

# Mesh Model

## **Bluetooth® Specification**

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### **Abstract:**

This Bluetooth specification defines models (along with their required states and messages) that are used to perform basic functionality on the nodes in a mesh network beyond the foundation models defined in the Bluetooth Mesh Profile specification [2]. This specification includes generic models defining functionality that is standard across device types, and models, such as lighting control, sensors, and time and scenes, to support key mesh scenarios.



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# 1 Introduction

This Bluetooth Mesh Model specification defines models (along with their required states and messages) that are used to define basic functionality of nodes on a mesh network.

## 1.1 Conformance

If conformance to this specification is claimed, all capabilities indicated as mandatory for this specification shall be supported in the specified manner (process-mandatory).

## 1.2 Bluetooth specification release compatibility

This specification is compatible with Bluetooth Mesh Profile specification v1.0 [2].

## 1.3 Language

### 1.3.1 Language conventions

The Bluetooth SIG has established the following conventions for use of the words **shall**, **must**, **will**, **should**, **may**, **can**, **is**, and **note** in the development of specifications:

shall	<u>is required to</u> – used to define requirements.
must	is used to express: a natural consequence of a previously stated mandatory requirement. OR an indisputable statement of fact (one that is always true regardless of the circumstances).
will	<u>it is true that</u> – only used in statements of fact.
should	<u>is recommended that</u> – used to indicate that among several possibilities one is recommended as particularly suitable, but not required.
may	<u>is permitted to</u> – used to allow options.
can	<u>is able to</u> – used to relate statements in a causal manner.
is	<u>is defined as</u> – used to further explain elements that are previously required or allowed.
note	Used to indicate text that is included for informational purposes only and is not required in order to implement the specification. Each note is clearly designated as a “Note” and set off in a separate paragraph.

For clarity of the definition of those terms, see Core Specification Volume 1, Part E, Section 1.

### 1.3.2 Reserved for Future Use

Where a field in a packet, Protocol Data Unit (PDU), or other data structure is described as "Reserved for Future Use" (irrespective of whether in uppercase or lowercase), the device creating the structure shall set its value to zero unless otherwise specified. Any device receiving or interpreting the structure shall ignore that field; in particular, it shall not reject the structure because of the value of the field.

Where a field, parameter, or other variable object can take a range of values, and some values are described as "Reserved for Future Use," a device sending the object shall not set the object to those values. A device receiving an object with such a value should reject it, and any data structure

containing it, as being erroneous; however, this does not apply in a context where the object is described as being ignored or it is specified to ignore unrecognized values.

When a field value is a bit field, unassigned bits can be marked as Reserved for Future Use and shall be set to 0. Implementations that receive a message that contains a Reserved for Future Use bit that is set to 1 shall process the message as if that bit was set to 0, except where specified otherwise.

The acronym RFU is equivalent to Reserved for Future Use.

### 1.3.3 Prohibited

When a field value is an enumeration, unassigned values can be marked as “Prohibited.” These values shall never be used by an implementation, and any message received that includes a Prohibited value shall be ignored and shall not be processed and shall not be responded to.

Where a field, parameter, or other variable object can take a range of values, and some values are described as “Prohibited,” devices shall not set the object to any of those Prohibited values. A device receiving an object with such a value should reject it, and any data structure containing it, as being erroneous.

“Prohibited” is never abbreviated.

## 1.4 Architectural concepts

This specification is based on the concepts of states, bindings, messages, elements, addresses, models, and the publish-subscribe paradigm for message exchange that are defined in the Mesh Profile specification [2].

This specification in addition provides a detailed discussion of state transitions (see Section 1.4.1) and introduces the concept of a *device property* as it relates to mesh models (see Section 2).

### 1.4.1 State transitions

A *state* is a value that represents a condition of an element. An element exposing a state is referred to as a *server*. For example, the simplest server is a Generic OnOff Server (see Section 3.3.1), which represents that the state is either on or off. An element accessing a state is referred to as a *client*. For example, the simplest client is a Generic OnOff Client (a binary switch) that is able to control a Generic OnOff Server via messages accepted by the Generic OnOff Server model.

States can be changed as a result of any of the following:

- A state-changing message that is received and processed by a server
- An asynchronous event, such as a scheduler action being executed (see Section 5.1.4)
- A local (non-network) event such as a press of a button located on a networked lamp

A change of state may be instantaneous (e.g., a state reported by a sensor) or may take some time (e.g., a lamp that dims gradually or a motor that moves a physical object). The time that it takes for a state to change from a present state to the target state (the state that the state server is changing to) is called the transition time.

States may support non-instantaneous change using either the Generic Default Transition Time (see Section 3.1.3) or the transition time specified as a field in the state-changing message.

Messages may support a delay parameter that indicates a delay between receiving a message and starting the state transition. This helps when synchronizing actions of multiple receivers (such as lights) when senders retransmit messages multiple times. Each retransmitted message may indicate a different delay, compensating for the time elapsed since transmitting the first message.

Some states have associated messages that are able to report the state in transition. Whenever a changing state is reported, the message is sent to the state that is present at the moment. There are also messages reporting both the present state and the target state, along with the remaining time, which is the time it will take from the moment the message is sent to the end of transition to the target state. This is illustrated in [Figure 1.1](#).

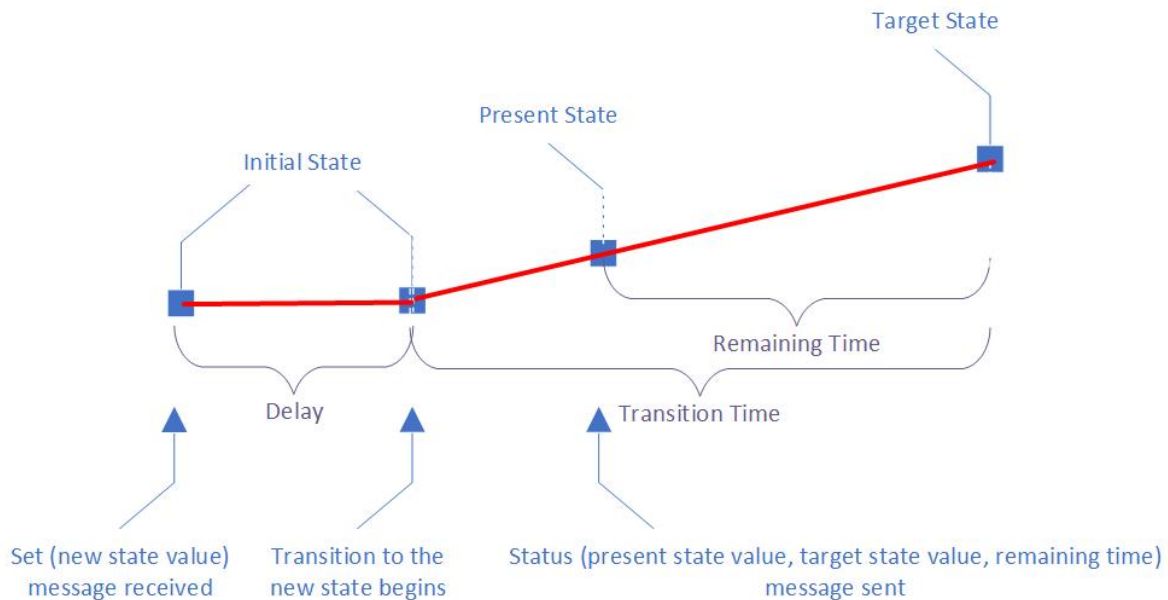


Figure 1.1: State transition

During the transition time, when a new message that results in a new transition involving that state is received and processed, the new target state and the new transition time overwrite the existing target state and transition time for this state.

**Note:** It is recommended that the state is changed linearly during the transition, when the transition is a result of processing a message directly changing that state. The bound states are changed according to the binding formulas.

States can have multiple dimensions. For example, the Light HSL state (see [Section 6.1.4](#)) is a 3-dimensional state that combines the Light HSL Lightness (see [Section 6.1.4.5](#)), Light HSL Hue (see [Section 6.1.4.1](#)), and Light HSL Saturation (see [Section 6.1.4.2](#)) states.

State transitions in each dimension are independent. For a combined multidimensional state transition, the transition time and the remaining time represent the combined transition and remaining times of individual dimensions. This is illustrated by [Figure 1.2](#).

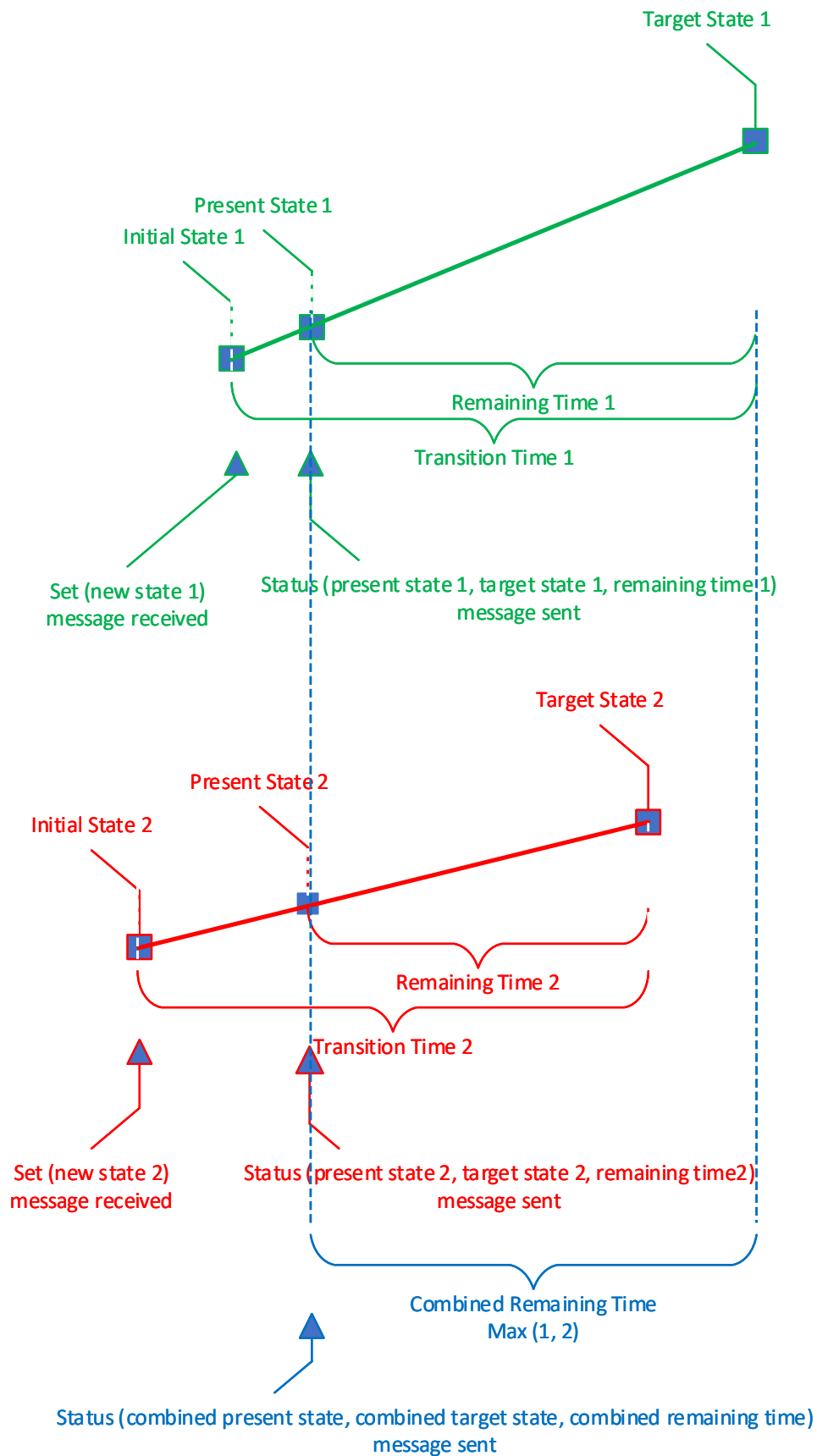


Figure 1.2: Multidimensional state transition

### 1.4.1.1 Bound states

When a state is bound to another state, a change in one state results in a change in the other state. Bound states may be from different models, and may be in one or more elements.

For example, a common type of binding is between a 'Level' state and an 'OnOff' state, such as the Generic Power Level state (see Section 3.1.5) and the Generic OnOff state (see Section 3.1.1): changing the Level to zero changes the bound OnOff state to Off, and changing the Level to a non-zero value changes the bound OnOff state to On. Such binding is a unidirectional binding. Bindings also may be bi-directional such as changing the OnOff state to Off changes the bound Level state to zero, and changing the OnOff state to On changes the bound Level state to its last known non-zero value. The binding rules are defined explicitly in state definitions.

#### 1.4.1.1.1 Subscription Lists on bound states

As defined in the Mesh Profile specification [2], the Subscription List is a list of group addresses or virtual addresses that are assigned to a model. Each address in the list is considered a subscription filter for messages received. Models that operate on bound states share a single instance of a Subscription List per element.

For example, a Light HSL Server model (see Section 6.4.3.3.1), a Light Lightness Server model (see Section 6.4.1), and a Generic Power OnOff Server model (see Section 3.3.4) on a Light HSL main element share a single instance of a Subscription List. This means that subscribing one of the models (e.g., Light Lightness Server) to a group results in the other models (the Generic Power OnOff Server and the Light HSL Server) also subscribing to the same group.

### 1.4.1.2 Composite states

Multiple states can be grouped together as a shorthand notation referred to as a composite state. This allows a model to refer to this composite state instead of each of the individual grouped states. For example, the Light Lightness state (see Section 6.1.2) is composed of the Light Lightness Actual state, the Light Lightness Last state, and the Light Lightness Default state. A model can then refer to changes in the Light Lightness state instead of a change to the Light Lightness Actual state, or a change to the Light Lightness Last state, or a change to the Light Lightness Default state.

## 1.4.2 Messages

All communication within a mesh network is accomplished by sending messages. Messages operate on states. For each state, there is a defined set of messages that a server supports and that a client may use to request the value of a state or to change a state. A server may also transmit unsolicited messages that carry information about states and/or changing states.

A message is defined as having an opcode and associated parameters. For a description of the opcode and its parameters, see the Mesh Profile specification [2].

### 1.4.2.1 Transactions

Messages may support transactions. A client can send a series of state-changing messages such as Set, Recall, or Clear within a single transaction. A transaction is considered unique in the context of a Transaction Identifier (if present in a message), a Source Address, a Destination Address, and an instance of a state. Specific behaviors for transactions are included in model behaviors.

## 1.5 Endianness and field ordering

All multiple-octet numeric values shall be little endian.

Where data structures are made of multiple fields, the fields are listed in the tables from top to bottom, and they appear in the corresponding figures from left to right (i.e., the top row of the table corresponds to the left of the figure). Table 1.1 and Figure 1.3 show an example data structure made up of multiple fields.

Field	Size (octets or bits)	Field Content Description
Field 0	1 or more	Start of this field is in Octet 0 (left most octet in corresponding figure)
...	...	
Field n	1 or more	End of this field is in Octet m

Table 1.1: Field ordering example

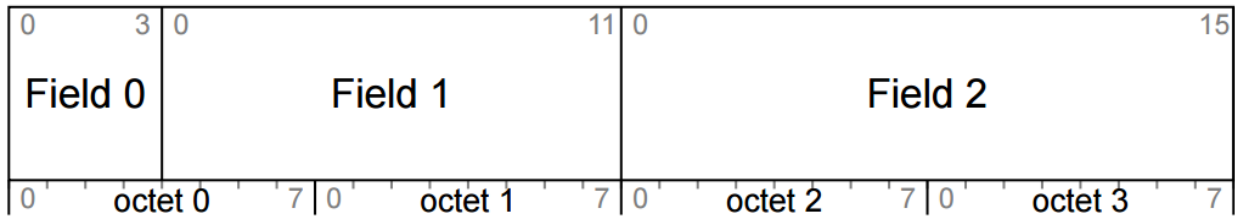


Figure 1.3: Field ordering example

In order to convert the data structure defined in a table into a series of octets the following procedure is used. The binary number with N unassigned bits is created. The number of bits N in the number is equal to the sum of the number of bits of every field in the table. The least significant bits (LSbs) of the number are set to the value of Field 0 (first row of the table), then the number's unassigned LSbs are set to the value of Field 1. This procedure is continued for consecutive fields of the table and ends when the most significant bits (MSbs) of the number are set to the value of last field of the table. As a final step the number is transmitted in little endian form (i.e., least significant octet first).

For example, the field 0 is 4 bits wide and has a value of 0x6, field 1 is 12 bits wide and has a value of 0x987, and field 2 is 16 bits wide and has a value of 0x1234. The value of the binary number is 0x12349876 and shall be transmitted as 0x76, 0x98, 0x34, 0x12.



## 2 Device properties

A device property is a collection of one or more format descriptors that interpret data contained by a server state.

