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ZIGBEE HOME AUTOMATION PUBLIC APPLICATION PROFILE

Home Automation Profile Specification

ZigBee Profile: 0x0104

Revision 25

Version 1.0

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Accepted by	This document has been accepted for release by the ZigBee Alliance Board of Directors.
Abstract	This document defines the home automation profile.
Keywords	ZigBee, Profile, Home Automation, Application Framework.

October 27, 2007



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DOCUMENT HISTORY

Table 1.1 shows the change history for this specification.

Table 1.1 Document Revision Change History

Revision	Version	Description
0	0.1	Original version.
1	0.1	Store scene command added to general cluster.
2	0.1	Group Identifier and Vendor Identifier fields added into the general frame format to harmonize with CBA. ThermostatControl cluster and Thermostat device description added. Many editorial fixes.
3	0.3	Added clusters for ThermostatUnit, TempSensor, BinaryInput, BinaryOutput, PumpControl. Many editorial changes.
4	0.4	Moved all the cluster specifications to library files. Streamlined the rest of the document accordingly.
5, 6	0.4	Added space heating / cooling devices.
7	0.4	Added remote control and range extender. Many minor editorial changes.
8	0.4	Added mains power outlet.
9	0.4	Added constants, generic device, generic switchable device, generic level controllable device, configuration device and scene selection device. Streamlined cluster descriptions. Many editorial improvements.
10, 11, 12	0.5	Made changes to resolve comments from LB9.
13	0.5	Final changes to resolve comments from LB9. Specifically, text was added for polling rates, reporting, commissioning and modifications due to changes in the ZCL.
14	0.5	A couple more final adjustments.
15	0.6	Changes made due to initial comment resolution for LB13.

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Table 1.1 Document Revision Change History (Continued)

Revision	Version	Description
16	0.6	Final changes due to comment resolution. Profile is ready for testing.
17	0.7	Added text to specify mandatory start up settings and commissioning behaviors.
18	0.7	Added text to specify mandatory and optional features and functions per device type.
19-24	0.7-0.9	Added text reflecting changes from Paris 2007 meeting to ensure interoperability between HA profile devices.
25	1.0	Editorial changes for release.

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C H A P T E R

1

INTRODUCTION

1.1 Scope

This profile defines device descriptions and standard practices for applications needed in a residential or light commercial environment. Installation scenarios range from a single room to an entire home up to 20,000 square feet (approximately 1850m²). The key application domains included in this initial version are lighting, HVAC, window shades and security. Other applications will be added in future versions.

1.2 Purpose

This specification provides standard interfaces and device definitions to allow interoperability among ZigBee devices produced by various manufacturers of home automation products.

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CHAPTER

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REFERENCES

The following standards and specifications contain provisions, which through reference in this document constitute provisions of this specification. All the standards and specifications listed are normative references. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the standards and specifications indicated below.

2.1 ZigBee Alliance Documents

- [R1] ZigBee document 064321r01, ZigBee Stack Profile
- [R2] ZigBee document 053936r04, ZigBee Cluster Library, Functional Domain: General, ZigBee Application Framework Working Group
- [R3] ZigBee document 053906r04, ZigBee Cluster Library, Functional Domain: Measurement and Sensing, ZigBee Application Framework Working Group
- [R4] ZigBee document 053990r04, ZigBee Cluster Library, Functional Domain: Lighting, ZigBee Application Framework Working Group
- [R5] ZigBee document 06023r05, ZigBee Cluster Library, Functional Domain: Closures, ZigBee Application Framework Working Group
- [R6] ZigBee document 06024r05, ZigBee Cluster Library, Functional Domain: Security and Safety, ZigBee Application Framework Working Group
- [R7] ZigBee document 06014r06, ZigBee Cluster Library, Functional Domain: HVAC, ZigBee Application Framework Working Group
- [R8] ZigBee document 06027r04, ZigBee Cluster Library, Foundation, ZigBee Application Framework Working Group

[R9] ZigBee document 064309r02, Commissioning Framework

2.2 European Standards Documents

[R10] EN 50131 European Standards Series for Intruder Alarm Systems

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CHAPTER

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DEFINITIONS

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3.1 Conformance Levels

Expected: A key word used to describe the behavior of the hardware or software in the design models assumed by this Draft. Other hardware and software design models may also be implemented.

May: A key word indicating a course of action permissible within the limits of the standard (“may” equals “is permitted”).

Shall: A key word indicating mandatory requirements to be strictly followed in order to conform to the standard; deviations from shall are prohibited (“shall” equals “is required to”).

Should: A key word indicating that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; that a certain course of action is preferred but not necessarily required; or, that (in the negative form) a certain course of action is deprecated but not prohibited (“should” equals “is recommended that”).

3.2 ZigBee Definitions

Attribute: A data entity which represents a physical quantity or state. This data is communicated to other devices using commands.

Cluster: A container for one or more attributes and/or messages in a command structure.

Cluster identifier: A reference to the unique enumeration of clusters within a specific application profile. The cluster identifier is a 16-bit number unique within the scope of the application profile and identifies a specific cluster. Cluster identifiers are designated as inputs or outputs in the simple descriptor for use in creating a binding table.

Device: A description of a specific device within an application profile. For example, the light sensor device description is a member of the home automation application profile. The device description also has a unique identifier that is exchanged as part of the discovery process.

Node: Same as a unit.

Product: A product is a unit that is intended to be marketed. It implements application profiles that may be a combination of private, published, and standard.

Service discovery: The ability of a device to locate services of interest.

Unit: A unit consists of one or more physical objects (e.g., switch, controller, etc.) and their corresponding application profile(s) that share a single 802.15.4 radio. Each unit has a unique 64-bit IEEE address.

ZigBee coordinator: An IEEE 802.15.4-2003 PAN coordinator.

ZigBee end device: an IEEE 802.15.4-2003 RFD or FFD participating in a ZigBee network, which is neither the ZigBee coordinator nor a ZigBee router.

ZigBee router: an IEEE 802.15.4-2003 FFD participating in a ZigBee network, which is not the ZigBee coordinator but may act as an IEEE 802.15.4-2003 coordinator within its personal operating space, that is capable of routing messages between devices and supporting associations.

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CHAPTER

4

ACRONYMS AND ABBREVIATIONS

ACE	Ancillary Control Equipment	15
APS	Application Support Sub-layer	17
CIE	Control and Indicating Equipment	18
HA	Home Automation	20
IAS	Intruder Alarm Systems	21
WD	Warning Device	22
ZCL	ZigBee Cluster Library	24

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PROFILE DESCRIPTION

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5.1 A ZigBee Home Automation Network

Home Automation (HA) networks scale from 2 to 500 nodes. Real world experience suggests that use events and interactions become sluggish as the 500-node limit is approached. HA networks are primarily installed by either home owners, or home automation professionals that may not have any ZigBee expertise. Installation concepts must be easy and uniform across multiple OEM vendors.

A ZigBee Home Automation system is primarily focused on sporadic real time control of devices, that is, the network is normally quiet, but when a user presses a button on a device, he expects to see the result of that button press across the network quickly.

HA Networks could include nodes based on the ZigBee Feature Set or the ZigBee PRO Feature Set. It is recommended that the ratio of the nodes should not be 50/50, but the majority of the nodes in the network should be based on one Feature Set or the other to get consistent performance.

Not all products in an OEM home automation system need be “ZigBee HA Certified”, though it is recommended that they all be MSP (Manufacturer Specific Profile) certified. For example, system controllers and remote controls tend to be very OEM system-specific and provide the OEM value. Lighting devices and sensors could be mix and match from multiple vendors. The normal customer experience is that the customer will buy a home automation system based on a single OEM’s ZigBee home automation products and then addend the system with a smaller number of ZigBee home automation products from other vendors.

ZigBee HA certified products also must be MSP certified. This provides a reassurance that the underlying golden stack is behaving properly and the application is not abusive to the network.

Though encouraged, ZigBee HA products do not require the support of the ZigBee commissioning cluster. They all are required to support “E-mode” commissioning. E-mode commissioning would classically involve a button push or two, but could also use an OEM-provided simple tool, such as a remote control.

No assurances can be made that a ZigBee HA system will interoperate at all with other ZigBee devices, even if they are ZigBee certified under other application profile tests. This is because the other devices may have stack and security settings that are incompatible with the HA application profile, or that their commissioning procedure requires tools that are unavailable to the HA installer.

