



## 3.10 Level

### 3.10.1 Overview

Please see Chapter 2 for a general cluster overview defining cluster architecture, revision, classification, identification, etc.

This cluster provides an interface for controlling a characteristic of a device that can be set to a level, for example the brightness of a light, the degree of closure of a door, or the power output of a heater.

NOTE: This cluster specification is a base cluster for generic level control. Also, in this document, is the Level Control for Lighting cluster specification, formerly just Level Control. Level Control for Lighting is derived from this cluster specification, and has further requirements for the lighting application. Please see section 3.18 for the Level Control for Lighting.

### 3.10.1.1 Revision History

The global *ClusterRevision* attribute value SHALL be the highest revision number in the table below.

Rev	Description
1	global mandatory <i>ClusterRevision</i> attribute added
2	added <i>Options</i> attribute, state change table; ZLO 1.0; Base cluster (no change) CCB 2085 1775 2281 2147
3	CCB 2574 2616 2659 2702 2814 2818 2819 2898

### 3.10.1.2 Classification

Hierarchy	Role	PICS Code	Primary Transaction
Base	Application	LVL	Type 1 (client to server)

### 3.10.1.3 Cluster Identifiers

Derived cluster specifications are defined elsewhere. This base cluster specification MAY be used for generic level control; however, it is recommended to derive another cluster to better define the application and domain requirements. If one of more derived cluster identifiers and the base identifier exists on a device endpoint, then they SHALL all represent a single instance of the device level control. See Chapter 2 – Instance Model for more information.

Identifier	Hierarchy	Name
0x0008	Base	Level (this cluster specification)
0x0008	Derived	Level Control for Lighting (3.19)
0x001c	Derived	Pulse Width Modulation (3.20)

## 3.10.2 Server

### 3.10.2.1 Dependencies

For many applications, a close relationship between this cluster and the On/Off cluster is needed. This section describes the dependencies that are required when an endpoint that implements this server cluster and also implements the On/Off server cluster.

The *OnOff* attribute of the On/Off cluster and the *CurrentLevel* attribute of the Level Control cluster are intrinsically independent variables, as they are on different clusters. However, when both clusters are implemented on the same endpoint, dependencies MAY be introduced between them. Facilities are provided to introduce dependencies if required.

### 3.10.2.1.1 Effect of On/Off Commands on the *CurrentLevel* Attribute

The attribute *OnLevel* (see 3.10.2.2.10) determines whether commands of the On/Off cluster have a permanent effect on the *CurrentLevel* attribute or not. If this attribute is defined (i.e., implemented and not 0xff) they do have a permanent effect, otherwise they do not. There is always a temporary effect, due to fading up / down.

The effect on the Level Control cluster on receipt of the various commands of the On/Off cluster are as detailed in Table 3-55. In this table, and throughout this cluster specification, 'level' means the value of the *CurrentLevel* attribute.

**Table 3-55. Actions on Receipt for On/Off Commands, when Associated with Level Control**

Command	Action On Receipt
On	Temporarily store <i>CurrentLevel</i> . Set <i>CurrentLevel</i> to the minimum level allowed for the device. Change <i>CurrentLevel</i> to <i>OnLevel</i> , or to the stored level if <i>OnLevel</i> is not defined, over the time period <i>OnOffTransitionTime</i> .
Off	Temporarily store <i>CurrentLevel</i> . Change <i>CurrentLevel</i> to the minimum level allowed for the device over the time period <i>OnOffTransitionTime</i> . If <i>OnLevel</i> is not defined, set the <i>CurrentLevel</i> to the stored level.
Toggle	If the <i>OnOff</i> attribute has the value Off, proceed as for the On command. Otherwise proceed as for the Off command.

Intention of the actions described in the table above is that *CurrentLevel*, which was in effect before any of the On, Off or Toggle commands were issued, shall be restored, after the transition is completed. If another of these commands is received, before the transition is completed, the originally stored *CurrentLevel* shall be preserved and restored.

### 3.10.2.1.2 Effect of Level Control Commands on the *OnOff* Attribute

There are two sets of commands provided in the Level Control cluster. These are identical, except that the first set (Move to Level, Move and Step) SHALL NOT affect the *OnOff* attribute, whereas the second set ('with On/Off' variants) SHALL.

