GP feature and is set to '1' if the feature is supported or to '0' otherwise. The bitmap is detailed in [Table 3 on page 23](#). For a proxy node, certain bits must be set to specific values, as follows:
  - Bits 0 and 1 must be set to '1' (mandatory features)
  - Bits 6, 9, 17 and 18 must be set to '0' (non-applicable features)
- `b24ZgppActiveFunctionality` is a bitmap indicating the GP features that are currently enabled on the proxy node. Each bit corresponds to a GP feature and is set to '1' if the feature is enabled or to '0' otherwise. The bitmap is detailed in [Table 4 on page 23](#).

## Security Attributes

The following attributes are shared by the server and client sides of the GP cluster:

- **b8ZgpSharedSecKeyType** is an optional attribute indicating the type of security key to be used for communication with all GP devices paired with the proxy node. The possible values are as follows:

Values	Security Key Type
0x00	None
0x01	ZigBee network key *
0x02	Green Power group key programmed into all GP devices of group *
0x03	Green Power group key derived from network key
0x04	Individual 'out-of-the-box' GP device key *
0x05-0x06	Reserved
0x07	Individual GP device key derived from Green Power group key (0x02)

\* 0x01, 0x02 and 0x04 are the only key types supported in the current software release

- **sZgpSharedSecKey** is an optional attribute containing the security key shared between GP nodes. This attribute is only valid if **b8ZgpSharedSecKeyType** has been set to 0x02 or 0x07 (it is not required for any other security key type).
- **sZgpLinkKey** is an optional attribute containing the link key to be used to encrypt a key which is transmitted during GP device commissioning. The default link key is the ZigBee Trust Centre key and if this default is to be used, this attribute is not required.

Bits	Feature
0	Green Power (as feature)
1	Direct communication (reception of GP frame via GP stub rather than stack)
2	Derived groupcast communication
3	Pre-commissioned groupcast communication
4	Unicast communication
5	Lightweight unicast communication
6	Single-hop (in range of sink) bi-directional operation
7	Multi-hop (proxy-based) bi-directional operation
8	Proxy table maintenance (active and passive, for GP device mobility and GP proxy robustness)
9	Single-hop (in range of sink) commissioning (uni-directional and bi-directional)
10	Multi-hop (proxy-based) commissioning (uni-directional and bi-directional)
11	CT-based commissioning
12	Maintenance of GP device (deliver channel/key during operation)
13	No security (b8ZgpsSecLevel = 0x00)
14	Reserved
15	Security with b8ZgpsSecLevel = 0x02 (see attribute description)
16	Security with b8ZgpsSecLevel = 0x03 (see attribute description)
17	Sink table-based groupcast forwarding
18	Translation Table
19	Use of GP device's IEEE address
20-23	Reserved

**Table 2: GPSink Features Bitmap**

Bits	Feature
0	Green Power (as feature)
1	Direct communication (reception of GP frame via GP stub rather than stack)
2	Derived groupcast communication
3	Pre-commissioned groupcast communication
4	Unicast communication
5	Lightweight unicast communication
6	Reserved
7	Multi-hop (proxy-based) bi-directional operation
8	Proxy table maintenance (active and passive, for GP device mobility and GP proxy robustness)
9	Reserved
10	GP commissioning
11	CT-based commissioning
12	Maintenance of GP device (deliver channel/key during operation)
13	No security (b8ZgpsSecLevel = 0x00)
14	Reserved
15	Security with b8ZgpsSecLevel = 0x02 (see attribute description)
16	Security with b8ZgpsSecLevel = 0x03 (see attribute description)
17	Reserved
18	Reserved
19	Use of GP device's IEEE address
20-23	Reserved

**Table 3: GP Proxy Features Bitmap**

Bits	Feature
0	Green Power (as feature)
1-23	All bits should be set to '1' for the current GP specification

**Table 4: Active GP Features Bitmap**

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## 1.4 Green Power Concepts

This section describes some of the main concepts required for an understanding of ZigBee Green Power, including GP tables, commands, transmission modes and addresses.

---

### 1.4.1 Green Power Tables

In order to support the Green Power feature, the following tables are maintained on the sink and/or proxy nodes:

- Translation table (see [Section 1.4.1.1](#))
- Sink table (see [Section 1.4.1.2](#))
- Proxy table (see [Section 1.4.1.3](#))
- Duplicate table (see [Section 1.4.1.4](#))

Each of the above tables is outlined below, but full details can be found in the ZigBee Green Power Specification.

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#### 1.4.1.1 Translation Table

A sink node for GP commands must be able to interpret a received command and perform the required action. However, the commands sent from the GP device do not come from a standard ZigBee command set. Therefore, the sink node must translate the received GP command into a ZigBee command. For this purpose, local 'translation tables' are used:

- **Default Translation Table:** This table is pre-defined and contains an entry for every source GP device type/GP command combination that is relevant to the local sink node. It is stored in a place that is application-defined (e.g. Flash memory) and is used by the Translation Table in RAM (see below).
- **Translation Table in RAM:** This table is created during commissioning and is used to perform the translations. It contains an entry for every GP device with which the local node is paired and this entry contains a pointer to an entry of the Default Translation Table (above).

Each of the above tables is contained in an array. An array element of the Translation Table in RAM is a `tsGP_TranslationTableEntry` structure. An array element of the Default Translation Table is a `tsGP_GpToZclCommandInfo` structure.

- `tsGP_TranslationTableEntry` contains the details of a GP device and includes a pointer to a set of `tsGP_GpToZclCommandInfo` structures (see below), with one structure for each GP command supported by the device.
- `tsGP_GpToZclCommandInfo` contains the details of the commands (including the corresponding clusters) to which a GP command from a particular source GP device type is mapped.

Mappings between these two tables are illustrated in [Figure 3](#) below (for simplification, all the GP devices shown are of the same GP device type and so map to the same set of Default Translation Table entries).



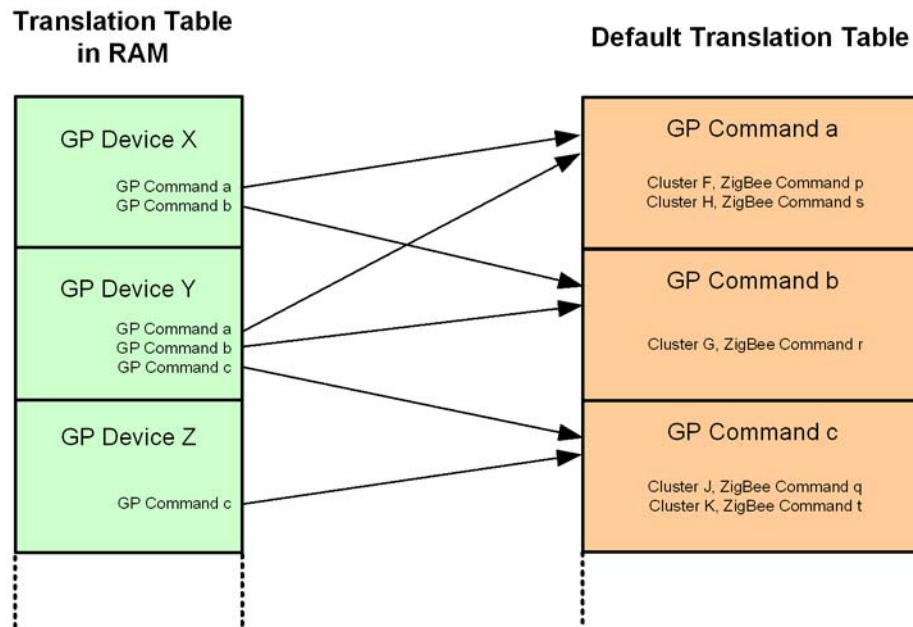


Figure 3: Translation Tables

A pointer to the start of the allocated space for the Translation Table in RAM is specified when the Green Power endpoint is registered on the node using the function **eGP\_RegisterComboBasicEndPoint()** - see [Section 1.5](#). A full description of creating translation tables is provided in [Section 1.8.3](#).

#### 1.4.1.2 Sink Table

A sink node must keep a record of the source GP devices with which it is paired. This information is stored in a local 'sink table', which contains an entry for each paired GP device. This table allows the sink node to determine whether a GP frame received from a GP device (directly or via a proxy node) is intended for itself. The sink table is automatically built up by the Green Power cluster as a part of the commissioning process (see [Section 1.6](#)), but the application can also access the sink table using the following functions:

- **bGP\_GetFreeProxySinkTableEntry()** can be used to obtain a free sink table entry for a new GP device
- **bGP\_IsSinkTableEntryPresent()** can be used to obtain or update an existing sink table entry for a GP device
- **vGP\_RemoveGPDeviceFromProxySinkTable()** can be used to remove a GP device from a sink table entry

For more details of these sink table operations, refer to the function descriptions in [Section 1.10](#).

A sink table entry includes a 'group list' field, which contains a 16-bit address for the group of nodes with which the relevant GP device is paired. This address is used to groupcast a command from the GP device into the network (see [Section 1.4.3.2](#)).

The default size of the sink table is 5, but this size can over-riden using a compile-time option - see [Section 1.14](#). If the table becomes full then one of the existing sink table entries can be replaced, but this replacement must observe the following set of priorities for the existing entries:

- Priority 1: Node also in translation table
- Priority 2: Node not in translation table but direct command received
- Priority 3: Node not in translation table but tunnelled command received

Note that on a Combo Basic node, the proxy table and sink table are combined into a single table for the optimisation of storage space.

---

### **1.4.1.3 Proxy Table**

A proxy node must keep information about the source GP devices for which it acts as a proxy. This information is stored in a local 'proxy table', which contains an entry for each GP device which is in direct range. A proxy table entry stores pairing information about the GP device and the paired sink node, including the security requirements and communication mode. The proxy table is automatically built up by the Green Power cluster as a part of the commissioning process (see [Section 1.6](#)), but the application can also access the proxy table using the following functions:

- **bGP\_GetFreeProxySinkTableEntry()** can be used to obtain a free proxy table entry for a new GP device
- **bGP\_IsProxyTableEntryPresent()** can be used to obtain or update an existing proxy table entry for a GP device
- **vGP\_RemoveGPDFromProxySinkTable()** can be used to remove a GP device from a proxy table entry

For more details of these proxy table operations, refer to the function descriptions in [Section 1.10](#).

A proxy table entry includes a 'group list' field, which contains a 16-bit address for the group of nodes with which the relevant GP device is paired. This address is used to groupcast a GP command into the network (see [Section 1.4.3.2](#)).

The default size of the proxy table is 5, but this size can over-riden using a compile time option - see [Section 1.14](#).

Note that on a Combo Basic node, the proxy table and sink table are combined into a single table for the optimisation of storage space.

### 1.4.1.4 Duplicate Table

A proxy node or sink node may receive the same GP command multiple times via different routes (e.g. from the GP device directly and from one or more proxy nodes). The node should discard duplicate commands and for this purpose maintains a 'duplicate table'. The GP cluster adds each (unique) received GP command to this table. When a GP command arrives, it is compared with the commands in this table. If it matches an existing command, it is discarded.

The entries of the duplicate table have an associated 'ageing time' or timeout, after which the entry is automatically removed from the table. By default, this timeout is 2 seconds, but an alternative value can be set using a compile-time option. The default size of the table is 5, but this size can also be set using a compile-time option. Refer to [Section 1.14](#) for these compile-time options. Use of the duplicate table is further described in [Section 1.8.1](#).

## 1.4.2 Commands and Transmission Modes

The commands that are sent from a source GP device are incorporated in the payloads of IEEE 802.15.4 frames. Once they reach the ZigBee PRO network, these commands are 'tunnelled' inside ZigBee frames by a proxy node. On reaching their final destination(s), the commands are translated into ZigBee commands supported by the sink node.

Proxy nodes and sink nodes within the ZigBee PRO network must support a range of GP-specific commands, as follows:

- Commissioning commands, used in setting up the GP functionality
- Pairing commands, used in setting up relationships between GP nodes
- Notifications, containing operational commands
- Translation Table commands, used to access the translation table that a sink node uses to translate GP device commands - see [Section 1.4.1.1](#)

The above commands may be sent by a proxy node in the following ways:

Transmission Mode	Description
Unicast *	A frame is sent to one particular node
Broadcast	A frame is sent to all nodes within radio range, without discrimination
Groupcast **	A frame is sent to all nodes within a group of nodes identified by the 'group list' field in the relevant sink/proxy table entry (in practice, the frame is broadcast to all nodes and each recipient determines whether it is in the target group - this filtering is automatically handled by the ZigBee PRO stack)

**Table 5: Transmission Modes**

\* Unicast is also available with the 'lightweight' feature in which the proxy node forwards a command without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command.

\*\* The current NXP GP software release supports only groupcast transmissions for sink nodes.

The transmission mode that is required by a sink node can be selected via the GP cluster attribute `b8ZgpsCommunicationMode` and the corresponding feature must be enabled in the attribute `b24ZgpsFeatures` on the node (see [Section 1.3](#)).

---

### 1.4.3 Green Power Addresses

A GP device (ZGPD) has a unique 32-bit Green Power address which is assigned by the ZigBee Alliance. No two GP devices in the world will have the same GP address.

Within the ZigBee PRO network, the 32-bit GP address of the GP device is substituted by a 16-bit network (short) address for the purpose of specifying the source address of a GP frame. The methods for assigning this address are described in [Section 1.4.3.1](#).

A 16-bit address may also be associated with a GP device for groupcast transmissions. This group address is used to identify a group of nodes that are the targets for GP commands from the GP device. The methods for assigning a group address are described in [Section 1.4.3.2](#).



**Note 1:** The use of pre-commissioned addresses, described in [Section 1.4.3.1](#) and [Section 1.4.3.2](#), requires the GP device to be introduced to the ZigBee PRO network using a commissioning tool. However, this method of commissioning is not supported in the current NXP Green Power software release.

**Note 2:** A 16-bit network address assigned as a source address can conflict with an existing network address within the ZigBee PRO network. In this case, Green Power takes priority and the GP cluster requests the network to remove the conflict by replacing the pre-existing network address.

**Note 3:** The 64-bit IEEE address of a GP device can also be used (as well as the 32-bit GP address) to identify the node. If required, it can be enabled in the compile-time options (see [Section 1.14](#)).

### 1.4.3.1 Source Addresses

During commissioning, a 16-bit network (short) address can be assigned to a source GP device in one of two ways:

- **Derived source address:** The 16-bit network (source) address is derived from the 32-bit GP address of the GP device using an algorithm. In the current NXP Green Power release, the 16-bit address is obtained simply by taking the 16 least significant bits of the 32-bit GP address (with rules to avoid the special values 0x0000 and 0xFFFF8 to 0xFFFF). The network address is assigned to the GP device by the proxy or sink node which is in direct contact with the GP device during the commissioning phase. This is the default method of assigning the 16-bit network address and is used in the commissioning process described in this manual (see [Section 1.6](#)).
- **Pre-commissioned source address:** The 16-bit network (source) address is pre-defined before the GP device is introduced to the network. A network address obtained in this way is also referred to as an 'assigned alias'. An assigned alias can be remotely inserted in the sink table on the sink node using the Pairing Configuration command (see [Section 1.12.20](#)) or written directly to a sink table using a commissioning tool (the latter method is not supported in the current NXP Green Power software release).

### 1.4.3.2 Group Addresses

The group address for a groupcast transmission is an address which is held on all the sink nodes that are members of the group. When a GP command is broadcast which is addressed to this group address, each group member is able to identify that the command is intended for itself (this filtering is performed by the ZigBee PRO stack and is transparent to the application).

During commissioning, a 16-bit group address can be assigned to a group in one of two ways:

- **Derived group address:** The 16-bit group address is taken to be the 'derived' 16-bit source address of the GP device, obtained as described in [Section 1.4.3.1](#). The address is assigned to the group by the proxy or sink node which is in direct contact with the GP device during the commissioning phase. This is the default method of assigning a group address and can be used in the commissioning process described in this manual (see [Section 1.6](#)).
- **Pre-commissioned group address:** The 16-bit group address is pre-defined before the GP device is introduced to the network. A group address can be remotely inserted in the sink table on a sink node using the Pairing Configuration command (see [Section 1.12.20](#)) or written directly to the sink table using a commissioning tool (the latter method is not supported in the current NXP Green Power software release).

## 1.5 Initialisation

In order to support the Green Power feature, the application on a proxy node or sink node must register a Green Power endpoint by calling the registration function **eGP\_RegisterProxyBasicEndPoint()** or **eGP\_RegisterComboBasicEndPoint()**, respectively. While endpoint 242 is reserved for the Green Power cluster, this function maps this endpoint to an endpoint in the range 1-240 specified in the function call. The function creates a Green Power cluster instance. Note the following:

- The Green Power feature must be enabled in the `config.h` file of the application. The GP Transmit Queue Size and GP Security Table Size may be configured in the file `zps_globals.c`.
- The application build options in the file **config.h** (see [Section 1.14](#)) must enable the local device as a Combo Basic device or a Proxy Basic device by including the macro `GP_COMBO_BASIC_DEVICE` or `GP_PROXY_BASIC_DEVICE`, respectively.
- The Green Power endpoint must be included in the maximum number of endpoints for the application profile, as defined in the file **zcl\_options.h** (e.g. using the macro `ZCL_NUMBER_OF_ENDPOINTS`).
- The above registration function must be called after the initialisation function **eZCL\_Initialise()**.
- After registering the GP device (using one of the above registration functions), the application must call the function **vGP\_RestorePersistedData()** in order to load persisted data or to set attributes to their default values.
- By default, the `b8ZgpsCommunicationMode` attribute value is 0x01, but should be updated according to the required communication mode after calling **vGP\_RestorePersistedData()**.
- For a sink node, a Default Translation Table must be provided and a pointer to RAM space reserved for a Translation Table must be specified in the registration function (see [Section 1.4.1.1](#) and [Section 1.8.3](#)).
- A source GP device does not need any GP initialisation since it behaves as a standard IEEE 802.15.4 node.
- The GP cluster requires a 1-ms software timer to support its own timed operations - for example, to implement a delay before broadcasting a commissioning notification. For this purpose, the function **vZCL\_EventHandler()** should be called every 1 ms with the `eEventType` field of the structure `tsZCL_CallbackEvent` set to `E_ZCL_CBET_TIMER_MS`. This function should be invoked outside of timer interrupt context.
- By default, the `b8ZgpsSecLevel` attribute value is 0x02 but should be updated according to the required security level (or no security).
- By default, the `b8ZgpSharedSecKeyType` attribute value is 0x00 but should be updated according to the required security key type, if security is used.
- When security is used, the application build options should include the macro `CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY` to enable the optional shared security key attribute (`sZgpSharedSecKey`).

- When security is used, the application build options should include the macro `CLD_GP_ATTR_ZGP_LINK_KEY` to enable the optional link key attribute (`sZgpLinkKey`) if the application needs to send a key encrypted using a link key during commissioning.

---

## 1.6 Commissioning

Before nodes can operate using the ZigBee Green Power feature, they must be commissioned to establish their relationships with each other (from a GP perspective).

Note the following:

- A sink node must be paired with a source GP device (so that the GP device can control the sink node). This is done by creating a sink table entry for the pairing on the sink node. This sink table entry will allow the sink node to recognise that GP frames received from the GP device are intended for itself.
- If the sink node is out of radio range of the source GP device with which it is to be paired, it will need a proxy node to act as a router. In this case, the sink node must establish the pairing with the GP device via the proxy node.
- Only one sink node in the network must be commissioned at any one time.
- The proxy functionality and sink functionality can be combined in a 'combo' node, using the Combo Basic device (see [Section 1.2.2](#)). A 'combo' node also needs a sink table in order to determine whether received GP frames are intended for itself.
- In this NXP release, you should use the Combo Basic device on nodes that need to support only the sink functionality or both sink and proxy functionality. A Proxy Basic device is available for nodes that need to support only the proxy functionality. For more information on the GP infrastructure devices, refer to [Section 1.2.2](#).

The commissioning process for pairing a source GP device with a sink node can be conducted in any of the following ways, depending on the commissioning mode of the GP device:

1. GP device operates in auto-commissioning mode - see [Section 1.6.1](#)
2. GP device operates in uni-directional commissioning mode - see [Section 1.6.2](#)
3. GP device operates in bi-directional commissioning mode - see [Section 1.6.3](#)



**Note 1:** The proxy node is not required for the commissioning process when the sink node is in direct range of the source GP device.



## 1.6.1 GP Device in Auto-Commissioning Mode

When in auto-commissioning mode, the GP device is only able to transmit (and not receive). Commissioning of the node into a ZigBee network is requested by the GP device transmitting any GP command with the 'auto-commissioning' flag set. The channel number used by the GP device must match the channel number used by the ZigBee network (the method used to determine this channel is not prescribed by ZigBee and is application-specific).



**Note 1:** The commissioning process detailed in this section assumes that the sink node is out-of-range of the source GP device and therefore a proxy node is required to relay messages.

The commissioning process for this case is detailed below and is illustrated in [Figure 4](#).

### 1. On sink node:

The application on the sink node puts the node into 'self-commissioning' mode by calling the function **eGP\_ProxyCommissioningMode()** with the action `E_GP_PROXY_COMMISSION_ENTER` specified - this function call results from a user prompt, such as pressing a button on the node. The function causes a Proxy Commissioning Mode command to be broadcast, to request that the receiving proxy nodes enter 'remote commissioning' mode.



**Note:** The sink node will remain in 'self-commissioning' mode until an exit condition is met which has been configured in the `b8ZgpsCommissioningExitMode` attribute (see [Section 1.3](#)).

### 2. On proxy nodes:

The proxy nodes receive the Proxy Commissioning Mode command. This causes the GP cluster on a proxy node to generate the event `E_GP_COMMISSION_MODE_ENTER` for the application, but the GP cluster automatically enters remote commissioning mode without the intervention of the application.





**Note:** For the GP cluster on a proxy node to accept a Proxy Commissioning Mode command, the IEEE address of the sink node which sent the command must be in the Address Map table of the ZigBee PRO stack. It is the responsibility of the proxy node application to ensure that the IEEE addresses of all the sink nodes in the network are in this table. Maintaining the Address Map table is described in the *ZigBee 3.0 Stack User Guide (ZB3STAUG)*.

### 3. On GP device:

The source GP device must transmit a command - this will result from a user action, such as flipping a switch on the node. Any command can be transmitted, as the 'auto-commissioning' bit must always be set in commands generated on the GP device. In the case of an 'energy harvesting' GP device (and depending on the application), this command may be repeatedly transmitted for as long as the node has energy.

### 4. On proxy nodes:

The proxy nodes within radio range of the source GP device receive the transmitted command. On each of these proxy nodes, the GP stub passes the received command in a ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event up to the GP cluster. First the cluster determines whether it has already received and processed the command (from a previous GP device or proxy node transmission) - this 'de-duplication' stage is described in [Section 1.8.1](#). Provided that the command is not a duplicate:

- a) If the local node is also a sink (a combo node), the GP cluster checks the local sink table to determine whether there is an entry for the GP device that originated the command. If this is the case, it updates the entry, otherwise it creates a new entry (if a free entry exists).
- b) If the local node is a proxy only (a proxy node), the GP cluster checks the local proxy table to determine whether there is an entry for the GP device that originated the command. If this is the case, it will update the entry, otherwise it will create a new entry (if a free entry exists). This update/creation is done once a Pairing command has been received from the sink node (see Step 6a).
- c) The cluster initiates a broadcast of a 'commissioning notification' message in order to forward the command to other GP-enabled nodes in the network.

**5. On sink node:**

The sink node that initiated the commissioning should receive a commissioning notification message containing the source GP device command from a proxy node. The ZigBee PRO stack passes this command to the GP cluster by means of a ZPS\_EVENT\_APS\_DATA\_INDICATION event. The same notification message may be received from more than one proxy node but the GP cluster applies the de-duplication process, described in [Section 1.8.1](#), to discard duplicate commands. Provided that the command is not a duplicate:

- a) The GP cluster generates an E\_GP\_COMMISSION\_DATA\_INDICATION event for the application.
- b) The application must search for the received GP Command ID in the Default Translation Table. If an entry is found containing this Command ID then the application must add an entry for the GP device (referring to the default entry in which the Command ID was found) to the Translation Table in RAM - refer to [Section 1.8.3](#) for example code. It must also set the event status to E\_ZCL\_SUCCESS. Otherwise, it must set the event status to E\_ZCL\_FAIL.
- c) The GP cluster adds an entry to the local sink table to pair the source GP device and the sink node (irrespective of the event status set by the application).
- d) If the event status has been set to E\_ZCL\_SUCCESS by the application, the GP cluster adds the sink node to a group with an identifier derived from the source identifier.
- e) The GP cluster broadcasts Device Announce and Pairing commands to the other sink and proxy nodes in the network. On sending the Pairing command, an E\_GP\_SINK\_TABLE\_ENTRY\_ADDED event is generated on the sink node.
- f) The GP cluster broadcasts a Proxy Commissioning Mode command with the action E\_GP\_PROXY\_COMMISSION\_EXIT specified, in order to request the proxy nodes to exit commissioning mode.

**6. On proxy nodes:**

On receiving the Pairing and Proxy Commissioning Mode commands, the proxy nodes perform the following actions:

- a) The Pairing command prompts a proxy node to update or create the relevant proxy table entry (see Step 4b).
- b) The Proxy Commissioning Mode command causes the GP cluster on a proxy node to generate the event E\_GP\_COMMISSION\_MODE\_EXIT for the application, but the GP cluster will automatically exit remote commissioning mode without the intervention of the application. A proxy node will leave remote commissioning mode when an exit condition has been met which was configured in the attribute `b8ZgpsCommissioningExitMode` (see [Section 1.3](#)) on the sink node that initiated the commissioning (these exit conditions were communicated to the proxy node in the original Proxy Commissioning Mode command).

The above stages (1 to 6) are indicated by the red numerals in [Figure 4](#) below, which illustrates Green Power commissioning for a network with two proxy nodes that can be reached directly from the source GP device.

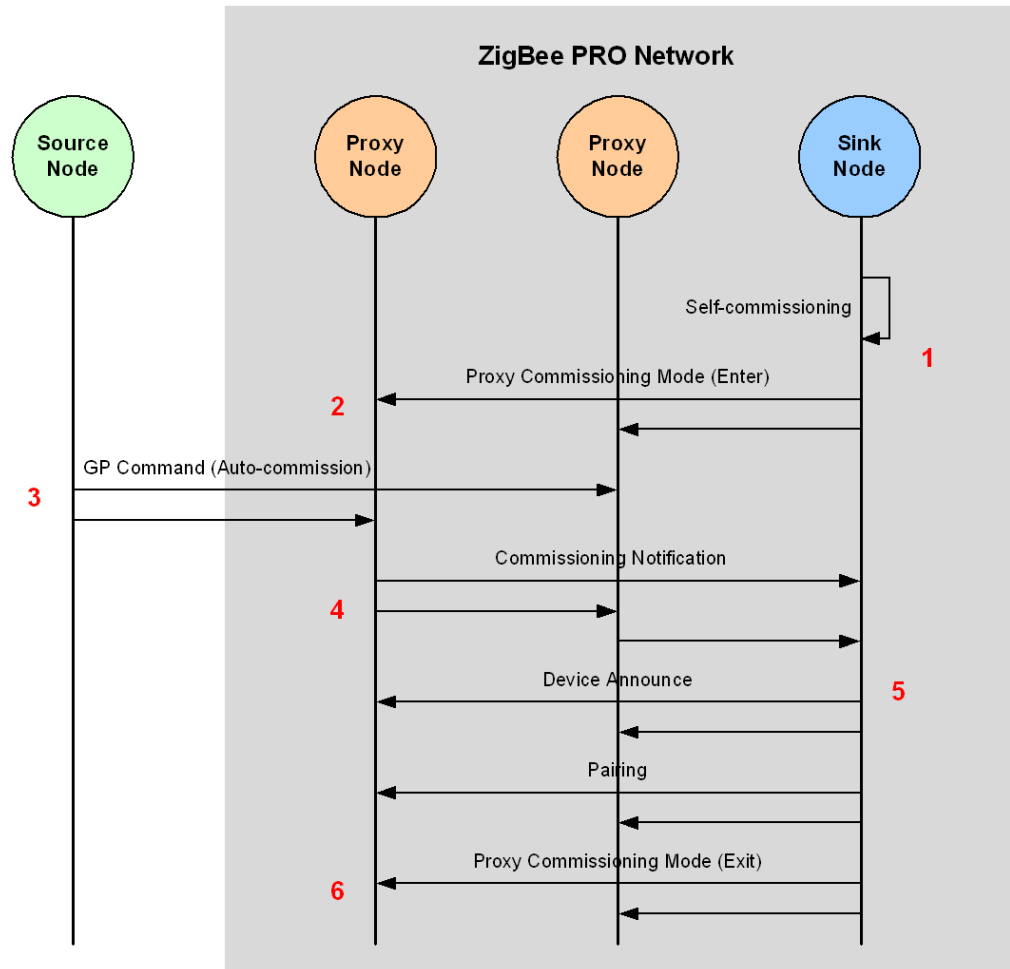


Figure 4: Example of Green Power Auto-Commissioning Mode

## 1.6.2 GP Device in Uni-directional Commissioning Mode

When in uni-directional commissioning mode, the source GP device is only able to transmit (and not receive). Commissioning of the node into a ZigBee network is requested by the GP device transmitting a GP Commissioning command. The channel number used by the GP device must match the channel number used by the ZigBee network (the method used to determine this channel is not prescribed by ZigBee and is application-specific).



**Note 1:** The commissioning process detailed in this section assumes that the sink node is out-of-range of the source GP device and therefore a proxy node is required to relay messages.

The commissioning process for this case is detailed below and is illustrated in [Figure 6](#). The first two steps of the process are identical to Steps 1 and 2 in [Section 1.6.1](#).

1. **On sink node:** As described in Step 1 in [Section 1.6.1](#).
2. **On proxy nodes:** As described in Step 2 in [Section 1.6.1](#).
3. **On source GP device:**

The source GP device must transmit a GP Commissioning command (E\_GP\_COMMISSIONING) - this will result from a user action, such as flipping a switch on the node. In the case of an 'energy harvesting' GP device (and depending on the application), this command may be repeatedly transmitted for as long as the node has energy.