A ZigBee HA makes possible networks such as the following:

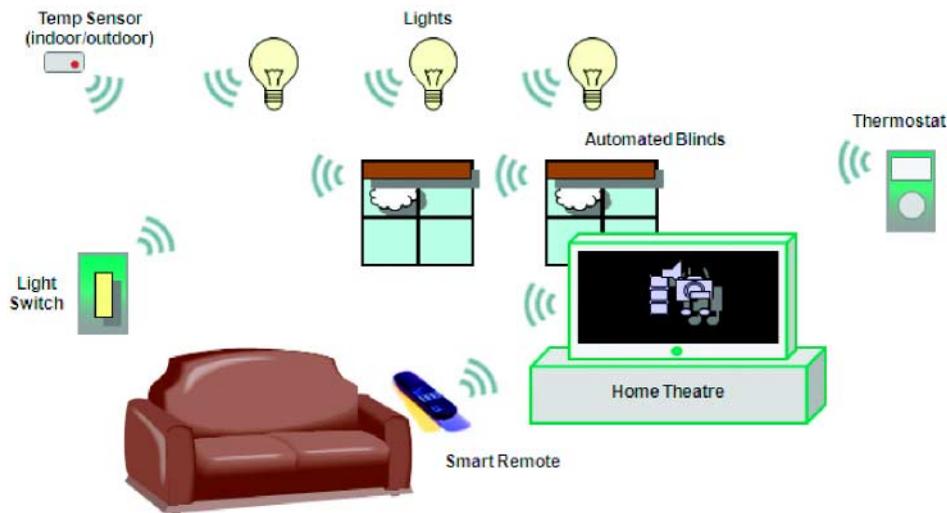


Figure 5.1 Home network enabled by ZigBee HA

The lights and switches might be controlled wirelessly through ZigBee, as well as blinds, the thermostat and other devices. Using the scene mechanism, what is now a very advanced home theatre system may be implemented with relatively low-cost devices. A single press of a button on the remote control could dim the lights, lower the blinds, turn on the television and begin playing a movie in the DVD player. Another button press, either on the remote or a specific switch within the home could place the home in the “I’m at work” mode, lowering the air-conditioner or heating in all rooms except the atrium, and turning off all lights in the home once motion is no longer detected. The television or PC might provide easy configuration and access to the ZigBee network, and a WiFi router might provide internet access to ZigBee as well.

5.2 ZigBee Stack Profile

Products that conform to this specification shall use stack profile number 0x01 or profile 0x02, as defined in [R1]. In addition to the requirements specified in [R1], the following requirements are mandatory for this application profile.

- Source binding and groups/scenes shall be implemented on a device type basis, see device descriptions for applicability.
- In their normal operating state, ZigBee end devices shall poll no more frequently than once every 7.5 seconds except where this specification indicates otherwise for a particular device description (e.g., the IAS WD), or under the following conditions. ZigBee end devices may operate with a higher polling rate during commissioning, network maintenance, alarm states, and for short periods after transmitting a message to allow for acknowledgements and or responses to be received quickly, but they must return to the standard rate indicated previously during normal operation. It is recommended that ZigBee end devices poll much less frequently than once per 7.5 seconds, especially when the device normally only communicates due to user interaction (e.g. the On/Off Light Switch).

5.2.1 ZigBee Routing Table Size Recommendations

If a HA device is intended to be primarily deployed in a network that does not support many-to-one routing, its routing table size should be increased as much as possible to account for the typically dense topology of a ZigBee HA deployment. Alternatively, it is recommended that devices that will primarily be installed into many-to-one deployments also increase their own routing tables if possible, in case the devices are deployed in networks that use AODV routing for the majority of their messaging, though this may be of secondary concern.

5.2.2 ZigBee HA Coordinator Recommendations

The coordinator should indicate to the installer when a new device joins the network. This could be via PC client, LCD screen, or other simple LED indication.

5.3 Startup Attribute Set (SAS)

In order to insure interoperability, all ZigBee HA devices should implement compatible Startup Attribute Sets (SAS). This does not mean that set must be modifiable through a commissioning cluster, but that the device must internally implement these stack settings to insure compatibility and consistent user

experience. The start up set parameters described by the commissioning cluster provide a good basis to specify a HA startup set.

5.3.1 Start Up Parameters

Short Address: 0xFFFF

E PANiD: 0x0000000000000000

PAN ID: 0xFFFF

Channel Mask: All channels in frequency band. If needed, the power transmitted by the device on channel 26 can be lowered to comply with FCC regulations.

Protocol Version: 0x02 (2006 and later).

Stack Profile: 1 (2006) or 2 (2007).

Startup Control:

3 (three) if un-commissioned, so it will join network by association when join command is indicated by button press sequence.

0 (Zero) if commissioned. Indicates that the device should consider itself a part of the network indicated by the *ExtendedPANId* attribute. In this case it will not perform any explicit join or rejoin operation.

Trust Center Address: 0x0000.

Master Key: NULL (This only applies to 2007 stack profile devices).

Network Key: NULL.

Use Insecure Join: 0x01 (True). This flag enables the use of insecure join as a fallback case at startup time. (This only applies to 2007 stack profile devices).

5.3.2 Join Parameters

ScanAttempts: At boot time or when instructed to join a network, the device should make up to three (3) scan attempts to find a ZigBee Coordinator or Router to associate with. If it has not been commissioned, this means that when the user presses a button or uses another methodology to get it to join a network, it will scan through all of the channels up to three times to find a network that allows joining. If it has already been commissioned, it should scan up to three times to find its old PAN to join. (2007 devices should scan for their old extended PAN ID and 2006 devices can only scan for their old PAN ID).

TimeBetweenScans: (1 second) Determines the number of seconds between each unsuccessful scan attempt

RejoinInterval: (60 seconds or shorter) Is how soon a device will attempt to rejoin the network if it finds itself disconnected.

MaxRejoinInterval: (15 minutes) Imposes an upper bound on the RejoinInterval parameter. This interval must be restarted if the device is touched by a human user, i.e. by a button press. This parameter is intended to throttle how often a device will scan to find its network in case the network is no longer present and therefore a scan attempt by the device would always fail, i.e., if a device finds itself disconnected, it will try to rejoin the network, scanning all channels if necessary. If the scan fails to find the network, or fails to successfully rejoin, the device will wait for 15 minutes before attempting to rejoin again.

5.3.3 Security Parameters

SecurityTimeoutPeriod: Determined by the stack profile.

TrustCenterNetworkKey: The Trust Center will pick the network key. ZigBee HA devices shall not depend on pre-configured keys to be commissioned or to interoperate.

5.3.4 End Device Parameters

IndirectPollRate: Set by stack profile. This is how often a device will poll its parent for new data. It is recommended that an end device designed to receive data should poll its parent every 60 seconds.

5.3.5 Link Status Parameters

LinkStatusPeriod: Set by the stack profile.

RouterAgeLimit: Set by the stack profile.

RepairThreshold: Set by the stack profile.

UpdatedDevice: Set by the stack profile.

UpdatedDeviceAlarmMask: Set by the stack profile.

5.3.6 Concentrator Parameters

ConcentratorFlag: Configures the device to be a concentrator. This would be typically part of an OEM “system controller” and not required to be on a HA certified device or configurable by 3rd party tool. If an OEM does make a device that can be a concentrator, it does not have to be configurable in any standardized way.

ConcentratorRadius: 5 (five). OEMs that make a concentrator product will set the max concentrator radius to this value.

ConcentratorDiscoveryTime: Set by the stack profile. Indicates how soon nodes should reply to a concentrator after hearing a route request command.

5.3.7 APS Transport Parameters

MaxFrameRetries: Set by stack profile. This determines the maximum number of retries allowed after a transmission failure.

AckWaitDuration: Set by stack profile. This is the maximum number of seconds to wait for acknowledgement of an APS frame.

5.3.8 Binding Parameters

EndDeviceBindTimeout: 60 seconds. This is the timeout value for end device binding. End device binding is set by coordinator.

5.4 ZDO Config for HA Devices

ZDO messages relating to binding are either mandatory or optional based on a device-by-device basis. See the device description sections for details on each device and which ZDO messages that each must support.

5.5 Other HA Requirements and Best Practices

Preferred Channels (11, 14, 15, 19, 20, 24, 25)

When forming a new network, or scanning to join a network, HA devices should do channel scans using the above channel mask before scanning the rest of the channels in order to avoid the most commonly used WiFi channels. This is to improve the user experience during installation (quicker joining) and possibly improve bandwidth (on average).

Broadcast Policy

Broadcasts are to be strongly discouraged for HA devices, except for when invoking scenes.

Devices are limited to a maximum broadcast frequency of one broadcast per second and strongly encouraged to exercise broadcasts much less frequently.

Frequency Agility

Frequency Agility would only be officially exercised in a 2007 based network by an OEM system controller, or higher functioning device (system remote etc.).

- 2007 devices must support frequency agility hooks to be commanded to “go to channel X”.