The first set is used to maintain independence between the *CurrentLevel* and *OnOff* attributes, so changing *CurrentLevel* has no effect on the *OnOff* attribute. As examples, this represents the behavior of a volume control with a mute button, or a 'turn to set level and press to turn on/off' light dimmer.

The second set is used to link the *CurrentLevel* and *OnOff* attributes. When the level is reduced to its minimum the *OnOff* attribute is automatically turned to Off, and when the level is increased above its minimum the *OnOff* attribute is automatically turned to On. As an example, this represents the behavior of a light dimmer with no independent on/off switch.

### 3.10.2.1.3 GlobalSceneControl and Commands with On/Off

If a *Move to Level (with On/off)*, *Move (with on/Off)* or *Step (with On/Off)* command is received that causes a change to the value of the *OnOff* attribute of the On/Off cluster, the value of the *GlobalSceneControl* attribute of the On/Off cluster SHALL be updated according to section 3.8.2.2.2.

### 3.10.2.2 Attributes

The attributes of the Level Control server cluster are summarized in Table 3-56.

**Table 3-56. Attributes of the Level Control Server Cluster**

<b>Id</b>	<b>Name</b>	<b>Type</b>	<b>Range</b>	<b>Acc</b>	<b>Default</b>	<b>M/O</b>
0x0000	<i>CurrentLevel</i>	uint8	<i>MinLevel</i> to <i>MaxLevel</i>	RPS	0xff	M
0x0001	<i>RemainingTime</i>	uint16	0x0000 to 0xffff	R	0	O
0x0002	<i>MinLevel</i>	uint8	0 to <i>MaxLevel</i>	R	0	O
0x0003	<i>MaxLevel</i>	uint8	<i>MinLevel</i> to 0xff	R	0xff	O
0x0004	<i>CurrentFrequency</i>	uint16	<i>MinFrequency</i> to <i>MaxFrequency</i>	RPS	0	O
0x0005	<i>MinFrequency</i>	uint16	0 to <i>MaxFrequency</i>	R	0	O
0x0006	<i>MaxFrequency</i>	uint16	<i>MinFrequency</i> to 0xffff	R	0	O
0x0010	<i>OnOffTransitionTime</i>	uint16	0x0000 to 0xffff	RW	0	O
0x0011	<i>OnLevel</i>	uint8	<i>MinLevel</i> to <i>MaxLevel</i>	RW	0xff	O
0x0012	<i>OnTransitionTime</i>	uint16	0x0000 to 0xfffe	RW	0xffff	O
0x0013	<i>OffTransitionTime</i>	uint16	0x0000 to 0xfffe	RW	0xffff	O
0x0014	<i>DefaultMoveRate</i>	uint8 <sup>51</sup>	0x00 to 0xfe	RW	<i>MS</i>	O
0x000F	<i>Options</i>	map8	descr	RW	0	O
0x4000	<i>StartUpCurrentLevel</i>	uint8	0x00 to 0xff	RW	<i>MS</i>	O

#### 3.10.2.2.1 *CurrentLevel* Attribute

The *CurrentLevel* attribute represents the current level of this device. The meaning of 'level' is device dependent.

#### 3.10.2.2.2 *RemainingTime* Attribute

The *RemainingTime* attribute represents the time remaining until the current command is complete - it is specified in 1/10ths of a second.

#### 3.10.2.2.3 *MinLevel* Attribute

The *MinLevel* attribute indicates the minimum value of *CurrentLevel* that is capable of being assigned.

<sup>51</sup> CCB 2574 all other text and scripts treat as an unsigned 8-bit integer

#### 3.10.2.2.4 **MaxLevel Attribute**

The *MaxLevel* attribute indicates the maximum value of *CurrentLevel* that is capable of being assigned.

#### 3.10.2.2.5 **CurrentFrequency Attribute**

The *CurrentFrequency* attribute represents the frequency that the devices is at *CurrentLevel*. A *CurrentFrequency* of 0 is unknown.

#### 3.10.2.2.6 **MinFrequency Attribute**

The *MinFrequency* attribute indicates the minimum value of *CurrentFrequency* that is capable of being assigned. *MinFrequency* shall be less than or equal to *MaxFrequency*. A value of 0 indicates undefined.

#### 3.10.2.2.7 **MaxFrequency Attribute**

The *MaxFrequency* attribute indicates the maximum value of *CurrentFrequency* that is capable of being assigned. *MaxFrequency* shall be greater than or equal to *MinFrequency*. A value of 0 indicates undefined.