4. **On proxy nodes:**

The proxy nodes within radio range of the source GP device receive the GP Commissioning command. On each of these proxy nodes, the GP stub passes the received command in a ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event up to the GP cluster. First the cluster determines whether it has already received and processed the command (from a previous GP device or proxy node transmission) - this 'de-duplication' stage is described in [Section 1.8.1](#). Provided that the command is not a duplicate:

- a) If the local node is also a sink (a combo node), the GP cluster checks the local sink table to determine whether there is an entry for the GP device that originated the command. If this is the case, it updates the entry, otherwise it creates a new entry (if a free entry exists).
- b) If the local node is a proxy only (a proxy node), the GP cluster checks the local proxy table to determine whether there is an entry for the GP device that originated the command. If this is the case, it will update the entry, otherwise it will create a new entry (if a free entry exists). This update/creation is done once a Pairing command has been received from the sink node (see Step 6a).
- c) The cluster initiates a broadcast of a 'commissioning notification' message in order to forward the command to other GP-enabled nodes in the network.

## **5. On sink node:**

The sink node that initiated the commissioning should receive a commissioning notification message containing the source GP device command from a proxy node. The ZigBee PRO stack passes this command to the GP cluster by means of a `ZPS_EVENT_APS_DATA_INDICATION` event. The same notification message may be received from more than one proxy node but the GP cluster applies the de-duplication process, described in [Section 1.8.1](#), to discard duplicate commands. Provided that the command is not a duplicate:

- a) The GP cluster generates an `E_GP_COMMISSION_DATA_INDICATION` event for the application.
- b) The application must search for the received GP Device ID (identifying the source GP device type) in the Default Translation Table. If an entry is found containing this Device ID then the application must add an entry for the GP device (referring to the default entry in which the Device ID was found) to the Translation Table in RAM - refer to [Section 1.8.3](#) for example code. It must also set the event status to `E_ZCL_SUCCESS`. Otherwise, it must set the event status to `E_ZCL_FAIL`.
- c) The GP cluster adds an entry to the local sink table to pair the source GP device and the sink node (irrespective of the event status set by the application).
- d) If the event status has been set to `E_ZCL_SUCCESS` by the application, the GP cluster adds the sink node to a group (by calling the ZigBee PRO Stack function `ZPS_eAplZdoGroupEndpointAdd()`) with a group ID derived from the GP source address of the GP device or a pre-commissioned group ID.
- e) The GP cluster broadcasts Device Announce and Pairing commands to the other sink and proxy nodes in the network. On sending the Pairing command, an `E_GP_SINK_TABLE_ENTRY_ADDED` event is generated on the sink node.
- f) The GP cluster broadcasts a Proxy Commissioning Mode command with the action `E_GP_PROXY_COMMISSION_EXIT` specified, in order to request the proxy nodes to exit commissioning mode.
- g) The sink node switches to operational mode according to the 'exit mode' condition which has been configured in the attribute `b8ZgpsCommissioningExitMode` (see [Section 1.3](#)). This causes the GP cluster on a sink node to generate the event `E_GP_COMMISSION_MODE_EXIT` for the application.

## 6. On proxy nodes:

On receiving the Pairing and Proxy Commissioning Mode commands, the proxy nodes perform the following actions:

- a) The Pairing command prompts a proxy node to update or create the relevant proxy table entry (see Step 4b).
- b) The Proxy Commissioning Mode command causes the GP cluster on a proxy node to generate the event `E_GP_COMMISSION_MODE_EXIT` for the application, but the GP cluster will automatically exit remote commissioning mode without the intervention of the application. A proxy node will leave remote commissioning mode when an exit condition has been met which was configured in the attribute `b8ZgpsCommissioningExitMode` (see [Section 1.3](#)) on the sink node that initiated the commissioning (these exit conditions were communicated to the proxy node in the original Proxy Commissioning Mode command).

The above stages (1 to 6) are indicated by the red numerals in [Figure 6](#) below, which illustrates Green Power commissioning for a network with two proxy nodes that can be reached directly from the source GP device.

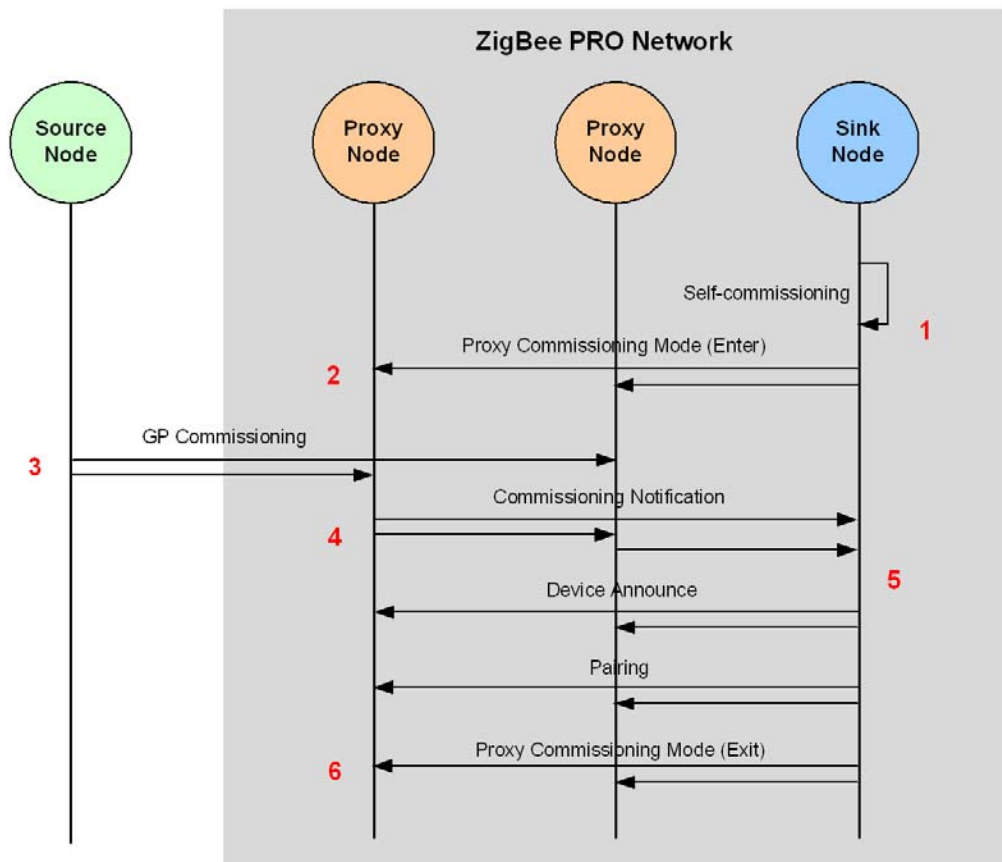


Figure 5: Example of Green Power Uni-directional Commissioning Mode

### 1.6.3 GP Device in Bi-directional Commissioning Mode

When in bi-directional commissioning mode, the source GP device is able to both transmit and receive. In this case, the receive functionality of the GP device is restricted to receiving certain configuration parameters, such as a channel number and security key. The channel number used by the GP device during normal operation must be the channel number used by the ZigBee network, and this number is requested by the GP device as part of the commissioning process.



**Note 1:** The commissioning process detailed in this section assumes that the sink node is out-of-range of the source GP device and therefore a proxy node is required to relay messages.

The commissioning process for this case is detailed below and is illustrated in [Figure 6](#). The first two steps of the process are identical to Steps 1 and 2 in [Section 1.6.1](#).

1. **On sink node:** As described in Step 1 in [Section 1.6.1](#).
2. **On proxy nodes:** As described in Step 2 in [Section 1.6.1](#).
3. **On source GP device:**

The source GP device must transmit a GP Channel Request command (E\_GP\_CHANNEL\_REQUEST) to request the operational channel of the ZigBee PRO network - this will result from a user action, such as flipping a switch on the node. Since the GP device does not yet know this channel, it must send the request in all supported channels (in turn), with the Receive Capability (RxAfterTx) enabled. The request must indicate the channel in which the GP device will expect a response. Following the transmission of this request, the GP device must remain in receive mode for as long as its energy budget allows.

In response, the GP device will expect to (eventually) receive a Channel Configuration command containing the operational channel number of the ZigBee PRO network - see Step 7. The GP device should periodically send the Channel Request command until the Channel Configuration command is received. The period between consecutive transmissions of the request should be greater than one second and less than 5 seconds.



**4. On proxy nodes:**

The proxy nodes within radio range of the source GP device receive a transmitted Channel Request command in the operational channel. On each of these proxy nodes, the GP stub passes the received command in a ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event up to the GP cluster.

- a) The GP cluster will check whether the proxy table is full. If there is no free proxy table entry then it will discard the channel request (and not respond). If there is a free proxy table entry then the GP cluster will generate an E\_GP\_RECEIVED\_CHANNEL\_REQUEST event for the application.
- b) The application must now decide whether it is able to respond to the request, which will require it to temporarily switch (for 5 seconds) from the operational channel of the network to the response channel specified in the request. The application must set the value of `bIsActAsTempMaster` to TRUE if it is able to switch channel or FALSE if it must remain on the operational channel. If the application returns FALSE, the cluster will not process the Channel Request and will not broadcast a Commissioning Notification command (see below).
- c) The GP cluster will broadcast a Commissioning Notification message into the network (in the operational channel). The message uses the proxy node's own source address and sequence number.

**5. On sink node:**

The sink node that initiated the commissioning should receive a Commissioning Notification message containing the source GP device command from a proxy node. The ZigBee PRO stack passes this command to the GP cluster by means of a ZPS\_EVENT\_APS\_DATA\_INDICATION event. The same notification message may be received from more than one proxy node but the GP cluster applies the de-duplication process, described in [Section 1.8.1](#), to discard duplicate commands.

Provided that the command is not a duplicate, the sink node prepares a response containing a GP Channel Configuration command in its payload. This command contains the operational channel number of the network. The sink node elects the relevant proxy node to act as the 'temporary master' for communication with the GP device and includes the 16-bit network address of this proxy node in the response payload. This response is then broadcast within the network.

**6. On proxy nodes:**

On receipt of the response containing the GP Channel Configuration command from the sink node, a proxy node checks whether its network address matches the address of the 'temporary master' specified in the command.

- If there is no match, the proxy node discards the command and removes any previous pending commands for this GP device from its GP transmit queue.
- If there is a match, the proxy node adds the Channel Configuration command (in a GP frame) to its GP transmit queue for transmission to the GP device. It then switches to the response channel (specified by the GP device), with a 5-second timeout, and enters receive mode.

In receive mode, the proxy node first waits for another Channel Request from the GP device. This is necessary to ensure that the GP device is in receive



mode when the Channel Configuration command is sent to it (since the GP device may have a low energy-budget, it may not still be in receive mode following the initial Channel Request). Once this second Channel Request has been received, the Channel Configuration command is transmitted to the GP device (in the response channel). If no Channel Request is received within the 5-second timeout, the Channel Configuration command is removed from the transmit queue. After a successful transmission or at the end of the timeout, the proxy node returns to the operational channel (still in commissioning mode).

**7. On source GP device:**

After receiving the Channel Configuration command (containing the operational channel number of the network), the GP device stores the channel information and generates a GP Commissioning command. This and all future GP frames are transmitted to the proxy node in the operational channel.

In response, the GP device will expect to (eventually) receive a Commissioning Reply command - see Step 10. The GP device should periodically send the Commissioning command until the Commissioning Reply command is received.

**8. On proxy nodes:**

The proxy nodes within radio range of the source GP device receive the GP Commissioning command. On each of these proxy nodes, the GP stub passes the received command in a ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event up to the GP cluster. First the cluster determines whether it has already received and processed the command (from a previous transmission) - this 'de-duplication' stage is described in [Section 1.8.1](#). Provided that the command is not a duplicate:

- a) If the local node is also a sink (a combo node), the GP cluster checks the local sink table to determine whether there is an entry for the GP device that originated the command. If this is the case, it updates the entry, otherwise it creates a new entry (if a free entry exists).
- b) If the local node is a proxy only (a proxy node), the GP cluster checks the local proxy table to determine whether there is an entry for the GP device that originated the command. If this is the case, it will update the entry, otherwise it will create a new entry (if a free entry exists). This update/creation is done once a Proxy Commissioning Mode command has been received from the sink node (see Step 14a).
- c) The cluster initiates a broadcast of a 'commissioning notification' message in order to forward the command to other GP-enabled nodes in the network.

**9. On sink node:**

The sink node that initiated the commissioning should receive a commissioning notification message containing the source GP device command from a proxy node. The ZigBee PRO stack passes this command to the GP cluster by means of a ZPS\_EVENT\_APS\_DATA\_INDICATION event. The same notification message may be received from more than one proxy node but the GP cluster applies the de-duplication process, described in [Section 1.8.1](#), to discard duplicate commands. Provided that the command is not a duplicate:

- a) The GP cluster generates an E\_GP\_COMMISSION\_DATA\_INDICATION event for the application.

- b) The application must search for the received GP Device ID (identifying the GP source device type) in the Default Translation Table. If entries are found containing this Device ID then the application must add corresponding entries for the GP device (referring to the Default Translation Table entries in which the Device ID was found) to the Translation Table in RAM (refer to [Section 1.8.3](#) for example code), and set the event status to E\_ZCL\_SUCCESS. Otherwise, it must set the event status to E\_ZCL\_FAIL.
- c) If the event status has been set to E\_ZCL\_SUCCESS by the application, the GP cluster generates a response command with a GP Commissioning Reply in the payload, otherwise the commissioning notification is dropped. The sink node elects the relevant proxy node to act as the 'temporary master' for communication with the GP device and includes the 16-bit network address of this proxy node in the response payload. This response is then broadcast within the network.

#### **10. On proxy nodes:**

On receipt of the response containing the GP Commissioning Reply command from the sink node, a proxy node checks whether its network address matches the address of the 'temporary master' specified in the command.

- If there is no match, the proxy node discards the command and removes any previous pending commands for this GP device from its GP transmit queue.
- If there is a match, the proxy node adds the Commissioning Reply command (in a GP frame) to its GP transmit queue for transmission to the GP device and enters receive mode.

In receive mode, the proxy node first waits for another GP Commissioning command transmitted from the source GP device in the operational channel. This is necessary to ensure that the GP device is in receive mode when the GP Commissioning Reply command is sent to it (since the GP device may have a low energy-budget, it may not still be in receive mode following the initial Commissioning command). Once this second Commissioning command has been received, the Commissioning Reply command is transmitted to the GP device (in the operational channel).

#### **11. On source GP device:**

After receiving the Commissioning Reply command, the GP device checks whether the GP source address or IEEE address within the command matches its own and, if this is the case, stores the supplied commissioning parameters (e.g. channel, PANID, key) in non-volatile memory. It then transmits a GP Success command.

#### **12. On proxy nodes:**

The proxy nodes within radio range of the source GP device receive the GP Success command. The GP cluster initiates a broadcast of a 'commissioning notification' message in order to forward the command to other GP-enabled nodes in the network.

On those proxy nodes that are also sinks, on receiving the GP Success command an E\_GP\_SINK\_TABLE\_ENTRY\_ADDED event is generated for the application to indicate that a local sink table entry has been created or modified (see Step 8a).

### 13. On sink node:

The sink node that initiated the commissioning should receive a commissioning notification message containing the source GP device command from a proxy node. The ZigBee PRO stack passes this command to the GP cluster by means of a ZPS\_EVENT\_APS\_DATA\_INDICATION event. The same notification message may be received from more than one proxy node but the GP cluster applies the de-duplication process, described in [Section 1.8.1](#), to discard duplicate commands. Provided that the command is not a duplicate:

- a) The GP cluster generates an E\_GP\_SUCCESS\_CMD\_RCVD event for the application.
- b) The GP cluster adds the sink node to a group (by calling the ZigBee PRO Stack function **ZPS\_eAplZdoGroupEndpointAdd()**) with a group ID derived from the GP source address of the GP device or a pre-commissioned group ID. An E\_GP\_SINK\_TABLE\_ENTRY\_ADDED event is generated to notify the application of this addition.
- c) The GP cluster broadcasts Device Announce and Pairing commands to the other sink and proxy nodes in the network.
- d) The GP cluster broadcasts a Proxy Commissioning Mode command with the action E\_GP\_PROXY\_COMMISSION\_EXIT specified, in order to request the proxy nodes to exit commissioning mode.
- e) The sink node switches to operational mode according to the 'exit mode' condition which has been configured in the attribute `b8ZgpsCommissioningExitMode` (see [Section 1.3](#)). This causes the GP cluster on a sink node to generate the event E\_GP\_COMMISSION\_MODE\_EXIT for the application.

### 14. On proxy nodes:

On receiving the Proxy Commissioning Mode commands, the proxy nodes performs the following actions:

- a) The Proxy Commissioning Mode command prompts a proxy node to update or create the relevant proxy table entry (see Step 8b).
- b) The Proxy Commissioning Mode command causes the GP cluster on a proxy node to generate the event E\_GP\_COMMISSION\_MODE\_EXIT for the application, but the GP cluster will automatically exit remote commissioning mode without the intervention of the application. A proxy node will leave remote commissioning mode when an exit condition has been met which was configured in the attribute `b8ZgpsCommissioningExitMode` (see [Section 1.3](#)) on the sink node that initiated the commissioning (these exit conditions were communicated to the proxy node in the original Proxy Commissioning Mode command).

The above stages (1 to 14) are indicated by the red numerals in [Figure 6](#) below, which illustrates Green Power commissioning for a network with two proxy nodes that can be reached directly from the source GP device.

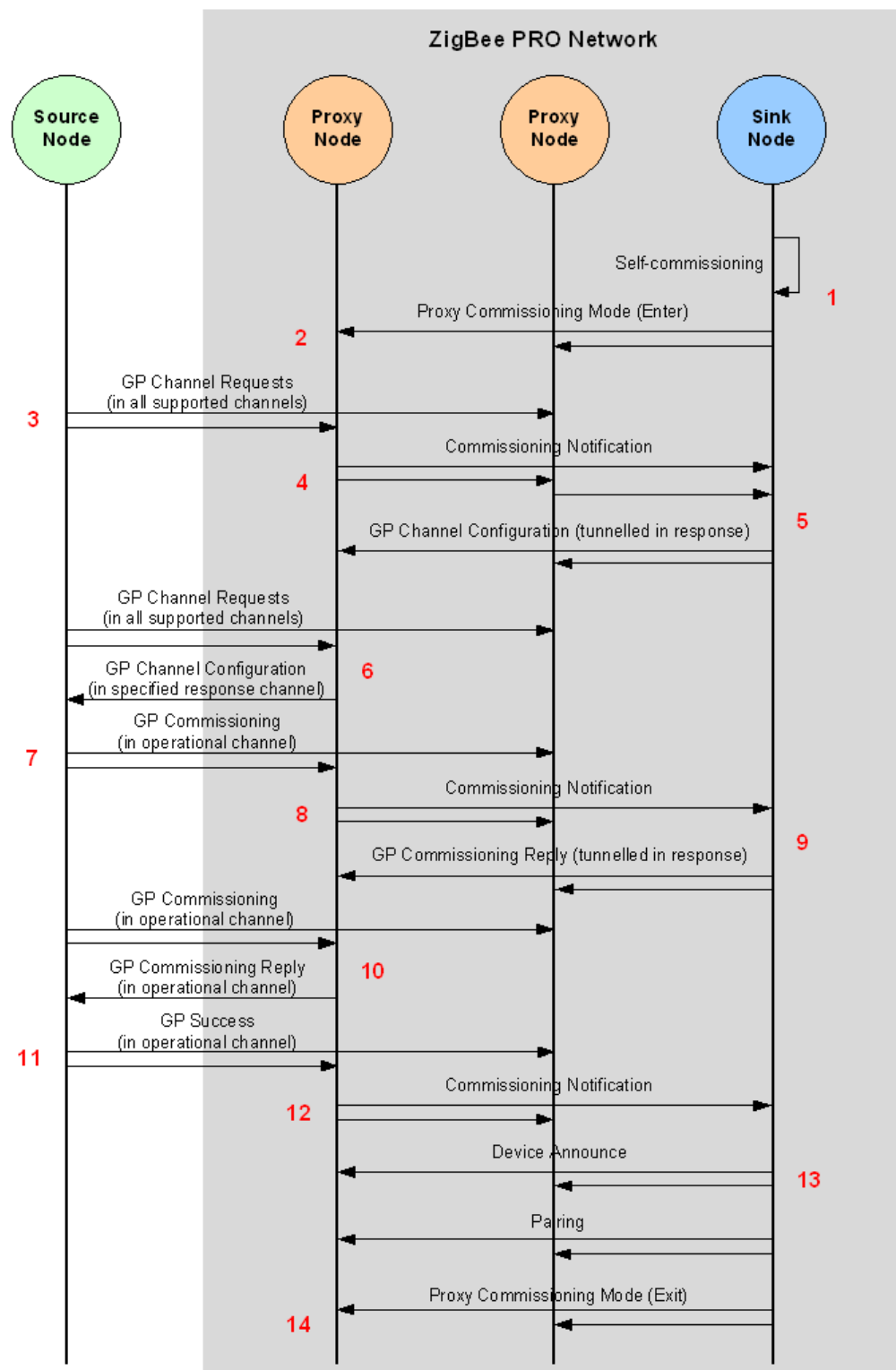


Figure 6: Example of Green Power Bi-directional Commissioning Mode

## 1.6.4 Decommissioning

This section describes how a GP device can be decommissioned from operating with a ZigBee PRO network. A GP device can be decommissioned while in commissioning mode (see Steps 1 and 2 in [Section 1.6.1](#)) or, provided packets are secured, in operational mode.

### 1. On source GP device:

The GP device must transmit a Decommissioning command (E\_GP\_DECOMMISSIONING) - this will result from a user action, such as flipping a switch on the node. In the case of an 'energy harvesting' GP device (and depending on the application), this command may be repeatedly transmitted for as long as the node has energy.

### 2. On proxy nodes:

The proxy nodes within radio range of the source GP device receive the transmitted command. On each of these proxy nodes, the GP stub passes the received command in a ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event up to the GP cluster. First the cluster determines whether it has already received and processed the command (from a previous GP device or proxy node transmission) - this 'de-duplication' stage is described in [Section 1.8.1](#). Provided that the command is not a duplicate, the cluster initiates a broadcast of a 'GP notification' message (if in operational mode) or a 'GP commissioning notification' message (if in commissioning mode), in order to forward the command to other GP-enabled nodes in the network.

### 3. On sink node:

The sink node that initiated the commissioning should receive a commissioning notification message containing the source GP device command from a proxy node. The ZigBee PRO stack passes this command to the GP cluster by means of a ZPS\_EVENT\_APS\_DATA\_INDICATION event. The same notification message may be received from more than one proxy node but the GP cluster applies the de-duplication process, described in [Section 1.8.1](#), to discard duplicate commands. Provided that the command is not a duplicate:

- a) The GP cluster first searches for a sink table entry for the GP device. If none is found, the command is discarded (and the steps below are omitted).
- b) The GP cluster then checks that the security level and key type specified in the received command match those contained in the sink table entry.
- c) If the security checks are satisfied, the GP cluster removes the sink table entry. If the GP device has an associated group address, this is also deleted from the local group address table.
- d) If the security checks are satisfied, the GP cluster also generates an E\_GP\_DECOMM\_CMD\_RCVD event for the application.
- e) The application must now delete the Translation Table entries (in RAM) for the GP device.
- f) If the removed sink table entry included a group address, the GP cluster broadcasts a 'pairing configuration' command with the 'RemoveGPD' bit set. The transmitted command instructs the receiving nodes that are in the relevant group to remove the GP device from their sink tables.

- g) If the decommissioning was performed in commissioning mode, the sink node switches to operational mode according to the 'exit mode' condition configured in the attribute `b8ZgpsCommissioningExitMode` (see [Section 1.3](#)). This causes the GP cluster on a sink node to generate the event `E_GP_COMMISSION_MODE_EXIT` for the application.

---

## 1.7 Operation

Once nodes have been commissioned for Green Power (as described in [Section 1.6](#)), they will operate as outlined below (and illustrated in [Figure 7](#)):

**1. On source GP device:**

The source GP device sends a command in a Green Power frame to the network (as the result of a user action, such as pressing a button on the node).

**2. On proxy nodes:**

The proxy nodes within radio range receive the GP frame, which is passed to the GP cluster in a ZCL event.



**Note:** The GP frame has exactly the same format as it had in commissioning mode (with the 'auto-commissioning' bit set), but the proxy node is now in operational mode and so treats the frame as an operational command.

If the local node is also a sink (as well as a proxy), the GP frame will be processed as described for a sink node in Step 5.

**3. On proxy nodes:**

The GP command is 'tunnelled' in a ZigBee frame and groupcast within the network.



**Note:** All proxy nodes forward the GP command in identical ZigBee frames with the same source address and APS sequence number, both derived from the GP frame. This allows ZigBee to identify duplicate broadcasts and reduce flooding within the network.

**4. On proxy nodes:**

The proxy nodes receive the forwarded GP command from each other, recognise it as a duplicate (see [Section 1.8.1](#)) and discard it.

## 5. On sink node(s):

A target sink node receives the tunnelled GP command from the proxy nodes (all except one command will be identified as duplicates and discarded - see [Section 1.8.1](#)). The GP cluster checks the local sink and translation tables to determine whether the command is for the local node. If it finds relevant entries in both tables, it generates an E\_GP\_ZGPD\_COMMAND\_RCVD event for the application and translates the GP command. It then directs the command to the relevant cluster command handler. The application then takes the appropriate action (such as switching on a lamp).



**Note:** If the sink node receives the GP command directly from the source GP device (without being tunnelled) and it is also a proxy node, it must tunnel the command into the network in case other sink nodes also require the command.

The above stages (1 to 5) are indicated by the red numerals in [Figure 7](#) below, which illustrates Green Power operation for a network with two proxy nodes that can be reached directly from the source GP device.

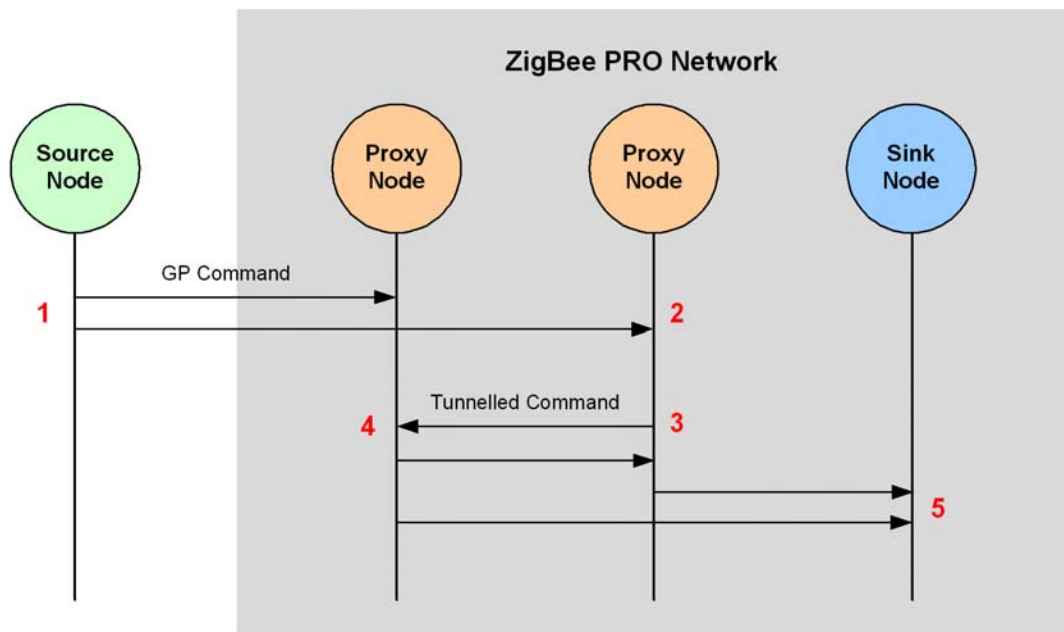


Figure 7: Example of Green Power Operation



---

## 1.8 Useful Commissioning and Operational Topics

This section describes the following topics which are referenced elsewhere in the chapter:

- De-duplication - see [Section 1.8.1](#)
- Pairing a source GP device with multiple sink nodes - see [Section 1.8.2](#)
- Creating a translation table - see [Section 1.8.3](#)
- Persistent data management - see [Section 1.8.4](#)

---

### 1.8.1 De-duplication

A proxy or sink node can receive the same GP command multiple times due to consecutive re-transmissions by the source GP device and/or tunnelled re-broadcasts by proxy nodes. Duplicate commands must be identified and discarded.

The Green Power cluster therefore implements a de-duplication process on received GP commands. These commands can be received by the GP cluster via two stack routes (refer to [Figure 2](#)):

- via the GP stub, for a GP command received directly from the GP device
- via the ZigBee PRO stack layers, for a tunnelled command in a ZigBee frame

The cluster maintains a 'duplicate table', containing an entry for each GP command received, irrespective of its route. A command is identified by means of its source address and an 8-bit random sequence number generated by the GP device. Since the probability of a new command having the same sequence number as an earlier command (from the same GP device) is not insignificant, the CRC value of a GP command frame is also stored to help identify the command. Thus, when a command is received, the cluster compares all the above identifiers with those of the commands in the duplicate table:

- If the new command is a duplicate of a command in the table, it is discarded
- If the new command is not a duplicate, it is added to the table

Since it is possible that the GP device will eventually generate a valid new command with identical identifiers to an earlier command, an 'ageing time' or timeout is applied to the entries of the duplicate table - by default, this is 2 seconds. After remaining in the table for this time, a command is automatically removed from the table.

The duplicate table size is 5, by default. However, the default values for the table size and ageing time can be over-ridden in the file **zcl\_options.h** (see [Section 1.14](#)).



## 1.8.2 Pairing a GP Device with Multiple Sink Nodes

A source GP device can be paired with multiple sink nodes - for example, a single switch that controls a set of five lamps. Some of the sink nodes could also act as proxy nodes.