- 2006 end devices in a 2007 based network must implement the 2006 orphan join feature so that they will find a 2007 network that has changed channels.

Key Updates

HA devices are only required to support 2006 “residential mode” security or 2007 “standard mode”.

Network key updates should be limited due to the possibility of end devices missing two key updates.

It is strongly encouraged that key updates should only be initiated by the user via interaction with the Trust Center. Auto updates of security keys poses the risk that battery operated devices will miss two key updates and need to be re-commissioned.

Return to Factory Defaults

In support of a return to factory default capability, HA devices shall implement the ZDO Management Leave server service. When invoked with a unicast address and the DeviceAddress set to NULL=0x00000000, the device shall implement a NWK Leave. When invoked with a broadcast address and the DeviceAddress set to NULL=0x00000000, the device shall wait the broadcast timeout period to allow the message to propagate through network, then the device shall implement a NWK Leave. Prior to execution of the NWK Leave in either case, processing in the device shall ensure all operating parameters are reset to allow a reset to factory defaults.

5.6 Device Descriptions

Device descriptions specified in this profile are summarized in Table 5.1, “Devices Specified in the HA Profile”. The devices are organized according the end application areas they address. A product that conforms to this specification shall implement at least one of these device descriptions and shall also include the device descriptions corresponding to all applications implemented on the product where a standard device description is specified in this profile. For example, if a product implements both a light dimmer and a light sensor application, then the Dimmable Light and Light Sensor device descriptions must both be supported.

This list will be added to in future versions of the profile as new clusters are developed to meet the needs of manufacturers. The reserved values shall not be used until the profile defines them. Manufacturer-specific device descriptions shall reside on a separate endpoint and use a private profile ID.

Table 5.1 Devices Specified in the HA Profile

	Device	Device ID
Generic	On/Off Switch	0x0000
	Level Control Switch	0x0001
	On/Off Output	0x0002
	Level Controllable Output	0x0003
	Scene Selector	0x0004
	Configuration Tool	0x0005
	Remote Control	0x0006
	Combined Interface	0x0007
	Range Extender	0x0008
	Mains Power Outlet	0x0009
	Reserved	0x000A – 0x00FF
Lighting	On/Off Light	0x0100
	Dimmable Light	0x0101
	Color Dimmable Light	0x0102
	On/Off Light Switch	0x0103
	Dimmer Switch	0x0104
	Color Dimmer Switch	0x0105
	Light Sensor	0x0106
	Occupancy Sensor	0x0107
	Reserved	0x0108 – 0x1FFF
Closures	Shade	0x0200
	Shade Controller	0x0201
	Reserved	0x0202 – 0x2FFF

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Table 5.1 Devices Specified in the HA Profile (Continued)

HVAC	Heating/Cooling Unit	0x0300
	Thermostat	0x0301
	Temperature Sensor	0x0302
	Pump	0x0303
	Pump Controller	0x0304
	Pressure Sensor	0x0305
	Flow Sensor	0x0306
	Reserved	0x0307 - 0x3FFF
Intruder Alarm Systems	IAS Control and Indicating Equipment	0x0400
	IAS Ancillary Control Equipment	0x0401
	IAS Zone	0x0402
	IAS Warning Device	0x0403
	Reserved	0x0404-0xFFFF

5.7 ZigBee Cluster Library (ZCL)

This profile utilizes the clusters specified in the ZigBee Cluster Library. The implementation details for each cluster are given in the ZCL specifications. Further specification and clarification are given in this profile where necessary.

The ZCL provides a mechanism for clusters to report changes to the value of various attributes. It also provides commands to configure the reporting parameters. The attributes that a particular cluster is capable of reporting are listed in the ZCL specification for each cluster. Products shall support the reporting mechanism for all attributes specified in the ZCL that the product implements within a given cluster. The minimum reporting interval specified in [R8] shall be set to a value greater than or equal to 0x0001. The maximum reporting interval should be set to 0x0000 by default, and if it is set to a non-zero value it shall be set to a value greater than or equal to 0x003C and greater than the value of the minimum reporting interval. These settings will restrict the attributes from being reported more often than once every second if the attribute is changing quickly and at least once every minute if the attribute does not change for a long time. It is recommended that the minimum reporting interval be set to a higher value whenever the application can tolerate it. It is recommended that the maximum reporting interval be set to a much greater value to avoid unnecessary traffic.

5.8 Cluster List

The clusters used in this profile are listed in Table 5.2. The clusters are listed according to the functional domain they belong to in the ZCL. The corresponding cluster identifiers can be found in the ZCL Foundation specification [R8].

The functionality made available by all supported clusters shall be that given in their ZCL specifications except where a device description in this profile includes further specification, clarification or restriction as needed for that particular device.

Most clusters include optional attributes. The application designer must be aware that optional attributes may not be implemented on a particular device. It is the responsibility of a device's application to discover and deal with unsupported attributes on other devices.

It is expected that clusters will continue to be developed in the ZCL that will be useful in this profile. In many cases, new clusters will be organized into new device descriptions that are separate from those currently defined. There may also be situations where it makes sense to add clusters as optional or possibly even mandatory elements of existing device descriptions. Creating new device descriptions is the preferred method of adding new clusters to this specification, because new functionality can be mandated in a new device description without causing compatibility issues with previously-defined devices.

Manufacturer-specific clusters may be added to any device description in this profile as long as they follow the specifications given in the ZCL Foundation specification [R8].

Table 5.2 Clusters Used in the HA Profile

Functional Domain	Cluster Name
General	Basic
General	Power Configuration
General	Device Temperature Configuration
General	Identify
General	Groups
General	Scenes
General	On/Off
General	On/Off Switch Configuration
General	Level control
General	Alarms
Measurement & Sensing	Illuminance Measurement

Table 5.2 Clusters Used in the HA Profile (Continued)

Measurement & Sensing	Illuminance Level Sensing
Measurement & Sensing	Temperature Measurement
Measurement & Sensing	Pressure Measurement
Measurement & Sensing	Flow Measurement
Measurement & Sensing	Relative Humidity Measurement
Measurement & Sensing	Occupancy sensing
Lighting	Color Control
HVAC	Pump Configuration and Control
HVAC	Thermostat
HVAC	Fan Control
HVAC	Thermostat User Interface Configuration
Closures	Shade Configuration
Security and Safety	IAS ACE
Security and Safety	IAS Zone
Security and Safety	IAS WD

5.9 Commissioning

Many, if not all of the devices described in this document will require some form of commissioning, even if the user or installer doesn't see it. This is because, for example, an actuating device needs to be bound to some sort of target in order to do useful work, and even if the required initializations are done at the factory before the device is sold, the required operations are virtually the same as is the outcome.

The ZigBee Alliance has recognized the importance of commissioning and, in particular, the importance of specifications for commissioning in a multi-vendor environment. Thus, commissioning procedures are being designed outside the context of any particular profile, where possible, and grouped under the auspices of the Commissioning Tools Task Group (CTTG). This task group is developing a commissioning framework specification [R9].

5.9.1 Forming the Network (Start-up Sequence)

HA devices must form their own network or join an existing network. The commissioning framework [R9] discusses some of the relevant issues in this procedure.

It is intended that an HA network use simple methods to form a network and to commission devices into it. The primary means of commissioning a network will use E-mode methods (button presses or similar user actions) to get nodes to join a network.

This specification has no mandates to the start-up sequence of devices or the network, however, there are some recommended practices:

- A device should be able to indicate to the user that it has decided to become the coordinator of a network.
- A device should be able to indicate to the user, that it has successfully joined a network.
- A device should be able to indicate to the user, that it is in the process of searching for or joining a network.

These indications can be implemented in a number of ways including blinking indicator lights, colored indicator lights, arrays of indicator lights, text displays, graphic displays, audible indicators such as buzzers and speakers, etc. Blinking a green indicator light is the recommended method.

5.9.2 Support for Commissioning Modes

Three different commissioning modes are discussed in [R9]. They are denoted A, E and S-mode. All HA devices must support E-mode and may optionally support S-mode. A-mode is not to be supported. E-mode commissioning may be a simple button press or may involve a separate low-cost commissioning tool (like a remote control) that is typically purchased with the vendor's HA product.

5.9.3 Commissioning Documentation

To ensure a uniform user experience when commissioning HA devices, all ZigBee HA devices are required to provide documentation with their product that explains how to perform device commissioning in using a common language set, i.e., “form network”, “join network”, etc. The following table is representative of what should be included in the product documentation and also shows the common language to be used. Note that some items are not required to be supported by the device, but if not supported, should be indicated as such in the table. Using a common language set among all HA devices will make it intuitive for a user to

install a new device into an existing network, even if the new device is manufactured by a different OEM than the devices in the existing network.

