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Control your world

ZIGBEE HOME AUTOMATION PUBLIC APPLICATION PROFILE

Home Automation Public Application Profile

ZigBee Profile: 0x0104

Revision 26

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TABLE OF CONTENTS

	1
	2
	3
	4
Notice of Use and Disclosure	i
	5
Participants	iii
	6
List of Tables	ix
	7
List of Figures	xiii
	8
Document History	xv
	9
	10
	11
Chapter 1 Introduction	1
	12
1.1 Scope	1
	13
1.2 Purpose	1
	14
	15
Chapter 2 References	3
	16
2.1 ZigBee Alliance Documents	3
	17
2.2 European Standards Documents	3
	18
	19
Chapter 3 Definitions	5
	20
3.1 Conformance Levels	5
	21
3.2 ZigBee Definitions	5
	22
	23
Chapter 4 Acronyms and Abbreviations	7
	24
Chapter 5 Profile Description	9
	25
5.1 A ZigBee Home Automation Network	9
	26
5.2 ZigBee Stack Profile	10
	27
5.2.1 ZigBee Routing Table Size Recommendations	11
	28
5.2.2 ZigBee HA Coordinator Recommendations	12
	29
5.3 Startup Attribute Set (SAS)	12
	30
5.3.1 Start Up Parameters	12
	31
5.3.2 Join Parameters	13
	32
5.3.3 Security Parameters	14
	33
5.3.4 End Device Parameters	14
	34
5.3.5 Link Status Parameters	14
	35
5.3.6 Concentrator Parameters	15
	36
5.3.7 APS Transport Parameters	15
	37
5.3.8 Binding Parameters	15
	38
5.4 ZDO Config for HA Devices	15
	39
5.5 Other HA Requirements and Best Practices	15
	40
5.6 Device Descriptions	16
	41
	42
	43
	44
	45

5.7 ZigBee Cluster Library (ZCL)	18	
5.8 Cluster List	19	1
5.9 Commissioning	20	2
5.9.1 Forming the Network (Start-up Sequence)	20	3
5.9.2 Support for Commissioning Modes	21	4
5.9.3 Commissioning Documentation	22	5
5.9.4 Group Commissioning	23	6
5.9.5 Group Messaging vs. Unicast Messaging	24	7
		8
		9
Chapter 6 Constants, Error Codes and General Alarms	25	10
Chapter 7 Device Specifications	29	11
7.1 Common Clusters	29	12
7.1.1 Optional Support for Clusters With Reporting Capability ..	30	13
7.1.2 Groups and Scene Cluster Clarification	30	14
7.1.3 Level Control Cluster Clarification	31	15
7.1.4 Client Cluster Mandatory Commands Clarification	35	16
7.1.5 Configure Reporting Optional for Certain Device Types ...	36	17
7.1.6 Manufacturer-Specific Clusters	36	18
7.1.7 Cluster Usage Restrictions	36	19
		20
		21
7.2 Feature and Function Description	37	22
7.3 Generic Devices	39	23
7.3.1 On/Off Switch	39	24
7.3.2 Level Control Switch	40	25
7.3.3 On/Off Output	42	26
7.3.4 Level Controllable Output	43	27
7.3.5 Scene Selector	45	28
7.3.6 Configuration Tool	46	29
7.3.7 Remote Control	48	30
7.3.8 Combined Interface	51	31
7.3.9 Range Extender	53	32
7.3.10 Mains Power Outlet	54	33
7.3.11 Door Lock	56	34
7.3.12 Door Lock Controller	57	35
7.3.13 Simple Sensor	58	36
		37
		38
		39
7.4 Lighting Devices	60	40
7.4.1 On/Off Light	60	41
7.4.2 Dimmable Light	61	42
7.4.3 Color Dimmable Light	63	43
7.4.4 On/Off Light Switch	65	44
		45

7.4.5 Dimmer Switch	67	
7.4.6 Color Dimmer Switch	68	1
7.4.7 Light Sensor	70	2
7.4.8 Occupancy Sensor	71	3
7.5 Closure Devices	73	4
7.5.1 Shade	73	5
7.5.2 Shade Controller	75	6
7.5.3 Window Covering Device	76	7
7.5.4 Window Covering Controller	78	8
7.6 HVAC Devices	80	9
7.6.1 Heating/Cooling Unit	80	10
7.6.2 Thermostat	81	11
7.6.3 Temperature Sensor	84	12
7.6.4 Pump	85	13
7.6.5 Pump Controller	88	14
7.6.6 Pressure Sensor	89	15
7.6.7 Flow Sensor	91	16
7.7 Intruder Alarm System Devices	92	17
7.7.1 IAS Control and Indicating Equipment (CIE)	92	18
7.7.2 IAS Ancillary Control Equipment (ACE)	94	19
7.7.3 IAS Zone	96	20
7.7.4 IAS Warning Device (WD)	97	21
A.1 Door Lock Cluster	101	22
A.1.1 Server	102	23
A.1.2 Client	103	24
A.2 Window Covering Cluster	104	25
A.2.1 Overview	104	26
A.2.2 Server	104	27
B.1 CCB #1169	121	28
B.2 CCB #1097	122	29
B.3 CCB #1092	123	30
B.4 CCB #1093	124	31
B.5 CCB #1094	124	32
B.6 CCB #1085	125	33
C.1 General E-mode Commissioning Recommendations	127	34
C.1.1 End Device Bind	127	35
C.1.2 Group Commissioning	128	36
C.2 Sensor E-mode Commissioning Recommendations	128	37
		38
		39
		40
		41
		42
		43
		44
		45

C.2.1 1. EDB + Bind.	128
C.3 General Recommendations	129

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
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23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45

LIST OF TABLES

	1
	2
	3
	4
Table 1.1 Document Revision Change History	xv
Table 5.1 Devices Specified in the HA Profile	17
Table 5.2 Clusters Used in the HA Profile	19
Table 5.3 Example Commissioning Documentation	22
Table 6.1 Constants Specific to the HA Profile	25
Table 7.1 Clusters Common to All Devices	29
Table 7.2 Move Commands Without On/Off	31
Table 7.3 Move Commands With On/Off	33
Table 7.4 Example Features and Functions Configuration for an HA Device	37
Table 7.5 Clusters Supported by the On/Off Switch Device	39
Table 7.6 Example Features and Functions Supported by the On/Off Switch Device	39
Table 7.7 Clusters Supported by the Level Control Switch Device ..	40
Table 7.8 Example Features and Functions Supported by the Level Control Switch Device	41
Table 7.9 Clusters Supported by the On/Off Output Device	42
Table 7.10 Example Features and Functions Supported by the On/Off Output Device	43
Table 7.11 Clusters Supported by the Level Controllable Output Device 44	44
Table 7.12 Example Features and Functions Supported by the Level Controllable Output Device	44
Table 7.13 Clusters Supported by the Scene Selector Device	45
Table 7.14 Example Features and Functions Supported by the Scene Selector Device	46
Table 7.15 Clusters Supported by the Configuration Tool Device ..	47
Table 7.16 Example Features and Functions Supported by the Configuration Tool Device	48
Table 7.17 Clusters Supported by the Remote Control Device	49
Table 7.18 Example Features and Functions Supported by the Remote Control Device	50
Table 7.19 Clusters Supported by the Combined Interface Device ..	51

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45

Table 7.20 Example Features and Functions Supported by the Combined Interface Device	52	1
Table 7.21 Example Features and Functions Supported by the Range Extender Device	53	2
Table 7.22 Clusters Supported by the Mains Power Outlet Device	54	3
Table 7.23 Example Features and Functions Supported by the Mains Power Outlet Device	55	4
Table 7.24 Clusters Supported by the Door Lock Device	56	5
Table 7.25 Example Features and Functions Supported by the Door Lock Device	56	6
Table 7.26 Clusters Supported by the Door Lock Controller	57	7
Table 7.27 Example Features and Functions Supported by the Door Lock Device	58	8
Table 7.28 Clusters Supported by the Simple Sensor	59	9
Table 7.29 Example Features and Functions Supported by the Simple Sensor Device	59	10
Table 7.30 Clusters Supported by the On/Off Light Device	60	11
Table 7.31 Example Features and Functions Supported by the On/Off Light Device	61	12
Table 7.32 Clusters Supported by the Dimmable Light Device	62	13
Table 7.33 Example Features and Functions Supported by the Dimmable Light Device	63	14
Table 7.34 Clusters Supported by the Color Dimmable Light Device	64	15
Table 7.35 Example Features and Functions Supported by the Color Dimmable Light Device	64	16
Table 7.36 Clusters Supported by the On/Off Light Switch	66	17
Table 7.37 Example Features and Functions Supported by the On/Off Light Switch	66	18
Table 7.38 Clusters Supported by the Dimmer Switch Device	67	19
Table 7.39 Example Features and Functions Supported by the Dimmer Switch Device	68	20
Table 7.40 Clusters Supported by the Color Dimmer Switch Device	69	21
Table 7.41 Example Features and Functions Supported by the Color Dimmer Switch Device	69	22
Table 7.42 Clusters Supported by the Light Sensor Device	70	23
Table 7.43 Example Features and Functions Supported by the Light Sensor Device	71	24
Table 7.44 Clusters Supported by the Occupancy Sensor Device	72	25
		26
		27
		28
		29
		30
		31
		32
		33
		34
		35
		36
		37
		38
		39
		40
		41
		42
		43
		44
		45

Table 7.45 Example Features and Functions Supported by the Occupancy Sensor Device	72	1
Table 7.46 Clusters Supported by the Shade Device	73	2
Table 7.47 Example Features and Functions Supported by the Shade Device	74	3
Table 7.48 Clusters Supported by the Shade Controller Device	75	4
Table 7.49 Example Features and Functions Supported by the Shade Controller Device	76	5
Table 7.50 Clusters Supported by the Window Covering Device	77	6
Table 7.51 Example Features and Functions Supported by the Window Covering Device	77	7
Table 7.52 Clusters Supported by the Window Covering Controller Device	78	8
Table 7.53 Example Features and Functions Supported by the Window Covering Controller Device	79	9
Table 7.54 Clusters Supported by the Heating/Cooling Unit Device	80	10
Table 7.55 Example Features and Functions Supported by the Heating/Cooling Unit Device	81	11
Table 7.56 Clusters Supported by the Thermostat Device	82	12
Table 7.57 Example Features and Functions Supported by the Thermostat Device	83	13
Table 7.58 Clusters Supported by the Temperature Sensor Device	84	14
Table 7.59 Example Features and Functions Supported by the Temperature Sensor Device	84	15
Table 7.60 Clusters Supported by the Pump Device	85	16
Table 7.61 Pump Actions on Receipt for On/Off Commands	86	17
Table 7.62 Relationship Between Level and Setpoint	86	18
Table 7.63 Example Features and Functions Supported by the Pump Device	87	19
Table 7.64 Clusters Supported by the Pump Controller Device	88	20
Table 7.65 Example Features and Functions Supported by the Pump Controller Device	89	21
Table 7.66 Clusters Supported by the Pressure Sensor Device	90	22
Table 7.67 Example Features and Functions Supported by the Pressure Sensor Device	90	23
Table 7.68 Clusters Supported by the Flow Sensor Device	91	24
Table 7.69 Example Features and Functions Supported by the Flow Sensor Device	91	25