#### 3.10.2.2.8 **Options Attribute**

The *Options* attribute is meant to be changed only during commissioning. The *Options* attribute is a bitmap that determines the default behavior of some cluster commands. Each command that is dependent on the *Options* attribute SHALL first construct a temporary Options bitmap that is in effect during the command processing. The temporary Options bitmap has the same format and meaning as the *Options* attribute, but includes any bits that may be overridden by command fields.

Below is the format and description of the *Options* attribute and temporary Options bitmap and the effect on dependent commands.

**Table 3-57. Options Attribute**

Bit	Name	Values & Summary
0	ExecuteIfOff	0 – Do not execute command if OnOff is 0x00 (FALSE) 1 – Execute command if OnOff is 0x00 (FALSE)
1	<i>Reserved for Derived Clusters</i>	This bit has been defined in these derived clusters for a specific application: Level Control for Lighting

##### 3.10.2.2.8.1 **ExecuteIfOff Options Bit**

Command execution SHALL NOT continue beyond the *Options* processing if all of these criteria are true:

- The command is one of the ‘without On/Off’ commands: Move, Move to Level, Stop, or Step.
- The On/Off cluster exists on the same endpoint as this cluster.
- The *OnOff* attribute of the On/Off cluster, on this endpoint, is 0x00 (FALSE).
- The value of the ExecuteIfOff bit is 0.

### 3.10.2.2.9 OnOffTransitionTime Attribute

The *OnOffTransitionTime* attribute represents the time taken to move to or from the target level when On or Off commands are received by an On/Off cluster on the same endpoint. It is specified in 1/10ths of a second.

The actual time taken SHOULD be as close to *OnOffTransitionTime* as the device is able. N.B. If the device is not able to move at a variable rate, the *OnOffTransitionTime* attribute SHOULD NOT be implemented.

### 3.10.2.2.10 OnLevel Attribute

The *OnLevel* attribute determines the value that the *CurrentLevel* attribute is set to when the *OnOff* attribute of an On/Off cluster on the same endpoint is set to On, as a result of processing an On/Off cluster command. If the *OnLevel* attribute is not implemented, or is set to the non-value, it has no effect. For more details see 3.10.2.1.1.

### 3.10.2.2.11 OnTransitionTime Attribute

The *OnTransitionTime* attribute represents the time taken to move the current level from the minimum level to the maximum level when an On command is received by an On/Off cluster on the same endpoint. It is specified in 10ths of a second. If this command is not implemented, or contains a non-value, the *OnOffTransitionTime* will be used instead.

### 3.10.2.2.12 OffTransitionTime Attribute

The *OffTransitionTime* attribute represents the time taken to move the current level from the maximum level to the minimum level when an Off command is received by an On/Off cluster on the same endpoint. It is specified in 10ths of a second. If this command is not implemented, or contains a non-value, the *OnOffTransitionTime* will be used instead.

### 3.10.2.2.13 DefaultMoveRate Attribute

The *DefaultMoveRate* attribute determines the movement rate, in units per second, when a Move command is received with a non-value Rate parameter.

### 3.10.2.2.14 StartUpCurrentLevel Attribute

The *StartUpCurrentLevel* attribute SHALL define the desired startup level for a device when it is supplied with power and this level SHALL be reflected in the *CurrentLevel* attribute. The values of the *StartUpCurrentLevel* attribute are listed below:

Table 3-58. Values of the *StartUpCurrentLevel* attribute

Value	Action on power up
0x00	Set the <i>CurrentLevel</i> attribute to the minimum value permitted on the device
0xff	Set the <i>CurrentLevel</i> attribute to its previous value
other values	Set the <i>CurrentLevel</i> attribute to this value

### 3.10.2.3 Commands Received

The command IDs for the Level Control cluster are listed below.

**Table 3-59. Command IDs for the Level Control Cluster**

ID	Description	M/O
0x00	Move to Level	M
0x01	Move	M
0x02	Step	M
0x03	Stop	M
0x04	Move to Level (with On/Off)	M
0x05	Move (with On/Off)	M
0x06	Step (with On/Off)	M
0x07	Stop	M
0x08	Move to Closest Frequency	M: <i>CurrentFrequency</i> attribute supported

#### 3.10.2.3.1 Move to Level Command

##### 3.10.2.3.1.1 Payload Format

The Move to Level command payload SHALL be formatted as illustrated in Figure 3-40.