Table 5.3 Example Commissioning Documentation

ZigBee Action	What To Do To Device To Perform Action
Join Network	Press the red button four times.
Form Network	Press the green button four times.
Allow Others To Join Network	Hold the red button and press the green button four times.
Restore Factory Fresh Settings	Hold the red and green buttons down simultaneously for 15 seconds.
Pair Devices	Press the red button five times, followed by the green button five times.
Enable Identify Mode	Press the red button six times, followed by the green button six times.
Create Scene	Not supported.

Chapter 7, “Device Specifications”, lists which commissioning actions are mandatory or optional on each HA device. The following section describes each action:

Join Network: Go find and join the first available HA network.

Form Network: For devices that can start a network.

Allow Others to Join Network: For routers and coordinators only. Allows you can add more nodes to an existing network. This must have a mandatory timeout of 60 seconds.

Restore to Factory Fresh Settings: Restore the device settings to fresh state (also performs leave).

Pair Devices (End Device Bind Request): Bind to any device you can find matching clusters on. This will toggle the bind each time you do it. The ZigBee coordinator does the pairing.

Example: A user would like to pair two devices (e.g., a switch and a light).

A button on each device is pressed and the “pairing” is done using the end device bind request.

It is required that the Coordinator include the “bind manager”/End device response. The Bind manager uses the ZDP bind/unbind request to create the source binding in the devices.

If a device does not contain buttons, a propriety remote control could be used to initiate the same function by sending a telegram to the device (emulating a button press).

Enable Identify Mode: Sets the device in Identify mode for 60 seconds. This is used for adding devices to a group or create a scene.

Group Nodes: Used to add devices to a group. This action sends the “Add group if Identifying” command. This adds all devices that are in “identify mode” to the group. The group ID is picked by the implementer.

Create Scene: This action creates a scene using devices present in a group.

For example, by a button press a “store scene” command is sent. The store scene command should sent to a Group already existing in the network. The Group ID is up to the implementer to pick.

If a device does not support an action, the action it must be listed in the device’s documentation as “Not Supported”.

5.9.4 Group Commissioning

A description of the principals underlying group commissioning, and to some extent commissioning in general, can be found in [R9]. A device that implements the Identify client cluster must implement means for a user interaction to perform E-mode group commissioning initiated from that device. By user interaction on that device, the device shall be possible to:

- Set matching devices in identify mode.
- Perform group binding on selected matching devices.

An example of such an implementation could be:

The user interacts with a device implementing the Identify client cluster to make it enter E-mode group commissioning. When this mode is entered, the device performs the following:

- Find devices on the network that match services of a cluster on the device.
- Put the matched devices in identify mode one at a time.
- When a user interaction is performed, the device currently identifying is made subject to a group binding.

For an On/Off Light Switch the process could be:

- The user flips the physical switch 4 times rapidly. The switch (implementing the On/Off client cluster) searches for devices on the network with matching services (implementing the On/Off server cluster).
- The matched devices are put in identify mode for a short period one at a time. For On/Off Lights, the light bulb could be flashing.

- When a device that the user wants to be a part of this group is identifying, the user flips the switch once. The switch initiates a group binding to the device currently identifying.

5.9.5 Group Messaging vs. Unicast Messaging

It is important to consider that groups make use of broadcast transmissions. Group messaging should only be used when a device needs to communicate with a group of greater than 5. For groups of less than 5, standard binding and unicast messages should be employed. Also, there is no acknowledgement service for group messages, because they are broadcast. Unicast messaging shall be used if a device requires APS acknowledgments.

The procedures for group commissioning described above and in [R9] can also be used to create one-to-one bindings for unicast messaging with little or no modification. When these procedures are utilized, the decision to create a group or not can be made by the application based on a local device policy. If a device is being bound to only 2 or 3 other devices, a unicast binding entry can be created for each target, and three unicasts will be sent instead of a group broadcast. When the destination is a large number of devices, a group binding entry should be created. This makes group vs. unicast messaging transparent to the user.

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CHAPTER

6

**CONSTANTS, ERROR CODES AND
GENERAL ALARMS**

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Profile-specific constants are shown in Table 6.1.

Table 6.1 Constants Specific to the HA Profile

Constant	Description	Value
minHAGroups	Minimum number of groups that shall be supported per node, across all endpoints on that node.	16
minHAScenes	Minimum number of scenes that shall be supported per node, across all groups on all endpoints on that node. This only applies to nodes that implement the server-side of the Scenes cluster on at least one endpoint.	16
Values of the <i>LocationType</i> attribute of the Basic cluster for use with this profile.	Atrium	0x01
	Bar	0x02
	Courtyard	0x03
	Bathroom	0x04
	Bedroom	0x05
	Billiard Room	0x06
	Utility Room	0x07
	Cellar	0x08
	Closet	0x09
	Theater	0x0A
Office	0x0B	

Table 6.1 Constants Specific to the HA Profile (Continued)

Values of the LocationType attribute of the Basic cluster for use with this profile.	Deck	0x0C	1
	Den	0x0D	2
	Dining Room	0x0E	3
	Electrical Room	0x0F	4
	Elevator	0x10	5
	Entry	0x11	6
	Family Room	0x12	7
	Main Floor	0x13	8
	Upstairs	0x14	9
	Downstairs	0x15	10
	Basement/Lower Level	0x16	11
	Gallery	0x17	12
	Game Room	0x18	13
	Garage	0x19	14
	Gym	0x1A	15
	Hallway	0x1B	16
	House	0x1C	17
	Kitchen	0x1D	18
	Laundry Room	0x1E	19
	Library	0x1F	20
	Master Bedroom	0x20	21
	Mud Room (small room for coats and boots)	0x21	22
	Nursery	0x22	23
	Pantry	0x23	24
	Office	0x24	25
	Outside	0x25	26
	Pool	0x26	27
	Porch	0x27	28
	Sewing Room	0x28	29
	Sitting Room	0x29	30
Stairway	0x2A	31	
Yard	0x2B	32	

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Table 6.1 Constants Specific to the HA Profile (Continued)

Values of the LocationType attribute of the Basic cluster for use with this profile.	Attic	0x2C	1
	Hot Tub	0x2D	2
	Living Room	0x2E	3
	Sauna	0x2F	4
	Shop/Workshop	0x30	5
	Guest Bedroom	0x31	6
	Guest Bath	0x32	7
	Powder Room (1/2 bath)	0x33	8
	Back Yard	0x34	9
	Front Yard	0x35	10
	Patio	0x36	11
	Driveway	0x37	12
	Sun Room	0x38	13
	Living Room	0x39	14
	Spa	0x3A	15
	Whirlpool	0x3B	16
	Shed	0x3C	17
	Equipment Storage	0x3D	18
	Hobby/Craft Room	0x3E	19
	Fountain	0x3F	20
	Pond	0x40	21
	Reception Room	0x41	22
	Breakfast Room	0x42	23
	Nook	0x43	24
	Garden	0x44	25
	Balcony	0x45	26
	Panic Room	0x46	27
	Terrace	0x47	28
Roof	0x48	29	

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CHAPTER

7

DEVICE SPECIFICATIONS

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7.1 Common Clusters

Support for certain clusters is common to all the devices in this profile. The clusters shown in Table 7.1 shall be supported by all devices in this profile as mandatory or optional according the designation given here. Individual device descriptions may place further restrictions on support of the optional clusters shown here.

Table 7.1 Clusters Common to All Devices

Server Side	Client Side
Mandatory	
Basic	<i>None</i>
Identify	
Optional	
Clusters with reporting capability (see sub-clause 7.1.1 for details)	Clusters with reporting capability (see sub-clause 7.1.1 for details)
Power Configuration	
Device Temperature Configuration	
Alarms	
Manufacturer-specific (see sub-clause 7.1.2 for details)	Manufacturer-specific (see sub-clause 7.1.2 for details)

7.1.1 Optional Support for Clusters With Reporting Capability

Some clusters support the ability to report changes to the value of particular attributes. These reports are typically received by the client side of the cluster. All devices in this profile may support any cluster that receives attribute reports.

7.1.2 Manufacturer-Specific Clusters

The ZCL provides a range of cluster IDs that are reserved for manufacturer-specific clusters. Manufacturer-specific clusters that conform to the requirements given in the ZCL may be added to any device description specified in this profile.

7.1.3 Cluster Usage Restrictions

Only the clusters specified as mandatory or optional for a device in this specification shall be implemented for any device in this profile.

7.2 Feature and Function Description

Each device must support a certain set of features and functions. The table below specifies the mandatory and optional features and functions of each device. This chapter contains a description of what must be supported if the feature or function is supported by the device. The mandatory or optional configuration for each device is described in the following sections.