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
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23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45

Table 7.70 Clusters Supported by the IAS CIE Device	93	1
Table 7.71 Example Features and Functions Supported by the IAS CIE Device	93	2
Table 7.72 Clusters Supported by the IAS ACE Device	94	3
Table 7.73 Example Features and Functions Supported by the IAS ACE Device	95	4
Table 7.74 Clusters Supported by the IAS Zone Device	96	5
Table 7.75 Example Features and Functions Supported by the IAS Zone Device	96	6
Table 7.76 Clusters Supported by the IAS WD	97	7
Table 7.77 Example Features and Functions Supported by the IAS WD	98	8
Table A.1 Server Attributes	102	9
Table A.2 Commands Received by the Server Cluster	103	10
Table A.3 Commands Received by the Client Cluster	104	11
Table A.4 Window Covering Attribute Sets	105	12
Table A.5 Window Covering Information Attribute Set	105	13
Table A.6 Window Covering Types	106	14
Table A.7 Bit Meanings for the Config/Status Attribute	107	15
Table A.8 Window Covering Settings Attribute Set	109	16
Table A.9 Bit Meanings for the Mode Attribute	111	17
Table A.10 Commands Received by the Window Covering Server Cluster 112	112	18
Table A.11 Commands Generated by the Window Covering Client .	119	19
Table B.1 ZCL Default Response Clarification	122	20
		21
		22
		23
		24
		25
		26
		27
		28
		29
		30
		31
		32
		33
		34
		35
		36
		37
		38
		39
		40
		41
		42
		43
		44
		45

LIST OF FIGURES

	1
	2
	3
	4
Figure 5.1 Home network enabled by ZigBee HA	10
	5
Figure A.1 Format of the Go To Lift Setpoint Command	113
	6
Figure A.2 Format of the Go To Lift Value Command	114
	7
Figure A.3 Format of the Go To Lift Percentage Command	114
	8
Figure A.4 Format of the Go To Tilt Setpoint Command	115
	9
Figure A.5 Format of the Go To Tilt Value Command	115
	10
Figure A.6 Format of the Go To Tilt Percentage Command	116
	11
Figure A.7 Format of the Program Setpoint Command	117
	12
Figure A.8 Format of the Program Setpoint command	117
	13
	14
	15
	16
	17
	18
	19
	20
	21
	22
	23
	24
	25
	26
	27
	28
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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 inter operability between HA profile devices.
25	1.0	Editorial changes for release.
26	0.9	Added CCB resolutions

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CHAPTER

1

INTRODUCTION

1.1 Scope

This profile defines device descriptions and standard practices for applications commonly found in a residential or light commercial environment. Installation scenarios range from a single room to an entire home. The key applications included in this profile are lighting, HVAC, window shades and security.

1.2 Purpose

This profile provides standard interfaces and device definitions to allow inter operability among ZigBee Home Automation devices produced by various manufacturers.

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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

- [B1] ZigBee document 08006r03, ZigBee PICS And Stack Profiles
[B2] ZigBee document 075123r02, ZigBee Cluster Library Specification.
[B3] ZigBee document 075356r15ZB, ZigBee Smart Energy Profile Specification

2.2 European Standards Documents

- [B4] EN 50131 European Standards Series for Intruder Alarm Systems

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CHAPTER

3

DEFINITIONS

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17
18
19
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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 a profile. For example, the light sensor device description is a member of the ZigBee Home Automation public 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 a public application profile.

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

Unit: A unit consists of one or more physical objects (for example: 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	1
APS	Application Support Sub-layer	2
CIE	Control and Indicating Equipment	3
HA	Home Automation	4
IAS	Intruder Alarm Systems	5
WD	Warning Device	6
ZCL	ZigBee Cluster Library	7

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CHAPTER

5

PROFILE DESCRIPTION

5.1 A ZigBee Home Automation Network

Home Automation (HA) networks scale from 2 to 500 nodes. HA networks are easily installed by either homeowners, or home automation professionals. Installation concepts are simple and uniform across multiple OEM vendors.

ZigBee Home Automation 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 which are based on the ZigBee Feature Set and ZigBee PRO Feature Set.

Consumers are expected to buy a home automation system based on a single manufacturer's certified ZigBee Home Automation product suite and then expand the system with certified ZigBee Home Automation products from other vendors. It can occur that not all products in a home automation system are ZigBee Home Automation devices. In this case ZigBee Home Automation certified bridge devices are recommended that can bridge with the non-ZigBee home automation network. For instance, you can connect your ZigBee Home Automation certified devices to a computer equipped with a ZigBee Home Automation certified dongle.

Any ZigBee devices connecting to a ZigBee Home Automation network must be ZigBee certified.

Though encouraged, ZHA 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.

All ZHA certified devices will interoperate with any other ZHA certified devices. ZHA may interoperate with other ZigBee public application profile devices (ZigBee Health Care, ZigBee Smart Energy, etc.) if a device is in the ZHA network that is certified for both or multiple ZigBee public application profile.

ZigBee Home Automation makes possible networks such as the following:

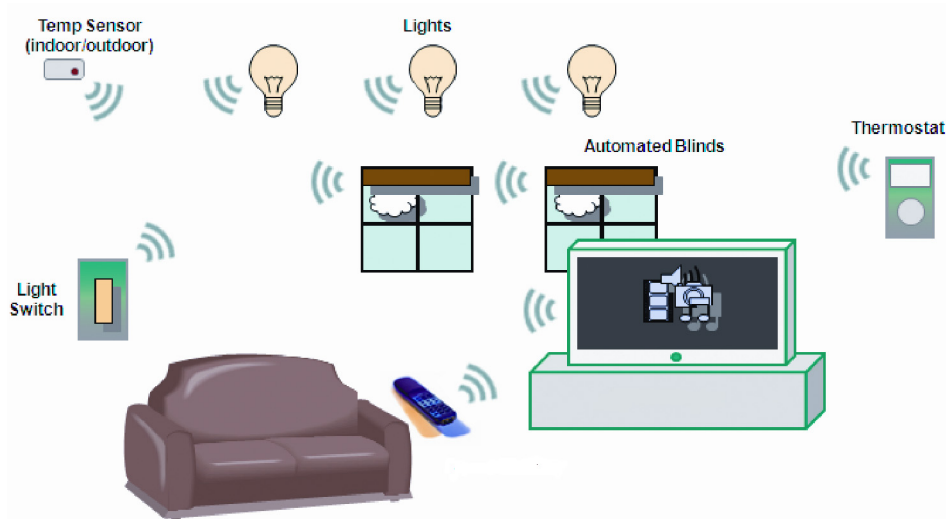


Figure 5.1 Home network enabled by ZigBee HA

In the above figure, the lights and switches can be controlled wirelessly, as well as blinds, the thermostat and other devices. Using the scene mechanism, a single press of a button on the remote control could dim the lights, lower the blinds, in preparation to watch a movie. Another button press, either on the remote or a specific switch within the home could place the home in the “At work” mode, lowering the air conditioner or heating in all rooms except the home office, 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 networks 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 [B1]. In addition to the requirements specified in [B1], the following requirements are mandatory for this application profile.

- Support for Application link keys is required.

- Source binding and groups/scenes shall be implemented on a device type basis, see device descriptions for applicability. 1
- 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 (for example, 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 (for example, the On/Off Light Switch). 2
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- Devices shall support the mandatory stack profile interoperability as described in section 7.2. and 7.3 of the document [B1], ZigBee PICS And Stack Profiles. 14
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- Fragmentation is not supported in ZHA. It is therefor recommended that a device does not ask for a larger response than what can fit in an non fragmented packet. especially during read or write of multiple attribute this can be the case. 17
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- If fragmentation is enabled the device shall first query the Node descriptor of the device it will communicate with to determine the maximum incoming transfer size unless manufacturer specific packets are sent. The sending device must use a message size during fragmentation that is smaller than this value. If Fragmentation is supported by the device is it recommend to have apsInterFramDelay set to 50 and apsMaxWindowSize set to 1 in order to ensure maximum interoperability. 20
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5.2.1 ZigBee Routing Table Size Recommendations 28

If a ZHA 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 *ad hoc* On-Demand Distance Vector (AODV) routing for the majority of their messaging, though this may be of secondary concern. 29
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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 (ZigBee Specification revision 17 (2007) and later).

Stack Profile

1 (ZigBee Feature Set) or 2 (ZigBee PRO Feature Set).

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

Network Key

NULL.

Default Trust Center Link Key

0x5A 0x69 0x67 0x42 0x65 0x65 0x41 0x6C 0x6C 0x69 0x61 0x6E 0x63 0x65
0x30 0x39

Note: The Link Key is listed in little-endian format.

Use Insecure Join

0x01 (True). This flag enables the use of insecure join as a fallback case at startup time.

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 network to join.

TimeBetweenScans

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

Network Rejoin

A device may attempt to rejoin for a period of maximum 15 minutes, and shall back off for minimum 15 minutes before attempting to rejoin again, unless prompted to rejoin by user interaction. The rejoin attempts in the rejoin period can be secure, unsecure or a combination.

Devices shall set either the ZigBee stack rejoin settings `Config_Rejoin_Interval/RejoinInterval` and `Config_Max_Rejoin_Interval/MaxRejoinInterval`, or the application shall put into effect the appropriate rejoin back off behavior through implementation specific means.

Examples:

- 1 An “OnOff Switch” end device loses network connection and attempts to rejoin for 1 minutes and then backs off forever. When user presses the switch the device will attempt another rejoin.
- 2 An “OnOff Light” end device loses network connection and attempts to rejoin for 15 minutes and then backs off 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.

Trust Center Link Key

0x5A 0x69 0x67 0x42 0x65 0x65 0x41 0x6C 0x6C 0x69 0x61 0x6E 0x63
0x65 0x30 0x39

Note: The Link Key is listed in little-endian format.

The current network key shall be transported using the default TC link key in the case where the joining device is unknown or has no specific authorization associated with it. This allows for the case where alternative pre-configured link keys specifically associated with a device can be used as well.

It is not required to use Link keys for communication when a device has joined the network unless explicitly specified by the individual device which clusters require link keys. Only network level security is required when not specified.

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.

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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 discouraged for HA devices, except for when controlling groups or invoking scenes.

Devices are limited to a maximum broadcast frequency of 9 broadcasts in 9 seconds but strongly encouraged to exercise broadcasts much less frequently. As an example, a latency sensitive application that normally has very low frequency of transmission may transmit two or three broadcasts consecutively within one second.

Frequency Agility

Frequency Agility would only OEM system controller, or higher functioning device (system remote etc.).

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

Key Updates

It is recommended that upon join the Trust Center updates the joining device with a new network or device specific Trust Center link key.