A device property is identified by a 16-bit assigned Property ID (see Section 2.1), which references GATT characteristics, and has a state called the Property Value (see Section 2.2).

### 2.1 Property ID

The Property ID is an assigned 16-bit number that identifies a device property that is associated with a defined characteristic [10].

### 2.2 Property Value

The Property Value is the value of the characteristic referenced by a device property. The value is not self-describing.

### 2.3 Interpretation of Device Property Values

The format of each characteristic referenced by a device property [12] determines how each Raw Value contained in a device property is formatted.

Characteristics referenced by device properties may represent scalar or non-scalar values. Interpretation of scalar values is defined in Section 2.3.1 and interpretation of non-scalar values is defined in Section 2.3.2.

#### 2.3.1 Device property scalar value

For scalar values, the represented value is related to the Device Property Value by the following equation, where the M, d, and b coefficients are defined for each field of the characteristic:

$$R = C * M * 10^d * 2^b$$

Where:

R = represented value

C = raw value

M = multiplier

d = decimal exponent

b = binary exponent

##### 2.3.1.1 Example decimal exponent

To represent a length in decimeters with a resolution of 1 decimeter within a characteristic value, the following values are used:

$$M = 1, d = -1, b = 0$$

##### 2.3.1.2 Example binary exponent

To represent a duration in 256ths of a second with a precision of 1/256 of a second within a characteristic value, the following values are used:

$$M = 1, d = 0, b = -8$$

### 2.3.1.3 Example multiplier

To represent the horizontal dilution of precision with an accuracy of 1/5 with a precision of 1/5 within a characteristic value, the following values are used:

$$M = 2, d = -1, b = 0$$

### 2.3.2 Device property non-scalar value

For non-scalar data, the represented value is the Device Property Value as defined by the characteristic's Format field.

## 2.4 Required device properties summary

Table 2.1 lists the device properties that are required by this specification. The device properties are defined in [13].

Device Property Name
Light Control Time Occupancy Delay
Light Control Time Fade On
Light Control Time Run On
Light Control Time Fade
Light Control Time Prolong
Light Control Time Fade Standby Auto
Light Control Time Fade Standby Manual
Light Control Lightness On
Light Control Lightness Prolong
Light Control Lightness Standby
Light Control Ambient LuxLevel On
Light Control Ambient LuxLevel Prolong
Light Control Ambient LuxLevel Standby
Light Control Regulator Kiu
Light Control Regulator Kid
Light Control Regulator Kpu
Light Control Regulator Kpd
Light Control Regulator Accuracy
Motion Sensed
Time Since Motion Sensed
People Count
Presence Detected
Present Ambient Light Level

Table 2.1: Summary of required device properties for mesh models

## 3 Generics

This section of the specification defines a number of generic states, messages and models that are explicitly defined to be non-specific in their functionality. For example, many devices can be turned on and off regardless of whether they are a fan, an air conditioning unit, a light, or a power socket. All of those devices would support the Generic OnOff states, messages, and models instead of having separate OnOff states, messages, and models for each type of device.

### 3.1 Generic states

#### 3.1.1 Generic OnOff

The Generic OnOff state is a Boolean value that represents the state of an element. The values for the Generic On/Off state are defined in the following table. The meaning of the state is determined by the model.

Value	Description
0x00	Off
0x01	On
0x02–0xFF	Prohibited

Table 3.1: Generic OnOff states

##### 3.1.1.1 Binary state transitions

Because binary states cannot support transitions, when changing to 0x01 (On), the Generic OnOff state shall change immediately when the transition starts, and when changing to 0x00, the state shall change when the transition finishes.

Figure 3.1 illustrates the behavior for a Generic OnOff state bound to a Generic Power Actual state (see Section 3.1.5.1.2) when changing to 0x01 (On). Figure 3.2 illustrates the behavior for a Generic OnOff state bound to a Generic Power Actual state when changing to 0x00 (Off).

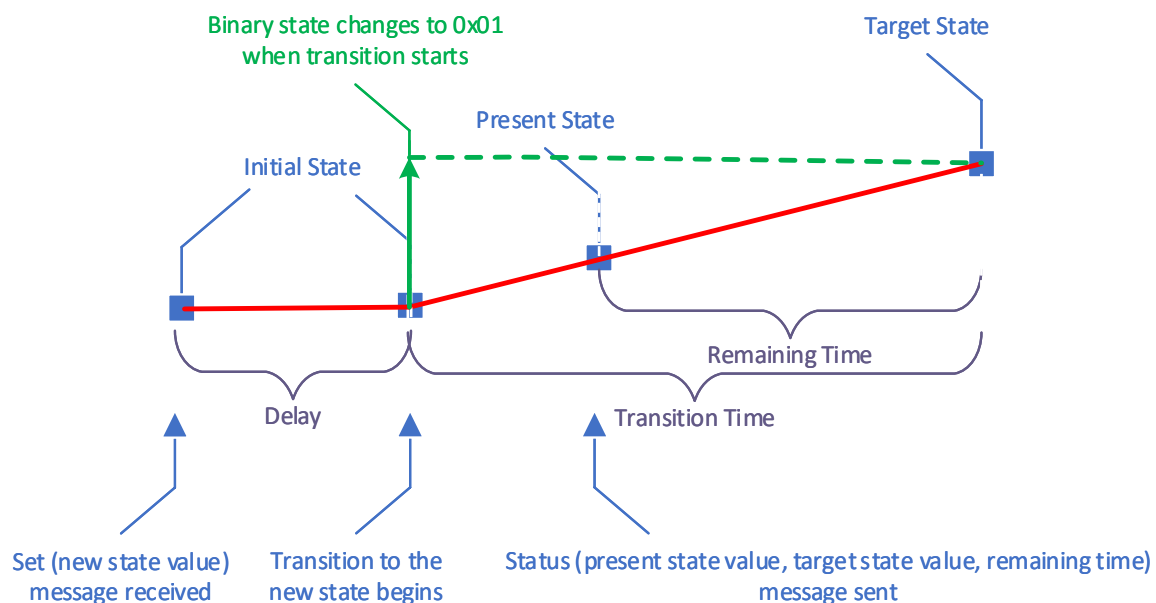


Figure 3.1: Binary state transitions from 0x00 to 0x01

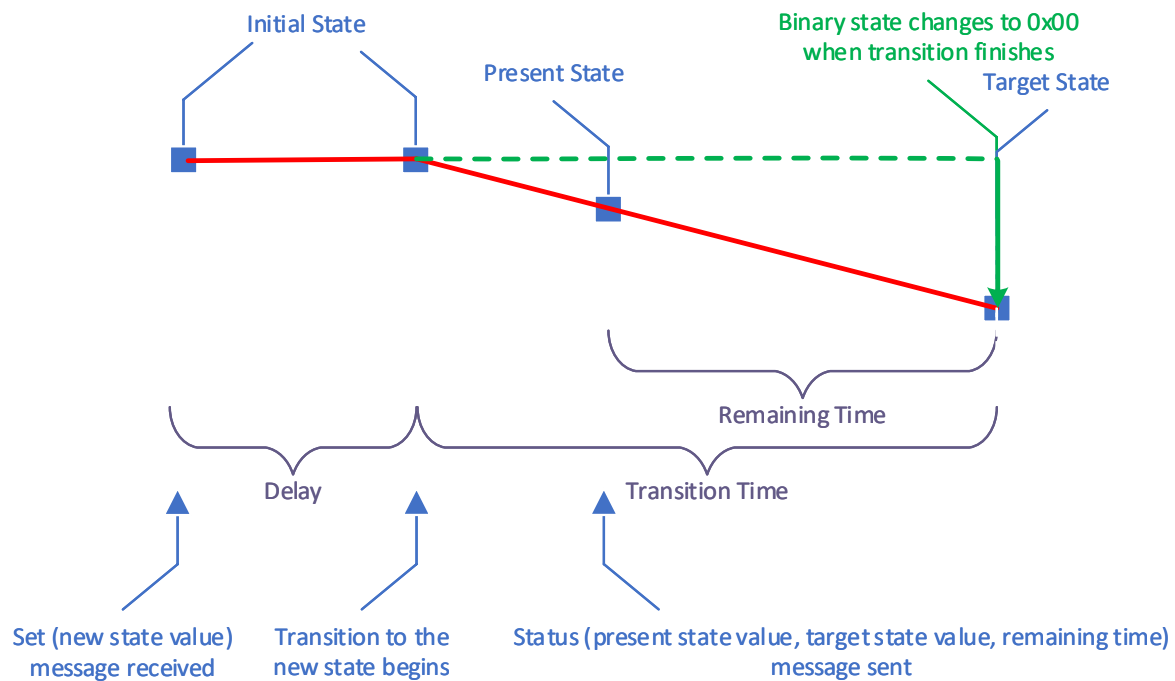


Figure 3.2: Binary state transitions from 0x01 to 0x00

### 3.1.2 Generic Level

The Generic Level state is a 16-bit signed integer (2's complement) representing the state of an element. The values are defined in the following table. The meaning of the level is determined by a model.

Value	Description
0x8000–0x7FFF	The Generic Level state of an element, represented as a 16-bit signed integer (the complement of 2)

Table 3.2: Generic Level states

### 3.1.3 Generic Default Transition Time

The Generic Default Transition Time state determines how long an element shall take to transition from a present state to a new state (see Section 1.4.1.1). This is a 1-octet value that consists of two fields: a 2-bit bit field representing the step resolution and a 6-bit bit field representing the number of transition steps. The format of this state is defined in Table 3.3 and illustrated in Figure 3.3 below:

Field	Size (bits)	Definition
Default Transition Number of Steps	6	The number of Steps
Default Transition Step Resolution	2	The resolution of the Default Transition Number of Steps field

Table 3.3: Generic Default Transition Time state format

Figure 3.3 illustrates the format of the Generic Default Transition Time state.

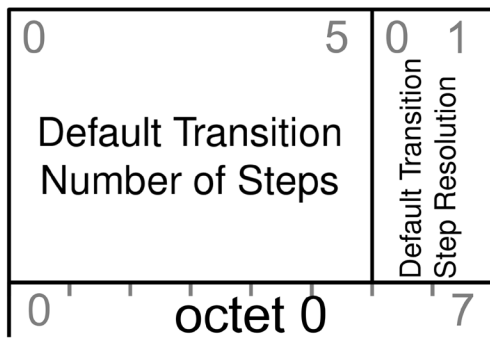


Figure 3.3: Generic Default Transition Time state format

This mechanism covers a wide range of times that may be required by different applications:

- For 100 millisecond step resolution, the range is 0 through 6.2 seconds.
- For 1 second step resolution, the range is 0 through 62 seconds.
- For 10 seconds step resolution, the range is 0 through 620 seconds (10.5 minutes).
- For 10 minutes step resolution, the range is 0 through 620 minutes (10.5 hours).

The Generic Default Transition Time is calculated using the following formula:

$$\text{Generic Default Transition Time} = \text{Default Transition Step Resolution} * \text{Default Transition Number of Steps}$$

Default values for the Generic Default Transition Step Resolution and the Default Transition Number of Steps are implementation-specific and are defined by a device manufacturer.

### 3.1.3.1 Default Transition Step Resolution

The Default Transition Step Resolution field is a 2-bit bit field that determines the resolution of the Generic Default Transition Time state. The field values represent the states defined in the following table.

Value	Description
0b00	The Default Transition Step Resolution is 100 milliseconds
0b01	The Default Transition Step Resolution is 1 second
0b10	The Default Transition Step Resolution is 10 seconds
0b11	The Default Transition Step Resolution is 10 minutes

Table 3.4: Default Transition Step Resolution values

### 3.1.3.2 Default Transition Number of Steps

The Default Transition Number of Steps field is a 6-bit value representing the number of transition steps. The field values represent the states defined in the following table.

Value	Description
0x00	The Generic Default Transition Time is immediate.
0x01–0x3E	The number of steps.
0x3F	The value is unknown. The state cannot be set to this value, but an element may report an unknown value if a transition is higher than 0x3E or not determined.

Table 3.5: Default Transition Number of Steps values

### 3.1.4 Generic OnPowerUp

The Generic OnPowerUp state is an enumeration representing the behavior of an element when powered up. The values for the state are defined in the following table.

Value	Description
0x00	Off. After being powered up, the element is in an off state.
0x01	Default. After being powered up, the element is in an On state and uses default state values.
0x02	Restore. If a transition was in progress when powered down, the element restores the target state when powered up. Otherwise the element restores the state it was in when powered down.
0x03–0xFF	Prohibited

Table 3.6: Generic OnPowerUp states

### 3.1.5 Generic Power Level

The Generic Power Level state is a composite state that includes a Generic Power Actual state (see Section 3.1.5.1), a Generic Power Last state (see Section 3.1.5.2), a Generic Power Default state (see Section 3.1.5.3), and a Generic Power Range state (see Section 3.1.5.4).

#### 3.1.5.1 Generic Power Actual

The Generic Power Actual state determines the linear percentage of the maximum power level of an element, representing a range from 0 percent through 100 percent. The value is derived using the following formula:

$$\text{Represented power level [\%]} = 100 [\%] * \text{Generic Power Actual} / 65535$$

The state is bound to the Generic Level state (see Section 3.1.2) and the Generic OnOff state (see Section 3.1.1). The values for the Generic Power Actual state are defined in the following table.

Value	Description
0x0000–0xFFFF	Represents the power level relative to the maximum power level

Table 3.7: Generic Power Actual states

An element that has the Generic Power Actual set to 0x0000 may continue to power the wireless communications and the microcontroller necessary to change the Generic Power Actual state back to a non-zero value.

Additional regulatory requirements may determine the maximum energy use when the element has the Generic Power Actual state set to 0x0000.

#### 3.1.5.1.1 Binding with the Generic Level state

The Generic Power Actual state is bound to an instance of the Generic Level state (see Section 3.1.2), meaning that whenever the Generic Level state of an element changes, the following calculation shall be performed:

$$\text{Generic Power Actual} = \text{Generic Level} + 32768$$

A reverse binding is also defined, meaning that whenever the Generic Power Actual state of an element changes, the following calculation shall be performed:

$$\text{Generic Level} = \text{Generic Power Actual} - 32768$$

The Generic Power Actual state shall not wrap around (i.e., from 65535 to 0, or 0 to 65535) when it reaches the maximum or minimum value.

### 3.1.5.1.2 Binding with the Generic OnOff state

The Generic Power Actual state is bound to an instance of the Generic OnOff state (see Section 3.1.1), meaning that whenever the Generic OnOff state of an element is set, the following calculations shall be performed:

Generic Power Actual = 0x0000

when the value of the Generic OnOff state is equal to 0x00, or

Generic Power Actual = Generic Power Last

when the value of the Generic OnOff state is equal to 0x01, when value of the Generic Power Default state is equal to 0x0000, or

Generic Power Actual = Generic Power Default

when the value of the Generic OnOff state is equal to 0x01 and the value of the Generic Power Default state is not equal to 0x0000.

A reverse binding is also defined, meaning that whenever the Generic Power Actual state of an element changes, the following calculations shall be performed:

Generic OnOff = 0x00

when the value of the Generic Power Actual is equal to 0x0000, or

Generic OnOff = 0x01

when the value of the Generic Power Actual is greater than 0x0000.

### 3.1.5.1.3 Binding with the Generic OnPowerUp state

The Generic Power Actual state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power-up sequence (when an element is physically powered up), the following calculations shall be performed:

Generic Power Actual = 0

when the value of the Generic OnPowerUp state is equal to 0x00, or

Generic Power Actual = Generic Power Default

when the value of the Generic OnPowerUp state is equal to 0x01 and Generic Power Default is not equal to zero, or

Generic Power Actual = Generic Power Last (see Section 3.1.5.2)

when the value of the Generic OnPowerUp state is equal to 0x01 and Generic Power Default equal to zero, or

Generic Power Actual = last known value of the Generic Power Actual state before the node is powered down

when the value of the Generic OnPowerUp state is equal to 0x02.

### 3.1.5.1.4 Binding with the Generic Power Range state

The Generic Power Actual state is bound to an instance of the Generic Power Range state (see Section 3.1.5.4), meaning that whenever the Generic Power Actual state of an element changes, the following calculations shall be performed:

Generic Power Actual = Generic Power Range Min

when the non-zero values of the Generic Power Actual state are less than the value of the Generic Power Range Min state

Generic Power Actual = Generic Power Range Max

when the non-zero values of the Generic Power Actual state are greater than the value of the Generic Power Range Max state

### 3.1.5.2 Generic Power Last

The Generic Power Last state is a 16-bit value representing a percentage ranging from (1/65535) percent to 100 percent. The value is derived using the following formula:

$$\text{Represented power level [\%]} = 100 [\%] * \text{Generic Power Last} / 65535$$

The purpose of the Generic Power Last state is to store the last known non-zero value of the Generic Power Actual state, which is a result of a completed transactional change of the state. Depending on the value of the Generic OnPowerUp state (see Section 3.1.4), It may also be used as a default value when an element is powered up.