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Table 7.2 Example Features and Functions Configuration for an HA Device

Device Type/Feature or Function	Mandatory/ Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

Join (End Devices and Routers):

As described in Section sub-clause 5.9.3.

Form Network (Coordinator):

As described in Section sub-clause 5.9.3.

Allow Others to Join Network (Router and Coordinator Only):

As described in Section sub-clause 5.9.3.

Restore to Factory Fresh Settings:

As described in Section sub-clause 5.9.3.

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Pair Devices (End Device Bind Request):

The device must provide a way for the user to issue an End Device Bind request.

Enable Identify Mode:

The device must provide a way for the user to enable Identify for 60 seconds.

Group Nodes (Add Group If Identify):

If this feature is supported the device must provide a way for the user to send an “Add Group if Identifying Request”.

Create Scene (Store Scene):

The device must provide a way for the user to send a Store Scene request.

Service Discovery (Match Descriptor Request):

The device must provide a way to send Match Descriptor request, receive Match Descriptor responses and utilize them for commissioning the device.

ZDP Bind Response:

The device must be able to receive a ZDP Bind Request and respond correctly with an ZDP Bind Response.

ZDP Unbind Response:

The device must be able to receive a ZDP Unbind Request and respond correctly with an ZDP Unbind Response.

End Device Annce/Device Annce:

The device must Send End Device Annce (ZigBee r13 specification)/Send Device Annce (ZigBee r17 specification) upon joining and re-joining a network.

Service Discovery Response:

The Device must be able to receive a Match Descriptor request, and respond with a Match Descriptor response correctly.

7.3 Generic Devices

7.3.1 On/Off Switch

The On/Off Switch is capable of sending on, off and toggle commands to devices to switch them on or off. This device should only be used when a more specific device specification (e.g., an On/Off Light Switch) is not available.

7.3.1.1 Supported Clusters

In addition to those specified in Table 7.1, the On/Off Switch device shall support the clusters listed in Table 7.3.

Table 7.3 Clusters Supported by the On/Off Switch Device

Server Side	Client Side
Mandatory	
On/Off Switch Configuration	On/Off (subject to binding)
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.3.1.2 Supported Features and Functions

The On/Off Switch device shall support the features and functions listed below.

Table 7.4 Example Features and Functions Supported by the On/Off Switch Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O

Table 7.4 Example Features and Functions Supported by the On/Off Switch Device (Continued)

Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.2 Level Control Switch

The Level Control Switch device is capable of sending on, off and toggle commands to a wide range of devices to switch them on or off, and can also control the level of a characteristic of such devices (e.g., brightness of a light or height of a shade). This device should only be used when a more specific device specification (e.g., an On/Off Light Switch) is not available.

7.3.2.1 Supported Clusters

In addition to those specified in Table 7.1, the Level Control Switch device shall support the clusters listed in Table 7.5.

Table 7.5 Clusters Supported by the Level Control Switch Device

Server Side	Client Side
Mandatory	
On/Off Switch Configuration	On/Off (subject to binding)
	Level Control (subject to binding)
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.3.2.2 Supported Features and Functions

The Level Control Switch device shall support the features and functions listed below.

Table 7.6 Example Features and Functions Supported by the Level Control Switch Device

Device Type/Feature or Function	Mandatory/ Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.3 On/Off Output

The On/Off Output device is capable of being switched on and off. This device should only be used when a more specific device specification (e.g., a Basic Light) is not available.

7.3.3.1 Supported Clusters

In addition to those specified in Table 7.1, the On/Off Output device shall support the clusters listed in Table 7.7.

Table 7.7 Clusters Supported by the On/Off Output Device

Server Side	Client Side
Mandatory	
On/Off	<i>None</i>
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

7.3.3.2 Supported Features and Functions

The On/Off Output device shall support the features and functions listed below.

Table 7.8 Example Features and Functions Supported by the On/Off Output Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M (applies to On/Off cluster only)

Table 7.8 Example Features and Functions Supported by the On/Off Output Device (Continued)

Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.4 Level Controllable Output

The Level Controllable Output device can be switched on and off, and its output level adjusted. This device should only be used when a more specific device specification (e.g., a Dimmer Switch) is not available.

7.3.4.1 Supported Clusters

In addition to those specified in Table 7.1, the Level Controllable Output device shall support the clusters listed in Table 7.9.

Table 7.9 Clusters Supported by the Level Controllable Output Device

Server Side	Client Side
Mandatory	
On/Off	<i>None</i>
Level Control	
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

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7.3.4.2 Supported Features and Functions

The Level Controllable Output device shall support the features and functions listed below.

Table 7.10 Example Features and Functions Supported by the Level Controllable Output Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M (applies to On/Off and Level Control cluster only)
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.5 Scene Selector

The Scene Selector device is capable of setting up and selecting scenes on other devices (including groups of devices).

7.3.5.1 Supported Clusters

In addition to those specified in Table 7.1, the Scene Selector device shall support the clusters listed in Table 7.11.

Table 7.11 Clusters Supported by the Scene Selector Device

Server Side	Client Side
Mandatory	
<i>None</i>	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.3.5.2 Supported Features and Functions

The Scene Selector device shall support the features and functions listed below.

Table 7.12 Example Features and Functions Supported by the Scene Selector Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	M
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O

Table 7.12 Example Features and Functions Supported by the Scene Selector Device (Continued)

ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.6 Configuration Tool

The Configuration Tool device is capable of configuring other devices. This device is intended for configuring newly installed devices and may be used for performance optimization thereafter.

The intention of this specification is to define a generic configuration device type. In future versions of the profile, new configuration devices may be specified by explicitly specifying the supported clusters.

7.3.6.1 Supported Clusters

In addition to those specified in Table 7.1, the Configuration Tool device shall support all of the mandatory and at least one of the optional clusters listed in Table 7.13.

Both client and server forms of the Basic cluster are mandatory, so that the device can interrogate what other devices are present on the network, and so that other devices can also interrogate it if required. The Identify client cluster is mandatory so that the device can ask other devices to identify themselves.

Table 7.13 Clusters Supported by the Configuration Tool Device

Server Side	Client Side
Mandatory	
<i>None</i>	<i>None</i>
Optional	
<i>None</i>	Basic
	Identify
	Groups
	Scenes
	I luminance Level Sensing

Table 7.13 Clusters Supported by the Configuration Tool Device (Continued)

	Temperature Measurement
	Pressure Measurement
	Flow Measurement
	Occupancy Sensing
	Pump Configuration and Control
	Shade Configuration
	Thermostat User Interface Configuration

7.3.6.2 Supported Features and Functions

The Configuration Tool device shall support the features and functions listed below.

Table 7.14 Example Features and Functions Supported by the Configuration Tool Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	M
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.14 Example Features and Functions Supported by the Configuration Tool Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.7 Remote Control

The Remote Control device is capable of controlling and monitoring other devices.

Typically the Remote Control device is a handheld, battery powered device, that can control devices (e.g., turn a light on/off), monitor devices (e.g., read the status of a temperature sensor) or do some user configuration (e.g., change the setpoint of a thermostat or a light sensor).

7.3.7.1 Supported Clusters

In addition to those specified in Table 7.1, the Remote Control device shall support all mandatory and any of the optional clusters listed in Table 7.15.

Both client and server ends of the Basic cluster are mandatory, so that the device can interrogate what other devices are present on the network, and so that other devices can also interrogate it if required. The client side of the Identify cluster is mandatory so that the device can instruct other devices to identify themselves.

The intention of this specification is to define a generic remote control device type. New, explicit remote control devices may be specified in future versions by (more) explicitly specifying the supported clusters.

Table 7.15 Clusters Supported by the Remote Control Device

Server Side	Client Side
Mandatory	
<i>None</i>	Basic
	Identify
	On/Off
	Level Control
	Groups
	Scenes

Table 7.15 Clusters Supported by the Remote Control Device (Continued)

Server Side	Client Side
Optional	
<i>None</i>	Color Control
	Pump Configuration and Control
	Shade Configuration
	On/Off Switch Configuration
	Temperature Measurement
	Illuminance Level Sensing
	Illuminance Measurement

7.3.7.2 Supported Features and Functions

The Remote Control device shall support the features and functions listed below.

Table 7.16 Example Features and Functions Supported by the Remote Control Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.16 Example Features and Functions Supported by the Remote Control Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.7.3 Notes on Operation

To ensure interoperability, a remote controller shall allow the presence of other control devices in the network. In particular, this device should take measures to avoid “fighting” for control.

7.3.8 Combined Interface

The Combined Interface device is capable of controlling and monitoring other devices. It is typically a mains-powered device like a personal computer.