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
	Door Lock	0x000A
	Door Lock Controller	0x000B
	Simple Sensor	0x000C
	Reserved	0x000C– 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 – 0x1FF
Closures	Shade	0x0200
	Shade Controller	0x0201
	Window Covering Device	0x0202
	Window Covering Controller	0x0203
	Reserved	0x0204 – 0x2FF

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Table 5.1 Devices Specified in the HA Profile (Continued)

	Device	Device ID
HVAC	Heating/Cooling Unit	0x0300
	Thermostat	0x0301
	Temperature Sensor	0x0302
	Pump	0x0303
	Pump Controller	0x0304
	Pressure Sensor	0x0305
	Flow Sensor	0x0306
	Reserved	0x0307 - 0x3FF
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 [B2] 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 ZigBee Cluster Library specification [B2].

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 ZigBee Cluster Library [B2].

Table 5.2 Clusters Used in the HA Profile

Functional Domain	Cluster Name	Cluster ID
General	Basic	0x0000
General	Power Configuration	0x0001
General	Device Temperature Configuration	0x0002
General	Identify	0x0003
General	Groups	0x0004
General	Scenes	0x0005
General	On/Off	0x0006
General	On/Off Switch Configuration	0x0007
General	Level control	0x0008
General	Alarms	0x0009
General	Binary Input (Basic)	0x000F

Table 5.2 Clusters Used in the HA Profile (Continued)

Functional Domain	Cluster Name	Cluster ID
Measurement & Sensing	I luminance Measurement	0x0400
Measurement & Sensing	I luminance Level Sensing	0x0401
Measurement & Sensing	Temperature Measurement	0x0402
Measurement & Sensing	Pressure Measurement	0x0403
Measurement & Sensing	Flow Measurement	0x0404
Measurement & Sensing	Relative Humidity Measurement	0x0405
Measurement & Sensing	Occupancy sensing	0x0406
Lighting	Color Control	0x0300
HVAC	Pump Configuration and Control	0x0200
HVAC	Thermostat	0x0201
HVAC	Fan Control	0x0202
HVAC	Thermostat User Interface Configuration	0x0204
Closures	Shade Configuration	0x0100
Closures	Door Lock	0x0101
Closures	Window Covering	0x0102
Security and Safety	IAS ACE	0x0501
Security and Safety	IAS Zone	0x0500
Security and Safety	IAS WD	0x0502
Smart Energy	Meter	0x0702

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.

5.9.1 Forming the Network (Start-up Sequence)

HA devices must form their own network or join an existing network.

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 typically discussed with in the ZigBee Alliance:

A-mode (automatic mode), which involves automatic commissioning of devices. The A-mode generally allows for minimal (or no) human intervention.

E-mode (easy mode), which involves the use of buttons or other physical mechanisms on devices to direct devices during commissioning. The E-mode allows for simpler end-user or professional installer commissioning. It usually targets small installations (maximum size: typical home).

S-mode (system mode), which involves the use of external tools and are typically used by expert installers. The S-mode represents the most complex form of commissioning and includes the highest level of human intervention. It usually targets larger installations such as commercial premises and high-end residential environments.

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. The device can use some form of automatic behavior for instance, joining the network upon Power up, but shall still provide the means for the end user to commission the device.

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	User Action on Device
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 (for example, 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 is not covered in this document however this section describes how group commissioning can be accomplished. 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 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.

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.	8
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>PhysicalEnvironment</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)

Constant	Description	Value
Values of the PhysicalEnvironment attribute of the Basic cluster for use with this profile.	Deck	0x0C
	Den	0x0D
	Dining Room	0x0E
	Electrical Room	0x0F
	Elevator	0x10
	Entry	0x11
	Family Room	0x12
	Main Floor	0x13
	Upstairs	0x14
	Downstairs	0x15
	Basement/Lower Level	0x16
	Gallery	0x17
	Game Room	0x18
	Garage	0x19
	Gym	0x1A
	Hallway	0x1B
	House	0x1C
	Kitchen	0x1D
	Laundry Room	0x1E
	Library	0x1F
	Master Bedroom	0x20
	Mud Room (small room for coats and boots)	0x21
	Nursery	0x22
	Pantry	0x23
	Office	0x24
	Outside	0x25
	Pool	0x26
	Porch	0x27
	Sewing Room	0x28
Sitting Room	0x29	

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Table 6.1 Constants Specific to the HA Profile (Continued)

Constant	Description	Value
	Stairway	0x2A
	Yard	0x2B
Values of the PhysicalEnvironment attribute of the Basic cluster for use with this profile.	Attic	0x2C
	Hot Tub	0x2D
	Living Room	0x2E
	Sauna	0x2F
	Shop/Workshop	0x30
	Guest Bedroom	0x31
	Guest Bath	0x32
	Powder Room (1/2 bath)	0x33
	Back Yard	0x34
	Front Yard	0x35
	Patio	0x36
	Driveway	0x37
	Sun Room	0x38
	Living Room	0x39
	Spa	0x3A
	Whirlpool	0x3B
	Shed	0x3C
	Equipment Storage	0x3D
	Hobby/Craft Room	0x3E
	Fountain	0x3F
	Pond	0x40
	Reception Room	0x41
	Breakfast Room	0x42
	Nook	0x43
	Garden	0x44
	Balcony	0x45
	Panic Room	0x46
	Terrace	0x47

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Table 6.1 Constants Specific to the HA Profile (Continued)

Constant	Description	Value
	Roof	0x48

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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 (see 7.1.4)
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	
Meter	Meter
Manufacturer-specific (see sub-clause 7.1.6 for details)	Manufacturer-specific (see sub-clause 7.1.6 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 Groups and Scene Cluster Clarification

As Groupcasts are made on a broadcast to all devices for which `macRxOnWhenIdle = TRUE`, Sleeping end devices will not be able to benefit from the features of the Groups and Scenes server Cluster. For example, a door lock which would typically be a sleeping end device would not be able to receive the telegrams required to commission a scene or change for example, to a night scene. It is therefor not Mandatory but only optional to support the Groups and Scenes Server cluster if the device is a Sleeping end device (even when listed as Mandatory).

7.1.2.1 Scenes Clarification

Certain devices has several extension field sets. An example is the Dimmable Light that has an OnOff cluster and a level control cluster. It is required that a scene commissioned shall contain all extension field sets. For example, an Add Scene command sent to an Dimmable light shall contain a OnOff and CurrentLevel. A View Scene response would also contain all extension field sets.

7.1.3 Level Control Cluster Clarification

The following tables shows how the level control cluster shall be implemented.

Table 7.2 Move Commands Without On/Off

State Before Command			Command	State After Command			
Current Level Attribute	On/Off Attribute	Physical Light		Current Level Attribute	On/Off Attribute	Physical Light	
0	0	Off	Move to level 128 over 2 sec	128	0	Off	Light stays off, level is changed
128	0	Off	Move to level 128 over 2 sec	128	0	Off	Light stays off
255	0	Off	Move to level 128 over 2 sec	128	0	Off	Light stays off, level is changed
0	1	Off (on at 0%)	Move to level 128 over 2 sec	128	1	On 50%	Light is on, so physical level adjusts up to half on
128	1	On 50%	Move to level 128 over 2 sec	128	1	On 50%	Same level so no changes
255	1	On full	Move to level 128 over 2 sec	128	1	On 50%	Light is on, so physical level adjusts down to half on
0	0	Off	Move rate = up 64 per second	255	0	Off	Light stays off, level is changed
128	0	Off	Move rate = up 64 per second	255	0	Off	Light stays off
255	0	Off	Move rate = up 64 per second	255	0	Off	Light stays off, level is changed
0	1	Off (on at 0%)	Move rate = up 64 per second	255	1	On full	Light is on, so physical level adjusts up to full on

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Table 7.2 Move Commands Without On/Off (Continued)

State Before Command				State After Command			
Current Level Attribute	On/Off Attribute	Physical Light	Command	Current Level Attribute	On/Off Attribute	Physical Light	
128	1	On 50%	Move rate = up 64 per second	255	1	On full	Light is on, so physical level adjusts up to full on
255	1	On full	Move rate = up 64 per second	255	1	On full	Light is on already at full, so no changes
0	0	Off	Move rate = down 64 per second	0	0	Off	Light stays off
128	0	Off	Move rate = down 64 per second	0	0	Off	Light stays off, level is changed
255	0	Off	Move rate = down 64 per second	0	0	Off	Light stays off, level is changed
0	1	Off (on at 0%)	Move rate = down 64 per second	0	1	Off (on at 0%)	Level is already at 0 -- no changes to level or physical light
128	1	On 50%	Move rate = down 64 per second	0	1	Off (on at 0%)	Level moves down to zero, leaving the physical light off (0% on) and on/off attribute at 1
255	1	On full	Move rate = down 64 per second	0	1	Off (on at 0%)	Level moves down to zero, leaving the physical light off (0% on) and on/off attribute at 1

Table 7.3 Move Commands With On/Off

State Before Command			Command	State After Command			
Current Level Attribute	On/Off Attribute	Physical Light		Level Attribute	On/Off Attribute	Physical Light	
0	0	Off	Move to level 128 over 2 sec	128	1	On 50%	Physical light changes to ON, on/off attr is also adjusted
128	0	Off	Move to level 128 over 2 sec	128	1	On 50%	Physical light changes to ON, on/off attribute is also adjusted
255	0	Off	Move to level 128 over 2 sec	128	1	On 50%	Physical light changes to ON, on/off attr is also adjusted
0	1	off (on at 0%)	Move to level 128 over 2 sec	128	1	On 50%	Physical light goes from off to half on
128	1	On 50%	Move to level 128 over 2 sec	128	1	On 50%	Light is already half on, no change
255	1	On full	Move to level 128 over 2 sec	128	1	On 50%	Physical light goes from full on to half on
0	0	Off	Move rate = up 64 per second	255	1	On full	Physical light changes to ON, on/off attr is also adjusted
128	0	Off	Move rate = up 64 per second	255	1	On full	Physical light changes to ON, on/off attr is also adjusted
255	0	Off	Move rate = up 64 per second	255	1	On full	Physical light changes to ON, on/off attr is also adjusted

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Table 7.3 Move Commands With On/Off (Continued)

State Before Command			Command	State After Command			
Current Level Attribute	On/Off Attribute	Physical Light		Level Attribute	On/Off Attribute	Physical Light	
0	1	Off (on at 0%)	Move rate = up 64 per second	255	1	On full	Physical level adjusts from off to full on
128	1	On 50%	Move rate = up 64 per second	255	1	On full	Physical level adjusts from half on to full on
255	1	On full	Move rate = up 64 per second	255	1	On full	Light is already on at full level, no changes
0	0	Off	Move rate = down 64 per second	0	0	Off	Light stays off, level is also at 0
128	0	Off	Move rate = down 64 per second	0	0	Off	Light stays off, level is also at 0
255	0	Off	Move rate = down 64 per second	0	0	Off	Light stays off, level is also at 0
0	1	Off (on at 0%)	Move rate = down 64 per second	0	0	Off	Physical light is already off, on/off attr is also adjusted
128	1	On 50%	Move rate = down 64 per second	0	0	Off	Light physically turns off, on/off attr is also adjusted
255	1	On full	Move rate = down 64 per second	0	0	Off	Light physically turns off, on/off attr is also adjusted

7.1.4 Client Cluster Mandatory Commands Clarification

For the following clusters the client generates the cluster-specific commands detailed in 'Commands Received' section of the server cluster as required by the application. This means that even through all commands are listed as mandatory it is only required to implement the client side required for the application.