Whenever the Generic Power Actual state is changed to a non-zero value as a result of a non-transactional message or a completed sequence of transactional messages, the value of the Generic Power Last state shall be set to the value of the Generic Power Actual state.

The values for the Generic Power Last state are defined in the following table.

Value	Description
0x0000	Prohibited
0x0001–0xFFFF	Represents the power level relative to the maximum power level

Table 3.8: Generic Power Last states

### 3.1.5.3 Generic Power Default

The Generic Power Default state is a 16-bit value ranging from 0 through 65535. Values from 0x0001 through 0xFFFF represent the percentage of power level, derived using the following formula:

$$\text{Represented power level [\%]} = 100 [\%] * \text{Generic Power Default} / 65535$$

Value 0x0000 has a special meaning defined: use the value of the Generic Power Last state as the default value. The purpose of the Generic Power Default state is to determine the power level of an element when the device is powered up and when the Generic OnPowerUp state (see Section 3.1.3) bound to the Generic Power Level state is set to 0x01 (Default).

The values for the Generic Power Default state are defined in the following table.

Value	Description
0x0000	Use the Power Last value (see Section 3.1.5.1.1).
0x0001–0xFFFF	Represents the power level relative to the maximum power level.

Table 3.9: Generic Power Default states

### 3.1.5.4 Generic Power Range

The Generic Power Range state determines the minimum and maximum power levels of an element relative to the maximum power level an element can output. This is a pair of 16-bit unsigned integers: Generic Power Range Min and Generic Power Range Max.

The Generic Power Range Min state determines the minimum non-zero power level an element can be configured to. The Generic Power Range Max state determines the maximum power level an element can be configured to. The values for the states are defined in the following table.



Value	Description
0x0000	Prohibited
0x0001–0xFFFF	Represents the power level relative to the maximum power level.

Table 3.10: Generic Power Min and Generic Power Max states

### 3.1.6 Generic Battery

The Generic Battery state is a set of four values representing the state of a battery: a charge level (Generic Battery Level), remaining time to complete discharging (Generic Battery Time to Discharge), remaining time to complete charging (Generic Battery Time to Charge), and a flags bit field (Generic Battery Flags).

#### 3.1.6.1 Generic Battery Level

The Generic Battery Level state is a value ranging from 0 percent through 100 percent. The values for the state are defined in the following table.

Value	Description
0x00–0x64	The percentage of the charge level. 100% represents fully charged. 0% represents fully discharged.
0x65–0xFE	Prohibited
0xFF	The percentage of the charge level is unknown.

Table 3.11: Generic Battery Level states

#### 3.1.6.2 Generic Battery Time to Discharge

The Generic Battery Time to Discharge state is a 24-bit unsigned value ranging from 0 through 0xFFFFFFFF. The values for the state are defined in the following table.

Value	Description
0x000000–0xFFFFFE	The remaining time (in minutes) of the discharging process
0xFFFFFFFF	The remaining time of the discharging process is not known.

Table 3.12: Generic Battery Time to Discharge states

#### 3.1.6.3 Generic Battery Time to Charge

The Generic Battery Time to Charge state is a 24-bit unsigned value ranging from 0 through 0xFFFFFFFF. The values for the state are defined in the following table.

Value	Description
0x000000–0xFFFFFE	The remaining time (in minutes) of the charging process
0xFFFFFFFF	The remaining time of the charging process is not known.

Table 3.13: Generic Battery Time to Charge states

#### 3.1.6.4 Generic Battery Flags

The Generic Battery Flags state is a concatenation of four 2-bit bit fields: Presence, Indicator, Charging, and Serviceability as defined in [Table 3.14](#). The values for the state are defined in the following table.

Bit	Definition
0-1	Generic Battery Flags Presence
2-3	Generic Battery Flags Indicator
4-5	Generic Battery Flags Charging

Bit	Definition
6–7	Generic Battery Flags Serviceability

Table 3.14: Generic Battery Flags states

#### 3.1.6.4.1 Generic Battery Flags Presence

The Generic Battery Flags Presence state bit field indicates presence of a battery. The values for the state are defined in the following table.

Value	Description
0b00	The battery is not present.
0b01	The battery is present and is removable.
0b10	The battery is present and is non-removable
0b11	The battery presence is unknown.

Table 3.15: Generic Battery Flags Presence states

#### 3.1.6.4.2 Generic Battery Flags Indicator

The Generic Battery Flags Indicator state bit field indicates the charge level of a battery. The values for the state are defined in the following table.

Value	Description
0b00	The battery charge is Critically Low Level.
0b01	The battery charge is Low Level.
0b10	The battery charge is Good Level.
0b11	The battery charge is unknown.

Table 3.16: Generic Battery Flags Indicator states

The implementation determines what represents a good, low, or critically low battery level.

#### 3.1.6.4.3 Generic Battery Flags Charging

The Generic Battery Flags Charging state bit field indicates whether a battery is charging. The values for the state are defined in the following table.

Value	Description
0b00	The battery is not chargeable.
0b01	The battery is chargeable and is not charging.
0b10	The battery is chargeable and is charging.
0b11	The battery charging state is unknown.

Table 3.17: Generic Battery Flags Charging states

#### 3.1.6.4.4 Generic Battery Flags Serviceability

The Generic Battery Flags Serviceability state bit field indicates the serviceability of a battery. The values for the state are defined in the following table.

Value	Description
0b00	Reserved for Future Use
0b01	The battery does not require service.

Value	Description
0b10	The battery requires service.
0b11	The battery serviceability is unknown.

Table 3.18: Generic Battery Flags Serviceability states

### 3.1.7 Generic Location

The Generic Location state defines location information of an element. The state is composed of the fields defined in Table 3.19.

Field	Size (octets)	Notes
Global Latitude	4	Global Coordinates (Latitude)
Global Longitude	4	Global Coordinates (Longitude)
Global Altitude	2	Global Altitude
Local North	2	Local Coordinates (North)
Local East	2	Local Coordinates (East)
Local Altitude	2	Local Altitude
Floor Number	1	Floor Number
Uncertainty	2	Uncertainty

Table 3.19: Generic Location state

#### 3.1.7.1 Global Latitude

The Global Latitude field describes the global WGS84 North coordinate [8] of the element. The format of the field is a signed integer of size 32 bits encoded as signed magnitude.

Latitude is based on WGS84 [8] datum. The relationship between Latitude  $X$  in the range  $[-90^\circ, 90^\circ]$  and the encoded number  $N$  is derived using the following formula:

$$N = \text{floor}\left(\frac{X}{90}(2^{31} - 1)\right)$$

where  $N$  is bounded to the range  $-2^{31}+1 \leq N \leq 2^{31}-1$ . If  $N$  exceeds the bounds, the closest value within the bounds shall be used.

The floor operation shall be performed according to IEEE standards [9].

The value 0x80000000 in the Global Latitude field indicates the Global Latitude is not configured.

#### 3.1.7.2 Global Longitude

The Global Longitude field describes the global WGS84 East coordinate [8] of the element. The format of the field is a signed integer of size 32 bits encoded as signed magnitude.

Longitude is based on WGS84 [8] datum. The relationship between Longitude  $X$  in the range  $[-180^\circ, 180^\circ]$  and the encoded number  $N$  is derived using the following formula:

$$N = \text{floor}\left(\frac{X}{180}(2^{31} - 1)\right)$$

where  $N$  is bounded to the range  $-2^{31}+1 \leq N \leq 2^{31}-1$ . If  $N$  exceeds the bounds, the closest value within the bounds shall be used.

The floor operation shall be performed according to IEEE standards [9].

The value 0x80000000 in the Global Latitude field indicates the Global Longitude is not configured.

### 3.1.7.3 Global Altitude

The Global Altitude field determines the altitude of the device above the WGS84 datum. It expresses the altitude beyond the WGS84 ellipsoid [8] of the element that exposed its position. This is a 16-bit signed integer in meters.

The values for the state are defined in the following table.

Value	Meaning
0x7FFF	Global Altitude is not configured.
0x7FFE	Global Altitude is greater than or equal to 32766 meters.
0x8000–0x7FFD	Global Altitude is (field value) from -32768 meters through 32765 meters.

Table 3.20: Global Altitude field values

### 3.1.7.4 Local North

The Local North field describes the North coordinate of the device using a local coordinate system. It is relative to the north orientation on a predefined map. The format of the field is a signed integer of size 16 bits.

The Local North value is encoded in decimeters and has a range of -32767 decimeters through 32767 decimeters. The value 0x8000 means the Local North information is not configured.

### 3.1.7.5 Local East

The Local East field describes the East coordinate of the device using a local coordinate system. It is relative to the east orientation of a predefined map. The format of the field is a signed integer of size 16 bits.

The Local East value is encoded decimeters and it ranges from -32767 decimeters through 32767 decimeters. The value 0x8000 means the Local East information is not configured.

### 3.1.7.6 Local Altitude

The Local Altitude field determines the altitude of the device relative to the Generic Location Global Altitude. This is a 16-bit signed integer in decimeters.

The valid range is from -32768 decimeters through 32765 decimeters.

The values for the state are defined in the following table.

Value	Meaning
0x7FFF	Local Altitude is not configured.
0x7FFE	Local Altitude is greater than or equal to 32766 decimeters.
0x8000–0x7FFD	Local Altitude is (field value) from -32768 decimeters through 32765 decimeters.

Table 3.21: Local Altitude field values

### 3.1.7.7 Floor Number

The Floor Number field describes the floor number where the element is installed.

The floor number, N, is encoded as  $X = N + 20$ , where X is the encoded floor number.

Floor number = -20 (X=0) has a special meaning, indicating the floor -20, and also any floor below that.

Floor number = 232 (X=252) has a special meaning, indicating the floor 232, and also any floor above that.

The values for the state are defined in the following table.

Encoded Value X	Floor number N
0x00	Floor -20 or any floor below -20.
0x01–0xFB	Floor number N, encoded as $X = N + 20$ .
0xFC	Floor 232 or any floor above 232.
0xFD	Ground floor. Floor 0.
0xFE	Ground floor. Floor 1.
0xFF	Not configured

Table 3.22: Floor Number field values

Note: The reason for having two definitions of ground floor (0 or 1) is to allow for different conventions applicable in different countries.

The format of the field is an unsigned integer of size 8 bits.

### 3.1.7.8 Uncertainty

The Uncertainty field is a 16-bit bit field that describes the uncertainty of the location information the element exposes. The field consists of several values. The meaning of each bit is described in the following table.

Bits	Field	Description
0	Stationary	This bit indicates whether the device broadcasting the location information has a stationary location or is mobile. (0 = stationary, 1 = mobile)
1–7	RFU	Reserved for Future Use
8–11	Update Time	This value (x) is a 4-bit value ranging from 0 through 15. It represents the time (t) elapsed since the last update of the device's position, measured in seconds using the following formula: $t = 2^{x-3}$ The represented range is from 0.125 seconds through 4096 seconds.  Note: If <stationary> is set, this value can be ignored.
12–15	Precision	This value (y) is a 4-bit value ranging from 0 through 15. It represents a location precision with the formula: $Precision = 2^{y-3}$ The represented range is from 0.125 meters through 4096 meters.

Table 3.23: Uncertainty bit field values

### 3.1.8 Generic Property states

Generic Property states are used to represent any value to be stored by an element. Generic Properties are organized in three categories with respect to access rights: Generic User Properties (see Section 3.1.8.1), Generic Admin Properties (see Section 3.1.8.2), and Generic Manufacturer Properties (see Section 3.1.8.3).

Generic Manufacturer Properties cannot be written, but a client that has access to the Generic Manufacturer Property Server (see Section 3.3.13) may decide if the device properties are accessible by clients via the Generic User Property Server (see Section 3.3.11).

Generic Admin Properties can be read or written, and a client that has access to the Generic Admin Property Server (see Section 3.3.12) may decide whether these device properties are accessible by clients via the Generic User Property Server (see Section 3.3.11) and whether this access is read-only, write-only, or read-write.

Figure 3.4 illustrates the hierarchy of Generic Property states.

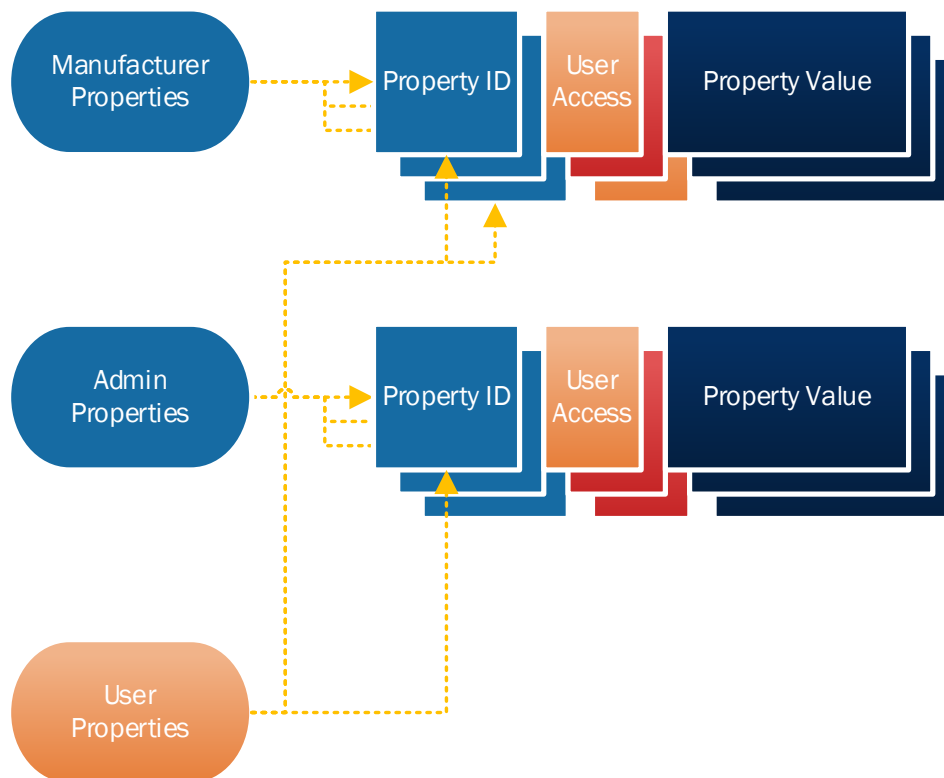


Figure 3.4: Generic Property states hierarchy

#### 3.1.8.1 Generic User Property

Generic User Property is a state representing a device property of an element. Depending on how the device property is defined, this may be a read-only state or a read-write state. The values for the state are defined in the following table.

Field	Size (octets)	Notes
User Property ID	2	Defined in Section 3.1.8.1.1.
User Access	1	Defined in Section 3.1.8.1.2.
User Property Value	variable	Scalar or String value, defined in Section 3.1.8.1.3.

Table 3.24: Generic User Property states

### 3.1.8.1.1 User Property ID

The User Property ID field is a 2-octet Assigned Number value referencing a device property (see Section 2).

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 3.25: User Property ID field values

### 3.1.8.1.2 User Access

The User Access field is an enumeration indicating whether the device property can be read or written as a Generic User Property. The values for the field are defined in the following table.

Value	Meaning
0x00	Prohibited
0x01	The device property can be read.
0x02	The device property can be written.
0x03	The device property can be read and written.
0x04–0xFF	Prohibited

Table 3.26: User Access field values

### 3.1.8.1.3 User Property Value

The User Property Value field is a conditional field. Depending on the format defined by the characteristic that the device property references, the field contains a scalar value, as described in Section 2.3.1, or a string value, as described in Section 2.3.2.

## 3.1.8.2 Generic Admin Property

Generic Admin Property is a state representing a device property of an element that can be read or written. The values for the state are defined in the following table.

Field	Size (octets)	Notes
Admin Property ID	2	Defined in Section 3.1.8.2.1.
Admin User Access	1	Defined in Section 3.1.8.2.2.
Admin Property Value	variable	Scalar or String value, defined in Section 3.1.8.2.3.

Table 3.27: Generic Admin Property states

### 3.1.8.2.1 Admin Property ID

The Admin Property ID field is a 2-octet Assigned Number value referencing a device property (see Section 2).

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 3.28: Admin Property ID field values

### 3.1.8.2.2 Admin User Access

The Admin User Access field is an enumeration indicating whether the device property can be read or written as a Generic User Property. The values for the field are defined in the following table.

Value	Meaning
0x00	The device property is not a Generic User Property.
0x01	The device property is a Generic User Property and can be read.
0x02	The device property is a Generic User Property and can be written.
0x03	The device property is a Generic User Property and can be read and written.
0x04–0xFF	Prohibited

Table 3.29: Admin User Access field values

### 3.1.8.2.3 Admin Property Value

The Admin Property Value field is a conditional field. Depending on the format defined by the characteristic that the device property references, the field contains either a scalar value, as described in Section 2.3.1, or a string value, as described in Section 2.3.2.

### 3.1.8.3 Generic Manufacturer Property

Generic Manufacturer Property is a state representing a device property of an element that is programmed by a manufacturer and can be read. The values for the state are defined in the following table.