**Figure 3-40. Format of the Move to Level Command Payload**

Octets	1	2	1	1
Data Type	uint8	uint16	map8	map8
Field Name	Level	Transition time	OptionsMask	OptionsOverride
Default	n/a	n/a	0	0 <sup>52</sup>

##### 3.10.2.3.1.2 Effect on Receipt

The OptionsMask & OptionsOverride fields SHALL both be present<sup>53</sup>. Default values are provided to interpret missing fields from legacy devices. A temporary Options bitmap SHALL be created from the *Options* attribute, using the OptionsMask & OptionsOverride fields. Each bit of the temporary Options bitmap SHALL be determined as follows:

Each bit in the *Options* attribute SHALL determine the corresponding bit in the temporary Options bitmap, unless the OptionsMask field is present and has the corresponding bit set to 1, in which case the corresponding bit in the OptionsOverride field SHALL determine the corresponding bit in the temporary Options bitmap.

<sup>52</sup> CCB 2814 defaults for legacy devices

<sup>53</sup> CCB 2814 fields are mandatory because fields may follow

The resulting temporary Options bitmap SHALL then be processed as defined in section 3.10.2.2.8<sup>54</sup>.

On receipt of this command, a device SHALL move from its current level to the value given in the Level field. The meaning of ‘level’ is device dependent – e.g., for a light it MAY mean brightness level.

The movement SHALL be as continuous as technically practical, i.e., not a step function, and the time taken to move to the new level SHALL be equal to the value of the Transition time field, in tenths of a second, or as close to this as the device is able.

If the Transition time field takes the value 0xffff then the time taken to move to the new level SHALL instead be determined by the *OnOffTransitionTime* attribute. If *OnOffTransitionTime*, which is an optional attribute, is not present, the device SHALL move to its new level as fast as it is able.

If the device is not able to move at a variable rate, the Transition time field MAY be disregarded.

### 3.10.2.3.2 Move Command

#### 3.10.2.3.2.1 Payload Format

The Move command payload SHALL be formatted as illustrated in Figure 3-41.

Figure 3-41. Format of the Move Command Payload

Octets	1	1	1	1
Data Type	enum8	uint8	map8	map8
Field Name	Move mode	Rate	OptionsMask	OptionsOverride
Default	n/a	n/a	0	0 <sup>55</sup>

#### 3.10.2.3.2.2 Move Mode Field

The Move mode field SHALL be one of the non-reserved values in Table 3-60.

Table 3-60. Values of the Move Mode Field

Fade Mode Value	Description
0x00	Up
0x01	Down

#### 3.10.2.3.2.3 Rate Field

The Rate field specifies the rate of movement in units per second. The actual rate of movement SHOULD be as close to this rate as the device is able. If the Rate field is 0xFF, then the value in *DefaultMoveRate* attribute SHALL be used. If the Rate field is 0xFF and the *DefaultMoveRate* attribute is not supported, then the device SHOULD move as fast as it is able. If the device is not able to move at a variable rate, this field MAY be disregarded.

#### 3.10.2.3.2.4 Effect on Receipt

<sup>54</sup> CCB 2702

<sup>55</sup> CCB 2814 defaults for legacy devices



On receipt of this command, a device SHALL first create and process a temporary Options bitmap as described in section 3.10.2.3.1.2.

On receipt of this command, a device SHALL move from its current level in an up or down direction in a continuous fashion, as detailed in Table 3-61.

**Table 3-61. Actions on Receipt for Move Command**

Fade Mode	Action on Receipt
Up	Increase the device's level at the rate given in the Rate field. If the level reaches the maximum allowed for the device, stop.
Down	Decrease the device's level at the rate given in the Rate field. If the level reaches the minimum allowed for the device, stop.

### 3.10.2.3.3 Step Command

#### 3.10.2.3.3.1 Payload Format

The Step command payload SHALL be formatted as illustrated in Figure 3-42.

**Figure 3-42. Format of the Step Command Payload**

Octets	1	1	2	1	1
Data Type	enum8	uint8	uint16	map8	map8
Field Name	Step mode	Step size	Transition time	OptionsMask	OptionsOverride
Default	n/a	n/a	n/a	0	0 <sup>56</sup>

The Step mode field SHALL be one of the non-reserved values in Table 3-62.