For example, an On/Off switch might only implement the Toggle command and not the On and Off commands.

Clusters:

- Power Configuration
- Device Temperature Configuration
- Identify
- Groups
- Scenes
- On/Off
- On/Off Switch Configuration
- Level control
- Alarms
- Illuminance Measurement
- Illuminance Level Sensing
- Temperature Measurement
- Pressure Measurement
- Flow Measurement
- Relative Humidity Measurement
- Occupancy sensing
- Color Control
- Pump Configuration and Control
- Thermostat
- Fan Control
- Thermostat User Interface Configuration
- Shade Configuration
- IAS ACE

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- IAS Zone
- IAS WD

7.1.5 Configure Reporting Optional for Certain Device Types

While the HA profile should encourage those devices that are conducting regular reporting to use the standard reporting commands and configure reporting messages, the use of the reporting commands will not be mandatory for the following devices:

Generic Devices:

- On/Off Switch
- On/Off Output
- Level Control Switch
- Level Controllable Output
- Mains Outlet.

Lighting Devices:

- On/Off Light
- On/Off Light Switch
- Dimmable Light
- Dimmer Switch
- Color Dimmable Light
- Color Dimmer Switch

7.1.6 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.

7.1.7 Cluster Usage Restrictions

It is allowed to add any cluster defined in the ZigBee Cluster Specification as an optional cluster for any device in this profile and the Smart Energy Application Profile specification Annex D.

Any additional cluster added shall be declared on the device PICS and shall be tested in accordance with the based network and security configurations in this document and the messaging and behavior from that specific cluster test plan.

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.

Table 7.4 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)	1
As described in Section sub-clause 5.9.3.	2
Form Network (Coordinator)	3
As described in Section sub-clause 5.9.3.	4
Allow Others to Join Network (Router and Coordinator Only)	5
As described in Section sub-clause 5.9.3.	6
Restore to Factory Fresh Settings	7
As described in Section sub-clause 5.9.3.	8
Pair Devices (End Device Bind Request)	9
The device must provide a way for the user to issue an End Device Bind request.	10
Enable Identify Mode	11
The device must provide a way for the user to enable Identify for 60 seconds.	12
Group Nodes (Add Group If Identify)	13
If this feature is supported the device must provide a way for the user to send an “Add Group if Identifying Request”.	14
Create Scene (Store Scene)	15
The device must provide a way for the user to send a Store Scene request.	16
Service Discovery (Match Descriptor Request)	17
The device must provide a way to send Match Descriptor request, receive Match Descriptor responses and utilize them for commissioning the device.	18
ZDP Bind Response	19
The device must be able to receive a ZDP Bind Request and respond correctly with an ZDP Bind Response.	20
ZDP Unbind Response	21
The device must be able to receive a ZDP Unbind Request and respond correctly with an ZDP Unbind Response.	22
End Device Annce/Device Annce	23
The device must Send Device Annce upon joining and re-joining a network.	24
Service Discovery Response	25
The Device must be able to receive a Match Descriptor request, and respond with a Match Descriptor response correctly.	26
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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 (for example, 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 7.5.

Table 7.5 Clusters Supported by the On/Off Switch Device

Server Side	Client Side (see 7.1.4)
Mandatory	
	On/Off (subject to binding)
Optional	
	Scenes
	Groups
On/Off Switch Configuration	Identify

7.3.1.2 Supported Features and Functions

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

Table 7.6 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

Table 7.6 Example Features and Functions Supported by the On/Off Switch Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.3.2 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 (for example, brightness of a light or height of a shade). This device should only be used when a more specific device specification (for example, 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 7.7.

Table 7.7 Clusters Supported by the Level Control Switch Device

Server Side	Client Side (see 7.1.4)
Mandatory	
	On/Off (subject to binding)
	Level Control (subject to binding)
Optional	

Table 7.7 Clusters Supported by the Level Control Switch Device (Continued)

Server Side	Client Side (see 7.1.4)
On/Off Switch Configuration	<i>None</i>
	Scenes
	Groups
	Identify

7.3.2.2 Supported Features and Functions

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

Table 7.8 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

Table 7.8 Example Features and Functions Supported by the Level Control Switch Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 (for example, 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 7.9.

Table 7.9 Clusters Supported by the On/Off Output Device

Server Side	Client Side (see 7.1.4)
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 7.10 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)
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 (for example, 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 7.11.

Table 7.11 Clusters Supported by the Level Controllable Output Device

Server Side	Client Side (see 7.1.4)
Mandatory	
On/Off	<i>None</i>
Level Control	
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

7.3.4.2 Supported Features and Functions

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

Table 7.12 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

Table 7.12 Example Features and Functions Supported by the Level Controllable Output Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 7.13.

Table 7.13 Clusters Supported by the Scene Selector Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	Scenes
	Groups
Optional	
<i>None</i>	Identify

7.3.5.2 Supported Features and Functions

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

Table 7.14 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
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 7.15.

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 7.15 Clusters Supported by the Configuration Tool Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	Minimum one optional cluster
Optional	
<i>None</i>	Basic
	Identify
	Groups
	Scenes
	I luminance Level Sensing
	Temperature Measurement
	Pressure Measurement
	Flow Measurement
	Occupancy Sensing
	Pump Configuration and Control
	Shade Configuration
	Thermostat User Interface Configuration

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7.3.6.2 Supported Features and Functions

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

Table 7.16 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
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 (for example, turn a light on/off), monitor devices (for

example, read the status of a temperature sensor) or do some user configuration (for example, 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 7.17.

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 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. Minimum one optional cluster shall be implemented. It is not allowed to have an Device with no actual functionality.

Table 7.17 Clusters Supported by the Remote Control Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	Minimum one optional cluster
Optional	
	Basic
	Identify
<i>None</i>	On/Off
	Level Control
	Groups
	Scenes
	Color Control
	Pump Configuration and Control
	Shade Configuration
	On/Off Switch Configuration
	Temperature Measurement
	Illuminance Level Sensing
	Illuminance Measurement

Table 7.17 Clusters Supported by the Remote Control Device (Continued)

Server Side	Client Side (see 7.1.4)
	Window Covering
	Door Lock
	Thermostat

7.3.7.2 Supported Features and Functions

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

Table 7.18 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
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 7.19.

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. Minimum one optional cluster shall be implemented. It is not allowed to have an Device with no actual functionality.

Table 7.19 Clusters Supported by the Combined Interface Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	Minimum one optional Cluster
Optional	
	Basic
	Identify
<i>None</i>	Color Control
	Pump Configuration and Control
	Shade Configuration
	On/Off Switch Configuration
	Temperature Measurement
	I luminance Level Sensing
	I luminance Measurement
	Thermostat User Interface Configuration
	Level Control

Table 7.19 Clusters Supported by the Combined Interface Device (Continued)

Server Side	Client Side (see 7.1.4)
	Groups
	Scenes
	Window Covering
	Door Lock
	Thermostat
	On/Off

7.3.8.2 Supported Features and Functions

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

Table 7.20 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 7.20 Example Features and Functions Supported by the Combined Interface Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 7.21 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

Table 7.21 Example Features and Functions Supported by the Range Extender Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.3.10 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 7.22.

Table 7.22 Clusters Supported by the Mains Power Outlet Device

Server Side	Client Side (see 7.1.4)
Mandatory	
On/Off	<i>None</i>
Scenes	

Table 7.22 Clusters Supported by the Mains Power Outlet Device (Continued)

Server Side	Client Side (see 7.1.4)
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 7.23 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

7.3.11 Door Lock

The Door Lock is capable of receiving Door Lock cluster commands

7.3.11.1 Supported Clusters

In addition to those specified in Table 7.1, the Door Lock Device shall support the clusters listed in Table 7.24.

Table 7.24 Clusters Supported by the Door Lock Device

Server Side	Client Side (see 7.1.4)
Mandatory	
Door Lock	
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

7.3.11.2 Supported Features and Functions

The Door Lock Device shall support the features and functions listed below.

Table 7.25 Example Features and Functions Supported by the Door Lock 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 7.25 Example Features and Functions Supported by the Door Lock Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.3.12 Door Lock Controller

The Door Lock Controller is capable of Sending Door Lock cluster commands

7.3.12.1 Supported Clusters

In addition to those specified in Table 7.1, the Door Lock Controller shall support the clusters listed in Table 7.26.

Table 7.26 Clusters Supported by the Door Lock Controller

Server Side	Client Side (see 7.1.4)
Mandatory	
	Door Lock
	Scenes
	Groups
	Identify
Optional	
<i>None</i>	<i>None</i>

7.3.12.2 Supported Features and Functions

The Door Lock Device shall support the features and functions listed below.

Table 7.27 Example Features and Functions Supported by the Door Lock 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

7.3.13 Simple Sensor

The Simple Sensor is a Simple Sensor only supporting a binary input. Examples of usage are window magnet contacts and other simple on/off devices that has no “active” function but only can report their status.

In addition to those specified in Table 7.1, the Simple Sensor shall support the clusters listed in Table 7.28.

Table 7.28 Clusters Supported by the Simple Sensor

Server Side	Client Side (see 7.1.4)
Mandatory	
Binary Input (Basic)	
Optional	
<i>None</i>	<i>None</i>

7.3.13.1 Supported Features and Functions

The Simple Sensor Device shall support the features and functions listed below.

Table 7.29 Example Features and Functions Supported by the Simple 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

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Table 7.29 Example Features and Functions Supported by the Simple Sensor Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
ZDP Bind Response	M
ZDP Unbind Response	M
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 7.30.

Table 7.30 Clusters Supported by the On/Off Light Device

Server Side	Client Side (see 7.1.4)
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 7.31 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
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 7.32.

Table 7.32 Clusters Supported by the Dimmable Light Device

Server Side	Client Side (see 7.1.4)
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 [B2].

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 [B4].

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 7.33 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
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 7.34.

Table 7.34 Clusters Supported by the Color Dimmable Light Device

Server Side	Client Side (see 7.1.4)
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 7.35 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

Table 7.35 Example Features and Functions Supported by the Color Dimmable Light Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 sub-clause 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.

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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 7.36.

Table 7.36 Clusters Supported by the On/Off Light Switch

Server Side	Client Side (see 7.1.4)
Mandatory	
	On/Off
Optional	
	Scenes
	Groups
On/Off Switch Configuration	Identify

7.4.4.2 Supported Features and Functions

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

Table 7.37 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
Create Scene (Store Scene)	O
Service discovery (Match Descriptor Request)	O

Table 7.37 Example Features and Functions Supported by the On/Off Light Switch (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 7.38.