Field	Size (octets)	Notes
Manufacturer Property ID	2	Defined in Section 3.1.8.3.1.
Manufacturer User Access	1	Defined in Section 3.1.8.3.2.
Manufacturer Property Value	variable	Scalar or String value, defined in Section 3.1.8.3.3.

Table 3.30: Generic Manufacturer Property states

#### 3.1.8.3.1 Manufacturer Property ID

The Manufacturer Property ID field is a 2-octet Assigned Number value that references a device property (see Section 2).

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 3.31: Manufacturer Property ID field values





### 3.1.8.3.2 Manufacturer User Access

The Manufacturer User Access field is an enumeration indicating whether or not the device property can be read as a Generic User Property. The values for the field are defined in the following table.

Value	Meaning
0x00	The device property is not a Generic User Property.
0x01	The device property is a Generic User Property and can be read.
0x02–0xFF	Prohibited

Table 3.32: Manufacturer User Access field values

### 3.1.8.3.3 Manufacturer Property Value

The Manufacturer Property Value field is a conditional field. Depending on the format defined by the characteristic that the device property references, the field contains either a scalar value, as described in Section 2.3.1, or a string value, as described in Section 2.3.2.

## 3.1.9 Generic Client Property

Generic Client Property is a read-only state representing a device property that an element supports. It is used by a client to indicate a device property that the client supports and is capable of consuming. The value for the state is described in the following table.

Field	Size (octets)	Notes
Client Property ID	2	Defined in Section 3.1.9.1.

Table 3.33: Generic Client Property state

### 3.1.9.1 Client Property ID

The Client Property ID field is a 2-octet Assigned Number value that references a device property (see Section 2).

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 3.34: Client Property ID field values

## 3.2 Generic messages

Generic messages operate on Generic states (see Section 3.1).

### 3.2.1 Generic OnOff messages

#### 3.2.1.1 Generic OnOff Get

Generic OnOff Get is an acknowledged message used to get the Generic OnOff state of an element (see Section 3.1.1).

The response to the Generic OnOff Get message is a Generic OnOff Status message.

There are no parameters for this message.

### 3.2.1.2 Generic OnOff Set

Generic OnOff Set is an acknowledged message used to set the Generic OnOff state of an element (see Section 3.1.1).

The response to the Generic OnOff Set message is a Generic OnOff Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
OnOff	1	The target value of the Generic OnOff state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.35: Generic OnOff Set message parameters

The OnOff field identifies the Generic OnOff state of the element (see Section 3.1.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.1.2.2.

If present, the Transition Time field identifies the time that an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the value of the Transition Number of Steps field.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.1.3 Generic OnOff Set Unacknowledged

Generic OnOff Set Unacknowledged is an unacknowledged message used to set the Generic OnOff state of an element (see Section 3.1.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
OnOff	1	The target value of the Generic OnOff state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 milliseconds steps (so)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.36: Generic OnOff Set Unacknowledged message parameters

The OnOff field identifies the Generic OnOff state of the element (see Section 3.1.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.1.2.2.

If present, the Transition Time field identifies the time that an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the

format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the value of the Transition Number of Steps field.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.1.4 Generic OnOff Status

Generic OnOff Status is an unacknowledged message used to report the Generic OnOff state of an element (see Section 3.1.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present OnOff	1	The present value of the Generic OnOff state.
Target OnOff	1	The target value of the Generic OnOff state (optional).
Remaining Time	1	Format as defined in Section 3.1.3. (C.1)

C.1: If the Target OnOff field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 3.37: Generic OnOff Status message parameters

The Present OnOff field identifies the present Generic OnOff state of the element (see Section 3.1.1).

If present, the Target OnOff field identifies the target Generic OnOff state that the element is to reach (see Section 3.1.1).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Generic OnOff state of the node (see Section 1.4.1.1 and 3.1.1).

## 3.2.2 Generic Level messages

### 3.2.2.1 Generic Level Get

Generic Level Get is an acknowledged message used to get the Generic Level state of an element (see Section 3.1.2).

The response to the Generic Level Get message is a Generic Level Status message.

There are no parameters for this message.

### 3.2.2.2 Generic Level Set

Generic Level Set is an acknowledged message used to set the Generic Level state of an element (see Section 3.1.2) to a new absolute value.

The response to the Generic Level Set message is a Generic Level Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Level	2	The target value of the Generic Level state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 milliseconds steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.38: Generic Level Set message parameters

The Level field identifies the Generic Level state of the element (see Section 3.1.2).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.2.2.2.

If present, the Transition Time field identifies the time that an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.2.3 Generic Level Set Unacknowledged

Generic Level Set Unacknowledged is an unacknowledged message used to set the Generic Level state of an element (see Section 3.1.2) to a new absolute value.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Level	2	The target value of the Generic Level state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.39: Generic Level Set Unacknowledged message parameters

The Level field identifies the Generic Level state of the element (see Section 3.1.2).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.2.2.2.

If present, the Transition Time field identifies the time that an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.2.4 Generic Delta Set

Generic Delta Set is an acknowledged message used to set the Generic Level state of an element (see Section 3.1.2) by a relative value. The message is transactional – it supports changing the state by a cumulative value with a sequence of messages that are part of a transaction.

The response to the Generic Delta Set message is a Generic Level Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Delta Level	4	The Delta change of the Generic Level state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 milliseconds steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.40: Generic Delta Set message parameters

The Delta Level field identifies the increase (when positive) or decrease (if negative) of the Generic Level state of the element (see Section 3.1.2).

The TID field is a transaction identifier and shall be used to logically group a series of Generic Delta Set messages. When starting a new transaction, TID should be assigned a least recently used value, as described in Section 3.4.2.2.3.

The Transition Time field identifies the time that an element will take to transition to the target state from the present state. The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.2.5 Generic Delta Set Unacknowledged

Generic Delta Set Unacknowledged is an unacknowledged message used to set the Generic Level state of an element (see Section 3.1.2) by a relative value.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Delta Level	4	The Delta change of the Generic Level state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 milliseconds steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.41: Generic Delta Set Unacknowledged message parameters

The Delta Level field identifies the increase (when positive) or decrease (if negative) of the Generic Level state of the element (see Section 3.1.2).

The TID field is a transaction identifier and shall be used to logically group a series of Generic Delta Set Unacknowledged messages. When starting a new transaction, the TID should be assigned a least recently used value.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state. The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.2.6 Generic Move Set

Generic Move Set is an acknowledged message used to start a process of changing the Generic Level state of an element (see Section 3.1.2) with a defined transition speed.

The response to the Generic Move Set message is a Generic Level Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Delta Level	2	The Delta Level step to calculate Move speed for the Generic Level state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3 (optional).
Delay	1	Message execution delay in 5 milliseconds steps (C.1).

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.42: Generic Move Set message parameters

The Delta Level field shall be used to calculate the speed of the transition of the Generic Level state.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.2.2.4.

If present, the Transition Time field shall be used to calculate the speed of the transition of the Generic Level state. The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps. If the resulting Transition Time is equal to 0 or is undefined, the Generic Move Set command will not initiate any Generic Level state change.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.2.7 Generic Move Set Unacknowledged

Generic Move Set Unacknowledged is an unacknowledged message used to start a process of changing the Generic Level state of an element (see Section 3.1.2) with a defined transition speed.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Delta Level	2	The Delta Level step to calculate Move speed for the Generic Level state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional).
Delay	1	Message execution delay in 5 milliseconds steps (C.1).

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.43: Generic Move Set Unacknowledged message parameters

The Delta Level field shall be used to calculate the speed of the transition of the Generic Level state.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.2.2.4.

If present, the Transition Time field shall be used to calculate the speed of the transition of the Generic Level state. The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps. If the resulting Transition Time is equal to 0 or undefined, the Generic Move Set command will not initiate any Generic Level state change.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.2.8 Generic Level Status

Generic Level Status is an unacknowledged message used to report the Generic Level state of an element (see Section 3.1.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Level	2	The present value of the Generic Level state.
Target Level	2	The target value of the Generic Level state (Optional).
Remaining Time	1	Format as defined in Section 3.1.3 (C.1).

C.1: If the Target Level field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 3.44: Generic Level Status message parameters

The Present Level field identifies the present Generic Level state of the element (see Section 3.1.2).

If present, the Target Level field identifies the target Generic Level state that the element is to reach (see Section 3.1.2).

If present, the Remaining Time field identifies the time that it will take the element to complete the transition to the target Generic Level state of the element (see Section 3.1.2).

## 3.2.3 Generic Default Transition Time messages

### 3.2.3.1 Generic Default Transition Time Get

Generic Default Transition Time Get is an acknowledged message used to get the Generic Default Transition Time state of an element (see Section 3.1.3).

The response to the Generic Default Transition Time Get message is a Generic Default Transition Time Status message.

There are no parameters for this message.

### 3.2.3.2 Generic Default Transition Time Set

Generic Default Transition Time Set is an acknowledged message used to set the Generic Default Transition Time state of an element (see Section 3.1.3).

The response to the Generic Default Transition Time Set message is a Generic Default Transition Time Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Transition Time	1	The value of the Generic Default Transition Time state.

Table 3.45: Generic Default Transition Time Set message parameters

The Transition Time field identifies the Generic Default Transition Time state of the element (see Section 3.1.3). Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

### 3.2.3.3 Generic Default Transition Time Set Unacknowledged

Generic Default Transition Time Set Unacknowledged is an unacknowledged message used to set the Generic Default Transition Time state of an element (see Section 3.1.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Transition Time	1	The value of the Generic Default Transition Time state.

Table 3.46: Generic Default Transition Time Set Unacknowledged message parameters

The Transition Time field identifies the Generic Default Transition Time state of the element (see Section 3.1.3).

### 3.2.3.4 Generic Default Transition Time Status

Generic Default Transition Time Status is an unacknowledged message used to report the Generic Default Transition Time state of an element (see Section 3.1.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Transition Time	1	The value of the Generic Default Transition Time state.

Table 3.47: Generic Default Transition Time Status message parameters

The Transition Time field identifies the Generic Default Transition Time state of the element (see Section 3.1.3).

## 3.2.4 Generic OnPowerUp messages

### 3.2.4.1 Generic OnPowerUp Get

Generic OnPowerUp Get is an acknowledged message used to get the Generic OnPowerUp state of an element (see Section 3.1.3).



The response to the Generic OnPowerUp Get message is a Generic OnPowerUp Status message.

There are no parameters for this message.

### 3.2.4.2 Generic OnPowerUp Set

Generic OnPowerUp Set is an acknowledged message used to set the Generic OnPowerUp state of an element (see Section 3.1.3).

The response to the Generic OnPowerUp Set message is a Generic OnPowerUp Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
OnPowerUp	1	The value of the Generic OnPowerUp state.

Table 3.48: Generic OnPowerUp Set message parameters

The OnPowerUp field identifies the Generic OnPowerUp state of the element (see Section 3.1.3).

### 3.2.4.3 Generic OnPowerUp Set Unacknowledged

Generic OnPowerUp Set Unacknowledged is an unacknowledged message used to set the Generic OnPowerUp state of an element (see Section 3.1.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
OnPowerUp	1	The value of the Generic OnPowerUp state.

Table 3.49: Generic OnPowerUp Set Unacknowledged message parameters

The OnPowerUp field identifies the Generic OnPowerUp state of the element (see Section 3.1.3).

### 3.2.4.4 Generic OnPowerUp Status

Generic OnPowerUp Status is an unacknowledged message used to report the Generic OnPowerUp state of an element (see Section 3.1.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
OnPowerUp	1	The value of the Generic OnPowerUp state.

Table 3.50: Generic OnPowerUp Status message parameters

The OnPowerUp field identifies the Generic OnPowerUp state of the element (see Section 3.1.3).

## 3.2.5 Generic Power Level messages

### 3.2.5.1 Generic Power Level Get

Generic Power Level Get message is an acknowledged message used to get the Generic Power Actual state of an element (see Section 3.1.5.1).

The response to the Generic Power Level Get message is a Generic Power Level Status message.

There are no parameters for this message.

### 3.2.5.2 Generic Power Level Set

Generic Power Level Set is an acknowledged message used to set the Generic Power Actual state of an element (see Section 3.1.5.1).

The response to the Generic Power Level Set message is a Generic Power Level Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Power	2	The target value of the Generic Power Actual state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 milliseconds steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.51: Generic Power Level Set message parameters

The Power field identifies the target Generic Power Actual state of the element, as defined in Section 3.1.5.1.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.5.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.5.3 Generic Power Level Set Unacknowledged

Generic Power Level Set Unacknowledged is an unacknowledged message used to set the Generic Power Actual state of an element (see Section 3.1.5.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Power	2	The target value of the Generic Power Actual state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 milliseconds steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 3.52: Generic Power Level Set Unacknowledged message parameters

The Power field identifies the target Generic Power Actual state of the element, as defined in Section 3.1.5.1.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 3.4.5.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 3.2.5.4 Generic Power Level Status

Generic Power Level Status is an unacknowledged message used to report the Generic Power Actual state of an element (see Section 3.1.5.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Power	2	The present value of the Generic Power Actual state.
Target Power	2	The target value of the Generic Power Actual state (optional).
Remaining Time	1	Format as defined in Section 3.1.3 (C.1).

C.1: If the Target Power field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 3.53: Generic Power Level Status message parameters

The Present Power field identifies the Generic Power Actual state of the element, as defined in Section 3.1.5.1.

If present, the Target Power field identifies the target Generic Power Actual state that the element is to reach (see Section 3.1.5.1).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Generic Power Actual state of the element (see Section 1.4.1.1 and 3.1.5.1).

### 3.2.5.5 Generic Power Last Get

Generic Power Last Get is an acknowledged message used to get the Generic Power Last state of an element (see Section 3.1.5.1.1).

The response to a Generic Power Last Get message is a Generic Power Last Status message.

There are no parameters for this message.

### 3.2.5.6 Generic Power Last Status

Generic Power Last Status is an unacknowledged message used to report the Generic Power Last state of an element (see Section 3.1.5.1.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Power	2	The value of the Generic Power Last state.

Table 3.54: Generic Power Last Status message parameters

The Power field identifies the Generic Power Last state of the element, as defined in Section 3.1.5.1.1.

### 3.2.5.7 Generic Power Default Get

Generic Power Default Get is an acknowledged message used to get the Generic Power Default state of an element (see Section 3.1.5.3).

The response to a Generic Power Default Get message is a Generic Power Default Status message.

There are no parameters for this message.

### 3.2.5.8 Generic Power Default Set

Generic Power Default Set is an acknowledged message used to set the Generic Power Default state of an element (see Section 3.1.5.3).

The response to the Generic Power Default Set message is a Generic Power Default Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Power	2	The value of the Generic Power Default state.

Table 3.55: Generic Power Default Set message parameters

The Power field identifies the Generic Power Default state of the element, as defined in Section 3.1.5.3.

### 3.2.5.9 Generic Power Default Set Unacknowledged

Generic Power Default Set Unacknowledged is an unacknowledged message used to set the Generic Power Default state of an element (see Section 3.1.5.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Power	2	The value of the Generic Power Default state.

Table 3.56: Generic Power Default Set Unacknowledged message parameters

The Power field identifies the Generic Power Default state of the element, as defined in Section 3.1.5.3.

### 3.2.5.10 Generic Power Default Status

Generic Power Default Status is an unacknowledged message used to report the Generic Power Default state of an element (see Section 3.1.5.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Power	2	The value of the Generic Power Default state.

Table 3.57: Generic Power Default Status message parameters

The Power field identifies the Generic Power Default state of the element, as defined in Section 3.1.5.3.

### 3.2.5.11 Generic Power Range Get

Generic Power Range Get is an acknowledged message used to get the Generic Power Range state of an element (see Section 3.1.5.4).

The response to the Generic Power Range Get message is a Generic Power Range Status message.

There are no parameters for this message.

### 3.2.5.12 Generic Power Range Set

Generic Power Range Set is an acknowledged message used to set the Generic Power Range state of an element (see Section 3.1.5.4).

The response to the Generic Power Range Set message is a Generic Power Range Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Range Min	2	The value of the Generic Power Min field of the Generic Power Range state.
Range Max	2	The value of the Generic Power Range Max field of the Generic Power Range state.

Table 3.58: Generic Power Range Set message parameters

The Range Min field identifies the Generic Power Range Min field of the Generic Power Range state of the element (see Section 3.1.5.4).

The Range Max field identifies the Generic Power Max field of the Generic Power Range state of the element (see Section 3.1.5.4).

The value of the Range Max field shall be greater or equal to the value of the Range Min field.

### 3.2.5.13 Generic Power Range Set Unacknowledged

Generic Power Range Set Unacknowledged is an unacknowledged message used to set the Generic Power Range state of an element (see Section 3.1.5.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Range Min	2	The value of the Generic Power Min field of the Generic Power Range state.
Range Max	2	The value of the Generic Power Range Max field of the Generic Power Range state.

Table 3.59: Generic Power Range Set Unacknowledged message parameters

The Range Min field identifies the Generic Power Range Min field of the Generic Power Range state of the element (see Section 3.1.5.4).