7.3.8.1 Supported Clusters

In addition to those specified in Table 7.1, the Combined Interface device shall support all mandatory and any of the optional clusters listed in Table 7.17.

Both client and server ends of the Basic cluster are mandatory, so that the device can interrogate what other devices are present on the network, and so that other devices can also interrogate it if required. The client side of the Identify cluster is mandatory so that the device can ask other devices to identify themselves.

Table 7.17 Clusters Supported by the Combined Interface Device

Server Side	Client Side
Mandatory	
<i>None</i>	Basic
	Identify
	On/Off
Optional	
<i>None</i>	Color Control
	Pump Configuration and Control
	Shade Configuration
	On/Off Switch Configuration

Table 7.17 Clusters Supported by the Combined Interface Device (Continued)

Server Side	Client Side
	Temperature Measurement
	I luminance Level Sensing
	I luminance Measurement
	Thermostat User Interface Configuration
	Level Control
	Groups
	Scenes

7.3.8.2 Supported Features and Functions

The Combined Interface device shall support the features and functions listed below.

Table 7.18 Example Features and Functions Supported by the Combined Interface Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.18 Example Features and Functions Supported by the Combined Interface Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.8.3 Notes on Operation

To ensure interoperability, a Combined Interface device shall allow the presence of other control devices in the network. In particular, this device should take measures to avoid “fighting” for control.

7.3.9 Range Extender

The Range Extender is a simple device that acts as a router for other devices. The Range Extender device shall not be a ZigBee end device. A product that implements the Range Extender devices shall not implement any other devices defined in this profile. This device shall only be used if the product is not intended to have any other application, or if a private application is implemented that has not been addressed by this profile.

7.3.9.1 Supported Clusters

The Range Extender device shall only support the mandatory common clusters listed in Table 7.1.

7.3.9.2 Supported Features and Functions

The Range Extender device shall support the features and functions listed below.

Table 7.19 Example Features and Functions Supported by the Range Extender Device

Device Type/Feature or Function	Mandatory/ Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M

Table 7.19 Example Features and Functions Supported by the Range Extender Device (Continued)

Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.3.10 Mains Power Outlet

The Mains Power Outlet device is capable of being switched on and off. This device shall control a mains power outlet.

7.3.10.1 Supported Clusters

In addition to those specified in Table 7.1, the Mains Power Outlet device shall support the clusters listed in Table 7.20.

Table 7.20 Clusters Supported by the Mains Power Outlet Device

Server Side	Client Side
Mandatory	
On/Off	<i>None</i>
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

7.3.10.2 Supported Features and Functions

The Mains Power Outlet device shall support the features and functions listed below.

Table 7.21 Example Features and Functions Supported by the Mains Power Outlet Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4 Lighting Devices

7.4.1 On/Off Light

The On/Off Light device is a light that can be switched on and off.

7.4.1.1 Supported Clusters

In addition to those specified in Table 7.1, the On/Off Light device shall support the clusters listed in Table 7.22.

Table 7.22 Clusters Supported by the On/Off Light Device

Server Side	Client Side
Mandatory	
On/Off	<i>None</i>
Scenes	
Groups	
Optional	
<i>None</i>	Occupancy Sensing

7.4.1.2 Occupancy Sensing Cluster Support

If an On/Off Light device supports the Occupancy Sensing cluster, the action taken upon receipt of a report (indicating a change in state of the Occupancy attribute) is left up to the manufacturer. The ability to configure this behavior may be included in a future version of this application profile.

7.4.1.3 Supported Features and Functions

The On/Off Light device shall support the features and functions listed below.

Table 7.23 Example Features and Functions Supported by the On/Off Light Device

Device Type/Feature or Function	Mandatory/ Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	M

Table 7.23 Example Features and Functions Supported by the On/Off Light Device (Continued)

Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.2 Dimmable Light

The Dimmable Light device is a light that can be switched on and off, and whose luminance level may be controlled.

7.4.2.1 Supported Clusters

In addition to those specified in Table 7.1, the Dimmable Light device shall support the clusters listed in Table 7.24.

Table 7.24 Clusters Supported by the Dimmable Light Device

Server Side	Client Side
Mandatory	
On/Off	<i>None</i>
Level Control	
Scenes	
Groups	
Optional	
<i>None</i>	Occupancy Sensing

7.4.2.2 Level Control Cluster (Server) Clarification

The Level Control cluster shall allow control over the luminance level of the light. The functionality made available by this cluster shall be that given in specification [R2].

When the level is set to 0, the light shall be turned fully off. When the level is set to 254, the light shall be turned on to the maximum level possible for the device.

It is recommended that the luminance is interpreted as a logarithmic scale, according to what is given in specification [R4].

7.4.2.3 Occupancy Sensing Cluster Support

If a Dimmable Light supports the Occupancy Sensing cluster, the action taken upon receipt of a report indicating a change in state of the *Occupancy* attribute is left up to the manufacturer. The ability to configure this behavior may be included in a future version of this application profile.

7.4.2.4 Supported Features and Functions

The Dimmable Light device shall support the features and functions listed below.

Table 7.25 Example Features and Functions Supported by the Dimmable Light Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	M
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.25 Example Features and Functions Supported by the Dimmable Light Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.3 Color Dimmable Light

The Color Dimmable Light device can be switched on and off, and its luminance, hue, and saturation levels may be controlled.

7.4.3.1 Supported Clusters

In addition to those specified in Table 7.1, the Color Dimmable Light device shall support the clusters listed in Table 7.26.

Table 7.26 Clusters Supported by the Color Dimmable Light Device

Server Side	Client Side
Mandatory	
On/Off	<i>None</i>
Level Control	
Color Control	
Scenes	
Groups	
Optional	
<i>None</i>	Occupancy Sensing

7.4.3.2 Occupancy Sensing Cluster Support

If a Color Dimmable Light supports the Occupancy Sensing cluster, the action taken upon receipt of a report indicating a change in state of the *Occupancy* attribute is left up to the manufacturer. The ability to configure this behavior may be included in a future version of this application profile.

7.4.3.3 Supported Features and Functions

The Color Dimmable Light device shall support the features and functions listed below.

Table 7.27 Example Features and Functions Supported by the Color Dimmable Light Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	M
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.4 On/Off Light Switch

The On/Off Light Switch device can send on, off and toggle commands to devices (typically lights) to switch them on or off.

The On/Off Light Switch is identical in functionality to the On/Off Switch (see 7.3.1), and supports the same clusters.

It has a different Device ID (see Table 5.1) to enable more detailed matching if required, and a more specific icon to be drawn where needed.

7.4.4.1 Supported Clusters

In addition to those specified in Table 7.1, the On/Off Light Switch shall support the clusters listed in Table 7.28.

Table 7.28 Clusters Supported by the On/Off Light Switch

Server Side	Client Side
Mandatory	
On/Off Switch Configuration	On/Off
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.4.4.2 Supported Features and Functions

The On/Off Light Switch shall support the features and functions listed below.

Table 7.29 Example Features and Functions Supported by the On/Off Light Switch

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O

Table 7.29 Example Features and Functions Supported by the On/Off Light Switch (Continued)

Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.5 Dimmer Switch

The Dimmer Switch device can send on, off and toggle commands to devices (typically lights) to switch them on or off, and can also control the level of a characteristic of such devices (typically the brightness of lights).

The Dimmer Switch is identical in functionality to the Level Control Switch (see sub-clause 7.3.2), and supports the same clusters.

It has a different Device ID (see Table 5.1) to enable more detailed matching if required, and a more specific icon to be drawn where needed.

7.4.5.1 Supported Clusters

In addition to those specified in Table 7.1, the Dimmer Switch device shall support the clusters listed in Table 7.30.

Table 7.30 Clusters Supported by the Dimmer Switch Device

Server Side	Client Side
Mandatory	
On/Off Switch Configuration	On/Off
	Level Control
	Scenes
	Groups
Optional	
<i>None</i>	<i>None</i>

7.4.5.2 Supported Features and Functions

The Dimmer Switch device shall support the features and functions listed below.

Table 7.31 Example Features and Functions Supported by the Dimmer Switch Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.6 Color Dimmer Switch

The Color Dimmer Switch device can turn a light on and off, and control the luminance, hue and saturation levels of a multi-color light.

7.4.6.1 Supported Clusters

In addition to those specified in Table 7.1, the Color Dimmer Switch shall support the clusters listed in Table 7.32.

Table 7.32 Clusters Supported by the Color Dimmer Switch Device

Server Side	Client Side
Mandatory	
On/Off Switch Configuration	On/Off
	Level Control
	Color Control
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.4.6.2 Supported Features and Functions

The Color Dimmer Switch device shall support the features and functions listed below.