Table 7.38 Clusters Supported by the Dimmer Switch Device

Server Side	Client Side (see 7.1.4)
Mandatory	
	On/Off
	Level Control
Optional	
	Scenes
On/Off Switch Configuration	Groups

7.4.5.2 Supported Features and Functions

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

Table 7.39 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.

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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 7.40.

Table 7.40 Clusters Supported by the Color Dimmer Switch Device

Server Side	Client Side (see 7.1.4)
Mandatory	
	On/Off
	Level Control
	Color Control
Optional	
On/Off Switch Configuration	Scenes
	Groups
	Identify

7.4.6.2 Supported Features and Functions

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

Table 7.41 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

Table 7.41 Example Features and Functions Supported by the Color Dimmer Switch Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.4.7 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 7.42.

Table 7.42 Clusters Supported by the Light Sensor Device

Server Side	Client Side (see 7.1.4)
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 7.43 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.

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 7.44.

Table 7.44 Clusters Supported by the Occupancy Sensor Device

Server Side	Client Side (see 7.1.4)
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 7.45 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 7.45 Example Features and Functions Supported by the Occupancy Sensor Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
ZDP Unbind Response	O
End Device Annce/Device Annce	M
Service Discovery Response (Match Descriptor Response)	M

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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 7.46.

Table 7.46 Clusters Supported by the Shade Device

Server Side	Client Side (see 7.1.4)
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 [B2]. 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 [B2].

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 7.47 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 7.47 Example Features and Functions Supported by the Shade Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 7.48.

Table 7.48 Clusters Supported by the Shade Controller Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	On/Off
	Level Control
Optional	
	Shade Configuration
	Scenes
	Groups
<i>None</i>	Identify

7.5.2.2 Supported Features and Functions

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

Table 7.49 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

7.5.3 Window Covering Device

The Window Covering device represents an automatic window covering

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7.5.3.1 Supported Clusters

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

Table 7.50 Clusters Supported by the Window Covering Device

Server Side	Client Side (see 7.1.4)
Mandatory	
Window Covering	<i>None</i>
Scenes	
Groups	
Optional	
<i>None</i>	<i>None</i>

7.5.3.2 Supported Features and Functions

The Window Covering device shall support the features and functions listed below.

Table 7.51 Example Features and Functions Supported by the Window Covering 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

Table 7.51 Example Features and Functions Supported by the Window Covering Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.5.4 Window Covering Controller

The Window Covering controller is a device that controls an automatic window covering.

7.5.4.1 Supported Clusters

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

Table 7.52 Clusters Supported by the Window Covering Controller Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	Window Covering
Optional	
	Scenes
	Groups
<i>None</i>	Identify

7.5.4.2 Supported Features and Functions

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

Table 7.53 Example Features and Functions Supported by the Window Covering 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 (for example, 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 7.54.

Table 7.54 Clusters Supported by the Heating/Cooling Unit Device

Server Side	Client Side (see 7.1.4)
Mandatory	
On/Off	Thermostat
Optional	
Fan Control	<i>None</i>
Level Control	
Groups	

7.6.1.2 Thermostat Cluster (Client)

The Thermostat client cluster shall support a subset of the functionality specified in [B2], 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 7.55 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
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 (for example, 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 7.56.

Table 7.56 Clusters Supported by the Thermostat Device

Server Side	Client Side (see 7.1.4)
Mandatory	
Thermostat	<i>None</i>
Optional	
Scenes	
Groups	
Thermostat User Interface Configuration	Fan Control
Fan Control	Temperature Measurement
Temperature Measurement	Occupancy Sensing
Occupancy Sensing	Relative Humidity Measurement
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 [B2]. 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 [B2]. 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 [B2]. 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

7.6.2.6 Supported Features and Functions

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

Table 7.57 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.

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 7.58.

Table 7.58 Clusters Supported by the Temperature Sensor Device

Server Side	Client Side (see 7.1.4)
Mandatory	
Temperature Measurement	<i>None</i>
Optional	
<i>None</i>	Groups

7.6.3.2 Supported Features and Functions

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

Table 7.59 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

Table 7.59 Example Features and Functions Supported by the Temperature Sensor Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.6.4 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 7.60.

Table 7.60 Clusters Supported by the Pump Device

Server Side	Client Side (see 7.1.4)
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 7.61.

Table 7.61 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 [B2], however the transition time is always ignored.

The Setpoint of the pump is a percentage related to the Level according to Table 7.62.

Table 7.62 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 7.63 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 7.64.

Table 7.64 Clusters Supported by the Pump Controller Device

Server Side	Client Side (see 7.1.4)
Mandatory	
<i>None</i>	Pump Configuration and Control
	On/Off
Optional	
<i>None</i>	Scenes
	Groups
	Identify
	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 7.65 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 7.66.

Table 7.66 Clusters Supported by the Pressure Sensor Device

Server Side	Client Side (see 7.1.4)
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 7.67 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

Table 7.67 Example Features and Functions Supported by the Pressure Sensor Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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 7.68.

Table 7.68 Clusters Supported by the Flow Sensor Device

Server Side	Client Side (see 7.1.4)
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 7.69 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

Table 7.69 Example Features and Functions Supported by the Flow Sensor Device (Continued)

Device Type/Feature or Function	Mandatory/ Optional
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

7.7 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 7.70.

Table 7.70 Clusters Supported by the IAS CIE Device

Server Side	Client Side (see 7.1.4)
Mandatory	
IAS ACE	IAS WD
	Identify
	IAS Zone
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 1.

7.7.1.3 Supported Features and Functions

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

Table 7.71 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

Table 7.71 Example Features and Functions Supported by the IAS CIE Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.7.2 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 [B4]). 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 7.72.

Table 7.72 Clusters Supported by the IAS ACE Device

Server Side	Client Side (see 7.1.4)
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 1.

7.7.2.3 Supported Features and Functions

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

Table 7.73 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 (for example, 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 7.74.

Table 7.74 Clusters Supported by the IAS Zone Device

Server Side	Client Side (see 7.1.4)
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 1.

7.7.3.3 Supported Features and Functions

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

Table 7.75 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

Table 7.75 Example Features and Functions Supported by the IAS Zone Device (Continued)

Device Type/Feature or Function	Mandatory/Optional
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

7.7.4 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 7.76.

Table 7.76 Clusters Supported by the IAS WD

Server Side	Client Side (see 7.1.4)
Mandatory	
IAS WD	<i>None</i>
IAS Zone	

Table 7.76 Clusters Supported by the IAS WD

Server Side	Client Side (see 7.1.4)
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 1.

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 7.77 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

Table 7.77 Example Features and Functions Supported by the IAS WD (Continued)

Device Type/Feature or Function	Mandatory/Optional
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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A P P E N D I X

A

**HOME AUTOMATION CLUSTER
DESCRIPTIONS**

The candidate material in this appendix describing the new Home Automation Clusters, when approved, will be merged into the Foundation document of the ZigBee Cluster Library (ZCL) by the Cluster Library Development Board.

A.1 Door Lock Cluster

The door lock cluster provides an interface into a generic way to secure a door. The physical object that provides the locking functionality is abstracted from the cluster. The cluster has a small list of mandatory attributes and functions and a list of optional features.

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A.1.1 Server

Table A.1 Server Attributes

Attribute Identifier	Description	Type	Read/Write	Mandatory/Optional	Reportable	Default
0x0000	<i>Lock State</i> 0x00: Not fully locked 0x01: Locked 0x02: Unlocked	Enum8	Read Only	M	Yes	0
0x0001	<i>Lock Type</i> 0 = dead bolt 1 = magnetic 2 = other 3 – 0xff reserved	Enum8	Read Only	M	No	0
0x0002	Actuator Enabled	Boolean	Read Only	M	No	0
0x0003	<i>Door State</i> 0 = Open 1 = Closed 2 = Error (Jammed) 3 = Error (Forced Open) 4 = Error (Unspecified) 5 – 0xff reserved	Enum8	Read Only	O	Yes	0
0x0004	Number of Door Open Events	Int32u	Read/Write	O	No	0
0x0005	Number of Door Closed Events	Int32u	Read/Write	O	No	0
0x0006	Number of minutes door has been open since this last time it transitioned from close to open	Int16u	Read/Write	O	No	0

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A.1.1.1 Commands

Table A.2 Commands Received by the Server Cluster

Command ID	Description	Mandatory/ Optional
0x00	Lock door	M
0x01	Unlock door	M

A.1.1.2 Lock Door Command

This command (sent by the client to the server) causes the lock device to lock the door. It has no payload.

A.1.1.3 Unlock Door Command

This command causes the lock device to unlock the door. It has no payload.

A.1.1.4 Scene Table Extensions

If the Scene server cluster is implemented, the following extension field is added to the Scene table:

- **Lock State**

When the *Lock State* attribute is part of a Scene table, the attribute is treated as a writable command, that is, setting the *Lock State* to lock will command the lock to lock, and setting the *Lock State* to unlocked will command the lock to unlock. Setting the *Lock State* attribute to “not fully locked” is not supported. The transition time field in the Scene table will be treated as a delay before setting the *Lock State* attribute, that is it is possible to activate a scene with the lock actuation some seconds later.

Locks that do not have an actuation mechanism should not support the Scene table extension.

A.1.2 Client

A.1.2.1 Attributes

The client has no attributes.

A.1.2.2 Commands

Table A.3 Commands Received by the Client Cluster

Command ID	Description	Mandatory /Optional
0x00	Lock Response	M
0x01	Unlock Door Response	M

A.1.2.3 Lock Response

This command is sent in response to a Lock command. It returns command ID byte and one status byte.

0 = ZCL_SUCCESS

1 = ZCL_FAILURE

A.1.2.4 Unlock Door Response

This command is sent in response to an Unlock door command. It returns command ID byte and one status byte.

0 = ZCL_SUCCESS

1 = ZCL_FAILURE

A.2 Window Covering Cluster

A.2.1 Overview

The window covering cluster provides an interface for controlling and adjusting automatic window coverings such as drapery motors, automatic shades, and blinds.

A.2.2 Server

A.2.2.1 Attributes

For convenience, the attributes defined in this cluster are arranged into sets of related attributes; each set can contain up to 16 attributes. Attribute identifiers are encoded such that the most significant three nibbles specify the attribute set and

the least significant nibble specifies the attribute within the set. The currently defined attribute sets are listed in Table A.4.

Table A.4 Window Covering Attribute Sets

Attribute Set Identifier	Description
0x000	Window Covering Information
0x001	Window Covering Settings
0x002 – 0xFF	Reserved

A.2.2.1.1 Window Covering Information Attribute Set

The Window Covering Information attribute set contains the attributes summarized in Table A.5.