All of the sink nodes can be paired with the GP device in a single commissioning session (described in [Section 1.6](#)), as follows:

1. One of the sink nodes must initiate the commissioning session using the function **eGP\_ProxyCommissioningMode()**. This will put all of the other sink/proxy nodes into remote commissioning mode.
2. The relevant sink nodes must then be put into pairing mode. This should be done on the sink nodes (except the initial sink node) by calling the function **eGP\_ProxyCommissioningMode()** as the result of a user action - if this function is called while the host node is in remote commissioning mode then the node will enter pairing mode (and no Proxy Commissioning Mode command will be broadcast).
3. The GP device must then transmit a command initiated by a user action. This will result in commissioning notifications propagating through the network.
4. Once a commissioning notification (containing the GP device command) has been received by a sink node, this node will update its translation and sink tables to establish a pairing with the GP device.



**Note:** Pairing a source GP device with multiple sink nodes is not possible when the GP device is operating in bi-directional commissioning mode (but is possible in auto-commissioning and uni-directional commissioning modes).

## 1.8.3 Creating a Translation Table

A sink node must have a translation table, which is used to translate GP commands from the source GP device into standard ZigBee commands on the sink node. The table contains a translation for every possible command from each GP device with which the sink node is paired. Translation Tables are fully introduced in [Section 1.4.1.1](#).

A translation table is established in RAM on a sink node during the commissioning phase of the node and its entries refer to a pre-defined 'Default Translation Table', which is stored by the application (for example, in Flash memory).

---

### 1.8.3.1 Defining a Translation Table in RAM

The application on the sink node must define a Translation Table in RAM as the following array:

```
tsGP_TranslationTableEntry  
asTranslationTable[GP_NUMBER_OF_TRANSLATION_TABLE_ENTRIES];
```

where each array element is a `tsGP_TranslationTableEntry` structure for one GP device with which the local sink node will be paired (this structure is described in [Section 1.12.11](#)):

```
struct tsGP_TranslationTableEntry  
{  
    zbmap8                        b8Options;  
    tuGP_ZgpdDeviceAddr          uZgpdDeviceAddr;  
    uint8                        u8NoOfCmdInfo;  
    tsGP_GpToZclCommandInfo      *psGpToZclCmdInfo;  
};
```

Once populated (see below), this structure contains the address of the GP device and points to the 'Default Translation Table' entries for the relevant GP device type (identified by its Device ID) and GP commands.

The above array declaration reserves RAM space for the Translation Table and the array will be populated by the application during the commissioning process. The value of `GP_NUMBER_OF_TRANSLATION_TABLE_ENTRIES` is defined in the compile-time options (see [Section 1.14](#)).

A pointer (memory address) to the above (empty) Translation Table must be provided in the endpoint registration function **eGP\_RegisterComboBasicEndPoint()** during initialisation (see [Section 1.5](#)).

---

### 1.8.3.2 Defining a Default Translation Table

As described in [Section 1.4.1.1](#), the entries of the above Translation Table in RAM refer to the 'Default Translation Table' entries that are pre-defined as constants and held in Flash memory. In the Default Translation Table, each entry contains a single command translation for a GP source device type (identified by its Device ID). The table contains entries for all the commands supported by all the device types with which the local sink node could potentially be paired.

The Default Translation Table must be defined as a **const** in the application. Example Default Translation Table entries are provided below.

```
const tsGP_GpToZclCommandInfo asGpToZclCmdInfo[] = {  
#ifdef GP_ON_OFF_SWITCH  
    {0x02, 0x20, 0x00, 0x01, 0x0006, 0x00, {0}}, /* On/Off Switch, GP  
    Off Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload Length, NULL data */  
    {0x02, 0x21, 0x01, 0x01, 0x0006, 0x00, {0}}, /* On/Off Switch, GP  
    On Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload Length, NULL data */
```

```

        {0x02, 0x22, 0x02, 0x01, 0x0006, 0x00, {0}}, /* On/Off Switch, GP
Toggle Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload Length, NULL data */
    #endif

    #ifdef GP_LEVEL_CONTROL_SWITCH
        {0x03, 0x35, 0x05, 0x01, 0x0008, 0x02, {0x00, 0x64}}, /* On/Off L
Switch, GP Move Up with On/Off Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload
Length, NULL data */
        {0x03, 0x36, 0x05, 0x01, 0x0008, 0x02, {0x01, 0x64}}, /* On/Off L
Switch, GP Move Down with On/Off Cmd Id, EP, Cluster ID, ZB Payload Length,
NULL data */
    #endif
};

```

### 1.8.3.3 Populating the Translation Table in RAM

During the commissioning process (see [Section 1.6](#)), on receiving the event `E_GP_COMMISSION_DATA_INDICATION`, the application on a sink node must populate the translation table. It must search for the received GP Device ID/Command ID combination in the translation table in RAM. If an entry containing this Device ID/Command ID combination is not found then the application must add an entry (`tsGP_TranslationTableEntry`) for it to the Translation Table in RAM. This entry contains a pointer (`psGpToZclCmdInfo`) to a 'Default Translation Table' entry (`tsGP_GpToZclCommandInfo`) for the command. If an entry for this command is not present in the Default Translation Table, the application must add it. Finally, the application must populate the pointer (`psGpToZclCmdInfo`) in the translation table entry and also update the number of commands mapped for the particular device (`u8NoOfCmdInfo`).

This is illustrated in the following example code.

```

tsGP_TranslationTableEntry
asGpTranslationTable[GP_NUMBER_OF_TRANSLATION_TABLE_ENTRIES];
tsGP_GpToZclCommandInfo asGpToZclLevelControlCmdInfo[] = {
    /* On/Off Switch, GP Off Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload
Length, NULL data */
    {E_GP_ZGP_LEVEL_CONTROL_SWITCH, E_GP_OFF, 0x00, 1,
GP_GENERAL_CLUSTER_ID_ONOFF, 0x00, {0}},
    /* On/Off Switch, GP On Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload Length, NULL
data */
    {E_GP_ZGP_LEVEL_CONTROL_SWITCH, E_GP_ON, 0x01, 1,
GP_GENERAL_CLUSTER_ID_ONOFF, 0x00, {0}},
    /* On/Off Switch, GP Toggle Cmd Id, ZB Cmd Id, EP, Cluster ID, ZB Payload
Length, NULL data */
    {E_GP_ZGP_LEVEL_CONTROL_SWITCH, E_GP_TOGGLE, 0x02, 1,
GP_GENERAL_CLUSTER_ID_ONOFF, 0x00, {0}},
    /* Level control switch , Level control stop, ZB Cmd Id, EP, Cluster ID, ZB Payload
Length, NULL data */
    {E_GP_ZGP_LEVEL_CONTROL_SWITCH, E_GP_LEVEL_CONTROL_STOP,
E_CLD_LEVELCONTROL_CMD_STOP, 1, GP_GENERAL_CLUSTER_ID_LEVEL_CONTROL, 0x00, {0}},
    /* Level control switch, Move Up, ZB Cmd Id, EP, Cluster ID, ZB Payload Length, NULL
data */

```

## Chapter 1

### Green Power Cluster

```
{E_GP_ZGP_LEVEL_CONTROL_SWITCH, E_GP_MOVE_UP_WITH_ON_OFF,
E_CLD_LEVELCONTROL_CMD_MOVE_WITH_ON_OFF, 1, GP_GENERAL_CLUSTER_ID_LEVEL_CONTROL,
0x02, {0,10}},
/* Level control switch, Move down, ZB Cmd Id, EP, Cluster ID, ZB Payload
Length, NULL data */

{E_GP_ZGP_LEVEL_CONTROL_SWITCH, E_GP_MOVE_DOWN_WITH_ON_OFF,
E_CLD_LEVELCONTROL_CMD_MOVE_WITH_ON_OFF, 1, GP_GENERAL_CLUSTER_ID_LEVEL_CONTROL,
0x02, {1,10}},
};
void vHandleGreenPowerEvent(tsGP_GreenPowerCallBackMessage *psGPMessage)
{
    switch(psGPMessage->eEventType)
    {
        case E_GP_COMMISSION_DATA_INDICATION:
        {
            tsGP_ZgpCommissionIndication *psZgpCommissionIndication;

            psZgpCommissionIndication = psGPMessage-
            >uMessage.psZgpCommissionIndication;

            /* add device to translation table and map commands */
            if( bAppAddTransTableEntries(
                psZgpCommissionIndication->uZgpdDeviceAddr,
                (uint8)(psZgpCommissionIndication->b8AppId)
                ) == TRUE)
            {
                psZgpCommissionIndication->eStatus = E_ZCL_SUCCESS;
            }
            else
            {
                psZgpCommissionIndication->eStatus = E_ZCL_FAIL;
            }

            break;
        }

        /* Handle other events here */
        .....
    }
}

bool bAppAddTransTableEntries(
    tuGP_ZgpdDeviceAddr      uRcvdGPDAddr,
    zbmap8                   b8Options
)
{
    uint8 u8Count = 0;
    tsGP_TranslationTableEntry *psTranslationTableEntry;
```

```

/* get free translation entry( entry with 0x00(uDummydeviceAddr) as src id )*/
psTranslationTableEntry = psApp_GPGetTranslationTable(0, &uDummydeviceAddr);
/* check pointer */
if(psTranslationTableEntry != NULL)
{
    psTranslationTableEntry->b8Options =
        b8Options;
    psTranslationTableEntry->uZgpdDeviceAddr =
        uRcvdGPDAddr;

    psTranslationTableEntry->psGpToZclCmdInfo =
asGpToZclLevelControlCmdInfo;
    psTranslationTableEntry->u8NoOfCmdInfo =
sizeof(asGpToZclLevelControlCmdInfo)/sizeof(tsGP_GpToZclCommandInfo);

    return TRUE;
}
else
{
    return FALSE;
}
}
PRIVATE tsGP_TranslationTableEntry* psApp_GPGetTranslationTable(
    uint8          u8AppId,
    tuGP_ZgpdDeviceAddr *uSrcAddr)
{
    uint8 u8Count;

    for(u8Count = 0; u8Count < GP_NUMBER_OF_TRANSLATION_TABLE_ENTRIES; u8Count++)
    {
        /* if ZGPD Src ID is zero then it is free entry */
        if(bGP_CheckGPDAddressMatch(
            sGP_PDM_Data.asGpTranslationTable[u8Count].b8Options,
            u8AppId,
            &sGP_PDM_Data.asGpTranslationTable[u8Count].uZgpdDeviceAddr,
            uSrcAddr
        ))
        {
            return &(sGP_PDM_Data.asGpTranslationTable[u8Count]);
        }
    }

    return NULL;
}

```

In the above example code, an entry for only one command is added to the Translation Table in RAM during the event. However, the application can add entries for other relevant commands for the GP device, based on the received Command ID. For

example, if the received Command ID is 20 (Off Cmd), the application can also set up entries for the related commands corresponding to Command IDs 21 and 22.



**Note:** A sink node may be paired with two or more source GP devices of the same GP device type (with the same Device ID). In this case, in the Translation Table in RAM, there will be separate entries for these GP devices (distinguished by their addresses), even though these entries are based on common 'Default Translation Table' entries for their device type.

---

### 1.8.4 Persistent Data Management

The Green Power cluster requires attribute data to be preserved in non-volatile memory (e.g. Flash memory) in order to facilitate a recovery of the attribute data (such as a sink table and security key) following a device reboot. **The Flash Management and Non-Volatile Storage Module should be used to perform this data saving and recovery, which is described in the *Connectivity Framework Reference Manual (CONNFWKRM)*.**

When the sink/proxy table on the local node has been changed, the Green Power cluster will generate the event `E_GP_PERSIST_SINK_PROXY_TABLE`, which will contain the data to be saved to non-volatile memory. **The application should perform the data storage using the functions of the Flash Management and Non-Volatile Storage Module.**

The following code fragment illustrates the reservation of memory space for persistent attribute data:

```
typedef struct
{
    tsGP_PersistedData sPersistedGpData;
} tsDevice;
PUBLIC tsDevice s_sDevice;
PUBLIC PDM_tsRecordDescriptor s_GPPDDesc;
```

When a device is restarted, the function **`vGP_RestorePersistedData()`** should be called during application initialisation after the endpoint registration function has been called. If persisted data is available on the device, the *bSetToDefault* parameter in the function should be set to the appropriate bitmap, from the following:

- `E_GP_DEFAULT_ATTRIBUTE_VALUE` to reset the attribute values
- `E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE` to reset the sink/proxy table entries

If no persisted data is available, the *bSetToDefault* parameter should be set to zero in order to reset the Green Power cluster attributes to their default values.

## 1.9 Green Power Events

The Green Power cluster has its own events that are handled through the callback mechanism described in the *ZCL User Guide (ZB3ZCLUG)*. If a device uses the Green Power cluster then GP event handling must be included in the callback function for the GP endpoint, where this callback function is registered through the function **eGP\_RegisterComboBasicMinimumEndPoint()** or **eGP\_RegisterProxyBasicEndPoint()**. The registered callback function will then be invoked whenever a GP event occurs.

For a Green Power event, the `eEventType` field of the `tsZCL_CallBackEvent` structure is set to `E_ZCL_CBET_CLUSTER_CUSTOM`. This event structure also contains an element `sClusterCustomMessage`, which is itself a structure containing a field `pvCustomData`. This field is a pointer to the following `tsGP_GreenPowerCallBackMessage` structure:

```
typedef struct
{
    teGP_GreenPowerCallBackEventType    eEventType;

    union
    {
        tsGP_ZgpsProxySinkTable        *psZgpsProxySinkTable;
        tsGP_ZgpCommissionIndication    *psZgpCommissionIndication;
        ZPS_teStatus                    eAddGroupTableStatus;
        ZPS_teStatus                    eRemoveGroupTableStatus;
        bool_t                           bIsActAsTempMaster;
        tsGP_ZgpTransTableResponseCmdPayload *psZgpTransRspCmdPayload;
        tsGP_ZgpsTranslationTableUpdate *psTransationTableUpdate;
        tsGP_ZgpsPairingConfigCmdRcvd    *psPairingConfigCmdRcvd;
        tsGP_PersistedData                *psPersistedData;
        tsGP_ZgpDecommissionIndication    *psZgpDecommissionIndication;
    }uMessage;

    tsGP_ProxyTableRespCmdPayload        *psZgpProxyTableRespCmdPayload;
    tsGP_ZgpResponseCmdPayload           *psZgpResponseCmdPayload;
    tsGP_ZgpNotificationCmdPayload       *psZgpNotificationCmdPayload;
    tsGP_ZgpCommissioningNotificationCmdPayload *psZgpCommissioningNotificationCmdPayload;
    tsGP_ZgpPairingCmdPayload            *psZgpPairingCmdPayload;
    tsGP_ZgpPairingConfigCmdPayload      *psZgpPairingConfigCmdPayload;
}tsGP_GreenPowerCallBackMessage;
```

The `eEventType` field of the above structure specifies the type of GP event that has been generated - these event types are enumerated in the following `teGP_GreenPowerCallBackEventType` structure:

```
typedef enum PACK
{
    E_GP_COMMISSION_DATA_INDICATION = 0x00,
    E_GP_COMMISSION_MODE_ENTER,
    E_GP_COMMISSION_MODE_EXIT,
    E_GP_CMD_UNSUPPORTED_PAYLOAD_LENGTH,
    E_GP_SINK_PROXY_TABLE_ENTRY_ADDED,
    E_GP_SINK_PROXY_TABLE_FULL,
    E_GP_ZGPD_COMMAND_RCVD,
    E_GP_ZGPD_CMD_RCVD_WO_TRANS_ENTRY,
    E_GP_ADDING_GROUP_TABLE_FAIL,
    E_GP_RECEIVED_CHANNEL_REQUEST,
    E_GP_TRANSLATION_TABLE_RESPONSE_RCVD,
    E_GP_TRANSLATION_TABLE_UPDATE,
    E_GP_SECURITY_LEVEL_MISMATCH,
    E_GP_SECURITY_PROCESSING_FAILED,
    E_GP_REMOVING_GROUP_TABLE_FAIL,
    E_GP_PAIRING_CONFIGURATION_CMD_RCVD,
    E_GP_PERSIST_SINK_PROXY_TABLE,
    E_GP_SUCCESS_CMD_RCVD,
    E_GP_DECOMM_CMD_RCVD,
    E_GP_SHARED_SECURITY_KEY_TYPE_IS_NOT_ENABLED,
    E_GP_SHARED_SECURITY_KEY_IS_NOT_ENABLED,
    E_GP_LINK_KEY_IS_NOT_ENABLED,
    E_GP_ZGPD_SINK_TABLE_RESPONSE_RCVD,
    E_GP_ZGPD_PROXY_TABLE_RESPONSE_RCVD,
    E_GP_NOTIFICATION_RCVD,
    E_GP_COMM_NOTIFICATION_RCVD,
    E_GP_RESPONSE_RCVD,
    E_GP_PAIRING_CMD_RCVD,
    E_GP_PAIRING_CONFIG_CMD_RCVD,
    E_GP_CBET_ENUM_END
}teGP_GreenPowerCallBackEventType;
```

The above events are described below.



## **E\_GP\_COMMISSION\_DATA\_INDICATION**

The E\_GP\_COMMISSION\_DATA\_INDICATION event is generated on a Green Power cluster server on receiving a commissioning command (GP frame with auto-commissioning flag set to '1') directly from a source GP device or via a proxy node, with the server in commissioning mode.

In the `tsGP_GreenPowerCallBackMessage` structure, the field `eEventType` is set to `E_GP_COMMISSION_DATA_INDICATION` and the field `psZgpCommissionIndication` of the union is used with the following structure:

```
typedef struct
{
    tsGP_CommandType          eCmdType;
    tsGP_GreenPowerStatus     eStatus;
    tsGP_GpToZclCommandInfo   *psGpToZclCommandInfo;
    union
    {
        tsGP_ZgpCommissioningNotificationCmdPayload
            sZgpCommissioningNotificationCmdPayload;
        tsGP_ZgpCommissionCmdPayload          sZgpCommissionCmd;
        tsGP_ZgpDataCmdWithAutoCommPayload    sZgpDataCmd;
    } uCommands;
} tsGP_ZgpCommissionIndication;
```

The `eCmdType` field in this event specifies whether the command arrived in a directly received GP frame or a tunnelled GP frame (commissioning notification). Based on this field, the application should access the appropriate union member in `uCommands`, as indicated in the table below.

<b>eCmdType</b>	<b>uCommands</b>
E_GP_COMM_CMD	sZgpCommissionCmd
E_GP_DATA_CMD_AUTO_COMM	sZgpDataCmd
E_GP_COMM_NOTF_CMD	sZgpCommissioningNotificationCmdPayload

On receiving this event, the application should check for the received GP command in the default Translation Table held in Flash memory. If the application finds a default table entry containing this command, it should assign a start address in RAM for a Translation Table entry for the GP device and set `psGpToZclCmdInfo` to point at this memory location.

If the application finds a Default Translation Table entry for the GP device, the field `eStatus` should be set to `E_ZCL_SUCCESS`, otherwise it should be set to `E_ZCL_FAIL`.

The application should populate the translation table as described in [Section 1.8.3](#).

### **E\_GP\_COMMISSION\_MODE\_ENTER**

The E\_GP\_COMMISSION\_MODE\_ENTER event is generated on the Green Power cluster on receiving a Proxy Commissioning Mode command with the 'Enter' action. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_COMMISSION\_MODE\_ENTER.

No action needs to be performed by the application as a result of this event.

### **E\_GP\_COMMISSION\_MODE\_EXIT**

The E\_GP\_COMMISSION\_MODE\_EXIT event is generated on the Green Power cluster on receiving a Proxy Commissioning Mode command with the 'Exit' action, or when the commissioning window timeout has expired, or when node pairing has been successfully completed. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_COMMISSION\_MODE\_EXIT.

No action needs to be performed by the application as a result of this event.

### **E\_GP\_CMD\_UNSUPPORTED\_PAYLOAD\_LENGTH**

The E\_GP\_CMD\_UNSUPPORTED\_PAYLOAD\_LENGTH event is generated on a Green Power cluster on receiving a GP frame with a payload which is longer than the maximum defined by the macro `GP_MAX_ZB_CMD_PAYLOAD_LENGTH` (see [Section 1.14](#)). In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_CMD\_UNSUPPORTED\_PAYLOAD\_LENGTH.

### **E\_GP\_SINK\_PROXY\_TABLE\_ENTRY\_ADDED**

The E\_GP\_SINK\_PROXY\_TABLE\_ENTRY\_ADDED event is generated on a Green Power infrastructure device when a sink/proxy table entry is created as the result of receiving a commissioning command (or a GP frame with the auto-commissioning flag set to '1') from a GP device, with the server is in commissioning mode. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_SINK\_PROXY\_TABLE\_ENTRY\_ADDED and the new sink/proxy table entry is passed through the `psZgpsSinkProxyTable` field. When the application is in pairing mode, it can use this event to create a translation entry for the GP device.

### **E\_GP\_SINK\_PROXY\_TABLE\_FULL**

The E\_GP\_SINK\_PROXY\_TABLE\_FULL event is generated on a Green Power infrastructure device on receiving a commissioning command (or a GP frame with the auto-commissioning flag set to '1') from a GP device, with the infrastructure device in commissioning mode, but there is no free entry remaining in the sink/proxy table. In the structure `tsGP_GreenPowerCallbackMessage`, the `eEventType` field is set to E\_GP\_SINK\_PROXY\_TABLE\_FULL.

### **E\_GP\_ZGPD\_COMMAND\_RCVD**

The E\_GP\_ZGPD\_COMMAND\_RCVD event is generated on a Green Power cluster server when a GP command has been received (either directly from the GP device or indirectly via a proxy node), and entries for the node/command have been found in the local sink and translation tables. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_ZGPD\_COMMAND\_RCVD.

## **E\_GP\_ZGPD\_CMD\_RCVD\_WO\_TRANS\_ENTRY**

The `E_GP_ZGPD_CMD_RCVD_WO_TRANS_ENTRY` event is generated on a Green Power cluster server when a GP command has been received (either directly from the GP device or indirectly via a proxy node) but there is no matching translation table entry for the node/command or a translation table pointer was not passed to the GP cluster through **`eGP_RegisterComboBasicEndPoint()`** during initialisation. In the `tsGP_GreenPowerCallBackMessage` structure, the `eEventType` field is set to `E_GP_ZGPD_CMD_RCVD_WO_TRANS_ENTRY`.

## **E\_GP\_ADDING\_GROUP\_TABLE\_FAIL**

The `E_GP_ADDING_GROUP_TABLE_FAIL` event is generated on a Green Power cluster server on receiving a commissioning command (or a GP frame with the auto-commissioning flag set to '1'), with the server in commissioning mode, but the cluster fails to add a group table entry. In the `tsGP_GreenPowerCallBackMessage` structure, the `eEventType` field is set to `E_GP_ADDING_GROUP_TABLE_FAIL` and the reason for failure is indicated through `eAddGroupTableStatus`.

## **E\_GP\_RECEIVED\_CHANNEL\_REQUEST**

The `E_GP_RECEIVED_CHANNEL_REQUEST` event is generated on a Green Power cluster client on a Proxy Basic device when a Channel Request from a GP device has been received during commissioning. In the `tsGP_GreenPowerCallBackMessage` structure, the `eEventType` field is set to `E_GP_RECEIVED_CHANNEL_REQUEST`. The local application can set the value of `bIsActAsTempMaster` to `TRUE` if it is acceptable to switch to the transmit channel for 5 seconds and `FALSE` if the device must remain on the operational channel. If the application returns `FALSE`, the cluster will not process the Channel Request.

## **E\_GP\_TRANSLATION\_TABLE\_RESPONSE\_RCVD**

The `E_GP_TRANSLATION_TABLE_RESPONSE_RCVD` event is generated on a Green Power cluster client on receiving a Translation Table Response command. In the `tsGP_GreenPowerCallBackMessage` structure, the `eEventType` field is set to `E_GP_TRANSLATION_TABLE_RESPONSE_RCVD` and the field `psZgpTransRspCmdPayload` of the union can be used by the application to insert the result of the Translation Table Request command.

## **E\_GP\_TRANSLATION\_TABLE\_UPDATE**

The `E_GP_TRANSLATION_TABLE_UPDATE` event is generated on a Green Power cluster server when it receives a Translation Table Update command. This event will be generated for each translation received in the command. In the `tsGP_GreenPowerCallBackMessage` structure, the `eEventType` field is set to `E_GP_TRANSLATION_TABLE_UPDATE` and the translation entry to update is passed through the field `psTransationTableUpdate` of the union. The application can take action according to the values of the `eAction` and `u8Index` fields of this union field. If the application is able to process the received translation successfully then it will set the `eStatus` field to `E_GP_TRANSLATION_UPDATE_SUCCESS`, or otherwise to `E_GP_TRANSLATION_UPDATE_FAIL`.

### **E\_GP\_SECURITY\_LEVEL\_MISMATCH**

The E\_GP\_SECURITY\_LEVEL\_MISMATCH event is generated on a Green Power cluster server or client when a received GP frame (directly from a GP device) does not support the minimum security level required by the GP infrastructure device. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_SECURITY\_LEVEL\_MISMATCH.

### **E\_GP\_SECURITY\_PROCESSING\_FAILED**

The E\_GP\_SECURITY\_PROCESSING\_FAILED event is generated on a Green Power cluster server or client when a received GP frame (directly from a GP device) fails the security processing performed by the GP infrastructure device. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_SECURITY\_PROCESSING\_FAILED.

### **E\_GP\_REMOVING\_GROUP\_TABLE\_FAIL**

The E\_GP\_REMOVING\_GROUP\_TABLE\_FAIL event is generated on a Green Power cluster server on receiving a Pairing Configuration command in which the action field is one of

E\_GP\_PAIRING\_CONFIG\_REPLACE\_SINK\_TABLE\_ENTRY  
E\_GP\_PAIRING\_CONFIG\_REMOVE\_SINK\_TABLE\_ENTRY  
E\_GP\_PAIRING\_CONFIG\_REMOVE\_GPD

but the cluster fails to remove a group table entry. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_REMOVING\_GROUP\_TABLE\_FAIL and the reason for failure is indicated through the `eRemoveGroupTableStatus` field of the union.

### **E\_GP\_PAIRING\_CONFIGURATION\_CMD\_RCVD**

The E\_GP\_PAIRING\_CONFIGURATION\_CMD\_RCVD event is generated on a Green Power cluster server when it receives a Pairing Configuration command. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_PAIRING\_CONFIGURATION\_CMD\_RCVD and the details of the command are passed through the `psPairingConfigCmdRcvd` field of the union. On receiving this event, the application should add or delete the corresponding translation table entry according to the action specified in the `eTranslationTableAction` field of this union field.

### **E\_GP\_PERSIST\_ATTRIBUTE\_DATA**

The E\_GP\_PERSIST\_ATTRIBUTE\_DATA event is generated on a Green Power cluster server or client to prompt the application to store attribute data in non-volatile memory. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_PERSIST\_ATTRIBUTE\_DATA and the attribute data to be saved is passed through the field `psPersistedData` of the union.

## **E\_GP\_SUCCESS\_CMD\_RCVD**

The E\_GP\_SUCCESS\_CMD\_RCVD event is generated on a Green Power cluster server on receiving a GP frame directly from a GP device or via a proxy node, with the server in commissioning mode (as described in [Section 1.6](#)), to inform the user that commissioning has been successful. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_SUCCESS\_CMD\_RCVD.

## **E\_GP\_DECOMM\_CMD\_RCVD**

The E\_GP\_DECOMM\_CMD\_RCVD event is generated on a Green Power cluster server on receiving a Decommission command directly from a GP device or via a proxy node, with the server in commissioning mode. In the `tsGP_GreenPowerCallbackMessage` structure, the `eEventType` field is set to E\_GP\_DECOMM\_CMD\_RCVD and the field `psZgpDecommissionIndication` of the union is used to pass the identifier of the GP device to be decommissioned. When this event occurs, the application should remove translation table entries for the relevant GP device.

## **E\_GP\_SHARED\_SECURITY\_KEY\_TYPE\_IS\_NOT\_ENABLED**

The E\_GP\_SHARED\_SECURITY\_KEY\_TYPE\_IS\_NOT\_ENABLED event is generated on a Green Power cluster server or client when it receives any secured GP frame and:

- the security level is other than E\_GP\_NO\_SECURITY
- CLD\_GP\_ATTR\_ZGP\_SHARED\_SECURITY\_KEY\_TYPE is not defined to enable the optional `b8ZgpSharedSecKeyType` attribute

In the `tsGP_GreenPowerCallbackMessage` structure, the field `eEventType` is set to E\_GP\_SHARED\_SECURITY\_KEY\_TYPE\_IS\_NOT\_ENABLED.

## **E\_GP\_SHARED\_SECURITY\_KEY\_IS\_NOT\_ENABLED**

The E\_GP\_SHARED\_SECURITY\_KEY\_IS\_NOT\_ENABLED event is generated on a Green Power cluster server or client when it receives any secured GP frame and:

- the security key type is E\_GP\_ZGPD\_GROUP\_KEY or E\_GP\_DERIVED\_INDIVIDUAL\_ZGPD\_KEY
- CLD\_GP\_ATTR\_ZGP\_SHARED\_SECURITY\_KEY is not defined to enable the optional `sZgpSharedSecKey` attribute

In the `tsGP_GreenPowerCallbackMessage` structure, the field `eEventType` is set to E\_GP\_SHARED\_SECURITY\_KEY\_IS\_NOT\_ENABLED.

## **E\_GP\_LINK\_KEY\_IS\_NOT\_ENABLED**

The E\_GP\_LINK\_KEY\_IS\_NOT\_ENABLED event is generated on a Green Power cluster server when it receives an encrypted security key in a commissioning command and CLD\_GP\_ATTR\_ZGP\_LINK\_KEY is not defined to enable the optional `sZgpLinkKey` attribute. In the `tsGP_GreenPowerCallbackMessage` structure, the field `eEventType` is set to E\_GP\_LINK\_KEY\_IS\_NOT\_ENABLED.

### **E\_GP\_ZGPD\_SINK\_TABLE\_RESPONSE\_RCVD**

The E\_GP\_ZGPD\_SINK\_TABLE\_RESPONSE\_RCVD event is generated on a Green Power cluster client when it receives a Sink Table Response from the server in response to a Sink Table Request command. In the `tsGP_GreenPowerCallBackMessage` structure, the field `eEventType` is set to E\_GP\_ZGPD\_SINK\_TABLE\_RESPONSE\_RCVD and the payload is updated in `psZgpSinkTableRespCmdPayload`.