**Table 3-62. Values of the Step Mode Field**

Fade Mode Value	Description
0x00	Up
0x01	Down

The Transition time field specifies the time that SHALL be taken to perform the step, in tenths of a second. A step is a change in the *CurrentLevel* of 'Step size' units. The actual time taken SHOULD be as close to this as the device is able. If the Transition time field is 0xffff the device SHOULD move as fast as it is able.

If the device is not able to move at a variable rate, the Transition time field MAY be disregarded.

#### 3.10.2.3.3.2 Effect on Receipt

On receipt of this command, a device SHALL first create and process a temporary Options bitmap as described in section 3.10.2.3.1.2.

<sup>56</sup> CCB 2814 defaults for legacy devices

On receipt of this command, a device SHALL move from its current level in an up or down direction as detailed in Table 3-63.

**Table 3-63. Actions on Receipt for Step Command**

Fade Mode	Action on Receipt
Up	Increase <i>CurrentLevel</i> by 'Step size' units, or until it reaches the maximum level allowed for the device if this reached in the process. In the latter case, the transition time SHALL be proportionally reduced.
Down	Decrease <i>CurrentLevel</i> by 'Step size' units, or until it reaches the minimum level allowed for the device if this reached in the process. In the latter case, the transition time SHALL be proportionally reduced.

### 3.10.2.3.4 Stop Command

#### 3.10.2.3.4.1 Payload Format

The command payload SHALL be formatted as illustrated below.

**Figure 3-43. Format of the Command Payload**

Octets	1	1
Data Type	map8	map8
Field Name	OptionsMask	OptionsOverride
Default	0	0 <sup>57</sup>

#### 3.10.2.3.4.2 Effect of Receipt

On receipt of this command, a device SHALL first create and process a temporary Options bitmap as described in section 3.10.2.3.1.2.

Upon receipt of this command, any Move to Level, Move or Step command (and their 'with On/Off' variants) currently in process SHALL be terminated. The value of *CurrentLevel* SHALL be left at its value upon receipt of the Stop command, and *RemainingTime* SHALL be set to zero.

This command has two entries in Table 3-5, one for the Move to Level, Move and Set commands, and one for their 'with On/Off' counterparts. This is solely for symmetry, to allow easy choice of one or other set of commands – the Stop commands are identical, because the dependency on On/Off is determined by the original command that is being stopped<sup>58</sup>.

### 3.10.2.3.5 Move to Closest Frequency Command

This command shall be mandatory if the CurrentFrequency attribute is supported.

#### 3.10.2.3.5.1 Payload Format

<sup>57</sup> CCB 2814 defaults for legacy devices

<sup>58</sup> CCB 2819

The command payload SHALL be formatted as illustrated below.

**Figure 3-44. Format of the Command Payload**

<b>Octets</b>	2 <sup>59</sup>
<b>Data Type</b>	uint16
<b>Field Name</b>	Frequency

### 3.10.2.3.5.2 Effect of Receipt

Upon receipt of this command, the device shall change its current frequency to the requested frequency, or to the closest frequency that it can generate. If the device cannot approximate the frequency, then it shall return a default response with an error code of INVALID\_VALUE. Determining if a requested frequency can be approximated by a supported frequency is a manufacturer-specific decision.

### 3.10.2.3.6 'With On/Off' Commands

The Move to Level (with On/Off), Move (with On/Off) and Step (with On/Off) commands have identical payloads to the Move to Level, Move and Step commands respectively<sup>60</sup>. They also have the same effects, except for the following additions.

Before commencing any command that has the effect of setting the *CurrentLevel* above the minimum level allowed by the device, the OnOff attribute of the On/Off cluster on the same endpoint, if implemented, SHALL be set to On.

If any command that has the effect of setting the CurrentLevel to the minimum level allowed by the device, the OnOff attribute of the On/Off cluster on the same endpoint, if implemented, SHALL be set to Off.

## 3.10.2.4 Commands Generated

The server generates no commands.

## 3.10.2.5 Scene Table Extensions<sup>61</sup>

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

*CurrentLevel*

## 3.10.3 Client

The client has no cluster specific attributes. The client generates the cluster specific commands received by the server<sup>62</sup>, as required by the application. No cluster specific commands are received by the client.

<sup>59</sup> CCB 2898 explain duplicate Stop command

<sup>60</sup> CCB 2818 'with On/Off commands are the same, including Options processing

<sup>61</sup> CCB 2659

<sup>62</sup> CCB 2616