Table A.5 Window Covering Information Attribute Set

Identifier	Name	Type	Range	Access	Default	Mandatory / Optional
0x0000	<i>WindowCoveringType</i>	8-bit Enumeration	0x00 – 0x09	Read only	0x00	M
0x0001	<i>PhysicalClosedLimit – Lift (cm)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	O
0x0002	<i>PhysicalClosedLimit – Tilt (tenth of an degree)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	O
0x0003	<i>CurrentPosition – Lift (cm)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	O
0x0004	<i>Current Position – Tilt (tenth of an degree)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	O
0x0005	<i>Number of Actuactions – Lift</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	O
0x0006	<i>Number of Actuactions – Tilt</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	O

Table A.5 Window Covering Information Attribute Set (Continued)

Identifier	Name	Type	Range	Access	Default	Mandatory / Optional
0x0007	<i>Config/Status</i>	8-bit-bitmap	0xxx xxxx	Read Only	0000 0011	M
0x0008	<i>Current Position Lift Percentage</i>	Unsigned 8-bit integer	0-0x64	Read Only	0x00	Mandatory if Closed Loop
0x0009	<i>Current Position Tilt Percentage</i>	Unsigned 8-bit integer	0-0x64	Read Only	0x00	Mandatory if Closed Loop

A.2.2.1.2 WindowCoveringType Attribute

The *WindowCoveringType* attribute identifies the type of window covering being controlled by this endpoint and shall be set to one of the non-reserved values in Table A.6.

Table A.6 Window Covering Types

Value	Window Covering Type
0x00	Rollershade
0x01	Rollershade - 2 Motor
0x02	Rollershade – Exterior
0x03	Rollershade - Exterior - 2 Motor
0x04	Drapery
0x05	Awning
0x06	Shutter
0x07	Tilt Blind - Tilt Only
0x08	Tilt Blind - Lift and Tilt
0x09	Projector Screen

A.2.2.1.2.1 PhysicalClosedLimit - Lift Attribute

The *PhysicalClosedLimit - Lift* attribute identifies the maximum possible encoder position possible (in centimeters) to position the height of the window covering – this is ignored if the device is running in Open Loop Control.

A.2.2.1.2.2 PhysicalClosedLimit - Tilt Attribute

The *PhysicalClosedLimit - Tilt* attribute identifies the maximum possible encoder position possible (tenth of a degrees) to position the angle of the window covering – this is ignored if the device is running in Open Loop Control.

A.2.2.1.2.3 CurrentPosition - Lift Attribute

The *CurrentPosition - Lift* attribute identifies the actual position (in centimeters) of the window covering from the top of the shade if Closed Loop Control is enabled. This attribute is ignored if the device is running in Open Loop Control.

A.2.2.1.2.4 Current Position - Tilt Attribute

The *CurrentPosition – Tilt* attribute identifies the actual tilt position (in tenth of an degree) of the window covering from Open if Closed Loop Control is enabled. This attribute is ignored if the device is running in Open Loop Control.

A.2.2.1.2.5 Number of Actuations - Lift Attribute

The *Number of Actuations – Lift* attribute identifies the total number of lift actuations applied to the Window Covering since the device was installed.

A.2.2.1.2.6 Number of Actuations - Tilt Attribute

The *Number of Actuations – Tilt* attribute identifies the total number of tilt actuations applied to the Window Covering since the device was installed.

A.2.2.1.2.7 Config/Status Attribute

The *Config/Status* attribute makes configuration and status information available. To change settings, devices shall write to the *Mode* attribute of the Window Covering Settings Attribute Set. The behavior causing the setting or clearing of each bit is vendor specific. See Table A.7 for details on each bit.

Table A.7 Bit Meanings for the Config/Status Attribute

Bit	Meaning	Description
bit0	0 = Not Operational 1 = Operational	<i>Operational</i> : This status bit defines if the Window Covering is operational.
bit1	0 = Not Online 1 = Online	<i>Online</i> : This status bit defines if the Window Covering is enabled for transmitting over the Zigbee network.
bit2	0 = Commands are normal 1 = Open/Up Commands have been reversed	<i>Reversal – Lift commands</i> : This status bit identifies if the direction of rotation for the Window Covering has been reversed in order for Open/Up commands to match the physical installation condition.

Table A.7 Bit Meanings for the Config/Status Attribute (Continued)

Bit	Meaning	Description
bit3	0 = Lift control is Open Loop 1 = Lift control is Closed Loop	<i>Control – Lift:</i> This status bit identifies if the window covering supports Open Loop or Closed Loop Lift Control
bit4	0 = Tilt control is Open Loop 1 = Tilt control is Closed Loop	<i>Control – Tilt:</i> This status bit identifies if the window covering supports Open Loop or Closed Loop Tilt Control
bit5	0 = Timer Controlled 1 = Encoder Controlled This bit is Ignored if running Lift in Open Loop Control.	<i>Encoder – Lift:</i> This status bit identifies if a Closed Loop Controlled Window Covering is employing an encoder for positioning the height of the window covering.
bit6	0 = Timer Controlled 1 = Encoder Controlled This bit is Ignored if running Tilt in Open Loop Control.	<i>Encoder – Tilt:</i> This status bit identifies if a Closed Loop Controlled Window Covering is employing an encoder for tilting the window covering.
bit7	Reserved	Reserved

A.2.2.1.3 Current Position Lift Percentage Attribute

The *CurrentPosition Lift Percentage* attribute identifies the actual position as a percentage between the *PhysicalOpenLimitLift* Attribute and the *PhysicalClosedLimitLift* attribute of the window covering from the top of the shade if Closed Loop Control is enabled. If the device is running in Open Loop Control or the device only support Tilt actions, this attribute is not required as an attribute but has a special interpretation when received as part of a scene command (see “Scene Table Extensions” below).

A.2.2.1.4 Current Position Tilt Percentage Attribute

The *CurrentPosition Tilt Percentage* attribute identifies the actual position as a percentage between the *PhysicalOpenLimitTilt* attribute and the *PhysicalClosedLimitTilt* attribute of the window covering from the top of the shade if Closed Loop Control is enabled. If the device is running in Open Loop Control or the device only support Lift actions, this attribute is not required as an attribute but has a special interpretation when received as part of a scene command (see “Scene Table Extensions” below).

A.2.2.1.5 Window Covering Settings Attribute Set

The Window Covering Settings attribute set contains the attributes summarized in Table A.8.

Table A.8 Window Covering Settings Attribute Set

Identifier	Name	Type	Range	Access	Default	Mandatory / Optional
0x0000	<i>InstalledOpenLimit – Lift (cm)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	M
0x0001	<i>InstalledClosedLimit – Lift (cm)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0xffff	M
0x0002	<i>InstalledOpenLimit – Tilt (tenth of an degree)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0x0000	M
0x0003	<i>InstalledClosedLimit – Tilt (tenth of an degree)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	0xffff	M
0x0004	<i>Velocity – Lift (cm/second)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read / Write	0x0000	O
0x0005	<i>Acceleration Time – Lift (tenth of a second)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read / Write	0x0000	O
0x0006	<i>Deceleration Time – Lift (tenth of a second)</i>	Unsigned 16-bit integer	0x0000 – 0xffff	Read / Write	0x0000	O

Table A.8 Window Covering Settings Attribute Set (Continued)

Identifier	Name	Type	Range	Access	Default	Mandatory / Optional
0x0007	<i>Mode</i>	8-bit-bitmap	xxx0 0000	Read / Write	0001 0100	M
0x0008	<i>Intermediate Setpoints – Lift</i>	Octet string	N, 0x0000, 0x0000, ... (N comma separated values)	Read / Write	“1,0x000 0”	O
0x0009	<i>Intermediate Setpoints – Tilt</i>	Octet string	N, 0x0000, 0x0000, ... (N comma separated values)	Read / Write	“1,0x000 0”	O

A.2.2.1.5.1 InstalledOpenLimit – Lift

The *InstalledOpenLimit – Lift* attribute identifies the Open Limit for Lifting the Window Covering whether position (in centimeters) is encoded or timed. This attribute is ignored if the device is running in Open Loop Control.

A.2.2.1.5.2 InstalledClosedLimit – Lift

The *InstalledClosedLimit – Lift* attribute identifies the Closed Limit for Lifting the Window Covering whether position (in centimeters) is encoded or timed. This attribute is ignored if the device is running in Open Loop Control.

A.2.2.1.5.3 InstalledOpenLimit – Tilt

The *InstalledOpenLimit – Tilt* attribute identifies the Open Limit for Tilting the Window Covering whether position (in tenth of a degree) is encoded or timed. This attribute is ignored if the device is running in Open Loop Control.

A.2.2.1.5.4 InstalledClosedLimit – Tilt

The *InstalledClosedLimit – Tilt* attribute identifies the Closed Limit for Tilting the Window Covering whether position (in tenth of a degree) is encoded or timed. This attribute is ignored if the device is running in Open Loop Control.

A.2.2.1.5.5 Velocity – Lift

The *Velocity – Lift* attribute identifies the velocity (in centimeters per second) associated with Lifting the Window Covering.

A.2.2.1.5.6 Acceleration Time – Lift

The *Acceleration Time – Lift* attribute identifies any ramp up times to reaching the velocity setting (in tenth of a second) for positioning the Window Covering.

A.2.2.1.5.7 Deceleration Time – Lift

The *Deceleration Time – Lift* attribute identifies any ramp down times associated with stopping the positioning (in tenth of a second) of the Window Covering.

A.2.2.1.5.7.1 Mode

The *Mode* attribute allows configuration of the Window Covering, such as: reversing the motor direction, placing the Window Covering into calibration mode, placing the motor into maintenance mode, disabling the ZigBee network, and disabling status LEDs. See Table A.9 for details.

Table A.9 Bit Meanings for the *Mode* Attribute

Bit	Meaning	Description
bit0	0 = motor direction is normal 1 = motor direction is reversed	Disables (0) or Enables (1) the reversal of the motor rotating direction associated with an UP/OPEN command. Should be set so that an UP/OPEN command matches moving the Window Covering physically in that direction.
bit1	0 = run in normal mode 1 = run in calibration mode	Disables (0) or Enables (1) placing the Window Covering into Calibration Mode where limits are either setup using physical tools or limits are learned by the controller based on physical setup of the Window Covering by an installer.
bit2	0 = motor is running normally 1 = motor is running in maintenance mode	Disables (0) or Enables (1) placing the motor into Maintenance Mode where the motor cannot be moved over the network or by a switch connected to a Local Switch Input.
bit3	0 = LEDs are off 1 = LEDs will display feedback	Disables (0) or Enables (1) the display of any feedback LEDs resident especially on the packaging of an endpoint where they may cause distraction to the occupant.
bit4 – bit7	Reserved	Reserved

A.2.2.1.5.8 Intermediate Setpoints – Lift

Identifies the number of Intermediate Setpoints supported by the Window Covering for Lift and then identifies the position settings for those Intermediate Setpoints if Closed Loop Control is supported.