The Range Max field identifies the Generic Power Max field of the Generic Power Range state of the element (see Section 3.1.5.4).

The value of the Range Max field shall be greater or equal to the value of the Range Min field.

### 3.2.5.14 Generic Power Range Status

Generic Power Range Status is an unacknowledged message used to report the Generic Power Range state of an element (see Section 3.1.5.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Status Code for the requesting message.
Range Min	2	The value of the Generic Power Range Min field of the Generic Power Range state.
Range Max	2	The value of the Generic Power Range Max field of the Generic Power Range state.

Table 3.60: Generic Power Range Status message parameters

The Status Code field identifies the Status Code for the last operation on the Generic Power Range state. The allowed values for status codes and their meanings are documented in Section 7.2.

The Range Min field identifies the Generic Power Range Min field of the Generic Power Range state of the element (see Section 3.1.5.4).

The Range Max field identifies the Generic Power Range Max field of the Generic Power Range state of the element (see Section 3.1.5.4).

## 3.2.6 Generic Battery messages

### 3.2.6.1 Generic Battery Get

Generic Battery Get message is an acknowledged message used to get the Generic Battery state of an element (see Section 3.1.6).

The response to the Generic Battery Get message is a Generic Battery Status message.

There are no parameters for this message.

### 3.2.6.2 Generic Battery Status

Generic Battery Status is an unacknowledged message used to report the Generic Battery state of an element (see Section 3.1.6).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Battery Level	1	The value of the Generic Battery Level state.
Time to Discharge	3	The value of the Generic Battery Time to Discharge state.
Time to Charge	3	The value of the Generic Battery Time to Charge state.
Flags	1	The value of the Generic Battery Flags state.

Table 3.61: Generic Battery Status message parameters

The Battery Level field identifies the Generic Battery Level state of the element, as defined in Section 3.1.6.1.

The Time to Discharge field identifies the Generic Battery Time to Discharge state of the element, as defined in Section 3.1.6.2.

The Time to Charge field identifies the Generic Battery Time to Charge state of the element, as defined in Section 3.1.6.3.

The Flags field identifies the Generic Battery Flags state of the element, as defined in Section 3.1.6.4.

## 3.2.7 Generic Location messages

### 3.2.7.1 Generic Location Global Get

Generic Location Global Get message is an acknowledged message used to get the selected fields of the Generic Location state of an element (see Section 3.1.7).

The response to the Generic Location Global Get message is a Generic Location Global Status message.

There are no parameters for this message.

### 3.2.7.2 Generic Location Global Set

Generic Location Global Set is an acknowledged message used to set the selected fields of the Generic Location state of an element (see Section 3.1.7).

The response to the Generic Location Global Set message is a Generic Location Global Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Global Latitude	4	Global Coordinates (Latitude)
Global Longitude	4	Global Coordinates (Longitude)
Global Altitude	2	Global Altitude

Table 3.62: Generic Location Global Set message parameters

The Global Latitude field identifies the Generic Location Global Latitude state of the element, as defined in Section 3.1.7.1.

The Global Longitude field identifies the Generic Location Global Longitude state of the element, as defined in Section 3.1.7.2.

The Global Altitude field identifies the Generic Location Global Altitude state of the element, as defined in Section 3.1.7.6.

### 3.2.7.3 Generic Location Global Set Unacknowledged

Generic Location Global Set Unacknowledged is an unacknowledged message used to set the selected fields of the Generic Location state of an element (see Section 3.1.7).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Global Latitude	4	Global Coordinates (Latitude)
Global Longitude	4	Global Coordinates (Longitude)
Global Altitude	2	Global Altitude

Table 3.63: Generic Location Global Set Unacknowledged message parameters

The Global Latitude field identifies the Generic Location Global Latitude state of the element, as defined in Section 3.1.7.1.

The Global Longitude field identifies the Generic Location Global Longitude state of the element, as defined in Section 3.1.7.2.

The Global Altitude field identifies the Generic Location Global Altitude state of the element, as defined in Section 3.1.7.6.

### 3.2.7.4 Generic Location Global Status

Generic Location Global Status is an unacknowledged message used to report the selected fields of the Generic Location state of an element (see Section 3.1.7).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Global Latitude	4	Global Coordinates (Latitude)
Global Longitude	4	Global Coordinates (Longitude)
Global Altitude	2	Global Altitude

Table 3.64: Generic Location Global Status message parameters

The Global Latitude field identifies the Generic Location Global Latitude state of the element, as defined in Section 3.1.7.1.

The Global Longitude field identifies the Generic Location Global Longitude state of the element, as defined in Section 3.1.7.2.

The Global Altitude field identifies the Generic Location Global Altitude state of the element, as defined in Section 3.1.7.6.

### 3.2.7.5 Generic Location Local Get

Generic Location Local Get message is an acknowledged message used to get the selected fields of the Generic Location state of an element (see Section 3.1.7).

The response to the Generic Location Local Get message is a Generic Location Local Status message.

There are no parameters for this message.

### 3.2.7.6 Generic Location Local Set

Generic Location Local Set is an acknowledged message used to set the selected fields of the Generic Location state of an element (see Section 3.1.7).

The response to the Generic Location Local Set message is a Generic Location Local Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Local North	2	Local Coordinates (North)
Local East	2	Local Coordinates (East)
Local Altitude	2	Local Altitude
Floor Number	1	Floor Number
Uncertainty	2	Uncertainty

Table 3.65: Generic Location Local Set message parameters

The Local North field identifies the Generic Location Local North state of the element, as defined in Section 3.1.7.4.

The Local East field identifies the Generic Location Local East state of the element, as defined in Section 3.1.7.5.



The Local Altitude field identifies the Generic Location Local Altitude state of the element, as defined in Section 3.1.7.6.

The Floor Number field identifies the Generic Location Floor Number state of the element, as defined in Section 3.1.7.7.

The Uncertainty field identifies the Generic Location Uncertainty state of the element, as defined in Section 3.1.7.8.

### 3.2.7.7 Generic Location Local Set Unacknowledged

Generic Location Local Set Unacknowledged is an unacknowledged message used to set the selected fields of the Generic Location state of an element (see Section 3.1.7).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Local North	2	Local Coordinates (North)
Local East	2	Local Coordinates (East)
Local Altitude	2	Local Altitude
Floor Number	1	Floor Number
Uncertainty	2	Uncertainty

Table 3.66: Generic Location Local Set Unacknowledged message parameters

The Local North field identifies the Generic Location Local North state of the element, as defined in Section 3.1.7.4.

The Local East field identifies the Generic Location Local East state of the element, as defined in Section 3.1.7.5.

The Local Altitude field identifies the Generic Location Local Altitude state of the element, as defined in Section 3.1.7.6.

The Floor Number field identifies the Generic Location Floor Number state of the element, as defined in Section 3.1.7.7.

The Uncertainty field identifies the Generic Location Uncertainty state of the element, as defined in Section 3.1.7.8.

### 3.2.7.8 Generic Location Local Status

Generic Location Local Status is an unacknowledged message used to report the selected fields of the Generic Location state of an element (see Section 3.1.7).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Local North	2	Local Coordinates (North)
Local East	2	Local Coordinates (East)
Local Altitude	2	Local Altitude
Floor Number	1	Floor Number
Uncertainty	2	Uncertainty

Table 3.67: Generic Location Local Status message parameters

The Local North field identifies the Generic Location Local North state of the element, as defined in Section 3.1.7.4.

The Local East field identifies the Generic Location Local East state of the element, as defined in Section 3.1.7.5.

The Local Altitude field identifies the Generic Location Local Altitude state of the element, as defined in Section 3.1.7.6.

The Floor Number field identifies the Generic Location Floor Number state of the element, as defined in Section 3.1.7.7.

The Uncertainty field identifies the Generic Location Uncertainty state of the element, as defined in Section 3.1.7.8.

## 3.2.8 Generic Property messages

### 3.2.8.1 Generic User Properties Get

Generic User Properties Get is an acknowledged message used to get the list of Generic User Property states of an element (see Section 3.1.8).

The response to the Generic User Properties Get message is a Generic User Properties Status message.

The message has no parameters.

### 3.2.8.2 Generic User Properties Status

Generic User Properties Status is an unacknowledged message used to report a list of the Generic User Properties states of an element (see Section 3.1.8).

The message is sent as a response to the Generic User Properties Get message or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
User Property IDs	2*N	A sequence of N User Property IDs present within an element, where N is the number of device property IDs included in the message.

Table 3.68: Generic User Properties Status message parameters

The User Property IDs field contains a sequence of all Generic User Property ID states of an element (see Section 3.1.8).

### 3.2.8.3 Generic User Property Get

Generic User Property Get is an acknowledged message used to get the Generic User Property state of an element (see Section 3.1.8).

The response to the Generic User Property Get message is a Generic User Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
User Property ID	2	Property ID identifying a Generic User Property

Table 3.69: Generic User Property Get message parameters

The User Property ID field identifies a Generic User Property ID state of an element (see Section 3.1.8).

### 3.2.8.4 Generic User Property Set

Generic User Property Set is an acknowledged message used to set the Generic User Property state of an element (see Section 3.1.8).

The response to the Generic User Property Set message is a Generic User Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
User Property ID	2	Property ID identifying a Generic User Property
User Property Value	variable	Raw value for the User Property

Table 3.70: Generic User Property Set message parameters

The User Property ID field identifies a User Property ID state of an element (see Section 3.1.8.1.1).

The User Property Value field identifies a User Property Value state of an element (see Section 3.1.8.1.3).

### 3.2.8.5 Generic User Property Set Unacknowledged

Generic User Property Set Unacknowledged is an unacknowledged message used to set the Generic User Property state of an element (see Section 3.1.8).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
User Property ID	2	Property ID identifying a Generic User Property
User Property Value	variable	Raw value for the User Property

Table 3.71: Generic User Property Set Unacknowledged message parameters

The User Property ID field identifies a User Property ID state of an element (see Section 3.1.8.1.1).

The User Property Value field identifies a User Property Value state of an element (see Section 3.1.8.1.3).

### 3.2.8.6 Generic User Property Status

Generic User Property Status is an unacknowledged message used to report the Generic User Property state of an element (see Section 3.1.8).

The message is sent as a response to the Generic User Property Get message and the Generic User Property Set message, or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
User Property ID	2	Property ID identifying a Generic User Property.
User Access	1	Enumeration indicating user access (Optional)
User Property Value	variable	Raw value for the User Property (C.1)

C.1: If the User Access field is present, the User Property Value field shall also be present; otherwise this field shall not be present.

Table 3.72: Generic User Property Status message parameters

The User Property ID field identifies a User Property ID state of an element (see Section 3.1.8.1.1).

The User Access field identifies a User Access state of an element (see Section 3.1.8.1.2).

The User Property Value field identifies a User Property Value state of an element (see Section 3.1.8.1.3).

### 3.2.8.7 Generic Admin Properties Get

Generic Admin Properties Get is an acknowledged message used to get the list of Generic Admin Property states of an element (see Section 3.1.8.2).

The response to the Generic Admin Properties Get message is a Generic Admin Properties Status message.

The message has no parameters.

### 3.2.8.8 Generic Admin Properties Status

Generic Admin Properties Status is an unacknowledged message used to report a list of the Generic Admin Properties states of an element (see Section 3.1.8.2).

The message is sent as a response to the Generic Admin Properties Get message or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Admin Property IDs	2*N	A sequence of N Admin Property IDs present within an element, where N is the number of device property IDs included in the message.

Table 3.73: Generic Admin Properties Status message parameters

The Admin Property IDs field contains a sequence of all Generic Admin Property ID states of an element (see Section 3.1.8.2).

### 3.2.8.9 Generic Admin Property Get

Generic Admin Property Get is an acknowledged message used to get the Generic Admin Property state of an element (see Section 3.1.8.2).

The response to the Generic Admin Property Get message is a Generic Admin Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Admin Property ID	2	Property ID identifying a Generic Admin Property.

Table 3.74: Generic Admin Property Get message parameters

The Admin Property ID field identifies an Admin Property ID state of an element (see Section 3.1.8.2.1).

### 3.2.8.10 Generic Admin Property Set

Generic Admin Property Set is an acknowledged message used to set the Generic Admin Property state of an element (see Section 3.1.8.2).

The response to the Generic Admin Property Set message is a Generic Admin Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Admin Property ID	2	Property ID identifying a Generic Admin Property.
Admin User Access	1	Enumeration indicating user access.
Admin Property Value	variable	Raw value for the Admin Property

Table 3.75: Generic Admin Property Set message parameters

The Admin Property ID field identifies an Admin Property ID state of an element (see Section 3.1.8.2.1).

The Admin User Access field identifies an Admin User Access state of an element (see Section 3.1.8.2.2).

The Admin Property Value field identifies an Admin Property Value state of an element (see Section 3.1.8.2.3).

### 3.2.8.11 Generic Admin Property Set Unacknowledged

Generic Admin Property Set Unacknowledged is an unacknowledged message used to set the Generic Admin Property state of an element (see Section 3.1.8.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Admin Property ID	2	Property ID identifying a Generic Admin Property.
Admin User Access	1	Enumeration indicating user access.
Admin Property Value	variable	Raw value for the Admin Property.

Table 3.76: Generic Admin Property Set Unacknowledged message parameters

The Admin Property ID field identifies an Admin Property ID state of an element (see Section 3.1.8.2.1).

The Admin User Access field identifies an Admin User Access state of an element (see Section 3.1.8.2.2).

The Admin Property Value field identifies an Admin Property Value state of an element (see Section 3.1.8.2.3).

### 3.2.8.12 Generic Admin Property Status

Generic Admin Property Status is an unacknowledged message used to report the Generic Admin Property state of an element (see Section 3.1.8.2).

The message is sent as a response to the Generic Admin Property Get message and the Generic Admin Property Set message, or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Admin Property ID	2	Property ID identifying a Generic Admin Property
Admin User Access	1	Enumeration indicating user access (Optional)
Admin Property Value	variable	Raw value for the Admin Property (C.1)

C.1: If the Admin User Access field is present, the Admin Property Value field shall also be present; otherwise this field shall not be present.

*Table 3.77: Generic Admin Property Status message parameters*

The Admin Property ID field identifies an Admin Property ID state of an element (see Section 3.1.8.2.1).

The Admin User Access field identifies an Admin User Access state of an element (see Section 3.1.8.2.2).

The Admin Property Value field identifies an Admin Property Value state of an element (see Section 3.1.8.2.3).

### 3.2.8.13 Generic Manufacturer Properties Get

Generic Manufacturer Properties Get is an acknowledged message used to get the list of Generic Manufacturer Property states of an element (see Section 3.1.8).

The response to the Generic Manufacturer Properties Get message is a Generic Manufacturer Properties Status message.

The message has no parameters.

### 3.2.8.14 Generic Manufacturer Properties Status

Generic Manufacturer Properties Status is an unacknowledged message used to report a list of the Generic Manufacturer Properties states of an element (see Section 3.1.8).

The message is sent as a response to the Generic Manufacturer Properties Get message or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Manufacturer Property IDs	2*N	A sequence of N Manufacturer Property IDs present within an element, where N is the number of device property IDs included in the message.

*Table 3.78: Generic Manufacturer Properties Status message parameters*

The Manufacturer Property IDs field contains a sequence of all Generic Manufacturer Property ID states of an element (see Section 3.1.8).

### 3.2.8.15 Generic Manufacturer Property Get

Generic Manufacturer Property Get is an acknowledged message used to get the Generic Manufacturer Property state of an element (see Section 3.1.8).

The response to the Generic Manufacturer Property Get message is a Generic Manufacturer Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Manufacturer Property ID	2	Property ID identifying a Generic Manufacturer Property

Table 3.79: Generic Manufacturer Property Get message parameters

The Manufacturer Property ID field identifies a Manufacturer Property ID state of an element (see Section 3.1.8.3.1).

### 3.2.8.16 Generic Manufacturer Property Set

Generic Manufacturer Property Set is an acknowledged message used to set the Generic Manufacturer Property User Access state of an element (see Section 3.1.8.3.1).

The response to the Generic Manufacturer Property Set message is a Generic Manufacturer Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Manufacturer Property ID	2	Property ID identifying a Generic Manufacturer Property
Manufacturer User Access	1	Enumeration indicating user access

Table 3.80: Generic Manufacturer Property Set message parameters

The Manufacturer Property ID field identifies a Manufacturer Property ID state of an element (see Section 3.1.8.3.1).

The Manufacturer User Access field identifies a Manufacturer User Access state of an element (see Section 3.1.8.3.1).

### 3.2.8.17 Generic Manufacturer Property Set Unacknowledged

The Generic Manufacturer Property Set Unacknowledged is an unacknowledged message used to set the Generic Manufacturer Property User Access state of an element (see Section 3.1.8).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Manufacturer Property ID	2	Property ID identifying a Generic Manufacturer Property
Manufacturer User Access	1	Enumeration indicating user access

Table 3.81: Generic Manufacturer Property Set Unacknowledged message parameters

The Manufacturer Property ID field identifies a Manufacturer Property ID state of an element (see Section 3.1.8.3.1).