### **E\_GP\_ZGPD\_PROXY\_TABLE\_RESPONSE\_RCVD**

The E\_GP\_ZGPD\_PROXY\_TABLE\_RESPONSE\_RCVD event is generated on a Green Power cluster server when it receives a Proxy Table Response from a client in response to a Proxy Table Request command. In the `tsGP_GreenPowerCallBackMessage` structure, the field `eEventType` is set to E\_GP\_ZGPD\_PROXY\_TABLE\_RESPONSE\_RCVD and the payload is updated in `psZgpProxyTableRespCmdPayload`.

### **E\_GP\_NOTIFICATION\_RCVD**

The E\_GP\_NOTIFICATION\_RCVD event is generated on a Green Power cluster server when it receives a GP Notification from a client, where this command contains a tunnelled GP message received from a source GP device. The field `eEventType` is set to E\_GP\_NOTIFICATION\_RCVD and the payload is updated in `psZgpNotificationCmdPayload`.

### **E\_GP\_COMM\_NOTIFICATION\_RCVD**

The E\_GP\_COMM\_NOTIFICATION\_RCVD event is generated on a Green Power cluster server when it receives a Commissioning Notification command from a client, where this command contains a tunnelled GP commissioning message received from a source GP device. In the `tsGP_GreenPowerCallBackMessage` structure, the field `eEventType` is set to E\_GP\_COMM\_NOTIFICATION\_RCVD and the payload is updated in `psZgpCommissioningNotificationCmdPayload`.

### **E\_GP\_RESPONSE\_RCVD**

The E\_GP\_RESPONSE\_RCVD event is generated on a Green Power cluster client when it receives a GP Response command from a server, where this command contains a tunnelled response to a GP device. In the `tsGP_GreenPowerCallBackMessage` structure, the field `eEventType` is set to E\_GP\_RESPONSE\_RCVD and the payload is updated in `psZgpResponseCmdPayload`.

### **E\_GP\_PAIRING\_CMD\_RCVD**

The E\_GP\_PAIRING\_CMD\_RCVD event is generated on a Green Power cluster client when it receives a Pairing command from a server to create pairing for a GP device. In the `tsGP_GreenPowerCallBackMessage` structure, the field `eEventType` is set to E\_GP\_PAIRING\_CMD\_RCVD and the payload is updated in `psZgpPairingCmdPayload`.

## **E\_GP\_PAIRING\_CONFIG\_CMD\_RCVD**

The E\_GP\_PAIRING\_CONFIG\_CMD\_RCVD event is generated on a Green Power infrastructure device when it receives a Pairing Configuration command to update a pairing. In the `tsGP_GreenPowerCallbackMessage` structure, the field `eEventType` is set to E\_GP\_PAIRING\_CONFIG\_CMD\_RCVD and payload is updated in `psZgpPairingConfigCmdPayload`.

---

## **1.10 Green Power Functions**

The following Green Power functions are provided:

<b>Function</b>	<b>Page</b>
<code>eGP_RegisterComboBasicEndPoint</code>	64
<code>eGP_RegisterProxyBasicEndPoint</code>	66
<code>eGP_ProxyCommissioningMode</code>	67
<code>bGP_IsSinkTableEntryPresent</code>	68
<code>bGP_GetFreeProxySinkTableEntry</code>	69
<code>vGP_RemoveGPDFFromProxySinkTable</code>	70
<code>bGP_IsProxyTableEntryPresent</code>	71
<code>eGP_SinkTableRequestSend</code>	72
<code>eGP_ProxyTableRequestSend</code>	73
<code>eGP_ZgpTranslationTableUpdateSend</code>	74
<code>eGP_ZgpTranslationTableRequestSend</code>	75
<code>eGP_ZgpPairingConfigSend</code>	76
<code>bGP_CheckGPDAddressMatch</code>	77
<code>vGP_RestorePersistedData</code>	78



## eGP\_RegisterComboBasicEndPoint

```
teZCL_Status eGP_RegisterComboBasicEndPoint(
    uint8 u8EndPointIdentifier,
    tfpZCL_ZCLCallbackFunction cbCallBack,
    tsGP_GreenPowerDevice *psDeviceInfo,
    uint16 u16ProfileId,
    tsGP_TranslationTableEntry *psTranslationTable);
```

### Description

This function is used on a 'Combo Basic' device to register a Green Power endpoint. The function must be called after the profile initialisation function (such as **eHA\_Initialise()**) and before starting the ZigBee PRO stack.

The Green Power cluster resides on a reserved endpoint, 242. However, the NXP ZCL implementation requires endpoints to be numbered consecutively starting at 1. The Green Power endpoint must therefore be mapped to an endpoint in this sequence in order to allow access to the GP cluster. This function will map the GP endpoint to the specified endpoint in the range 1 to 240 (endpoints 0 and 241 are reserved for ZigBee use). The specified number must be less than or equal to the value of the maximum number of endpoints for the application profile that is defined in the **zcl\_options.h** file (and this value must not exceed 240).

As part of this function call, you must specify a user-defined callback function that will be invoked when an event occurs that is associated with the endpoint (events are detailed in [Section 1.9](#)). This callback function is defined according to the typedef:

```
typedef void (* tfpZCL_ZCLCallbackFunction)
    (tsZCL_CallBackEvent *pCallBackEvent);
```

You must also provide a pointer to a **tsGP\_GreenPowerDevice** structure (see [Section 1.12.1](#)) which will be used to store all variables relating to the Green Power endpoint. The **sEndPoint** and **sClusterInstance** fields of this structure are set by this function and must not be directly written to by the application.

A translation table in RAM must be provided for a sink node. This translation table will be populated by the application during node commissioning. For information on creating a translation table, refer to [Section 1.8.3](#).

The identifier of the application profile used must also be specified to allow the translation of received GP data frames.

### Parameters

<i>u8EndPointIdentifier</i>	Identifier of endpoint to be registered - this is an endpoint number in the range 1 to 240
<i>cbCallBack</i>	Pointer to a callback function to handle events associated with the registered endpoint
<i>psDeviceInfo</i>	Pointer to the structure to be used to hold the Green Power device details (see <a href="#">Section 1.12.1</a> )
<i>u16ProfileId</i>	Identifier of the application profile used



*psTranslationTable*

Pointer to an array in RAM containing the (empty) translation table for a sink node (see [Section 1.8.3](#) and [Section 1.12.11](#))

## **Returns**

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL  
E\_ZCL\_ERR\_PARAMETER\_NULL  
E\_ZCL\_ERR\_PARAMETER\_RANGE  
E\_ZCL\_ERR\_EP\_RANGE  
E\_ZCL\_ERR\_CALLBACK\_NULL

---

## eGP\_RegisterProxyBasicEndPoint

---

```
teZCL_Status eGP_RegisterProxyBasicEndPoint(  
    uint8 u8EndPointIdentifier,  
    tfpZCL_ZCLCallbackFunction cbCallBack,  
    tsGP_GreenPowerDevice *psDeviceInfo);
```

### Description

This function is used on a 'Proxy' device to register a Green Power endpoint. The function must be called after the profile initialisation function (such as **eHA\_Initialise()**) and before starting the ZigBee PRO stack.

The Green Power cluster resides on a reserved endpoint, 242. However, the NXP ZCL implementation requires endpoints to be numbered consecutively starting at 1. The Green Power endpoint must therefore be mapped to an endpoint in this sequence in order to allow access to the GP cluster. This function will map the GP endpoint to the specified endpoint in the range 1 to 240 (endpoints 0 and 241 are reserved for ZigBee use). The specified number must be less than or equal to the value of the maximum number of endpoints for the application profile that is defined in the **zcl\_options.h** file (and this value must not exceed 240).

As part of this function call, you must specify a user-defined callback function that will be invoked when an event occurs that is associated with the endpoint (events are detailed in [Section 1.9](#)). This callback function is defined according to the typedef:

```
typedef void (* tfpZCL_ZCLCallbackFunction)  
    (tsZCL_CallbackEvent *pCallBackEvent);
```

You must also provide a pointer to a **tsGP\_GreenPowerDevice** structure (see [Section 1.12.1](#)) which will be used to store all variables relating to the Green Power endpoint. The **sEndPoint** and **sClusterInstance** fields of this structure are set by this function and must not be directly written to by the application.

### Parameters

<i>u8EndPointIdentifier</i>	Identifier of endpoint to be registered - this is an endpoint number in the range 1 to 240
<i>cbCallBack</i>	Pointer to a callback function to handle events associated with the registered endpoint
<i>psDeviceInfo</i>	Pointer to the structure to be used to hold the Green Power device details (see <a href="#">Section 1.12.1</a> )

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL  
E\_ZCL\_ERR\_PARAMETER\_NULL  
E\_ZCL\_ERR\_PARAMETER\_RANGE  
E\_ZCL\_ERR\_EP\_RANGE  
E\_ZCL\_ERR\_CALLBACK\_NULL

## eGP\_ProxyCommissioningMode

```
teZCL_Status eGP_ProxyCommissioningMode(
    uint8 u8SourceEndPointId,
    uint8 u8DestEndPointId,
    tsZCL_Address sDestinationAddress,
    teGP_GreenPowerProxyCommissionMode
        eGreenPowerProxyCommissionMode);
```

### Description

This function is used to initiate commissioning mode on a sink node, following a user trigger such as pressing a button. The function puts the (local) sink node into self-commissioning mode and puts proxy nodes into remote commissioning mode by broadcasting a ZGP Proxy Commissioning Mode command to them. The function can also be used to bring the proxy nodes out of commissioning mode.

If this function is called on a proxy node while it is in remote commissioning mode, the node will enter pairing mode which will allow it to automatically pair with a source GP device once it has received a commissioning notification containing a source GP device command.

### Parameters

<i>u8SourceEndPointId</i>	Number of the local Green Power endpoint (in the range 1 to 240)
<i>u8DestEndPointId</i>	Number of the remote Green Power endpoint on the proxy nodes - this is the reserved GP endpoint of 242
<i>sDestinationAddress</i>	Destination address for broadcast to proxy nodes (broadcast address must be specified)
<i>eGreenPowerProxyCommissionMode</i>	Enumeration indicating whether proxy commissioning mode should be entered or exited - one of: E_GP_PROXY_COMMISSION_ENTER E_GP_PROXY_COMMISSION_EXIT

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_ERR\_PARAMETER\_RANGE  
E\_ZCL\_ERR\_EP\_RANGE  
E\_ZCL\_ERR\_CLUSTER\_NOT\_FOUND  
E\_ZCL\_ERR\_CUSTOM\_DATA\_NULL  
E\_ZCL\_ERR\_PARAMETER\_NULL  
E\_ZCL\_ERR\_EP\_UNKNOWN  
E\_ZCL\_ERR\_ZBUFFER\_FAIL  
E\_ZCL\_ERR\_ZTRANSMIT\_FAIL

---

## bGP\_IsSinkTableEntryPresent

---

```
bool_t bGP_IsSinkTableEntryPresent(  
    uint8 u8GpEndPointId,  
    uint8 u8ApplicationId,  
    tuGP_ZgpdDeviceAddr *puZgpdAddress,  
    tsGP_ZgppProxySinkTable **psSinkTableEntry,  
    teGP_GreenPowerCommunicationMode  
        eCommunicationMode);
```

### Description

This function can be used on a sink node to find out whether an entry for a particular GP device is present in the local sink/proxy table - that is, to find out whether the local sink node is paired with a particular source GP device. The GP device of interest is specified by its address and the communication mode between the source and sink nodes. The function can also be used to update the sink table entry, if it is present (see below).

A pointer to a pointer to a `tsGP_ZgppProxySinkTable` structure must be specified.

- If a sink table entry is present for the GP device and the second pointer refers to an empty structure when the function is called, the second pointer will be set by the function to point at this table entry.
- If a sink table entry is present for the GP device and the second pointer refers to a structure populated with data when the function is called, the table entry will be updated with this data.

If the required sink table entry is not found, the function will not return or update any entry data.

### Parameters

<i>u8GpEndPointId</i>	Number of the local Green Power endpoint (in the range 1 to 240)
<i>u8ApplicationId</i>	Value indicating the type of address used to identify the GP device: 0x00 - 16-bit source address, 0x02 - 64-bit IEEE address (all other values are reserved)
<i>puZgpdAddress</i>	Pointer to a union containing address of GP device
<i>psSinkTableEntry</i>	Pointer to a pointer to a structure representing a sink table entry (may be empty or contain valid data, depending on the action)
<i>eCommunicationMode</i>	Communication mode between the source GP device and sink node - enumerations are provided in <a href="#">Section 1.13.5</a>

### Returns

TRUE if sink table entry for GP device was found  
FALSE if sink table entry for GP device was not found

## bGP\_GetFreeProxySinkTableEntry

```
bool bGP_GetFreeProxySinkTableEntry(
    uint8 u8GreenPowerEndPointId,
    bool bIsServer,
    tsGP_ZgppProxySinkTable **psProxySinkTableEntry);
```

### Description

This function can be used on an infrastructure device to obtain a free entry in the local sink/proxy table.

A pointer to a pointer must be provided, where the first pointer will receive a pointer to the allocated sink/proxy table entry.

### Parameters

<i>u8GreenPowerEndPointId</i>	Number of the local Green Power endpoint (in the range 1 to 240)
<i>bIsServer</i>	Type of infrastructure device on which function is called: TRUE: Combo Basic FALSE: Proxy Basic
<i>psProxySinkTableEntry</i>	Pointer to a pointer to a <code>tsGP_ZgppProxySinkTable</code> structure. This pointer will receive a pointer to the allocated sink table entry, if one is free.

### Returns

TRUE if a sink/proxy table entry is allocated  
FALSE otherwise

---

## vGP\_RemoveGPDeviceFromProxySinkTable

---

```
void vGP_RemoveGPDeviceFromProxySinkTable(  
    uint8 u8EndPointNumber,  
    uint8 u8AppID,  
    tuGP_ZgpdDeviceAddr *puZgpdDeviceAddr);
```

### Description

This function can be used on an infrastructure device to delete the entry for a particular GP device in the local sink/proxy table.

### Parameters

<i>u8GreenPowerEndPointId</i>	Number of the local Green Power endpoint (in the range 1 to 240)
<i>u8AppID</i>	Value indicating the type of address used to identify the GP device: 0x00 - 16-bit source address, 0x02 - 64-bit IEEE address (all other values are reserved)
<i>puZgpdDeviceAddr</i>	Pointer to a union containing address of GP device for which the sink/proxy table is to be removed

### Returns

None

## bGP\_IsProxyTableEntryPresent

```
bool_t bGP_IsProxyTableEntryPresent(
    uint8 u8GpEndPointId,
    bool bIsServer,
    uint8 u8ApplicationId,
    tuGP_ZgpdDeviceAddr *puZgpdAddress,
    tsGP_ZgppProxySinkTable **psProxySinkTableEntry);
```

### Description

This function can be used on a proxy node to find out whether an entry for a particular GP device is present in the local proxy table. The GP device of interest is specified by means of its address. The function can also be used to update the proxy table entry, if it is present (see below).

A pointer to a pointer to a `tsGP_ZgppProxySinkTable` structure must be specified.

- If a proxy table entry is present for the GP device and the second pointer refers to an empty structure when the function is called, the second pointer will be set by the function to point at this table entry.
- If a proxy table entry is present for the GP device and the second pointer refers to a structure populated with data when the function is called, the table entry will be updated with this data.

If the required proxy table entry is not found, the function will not return or update any entry data.

### Parameters

<i>u8GpEndPointId</i>	Number of the local Green Power endpoint (in the range 1 to 240)
<i>bIsServer</i>	Type of infrastructure device on which function is called: TRUE: Combo Basic FALSE: Proxy Basic
<i>u8ApplicationId</i>	Value indicating the type of address used to identify the GP device: 0x00 - 16-bit source address, 0x02 - 64-bit IEEE address (all other values are reserved)
<i>puZgpdAddress</i>	Pointer to a union containing address of GP device
<i>psProxySinkTableEntry</i>	Pointer to a pointer to a structure representing a proxy table entry (may be empty or contain valid data, depending on the action)

### Returns

TRUE if proxy table entry for GP device was found  
FALSE if proxy table entry for GP device was not found

---

## eGP\_SinkTableRequestSend

---

```
teZCL_Status eGP_SinkTableRequestSend(  
    uint8 u8SourceEndPointId,  
    uint8 u8DestEndPointId,  
    tsZCL_Address sDestinationAddress,  
    tsGP_ZgpSinkTableRequestCmdPayload  
        *psZgpSinkTableRequestCmdPayload);
```

### Description

This function can be used on a Green Power cluster client to send a Sink Table Request command to a cluster server. This command can request either of the following:

- The sink table entry corresponding to a specified GP address
- All sink table entries starting at the specified table index

The method of requesting sink table data is specified in the command payload.

When a Sink Table Response is received back from the server, the event E\_GP\_ZGPD\_SINK\_TABLE\_RESPONSE\_RCVD is generated, containing the requested sink table entry or entries.

### Parameters

<i>u8SourceEndPointId</i>	Number of the local Green Power endpoint through which the command will be sent (in the range 1 to 240)
<i>u8DestEndPointId</i>	Number of the remote Green Power endpoint to which the command will be sent - this is the reserved GP endpoint of 242
<i>psDestinationAddress</i>	Pointer to structure containing the destination address for a broadcast to proxy nodes
<i>psZgpSinkTableRequestCmdPayload</i>	Pointer to a structure which contains Sink Table Request command payload (see <a href="#">Section 1.12.21</a> )

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL



## eGP\_ProxyTableRequestSend

```
teZCL_Status eGP_ProxyTableRequestSend(
    uint8 u8SourceEndPointId,
    uint8 u8DestEndPointId,
    tsZCL_Address sDestinationAddress,
    tsGP_ZgpProxyTableRequestCmdPayload
    *psZgpProxyTableRequestCmdPayload);
```

### Description

This function can be used on a Green Power cluster server to send a Proxy Table Request command to a cluster client. This command can request either of the following:

- The proxy table entry corresponding to a specified GP address
- All proxy table entries starting at the specified table index

The method of requesting proxy table data is specified in the command payload.

When a Proxy Table Response is received back from the client, the event E\_GP\_ZGPD\_PROXY\_TABLE\_RESPONSE\_RCVD is generated, containing the requested proxy table entry or entries.

### Parameters

<i>u8SourceEndPointId</i>	Number of the local Green Power endpoint through which the command will be sent (in the range 1 to 240)
<i>u8DestEndPointId</i>	Number of the remote Green Power endpoint to which the command will be sent - this is the reserved GP endpoint of 242
<i>psDestinationAddress</i>	Pointer to structure containing the destination address for a broadcast to proxy nodes
<i>psZgpProxyTableRequestCmdPayload</i>	Pointer to a structure which contains Proxy Table Request command payload (see <a href="#">Section 1.12.22</a> )

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL

---

## eGP\_ZgpTranslationTableUpdateSend

---

```
teZCL_Status eGP_ZgpTranslationTableUpdateSend(  
    uint8 u8SourceEndPointId,  
    uint8 u8DestinationEndPointId,  
    tsZCL_Address *psDestinationAddress,  
    uint8 *pu8TransactionSequenceNumber,  
    tsGP_ZgpTranslationUpdateCmdPayload  
        *psZgpTransTableUpdatePayload);
```

### Description

This function can be used on a Green Power cluster client to send a Translation Table Update command to the cluster server on a sink node in order to update the translation table on the node. This command allows a translation table entry to be remotely added, modified or removed - the required action is specified in the command payload (see [Section 1.12.17](#)).

On receiving the command, an E\_GP\_TRANSLATION\_TABLE\_UPDATE event is generated on the sink node for every translation contained in the command.

You are required to provide a pointer to a location to receive a Transaction Sequence Number (TSN) for the request. The TSN in the response will be set to match the TSN in the request, allowing an incoming response to be paired with a request. This is useful when sending more than one request to the same destination endpoint.

### Parameters

<i>u8SourceEndPointId</i>	Number of the local Green Power endpoint through which the command will be sent (in the range 1 to 240)
<i>u8DestEndPointId</i>	Number of the remote Green Power endpoint to which the command will be sent - this is the reserved GP endpoint of 242
<i>psDestinationAddress</i>	Pointer to structure containing the address of the sink node to which the command will be sent
<i>pu8TransactionSequenceNumber</i>	Pointer to a location to receive the Transaction Sequence Number (TSN) of the request
<i>psZgpTransTableUpdatePayload</i>	Pointer to a structure which contains Translation Table Update command payload (see <a href="#">Section 1.12.17</a> )

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL

## eGP\_ZgpTranslationTableRequestSend

```
teZCL_Status eGP_ZgpTranslationTableRequestSend(
    uint8 u8SourceEndPointId,
    uint8 u8DestinationEndPointId,
    tsZCL_Address *psDestinationAddress,
    uint8 *pu8TransactionSequenceNumber,
    uint8 *pu8StartIndex);
```

### Description

This function can be used on a Green Power cluster client to send a Translation Table Request to a cluster server on a sink node in order to obtain entries from its translation table. The index of the first entry to be read must be specified (entries are indexed from zero). As many entries as can fit in the response frame will be returned (see below). If further entries are required, the function must be called again with a different start index.

The function is non-blocking and returns immediately. As a result of this function call, a Translation Table Response will eventually be received from the sink node. On receiving this response, an E\_GP\_TRANSLATION\_TABLE\_RESPONSE\_RCVD event is generated, containing the requested information.

You are required to provide a pointer to a location to receive a Transaction Sequence Number (TSN) for the request. The TSN in the response will be set to match the TSN in the request, allowing an incoming response to be paired with a request. This is useful when sending more than one request to the same destination endpoint.

### Parameters

<i>u8SourceEndPointId</i>	Number of the local Green Power endpoint through which the request will be sent (in the range 1 to 240)
<i>u8DestEndPointId</i>	Number of the remote Green Power endpoint to which the request will be sent - this is the reserved GP endpoint of 242
<i>psDestinationAddress</i>	Pointer to structure containing the address of the sink node to which the request will be sent
<i>pu8TransactionSequenceNumber</i>	Pointer to a location to receive the Transaction Sequence Number (TSN) of the request
<i>pu8StartIndex</i>	Pointer to a location containing the index of the first translation table entry to be read

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL

---

## eGP\_ZgpPairingConfigSend

---

```
teZCL_Status eGP_ZgpPairingConfigSend(  
    uint8 u8SourceEndPointId,  
    uint8 u8DestinationEndPointId,  
    tsZCL_Address *psDestinationAddress,  
    uint8 *pu8TransactionSequenceNumber,  
    tsGP_ZgpPairingConfigCmdPayload  
        *psZgpPairingConfigPayload);
```

### Description

This function can be used on a Green Power cluster client to send a Pairing Configuration command to a cluster server on a sink node in order update its sink table. Through the sink table, the command allows a pairing with a source GP device to be created, modified, removed or replaced - the required action is specified in the command payload (see [Section 1.12.20](#)).

On receiving the command, an E\_GP\_PAIRING\_CONFIGURATION\_CMD\_RCVD event is generated on the sink node.

You are required to provide a pointer to a location to receive a Transaction Sequence Number (TSN) for the request. The TSN in the response will be set to match the TSN in the request, allowing an incoming response to be paired with a request. This is useful when sending more than one request to the same destination endpoint.

### Parameters

<i>u8SourceEndPointId</i>	Number of the local Green Power endpoint through which the command will be sent (in the range 1 to 240)
<i>u8DestEndPointId</i>	Number of the remote Green Power endpoint to which the command will be sent - this is the reserved GP endpoint of 242
<i>psDestinationAddress</i>	Pointer to structure containing the address of the sink node to which the command will be sent
<i>pu8TransactionSequenceNumber</i>	Pointer to a location to receive the Transaction Sequence Number (TSN) of the request
<i>psZgpPairingConfigPayload</i>	Pointer to a structure which contains Pairing Configuration command payload (see <a href="#">Section 1.12.20</a> )

### Returns

E\_ZCL\_SUCCESS  
E\_ZCL\_FAIL

---

**bGP\_CheckGPDeviceAddressMatch**

---

```
bool bGP_CheckGPDeviceAddressMatch(  
    uint8 u8AppIdSrc,  
    uint8 u8AppIdDst,  
    tuGP_ZgpdDeviceAddr *sAddrSrc,  
    tuGP_ZgpdDeviceAddr *sAddrDst);
```

**Description**

This function can be used to check whether two GP device addresses are the same.

Each address can be specified as a 32-bit GP source address or a 64-bit IEEE/MAC address. The type of address used is indicated through the parameters *u8AppIdSrc* and *u8AppIdDst*:

- 0 indicates a 32-bit GP source address
- 2 indicates a 64-bit IEEE/MAC address

All other values are reserved.

The actual addresses are specified through *tuGP\_ZgpdDeviceAddr* structures (see [Section 1.12.6](#)).

**Parameters**

<i>u8AppIdSrc</i>	Application ID of first GP device (see above)
<i>u8AppIdDst</i>	Application ID of second GP device (see above)
<i>sAddrSrc</i>	Structure containing address of first GP device
<i>sAddrDst</i>	Structure containing address of second GP device

**Returns**

TRUE if addresses match

FALSE if addresses do not match

---

## vGP\_RestorePersistedData

---

```
void vGP_RestorePersistedData(  
    tsGP_ZgppsProxySinkTable *psZgpsProxySinkTable,  
    teGP_ResetToDefaultConfig eSetToDefault);
```

### Description

This function can be used to set the Green Power attributes and sink/proxy table by restoring them from persisted data (saved in non-volatile memory using the PDM module) or by initialising them to their default values.

The data that is restored is dependent on the setting of the parameter *eSetToDefault*.

- If set to `E_GP_DEFAULT_ATTRIBUTE_VALUE`, the attributes will be initialised to their default values and the sink/proxy table will be restored with its persisted values.
- If set to `E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE`, the sink/proxy table will be initialised to its default state and the attributes will be restored with their persisted values.
- If set to `0x3`, the attributes and sink/proxy table will be initialised to their default values. In this case, *eSetToDefault* can be set to:  
`E_GP_DEFAULT_ATTRIBUTE_VALUE | E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE`.
- If set to `0x0`, the attributes and sink/proxy table will be restored with their persisted values.

For further information on persistent data management, refer to [Section 1.8.4](#).

### Parameters

<i>psZgpsProxySinkTable</i>	Pointer to proxy/sink table to be restored or initialised
<i>eSetToDefault</i>	Enumeration indicating which values are to be restored and which values are to be initialised (see above)

### Returns

None

---

## 1.11 Return Codes

The return codes used by the Green Power API functions are taken from the ZCL status enumerations, detailed in the *ZCL User Guide (ZB3ZCLUG)*.

---

## 1.12 Green Power Structures

---

### 1.12.1 tsGP\_GreenPowerDevice

The structure of type `tsGP_GreenPowerDevice` defines a Green Power device.

```
typedef struct
{
    tsZCL_EndPointDefinition          sEndPoint;
    tsGP_GreenPowerClusterInstances  sClusterInstance;
    tsCLD_GreenPower                 sServerGreenPowerCluster;
    tsCLD_GreenPower                 sClientGreenPowerCluster;
    tsGP_GreenPowerCustomData        sGreenPowerCustomDataStruct;
} tsGP_GreenPowerDevice;
```

where:

- `sEndPoint` defines the endpoint on which the Green Power device resides (the structure is described in the *ZCL User Guide (ZB3ZCLUG)*)
- `sClusterInstance` specifies details of the Green Power cluster instance(s) (server and/or client) on the device (see [Section 1.12.2](#))
- `sServerGreenPowerCluster` holds the attributes for the Green Power cluster server (if it exists) on the device (see [Section 1.3](#))
- `sClientGreenPowerCluster` holds the attributes for the Green Power cluster client (if it exists) on the device (see [Section 1.3](#))
- `sGreenPowerCustomDataStruct` is a custom structure holding user-defined data for the Green Power device

### 1.12.2 tsGP\_GreenPowerClusterInstances

The structure of type `tsGP_GreenPowerClusterInstances` contains details of Green Power cluster server and client instances.

```
typedef struct
{
    tsZCL_ClusterInstance    sGreenPowerServer;
    tsZCL_ClusterInstance    sGreenPowerClient;
} tsGP_GreenPowerClusterInstances;
```

where:

- `sGreenPowerServer` contains details of the GP cluster server instance
- `sGreenPowerClient` contains details of the GP cluster client instance

The structure `tsZCL_ClusterInstance` is described in the *ZCL User Guide (ZB3ZCLUG)*.