A.2.2.1.5.9 Intermediate Setpoints – Tilt

Identifies the number of Intermediate Setpoints supported by the Window Covering for Tilt and then identifies the position settings for those Intermediate Setpoints if Closed Loop Control is supported.

A.2.2.2 Commands Received

Table A.10 Commands Received by the Window Covering Server Cluster

Command ID	Description	Mandatory/ Optional
0x00	Up / Open	M
0x01	Down / Close	M
0x02	Stop	M
0x03	Go to Lift Setpoint	O
0x04	Go To Lift Value	O
0x05	Go to Lift Percentage	M
0x06	Go To Tilt Setpoint	O
0x07	Go to Tilt Value	O
0x08	Go to Tilt Percentage	M
0x09	Program Setpoint	O

A.2.2.2.1 Up / Open Command

A.2.2.2.1.1 Payload Format

This command has no payload.

A.2.2.2.1.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical lift is at the *InstalledOpenLimit – Lift* and the tilt is at the *InstalledOpenLimit – Tilt*. This will happen as fast as possible.

A.2.2.2.2 Down / Close Command

A.2.2.2.2.1 Payload Format

This command has no payload.

A.2.2.2.2.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical lift is at the *InstalledClosedLimit – Lift* and the tilt is at the *InstalledClosedLimit – Tilt*. This will happen as fast as possible.

A.2.2.2.3 Stop Command

A.2.2.2.3.1 Payload Format

This command has no payload.

A.2.2.2.3.2 Effect on Receipt

Upon receipt of this command, the Window Covering will stop any adjusting to the physical tilt and lift that is currently occurring.

A.2.2.2.4 Go To Lift Setpoint Command

A.2.2.2.4.1 Payload Format

The Go To Lift Setpoint command payload shall be formatted as illustrated in Figure A.1.

Octets	1
Data Type	Unsigned 8-bit integer
Field Name	Index of Lift Setpoint

Figure A.1 Format of the Go To Lift Setpoint Command

A.2.2.2.4.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical lift is at the value of the lift setpoint specified in the payload of this command as long as that setpoint is not larger than *InstalledOpenLimit – Lift* and not smaller than *InstalledClosedLimit - Lift*. If the setpoint is out of bounds a *default response* containing the status of INVALID_VALUE will be returned. If the setpoint index specified in the command has not been previously configured using the *Program Setpoint* command then no physical action will be taken and a

default response command with an error status code of NOT_FOUND will be returned.

A.2.2.2.5 Go To Lift Value

A.2.2.2.5.1 Payload Format

The Go To Lift Value command payload shall be formatted as illustrated in Figure A.2.

Octets	2
Data Type	Unsigned 16-bit integer
Field Name	Lift Value

Figure A.2 Format of the Go To Lift Value Command

A.2.2.2.5.1.1 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical lift is at the lift value specified in the payload of this command as long as that value is not larger than *InstalledOpenLimit – Lift* and not smaller than *InstalledClosedLimit – Lift*. If the lift value is out of bounds a *default response* containing the status of INVALID_VALUE will be returned.

A.2.2.2.5.2 Go to Lift Percentage

A.2.2.2.5.2.1 Payload Format

The Go To Lift Percentage command payload shall be formatted as illustrated in Figure A.3.

Octets	1
Data Type	Unsigned 8-bit integer
Field Name	Percentage lift value

Figure A.3 Format of the Go To Lift Percentage Command

A.2.2.2.5.2.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical lift is at the lift percentage specified in the payload of this command. The percentage value will be mapped to a 8-bit unsigned integer value between *InstalledOpenLimit* and *InstalledClosedLimit*. If the percentage lift value is larger than 100, no physical action will be taken and a default response containing the status of INVALID_VALUE will be returned. If the device only

supports open loop lift action then a zero percentage should be treated as a down/close command and a non-zero percentage should be treated as an up/open command. If the device is only a tilt control device, then the command should be ignored and a `UNSUPPORTED_COMMAND` status should be returned. The device must support either the Go To Lift Percentage or the Go To Tilt Percentage command.

A.2.2.2.5.3 Go To Tilt Setpoint

A.2.2.2.5.3.1 Payload Format

The Go To Tilt Setpoint command payload shall be formatted as illustrated in Figure A.4.

Octets	1
Data Type	Unsigned 8-bit integer
Field Name	Index of Tilt Setpoint

Figure A.4 Format of the Go To Tilt Setpoint Command

A.2.2.2.5.3.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical tilt is at the value of the tilt setpoint specified in the payload of this command as long as that setpoint is not larger than *InstalledOpenLimit - Tilt* and not smaller than *InstalledClosedLimit - Tilt*. If the setpoint is out of bounds a *default response* containing the status of `INVALID_VALUE` will be returned. If the setpoint index specified in the command has not been previously configured using the *Program Setpoint* command then no physical action will be taken and a *default response* command with an error status code of `NOT_FOUND` will be returned.

A.2.2.2.5.4 Go to Tilt Value

A.2.2.2.5.4.1 Payload Format

The Go To Tilt Value command payload shall be formatted as illustrated in Figure A.5.

Octets	2
Data Type	Unsigned 16-bit integer
Field Name	Tilt Value

Figure A.5 Format of the Go To Tilt Value Command

A.2.2.2.5.4.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical tilt is at the tilt value specified in the payload of this command as long as that value is not larger than *InstalledOpenLimit – Tilt* and not smaller than *InstalledClosedLimit – Tilt*. If the tilt value is out of bounds a *default response* containing the status of *INVALID_VALUE* will be returned.

A.2.2.2.5.5 Go to Tilt Percentage

A.2.2.2.5.5.1 Payload Format

The Go To Tilt Percentage command payload shall be formatted as illustrated in Figure A.6.

Octets	1
Data Type	Unsigned 8-bit integer
Field Name	Percentage tilt value

Figure A.6 Format of the Go To Tilt Percentage Command

A.2.2.2.5.5.2 Effect on Receipt

Upon receipt of this command, the Window Covering will adjust the window so the physical tilt is at the tilt percentage specified in the payload of this command. The percentage value will be mapped to a 8-bit unsigned integer value between *InstalledOpenLimit-Tilt* and *InstalledClosedLimit-Tilt*. If the percentage tilt value is larger than 100, no physical action will be taken and a default response containing the status of *INVALID_VALUE* will be returned. If the device only supports open loop tilt action then a zero percentage should be treated as a down/close command and a non-zero percentage should be treated as an up/open command. If the device is only a lift control device, then the command should be ignored and a *UNSUPPORTED_COMMAND* status should be returned. The device must support either the Go To Lift Percentage or the Go To Tilt Percentage command.

A.2.2.2.5.6 Program Setpoint VERSION 1

A.2.2.2.5.6.1 Payload Format

The Program Setpoint command payload shall be formatted as illustrated in Figure A.7.

Octets	1	1	2
Data Type	8-bit enum	Unsigned 8-bit integer	Unsigned 16-bit integer
Field Name	Setpoint type (0=lift, 1= tilt)	Setpoint index	Setpoint value

Figure A.7 Format of the Program Setpoint Command

A.2.2.2.5.6.2 Effect on Receipt

Upon receipt of this command, the Window Covering device will store the setpoint value and setpoint index pair for retrieval later with the commands *Go To Tilt Setpoint* or *Go To Lift Setpoint*. An entry is uniquely identified by the type and the index so it is permissible to set a value for tilt and a separate value for lift where both settings use the same index. If the device does not have room to store the value a default response with status of `INSUFFICIENT_SPACE` is returned.

A.2.2.2.5.7 Program Setpoint VERSION 2

A.2.2.2.5.7.1 Payload Format

The Program Setpoint command payload shall be formatted as illustrated in Figure A.8.

Octets	1
Data Type	Unsigned 8-bit integer
Field Name	Setpoint index

Figure A.8 Format of the Program Setpoint command

A.2.2.2.5.7.2 Effect on Receipt

Upon receipt of this command, the Window Covering device will store the current values of *CurrentPosition – Lift* and *CurrentPosition – Tilt* with the setpoint index specified for retrieval later with the commands *Go To Tilt Setpoint* or *Go To Lift Setpoint*. If the device does not have room to store the value a default response with status of `INSUFFICIENT_SPACE` is returned.

A.2.2.2.6 Commands Generated

This cluster uses the standard *Default Response* command defined in the ZCL specification for responding to received commands. Possible status values that can be returned are: SUCCESS, NOT_FOUND, NOT_AUTHORIZED, INSUFFICIENT_SPACE, UNSUP_CLUSTER_COMMAND, INVALID_FIELD, INVALID_VALUE, HARDWARE_FAILURE, FAILURE.

A.2.2.2.7 Scene Table Extensions

If the Window Covering server cluster is implemented, the following extension field is added to the Scene table:

- **CurrentPositionLiftPercentage**

When the *CurrentPositionLiftPercentage* attribute is part of a Scene table, the attribute is treated as a writeable command, that is, setting the lift percentage of the covering device to the value specified in the scene table extension over the specified transition time. The device may treat the command as a linear transition if appropriate or may accelerate and decelerate as it deems necessary. If the device is only a tilt controlling device this scene table extension is ignored. If the device is an open loop controlled lift device, then a percentage of 0 is treated as a close command and a non zero percentage is treated as an open command and the device will ignore the transition time and transition as fast as appropriate for that device.

- **CurrentPositionTiltPercentage**

When the *CurrentPositionTiltPercentage* attribute is part of a Scene table, the attribute is treated as a writeable command, that is, setting the tilt percentage of the covering device to the value specified in the scene table extension over the specified transition time. The device may treat the command as a linear transition if appropriate or may accelerate and decelerate as it deems necessary. If the device is only a lift controlling device this scene table extension is ignored. If the device is an open loop controlled tilt device, then a percentage of 0 is treated as a close command and a non zero percentage is treated as an open command and the device will ignore the transition time and transition as fast as appropriate for that device.

A.2.2.2.8 Attribute Reporting

This cluster shall support attribute reporting using the Report Attributes command and according to the minimum and maximum reporting interval settings described in the ZCL. The following attributes shall be reported:

Current Position - Lift

Current Position - Tilt

A.2.2.3 Client

A.2.2.3.1 Attributes

The client has no attributes.

A.2.2.3.2 Command Received

No cluster-specific commands are received by the client.

A.2.2.3.3 Commands Generated

The client generates the cluster-specific commands detailed in sub-clause A.1.2.2. See Table A.11 for an explanation of which commands are mandatory and optional for the client.

Table A.11 Commands Generated by the Window Covering Client

Command ID	Description	Mandatory/Optional
0x00	Up / Open	M
0x01	Down / Close	M
0x02	Stop	O
0x03	Go to Lift Setpoint	O
0x04	Go To Lift Value	O
0x05	Go to Lift Percentage	O
0x06	Go To Tilt Setpoint	O
0x07	Go to Tilt Value	O
0x08	Go to Tilt Percentage	O
0x09	Program Setpoint	O

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APPENDIX

B

HOME AUTOMATION CCBs

This appendix describes the new Home Automation ZigBee Cluster Library CCBs that shall be applied when developing an ZHA application

B.1 CCB #1169

Clarification of the Thermostat cluster.