The Manufacturer User Access field identifies a Manufacturer User Access state of an element (see Section 3.1.8.3.2).

### 3.2.8.18 Generic Manufacturer Property Status

The Generic Manufacturer Property Status is an unacknowledged message used to report the Generic Manufacturer Property state of an element (see Section 3.1.8).

The message is sent as a response to the Generic Manufacturer Property Get and Generic Manufacturer Property Set messages or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Manufacturer Property ID	2	Property ID identifying a Generic Manufacturer Property
Manufacturer User Access	1	Enumeration indicating user access (Optional)
Manufacturer Property Value	variable	Raw value for the Manufacturer Property (C.1)

C.1: If the Manufacturer User Access field is present, the Manufacturer Property Value field shall also be present; otherwise this field shall not be present.

*Table 3.82: Generic Manufacturer Property Status message parameters*

The Manufacturer Property ID field identifies a Manufacturer Property ID state of an element (see Section 3.1.8.3.1).

The Manufacturer User Access field identifies a Manufacturer User Access state of an element (see Section 3.1.8.3.2).

The Manufacturer Property Value field identifies a Manufacturer Property Value state of an element (see Section 3.1.8.3.3).

### 3.2.8.19 Generic Client Properties Get

Generic Client Properties Get is an acknowledged message used to get the list of Generic Client Property states of an element (see Section 3.1.9).

The response to the Generic Client Properties Get message is a Generic Client Properties Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Client Property ID	2	A starting Client Property ID present within an element

*Table 3.83: Generic Client Properties Get message parameters*

The Client Property ID field contains the smallest Property ID the client is requesting (see Section 3.1.9).

### 3.2.8.20 Generic Client Properties Status

The Generic Client Properties Status is an unacknowledged message used to report a list of the Generic Client Properties states of an element (see Section 3.1.9).

The message is sent as a response to the Generic Client Properties Get message or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Client Property IDs	2*N	A sequence of N Client Property IDs present within an element, where N is the number of device property IDs included in the message.

*Table 3.84: Generic Client Properties Status message parameters*

The Client Property IDs field contains a sequence of all Generic Client Property ID states of an element (see Section 3.1.9).



## 3.3 Generic server models

### 3.3.1 Generic OnOff Server

#### 3.3.1.1 Description

The Generic OnOff Server model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent a variety of devices that do not fit any of the model descriptions defined but support the generic properties of On/Off. The model defines the following state instances:

Generic OnOff Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic OnOff	Main	Yes	-	-	-

Table 3.85: Generic OnOff Server states and bindings

Table 3.86 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M

Table 3.86: Generic OnOff Server elements, states, and messages

#### 3.3.1.2 Generic OnOff state behavior

##### 3.3.1.2.1 Receiving a Generic OnOff Get message

When a Generic OnOff Server receives a Generic OnOff Get message, it shall respond with a Generic OnOff Status message (see Section 3.3.1.2.3).

##### 3.3.1.2.2 Receiving a Generic OnOff Set / Generic OnOff Set Unacknowledged message

When a Generic OnOff Server receives a Generic OnOff Set message or a Generic OnOff Set Unacknowledged message, it shall set the Generic OnOff state to the OnOff field of the message, unless the message has the same value for the SRC, DST, and TID fields as the previous message received within the past 6 seconds.

Both messages may optionally include a Transition Time field that indicates the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps that the server shall wait before executing any state-changing behavior for this message.

If the received message is a Generic OnOff Set message, the Generic OnOff Server shall respond with a Generic OnOff Status message (see Section 3.3.1.2.3).

### 3.3.1.2.3 Sending a Generic OnOff Status message

A Generic OnOff Server shall send the Generic OnOff Status message as a response to a Generic OnOff Get message (see Section 3.2.1.1), in response to a Generic OnOff Set message (see Section 3.2.1.2), or as an unsolicited message at any time.

When sending a Generic OnOff Status message, the Generic OnOff Server shall set the OnOff field to the present Generic OnOff state. If the Generic OnOff Server is in the process of changing the Generic OnOff state, it shall set the Target OnOff field to the target Generic OnOff state and shall set the Remaining Time field to the time it will take to complete the transition; otherwise, the Target Level and Remaining Time fields shall be omitted.

It is recommended to transmit a Generic OnOff Status message when the element has been physically turned on or off locally (as opposed to via the mesh network).

## 3.3.2 Generic Level Server

### 3.3.2.1 Description

The Generic Level Server model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model defines the following state instances.

Generic Level Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Level	Main	Yes	-	-	-

Table 3.87: Generic Level Server states and bindings

Table 3.88 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1002	Generic Level (see Section 3.1.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M

Table 3.88: Generic Level Server elements, states, and messages

### 3.3.2.2 Generic Level state behavior

#### 3.3.2.2.1 Receiving a Generic Level Get message

When a Generic Level Server receives a Generic Level Get message, the Generic Level Server shall respond with a Generic Level Status message (see Section 3.3.2.2.5).

### 3.3.2.2.2 *Receiving Generic Level Set / Generic Level Set Unacknowledged messages*

When a Generic Level Server receives a Generic Level Set message or a Generic Level Set Unacknowledged message, it shall set the Generic Level state to the Level field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay 5-millisecond steps that the server shall wait before executing any state-changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is the Generic Level Set message, the Generic Level Server shall respond with a Generic Level Status message (see Section 3.3.2.2.5).

### 3.3.2.2.3 *Receiving Generic Delta Set / Generic Delta Set Unacknowledged messages*

The Generic Delta Set message and the Generic Delta Set Unacknowledged message support transactional control. A number of Generic Delta Set and Generic Delta Set Unacknowledged messages with the same transaction identifier set in the TID field may be sent.

**Note:** The messages within a transaction carry the cumulative values of the Delta Level field. If one or more messages within a transaction are not received (e.g., because of radio collisions), the next received message will make up for the lost messages, carrying cumulative values of the Delta Level field.

A new transaction starts when the TID field value in the received message is different from the TID field value in the previously received message that was using the same source and destination addresses or from the most recently received message with the same TID field value that was received 6 or more seconds earlier. The present Generic Level state is stored as the Initial Generic Level value for this transaction.

A Generic Level Server shall abort a transaction upon receiving the message with a different source address or a different destination address. Incoming messages within an aborted transaction shall not result in any state changes.

When a Generic Level Server receives a Generic Delta Set message or a Generic Delta Set Unacknowledged message, it shall set the Generic Level state to the Delta Level field of the message added to the Initial Generic Level state.

When the Generic Level state is bound to another state that is not contiguous, the Generic Level Server shall set the Generic Level state to a value that satisfies the requirements of the bound state. For example, a Generic Level state may be bound to a Light Lightness state that is bound to a Light Lightness Range state (see Section 6.1.2.2.5) such that only values 0 and 1000–50000 are supported; therefore, if the resulting value of the bound Light Lightness range state is in the excluded open range of (0,1000), a value of 0 shall be set for negative Delta Level values and a value of 1000 shall be set for positive Delta Level values.

When the Generic Level state is not bound to any state, the overflow/underflow handling is implementation-specific. Some Generic Level Servers may stop at their maximum or minimum level, and some may wrap around.

When the Generic Level state is bound to another state, the overflow/underflow handling shall be defined by the wrap-around behavior of the bound state.

If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not included and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay 5-millisecond steps that the server shall wait before executing any state-changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

It is recommended to set the value of the Transition Time field to the expected interval after which the next message will be sent. For example, if the messages are sent every 200 milliseconds, the Transition Time should be set to 200 milliseconds.

Upon receiving a Generic Delta Set message, the Generic Level Server shall respond with a Generic Level Status message (see Section 3.3.2.2.5).

#### 3.3.2.2.4 *Receiving Generic Move Set / Generic Move Set Unacknowledged messages*

When a Generic Level Server receives a Generic Move Set message or a Generic Move Set Unacknowledged message, it shall start a process of changing the Generic Level state with a transition speed that is calculated by dividing the Delta Level by the Transition Time (i.e., it will be changing by a value of the Delta Level in time of the Transition Time), unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

When the Generic Level state is not bound to another state, the overflow/underflow handling is implementation-specific. Some Generic Level Servers may stop at their maximum or minimum levels, and some may wrap around.

When the Generic Level state is bound to another state, the overflow/underflow handling shall be defined by the wrap-around behavior of the bound state.

When a Generic Level Server receives the message with a value of the Delta Level field equal to 0, it shall stop changing the Generic Level state.

If present, the Transition Time field value shall be used as the time for calculating the transition speed towards the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the Generic Move Set command shall not initiate any Generic Level state change.

If the resulting Transition Time is equal to 0, the Generic Move Set command will not initiate any Generic Level state change.

If the Transition Time field is included, the Delay field is included and indicates a delay 5-millisecond steps that the server shall wait before executing any state-changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

Upon receiving a Generic Move Set message, the Generic Level Server shall respond with a Generic Level Status message (see Section 3.3.2.2.5). The target Generic Level state is the upper limit of the Generic Level state when the transition speed is positive, or the lower limit of the Generic Level state when the transition speed is negative.

### 3.3.2.2.5 Sending a Generic Level Status message

A Generic Level Server shall send the Generic Level Status message as a response to a Generic Level Get message (see Section 3.2.2), a Generic Level Set message (see Section 3.2.2.2), a Generic Delta Set message (see Section 3.2.2.4), a Generic Move Set message (see Section 3.2.2.6), or as an unsolicited message at any time.

It is recommended to send a Generic Level Status message when the Generic Level state (see Section 3.1.2) has changed as a result of a local action (as opposed to an action initiated via the mesh network), such as the element being turned on or off.

When sending a Generic Level Status message, the Generic Level Server shall set the Present Level field to the present Generic Level state. If the Generic Level Server is in the process of changing the Generic Level state, it shall set the Target Level field to the target Generic Level state and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target Level and Remaining Time fields shall be omitted.

## 3.3.3 Generic Default Transition Time Server

### 3.3.3.1 Description

The Generic Default Transition Time Server model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent a default transition time for a variety of devices. The model defines the following state instances.

Generic Default Transition Time Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Default Transition Time	Main	No	-	-	-

Table 3.89: Generic Default Transition Time Server states and bindings

Table 3.93 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1004	Generic Default Transition Time (Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M

Table 3.90: Generic Default Transition Time Server elements, states, and messages

The following method shall be used to determine which Generic Default Transition Time Server model instance to use:

- If a Generic Default Transition Time Server model is present on the main element of the model, that model instance shall be used.
- If a Generic Default Transition Time Server model is not present on the main element of the model, then the Generic Default Transition Time Server model instance that is present on the element with the largest address that is smaller than the address of the main element of the node shall be used; if no model instance is present on any element with an address smaller than the address of the main element, then the Generic Default Transition Time Server is not supported.

### 3.3.3.2 Generic Default Transition Time state behavior

#### 3.3.3.2.1 Receiving a Generic Default Transition Time Get message

When a Generic Default Transition Time Server receives a Generic Default Transition Time Get message, it shall respond with a Generic Default Transition Time Status message (see Section 3.3.3.2.3).

#### 3.3.3.2.2 Receiving Generic Default Transition Time Set / Generic Default Transition Time Set Unacknowledged messages

When a Generic Default Transition Time Server receives a Generic Default Transition Time Set message or a Generic Default Transition Time Set Unacknowledged message, it shall set the Generic Default Transition Time state to the Transition Time field of the message.

If the received message is a Generic Default Transition Time Set message, the Generic Default Transition Time Server shall respond with a Generic Default Transition Time Status message (see Section 3.3.3.2.3).

#### 3.3.3.2.3 Sending a Generic Default Transition Time Status message

A Generic Default Transition Time Server shall send the Generic Default Transition Time Status message as a response to a Generic Default Transition Time Get message (see Section 3.2.3.1), a Generic Default Transition Time Set message (see Section 3.2.3.2), or as an unsolicited message at any time.

When sending a Generic Default Transition Time Status message, the Generic Default Transition Time Server shall set the Transition Time field to the Generic Default Transition Time state.

### 3.3.4 Generic Power OnOff Server

#### 3.3.4.1 Description

The Generic Power OnOff Server model extends the Generic OnOff Server model. When this model is present on an element, the corresponding Generic Power OnOff Setup Server model (see Section 3.3.5) shall also be present.

This model may be used to represent a variety of devices that do not fit any of the model descriptions that have been defined but support the generic properties of On/Off.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 3.91 and messages listed in Table 3.92 to the models that it extends.

Generic Power OnOff Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic OnPowerUp	Main	No	-	-	-

Table 3.91: Generic Power OnOff Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M

Table 3.92: Generic Power OnOff Server messages

Table 3.93 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M

Table 3.93: Generic Power OnOff Server elements, states, and messages

### 3.3.4.2 PowerUp sequence behavior

A Generic Power OnOff Server shall use the Generic OnPowerUp state to determine the behavior after a node is powered up.

If the value of the Generic OnPowerUp state is 0x00, the Generic OnOff state shall be set to Off.

If the value of the Generic OnPowerUp state is 0x01, the Generic OnOff state shall be set to On. The bound states shall be set to their default values, if defined.

If the value of the Generic OnPowerUp state is 0x02, the bound states shall be restored to the states they were in when powered down. If the bound states were in transition to new target states when a node was powered down, they shall be restored to the target states. If the bound states were in transition with unknown target states (i.e., as a result of receiving a Generic Move message), they shall continue the transition.

If the value of the Generic OnPowerUp state is 0x02 and a transition was in progress when powered down, the element restores the target state when powered up.

If the value of the Generic OnPowerUp state is 0x02 and a transition was not in progress when powered down, the element restores the state it was in when powered down.

Each element shall transition to the determined state using its value of the Generic Default Transition Time state as the transition time. If the Generic Default Transition Time is not defined for the element, it shall transition to the determined state instantaneously.

### 3.3.4.3 Generic OnPowerUp state behavior

#### 3.3.4.3.1 Receiving a Generic OnPowerUp Get message

When a Generic Power OnOff Server receives a Generic OnPowerUp Get message, it shall respond with a Generic OnPowerUp Status message (see Section 3.3.4.3.2).

#### 3.3.4.3.2 Sending a Generic OnPowerUp Status message

A Generic Power OnOff Server shall send the Generic OnPowerUp Status message as a response to a Generic OnPowerUp Get message (see Section 3.2.4.1), a Generic OnPowerUp Set message (see Section 3.2.4.2), or as an unsolicited message at any time.

When sending a Generic OnPowerUp Status message, the Generic Power OnOff Server shall set the OnPowerUp field to the Generic OnPowerUp state.

## 3.3.5 Generic Power OnOff Setup Server

### 3.3.5.1 Description

The Generic Power OnOff Setup Server model extends the Generic Power OnOff Server model (see Section 3.3.4) and the Generic Default Transition Time Server model.



This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in Table 3.94 to the models that it extends.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1007	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	

Table 3.94: Generic Power OnOff Setup Server messages

Table 3.95 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1004	Generic Default Transition Time (Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1007	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	

Table 3.95: Generic Power OnOff Setup Server elements, states, and messages

### 3.3.5.2 Generic OnPowerUp state behavior

#### 3.3.5.2.1 Receiving Generic OnPowerUp Set / Generic OnPowerUp Set Unacknowledged messages

When a Generic Power OnOff Setup Server receives a Generic OnPowerUp Set message or a Generic OnPowerUp Set Unacknowledged message, it shall set the Generic OnPowerUp state to the value of the OnPowerUp field of the message.

If the received message is a Generic OnPowerUp Set message, the Generic Power OnOff Server shall respond with a Generic OnPowerUp Status message (see Section 3.3.4.3.2).



### 3.3.6 Generic Power Level Server

#### 3.3.6.1 Description

The Generic Power Level Server model extends the Generic Power OnOff Server model (see Section 3.3.4) and the Generic Level Server model (see Section 3.3.2). When this model is present on an Element, the corresponding Generic Power Level Setup Server model (see Section 3.3.7) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 3.96 and messages listed in Table 3.97 to the model that it extends.