### 1.12.3 tsGP\_GreenPowerCallbackMessage

The structure of type `tsGP_GreenPowerCallbackMessage` contains a Green Power callback event (also refer to [Section 1.9](#)).

```
typedef struct
{
    teGP_GreenPowerCallBackEventType    eEventType;

    union
    {
        tsGP_ZgppProxySinkTable        *psZgpsProxySinkTable;
        tsGP_ZgpCommissionIndication    *psZgpCommissionIndication;
        ZPS_teStatus                    eAddGroupTableStatus;
        ZPS_teStatus                    eRemoveGroupTableStatus;
        bool_t                          bIsActAsTempMaster;
        tsGP_ZgpTransTableResponseCmdPayload *psZgpTransRspCmdPayload;
        tsGP_ZgpsTranslationTableUpdate *psTransationTableUpdate;
        tsGP_ZgpsPairingConfigCmdRcvd    *psPairingConfigCmdRcvd;
        tsGP_ZgpDecommissionIndication    *psZgpDecommissionIndication;
        tsGP_SinkTableRespCmdPayload      *psZgpSinkTableRespCmdPayload;
        tsGP_ProxyTableRespCmdPayload      *psZgpProxyTableRespCmdPayload;
        tsGP_ZgpResponseCmdPayload        *psZgpResponseCmdPayload;
        tsGP_ZgpNotificationCmdPayload    *psZgpNotificationCmdPayload;
        tsGP_ZgpCommissioningNotificationCmdPayload *psZgpCommissioningNotificationCmdPayload;
        tsGP_ZgpPairingCmdPayload          *psZgpPairingCmdPayload;
        tsGP_ZgpPairingConfigCmdPayload    *psZgpPairingConfigCmdPayload;
    } uMessage;
}
```



where:

- `eEventType` specifies the type of GP event that has been generated, one of (described in [Section 1.9](#)):
  - `E_GP_COMMISSION_DATA_INDICATION`
  - `E_GP_COMMISSION_MODE_ENTER`
  - `E_GP_COMMISSION_MODE_EXIT`
  - `E_GP_CMD_UNSUPPORTED_PAYLOAD_LENGTH`
  - `E_GP_SINK_PROXY_TABLE_ENTRY_ADDED`
  - `E_GP_SINK_PROXY_TABLE_FULL`
  - `E_GP_ZGPD_COMMAND_RCVD`
  - `E_GP_ZGPD_CMD_RCVD_WO_TRANS_ENTRY`
  - `E_GP_ADDING_GROUP_TABLE_FAIL`
  - `E_GP_RECEIVED_CHANNEL_REQUEST`
  - `E_GP_TRANSLATION_TABLE_RESPONSE_RCVD`
  - `E_GP_TRANSLATION_TABLE_UPDATE`
  - `E_GP_SECURITY_LEVEL_MISMATCH`
  - `E_GP_SECURITY_PROCESSING_FAILED`
  - `E_GP_REMOVING_GROUP_TABLE_FAIL`
  - `E_GP_PAIRING_CONFIGURATION_CMD_RCVD`
  - `E_GP_PERSIST_SINK_PROXY_TABLE`
  - `E_GP_SUCCESS_CMD_RCVD`
  - `E_GP_DECOMM_CMD_RCVD`
  - `E_GP_SHARED_SECURITY_KEY_TYPE_IS_NOT_ENABLED`
  - `E_GP_SHARED_SECURITY_KEY_IS_NOT_ENABLED`
  - `E_GP_LINK_KEY_IS_NOT_ENABLED`
  - `E_GP_ZGPD_SINK_TABLE_RESPONSE_RCVD`
  - `E_GP_ZGPD_PROXY_TABLE_RESPONSE_RCVD`
  - `E_GP_NOTIFICATION_RCVD`
  - `E_GP_COMM_NOTIFICATION_RCVD`
  - `E_GP_RESPONSE_RCVD`
  - `E_GP_PAIRING_CMD_RCVD`
  - `E_GP_PAIRING_CONFIG_CMD_RCVD`
- `uMessage` is a union containing the event data (if any) in one of the following forms:
  - `psZgpsSinkTable` is used when the event type is `E_GP_SINK_TABLE_ENTRY_ADDED` and is a pointer to a structure containing a new entry that has been added to the local sink table (see [Section 1.12.4](#))

- `psZgpCommissionIndication` is used when the event type is `E_GP_COMMISSION_DATA_INDICATION` and is a pointer to a structure containing the commissioning data for a new GP device (see [Section 1.12.8](#))
- `eAddGroupTableStatus` is a structure containing the status for the addition of a new GP device to the local group list
- `eRemoveGroupTableStatus` is a structure containing the status for the removal of a GP device from the local group list
- `bIsActAsTempMaster` is used when the event type is `E_GP_RECEIVED_CHANNEL_REQUEST`. The application should set the value of this field to `TRUE` if it is acceptable to switch to the transmit channel for 5 seconds or to `FALSE` if the device must remain on the operational channel. If the application returns `FALSE` in this field, the cluster will not process the Channel Request.
- `psZgpTransRspCmdPayload` is used when the event type is `E_GP_TRANSLATION_TABLE_RESPONSE_RCVD` and is a pointer to a structure containing the payload of a Translation Table Response (see [Section 1.12.18](#))
- `psTransationTableUpdate` is used when the event type is `E_GP_TRANSLATION_TABLE_UPDATE` and is a pointer a structure containing the new data for a Translation Table entry update (see [Section 1.12.19](#))
- `psPairingConfigCmdRcvd` is used when the event type is `E_GP_PAIRING_CONFIGURATION_CMD_RCVD` and is a pointer a structure containing the payload of a Pairing Configuration command (see [Section 1.12.23](#))
- `psPersistedData` is used when the event type is `E_GP_PERSIST_ATTRIBUTE_DATA` and is a pointer to a structure which contains the persisted data that is to be stored in non-volatile memory using the JenOS PDM module on the device (see [Section 1.12.24](#))
- `psZgpDecommissionIndication` is used when the event type is `E_GP_DECOMM_CMD_RCVD` and is a pointer to a structure containing the address of the GP device that needs to be decommissioned (see [Section 1.12.6](#))
- `psZgpSinkTableRespCmdPayload` is used when the event type is `E_GP_ZGPD_SINK_TABLE_RESPONSE_RCVD` and is a pointer to a structure containing a received Sink Table Response command (see [Section 1.12.25](#)).
- `psZgpProxyTableRespCmdPayload` is used when the event type is `E_GP_ZGPD_PROXY_TABLE_RESPONSE_RCVD` and is a pointer to a structure containing a received Proxy Table Response command (see [Section 1.12.26](#)).
- `psZgpResponseCmdPayload` is used when the event type is `E_GP_RESPONSE_RCVD` and is a pointer to a structure containing a received GP Response command (see [Section 1.12.27](#)).
- `psZgpNotificationCmdPayload` is used when the event type is `E_GP_NOTIFICATION_RCVD` and is a pointer to a structure containing a received GP Notification command (see [Section 1.12.28](#)).

- `psZgpCommissioningNotificationCmdPayload` is used when the event type is `E_GP_COMM_NOTIFICATION_RCVD` and is a pointer to a structure containing a received GP Commissioning Notification command (see [Section 1.12.13](#)).
- `psZgpPairingCmdPayload` is used when the event type is `E_GP_PAIRING_CMD_RCVD` and is a pointer to a structure containing a received Pairing command (see [Section 1.12.30](#)).
- `psZgpPairingConfigCmdPayload` is used when the event type is `E_GP_PAIRING_CONFIG_CMD_RCVD` and is a pointer to a structure containing a received GP Pairing Configuration command (see [Section 1.12.20](#)).

## 1.12.4 tsGP\_ZgppProxySinkTable

The structure of type `tsGP_ZgppProxySinkTable` corresponds to a sink/proxy table entry, containing a pairing between a source GP device and sink node. The Proxy Basic device and Combo Basic device use this structure when forwarding a packet from the GP device. The Combo Basic device also uses this table to manage its own pairing.

```
typedef struct
{
#ifdef GP_COMBO_BASIC_DEVICE
/* Entries exclusive to Sink table */
    bool                bGPDPaired;
    teGP_GreenPowerSinkTablePriority eGreenPowerSinkTablePriority;
    teGP_ZgpdDeviceId    eZgpdDeviceId;
    zbmap16              b16SinkTableOptions;
#endif
    bool_t              bProxyTableEntryOccupied;
    uint8               u8Endpoint;
    uint8               u8SinkGroupListEntries;
    uint8               u8GroupCastRadius;
    uint8               u8SearchCounter;
    uint8               u8NoOfUnicastSink;
    zbmap8              b8SecOptions;
    zbmap16             b16Options;
    zbmap8              b16ExtOptions; //not used
    uint16              u16ZgpdAssignedAlias;
    uint32              u32ZgpdSecFrameCounter;
    tuGP_ZgpdDeviceAddr uZgpdDeviceAddr;
    tsGP_ZgpsGroupList  asSinkGroupList[GP_MAX_SINK_GROUP_LIST];
    tsZCL_Key           sZgpdKey;
    tsGP_ZgpsSinkAddrList sUnicastSinkAddr[GP_MAX_UNICAST_SINK];
}tsGP_ZgppProxySinkTable;
```

where:

- `bGPDPaired` (Combo Basic device only) is a Boolean indicating whether the GP device is paired with the local Combo Basic device: TRUE for paired, FALSE for not paired
- `eGreenPowerSinkTablePriority` is an enumeration indicating the priority of the sink table entry (for enumerations, see [Section 1.13.10](#))
- `eZgpdDeviceId` is the Device ID of the paired source GP device (for enumerations, see [Section 1.13.6](#))
- `bl6SinkTableOptions` is a bitmap containing the following information:

Bits	Sub-field
0-4	<p>Communication mode - contains information about the accepted tunnelling modes for this GP device:</p> <ul style="list-style-type: none"> <li>• 00: Unicast forwarding of GP notifications by (all) proxies</li> <li>• 01: Groupcast forwarding of GP notifications to a 'derived' group</li> <li>• 10: Groupcast forwarding of GP notifications to a 'pre-commissioned' group</li> <li>• 11: Unicast forwarding of GP notifications by proxies supporting the lightweight unicast feature (without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command)</li> </ul> <p><b>Note:</b> Currently only Groupcasts (01 and 10) are supported.</p>
5	<p>'Rx On' capability of this GP device:</p> <ul style="list-style-type: none"> <li>• 1: Device is receive-capable</li> <li>• 0: Device is not receive-capable</li> </ul>
6-15	Reserved

- `bProxyTableEntryOccupied` is a Boolean indicating whether the proxy table entry is occupied: TRUE for occupied, FALSE for not occupied
- `u8SinkGroupListEntries` is the number of entries in the sink group list for the GP device (`asSinkGroupList[]` array, described below)
- `u8GroupCastRadius` is the maximum radius (number of hops) for a groupcast communication for a command from the GP device
- `u8SearchCounter` is currently unused and should be always set to 0
- `u8NoOfUnicastSink` is the number of entries in the unicast sink list for the GP device (`sUnicastSinkAddr[]` array, described below)

- `b8SecOptions` is an 8-bit bitmap containing the security options for the GP device:

Bits	Sub-field
0-1	Security level: <ul style="list-style-type: none"> <li>• 00: No security</li> <li>• 01: Reserved</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
2-4	Security key type: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul> For further details, refer to the ZigBee Green Power Specification.
5-7	Reserved

- `b16Options` is a 16-bit bitmap containing options for the GP source node, as follows (for details of these options, refer to the Green Power specification, Proxy table options parameter):

Bits	Use
0-2	Application ID
3	Entry Active
4	Entry Valid
5	Sequence Number Capabilities
6	Unicast GPS
7	Derived Group GPS
8	Commissioned Group GPS
9	First To Forward
10	In Range
11	GPD Fixed
12	Has All Unicast Routes
13	Assigned Alias
14	Security Use
15	Reserved

- `u16ZgpdAssignedAlias` is an assigned 16-bit alias address for the GP device (if used)

- `u32ZgpdSecFrameCounter` is a 32-bit security frame counter for the GP device (if used)
- `uZgpdDeviceAddr` is a union containing a 32-bit GP address or the 64-bit IEEE/MAC address for the GP device (see [Section 1.12.6](#))
- `asSinkGroupList[]` is an array of the sink group addresses for the GP device, where each array element is a structure containing a 16-bit group address and alias (see [Section 1.12.9](#)). Note that the:
  - maximum number of entries in the array is by default 2, but can be set to an alternative value using the compile-time option `GP_MAX_SINK_GROUP_LIST` (see [Section 1.14](#))
  - actual number of entries in the array is as indicated in the field `u8ZgpsGroupListEntries`
- `sZgpdKey` is a security key for the GP device
- `sUnicastSinkAddr[]` is an array of the sink unicast addresses for the GP device, where each array element is a `tsGP_ZgpsSinkAddrList` structure containing the 16-bit network address and 64-bit IEEE/MAC address of a sink node (see [Section 1.12.5](#)). Note that the:
  - maximum number of entries in the array is by default 2, but can be set to an alternative value using the compile-time option `GP_MAX_UNICAST_SINK` (see [Section 1.14](#))
  - actual number of entries in the array is as indicated in the field `u8NoOfUnicastSink`

---

### 1.12.5 tsGP\_ZgpsSinkAddrList

This structure of type `tsGP_ZgpsSinkAddrList` contains the 16-bit network address and 64-bit IEEE/MAC address of a sink node.

```
typedef struct
{
    uint16 u16SinkNWKAddress;
    uint64 u64SinkIEEEAddress;
}tsGP_ZgpsSinkAddrList;
```

where:

- `u16SinkNWKAddress` is the network address of the sink node
- `u64SinkIEEEAddress` is the IEEE/MAC address of the sink node

---

### 1.12.6 tuGP\_ZgpdDeviceAddr

The union of type `tuGP_ZgpdDeviceAddr` contains a 32-bit GP address or the IEEE/MAC address for a GP device, depending on the Application ID.

```
typedef union
{
    uint32_t          u32ZgpdSrcId;
    tsGP_ZgpdDeviceAddrAppId2  sZgpdDeviceAddrAppId2;
}tuGP_ZgpdDeviceAddr;
```

where:

- `u32ZgpdSrcId` is a 32-bit source address for the GP device
- `sZgpdDeviceAddrAppId2` is a structure containing the 64-bit IEEE/MAC address of the GP device and an endpoint (see [Section 1.12.7](#))

---

### 1.12.7 tsGP\_ZgpdDeviceAddrAppId2

This structure of type `tsGP_ZgpdDeviceAddrAppId2` contains the 64-bit IEEE/MAC address of a GP device and the local endpoint used for the GP device.

```
typedef struct
{
    uint8_t    u8EndPoint;
    uint64_t    u64ZgpdIEEEAddr;
}tsGP_ZgpdDeviceAddrAppId2;
```

where:

- `u8EndPoint` is the number of the local endpoint that is used for the GP device - this allows multiple GP devices (on multiple endpoints) to use the same radio channel
- `u64ZgpdIEEEAddr` is the 64-bit IEEE/MAC address of the GP device

### 1.12.8 tsGP\_ZgpCommissionIndication

The structure `tsGP_ZgpCommissionIndication` contains the data for an event of the type `E_GP_COMMISSION_DATA_INDICATION`, which is generated when a GP frame arrives (directly from a source GP device or via a proxy node) and the local node is in commissioning mode.

```
typedef struct
{
    teGP_CommandType          eCmdType;
    teZCL_Status              eStatus;
    tsGP_GpToZclCommandInfo   *psGpToZclCommandInfo;
    bool                      bIsTunneledCmd;
    zbmap8                    b8AppId;
    tuGP_ZgpdDeviceAddr       uZgpdDeviceAddr;
    union
    {
        tsGP_ZgpCommissionCmdPayload          sZgpCommissionCmd;
        tsGP_ZgpDataCmdWithAutoCommPayload    sZgpDataCmd;
    } uCommands;
} tsGP_ZgpCommissionIndication;
```

where:

- `eCmdType` is an enumeration indicating the received commissioning command type (for the enumerations, refer to [Section 1.13.8](#))
- `eStatus` is a status field which should be updated to `E_ZCL_SUCCESS` or `E_ZCL_FAIL` by the application after checking the Default Translation Table entries for the relevant GP device and command
- `psGpToZclCommandInfo` is a pointer to a Translation Table entry which may be populated by the application if it finds a default entry for the GP device (see [Section 1.12.10](#))
- `bIsTunneledCmd` is a Boolean that indicates whether the commissioning command was received directly from the source GP device or tunneled via a proxy node:
  - `TRUE`: Received as a tunneled message (via proxy)
  - `FALSE`: Received directly from GP device
- `b8AppId` is the Application ID used by the GP device, indicating the type of address used to identify the GP device:
  - `0x00`: 32-bit GP source address
  - `0x02`: 64-bit IEEE/MAC address
- `uZgpdDeviceAddr` contains the address of the GP device address (see [Section 1.12.6](#)) of the address type indicated in the `b8AppId` field.



- `uCommands` is a union containing the command payload in one of the following forms (depending on the commissioning command type specified by the `eCmdType` field):
  - `sZgpCommissionCmd` is a structure containing the payload of a GP commissioning command from a GP device (see [Section 1.12.12](#))
  - `sZgpDataCmd` is a structure containing the payload of a GP frame (with the auto-commissioning flag set to TRUE) from a GP device (see [Section 1.12.15](#))

---

## 1.12.9 tsGP\_ZgpsGroupList

The `tsGP_ZgpsGroupList` structure contains a sink group list entry for groupcast communications.

```
typedef struct
{
    uint16    ul6SinkGroup;
    uint16    ul6Alias;
}tsGP_ZgpsGroupList;
```

where:

- `ul6SinkGroup` is the group address, either pre-commissioned or derived
- `ul6Alias` is the alias to be used jointly with the above group address, either pre-commissioned or derived

---

## 1.12.10 tsGP\_GpToZclCommandInfo

The `tsGP_GpToZclCommandInfo` structure contains data for a Default Translation Table entry. This data corresponds to a particular GP source device type (identified by its Device ID) and a particular GP command (identified by its Command ID) supported by the device type.

```
struct tsGP_GpToZclCommandInfo
{
    teGP_ZgpdDeviceId        eZgpdDeviceId;
    teGP_ZgpdCommandId       eZgpdCommandId;
    uint8                    u8ZbCommandId ;
    uint8                    u8EndpointId;
    uint16                   u16ZbClusterId ;
    uint8                    u8ZbCmdLength ;
    uint8                    au8ZbCmdPayload[GP_MAX_ZB_CMD_PAYLOAD_LENGTH] ;
};
```

where:

- `eZgpDeviceId` is the identifier of the GP source device type (Device ID enumerations are provided - see [Section 1.13.6](#))
- `eZgpCommandId` is the identifier of the GP command to be translated (Command ID enumerations are provided - see [Section 1.13.7](#))
- `u8ZbCommandId` is the identifier of the cluster command into which the GP command is translated
- `u8EndpointId` is the local endpoint for which the translation is valid
- `u16ZbClusterId` is the identifier of the cluster to which the translated command belongs
- `u8ZbCmdLength` is the length, in bytes, of the cluster command into which the GP command is translated
- `au8ZbCmdPayload` is an array which contains the payload of the cluster command into which the GP command is translated

### 1.12.11 tsGP\_TranslationTableEntry

The `tsGP_TranslationTableEntry` structure contains an entry for the Translation Table in RAM. This entry corresponds to a particular source GP device, identified by its address. It points to the Default Translation Table entries (in Flash memory) for the relevant GP device type and commands.

```
struct tsGP_TranslationTableEntry
{
    zbmap8                b8Options;
    tuGP_ZgpDeviceAddr    uZgpDeviceAddr;
    uint8                 u8NoOfCmdInfo;
    tsGP_GpToZclCommandInfo *psGpToZclCmdInfo;
};
```

where:

- `b8Options` is an 8-bit bitmap indicating the options related to this table:

Bits	Sub-field
0-2	Application ID: <ul style="list-style-type: none"> <li>• 000: GP device identified by 32-bit GP address</li> <li>• 001: Reserved</li> <li>• 010: GP device identified by 64-bit IEEE/MAC address</li> <li>• 011-111: Reserved</li> </ul>
3-7	Reserved

- `uZgpDeviceAddr` is a structure containing the address of the GP device that issued the GP command (see [Section 1.12.6](#)) - the type of address depends on the value of the 'Application ID' sub-field of `b8Options` above (0 indicates 32-bit GP address, 2 indicates 64-bit IEEE/MAC address)

- `u8NoOfCmdInfo` is the number of commands in the Translation Table entry for this GP device (and therefore in the array pointed to by `psGpToZclCmdInfo`).
- `psGpToZclCmdInfo` is a pointer to an array of Default Translation Table entries for the relevant GP device type and GP commands for this GP device (see [Section 1.12.10](#)).

### 1.12.12 tsGP\_ZgpCommissionCmdPayload

The `tsGP_ZgpCommissionCmdPayload` structure contains the payload of a GP commissioning command issued by a GP device.

```
typedef struct
{
    uint8          u8ApplicationInfo;
    uint8          u8NoOfGPDCCommands;
    uint8          u8NoOfClusters;
    teGP_ZgpdDeviceId eZgpdDeviceId;
    zbmap8         b8Options;
    zbmap8         b8ExtendedOptions;
    uint16         u16ManufID;
    uint16         u16ModelID;
    uint32         u32ZgpdKeyMic;
    uint32         u32ZgpdOutgoingCounter;
    uint8          u8CommandList[GP_COMM_MAX_COUNT_COMMAND_ID];
    uint16         u16ClusterList[GP_COMM_MAX_COUNT_CLUSTER];
    tsZCL_Key      sZgpdKey;
}tsGP_ZgpCommissionCmdPayload;
```

where:

- `u8ApplicationInfo` is a bitmap indicating the application information fields that are contained in the GP commissioning command, as follows:

Bit	Field
0	Manufacturer ID ( <code>u16ManufID</code> ): 1 - present, 0 - not present
1	Model ID ( <code>u16ModelID</code> ): 1 - present, 0 - not present
2	GP device commands ( <code>u8CommandList[]</code> ): 1 - present, 0 - not present
3	Cluster list ( <code>u16ClusterList[]</code> ): 1 - present, 0 - not present
4-7	Reserved

- `u8NoOfGPDCCommands` is the number of GP device commands contained in the `u8CommandList[]` field (if applicable).
- `u8NoOfClusters` is the number of cluster IDs contained in the `u16ClusterList[]` field (if applicable).

- `eZgpdDeviceId` is the identifier of the GP source device type (Device ID enumerations are provided - see [Section 1.13.6](#))
- `b8Options` is an 8-bit bitmap containing options related to this command, as follows:

Bit	Sub-field
0	Sequence number capabilities: <ul style="list-style-type: none"> <li>• 0: Uses random MAC sequence number</li> <li>• 1: Uses incremental MAC sequence number</li> </ul>
1	RxOn capability: <ul style="list-style-type: none"> <li>• 0: Receiver disabled in operational mode</li> <li>• 1: Receiver enabled in operational mode</li> </ul>
2	Reserved
3	Reserved
4	PAN ID request: <ul style="list-style-type: none"> <li>• 0: GP device is not requesting the PAN ID of the ZigBee network</li> <li>• 1: GP device is requesting the PAN ID of the ZigBee network</li> </ul>
5	GP security key request: <ul style="list-style-type: none"> <li>• 0: GP device is not requesting the GP security key</li> <li>• 1: GP device is requesting the GP security key</li> </ul>
6	Fixed location: <ul style="list-style-type: none"> <li>• 0: Node can change its position during operation of the network</li> <li>• 1: Node is not expected to change its position during operation of the network</li> </ul>
7	Extended options: <ul style="list-style-type: none"> <li>• 0: <code>b8ExtendedOptions</code> field (below) is not present in the structure</li> <li>• 1: <code>b8ExtendedOptions</code> field (below) is present in the structure</li> </ul>

- `b8ExtendedOptions` is a 8-bit bitmap containing the extended options related to this command. This field will be present only if it is enabled in `b8Options` (above) and the GP device is capable of supporting security. The extended options are as follows (for further details, refer to the ZigBee Green Power Specification):

Bits	Use
0-1	Security level capabilities: <ul style="list-style-type: none"> <li>• 00: No security level specified in frame</li> <li>• 01: 1-byte (LSB) of frame counter and short (2-byte) MIC</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>

Bits	Use
2-4	Security key type: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul>
5	GPD key present: <ul style="list-style-type: none"> <li>• 0: <code>sZgpdKey</code> field (below) is not present</li> <li>• 1: <code>sZgpdKey</code> field (below) is present</li> </ul>
6	GPD key encryption: <ul style="list-style-type: none"> <li>• 0: GPD key is not encrypted</li> <li>• 1: GPD key is encrypted</li> </ul>
7	GPD outgoing counter present: <ul style="list-style-type: none"> <li>• 0: <code>u32ZgpdOutgoingCounter</code> field (below) is not present</li> <li>• 1: <code>u32ZgpdOutgoingCounter</code> field (below) is present</li> </ul>

- `u16ManufID` is the manufacturer ID (if applicable) - it is typically present when the GP command list and/or cluster list are manufacturer-specific.
- `u16ModelID` is the manufacturer-defined identifier of the product type (if applicable).
- `u32ZgpdKeyMic` is the Message Integrity Code (MIC) for the encrypted GPD key (only present if encryption is enabled via bit 6 of `b8ExtendedOptions`).
- `u32ZgpdOutgoingCounter` is the 32-bit security frame counter for the GP device (only present if enabled via bit 7 of `b8ExtendedOptions`).
- `u8CommandList[]` is an array containing the GP device commands (if applicable), with one command per array element. The number of commands (and therefore array elements) is indicated in `u8NoOfGPDCCommands`. The maximum number of commands supported is specified by `GP_COMM_MAX_COUNT_COMMAND_ID` (default is 4) and the application can set this value.
- `u16ClusterList[]` is an array containing the cluster IDs (if applicable), with one cluster ID per array element. The number of clusters (and therefore array elements) is indicated in `u8NoOfClusters`. The maximum number of clusters supported is specified by `GP_COMM_MAX_COUNT_CLUSTER` (default is 4) and the application can set this value.
- `sZgpdKey` is a GDP security key for the GP device (only present if enabled via bit 5 of `b8ExtendedOptions`).

### 1.12.13 tsGP\_ZgpCommissioningNotificationCmdPayload

The `tsGP_ZgpCommissioningNotificationCmdPayload` structure contains the payload data for a commissioning notification, which is issued by a GP client to tunnel a GP command containing commissioning data.

```
typedef struct
{
    teGP_ZgpdCommandId      eZgpdCmdId;
    uint8                   u8GPP_GPD_Link;
    uint16                  u16ZgppShortAddr;
    zbmap16                 b16Options;
    uint32                  u32ZgpdSecFrameCounter;
    uint32                  u32Mic;
    tuGP_ZgpdDeviceAddr     uZgpdDeviceAddr;
    tsZCL_OctetString       sZgpdCommandPayload;
} tsGP_ZgpCommissioningNotificationCmdPayload;
```

where:

- `eZgpdCmdId` is the identifier copied from the 'Command ID' field of the GP command (for the command enumerations, refer to [Section 1.13.7](#)).
- `u8GPP_GPD_Link` indicates the 'distance' from the GP proxy node to the source GP device node to be used. This is a bitmap, as follows:

Bits	Sub-field
0-5	Capped RSSI value
6-7	LQI value

This is an optional field which will be valid if the 'Rx After Tx' sub-field of the `b16Options` field (see below) is set to '1'.