Table 7.33 Example Features and Functions Supported by the Color Dimmer Switch Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O

Table 7.33 Example Features and Functions Supported by the Color Dimmer Switch Device (Continued)

Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.7 Light Sensor

The Light Sensor device reports the illuminance of an area.

7.4.7.1 Supported Clusters

In addition to those specified in Table 7.1, the Light Sensor device shall support the clusters listed in Table 7.34.

Table 7.34 Clusters Supported by the Light Sensor Device

Server Side	Client Side
Mandatory	
Illuminance Measurement	<i>None</i>
Optional	
<i>None</i>	Groups

7.4.7.2 Supported Features and Functions

The Light Sensor device shall support the features and functions listed below.

Table 7.35 Example Features and Functions Supported by the Light Sensor Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.4.8 Occupancy Sensor

The Occupancy Sensor device reports the occupancy state of an area.

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7.4.8.1 Supported Clusters

In addition to those specified in Table 7.1, the Occupancy Sensor device shall support the clusters listed in Table 7.36.

Table 7.36 Clusters Supported by the Occupancy Sensor Device

Server Side	Client Side
Mandatory	
Occupancy sensing	<i>None</i>
Optional	
<i>None</i>	Groups

7.4.8.2 Supported Features and Functions

The Occupancy Sensor shall support the features and functions listed below.

Table 7.37 Example Features and Functions Supported by the Occupancy Sensor Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.37 Example Features and Functions Supported by the Occupancy Sensor Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.5 Closure Devices

7.5.1 Shade

The Shade device provides the ability to open or close window coverings, including setting partially open or partially closed states. This device type includes roller shades, drapes, and tilt-only blinds

7.5.1.1 Supported Clusters

In addition to those specified in Table 7.1, the Shade device shall support the clusters listed in Table 7.38.

Table 7.38 Clusters Supported by the Shade Device

Server Side	Client Side
Mandatory	
Shade Configuration	<i>None</i>
On/Off	
Level Control	
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

7.5.1.2 On/Off Cluster (Server) Clarification

The functionality of the supported On/Off cluster follows the specifications in the dependencies section of the Level Control cluster specification [R2]. For this device, “On” shall mean that the shade is open and “Off” shall mean that the shade is closed (i.e. at the level corresponding to the *ClosedLimit* attribute of the Shade Configuration cluster).

7.5.1.3 Level Control Cluster (Server) Clarification

The Level Control cluster shall allow control over the position of the shade. The functionality made available shall be that given in its specification [R2].

The position of the shade shall correspond to the level by the following relationship:

$$\text{Shade position} = \text{ClosedLimit} \times (255 - \text{Level}) / 255$$

When *Level* is 0 the shade is at the *ClosedLimit* and is closed. When *Level* is 255 the shade is at position 0 and is fully open.

7.5.1.4 Supported Features and Functions

The Shade device shall support the features and functions listed below.

Table 7.39 Example Features and Functions Supported by the Shade Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	M
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.39 Example Features and Functions Supported by the Shade Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.5.2 Shade Controller

The Shade Controller device can control the level of a shade, and put it into configuration mode so that the user may adjust its limits.

7.5.2.1 Supported Clusters

In addition to those specified in Table 7.1, the Shade Controller device shall support the clusters listed in Table 7.40.

Table 7.40 Clusters Supported by the Shade Controller Device

Server Side	Client Side
Mandatory	
<i>None</i>	On/Off
	Level Control
	Shade Configuration
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.5.2.2 Supported Features and Functions

The Shade Controller device shall support the features and functions listed below.

Table 7.41 Example Features and Functions Supported by the Shade Controller Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6 HVAC Devices

7.6.1 Heating/Cooling Unit

The Heating/Cooling Unit device can heat or cool a space in a house. It is not mandatory to provide both functionalities (e.g., the device may just heat but not cool). It may be an indoor air handler.

7.6.1.1 Supported Clusters

In addition to those specified in Table 7.1, the Heating/Cooling Unit device shall support the clusters listed in Table 7.42.

Table 7.42 Clusters Supported by the Heating/Cooling Unit Device

Server Side	Client Side
Mandatory	
On/Off	Thermostat
Scenes	
Groups	
Optional	
Fan Control	<i>None</i>
Level Control	

7.6.1.2 Thermostat Cluster (Client)

The Thermostat client cluster shall support a subset of the functionality specified in [R7], i.e., the ability to receive notifications of heating and/or cooling demand.

7.6.1.3 Supported Features and Functions

The Heating/Cooling Unit device shall support the features and functions listed below.

Table 7.43 Example Features and Functions Supported by the Heating/Cooling Unit Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M

Table 7.43 Example Features and Functions Supported by the Heating/Cooling Unit Device (Continued)

Enable Identify Mode	M
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	M
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6.2 Thermostat

The Thermostat device can have either built-in or separate sensors for temperature, humidity or occupancy. It allows the desired temperature to be set either remotely or locally. The thermostat may send heating and/or cooling requirement notifications to a heating/cooling unit (e.g., an indoor air handler) or may include a mechanism to control a heating or cooling unit directly.

7.6.2.1 Supported Clusters

In addition to those specified in Table 7.1, the Thermostat device shall support the clusters listed in Table 7.44.

Table 7.44 Clusters Supported by the Thermostat Device

Server Side	Client Side
Mandatory	
Thermostat	<i>None</i>
Scenes	
Groups	
Optional	
Thermostat User Interface Configuration	Fan Control

Table 7.44 Clusters Supported by the Thermostat Device (Continued)

Server Side	Client Side
	Temperature Measurement
	Occupancy Sensing
	Relative Humidity Measurement

7.6.2.2 Temperature Measurement Cluster (Client)

The functionality made available by the Temperature Measurement client cluster shall be that given in its specification [R3]. It is used to receive temperature measurements when either the local or outdoor temperature for the thermostat cluster is designated to be sensed remotely.

7.6.2.3 Occupancy Sensing Cluster (Client)

The functionality made available by the Occupancy Sensing client cluster shall be that given in its specification [R3]. It is used to receive occupancy notifications when occupancy for the thermostat cluster is designated to be sensed remotely.

7.6.2.4 Relative Humidity Measurement Cluster (Client)

The functionality made available by the Relative Humidity Measurement client cluster shall be that given in its specification [R3]. It is used to receive humidity measurements when humidity for the Thermostat cluster is designated to be sensed remotely.

7.6.2.5 Scene Table Extensions

The following extension fields shall be added to the Scenes table for the Thermostat cluster:

OccupiedCoolingSetpoint

OccupiedHeatingSetpoint

SystemMode

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7.6.2.6 Supported Features and Functions

The Thermostat device shall support the features and functions listed below.

Table 7.45 Example Features and Functions Supported by the Thermostat Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	M
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6.3 Temperature Sensor

The Temperature Sensor device reports measurements of temperature.

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7.6.3.1 Supported Clusters

In addition to those specified in Table 7.1, the Temperature Sensor device shall support the clusters listed in Table 7.46.

Table 7.46 Clusters Supported by the Temperature Sensor Device

Server Side	Client Side
Mandatory	
Temperature Measurement	<i>None</i>
Optional	
<i>None</i>	Groups

7.6.3.2 Supported Features and Functions

The Temperature Sensor device shall support the features and functions listed below.

Table 7.47 Example Features and Functions Supported by the Temperature Sensor Device

Device Type/Feature or Function	Mandatory/ Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.47 Example Features and Functions Supported by the Temperature Sensor Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6.4 Pump

The Pump device is a pump that may have variable speed. It may have optional built-in sensors and a regulation mechanism. It is typically used for pumping water.

7.6.4.1 Supported Clusters

In addition to those specified in Table 7.1, the Pump device shall support the clusters listed in Table 7.48.

Table 7.48 Clusters Supported by the Pump Device

Server Side	Client Side
Mandatory	
Pump Configuration and Control	<i>None</i>
On/Off	
Scenes	
Groups	
Optional	
Level Control	Pressure Measurement
Alarms	Temperature Measurement
Pressure Measurement	Flow Measurement
Temperature Measurement	
Flow Measurement	

7.6.4.2 On/Off Cluster (Server) Clarifications

The actions carried out by the pump on receipt of commands are shown in Table 7.49.

Table 7.49 Pump Actions on Receipt for On/Off Commands

Command	Action on Receipt
Off	If the pump is powered on, store the current level then immediately power it off.
On	If the pump is powered off, power it on and move immediately to the level stored by a previous Off command. If no such level has been stored, move immediately to the maximum level allowed for the pump.
Toggle	If the pump is powered on, proceed as for the Off command. If the device is powered off, proceed as for the On command.