The following attributes sets the limits to other attributes that are mandatory. If the limits are different than the default value, the attributes shall be included.

0x0015	<i>MinHeatSetpoint</i> Limit
0x0016	<i>MaxHeatSetpoint</i> Limit
0x0017	<i>MinCoolSetpoint</i> Limit
0x0018	<i>MaxCoolSetpoint</i> Limit
0x0019	<i>MinSetPointDead</i> Band

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B.2 CCB #1097

ZCL Default response clarification.

Table B.1 ZCL Default Response Clarification

Frame Type	MSP	Description	Range
00 = command acts on entire profile	0 = not manufacturer-specific	This set of commands is described in the ZCL spec in the section “General Command Frames”. These commands read, write, report, etc. for clusters described in the ZCL spec.	1
00 = command acts on entire profile	1 = manufacturer specific	This set of commands is described in the ZCL spec in the section “General Command Frames”. These commands read, write, report, etc. for manufacturer specific clusters that are not described in the ZCL spec, or for manufacturer specific attributes of clusters that are described in the ZCL spec. See notes below.	2
01 = command is specific to a cluster	0 = not manufacturer specific	These commands are described in the individual cluster sections within the ZCL spec or within the application profiles (when clusters have been defined or extended within these specs).	3
01 = command is specific to a cluster	1 = manufacturer specific	This range of commands is reserved for manufacturer specific commands defined by a particular manufacturer. The meaning of the command is interpreted using the manufacturer code and these commands should be ignored by a device that does not recognize the manufacturer code. See Notes below	4

Range 2: Any response to a command in this range should have the manufacturer bit set and use the same manufacturer ID as the original command.

For instance, if a command is not understood, the response will be a default response with status set to `ZCL_UNSUP_MANUF_GENERAL_COMMAND`, with frame control set to “00 = command acts on entire profile” and manufacturer bit set to “1 = manufacturer specific” and it will use the same manufacturer ID as the original command

Range 4: Any response to a command in this range should have the manufacturer bit set and use the same manufacturer ID as the original command.

For instance, if a command is not understood, the response will be a default response with status set to `ZCL_UNSUP_MANUF_CLUSTER_COMMAND`, with frame control set to “01 = command is specific to a cluster” and manufacturer bit set to “1 = manufacturer specific” and it will use the same manufacturer ID as the original command

Notes: If a manufacturer wishes to invent manufacturer specific commands, these should be in range 4 (“command is specific to a cluster” and “manufacturer specific”). It is not allowed to create new commands in range 1 or 3. It is not recommended to create new commands in range 2 (“command acts on the entire profile” and “manufacturer specific”) since the command IDs cannot be differentiated by the manufacturing code (a manufacturer specific command here means manufacturer specific attributes). If a new command is created in range 2 it cannot overlap with any existing command IDs and will cause confusion if it overlaps with future command IDs.

B.3 CCB #1092

Correction to the ZCL spec 075123r02 Section: 4.8 (Occupancy Sensing Cluster) changes are in bold

- 4.8.2.2.2.1 *PIROccupiedToUnoccupiedDelay* Attribute

The *PIROccupiedToUnoccupiedDelay* attribute is 8-bits in length and specifies the time delay, in seconds, before the PIR sensor changes to its **unoccupied** state when the sensed area becomes unoccupied. This attribute, along with *PIRUnoccupiedToOccupiedTime*, may be used to reduce sensor 'chatter' when used in an area where occupation changes frequently.

- 4.8.2.2.2.2 *PIRUnoccupiedToOccupiedDelay* Attribute

The *PIRUnoccupiedToOccupiedDelay* attribute is 8-bits in length and specifies the time delay, in seconds, before the PIR sensor changes to its **occupied** state when the sensed area becomes occupied.

- 4.8.2.2.3.1 *UltraSonicOccupiedToUnoccupiedDelay* Attribute

The *UltraSonicOccupiedToUnoccupiedDelay* attribute specifies the time delay, in seconds, before the ultrasonic sensor changes to its **unoccupied** state when the sensed area becomes unoccupied. This attribute, along with *UltraSonicUnoccupiedToOccupiedTime*, may be used to reduce sensor 'chatter' when used in an area where occupation changes frequently.

- 4.8.2.2.3.2 *UltraSonicUnoccupiedToOccupiedDelay* Attribute

The *UltraSonicUnoccupiedToOccupiedDelay* attribute specifies the time delay, in seconds, before the ultrasonic sensor changes to its **occupied** state when the sensed area becomes occupied.

B.4 CCB #1093

Additional optional attributes added to the ZCL spec 075123r02 Section: 4.8 (Occupancy Sensing Cluster).

These new attributes, *PIRUnoccupiedToOccupiedThreshold* and *UltraSonicUnoccupiedToOccupiedThreshold* can be used in conjunction with either the *PIRUnoccupiedToOccupiedDelay* or the *UltraSonicUnoccupiedToOccupiedDelay* attributes to reduce false positives (occupancy wrongly detected). In order to properly discount false positives in detection (such as isolated motion triggers not due to a change in occupancy), the sensor device firmware needs to take into account the frequency of occurrence in the detection events, meaning it has to have both a time duration and a number of sensor indications to accurately calculate the rate of occupancy events occurring in the detection region.

Attribute additions:

Name: PIRUnoccupiedToOccupiedThreshold

Identifier: 0x0012

Type: Unsigned 8-bit integer

Range: 0x00 – 0xFE

Access: Read/Write

Default: 0x01 (since 0 events over a time period isn't meaningful)

Mandatory/Optional: Optional

Name: UltraSonicUnoccupiedToOccupiedThreshold

Identifier: 0x0022

Type: Unsigned 8-bit integer

Range: 0x00 – 0xFE

Access: Read/Write

Default: 0x01 (since 0 events over a time period isn't meaningful)

Mandatory/Optional: Optional

B.5 CCB #1094

Attribute Type changes to the ZCL spec 075123r02 Section: 4.8 (Occupancy Sensing Cluster).

The attributes *PIROccupiedToUnoccupiedDelay* and *UltraSonicOccupiedToUnoccupiedDelay* should be type “Unsigned 16-bit integer” instead of “Unsigned 8-bit integer”.

The attributes *PIROccupiedToUnoccupiedDelay* and *UltraSonicOccupiedToUnoccupiedDelay* are used to decide how much inactivity constitutes “No Occupancy”. An 8-bit integer quantity in number of seconds is

not sufficient for some use cases. This is saying that the maximum amount of time a detection area can be tracked for inactivity is 254 seconds, which is less than 5 minutes. Changing these attributes to 16-bit Unsigned integers, allows a valid range of 0-65535 seconds (over 18 hours) of sensor inactivity before the area is considered Unoccupied.

B.6 CCB #1085

When the Binary Input (Basic) cluster is used for a open/close sensor (contact sensor) the value of *presentValue* attribute needs to be specified so devices can be interoperable.

For a contact sensor the meaning of the *presentValue* attribute is:

1 = Open

0 = Closed

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A P P E N D I X

C

HOME AUTOMATION E-MODE COMMISSIONING RECOMMENDATIONS

This appendix describes the recommended practices for E-mode commissioning in HA devices.

C.1 General E-mode Commissioning Recommendations

Examples use an OnOff switch (Client) and a light (Server) devices.

C.1.1 End Device Bind.

Each device sends an end device bind request on a button push and the matching clusters are bound.

End device bind is ideal for binding one or a few devices together. If more devices are expected, group commissioning should be considered.

Procedure:

- 1 Server or Client Device sends End Device Bind request by a button push.
- 2 Client or Server Device sends End Device Bind request by a button push.
- 3 Sleeping End Device shall now poll with an increased rate to ensure that all messages is received from the Binding Manager (example: 3-second poll rate, allows for 2 polls within the *NwkPersistenceTime*).
- 4 The Binding manager will now create the bindings.

Note: Bindings are created *only* on the client side.

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C.1.2 Group Commissioning

A number of devices (lights) are put in local identity mode by pressing a button. For example, on 3 lamps a button push makes the switch send out an “add group if identify” command.

The group used could be randomly generated, or the short address of the switch, or part of the IEEE address.

Procedure:

- 1 Server Devices are put in Identify mode for 30 seconds by a button push.
- 2 Client Device Sends “ZCL Add Group If Identify” on a button push.

Note: because group messages cannot be received by sleeping End devices it is not required to have an increase poll rate. However it is still recommended that sleeping End devices poll with an increase rate when enabling Identify mode as this allows commissioning through tools or other means in the identify period.

C.2 Sensor E-mode Commissioning Recommendations

The example used is a temperature sensor and a thermostat, but could also be an OS sensor and a light.

In all cases, a sensor should have configured reporting on itself when commissioning is complete such that the “client” device does not have to send too many telegram OTA. This report could be manufacturer-specific and would in most cases ensure the best possible operation and battery life time.

C.2.1 1. EDB + Bind

Both devices send End device Bind.

On success, the thermostat checks for bindings created on the Temperature Measurement cluster and sends a binding request to the target.

This binding could be a group, but should be considered carefully as too many reports might stagnate the network.

The thermostat can also send a configure report telegram, but a sensor should have a report set up by default, so the thermostat is not required to do so.

Procedure:

(Server is a temperature sensor and Client is a thermostat, or Server is OS sensor and Client is an OnOff light with OS cluster).

- 1 Server or Client Device sends End Device Bind request by a button push.

- 2 Client or Server Device sends End Device Bind request by a button push. 1
- 3 Sleeping End Device shall now poll with an increased rate to ensure that all 2
messages is received from the Binding Manager and Server Device (example: 3
3-second poll rate, allows for 2 polls within the NwkPersistenceTime). 4
- 4 The Binding manager will now create the bindings. 5
Note: Bindings are created *only* on the client side. 6
- 5 The Client device will now issue a bind request using the address bound to the 7
temp measurement (or OS measurement cluster) Cluster. 8
- 6 When the Service device ends its commissioning period or has received the 9
bind request it will send a configure reporting telegram with the direction field 10
set to 0x01 informing the client how it will report data. 11
- 7 The Server device (sensor) will now start sending reports. 12
- 8 Optionally the Client device issues a Configure reporting if it would like to 13
change the report conditions. 14

C.3 General Recommendations

- Devices, no matter how they are commissioned, should add their destination as 15
a binding. This would allow more professional tools (combined interfaces) to 16
use ZDP commands to read their configuration and re-configure them. 17
- Sleeping end devices should always have some kind of “configuration/ 18
commissioning” mode in which polling happens frequently for a specified 19
amount of time. Examples could be that pressing a EDB, Identify or other type 20
of “commissioning” action button would make the device poll every 1.5 or 3 21
seconds for a minute or two. This allows tools and other nodes to send 22
telegrams that will be delivered. 23
- All client devices shall/should support sending Add group if identify. 24
- All server devices shall/should support enabling local identify through a button 25
or other vendor-specific means. 26

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