- `u16ZgppShortAddr` is the network address of the GP proxy node to be used. This is an optional field which will be valid if the 'Appoint Temp Master' sub-field of the `b16Options` field (see below) is set to '1'.
- `b16Options` is a 16-bit bitmap containing the options related to this command:

Bits	Sub-field
0-2	Application ID: <ul style="list-style-type: none"> <li>• 000: GP device identified by 32-bit GP address</li> <li>• 001: Reserved</li> <li>• 010: GP device identified by 64-bit IEEE/MAC address</li> <li>• 011-111: Reserved</li> </ul>
3	'Rx After Tx' capability of the GP device: <ul style="list-style-type: none"> <li>• 1: Receiver on after transmission</li> <li>• 0: No receive capability</li> </ul>

Bits	Sub-field
4-5	Security Level (copied from GP frame received from GP device): <ul style="list-style-type: none"> <li>• 00: No security level specified in frame</li> <li>• 01: Reserved</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
6-8	Security Key Type: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul> For further details, refer to the ZigBee Green Power Specification.
9	Security Processing Failed: <ul style="list-style-type: none"> <li>• 1: Commissioning frame was secured but security check failed</li> <li>• 0: Otherwise</li> </ul>
10	Bidirectional capability of the Proxy device: <ul style="list-style-type: none"> <li>• 1: Supports bidirectional commissioning</li> <li>• 0: Does not support bidirectional commissioning</li> </ul>
11	Proxy device information present: <ul style="list-style-type: none"> <li>• 1: 16-bit network address and GPP-GPD link are present</li> <li>• 0: 16-bit network address and GPP-GPD link are not present</li> </ul>
12-15	Reserved

- `u32ZgpdSecFrameCounter` is the 32-bit security frame counter for the GP device
- `u32Mic` is the Message Integrity Code (MIC) of the GP command from the GP device. This is an optional field which will be valid if the 'Security Processing Failed' sub-field of the `b16Options` field (see above) is set to '1'
- `uZgpdDeviceAddr` contains the address copied from the 'Source ID' or 'MAC Header Source Address' field of the GP command from the GP device, depending on the value of the 'Application ID' sub-field in the GP command (0 indicates 32-bit GP address, 2 indicates 64-bit IEEE/MAC address)
- `sZgpdCommandPayload` is a byte string containing the payload of the GP command, copied from the GP command's 'Payload' field

---

### 1.12.14 tsGP\_ZgpDecommissionIndication

The structure `tsGP_ZgpDecommissionIndication` contains the data for an event of the type `E_GP_DECOMM_CMD_RCVD`, which is generated when a GP decommissioning command arrives (directly from a source GP device or via a proxy node) and the local node is in commissioning mode.

```
typedef struct
{
    uint8                                u8ApplicationId;
    tuGP_ZgpDeviceAddr                  uZgpDeviceAddr;
}tsGP_ZgpDecommissionIndication;
```

where :

- `u8ApplicationId` is the 'Application ID' contained in the GP command, indicating the type of address used to identify the GP device:
  - `0x00`: 32-bit GP source address
  - `0x02`: 64-bit IEEE/MAC address
- `uZgpDeviceAddr` is a structure containing the address of the GP device that issued the GP command - see [Section 1.12.6](#). The type of address depends on the value of `u8ApplicationId` above

---

### 1.12.15 tsGP\_ZgpDataCmdWithAutoCommPayload

The `tsGP_ZgpDataCmdWithAutoCommPayload` structure contains the payload of a GP data command issued by a GP device.

```
typedef struct
{
    teGP_ZgpCommandId                  eZgpCmdId;
    uint8                              u8ZgpCmdPayloadLength;
    uint8                              *pu8ZgpCmdPayload;
}tsGP_ZgpDataCmdWithAutoCommPayload;
```

where:

- `eZgpCmdId` is the identifier of GP command (for the command enumerations, refer to [Section 1.13.7](#))
- `u8ZgpCmdPayloadLength` is the payload length, in bytes, of the GP command
- `pu8ZgpCmdPayload` is a pointer to the payload of the GP command



### 1.12.16 tsGP\_ZgpsTranslationUpdateEntry

The `tsGP_ZgpsTranslationUpdateEntry` structure contains the translation table entry data for inclusion in the payload of a Translation Update command (see [Section 1.12.17](#)).

```
typedef struct
{
    uint8          u8Index;
    teGP_ZgpdCommandId  eZgpdCommandId;
    uint8          u8EndpointId;
    uint16         u16ProfileID;
    uint16         u16ZbClusterId;
    uint8          u8ZbCommandId;
    uint8          u8ZbCmdLength ;
    uint8          au8ZbCmdPayload[GP_MAX_ZB_CMD_PAYLOAD_LENGTH];
} tsGP_ZgpsTranslationUpdateEntry;
```

where:

- `u8Index` is the index of translation table entry to be updated
- `u16ProfileID` is the identifier of the ZigBee application profile supported on the target sink node
- `eZgpdCommandId` is the GP command ID to be mapped (for the command enumerations, refer to [Section 1.13.7](#))
- `u8EndpointId` is the number of the application endpoint for which this translation valid
- `u16ZbClusterId` is the identifier if the cluster which supports the translated command
- `u8ZbCommandId` is the ZigBee command ID of the target command
- `u8ZbCmdLength` is the length of the command (in bytes)
- `au8ZbCmdPayload` is an array of bytes containing the command payload (the number of array elements is indicated in the `u8ZbCmdLength` field)

### 1.12.17 tsGP\_ZgpTranslationUpdateCmdPayload

The `tsGP_ZgpTranslationUpdateCmdPayload` structure contains the payload of a Translation Update command, which is issued by a GP cluster client in order to update the translation table on a sink node.

```
typedef struct
{
    zbmap16                                b16Options;
    tuGP_ZgpdDeviceAddr                    uZgpdDeviceAddr;
    tsGP_ZgpsTranslationUpdateEntry
        asTranslationUpdateEntry[GP_MAX_TRANSLATION_UPDATE_ENTRY];
}tsGP_ZgpTranslationUpdateCmdPayload;
```

where:

- `b16Options` is a 16-bit bitmap indicating the options related to the command:

Bits	Sub-field
0-2	Application ID: <ul style="list-style-type: none"> <li>• 000: GP device identified by 32-bit GP address</li> <li>• 001: Reserved</li> <li>• 010: GP device identified by 64-bit IEEE/MAC address</li> <li>• 011-111: Reserved</li> </ul>
3-4	Action: <ul style="list-style-type: none"> <li>• 00: Add translation table entry</li> <li>• 01: Remove translation table entry</li> <li>• 10: Replace translation table entry</li> <li>• 11: Reserved</li> </ul>
5-7	Number of translation table entries included in the command
8-15	Reserved

- `uZgpdDeviceAddr` is a structure containing the address of the GP device that issued the command (see [Section 1.12.6](#)) - the type of address depends on the value of the 'Application ID' sub-field of `b16Options` above (0 indicates 32-bit GP address, 2 indicates 64-bit IEEE/MAC address)
- `asTranslationUpdateEntry` is an array of structures containing the data for the translation table entries to be updated

## 1.12.18 tsGP\_ZgpTransTableResponseCmdPayload

The `tsGP_ZgpTransTableResponseCmdPayload` structure contains the payload of a Translation Table Response, which is issued by a sink node as a result of a Translation Table Request.

```
typedef struct
{
    uint8      u8Status;
    zbmap8     b8Options;
    uint8      u8TotalNumOfEntries;
    uint8      u8StartIndex;
    uint8      u8EntriesCount;
    tsGP_ZgpsTransTblRspEntry
        asTransTblRspEntry[GP_MAX_TRANSLATION_RESPONSE_ENTRY];
}tsGP_ZgpTransTableResponseCmdPayload;
```

where:

- `u8Status` is the status resulting from the corresponding Translation Table Request and can take the value `SUCCESS` or `NOT_SUPPORTED`
- `b8Options` is a bitmap containing the following information:

Bits	Description
0-2	Application ID - Indicates the use of the GPD ID field in <code>sTransTblRspEntry</code> : <ul style="list-style-type: none"> <li>• 0b000 - contains Source ID of GP device</li> <li>• 0b010 - contains IEEE address of GP device</li> </ul> All other values are reserved
3-7	Reserved

- `u8TotalNumOfEntries` is the total number of entries in the translation table on the sink node (from which the response originates)
- `u8StartIndex` specifies the index in the translation table on the sink node (from which the response originates) of the first entry contained in the response
- `u8EntriesCount` is the number of translation table entries contained in the array `asTransTblRspEntry` (it is the number of array elements)
- `asTransTblRspEntry` is an array of structures containing the translation table entries reported in the response (see [Section 1.12.24](#))

---

### 1.12.19 tsGP\_ZgpsTranslationTableUpdate

The `tsGP_ZgpsTranslationTableUpdate` structure contains the data for an event of the type `E_GP_TRANSLATION_TABLE_UPDATE`, which is generated when a Translation Table Update command is received. This event will be generated for each translation received in the command and, therefore, this structure contains the data for one translation.

```
typedef struct
{
    teGP_GreenPowerStatus          eStatus;
    teGP_TranslationTableUpdateAction eAction;
    uint8                          u8ApplicationId;
    tuGP_ZgpdDeviceAddr            uZgpdDeviceAddr;
    tsGP_ZgpsTranslationUpdateEntry *psTranslationUpdateEntry;
} tsGP_ZgpsTranslationTableUpdate;;
```

where:

- `eStatus` is a status field which should be updated by the application to indicate whether application is able to process the received translation successfully - the possible values are:
  - `E_GP_TRANSLATION_UPDATE_SUCCESS`
  - `E_GP_TRANSLATION_UPDATE_FAIL`
- `eAction` specifies the action to be performed in the update, as one of:
  - `E_GP_TRANSLATION_TABLE_ADD_ENTRY`
  - `E_GP_TRANSLATION_TABLE_REPLACE_ENTRY`
  - `E_GP_TRANSLATION_TABLE_REMOVE_ENTRY`

For details of these actions, refer to [Section 1.13.11](#).

- `u8ApplicationId` indicates the type of address used to identify the GP device to which the translation table entry relates:
  - `0x00`: 32-bit GP source address
  - `0x02`: 64-bit IEEE/MAC address
- `uZgpdDeviceAddr` is a union containing a 32-bit GP source address or the 64-bit IEEE/MAC address for the GP device (see [Section 1.12.6](#)), as specified by `u8ApplicationId`
- `psTranslationUpdateEntry` is a pointer to the data to be used by the application to update the translation table entry (see [Section 1.12.16](#))

## 1.12.20 tsGP\_ZgpPairingConfigCmdPayload

The `tsGP_ZgpPairingConfigCmdPayload` structure contains the payload data for a Pairing Configuration command, which is issued by a GP client in order to create/update/remove/replace a pairing entry in the sink table on a sink node.

```
typedef struct
{
    uint8                u8Actions;
    teGP_ZgpdDeviceId    eZgpdDeviceId;
    uint8                u8ZgpsGroupListEntries;
    uint8                u8ForwardingRadius;
    zbmap8               b8SecOptions;
    uint8                u8NumberOfPairedEndpoints;
    uint8                au8PairedEndpoints[GP_MAX_PAIRED_ENDPOINTS];
    zbmap16              b16Options;
    uint16               u16ZgpdAssignedAlias;
    uint32               u32ZgpdSecFrameCounter;
    tuGP_ZgpdDeviceAddr  uZgpdDeviceAddr;
    tsGP_ZgpsGroupList   asZgpsGroupList[GP_MAX_SINK_GROUP_LIST];
    tsZCL_Key            sZgpdKey;
}tsGP_ZgpPairingConfigCmdPayload;
```

where:

- `u8Actions` is an 8-bit bitmap containing the actions for the sink node to perform on receiving the Pairing Configuration command - enumerations are provided (see [Section 1.13.12](#))
- `eZgpdDeviceId` is the identifier of the GP source device type (Device ID enumerations are provided - see [Section 1.13.6](#))
- `u8ZgpsGroupListEntries` is the number of entries in the group list for the GP device
- `u8ForwardingRadius` is the maximum radius (number of hops) for a groupcast communication of a command forwarded from the GP device

- `b8SecOptions` is an 8-bit bitmap containing the security options for the GP device:

Bits	Sub-field
0-1	Security level: <ul style="list-style-type: none"> <li>• 00: No security</li> <li>• 01: Reserved</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
2-4	Security key type: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul> For further details, refer to the ZigBee Green Power Specification.
5-7	Reserved

- `u8NumberOfPairedEndpoints` is number of endpoints listed in the field `au8PairedEndpoints` (below)
- `au8PairedEndpoints` is an array of the paired endpoint list for the GP device, where each array element contains the number of an endpoint with which the GP device can be paired
- `b16Options` is a 16-bit bitmap containing options for the GP device:

Bits	Sub-field
0-2	Application ID: <ul style="list-style-type: none"> <li>• 000: GP device identified by 32-bit GP address</li> <li>• 001: Reserved</li> <li>• 010: GP device identified by 64-bit IEEE/MAC address</li> <li>• 011-111: Reserved</li> </ul>
3-4	Communication mode: <ul style="list-style-type: none"> <li>• 00: Unicast forwarding of GP notifications by (all) proxies</li> <li>• 01: Groupcast forwarding of GP notifications to a 'derived' group</li> <li>• 10: Groupcast forwarding of GP notifications to a 'pre-commissioned' group</li> <li>• 11: Unicast forwarding of GP notifications by proxies supporting the lightweight unicast feature (without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command)</li> </ul>
5	Sequence number capabilities: <ul style="list-style-type: none"> <li>• 0: Uses random MAC sequence number</li> <li>• 1: Uses incremental MAC sequence number</li> </ul>
6	RxOn capability: <ul style="list-style-type: none"> <li>• 0: Receiver disabled in operational mode</li> <li>• 1: Receiver enabled in operational mode</li> </ul>

Bits	Sub-field
7	Fixed location: <ul style="list-style-type: none"> <li>• 0: Node can change its position during operation of the network</li> <li>• 1: Node is not expected to change its position during operation of the network</li> </ul>
8	Assigned alias: <ul style="list-style-type: none"> <li>• Uses assigned alias (specified in <code>u16ZgpdAssignedAlias</code> below)</li> <li>• Does not use assigned alias</li> </ul>
9	Security use: <ul style="list-style-type: none"> <li>• Uses security frame counter (specified in <code>u32ZgpdSecFrameCounter</code> below)</li> <li>• Does not use security frame counter</li> </ul>
10-15	Reserved

- `u16ZgpdAssignedAlias` is an assigned 16-bit alias address for the GP device (if used)
- `u32ZgpdSecFrameCounter` is a 32-bit security frame counter for the GP device (if used)
- `uZgpdDeviceAddr` is a union containing a 32-bit GP address or the 64-bit IEEE/MAC address for the GP device (see Section 1.7.5)
- `asZgpsGroupList` is an array of the group list for the GP device, where each array element is a structure containing a 16-bit group address and alias (see [Section 1.12.9](#)). Note that the:
  - The maximum number of entries in the array is 2, by default, but can be set to an alternative value using the compile-time option `GP_MAX_SINK_GROUP_LIST` (see [Section 1.12.9](#))
  - The actual number of entries in the array is as indicated in the field `u8ZgpsGroupListEntries`
- `sZgpdKey` is a security key for the GP device (not required if a common or derived key is used)

### 1.12.21 tsGP\_ZgpSinkTableRequestCmdPayload

The `tsGP_ZgpPairingConfigCmdPayload` structure contains the payload data for a Sink Table Request command, which requests the sink table entry corresponding to a specified GP address or all the sink table entries starting at a specified table index.

```
typedef struct
{
    zbmap8                b8Options;
    tuGP_ZgpdDeviceAddr   uZgpdDeviceAddr;
    uint8                 u8Index;
}tsGP_ZgpSinkTableRequestCmdPayload;
```

where:

- `b8Options` is a bitmap containing options concerned with the method of specifying the required sink table entry or entries:

Bits	Description
0-2	Application ID indicating the type of address used to identify the GP device: <ul style="list-style-type: none"><li>• 0: 32-bit GP source address</li><li>• 2: 64-bit IEEE/MAC address</li></ul> All other values are reserved.
3-4	Request type - method of identifying the relevant sink table entry or entries: <ul style="list-style-type: none"><li>• 0: Address of source GP device</li><li>• 1: Start index in sink table</li></ul> All other values are reserved.
5-7	Reserved

- `uZgpdDeviceAddr` is a structure containing the address of the GP device for which the sink table entry is required. This field is valid only if the request type specified in the `b8Options` bitmap is by address.
- `u8Index` is the start index of the required sink table entries. This field is valid only if the request type specified in the `b8Options` bitmap is by index.



## 1.12.22 tsGP\_ZgpProxyTableRequestCmdPayload

The `tsGP_ZgpProxyTableRequestCmdPayload` structure contains the payload data for a Proxy Table Request command, which requests the proxy table entry corresponding to a specified GP address or all the proxy table entries starting at a specified table index.

```
typedef struct
{
    zbmap8                b8Options;
    tuGP_ZgpdDeviceAddr   uZgpdDeviceAddr;
    uint8                 u8Index;
}tsGP_ZgpProxyTableRequestCmdPayload;
```

where:

- `b8Options` is a bitmap specifying options concerned with the method of specifying the required proxy table entry or entries:

Bits	Description
0-2	Application ID indicating the type of address used to identify the GP device: <ul style="list-style-type: none"> <li>• 0: 32-bit GP source address</li> <li>• 2: 64-bit IEEE/MAC address</li> </ul> All other values are reserved.
3-4	Request type - method of identifying the relevant proxy table entry or entries: <ul style="list-style-type: none"> <li>• 0: Address of GP device</li> <li>• 1: Start Index in proxy table</li> </ul> All other values are reserved.
5-7	Reserved

- `uZgpdDeviceAddr` is a structure containing the address of the GP device for which the proxy table entry is required. This field is valid only if the request type specified in the `b8Options` bitmap is by address.
- `u8Index` is the start index of the required proxy table entries. This field is valid only if the request type specified in the `b8Options` bitmap is by index.

### 1.12.23 tsGP\_ZgpsPairingConfigCmdRcvd

The `tsGP_ZgpsPairingConfigCmdRcvd` structure contains the data for an event of the type `E_GP_PAIRING_CONFIGURATION_CMD_RCVD`, which is generated when a Pairing Configuration command is received.

```
typedef struct
{
    teGP_GreenPowerPairingConfigAction  eAction;
    teGP_PairingConfigTranslationTableAction
                                     eTranslationTableAction;

    teGP_ZgpdDeviceId                 eZgpdDeviceId;
    teGP_GreenPowerCommunicationMode  eCommunicationMode;
    uint8                             u8ApplicationId;
    tuGP_ZgpdDeviceAddr               uZgpdDeviceAddr;
    uint8                             u8NumberOfPairedEndpoints;
    uint8                             au8PairedEndpointList[GP_MAX_PAIRED_ENDPOINTS];
    uint8                             u8SinkGroupListEntries;
    tsGP_ZgpsGroupList                asSinkGroupList[GP_MAX_SINK_GROUP_LIST];
} tsGP_ZgpsPairingConfigCmdRcvd;
```

where:

- `eAction` is a value indicating the action to perform as a result of the received command - enumerations are provided (see [Section 1.13.12](#))
- `eTranslationTableAction` is a value indicating the action to be performed in the translation table as a result of the received command - enumerations are provided (see [Section 1.13.13](#))
- `eZgpdDeviceId` is the identifier of the GP source device type - Device ID enumerations are provided (see [Section 1.13.6](#))
- `eCommunicationMode` indicates the communication mode used by the Pairing Configuration command:
  - 00: Unicast forwarding by (all) proxies
  - 01: Groupcast forwarding to a 'derived' group
  - 10: Groupcast forwarding to a 'pre-commissioned' group
  - 11: Unicast forwarding of GP notifications by proxies supporting the lightweight unicast feature (without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command)
- `u8ApplicationId` indicates the type of address used to identify the GP device in the command:
  - 0x00: 32-bit GP source address
  - 0x02: 64-bit IEEE/MAC address

- `uZgpdDeviceAddr` is a union containing a 32-bit GP source address or the 64-bit IEEE/MAC address for the GP device (see [Section 1.12.6](#)), as specified by `u8ApplicationId`
- `u8NumberOfPairedEndpoints` is the number of endpoints contained in the array `au8PairedEndpoints` (it is the number of array elements)
- `au8PairedEndpoints` is an array of the local endpoints to be paired with the GP device as a result of the received command
- `u8SinkGroupListEntries` is the number of group IDs contained in the array `asSinkGroupList` (it is the number of array elements)
- `asSinkGroupList` is an array containing the group IDs to be included in the sink table entry, with one group ID per array element - the number of array elements is indicated in the `u8SinkGroupListEntries` field

---

### 1.12.24 `tsGP_ZgpsTransTblRspEntry`

The `tsGP_ZgpsTransTblRspEntry` structure contains the translation entry data for the payload of a Translation Table Response command, which is issued by a sink node as the result of Translation Table Request command.

```
typedef struct
{
    teGP_ZgpdCommandId      eZgpdCommandId;
    uint8                   u8ZbCommandId ;
    uint8                   u8EndpointId;
    uint16                  u16ProfileID;
    uint16                  u16ZbClusterId ;
    uint8                   u8ZbCmdLength ;
    uint8
        au8ZbCmdPayload[GP_MAX_ZB_CMD_PAYLOAD_LENGTH];
    tuGP_ZgpdDeviceAddr     uZgpdDeviceAddr;
} tsGP_ZgpsTransTblRspEntry;
```

where :

- `eZgpdCommandId` is the identifier of the GP command to be translated (Command ID enumerations are provided - see [Section 1.13.7](#))
- `u8ZbCommandId` is the identifier of the cluster command into which the GP command is translated (for the command enumerations, refer to [Section 1.13.7](#))
- `u8EndpointId` is the endpoint for which the translation is valid
- `u16ProfileID` is the identifier of the ZigBee application profile supported on the node.
- `u16ZbClusterId` is the identifier of the cluster to which the translated command belongs

- `u8ZbCmdLength` is the length, in bytes, of the cluster command into which the GP command is translated
- `au8ZbCmdPayload` is an array which contains the payload of the cluster command into which the GP command is translated
- `uZgpdDeviceAddr` is a union containing a 32-bit GP address or the 64-bit IEEE/MAC address for the GP device (see [Section 1.12.6](#))

---

### 1.12.25 `tsGP_SinkTableRespCmdPayload`

The structure `tsGP_SinkTableRespCmdPayload` contains the data for an event of the type `E_GP_ZGPD_SINK_TABLE_RESPONSE_RCVD`, which is generated on client when a GP Sink Table Response is received from the server in reply to a GP Sink Table Request.

```
typedef struct
{
    uint8      u8Status;
    uint8      u8TotalNoOfEntries;
    uint8      u8StartIndex;
    uint8      u8EntriesCount;
    uint16     ul6SizeOfSinkTableEntries;
    uint8      *puSinkTableEntries;
}tsGP_SinkTableRespCmdPayload;
```

where:

- `u8Status` is the status of Sink Table Request and can take the value `E_ZCL_SUCCESS` or `E_ZCL_CMDS_NOT_FOUND`.
- `u8TotalNoOfEntries` is the total number of sink table entries present on the server.
- `u8StartIndex` is the position of first sink table entry included in the response (when requested by index). The value 0 corresponds to the first non-empty entry in the sink table.
- `u8EntriesCount` is the number of sink table entries included in the response.
- `puSinkTableEntries` is a pointer to the returned sink table entries - the format is described in the ZigBee Green Power specification.

---

### 1.12.26 tsGP\_ProxyTableRespCmdPayload

The structure `tsGP_ProxyTableRespCmdPayload` contains the data for an event of the type `E_GP_ZGPD_PROXY_TABLE_RESPONSE_RCVD`, which is generated on a server/commissioning tool when a Proxy Table Response is received from a client in reply to a Proxy Table Request.

```
typedef struct tsGP_ProxyTableRespCmdPayload
{
    uint8      u8Status;
    uint8      u8TotalNoOfEntries;
    uint8      u8StartIndex;
    uint8      u8EntriesCount;
    uint16     ul6SizeOfProxyTableEntries;
    uint8      *puProxyTableEntries;
}tsGP_ProxyTableRespCmdPayload;
```

where:

- `u8Status` is the status of Proxy Table Request and can take the value `E_ZCL_SUCCESS` or `E_ZCL_CMDS_NOT_FOUND`.
- `u8TotalNoOfEntries` is the total number of proxy table entries present on the client.
- `u8StartIndex` is the position of first proxy table entry included in the response (when requested by index). The value 0 corresponds to the first non-empty entry in the proxy table.
- `u8EntriesCount` is the number of proxy table entries included in the response.
- `puProxyTableEntries` is a pointer to the returned proxy table entries - the format is described in the ZigBee Green Power specification.

---

### 1.12.27 tsGP\_ZgpResponseCmdPayload

The structure `tsGP_ZgpResponseCmdPayload` contains the data for an event of the type `E_GP_RESPONSE_RCVD`, which is generated on a client when a GP Response is received (from a server) which is to be passed to a GP device.

```
typedef struct
{
    zbmap8      b8Options;
    zbmap8      b8TempMasterTxChannel;
    teGP_ZgpdCommandId  eZgpdCmdId;
    uint16     ul6TempMasterShortAddr;
    tuGP_ZgpdDeviceAddr  uZgpdDeviceAddr;
    tsZCL_OctetString  sZgpdCommandPayload;
}tsGP_ZgpResponseCmdPayload;
```

where:

- `b8Options` is a bitmap containing the following options:

Bits	Name	Description
0-2	Application ID	Indicates whether bit 3 (below) is used, and determines the length and meaning of the <code>uZgpDeviceAddr</code> field: <ul style="list-style-type: none"> <li>• 000 - <code>uZgpDeviceAddr</code> contains the GP device's source ID and is 4 bytes long, and Bit 3 is not used.</li> <li>• 010 - <code>uZgpDeviceAddr</code> contains the GP device's IEEE/MAC address and is 8 bytes long, and Bit 3 is used.</li> </ul>
3	Transmit on endpoint match	Indicates whether a matching endpoint number is needed for GP Response delivery: <ul style="list-style-type: none"> <li>• 0 - Endpoint number is not needed</li> <li>• 1 - If Application ID (bits 0-2) is 010, the GP Response will be delivered only to a GP device with a matching endpoint number</li> </ul>
4-7	Reserved	-

- `b8TempMasterTxChannel` is the number of the radio channel on which the response will be sent in a GP device frame to the GP device.
- `eZgpCmdId` is the GP command ID (for the command enumerations, refer to [Section 1.13.7](#)).
- `u16TempMasterShortAddr` is the address of the proxy node which will transmit the GP device frame to the GP device.
- `uZgpDeviceAddr` is a structure containing the target GP device address (see [Section 1.12.6](#)).
- `sZgpCommandPayload` is the command payload for the GP device frame.

## 1.12.28 tsGP\_ZgpNotificationCmdPayload

The structure `tsGP_ZgpNotificationCmdPayload` contains the data for an event of the type `E_GP_NOTIFICATION_RCVD`, which is generated on the server when a GP Notification command is received from a client that has received a GP command.

```
typedef struct
{
    teGP_ZgpdCommandId      eZgpdCmdId;
    uint8                   u8GPP_GPD_Link;
    uint16                  u16ZgppShortAddr;
    zbmap16                 b16Options;
    uint32                  u32ZgpdSecFrameCounter;
    tuGP_ZgpdDeviceAddr     uZgpdDeviceAddr;
    tsZCL_OctetString       sZgpdCommandPayload;
}tsGP_ZgpNotificationCmdPayload;
```

where:

- `eZgpdCmdId` is the command ID of the GP command (for the command enumerations, refer to [Section 1.13.7](#)).
- `u8GPP_GPD_Link` indicates the quality of the GP device frame in which the command was received.
- `u16ZgppShortAddr` is the 16-bit network address of the proxy node that received the GP command and sent the GP Notification command.
- `b16Options` is a bitmap containing the following options:

Bits	Name	Description
0-2	Application ID	Determines the length and meaning of the <code>uZgpdDeviceAddr</code> field, and whether the target endpoint number is present in the GP command: <ul style="list-style-type: none"> <li>• 000 - <code>uZgpdDeviceAddr</code> contains the GP device's source ID and is 4 bytes long, and endpoint number is absent</li> <li>• 010 - <code>uZgpdDeviceAddr</code> contains the GP device's IEEE/MAC address and is 8 bytes long, and endpoint number is present</li> </ul>
3	Unicast	If set (to 1), indicates that a sink node is paired with the GP device, requiring a unicast to the sink node.
4	Derived Group	If set (to 1), indicates that a derived group of sink nodes is associated with the GP device, requiring a groupcast.
5	Commissioned Group	If set (to 1), indicates that a pre-commissioned group of sink nodes is associated with the GP device, requiring a groupcast.

Bits	Name	Description
6-7	Security Level	Security level of received GP command: <ul style="list-style-type: none"> <li>• 00: No security</li> <li>• 01: Reserved</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
8-10	Security Key Type	Security key type for received GP command: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul> For further details, refer to the ZigBee Green Power Specification.
11	Rx After Tx	If set (to 1), indicates that the receiver is on after a transmit on the GP device.
12	GP Tx Queue Full	If set (to 1), indicates that the proxy node can still receive and store a GP Response for the GP device.
13	Bidirectional capability	If set (to 1), indicates that the node that sent the GP Notification command does NOT support bi-directional communication. Should always be set to 0 in the current GP version.
14	Proxy info present	If set (to 1), indicates that the fields <code>u8GPP_GPD_Link</code> and <code>u16ZgppShortAddr</code> (above) are present.
15	Reserved	-

- `u32ZgpdSecFrameCounter` is the frame counter value of the received GP command.
- `uZgpdDeviceAddr` is a structure containing the source GP device address (see [Section 1.12.6](#)).
- `sZgpdCommandPayload` contains the command payload of the GP device frame.



## 1.12.29 tsGP\_ZgpCommissioningNotificationCmdPayload

The structure `tsGP_ZgpCommissioningNotificationCmdPayload` contains the data for an event of the type `E_GP_COMM_NOTIFICATION_RCVD`, which is generated on the server when a GP Commissioning Notification command is received from a client that has received a GP command with the 'auto-commissioning' bit set (to indicate commissioning mode).

```
typedef struct
{
    uint8          u8ZgpdCmdId;
    uint8          u8GPP_GPD_Link;
    uint16         u16ZgppShortAddr;
    zbmap16        b16Options;
    uint32         u32ZgpdSecFrameCounter;
    uint32         u32Mic;
    tuGP_ZgpdDeviceAddr  uZgpdDeviceAddr;
    tsZCL_OctetString  sZgpdCommandPayload;
}tsGP_ZgpCommissioningNotificationCmdPayload;
```

where:

- `eZgpdCmdId` is the command ID of the GP command (for the command enumerations, refer to [Section 1.13.7](#)).
- `u8GPP_GPD_Link` indicates the quality of the GP device frame in which the command was received.
- `u16ZgppShortAddr` is the 16-bit network address of the proxy node that received the GP command and sent the GP Notification command.
- `b16Options` is a bitmap containing the following options:

Bits	Name	Description
0-2	Application ID	Determines the length and meaning of the <code>uZgpdDeviceAddr</code> field, and whether the target endpoint number is present in the GP command: <ul style="list-style-type: none"> <li>• 000 - <code>uZgpdDeviceAddr</code> contains the GP device's source ID and is 4 bytes long, and endpoint number is absent</li> <li>• 010 - <code>uZgpdDeviceAddr</code> contains the GP device's IEEE/MAC address and is 8 bytes long, and endpoint number is present</li> </ul>
3	Rx After Tx	If set (to 1), indicates that the receiver is on after a transmit on the GP device.

Bits	Name	Description
4-5	Security Level	Security level of received GP command: <ul style="list-style-type: none"> <li>• 00: No security</li> <li>• 01: Reserved</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
6-8	Security Key Type	Security key type for received GP command: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul> For further details, refer to the ZigBee Green Power Specification.
9	Security processing failed	If set (to 1), indicates that the security processing of the received GP command has failed.
10	Bidirectional capability	If set (to 1), indicates that the node that sent the GP Commissioning Notification command does NOT support bi-directional communication. Should always be set to 0 in the current GP version.
11	Proxy info present	If set (to 1), indicates that the fields <code>u8GPP_GPD_Link</code> and <code>u16ZgppShortAddr</code> (above) are present.
12-15	Reserved	-

- `u32ZgpdSecFrameCounter` is the frame counter value of the received GP command.
- `u32Mic` contains the MIC when the security processing fails.
- `uZgpdDeviceAddr` is a structure containing the source GP device address (see [Section 1.12.6](#)).
- `sZgpdCommandPayload` contains the command payload of the GP device frame.