7.6.4.3 Level Control Cluster (Server) Clarifications

The Level Control cluster shall allow controlling the pump setpoints as specified in [R2], however the transition time is always ignored.

The Setpoint of the pump is a percentage related to the Level according to Table 7.50.

Table 7.50 Relationship Between Level and Setpoint

Level	Setpoint	Meaning
0	N/A	Pump is stopped
1 - 200	Level / 2 (0.5 - 100.0%)	Pump setpoint in percent
201 - 255	100.0%	Pump setpoint is 100.0%

7.6.4.4 Pressure Measurement Notification (Server)

This cluster allows serving of internal pressure measurement if available. This is independent of the Pressure Measurement client cluster, which connects to an external networked pressure sensor.

7.6.4.5 Temperature Measurement Notification (Server)

This cluster allows serving of internal temperature measurement if available. This is independent of the Temperature Measurement client cluster, which connects to an external networked temperature sensor.

7.6.4.6 Flow Measurement Notification (Server)

This cluster allows serving of internal flow measurement if available. This is independent of the Flow Measurement client cluster, which connects to an external networked flow sensor.

7.6.4.7 Supported Features and Functions

The Pump device shall support the features and functions listed below.

Table 7.51 Example Features and Functions Supported by the Pump Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	M
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6.5 Pump Controller

The Pump Controller device can configure and control a Pump device.

7.6.5.1 Supported Clusters

In addition to those specified in Table 7.1, the Pump Controller device shall support the clusters listed in Table 7.52.

Table 7.52 Clusters Supported by the Pump Controller Device

Server Side	Client Side
Mandatory	
<i>None</i>	Pump Configuration and Control
	On/Off
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	Pressure Measurement
	Temperature Measurement
	Flow Measurement
	Level Control

7.6.5.2 Pressure Measurement (Client)

This cluster allows configuration and monitoring of the Pressure Sensor internal to a Pump device.

7.6.5.3 Temperature Measurement Notification (Client)

This cluster allows configuration and monitoring of the Temperature Sensor internal to a Pump device.

7.6.5.4 Flow Measurement Notification (Client)

This cluster allows configuration and monitoring of the Flow Sensor internal to a Pump device.

7.6.5.5 Supported Features and Functions

The Pump Controller device shall support the features and functions listed below.

Table 7.53 Example Features and Functions Supported by the Pump Controller Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6.6 Pressure Sensor

The Pressure Sensor device measures and periodically reports the pressure of a liquid (typically water).

7.6.6.1 Supported Clusters

In addition to those specified in Table 7.1, the Pressure Sensor device shall support the clusters listed in Table 7.54.

Table 7.54 Clusters Supported by the Pressure Sensor Device

Server Side	Client Side
Mandatory	
Pressure Measurement	<i>None</i>
Optional	
<i>None</i>	Groups

7.6.6.2 Supported Features and Functions

The Pressure Sensor device shall support the features and functions listed below.

Table 7.55 Example Features and Functions Supported by the Pressure Sensor Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

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Table 7.55 Example Features and Functions Supported by the Pressure Sensor Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.6.7 Flow Sensor

The Flow Sensor device measures and periodically reports the flow rate of a liquid (typically water).

7.6.7.1 Supported Clusters

In addition to those specified in Table 7.1, the Flow Sensor device shall support the clusters listed in Table 7.56.

Table 7.56 Clusters Supported by the Flow Sensor Device

Server Side	Client Side
Mandatory	
Flow Measurement	<i>None</i>
Optional	
<i>None</i>	Groups

7.6.7.2 Supported Features and Functions

The Flow Sensor device shall support the features and functions listed below.

Table 7.57 Example Features and Functions Supported by the Flow Sensor Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M

Table 7.57 Example Features and Functions Supported by the Flow Sensor Device (Continued)

Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

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7.7 Intruder Alarm System Devices

7.7.1 IAS Control and Indicating Equipment (CIE)

The IAS CIE device is the central Control and Indicating Equipment for an Intruder Alarm System. It receives inputs from sensors (Zones) and control equipment (ACE), and sends output to a warning device (WD).

7.7.1.1 Supported Clusters

In addition to those specified in Table 7.1, the IAS CIE device shall support the clusters listed in Table 7.58.

Table 7.58 Clusters Supported by the IAS CIE Device

Server Side	Client Side
Mandatory	
IAS ACE	IAS WD
	Identify
	IAS Zone

Table 7.58 Clusters Supported by the IAS CIE Device (Continued)

Server Side	Client Side
Optional	
<i>None</i>	Scenes
	Groups

7.7.1.2 Basic Cluster (Server) Restrictions

The ability to disable the device shall not be provided. That is, the *DeviceEnable* attribute shall be read-only and set to 0.

7.7.1.3 Supported Features and Functions

The IAS CIE device shall support the features and functions listed below.

Table 7.59 Example Features and Functions Supported by the IAS CIE Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O

Table 7.59 Example Features and Functions Supported by the IAS CIE Device (Continued)

ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.7.2 IAS Ancillary Control Equipment (ACE)

The IAS ACE device is a remote control for an Intruder Alarm System. A Zigbee enabled ACE device can access an IAS CIE device and manipulate the IAS system, on behalf of a level-2 user (see [R10]). The device can also act as a Zone sensor.

7.7.2.1 Supported Clusters

In addition to those specified in Table 7.1, the IAS ACE device shall support the clusters listed in Table 7.60.

Table 7.60 Clusters Supported by the IAS ACE Device

Server Side	Client Side
Mandatory	
IAS Zone	IAS ACE
	Identify
Optional	
<i>None</i>	<i>None</i>

7.7.2.2 Basic Cluster (Server) Restrictions

The ability to disable the device shall not be provided. That is, the *DeviceEnable* attribute shall be read-only and set to 0.

7.7.2.3 Supported Features and Functions

The IAS ACE device shall support the features and functions listed below.

Table 7.61 Example Features and Functions Supported by the IAS ACE Device

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.7.3 IAS Zone

An IAS Zone device detects alarm conditions (e.g. intrusion, fire) and signals them to the Control and Indicating Equipment (CIE) of an IAS system. An IAS Zone device supports up to two alarm types, low battery reports, and supervision of the IAS network.

7.7.3.1 Supported Clusters

In addition to those specified in Table 7.1, the IAS Zone device shall support the clusters listed in Table 7.62.

Table 7.62 Clusters Supported by the IAS Zone Device

Server Side	Client Side
Mandatory	
IAS Zone	<i>None</i>
Optional	
<i>None</i>	<i>None</i>

7.7.3.2 Basic Cluster (Server) Restrictions

The ability to disable the device shall not be provided. That is, the *DeviceEnable* attribute shall be read-only and set to 0.

7.7.3.3 Supported Features and Functions

The IAS Zone device shall support the features and functions listed below.

Table 7.63 Example Features and Functions Supported by the IAS Zone Device

Device Type/Feature or Function	Mandatory/ Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O

Table 7.63 Example Features and Functions Supported by the IAS Zone Device (Continued)

Service discovery (Match Descriptor Request)	O
ZDP Bind Response	M
ZDP Unbind Response	M
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

7.7.4 IAS Warning Device (WD)

An IAS WD device can produce audible and visible warning indications (siren, strobe lighting, etc.) when instructed to by an IAS Central Indicating Equipment (CIE) on detection of a system alarm condition. The IAS WD can also act as a sensor (Zone).

7.7.4.1 Supported Clusters

In addition to those specified in Table 7.1, the IAS WD shall support the clusters listed in Table 7.64.

Table 7.64 Clusters Supported by the IAS WD

Server Side	Client Side
Mandatory	
IAS WD	<i>None</i>
IAS Zone	
Optional	
Scenes	<i>None</i>
Groups	

7.7.4.2 Basic Cluster (Server) Restrictions

The ability to disable the device shall not be provided, i.e., the *DeviceEnable* attribute shall be read-only and set to 0.

7.7.4.3 Polling Rate Exception

The IAS WD may poll at a maximum rate of once per second when it is implemented as a battery-powered ZigBee end device that sleeps. It is recommended that this exception be used cautiously, and that the number of devices installed in a network that make use of this be kept to a minimum.

7.7.4.4 Supported Features and Functions

The IAS WD device shall support the features and functions listed below.

Table 7.65 Example Features and Functions Supported by the IAS WD

Device Type/Feature or Function	Mandatory/Optional
Join (end devices and routers only)	M
Form Network (Coordinator only)	M
Allow Others to Join Network (routers and Coordinators only)	M
Restore to Factory Fresh Settings	M
Pair Devices (End Device Bind Request)	O
Bind Manager (End Device Bind Response - Coordinator only)	M
Enable Identify Mode	O
Group Nodes (send out an Add Group If Identify)	O
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O
ZDP Bind Response	O
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

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