Generic Power Level Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Power Actual	Main	Yes	Generic Power Level Server	Generic Level	Main
			Generic Power Level Server	Generic OnOff	Main
			Generic Power Level Server	Generic Power Last	Main
Generic Level	Main	Yes	Generic Power Level Server	Generic Power	Main
Generic OnOff	Main	Yes	Generic Power Level Server	Generic Power	Main
Generic Power Last	Main	No	-	-	-
Generic Power Default	Main	No	-	-	-
Generic Power Range	Main	No			

Table 3.96: Generic Power Level Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1009	Generic Power Level (see Section 3.1.5)	Generic Power Level Get	M	
			Generic Power Level Set	M	
			Generic Power Level Set Unacknowledged	M	
			Generic Power Level Status		M
		Generic Power Last (see Section 3.1.5.1.1)	Generic Power Last Get	M	
			Generic Power Last Status		M
			Generic Power Default Get	M	

Element	SIG Model ID	States	Messages	Rx	Tx
		Generic Power Default (see Section 3.1.5.3)	Generic Power Default Status		M
		Generic Power Range (see Section 3.1.5.4)	Generic Power Range Get	M	
			Generic Power Range Status		M

Table 3.97: Generic Power Level messages

Table 3.98 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 3.1.5.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1009	Generic Power Level (see Section 3.1.5)	Generic Power Level Get	M	
			Generic Power Level Set	M	
			Generic Power Level Set Unacknowledged	M	
			Generic Power Level Status		M
			Generic Power Last Get	M	
			Generic Power Last Status		M
			Generic Power Default Get	M	
			Generic Power Default Status		M
		Generic Power Range (see Section 3.1.5.4)	Generic Power Range Get	M	
			Generic Power Range Status		M

Table 3.98: Generic Power Level Server elements, states, and messages

### 3.3.6.2 Generic Power Actual state behavior

#### 3.3.6.2.1 Receiving a Generic Power Level Get message

When a Generic Power Level Server receives a Generic Power Level Get message, it shall respond with a Generic Power Level Status message (see Section 3.3.6.2.3).

#### 3.3.6.2.2 Receiving Generic Power Level Set / Generic Power Level Set Unacknowledged messages

When a Generic Power Level Server receives a Generic Power Level Set message or a Generic Power Level Set Unacknowledged message, it shall set the Generic Power Actual state to the value of the Power field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay 5-millisecond steps that the server shall wait before executing any state-changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Generic Power Level Set message, the Generic Power Level Server shall respond with a Generic Power Level Status message (see Section 3.3.6.2.3).

#### 3.3.6.2.3 Sending a Generic Power Level Status message

A Generic Power Level Server shall send the Generic Power Level Status message as a response to a Generic Power Level Get message (see Section 3.2.1.1), a Generic Power Level Set message (see Section 3.2.1.2), or as an unsolicited message at any time.

When sending a Generic Power Level Status message, the Generic Power Level Server shall set the Power field to the Generic Power Actual state. If the Generic Power Level Server is in the process of changing the Generic Power Actual state, it shall set the Target Power field to the target Generic Power Actual state and shall set the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target Level and Remaining Time fields shall be omitted. It is recommended to transmit a Generic Power Level Status message when the element has been physically turned on or off or its Generic Power Actual state (see Section 3.1.5.1) has changed locally (as opposed to via the mesh network).

### 3.3.6.3 Generic Power Last state behavior

#### 3.3.6.3.1 Receiving a Generic Power Last Get message

When a Generic Power Level Server receives a Generic Power Last Get message, it shall respond with a Generic Power Last Status message (see Section 3.3.6.3.2).

#### 3.3.6.3.2 Sending a Generic Power Last Status message

A Generic Power Level Server shall send the Generic Power Last Status message as a response to a Generic Power Last Get message (see Section 3.2.1.1) or as an unsolicited message at any time.

When sending a Generic Power Last Status message, the Generic Power Level Server shall set the Power field to the Generic Power Last state.



### 3.3.6.4 Generic Power Default state behavior

#### 3.3.6.4.1 Receiving a Generic Power Default Get message

When a Generic Power Level Server receives a Generic Power Default Get message, it shall respond with a Generic Power Default Status message (see Section 3.3.6.4.2).

#### 3.3.6.4.2 Sending a Generic Power Default Status message

A Generic Power Level Server shall send the Generic Power Default Status message as a response to a Generic Power Default Get message (see Section 3.2.5.7), a Generic Power Default Set message (see Section 3.2.5.8), or as an unsolicited message at any time.

When sending a Generic Power Default Status message, the Generic Power Level Server shall set the Power field to the Generic Power Default state.

### 3.3.6.5 Generic Power Range state behavior

#### 3.3.6.5.1 Receiving a Generic Power Range Get message

When a Generic Power Level Server receives a Generic Power Range Get message, it shall respond with a Generic Power Range Status message (see Section 3.3.6.5.2).

#### 3.3.6.5.2 Sending a Generic Power Range Status message

A Generic Power Level Server shall send the Generic Power Range Status message as a response to a Generic Power Range Get message (see Section 3.2.5.11), a Generic Power Range Set message (see Section 3.2.5.12), or as an unsolicited message at any time.

When sending a Generic Power Range Status message, the Generic Power Server shall set the Range Min field to the Generic Power Range Min state, the Range Max field to the Generic Power Range Max state, and the Status Code field to the status of the last operation on the Generic Power Range state.

## 3.3.7 Generic Power Level Setup Server

### 3.3.7.1 Description

The Generic Power Level Setup Server model extends the Generic Power Level Server model (see Section 3.3.6) and the Generic Power OnOff Setup model (see Section 3.3.5).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in Table 3.99 to the model that it extends:

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x100A	Generic Power Default (see Section 3.1.5.3)	Generic Power Default Set	M	
			Generic Power Default Set Unacknowledged	M	
		Generic Power Level Range (see Section 3.1.5.4)	Generic Power Level Range Set	M	
			Generic Power Level Range Set Unacknowledged	M	

Table 3.99: Generic Power Level Setup Server messages

Table 3.100 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1004	Generic Default Transition Time (Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1002	Generic Level (see Section 3.1.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1009	Generic Power Level (see Section 3.1.5)	Generic Power Level Get	M	
			Generic Power Level Set	M	
			Generic Power Level Set Unacknowledged	M	
			Generic Power Level Status		M
			Generic Power Last Get	M	
			Generic Power Last Status		M
			Generic Power Default Get	M	
			Generic Power Default Status		M
		Generic Power Range (see Section 3.1.5.4)	Generic Power Range Get	M	
			Generic Power Range Status		M
	0x100A	Generic Power Default (see Section 3.1.5.3)	Generic Power Default Set	M	
			Generic Power Default Set Unacknowledged	M	
		Generic Power Range (see Section 3.1.5.4)	Generic Power Level Range Set	M	
			Generic Power Level Range Set Unacknowledged	M	

Table 3.100: Generic Power Level Setup Server elements, states, and messages

### 3.3.7.2 Generic Power Default state behavior

#### 3.3.7.2.1 Receiving Generic Power Default Set / Generic Power Default Set Unacknowledged messages

When a Generic Power Level Server receives a Generic Power Default Set message or a Generic Power Default Set Unacknowledged message, it shall set the Generic Power Default state to the value in the Power field of the message.

If the received message is a Generic Power Default Set message, the Generic Power Level Server shall respond with a Generic Power Default Status message (see Section 3.3.6.4.2).

### 3.3.7.3 Generic Power Range state behavior

#### 3.3.7.3.1 Receiving Generic Power Range Set / Generic Power Range Set Unacknowledged messages

When a Generic Power Level Setup Server receives a Generic Power Range Set message (see Section 3.2.5.2) or a Generic Power Range Set Unacknowledged message (see Section 3.2.5.3) with values that can be accepted, it shall set the Generic Power Range state fields to the corresponding fields of the message and shall set the status of the operation to 0x00 (Success).

When a Generic Power Level Setup Server receives a Generic Power Range Set message or a Generic Power Range Set Unacknowledged message with values that cannot be accepted, it shall set the status of the operation to a value representing the reason why the values cannot be accepted, as defined in Table 7.2.

If the Range Min value is greater than the Range Max value, then the message is considered invalid and is ignored. If the Range Min value is smaller than (or equal to) the Range Max value, then the message is valid. However, if the request for the Range Min value or the Range Max value cannot be satisfied, the Server responds with the error code.

If the received message is a Generic Power Range Set message, the Generic Power Level Setup Server shall respond with a Generic Power Range Status message (see Section 3.3.6.5.2).

## 3.3.8 Generic Battery Server

### 3.3.8.1 Description

The Generic Battery Server model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model may be used to represent an element that is powered by a battery.

The model defines the state instances defined in Table 3.101.

Generic Battery Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Battery	Main	No	-	-	-

Table 3.101: Generic Battery Server states and bindings

Table 3.102 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x100C	Generic Battery (see Section 3.1.6)	Generic Battery Get	M	
			Generic Battery Status		M

Table 3.102: Generic Battery Server elements, states, and messages

### 3.3.8.2 Generic Battery state behavior

#### 3.3.8.2.1 Receiving a Generic Battery Get message

Upon receiving a Generic Battery Get message, the Generic Battery Server shall respond with a Generic Battery Status message (see Section 3.3.8.2.2).

#### 3.3.8.2.2 Sending a Generic Battery Status message

A Generic Battery Server shall send a Generic Battery Status message (see Section 3.2.6.2) as a response to the Generic Battery Get message (see Section 3.2.6.1) or at any time as an unsolicited message.

It is recommended to send a Generic Battery Status message when any of the Generic Battery states (see Section 3.1.6) has changed.

### 3.3.9 Generic Location Server

#### 3.3.9.1 Description

The Generic Location Server model is a root model (i.e., it does not extend any other models). When this model is present on an Element, the corresponding Generic Location Setup Server model (see Section 3.3.10) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model may be used to represent an element that knows its location (global or local).

The model defines the state instances listed in Table 3.103.

Generic Location Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Location	Main	No	-	-	-

Table 3.103: Generic Location Server states and bindings

Table 3.104 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x100E	Generic Location (see Section 3.1.7)	Generic Location Global Get	M	
			Generic Location Global Status		M
			Generic Location Local Get	M	
			Generic Location Local Status		M

Table 3.104: Generic Location Server elements, states, and messages

### 3.3.9.2 Generic Location state behavior

#### 3.3.9.2.1 *Receiving a Generic Location Global Get message*

Upon receiving a Generic Location Global Get message, the Generic Location Server shall respond with a Generic Location Global Status message (see Section 3.3.9.2.3).

#### 3.3.9.2.2 *Receiving Generic Location Global Set / Generic Location Global Set Unacknowledged messages*

Upon receiving a Generic Location Global Set message or a Generic Location Global Set Unacknowledged message, the Generic Location Server shall set the Generic Location Global Latitude state to the value of the Global Latitude field, the Generic Location Global Longitude state to the value of the Global Longitude field, and the Generic Location Global Altitude state to the value of the Global Altitude field.

If the message is a Generic Location Global Set message, the Generic Location Server shall respond with a Generic Location Global Status message (see Section 3.3.9.2.3).

#### 3.3.9.2.3 *Sending a Generic Location Global Status message*

When sending a Generic Location Global Status message, the Generic Location Server shall set the Global Latitude field to the value of the Generic Location Global Latitude state, the Global Longitude field to the value of the Generic Location Global Longitude state, and the Global Altitude field to the value of the Generic Location Global Altitude state.

A Generic Location Server shall send a Generic Location Status message as a response to the Generic Location Global Get message (see Section 3.2.7.1) or at any time as an unsolicited message.

#### 3.3.9.2.4 *Receiving a Generic Location Local Get message*

Upon receiving a Generic Location Local Get message, the Generic Location Server shall respond with a Generic Location Local Status message (see Section 3.3.9.2.6).

#### 3.3.9.2.5 *Receiving Generic Location Local Set / Generic Location Local Set Unacknowledged messages*

Upon receiving a Generic Location Local Set message or a Generic Location Local Set Unacknowledged message, the Generic Location Server shall set the Generic Location Local North state to the value of the Local North field, the Generic Location Local East state to the value of the Local East field, the Generic Location Floor Number state to the value of the Floor Number field, the Generic Location Local Altitude state to the value of the Local Altitude field, and the Generic Location Uncertainty state to the value of the Uncertainty field.

Upon receiving a Generic Location Local Set message, the Generic Location Server shall respond with a Generic Location Local Status message (see Section 3.3.9.2.6).

#### 3.3.9.2.6 *Sending a Generic Location Local Status message*

When sending a Generic Location Local Status message, the Generic Location Server shall set the Local North field to the value of the Generic Location Local North state, the Local East field to the value of the Generic Location Local East state, the Floor Number field to the value of the Generic Location Floor Number state, the Local Altitude field to the value of the Generic Location Local Altitude field, and the Uncertainty field to the value of the Generic Location Uncertainty state.

A Generic Location Server shall send a Generic Location Status message as a response to the Generic Location Local Get message (see Section 3.2.7.5) or at any time as an unsolicited message.



### 3.3.10 Generic Location Setup Server

#### 3.3.10.1 Description

The Generic Location Setup Server model extends the Generic Location Server model (see Section 3.3.9).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in Table 3.105 to the model that it extends:

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x100F	Generic Location (see Section 3.1.7)	Generic Location Global Set	M	
			Generic Location Global Set Unacknowledged	M	
			Generic Location Local Set	M	
			Generic Location Local Set Unacknowledged	M	

Table 3.105: Generic Location Setup Server messages

#### 3.3.10.2 Generic Location state behavior

##### 3.3.10.2.1 Receiving Generic Location Global Set / Generic Location Global Set Unacknowledged messages

Upon receiving a Generic Location Global Set message or a Generic Location Global Set Unacknowledged message, the Generic Location Setup Server shall set the Generic Location Global Latitude state to the value of the Global Latitude field, the Generic Location Global Longitude state to the value of the Global Longitude field, and the Generic Location Global Altitude state to the value of the Global Altitude field.

If the message is a Generic Location Global Set message, the Generic Location Server shall respond with a Generic Location Global Status message (see Section 3.3.9.2.3).

##### 3.3.10.2.2 Receiving Generic Location Local Set / Generic Location Local Set Unacknowledged messages

Upon receiving a Generic Location Local Set message or a Generic Location Local Set Unacknowledged message, the Generic Location Setup Server shall set the Generic Location Local North state to the value of the Local North field, the Generic Location Local East state to the value of the Local East field, the Generic Location Floor Number state to the value of the Floor Number field, the Generic Location Local Altitude state to the value of the Local Altitude field, and the Generic Location Uncertainty state to the value of the Uncertainty field.

If the message is a Generic Location Local Set message, the Generic Location Server shall respond with a Generic Location Local Status message (see Section 3.3.9.2.6).

### 3.3.11 Generic User Property Server

#### 3.3.11.1 Description

The Generic User Property Server model is a root model.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model defines the state instances listed in Table 3.106.

Generic User Properties States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic User Property	Main	No	-	-	-

Table 3.106: Generic User Property Server states and bindings

Table 3.107 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1013	Generic User Property (see Section 3.1.8)	Generic User Properties Get	M	
			Generic User Properties Status		M
			Generic User Property Get	M	
			Generic User Property Set	M	
			Generic User Property Set Unacknowledged	M	
			Generic User Property Status		M

Table 3.107: Generic User Property Server elements, states, and messages

### 3.3.11.2 Generic User Property state behavior

#### 3.3.11.2.1 Receiving a Generic User Properties Get message

Upon receiving a Generic User Properties Get message, the Generic User Property Server shall respond with a Generic User Properties Status message (see Section 3.3.11.2.2).

#### 3.3.11.2.2 Sending a Generic User Properties Status message

A Generic User Property Server shall send a Generic User Properties Status message as a response to the Generic User Properties Get message (see Section 3.2.8.1) or at any-time as an unsolicited message, setting the User Property IDs field to the concatenated sequence of all User Property ID states within an element.

#### 3.3.11.2.3 Receiving a Generic User Property Get message

Upon receiving a Generic User Property Get message, the Generic User Property Server shall respond with a Generic User Property Status message (see Section 3.3.11.2.5).

#### 3.3.11.2.4 Receiving Generic User Property Set / Generic User Property Set Unacknowledged messages

Upon receiving a Generic User Property Set message or a Generic User Property Set Unacknowledged message, the Generic User Property Server shall set the User Property Value state to the value of the User Property Value field for a device property identified by the User Property ID, if the value of the User Access state for this device property is 0x02 (can be written) or 0x03 (can be read and written).

If the received message is a Generic User Property Set message, the Generic User Property Server shall respond with a Generic User Property Status message (see Section 3.3.11.2.5).

#### 3.3.11.2.5 Sending a Generic User Property Status message

A Generic User Property Server shall send a Generic User Property Status message as a response to the Generic User Property Get message (see Section 3.2.8.3), a Generic User Property Set message (see Section 3.2.8.4), or at any time as an unsolicited message, setting the User Property ID field to the value of the User Property ID state, the User Access field to the value of the User Access state, and the User Property Value field to the value of the User Property Value state for a device property identified by the User Property ID field.

If the message is sent as a response to the Generic User Property Get message or a Generic User Property Set message with a value of the User Property ID field that does not identify any existing User Property, the User Property ID field shall be set to the value of the User Property ID field of the incoming message, and the User Access and User Property Value fields shall be omitted.

If the message is sent as a response to the Generic User Property Get message with a value of the User Property ID field that identifies an existing User Property and the value of the User Access state is 0x02 (can be written), the User Property ID field shall be set to the value of the User Property ID field of the incoming message, the User Access field shall be set to the value of the User Access state field, and the User Property Value field shall be omitted.

If the message is sent as a response to the Generic User Property Set message with a User Property ID field that identifies an existing User Property, and the value of the User Access state is 0x01 (can be read), the User Property ID field shall be set to the value of the User Property ID field of the incoming message, the User Access field shall be set to the value of the User Access state field, and the User Property Value field shall be omitted.