### 1.12.30 tsGP\_ZgpPairingCmdPayload

The structure `tsGP_ZgpPairingCmdPayload` contains the data for an event of the type `E_GP_PAIRING_CMD_RCVD`, which is generated on a client when a GP Pairing command is received from the server.

```
typedef struct
{
    uint8          u8DeviceId;
    uint8          u8ForwardingRadius;
    uint16         u16SinkGroupID;
    uint16         u16AssignedAlias;
    zbmap24        b24Options;
    uint32         u32ZgpdSecFrameCounter;
    uint16         u16SinkNwkAddress;
    uint64         u64SinkIEEEAddress;
    tuGP_ZgpdDeviceAddr uZgpdDeviceAddr;
    tsZCL_Key      sZgpdKey;
}tsGP_ZgpPairingCmdPayload;
```

where:

- `u8DeviceId` is the device ID for the GP device to which the pairing relates.
- `u8ForwardingRadius` is the radius (maximum number of hops) in the network for groupcast forwarding of the GP device frame.
- `u16SinkGroupID` is the address of the group to which the sink node that originated the GP Pairing command belongs.
- `u16AssignedAlias` contains the 'assigned alias' (pre-commissioned) network address to be used for this GP device instead of the 'derived' network address.
- `b24Options` is a bitmap containing the following options:

Bits	Name	Description
0-2	Application ID	Determines the length and meaning of the <code>uZgpdDeviceAddr</code> field, and whether the target endpoint number is present in the GP command: <ul style="list-style-type: none"> <li>000 - <code>uZgpdDeviceAddr</code> contains the GP device's source ID and is 4 bytes long, and endpoint number is absent</li> <li>010 - <code>uZgpdDeviceAddr</code> contains the GP device's IEEE/MAC address and is 8 bytes long, and endpoint number is present</li> </ul>
3	Add Sink	Indicates whether the sink node is requesting the addition or removal of a pairing for the GP device. <ul style="list-style-type: none"> <li>1 - Add pairing</li> <li>0 - Remove pairing</li> </ul>

Bits	Name	Description
4	Remove GPD	Indicates whether the sink node is requesting that the GP device is removed from the network. <ul style="list-style-type: none"> <li>• 1 - Remove GP device from network</li> <li>• 0 - Do not remove GP device from network</li> </ul>
5-6	Communication mode	Contains information about the accepted tunnelling modes for this GP device: <ul style="list-style-type: none"> <li>• 00: Unicast forwarding of GP notifications by (all) proxies</li> <li>• 01: Groupcast forwarding of GP notifications to a 'derived' group</li> <li>• 10: Groupcast forwarding of GP notifications to a 'pre-commissioned' group</li> <li>• 11: Unicast forwarding of GP notifications by proxies supporting the lightweight unicast feature (without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command)</li> </ul>
7	GPD Fixed	If set (to 1), indicates that the GP device is fixed.
8	GPD MAC sequence number capabilities	If set (to 1), indicates that the GP device supports MAC sequence numbers.
9-10	Security Level	Security level supported by the GP device: <ul style="list-style-type: none"> <li>• 00: No security</li> <li>• 01: Reserved</li> <li>• 10: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 11: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
11-13	Security Key Type	Security key type supported by the GP device: <ul style="list-style-type: none"> <li>• 000: No key</li> <li>• 001: ZigBee network key</li> <li>• 010: GPD group key</li> <li>• 011: Network key derived from GPD group key</li> <li>• 100: Individual out-of-box GPD key</li> <li>• 101-110: Reserved</li> <li>• 111: Individual derived GPD key</li> </ul> For further details, refer to the ZigBee Green Power Specification.
14	GPD security Frame Counter present	If set (to 1), indicates that a security frame counter is present.
15	GPD security key present	If set (to 1), indicates that a security key is present.
16	Assigned Alias present	If set (to 1), indicates that an 'assigned alias' is present.
17	Forwarding Radius present	If set (to 1), indicates that a forwarding radius is present (specified in the field <code>u8ForwardingRadius</code> ).
18-23	Reserved	-

- `u32ZgpdSecFrameCounter` is the frame counter value for the received GP command.
- `u32Mic` is the MIC when the security processing fails.
- `u16SinkNwkAddress` contains the network address of the sink node - it is present if full or lightweight unicast communication mode is requested.
- `u64SinkIEEEAddress` contains the IEEE/MAC address of the sink node - it is present if full or lightweight unicast communication mode is requested.
- `uZgpdDeviceAddr` is a structure containing the GP device address (see [Section 1.12.6](#)).
- `sZgpdKey` is the key to be used for securing messages exchanged with this GP device.

---

## 1.13 Enumerations

---

### 1.13.1 'Attribute ID' Enumerations

---

The following structure contains the enumerations used to identify the attributes of the Green Power cluster.

```
typedef enum PACK
{
    /* Server Attribute IDs */
    E_CLD_GP_ATTR_ZGPS_MAX_SINK_TABLE_ENTRIES = 0x0000,
    E_CLD_GP_ATTR_ZGPS_SINK_TABLE,
    E_CLD_GP_ATTR_ZGPS_COMMUNICATION_MODE,
    E_CLD_GP_ATTR_ZGPS_COMMISSIONING_EXIT_MODE,
    E_CLD_GP_ATTR_ZGPS_COMMISSIONING_WINDOW,
    E_CLD_GP_ATTR_ZGPS_SECURITY_LEVEL,
    E_CLD_GP_ATTR_ZGPS_FEATURES,
    E_CLD_GP_ATTR_ZGPS_ACTIVE_FEATURES,

    /* Client Attribute IDs */
    E_CLD_GP_ATTR_ZGPP_MAX_PROXY_TABLE_ENTRIES = 0x0010,
    E_CLD_GP_ATTR_ZGPP_PROXY_TABLE,
    E_CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_NUMBER,
    E_CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_TIMER,
    E_CLD_GP_ATTR_ZGPP_MAX_SEARCH_COUNTER,
    E_CLD_GP_ATTR_ZGPP_BLOCKED_ZGPD_ID,
    E_CLD_GP_ATTR_ZGPP_FUNCTIONALITY,
    E_CLD_GP_ATTR_ZGPP_ACTIVE_FUNCTIONALITY,

    /* Shared Attributes between server and client */
    E_CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY_TYPE = 0x0020,
    E_CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY,
    E_CLD_GP_ATTR_ZGP_LINK_KEY
}teGP_GreenPowerClusterAttrIds;
```

The attributes corresponding to the above enumerations are listed in [Table 6](#) below. For details of these attributes, refer to [Section 1.3](#).

Enumeration	Attribute
E_CLD_GP_ATTR_ZGPS_MAX_SINK_TABLE_ENTRIES	u8ZgpsMaxSinkTableEntries
E_CLD_GP_ATTR_ZGPS_SINK_TABLE	sSinkTable
E_CLD_GP_ATTR_ZGPS_COMMUNICATION_MODE	b8ZgpsCommunicationMode
E_CLD_GP_ATTR_ZGPS_COMMISSIONING_EXIT_MODE	b8ZgpsCommissioningExitMode
E_CLD_GP_ATTR_ZGPS_COMMISSIONING_WINDOW	u16ZgpsCommissioningWindow
E_CLD_GP_ATTR_ZGPS_SECURITY_LEVEL	b8ZgpsSecLevel
E_CLD_GP_ATTR_ZGPS_FEATURES	b24ZgpsFeatures
E_CLD_GP_ATTR_ZGPS_ACTIVE_FEATURES	b24ZgpsActiveFeatures
E_CLD_GP_ATTR_ZGPP_MAX_PROXY_TABLE_ENTRIES	u8ZgppMaxProxyTableEntries
E_CLD_GP_ATTR_ZGPP_PROXY_TABLE	sProxyTable
E_CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_NUMBER	u8ZgppNotificationRetryNumber
E_CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_TIMER	u8ZgppNotificationRetryTimer
E_CLD_GP_ATTR_ZGPP_MAX_SEARCH_COUNTER	u8ZgppMaxSearchCounter
E_CLD_GP_ATTR_ZGPP_BLOCKED_ZGPD_ID	sZgppBlockedGpdID
E_CLD_GP_ATTR_ZGPP_FUNCTIONALITY	b24ZgppFunctionality
E_CLD_GP_ATTR_ZGPP_ACTIVE_FUNCTIONALITY	b24ZgppActiveFunctionality
E_CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY_TYPE	b8ZgpSharedSecKeyType
E_CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY	sZgpSharedSecKey
E_CLD_GP_ATTR_ZGP_LINK_KEY	sZgpLinkKey

**Table 6: Green Power Attribute ID Enumerations**

---

### 1.13.2 'Green Power Event' Enumerations

The event types generated by the Green Power cluster are enumerated in the `teGP_GreenPowerCallBackEventType` structure below.

```
typedef enum PACK
{
    E_GP_COMMISSION_DATA_INDICATION = 0x00,
    E_GP_COMMISSION_MODE_ENTER,
    E_GP_COMMISSION_MODE_EXIT,
    E_GP_CMD_UNSUPPORTED_PAYLOAD_LENGTH,
    E_GP_SINK_PROXY_TABLE_ENTRY_ADDED,
    E_GP_SINK_PROXY_TABLE_FULL,
    E_GP_ZGPD_COMMAND_RCVD,
    E_GP_ZGPD_CMD_RCVD_WO_TRANS_ENTRY,
    E_GP_ADDING_GROUP_TABLE_FAIL,
    E_GP_RECEIVED_CHANNEL_REQUEST,
    E_GP_TRANSLATION_TABLE_RESPONSE_RCVD,
    E_GP_TRANSLATION_TABLE_UPDATE,
    E_GP_SECURITY_LEVEL_MISMATCH,
    E_GP_SECURITY_PROCESSING_FAILED,
    E_GP_REMOVING_GROUP_TABLE_FAIL,
    E_GP_PAIRING_CONFIGURATION_CMD_RCVD,
    E_GP_PERSIST_SINK_PROXY_TABLE,
    E_GP_SUCCESS_CMD_RCVD,
    E_GP_DECOMM_CMD_RCVD,
    E_GP_SHARED_SECURITY_KEY_TYPE_IS_NOT_ENABLED,
    E_GP_SHARED_SECURITY_KEY_IS_NOT_ENABLED,
    E_GP_LINK_KEY_IS_NOT_ENABLED,
    E_GP_ZGPD_SINK_TABLE_RESPONSE_RCVD,
    E_GP_ZGPD_PROXY_TABLE_RESPONSE_RCVD,
    E_GP_NOTIFICATION_RCVD,
    E_GP_COMM_NOTIFICATION_RCVD,
    E_GP_RESPONSE_RCVD,
    E_GP_PAIRING_CMD_RCVD,
    E_GP_PAIRING_CONFIG_CMD_RCVD,
    E_GP_CBET_ENUM_END
}teGP_GreenPowerCallBackEventType;
```



The above event types are described in [Table 7](#) below. For further information on these events and event handling, refer to [Section 1.9](#).

Enumeration	Event Description
E_GP_COMMISSION_DATA_INDICATION	Generated on a Green Power cluster server on receiving a commissioning command (GP frame with auto-commissioning flag set to '1') directly from a GP device or via a proxy node, with the server in commissioning mode.
E_GP_COMMISSION_MODE_ENTER	Generated on the Green Power cluster on receiving a Proxy Commissioning Mode command with the 'Enter' action.
E_GP_COMMISSION_MODE_EXIT	Generated on the Green Power cluster on receiving a Proxy Commissioning Mode command with the 'Exit' action or when the commissioning window timeout has expired or when node pairing has been successfully completed.
E_GP_CMD_UNSUPPORTED_PAYLOAD_LENGTH	Generated on a Green Power cluster on receiving a GP frame with a payload which is longer than the maximum set in the <b>zcl_options.h</b> file (see <a href="#">Section 1.14</a> ).
E_GP_SINK_TABLE_ENTRY_ADDED	Generated on a Green Power cluster server when a sink table entry is created as the result of receiving a commissioning command (GP frame with auto-commissioning flag set to '1') from a GP device, with the server is in commissioning mode.
E_GP_SINK_TABLE_FULL	Generated on a Green Power cluster server on receiving a commissioning command (GP frame with auto-commissioning flag set to '1') from a GP device, with the server is in commissioning mode, but there is no free entry remaining in the sink table.
E_GP_ZGPD_COMMAND_RCVD	Generated on a Green Power cluster server when a GP command has been received (either directly from the GP device or indirectly via a proxy node), and entries for the node/command have been found in the local sink and translation tables.
E_GP_ZGPD_CMD_RCVD_WO_TRANS_ENTRY	Generated on a Green Power cluster server when a GP command has been received (either directly from the GP device or indirectly via a proxy node) but there is no matching translation table entry for the node/command or a NULL translation table pointer was passed to the GP cluster via <b>eGP_RegisterComboBasicEndPoint()</b> during initialisation.
E_GP_ADDING_GROUP_TABLE_FAIL	Generated on a Green Power cluster server on receiving a commissioning command (GP frame with auto-commissioning flag set to '1'), with the server in commissioning mode, but the cluster fails to add a group table entry.
E_GP_RECEIVED_CHANNEL_REQUEST	Generated on a Green Power cluster client on a Proxy Basic device when a Channel Request from a GP device has been received during commissioning.

**Table 7: Green Power Event Enumerations**

Enumeration	Event Description
E_GP_TRANSLATION_TABLE_RESPONSE_RCVD	Generated on a Green Power cluster client when a Translation Table Response is received.
E_GP_TRANSLATION_TABLE_UPDATE	Generated on a Green Power cluster server when a Translation Table Update command is received. This event will be generated for each translation in the received command.
E_GP_SECURITY_LEVEL_MISMATCH	Generated on a Green Power cluster server or client when a received GP frame (directly from a GP device) does not support the minimum security level required by the GP infrastructure device.
E_GP_SECURITY_PROCESSING_FAILED	Generated on a Green Power cluster server or client when a received GP frame (directly from a GP device) fails the security processing performed by the GP infrastructure device.
E_GP_REMOVING_GROUP_TABLE_FAIL	Generated on a Green Power cluster server when a Pairing Configuration command is received in which the action field is one of ...REPLACE_SINK_TABLE_ENTRY ...REMOVE_SINK_TABLE_ENTRY ...CONFIG_REMOVE_GPD (each prefixed with E_GP_PAIRING_CONFIG_) but the cluster fails to remove a group table entry.
E_GP_PAIRING_CONFIGURATION_CMD_RCVD	Generated on a Green Power cluster server when a Pairing Configuration command is received. The application should then add or delete the relevant translation table entry.
E_GP_PERSIST_ATTRIBUTE_DATA	Generated on a Green Power cluster server or client to prompt the application to store attribute data in non-volatile memory.
E_GP_SUCCESS_CMD_RCVD	Generated on a Green Power cluster server when a GP frame is received directly from a GP device or via a proxy node, with the server in commissioning mode, to inform the user that commissioning has been successful.
E_GP_DECOMM_CMD_RCVD	Generated on a Green Power cluster server when a Decommission command is received directly from a GP device or via a proxy node, with the server in commissioning mode. The application should then remove translation table entries for the relevant GP device.
E_GP_SHARED_SECURITY_KEY_TYPE_IS_NOT_ENABLED	Generated on a Green Power cluster server or client when a secured GP frame is received and security is enabled but there is no security key type selected on the receiving device.
E_GP_SHARED_SECURITY_KEY_IS_NOT_ENABLED	Generated on a Green Power cluster server or client when a secured GP frame is received and security is enabled but there is no shared security key defined on the receiving device.

**Table 7: Green Power Event Enumerations**

Enumeration	Event Description
E_GP_LINK_KEY_IS_NOT_ENABLED	Generated on a Green Power cluster server when an encrypted security key is received and security is enabled but there is no individual link key defined on the receiving device.
E_GP_ZGPD_SINK_TABLE_RESPONSE_RCVD	Generated on a Green Power cluster client when a Sink Table Response is received from a server.
E_GP_ZGPD_PROXY_TABLE_RESPONSE_RCVD	Generated on a Green Power cluster server when a Proxy Table Response is received from a server.
E_GP_NOTIFICATION_RCVD	Generated on a Green Power cluster server when a GP Notification command is received from a client.
E_GP_COMM_NOTIFICATION_RCVD	Generated on a Green Power cluster server when a GP Commissioning Notification command is received from a client.
E_GP_RESPONSE_RCVD	Generated on a Green Power cluster client when a GP Response command is received from a server.
E_GP_PAIRING_CMD_RCVD	Generated on a Green Power cluster client when a GP Pairing command is received from a server.
E_GP_PAIRING_CONFIG_CMD_RCVD	Generated on a Green Power cluster client when a GP Pairing Configuration command is received from a server.

**Table 7: Green Power Event Enumerations**

### 1.13.3 'Green Power Infrastructure Device' Enumerations

The Green Power 'infrastructure devices' (see [Section 1.2.2](#)) are enumerated in the `teGP_GreenPowerDeviceType` structure below:

```
typedef enum
{
    E_GP_ZGP_PROXY_BASIC_DEVICE    = 0x00,
    E_GP_ZGP_PROXY_DEVICE,
    E_GP_ZGP_TARGET_PLUS_DEVICE,
    E_GP_ZGP_TARGET_DEVICE,
    E_GP_ZGP_COMM_TOOL_DEVICE,
    E_GP_ZGP_COMBO_DEVICE,
    E_GP_ZGP_COMBO_BASIC_DEVICE
}teGP_GreenPowerDeviceType;
```

The above enumerations are described in [Table 8](#) below.

Enumeration	Description
E_GP_ZGP_PROXY_DEVICE	<b>GP Proxy</b> device, which supports a GP cluster server and/or client
E_GP_ZGP_PROXY_BASIC_DEVICE	<b>GP Proxy Basic</b> device, which is a proxy device that supports only a GP cluster client
E_GP_ZGP_TARGET_PLUS_DEVICE	<b>GP Target Plus</b> device, which is a sink device that supports a GP cluster server and/or client with full receive capability as a client and optionally a transmit capability as a server
E_GP_ZGP_TARGET_DEVICE	<b>GP Target</b> device, which is a sink device that supports a GP cluster server and/or client with restricted receive capability as a client (does not support the GP stub in the stack, so is not capable of directly receiving GP frames from a GP device)
E_GP_ZGP_COMM_TOOL_DEVICE	<b>GP Commissioning Tool</b> device, which supports only a GP cluster server with both transmit and receive capabilities
E_GP_ZGP_COMBO_DEVICE	<b>GP Combo</b> device, which is a combined proxy/sink device that supports a GP cluster server and/or client with a receive capability as a client and a transmit capability as a server
E_GP_ZGP_COMBO_BASIC_DEVICE	<b>GP Combo Basic</b> device, which is a combined proxy/sink device that supports a GP cluster server and/or client with a receive capability as a client and optionally a transmit capability as a server

**Table 8: Green Power Infrastructure Device Enumerations**

Full details of the above GP infrastructure devices can be found in the ZigBee Green Power Specification.

*The current ZigBee Green Power release from NXP supports only the Proxy Basic device (E\_GP\_ZGP\_PROXY\_BASIC\_DEVICE) and Combo Basic device (E\_GP\_ZGP\_COMBO\_BASIC\_DEVICE).*

### 1.13.4 'Green Power Device Mode' Enumerations

The GP device modes are enumerated in the `teGP_GreenPowerDeviceMode` structure below:

```
typedef enum
{
    E_GP_OPERATING_MODE = 0x00,
    E_GP_PAIRING_COMMISSION_MODE,
    E_GP_REMOTE_COMMISSION_MODE,
}teGP_GreenPowerDeviceMode;
```

The above enumerations are described in [Table 9](#) below.

Enumeration	Description
E_GP_OPERATING_MODE	GP device is in operating mode
E_GP_PAIRING_COMMISSION_MODE	GP device is in pairing mode
E_GP_REMOTE_COMMISSION_MODE	GP device is in remote pairing mode

**Table 9: Green Power Device Mode Enumerations**

### 1.13.5 'Communication Mode' Enumerations

The possible communication modes between the GP source and sink nodes are enumerated in the `teGP_GreenPowerCommunicationMode` structure below.

```
typedef enum PACK
{
    E_GP_UNI_FORWARD_ZGP_NOTIFICATION_BY_PROXIES_BOTH = 0x00,
    E_GP_GROUP_FORWARD_ZGP_NOTIFICATION_TO_DGROUP_ID,
    E_GP_GROUP_FORWARD_ZGP_NOTIFICATION_TO_PRE_COMMISSION_GROUP_ID,
    E_GP_UNI_FORWARD_ZGP_NOTIFICATION_BY_PROXIES_LIGHTWEIGHT
}teGP_GreenPowerCommunicationMode;
```

The above enumerations are described in [Table 10](#) below.

Enumeration	Description
E_GP_UNI_FORWARD_ZGP_NOTIFICATION_BY_PROXIES_BOTH	Unicast forwarding of the GP Notification command by proxies
E_GP_GROUP_FORWARD_ZGP_NOTIFICATION_TO_DGROUP_ID	Groupcast forwarding of the GP Notification command to derived Group address
E_GP_GROUP_FORWARD_ZGP_NOTIFICATION_TO_PRE_COMMISSION_GROUP_ID	Groupcast forwarding of the GP Notification command to a pre-commissioned Group address
E_GP_UNI_FORWARD_ZGP_NOTIFICATION_BY_PROXIES_LIGHTWEIGHT	Unicast forwarding of the GP Notification command by proxies supporting the lightweight unicast functionality (without observing the tunnelling delay and without the transmission/reception of the GP Tunnelling Stop command)

**Table 10: Communication Mode Enumerations**

### 1.13.6 'GPD Device ID' Enumerations

The GPD Device IDs are enumerated in the `teGP_ZgpdDeviceId` structure below. These IDs represent the types of GP device. The GPD Device ID is included in a commissioning notification and can be translated into the corresponding ZigBee Device ID from the ZigBee application profile in use.

```
typedef enum PACK
{
    E_GP_ZGP_SIMPLE_GENERIC_ONE_STATE_SWITCH = 0x00,
    E_GP_ZGP_SIMPLE_GENERIC_TWO_STATE_SWITCH,
    E_GP_ZGP_ON_OFF_SWITCH,
    E_GP_ZGP_LEVEL_CONTROL_SWITCH,
    E_GP_ZGP_SIMPLE_SENSOR,
    E_GP_ZGP_ADVANCED_GENERIC_ONE_STATE_SWITCH,
    E_GP_ZGP_ADVANCED_GENERIC_TWO_STATE_SWITCH
}teGP_ZgpdDeviceId;
```

The above enumerations are described in [Table 11](#) below.

Enumeration	GPD Device
E_GP_ZGP_SIMPLE_GENERIC_ONE_STATE_SWITCH	GP Simple Generic 1-state Switch
E_GP_ZGP_SIMPLE_GENERIC_TWO_STATE_SWITCH	GP Simple Generic 2-state Switch
E_GP_ZGP_ON_OFF_SWITCH	GP On/Off Switch
E_GP_ZGP_LEVEL_CONTROL_SWITCH	GP Level Control Switch
E_GP_ZGP_SIMPLE_SENSOR	GP Simple Sensor
E_GP_ZGP_ADVANCED_GENERIC_ONE_STATE_SWITCH	GP Advanced Generic 1-state Switch
E_GP_ZGP_ADVANCED_GENERIC_TWO_STATE_SWITCH	GP Advanced Generic 2-state Switch

**Table 11: GPD Device ID Enumerations**

For more information on ‘GPD devices’, see the ZigBee Green Power Specification.

### 1.13.7 'GPD Command ID' Enumerations

The GPD Command IDs are enumerated in the `teGP_ZgpdCommandId` structure below. These IDs represent the types of GP command from the GP device. They can be translated into the corresponding ZigBee cluster command IDs from the ZigBee application profile in use.

```
typedef enum PACK
{
    E_GP_IDENTIFY = 0x00,
    E_GP_OFF = 0x20,
    E_GP_ON,
    E_GP_TOGGLE,
    E_GP_LEVEL_CONTROL_STOP = 0x34,
    E_GP_MOVE_UP_WITH_ON_OFF,
    E_GP_MOVE_DOWN_WITH_ON_OFF,
    E_GP_STEP_UP_WITH_ON_OFF,
    E_GP_STEP_DOWN_WITH_ON_OFF,
    E_GP_COMMISSIONING = 0xE0,
    E_GP_DECOMMISSIONING,
    E_GP_SUCCESS,
    E_GP_CHANNEL_REQUEST,
    E_GP_COMMISSIONING_REPLY = 0xF0,
    E_GP_CHANNEL_CONFIGURATION = 0xF3,
    E_GP_ATTRIBUTE_REPORTING,
    E_GP_SENSOR_COMMAND,
    E_GP_ZGPD_CMD_ID_ENUM_END
}teGP_ZgpdCommandId;
```

The above enumerations are described in [Table 12](#) below.

Enumeration	GPD Command
E_GP_IDENTIFY	Identify [Payloadless, CommandID=0x00]
E_GP_OFF	Off [Payloadless, CommandID=0x20]
E_GP_ON	On [Payloadless, CommandID=0x21]
E_GP_TOGGLE	Toggle [Payloadless, CommandID=0x22]
E_GP_LEVEL_CONTROL_STOP	Level Control/Stop [Payloadless, CommandID=0x34]
E_GP_MOVE_UP_WITH_ON_OFF	Move Up (with On/Off) [With payload, CommandID=0x35]
E_GP_MOVE_DOWN_WITH_ON_OFF	Move Down (with On/Off) [With payload, CommandID=0x36]
E_GP_STEP_UP_WITH_ON_OFF	Step Up (with On/Off) [With payload, CommandID=0x37]
E_GP_STEP_DOWN_WITH_ON_OFF	Step Down (with On/Off) [With payload, CommandID=0x38]
E_GP_COMMISSIONING	Commissioning [With payload, CommandID=0xE0]
E_GP_DECOMMISSIONING	Decommissioning [Payloadless, CommandID=0xE1]
E_GP_SUCCESS	Success [Payloadless, CommandID=0xE2]
E_GP_CHANNEL_REQUEST	Channel Request [Payloadless, CommandID=0xE3]
E_GP_COMMISSIONING_REPLY	Commissioning Reply [With payload, CommandID=0xF0]
E_GP_CHANNEL_CONFIGURATION	Channel Configuration [With payload, CommandID=0xF3]
E_GP_ATTRIBUTE_REPORTING	Attribute Report
E_GP_SENSOR_COMMAND	Sensor

**Table 12: GPD Command ID Enumerations**

For more information on 'GPD commands', see the ZigBee Green Power Specification.

### 1.13.8 'GPD Commissioning Command Type' Enumerations

The GPD Commissioning Command types are enumerated in the `teGP_CommandType` structure below. They represent the GP command types that can be issued during the commissioning phase (from a source GP device or proxy node).

```
typedef enum PACK
{
    E_GP_COMM_CMD = 0x00,
    E_GP_DATA_CMD_AUTO_COMM,
} teGP_CommandType;
```



The above enumerations are described in [Table 13](#) below.

Enumeration	Command Type
E_GP_COMM_CMD	Direct commissioning command (from GP device)
E_GP_DATA_CMD_AUTO_COMM	Direct data command with auto-commissioning flag set to '1' (from GP device)

**Table 13: GPD Commissioning Command Type Enumerations**

### 1.13.9 'Proxy Commissioning Mode' Enumerations

The enter/exit actions that can be specified in a Proxy Commissioning Mode command are enumerated in the `teGP_GreenPowerProxyCommissionMode` structure below.

```
typedef enum PACK
{
    E_GP_PROXY_COMMISSION_EXIT = 0x00,
    E_GP_PROXY_COMMISSION_ENTER,
}teGP_GreenPowerProxyCommissionMode;
```

The above enumerations are described in [Table 14](#) below.

Enumeration	Commissioning Mode
E_GP_PROXY_COMMISSION_EXIT	Enter proxy commissioning mode
E_GP_PROXY_COMMISSION_ENTER	Exit proxy commissioning mode

**Table 14: Proxy Commissioning Mode Enumerations**

### 1.13.10 'Sink Table Priority' Enumerations

The sink table priorities are enumerated in the `teGP_GreenPowerSinkTablePriority` structure below.

```
typedef enum PACK
{
    E_GP_SINK_TABLE_P_1 = 0x01,
    E_GP_SINK_TABLE_P_2,
    E_GP_SINK_TABLE_P_3
}teGP_GreenPowerSinkTablePriority;
```

The above enumerations are described in [Table 15](#) below.

Enumeration	Priority Description
E_GP_SINK_TABLE_P_1	Priority 1: Entry found in translation table
E_GP_SINK_TABLE_P_2	Priority 2: Entry not found in translation table but direct command received
E_GP_SINK_TABLE_P_3	Priority 3: Entry not found in translation table but tunnelled command received

**Table 15: Sink Table Priority Enumerations**

### 1.13.11 'Translation Table Update Action' Enumerations

The translation table update actions are enumerated in the `teGP_TranslationTableUpdateAction` structure below.

```
typedef enum PACK
{
    E_GP_TRANSLATION_TABLE_ADD_ENTRY = 0x00,
    E_GP_TRANSLATION_TABLE_REPLACE_ENTRY,
    E_GP_TRANSLATION_TABLE_REMOVE_ENTRY
} teGP_TranslationTableUpdateAction;
```

The above enumerations are described in [Table 16](#) below.

Enumeration	Action
E_GP_TRANSLATION_TABLE_ADD_ENTRY	Add a new translation in the table entry specified in the command. If the entry is already occupied, the action will be aborted. A specified entry index of 0xFF instructs the device to use any free entry in the translation table.
E_GP_TRANSLATION_TABLE_REPLACE_ENTRY	Replace the translation in the specified table entry with the new translation.
E_GP_TRANSLATION_TABLE_REMOVE_ENTRY	Delete the translation in the specified table entry.

**Table 16: Translation Table Update Action Enumerations**

### 1.13.12 'Pairing Configuration Action' Enumerations

The pairing configuration actions are enumerated in the `teGP_GreenPowerPairingConfigAction` structure below.

```
typedef enum
{
    E_GP_PAIRING_CONFIG_NO_ACTION,
    E_GP_PAIRING_CONFIG_EXTEND_SINK_TABLE_ENTRY,
    E_GP_PAIRING_CONFIG_REPLACE_SINK_TABLE_ENTRY,
    E_GP_PAIRING_CONFIG_REMOVE_SINK_TABLE_ENTRY,
    E_GP_PAIRING_CONFIG_REMOVE_GPD
}teGP_GreenPowerPairingConfigAction;
```

The above enumerations are described in [Table 16](#) below.

Enumeration	Action
E_GP_PAIRING_CONFIG_NO_ACTION	None
E_GP_PAIRING_CONFIG_EXTEND_SINK_TABLE_ENTRY	Extend a sink table entry
E_GP_PAIRING_CONFIG_REPLACE_SINK_TABLE_ENTRY	Replace a sink table entry with a new pairing
E_GP_PAIRING_CONFIG_REMOVE_SINK_TABLE_ENTRY	Remove a sink table entry for a pairing
E_GP_PAIRING_CONFIG_REMOVE_GPD	Remove a GP device from the sink table

**Table 17: Pairing Configuration Action Enumerations**

### 1.13.13 'Pairing Config Translation Table Action' Enumerations

The pairing configuration translation table update actions are enumerated in the `teGP_PairingConfigTranslationTableAction` structure below.

```
typedef enum PACK
{
    E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_ADD_ENTRY = 0x00,
    E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_REMOVE_ENTRY,
    E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_EXTEND_ENTRY,
    E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_NO_ACTION
} teGP_PairingConfigTranslationTableAction;
```

The above enumerations are described in [Table 18](#) below.

Enumeration	Action
E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_ADD_ENTRY	Add an entry to the translation table
E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_REMOVE_ENTRY	Remove an entry from the translation table
E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_EXTEND_ENTRY	Extend an existing entry in the translation table
E_GP_PAIRING_CONFIG_TRANSLATION_TABLE_NO_ACTION	Take no action on translation table

**Table 18: Pairing Config Translation Table Action Enumerations**

---

#### 1.13.14 'Reset-To-Default' Enumerations

The 'Reset-To-Default' enumerations are used in a bitmap with the function **vGP\_RestorePersistedData()** to indicate that whether attributes and sink/proxy tables need to be initialised to their defaults.

```
typedef enum
{
    E_GP_DEFAULT_ATTRIBUTE_VALUE = 0x01,
    E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE = 0x02,
} teGP_ResetToDefaultConfig;
```

The above enumerations are described in [Table 19](#) below.

Enumeration	Action
E_GP_DEFAULT_ATTRIBUTE_VALUE	Sets bit to initialise attributes to their default values
E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE	Sets bit to initialise sink/proxy tables to their defaults

**Table 19: Reset-To-Default Enumerations**

### 1.13.15 ‘Data Restore/Initialise’ Enumerations

The options for restoring from persisted data or initialising from default values are enumerated in the `teGP_ResetToDefaultConfig` structure below.

```
typedef enum
{
    E_GP_DEFAULT_ATTRIBUTE_VALUE = 0x01,
    E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE = 0x02,
}teGP_ResetToDefaultConfig;
```

The above enumerations are described in [Table 20](#) below.

Enumeration	Action
E_GP_DEFAULT_ATTRIBUTE_VALUE	Attributes initialised to their default values and sink/proxy table restored with persisted values
E_GP_DEFAULT_PROXY_SINK_TABLE_VALUE	Sink/proxy table initialised to default state and attributes restored with persisted values.

**Table 20: Data Restore/Initialise Enumerations**

Note that both the attributes and the sink/proxy table can be initialised to their default values by combining the above enumerations as follows:

E\_GP\_DEFAULT\_ATTRIBUTE\_VALUE | E\_GP\_DEFAULT\_PROXY\_SINK\_TABLE\_VALUE

### 1.13.16 ‘Security Level’ Enumerations

The security levels available for GP devices are enumerated in the `teGP_GreenPowerSecLevel` structure below.

```
typedef enum
{
    E_GP_NO_SECURITY = 0x00,
    E_GP_FULL_FC_FULL_MIC = 0x02,
    E_GP_ENC_FULL_FC_FULL_MIC
}teGP_GreenPowerSecLevel;
```

The above enumerations are described in [Table 21](#) below.

Enumeration	Action
E_GP_NO_SECURITY	No security
E_GP_FULL_FC_FULL_MIC	Full (4-byte) frame counter and full (4-byte) MIC only
E_GP_ENC_FULL_FC_FULL_MIC	Encryption with full (4-byte) frame counter and full (4-byte) MIC

**Table 21: Security Level Enumerations**

### 1.13.17 'Security Key Type' Enumerations

The security key types available for GP devices are enumerated in the `teGP_GreenPowerSecKeyType` structure below.

```
typedef enum
{
    E_GP_NO_KEY = 0x00,
    E_GP_ZIGBEE_NWK_KEY,
    E_GP_ZGPD_GROUP_KEY,
    E_GP_NWK_KEY_DERIVED_ZGPD_GROUP_KEY,
    E_GP_OUT_OF_THE_BOX_ZGPD_KEY,
    E_GP_DERIVED_INDIVIDUAL_ZGPD_KEY = 0x07
}teGP_GreenPowerSecKeyType;
```

The above enumerations are described in [Table 22](#) below.

Enumeration	Action
E_GP_NO_KEY	No key
E_GP_ZIGBEE_NWK_KEY	ZigBee network key
E_GP_ZGPD_GROUP_KEY	Green Power group key programmed into all GP devices of group
E_GP_NWK_KEY_DERIVED_ZGPD_GROUP_KEY	Green Power group key derived from network key
E_GP_OUT_OF_THE_BOX_ZGPD_KEY	Individual 'out-of-the-box' GP device key
E_GP_DERIVED_INDIVIDUAL_ZGPD_KEY	Individual GP device key derived from Green Power group key

**Table 22: Security Key Types Enumerations**

---

## 1.14 Compile-Time Options

To incorporate the Green Power feature in the code to be built (for a sink or proxy node), it is necessary to add the following to the **config.h** file:

```
#define CLD_GREENPOWER
```

In addition, to include the software for a Combo Basic device or Proxy Basic device, it is necessary to add one of the following to the same file:

```
#define GP_COMBO_BASIC_DEVICE  
#define GP_PROXY_BASIC_DEVICE
```

The following may also be defined in the **zcl\_options.h** file.

### Optional Attributes for Client

The optional attributes for the GP cluster client (see [Section 1.3](#)) are enabled by adding the following:

GPP Notification Retry Number attribute

```
#define CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_NUMBER
```

GPP Notification Retry Timer attribute

```
#define CLD_GP_ATTR_ZGPP_NOTIFICATION_RETRY_TIMER
```

GPP Maximum Search Counter attribute

```
#define CLD_GP_ATTR_ZGPP_MAX_SEARCH_COUNTER
```

GPP Blocked GPD ID attribute

```
#define CLD_GP_ATTR_ZGPP_BLOCKED_GPD_ID
```

### Optional Shared Attributes for Client and Server

The optional attributes that can be used on the GP cluster client and server (see [Section 1.3](#)) are enabled by adding the following:

GP Shared Security Key Type attribute

```
#define CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY_TYPE
```

GP Shared Security Key attribute

```
#define CLD_GP_ATTR_ZGP_SHARED_SECURITY_KEY
```

GP Link Key attribute

```
#define CLD_GP_ATTR_ZGP_LINK_KEY
```

### **Commissioning Window Attribute**

The optional Commissioning Window attribute can be enabled as follows:

```
#define CLD_GP_ATTR_ZGPS_COMMISSIONING_WINDOW
```

### **Number of Sink/Proxy Table Entries**

The maximum number of entries that can be stored in the sink/proxy table can be set to the value n as follows (default is 5):

```
#define GP_NUMBER_OF_PROXY_SINK_TABLE_ENTRIES n
```

### **Number of Unicast Sink List Entries**

The maximum number of sink unicast addresses that can be stored in the proxy table entry for a GP device can be set to the value n as follows (default is 2):

```
#define GP_MAX_UNICAST_SINK n
```

### **Number of Sink Group List Entries**

The maximum number of sink group addresses that can be stored in the proxy table entry for a GP device can be set to the value n as follows (default is 2):

```
#define GP_MAX_SINK_GROUP_LIST n
```

### **Number of Translation Table Entries**

The maximum number of entries that can be stored in the Translation Table can be set to the value n as follows (default is 5):

```
#define GP_NUMBER_OF_TRANSLATION_TABLE_ENTRIES n
```

### **Number of Duplicate Table Entries**

The maximum number of entries that can be stored in the duplicate table can be set to the value n as follows (default is 5):

```
#define GP_MAX_DUPLICATE_TABLE_ENTRIES n
```

### **Duplicate Table Entries Timeout**

The maximum timeout, in seconds, of the entries stored in the duplicate table can be set to the value n as follows (default is 2):

```
#define GP_ZGP_DUPLICATE_TIMEOUT n
```

### **Commissioning Window Duration**

The maximum duration of the commissioning window, in seconds, can be set to the value n as follows (default is 180):

```
#define GP_COMMISSION_WINDOW_DURATION n
```



## **ZigBee Command Payload Length**

When the Application ID is 0 (32-bit GP source address used), the maximum length of the ZigBee frame payload, in bytes, can be set to the value *n* as follows (default is 59):

```
#define GP_MAX_ZB_CMD_PAYLOAD_LENGTH n
```

When the Application ID is 2 (64-bit IEEE address used), the maximum length of the ZigBee frame payload, in bytes, can be set to the value *n* as follows (default is 27):

```
#define GP_MAX_ZB_CMD_PAYLOAD_LENGTH_APP_ID_2 n
```

## **Commissioning Command Payload Length**

When the Application ID is 0 (32-bit GP source address used), the maximum length of a commissioning command payload, in bytes, can be set to the value *n* as follows (default is 55):

```
#define GP_MAX_ZB_COMM_CMD_PAYLOAD_LENGTH n
```

When the Application ID is 2 (64-bit IEEE address used), the maximum length of a commissioning command payload, in bytes, can be set to the value *n* as follows (default is 50):

```
#define GP_MAX_ZB_COMM_CMD_PAYLOAD_LENGTH_APP_ID_2 n
```

## **Maximum Number of Sink Entries in Sink Table Response**

The maximum number of sink entries that can be handled in a Sink Table Response command can be set to the value *n* as follows (default is 70):

```
#define MAX_SINK_TABLE_ENTRIES_LENGTH n
```

## **Maximum Number of Proxy Entries in Proxy Table Response**

The maximum number of proxy entries that can be handled in a Proxy Table Response command can be set to the value *n* as follows (default is 70):

```
#define MAX_PROXY_TABLE_ENTRIES_LENGTH n
```

## **Maximum Number of Translation Entries in Translation Table Response**

The maximum number of translation entries that can be handled in a Translation Table Response command can be set to the value *n* as follows (default is 10):

```
#define GP_MAX_TRANSLATION_RESPONSE_ENTRY n
```

## **Maximum Number of Paired Endpoints**

The maximum number of paired endpoints that can be handled in a Pairing Configuration command can be set to the value *n* as follows (default is 5):

```
#define GP_MAX_PAIRED_ENDPOINTS n
```

### **Timeout for GP Device Response**

The maximum time to wait, in seconds, for a GPD Response can be set to the value n as follows (default is 5):

```
#define GP_MAX_PAIRED_ENDPOINTS n
```

### **Groupcast Radius**

The groupcast radius for groupcast forwarding can be set to the value n as follows (default is 15):

```
#define GP_GROUPCAST_RADIUS n
```

### **IEEE Address Support for ZGPDs (GP devices)**

IEEE address support for ZGPDs (GP devices) can be enabled as follows:

```
#define GP_IEEE_ADDR_SUPPORT
```

### **Disable Security for Certification/Testing**

Security is enabled by default on a GP infrastructure device but can be disabled for network joining and transmitting/receiving unsecured packets during certification or testing as follows:

```
#define GP_DISABLE_SECURITY_FOR_CERTIFICATION
```

### **Optional Commands (Disable)**

Optional commands can be disabled as follows:

Proxy Commissioning Mode command

```
#define GP_DISABLE_PROXY_COMMISSION_MODE_CMD
```

Commissioning Notification command

```
#define GP_DISABLE_COMMISSION_NOTIFICATION_CMD
```

Pairing Search command

```
#define GP_DISABLE_PAIRING_SEARCH_CMD
```

Translation Table Request command

```
#define GP_DISABLE_TRANSLATION_TABLE_REQ_CMD
```

Translation Table Response command

```
#define GP_DISABLE_TRANSLATION_TABLE_RSP_CMD
```

ZGP Response command

```
#define GP_DISABLE_ZGP_RESPONSE_CMD
```

## 1.15 Green Power Terminology

The following key terminology is used in the description of ZigBee Green Power in this manual:

Term	Description
Combo node	A node which acts as both a sink node and proxy node.
Duplicate table	A table on a sink or proxy node, containing a list of recently received GP commands, allowing duplicate received commands to be identified and discarded (see <a href="#">Section 1.4.1.4</a> )
GP device	A self-powered (energy harvesting or batteries) node which transmits a command in a (short) GP frame that is received by a proxy node in a ZigBee PRO network and is re-transmitted 'tunnelled' inside a ZigBee frame.
Proxy node	A network node that can receive a GP frame from a source GP device and 'tunnel' this frame within a ZigBee frame, which is passed on to other network nodes.
Proxy table	A table on a proxy node, containing a list of source GP devices which are in direct range and for which the local node acts as a proxy. A table entry stores pairing information about the GP device and the paired sink node.
Sink node	A network node that is paired with a GP device and is the target for commands issued by the GP device.
Sink table	A table on a sink or proxy node, containing the pairings of the local node with GP devices (see <a href="#">Section 1.4.1.2</a> ).
Translation table	A table on a sink node, containing entries for GP devices and their associated GP commands, used to translate a received command into a command from the ZigBee application profile on the sink node (see <a href="#">Section 1.4.1.1</a> ).
Tunnelling	The process of embedding a (GP) frame in the payload of a longer (ZigBee) frame.
ZGPD (ZigBee Green Power Device)	A GP device (see above).
ZGPP (ZigBee Green Power Proxy)	A GP proxy node (see above).
ZGPS (ZigBee Green Power Sink)	A GP sink node (see above).

**Table 23: Key Green Power Terms**



---

## 2. ZigBee PRO Stack Features for Green Power

This chapter describes the ZigBee PRO stack enhancements that support the ZigBee Green Power feature. These stack enhancements are supplied in the Kinetis SDK, provided that the SDK has been built to include ZigBee 3.0.

---

### 2.1 Stack Configuration

The ZigBee PRO stack must be configured to support the Green Power feature on a device that will be used as a GP proxy node or sink node. The initialisation required in the application on the node is outlined in [Section 1.5](#) and includes enabling the GP feature in the ZigBee PRO stack, which is described in detail below.

This stack configuration is carried out in the file `zps_globals.c` ZPS Configuration Editor, which is described in the *ZigBee 3.0 Stack User Guide (ZB3STAUG)*. The configuration must be done in the `config.h` file of the application as described in [Section 1.14](#).

---

### 2.2 Stack Events

Enabling the Green Power feature adds two stack events to those provided in the `ZPS_tAfEventType` structure of the ZigBee PRO stack software (detailed in the *ZigBee 3.0 Stack User Guide (ZB3STAUG)*). These additional stack events are as follows:

- `ZPS_EVENT_APS_ZGP_DATA_INDICATION`
- `ZPS_EVENT_APS_ZGP_DATA_CONFIRM`

These events are described below.

### ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION

The ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event is generated on a Green Power cluster server when a GP command has been received (either directly from the source node or indirectly via a proxy node). The event contains details of the received command in a ZPS\_tsAfZgpDataIndEvent structure (see [Section 2.3.1](#)).

### ZPS\_EVENT\_APS\_ZGP\_DATA\_CONFIRM

The ZPS\_EVENT\_APS\_ZGP\_DATA\_CONFIRM event is generated when a data confirmation command is transmitted from a GP sink node to a GP source node. This event needs to be passed into the **vZCL\_EventHandler()** function by the application.

---

## 2.3 ZPS Structures

The structures detailed below are used for the stack events described in [Section 2.2](#).

---

### 2.3.1 ZPS\_tsAfZgpDataIndEvent

This structure is used in the ZPS\_EVENT\_APS\_ZGP\_DATA\_INDICATION event, which indicates the arrival of GP command on the local node.

The ZPS\_tsAfZgpDataIndEvent structure is detailed below.

```
typedef struct
{
    ZPS_tuGpAddress uGpAddress;
    PDUM_thAPduInstance hAPduInst;
    uint32    u8Status                : 8;
    uint32    u2ApplicationId         : 2;
    uint32    u2SecurityLevel         : 2;
    uint32    u2SecurityKeyType       : 2;
    uint32    u8LinkQuality           : 8;
    uint32    bAutoCommissioning      : 1;
    uint32    bRxAfterTx              : 1;
    uint32    u8CommandId             : 8;
    uint32    u32Mic;
    uint32    u32SecFrameCounter;
    uint16    u16SrcPanId;
    uint8     u8Rssi;
    uint8     u8SrcAddrMode;
    uint8     u8SeqNum;
    uint8     u8FrameType;
    uint8     u8Endpoint;
} ZPS_tsAfZgpDataIndEvent;
```

The fields of the above structure are detailed in [Table 1](#) below.

Field	Type	Valid Range	Description
uGpAddress	Unsigned 16-bit, 32-bit or 64-bit integer	16-bit, 32-bit or 64-bit value	Union containing an identifier of the GP device that sent GP command (as specified by u8SrcAddrMode) - one of: <ul style="list-style-type: none"> <li>• 64-bit IEEE/MAC address</li> <li>• 16-bit network (short) address</li> <li>• 32-bit source node identifier</li> </ul>
hAPduInst -> ul6Size	Unsigned 8-bit integer	See description	The number of bytes in the received frame (cannot exceed <i>aMaxMACFrameSize</i> - 9)
hAPduInst -> au8Storage	Set of bytes	-	The set of bytes forming the received frame
u8Status	8-bit enumeration	Any valid enumeration (see list)	Status code, returned by the GP stub. Can be any of the following: <ul style="list-style-type: none"> <li>• SECURITY_SUCCESS</li> <li>• NO_SECURITY</li> <li>• COUNTER_FAILURE</li> <li>• AUTH_FAILURE</li> <li>• UNPROCESSED</li> </ul>
u2ApplicationId	8-bit enumeration	0x00, 0x02	Application ID, indicating the type of address used to identify the source node: <ul style="list-style-type: none"> <li>• 0x00: 32-bit GP source address</li> <li>• 0x02: 64-bit IEEE/MAC address</li> </ul>
u2SecurityLevel	8-bit enumeration	0x00 – 0x03	Security level of received GP command: <ul style="list-style-type: none"> <li>• 0x00: No security</li> <li>• 0x01: 1-byte (LSB) of frame counter and short (2-byte) MIC</li> <li>• 0x02: Full (4-byte) frame counter and full (4-byte) MIC</li> <li>• 0x03: Encryption, full (4-byte) frame counter and full (4-byte) MIC</li> </ul>
u2SecurityKeyType	8-bit enumeration	0x00 – 0x07	Security key type successfully used to process GP command: <ul style="list-style-type: none"> <li>• 0x00: No key</li> <li>• 0x01: ZigBee network key</li> <li>• 0x02: GPD group key</li> <li>• 0x03: Network key derived from group key</li> <li>• 0x04: Individual out-of-box GPD key</li> <li>• 0x05: Reserved</li> <li>• 0x06: Reserved</li> <li>• 0x07: Individual derived GPD key</li> </ul>
u8LinkQuality	Unsigned 8-bit integer	0x00 – 0xFF	The link quality for the received frame, as assessed by the IEEE 802.15.4 MAC layer

**Table 1: ZPS\_tsAfZgpDataIndEvent Fields**

## Chapter 2

### ZigBee PRO Stack Features for Green Power

bAutoCommissioning	Boolean	0x00, 0x01	Indicates whether the 'auto-commissioning' flag of the received command was set to '1': • 0x00 (FALSE): Flag not set • 0x01 (TRUE): Flag set
bRxAfterTx	Boolean	0x00, 0x01	Indicates whether the receiver on the source node (that sent the GP command) is on or off after a transmission: • 0x00 (FALSE): Receiver off after Tx • 0x01 (TRUE): Receiver on after Tx
u8CommandId	Unsigned 8-bit integer	0x00 – 0xFF	The identifier of the received GP command (within the GP specification) - for values, see <a href="#">Section 1.13.7</a> .
u32Mic	Unsigned 16-bit or 32-bit integer	2-byte or 4-byte value	Set of bytes (2 or 4, as specified in u2SecurityLevel) forming the MIC for the received GP command
u32SecFrameCounter	Unsigned 32-bit Integer	1-byte or 4-byte value	A set of bytes (1 or 4, according to the value of u2SecurityLevel) containing the security frame counter value used on transmission of the GP command by the source node
u16SrcPanId	16-bit PAN ID	0x0000 – 0xFFFF	The 16-bit PAN ID of the source node entity from which the GP command was received
u8Rssi	Unsigned 8-bit integer	0x00 – 0xFF	RSSI (Received Signal Strength Indicator) level of received frame
u8SrcAddrMode	8-bit enumeration	0x00 – 0x03	The source addressing mode for this primitive corresponding to the received MPDU. This value can take one of the following values: 0x00: No address (u16SrcPanId and uSrcAddress omitted) 0x01: Reserved 0x02: 16-bit short address 0x03: 64-bit extended address
u8SeqNum	Unsigned 8-bit integer	0x00 – 0xFF	The sequence number from the MAC header of the received command
u8FrameType	Unsigned 8-bit integer	0x00 – 0xFF	The frame type, as follows: • 0x00: Data frame • 0x01: Maintenance frame All other values are reserved.
u8Endpoint	Unsigned 8-bit integer	0x00 – 0xFF	Number of target endpoint for command

**Table 1: ZPS\_tsAfZgpDataIndEvent Fields**



### 2.3.2 ZPS\_tsAfZgpDataConfEvent

This structure is used in the ZPS\_EVENT\_APS\_ZGP\_DATA\_CONFIRM event, which indicates that a data confirmation has been returned to the GP source node (that previously sent some data).

The ZPS\_tsAfZgpDataConfEvent structure is detailed below.

```
typedef struct {
    uint8 u8Status;
    uint8 u8Handle;
} ZPS_tsAfZgpDataConfEvent;
```

The fields of the above structure are detailed in [Table 2](#) below.

Field	Type	Valid Range	Description
u8Status	Enumeration	Any valid enumeration (see list)	Status code, returned by the GP stub. Can be any of the following: <ul style="list-style-type: none"> <li>• TX_QUEUE_FULL</li> <li>• ENTRY_REPLACED</li> <li>• ENTRY_ADDED</li> <li>• ENTRY_EXPIRED</li> <li>• ENTRY_REMOVED</li> <li>• GPDF_SENDING_FINALIZED</li> </ul>
u8Handle	Unsigned 8-bit integer	0x00 – 0xFF	The handle used between the proxy endpoint (EPP) and the lower stack layers to match the request with the confirmation

**Table 2: ZPS\_tsAfZgpDataConfEvent Fields**

### 2.3.3 ZPS\_tuGpAddress

This union structure contains the address details of a GP device.

```
typedef union {
    uint64 u64Addr;
    uint32 u32SrcId;
    uint16 u16Addr;
} ZPS_tuGpAddress;
```

where:

- u64Addr is the 64-bit IEEE/MAC address of the GP device
- u32SrcId is the 32-bit Source ID of the GP device
- u16Addr is the 16-bit network address of the GP device

---

### 2.3.4 ZPS\_tuAfZgpGreenPowerId

This union structure contains the address details of a GP device.

```
typedef union
{
    uint64 u64Address;
    uint32 u32SrcId;
}ZPS_tuAfZgpGreenPowerId;
```

where:

- u64Addr is the 64-bit IEEE/MAC address of the GP device
- u32SrcId is the 32-bit Source ID of the GP device

---

### 2.3.5 ZPS\_tsAfZgpGreenPowerReq

This structure contains the details of a GP command, such as a GP Channel Request, sent by a GP device.

```
typedef struct
{
    ZPS_tuAfZgpGreenPowerId uGpId;
    uint16 u16Panid;
    uint16 u16DstAddr;
    uint16 u16TxQueueEntryLifetime;
    uint8 u8Handle;
    uint8 u8ApplicationId;
    uint8 u8SeqNum;
    uint8 u8TxOptions;
    uint8 u8Endpoint;
    // bool_t bDataFrame;
}ZPS_tsAfZgpGreenPowerReq;
```

where:

- uGpId is a union containing an identifier of the source GP device of the command (see [Section 2.3.3](#)) - the type of identifier is specified in u8ApplicationId.
- u16Panid is the PAN ID of the target network for the command.
- u16DstAddr is the 16-bit network address of the target sink node.
- u16TxQueueEntryLifetime is the maximum length of time, in milliseconds, that the command should remain in the transmit queue on the GP device. The value 0x0000 indicates that the transmission must be immediate and 0xFFFF indicates an indefinite queuing time.
- u8Handle is a handle for the command.

- `u8ApplicationId` is a value indicating the type of identifier used in `uGpId` to specify the source GP device:
  - 0x00: Source ID
  - 0x02: IEEE/MAC address
- `u8SeqNum` is the sequence number used to match the response with the request.
- `u8TxOptions` is a bitmap indicating the transmission options for the request:

Bits	Description
0	Enables/disables use of the transmit queue on the source GP device: 1: Use transmit queue 0: Do not use transmit queue
1	Enables/disables use of CSMA/CA during transmission: 1: Use CSMA/CA 0: Do not use CSMA/CA
2	Enables/disables use of IEEE802.15.4 MAC acknowledgements: 1: Use MAC acks 0: Do not use MAC acks
3-4	Indicates the type of frame used: 00: Data frame 01: Maintenance frame Other values are reserved.
5-7	Reserved

- `u8Endpoint` is the number of the target endpoint (on the target sink node) for the request

## 2.3.6 ZPS\_tsAfZgpTxGpQueue

This structure contains the transmit queue on a GP device.

```
typedef struct
{
    ZPS_tsAfZgpTxGpQueueEntry*  psTxQTable;
    uint8                        u8Size;
} ZPS_tsAfZgpTxGpQueue;
```

where:

- `psTxQTable` is a pointer to the set of transmit queue entries, where each entry is a `ZPS_tsAfZgpTxGpQueueEntry` structure (see [Section 2.3.7](#)).
- `u8Size` is the number of entries in the transmit queue.

---

### 2.3.7 ZPS\_tsAfZgpTxGpQueueEntry

This structure contains an entry for a GP command in the transmit queue on a GP device.

```
typedef struct
{
    ZPS_tsAfZgpGreenPowerReq  sReq;
    PDUM_thNPdu                hNPdu;
    bool_t                     bValid;
} ZPS_tsAfZgpTxGpQueueEntry;
```

where:

- `sReq` is a structure containing the details of the GP command contained in the entry, as described in [Section 2.3.5](#).
- `hNPdu` is the handle of the NPDU allocated to the queue entry.
- `bValid` is a Boolean indicating whether the entry is valid (TRUE) or invalid (FALSE).

---

### 2.3.8 ZPS\_tsAfZgpGpst

This structure contains the security table of a GP device.

```
typedef struct
{
    ZPS_tsAfZgpGpstEntry*  psGpSecTable;
    uint8                  u8Size;
} ZPS_tsAfZgpGpst;
```

where:

- `psGpSecTable` is a pointer to a set of security table entries, where each entry is a `ZPS_tsAfZgpGpstEntry` structure (see [Section 2.3.9](#)).
- `u8Size` is the number of entries in the security table.

### 2.3.9 ZPS\_tsAfZgpGpstEntry

This structure contains an entry of the security table of a GP device.

```
typedef struct
{
    AESSW_Block_u          uSecurityKey;
    ZPS_tuAfZgpGreenPowerId uGpId;
    uint32                  u32Counter;
    uint8                   u8SecurityLevel;
    uint8                   u8KeyType;
    bool_t                  bValid;
} ZPS_tsAfZgpGpstEntry;
```

where:

- `uSecurityKey` is the AES encryption key used by the GP device.
- `uGpId` is a union containing an identifier of the GP device (see [Section 2.3.3](#)).
- `u32Counter` is a 32-bit security frame counter for the GP device (if used).
- `u8SecurityLevel` is the security level used by the GP device:
  - 0x00: No security
  - 0x01: Reserved
  - 0x02: Full (4-byte) frame counter and full (4-byte) MIC only
  - 0x03: Encryption with full (4-byte) frame counter and full (4-byte) MIC
  - 0x04-0x07: Reserved
- `u8KeyType` is the security key type used by the GP device:
  - 0x00: No key
  - 0x01: ZigBee network key
  - 0x02: GPD group key
  - 0x03: Network key derived from GPD group key
  - 0x04: Individual out-of-box GPD key
  - 0x05-0x06: Reserved
  - 0x07: Individual derived GPD key
- `bValid` is a Boolean indicating whether the entry is used:
  - TRUE: Used
  - FALSE: Unused

---

### 2.3.10 ZPS\_tsAfZgpSecReq

This structure contains the security details of the GP device.

```
typedef struct
{
    ZPS_tuAfZgpGreenPowerId  uGpId;
    uint32                    u32FrameCounter;
    uint32                    u32Mic;
    uint8                     u8SecurityLevel;
    uint8                     u8KeyType;
    uint8                     u8ApplicationId;
    uint8                     u8Endpoint;
} ZPS_tsAfZgpSecReq;
```

where:

- `uGpId` is a union containing an identifier of the GP device (see [Section 2.3.3](#)).
- `u32FrameCounter` is a 32-bit security frame counter for the GP device (if used).
- `u32Mic` is a set of four bytes forming the MIC.
- `u8SecurityLevel` is the security level used by the GP device:
  - 0x00: No security
  - 0x01: Reserved
  - 0x02: Full (4-byte) frame counter and full (4-byte) MIC only
  - 0x03: Encryption with full (4-byte) frame counter and full (4-byte) MIC
  - 0x04-0x07: Reserved
- `u8KeyType` is the security key type used by the GP device:
  - 0x00: No key
  - 0x01: ZigBee network key
  - 0x02: GPD group key
  - 0x03: Network key derived from GPD group key
  - 0x04: Individual out-of-box GPD key
  - 0x05-0x06: Reserved
  - 0x07: Individual derived GPD key
- `u8ApplicationId` is a value indicating the type of identifier used in `uGpId` to specify the source GP device:
  - 0x00: Source ID
  - 0x02: IEEE/MAC address
- `u8Endpoint` is the number of the endpoint on the corresponding sink node.

### 2.3.11 ZPS\_tsAfZgpGreenPowerContext

This structure contains the context data that is saved to non-volatile memory on a GP device.

```
typedef struct
{
    ZPS_tsAfZgpGpst      *psGpst;
    ZPS_tsAfZgpTxGpQueue *psTxQueue;
    ZPS_tsTsvTimer       *psTxAgingTimer;
    TSV_Timer_s          *psTxBiDirTimer;
    uint16               ul6MsecInterval;
    uint8                u8TxPoint;
} ZPS_tsAfZgpGreenPowerContext;
```

where:

- `psGpst` is a pointer to the security table of the GP device, contained in a `ZPS_tsAfZgpGpst` structure (see [Section 2.3.8](#)).
- `psTxQueue` is a pointer to the transmit queue, contained in a `ZPS_tsAfZgpTxGpQueue` structure (see [Section 2.3.6](#)).
- `psTxAgingTimer` is a pointer to a structure containing details of a software timer used for aging entries in the transmit queue.
- `psTxBiDirTimer` is a pointer to a structure containing details of a software timer used in bi-directional commissioning mode.
- `ul6MsecInterval` is the time-interval, in milliseconds, with which the device will periodically attempt to age data.
- `u8TxPoint` is the location in the transmit queue of the next frame to be transmitted.





## **Revision History**

<b>Version</b>	<b>Date</b>	<b>Comments</b>
0.1	10-Apr-2017	First draft for KW41Z adapted from JN51xx version
0.2	29-Sep-2017	Second draft for KW41Z; removed chapter MicroMAC Stack for Green Power

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