### 3.3.12 Generic Admin Property Server

#### 3.3.12.1 Description

The Generic Admin Property Server model extends the Generic User Property Server model (see Section 3.3.11).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 3.108 and messages listed in Table 3.109 to the model that it extends.

Generic Admin Properties States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Admin Property	Main	No	-	-	-

Table 3.108: Generic Admin Property Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1011	Generic Admin Property (see Section 3.1.8.2)	Generic Admin Properties Get	M	
			Generic Admin Properties Status		M
			Generic Admin Property Get	M	
			Generic Admin Property Set	M	
			Generic Admin Property Set Unacknowledged	M	
			Generic Admin Property Status		M

Table 3.109: Generic Admin Property messages

Table 3.110 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1013	Generic User Property (see Section 3.1.8.1)	Generic User Properties Get	M	
			Generic User Properties Status		M
			Generic User Property Get	M	



Element	SIG Model ID	States	Messages	Rx	Tx
			Generic User Property Set	M	
			Generic User Property Set Unacknowledged	M	
			Generic User Property Status		M
	0x1011	Generic Admin Property (see Section 3.1.8.2)	Generic Admin Properties Get	M	
			Generic Admin Properties Status		M
			Generic Admin Property Get	M	
			Generic Admin Property Set	M	
			Generic Admin Property Set Unacknowledged	M	
			Generic Admin Property Status		M

Table 3.110: Generic Admin Property Server elements, states, and messages

### 3.3.12.2 Generic Admin Property state behavior

#### 3.3.12.2.1 Receiving a Generic Admin Properties Get message

Upon receiving a Generic Admin Properties Get message, the Generic Admin Property Server shall respond with a Generic Admin Properties Status message (see Section 3.3.12.2.2).

#### 3.3.12.2.2 Sending a Generic Admin Properties Status message

A Generic Admin Property Server shall send a Generic Admin Properties Status message as a response to the Generic Admin Properties Get message (see Section 3.2.8.7) or at any-time as an unsolicited message, setting the Admin Property IDs field to the concatenated sequence of all Admin Property ID states within an element.

#### 3.3.12.2.3 Receiving a Generic Admin Property Get message

Upon receiving a Generic Admin Property Get message, the Generic Admin Property Server shall respond with a Generic Admin Property Status message (see Section 3.3.12.2.5).

#### 3.3.12.2.4 Receiving Generic Admin Property Set / Generic Admin Property Set Unacknowledged messages

Upon receiving a Generic Admin Property Set message or a Generic Admin Property Set Unacknowledged message, the Generic Admin Property Server shall set the Admin User Access state to the value of the Admin User Access field, and shall set the Admin Property Value state to the value of the Admin Property Value field for a device property that is identified by the User Property ID.

If the received message is a Generic Admin Property Set message, the Generic Admin Property Server shall respond with a Generic Admin Property Status message (see Section 3.3.12.2.5).

#### 3.3.12.2.5 Sending a Generic Admin Property Status message

A Generic Admin Property Server shall send a Generic Admin Property Status message as a response to the Generic Admin Property Get message (see Section 3.2.8.9), a Generic Admin Property Set message (see Section 3.2.8.10), or at any-time as an unsolicited message, setting the Admin Property ID field to the value of the Admin Property ID state, the Admin User Access field to the value of the Admin User Access state, and the Admin Property Value field to the value of the Admin Property Value state for a device property identified by the Admin Property ID field.

If the message is sent as a response to the Generic Admin Property Get message or a Generic Admin Property Set message with a value of the Admin Property ID field that does not identify any existing Admin Property, the Admin Property ID field shall be set to the value of the Admin Property ID

field of the incoming message, and the Admin User Access field and Admin Property Value field shall be omitted.

### 3.3.13 Generic Manufacturer Property Server

#### 3.3.13.1 Description

The Generic Manufacturer Property Server model extends the Generic User Property Server model (see Section 3.3.10).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 3.111 and messages listed in Table 3.112 to the model it extends.

Generic Manufacturer Properties States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Manufacturer Property	Main	No	-	-	-

Table 3.111: Generic Manufacturer Property Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1012	Generic Manufacturer Property (see Section 3.1.8)	Generic Manufacturer Properties Get	M	
			Generic Manufacturer Properties Status		M
			Generic Manufacturer Property Get	M	
			Generic Manufacturer Property Set	M	
			Generic Manufacturer Property Set Unacknowledged	M	
			Generic Manufacturer Property Status		M

Table 3.112: Generic Manufacturer Property messages

Table 3.113 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1013	Generic User Property (see Section 3.1.8)	Generic User Properties Get	M	
			Generic User Properties Status		M
			Generic User Property Get	M	
			Generic User Property Set	M	
			Generic User Property Set Unacknowledged	M	
			Generic User Property Status		M
	0x1012	Generic Manufacturer Property (see Section 3.1.8)	Generic Manufacturer Properties Get	M	
			Generic Manufacturer Properties Status		M
			Generic Manufacturer Property Get	M	
			Generic Manufacturer Property Set	M	
			Generic Manufacturer Property Set Unacknowledged	M	

Element	SIG Model ID	States	Messages	Rx	Tx
			Generic Manufacturer Property Status		M

Table 3.113: Generic Manufacturer Property Server elements, states, and messages

### 3.3.13.2 Generic Manufacturer Property state behavior

#### 3.3.13.2.1 Receiving a Generic Manufacturer Properties Get message

Upon receiving a Generic Manufacturer Properties Get message, the Generic Manufacturer Property Server shall respond with a Generic Manufacturer Properties Status message (see Section 3.3.13.2.2).

#### 3.3.13.2.2 Sending a Generic Manufacturer Properties Status message

A Generic Manufacturer Property Server shall send a Generic Manufacturer Properties Status message as a response to the Generic Manufacturer Properties Get message (see Section 3.2.8.1) or at any time as an unsolicited message, setting the Manufacturer Property IDs field to the concatenated sequence of all Manufacturer Property ID states within an element.

#### 3.3.13.2.3 Receiving a Generic Manufacturer Property Get message

Upon receiving a Generic Manufacturer Property Get message, the Generic Manufacturer Property Server shall respond with a Generic Manufacturer Property Status message (see Section 3.3.13.2.5).

#### 3.3.13.2.4 Receiving Generic Manufacturer Property Set / Generic Manufacturer Property Set Unacknowledged messages

Upon receiving a Generic Manufacturer Property Set message or a Generic Manufacturer Property Set Unacknowledged message, the Generic Manufacturer Property Server shall set the Manufacturer User Access state to the value of the Manufacturer User Access field for a device property identified by the User Property ID.

If the received message is a Generic Manufacturer Property Set message, the Generic Manufacturer Property Server shall respond with a Generic Manufacturer Property Status message (see Section 3.3.13.2.5).

#### 3.3.13.2.5 Sending a Generic Manufacturer Property Status message

A Generic Manufacturer Property Server shall send a Generic Manufacturer Property Status message as a response to the Generic Manufacturer Property Get message (see Section 3.2.8.15), a Generic Manufacturer Property Set message (see Section 3.2.8.16), or at any time as an unsolicited message, setting the Manufacturer Property ID field to the value of the Manufacturer Property ID state, the Manufacturer User Access field to the value of the Manufacturer User Access state, and the Manufacturer Property Value field to the value of the Manufacturer Property Value state for a property identified by the Manufacturer Property ID field.

If the message is sent as a response to the Generic Manufacturer Property Get message or a Generic Manufacturer Property Set message with a value of the Manufacturer Property ID field that does not identify any existing Manufacturer Property, the Manufacturer Property ID field shall be set to the value of the Manufacturer Property ID field of the incoming message, and the Manufacturer User Access field and Manufacturer Property Value field shall be omitted.

### 3.3.14 Generic Client Property Server

#### 3.3.14.1 Description

The Generic Client Property Server model is a root model.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model defines the state instances listed in Table 3.114.

Generic Client Properties States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Client Property	Main	No	-	-	-

Table 3.114: Generic Client Property Server states and bindings

Table 3.115 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1014	Generic Client Property (see Section 3.1.9)	Generic Client Properties Get	M	
			Generic Client Properties Status		M

Table 3.115: Generic Client Property Server elements, states, and messages

### 3.3.14.2 Generic Client Property state behavior

#### 3.3.14.2.1 Receiving a Generic Client Properties Get message

Upon receiving a Generic Client Properties Get message, the Generic Client Property Server shall respond with a Generic Client Properties Status message (see Section 3.3.14.2.2).

#### 3.3.14.2.2 Sending a Generic Client Properties Status message

A Generic Client Property Server shall send a Generic Client Properties Status message as a response to the Generic Client Properties Get message (see Section 3.2.8.19), setting the User Property IDs field to the concatenated sequence of Client Property ID states within the element. The sequence shall be in an ascending order of Property ID values and shall start with a smallest Property ID that is greater than or equal to the value of the Generic Client Property field of the Generic Client Properties Get message that it is responding to. The size of the Client Property IDs field is limited by the maximum size of a mesh message defined by the Mesh Profile specification [2]. If the sequence exceeds the maximum size, only the truncated part of the sequence that fits within the maximum size of a message shall be sent.

## 3.4 Generic client models

### 3.4.1 Generic OnOff Client

#### 3.4.1.1 Description

The Generic OnOff Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent a variety of elements that do not fit any of the model descriptions defined but can consume and control the generic properties of On/Off. The model may operate on states defined by the Generic Power OnOff Server model (see Section 3.3.4) via Generic OnOff Messages (see Section 3.2.1).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.



Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1001	Generic OnOff	Generic OnOff Get		O
			Generic OnOff Set		O
			Generic OnOff Set Unacknowledged		O
			Generic OnOff Status	C.1	

C.1: If any of the messages: Generic OnOff Get Generic OnOff Set are supported, the Generic OnOff Status message shall also be supported; otherwise, support for the Generic OnOff Status message is optional.

Table 3.116: Generic OnOff Client elements and messages

### 3.4.1.2 Generic OnOff procedure

#### 3.4.1.2.1 Sending a Generic OnOff Get message

To determine the Generic OnOff state of a Generic OnOff Server, a Generic OnOff Client shall send a Generic OnOff Get message. The response is a Generic OnOff Status message (see Section 3.4.1.2.3).

#### 3.4.1.2.2 Sending Generic OnOff Set / Generic OnOff Set Unacknowledged messages

To set the Generic OnOff state of a Generic OnOff Server with acknowledgment, a Generic OnOff Client shall send a Generic OnOff Set message, setting the OnOff field to the required value and the TID field to the least recently used transaction identifier. The response is a Generic OnOff Status message (see Section 3.4.1.2.3).

To set the Generic OnOff state of a Generic OnOff Server without acknowledgment, a Generic OnOff Client shall send a Generic OnOff Set Unacknowledged message, setting the OnOff field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a Model and executing the associated model behaviors.

To retransmit the message, a Generic OnOff Client shall use the same value for the TID field as in the previously sent message within 6 seconds from sending that message.

The choice to use a Generic OnOff Set or Generic OnOff Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Generic OnOff Set message or a Generic OnOff Set Unacknowledged message at any time.

#### 3.4.1.2.3 Receiving a Generic OnOff Status message

Upon receiving a Generic OnOff Status message, a Generic OnOff Client can determine the Generic OnOff state of a Generic OnOff Server, which is indicated by the OnOff field of the message.

If the Generic OnOff Server is in a process of changing the Generic OnOff state, the Generic OnOff Client can determine the target Generic OnOff state that is indicated by the Target OnOff field of the message as well as the remaining transition time that is indicated by the Remaining Time field of the message.



## 3.4.2 Generic Level Client

### 3.4.2.1 Description

The Generic Level Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent a variety of devices that do not fit any of the defined Model descriptions but can consume and control the generic properties of Level. The model operates on states defined by the Generic Level Server model (see Section 3.3.2) via Generic Level messages (see Section 3.2.2).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1003	Generic Level	Generic Level Get		O
			Generic Level Set		O
			Generic Level Set Unacknowledged		O
			Generic Delta Set		O
			Generic Delta Set Unacknowledged		O
			Generic Move Set		O
			Generic Move Set Unacknowledged		O
			Generic Level Status	C.1	

C.1: If any of the messages: Generic Level Get, Generic Level Set, Generic Delta Set, Generic Move Set are supported, the Generic Level Status message shall also be supported; otherwise, support for the Generic Level Status message is optional.

Table 3.117: Generic Level Client elements and messages

### 3.4.2.2 Generic Level procedure

#### 3.4.2.2.1 Sending a Generic Level Get message

To determine the Generic Level state of a Generic Level Server, a Generic Level Client shall send a Generic Level Get message. The response is a Generic Level Status message (see Section 3.4.2.2.5).

#### 3.4.2.2.2 Sending Generic Level Set / Generic Level Set Unacknowledged messages

To set the Generic Level state of a Generic Level Server with acknowledgment, a Generic Level Client shall send a Generic Level Set message, setting the Level field to the required value and the TID field to the least recently used value. The response is a Generic Level Status message (see Section 3.4.2.2.5).

To set the Generic Level state of a Generic Level Server without acknowledgment, a Generic Level Client shall send a Generic Level Set Unacknowledged message, setting the Level field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay, which represents the time interval between when a model received the message and when the associated model behaviors were executed.

To retransmit the message, a Generic Level Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Generic Level Set message or Generic Level Set Unacknowledged message is an implementation detail.

An element, typically as a result of user interaction, may send a Generic Level Set message or a Generic Level Set Unacknowledged message at any time.

#### 3.4.2.2.3 *Sending Generic Delta Set / Generic Delta Set Unacknowledged messages*

To change the Generic Level state of a Generic Level Server by a relative value with acknowledgment, a Generic Level Client shall send a Generic Delta Set message, setting the Delta Level field to the required relative value. The response is a Generic Level Status message (see Section 3.4.2.2.5).

To change the Generic Level state of a Generic Level Server by a relative value without acknowledgment, a Generic Level Client shall send a Generic Delta Set Unacknowledged message, setting the Delta Level field to the required relative value.

Both messages may optionally include a Transition Time field indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay, which represents the time interval between when a model received the message and when the associated model behaviors were executed.

Both messages support transactional control. A number of Generic Delta Set and Generic Delta Set Unacknowledged messages with the same transaction identifier in the TID field may be sent.

**Note:** The messages within a transaction carry the cumulative values of the Delta Level field. In case one or more messages within a transaction are not received by the Generic Level Server (e.g., as a result of radio collisions), the next received message will make up for the lost messages, carrying cumulative values of the Delta Level field. For example, a first message in a new transaction has the value of Delta Level equal to 20. Upon receiving this message, the server sets the current state as the Initial state for this transaction (see Section 3.3.2.2.3) and increases the value of the Initial state by 20. If the subsequent messages in the same transaction have values of the Delta field equal to 30, 40, and 50 respectively, each message sets the new state to the value relative to the Initial state stored when the transaction has been started. This mechanism is designed to ensure that a correct value will be set upon receiving any message, regardless of how many messages were lost. In this example, the final state is set to the value of the base state increased by 50, even if some messages within this transaction have not been received.

A new transaction is started when the TID field value in the sent message is different from the TID field value in the previously sent message, or when a message with the same TID field value was sent 6 or more seconds earlier.

To retransmit the message, a Generic Level Client shall use the same value for the TID field and the same value for the Delta Level fields as in the message previously sent within 6 seconds from sending that message.

The choice to use a Generic Delta Set message or Generic Delta Set Unacknowledged message is an implementation detail.

An element, typically as a result of user interaction, may send a Generic Delta Set message or a Generic Delta Set Unacknowledged message at any time or may start a transaction by selecting a new TID and sending a Generic Delta Set Unacknowledged message with the selected TID. As additional deltas are required, typically as a result of continuing user interaction, the element may continue to send additional Generic Delta Set Unacknowledged messages with the same TID. When the procedure is complete, typically due to the lack of user interaction, the element may send a Generic Delta Set message or a Generic Delta Set Unacknowledged message with the same TID. The sample message sequence chart (MSC) for this scenario is presented in Section 7.4.2.7.

#### 3.4.2.2.4 *Sending Generic Move Set / Generic Move Set Unacknowledged messages*

To start changing the Generic Level state of a Generic Level Server with a determined speed with acknowledgment, a Generic Level Client shall send a Generic Move Set message, which sets the Delta Level field to the required relative value and the TID field to the least recently used value. The response is a Generic Level Status message (see Section 3.4.2.2.5).

To start changing the Generic Level state of a Generic Level Server with a determined speed without acknowledgment, a Generic Level Client shall send a Generic Move Set Unacknowledged message, setting the Delta Level field to the required relative value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field indicating the transition time, which is used to calculate the speed of the transition. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay, which represents the time interval between when a model received the message and when the associated model behaviors were executed.

To stop changing the Generic Level state of a Generic Level Server with acknowledgment, a Generic Level Client shall send a Generic Move Set message, setting the Delta Level field to 0x0000. The response is a Generic Level Status message (see Section 3.4.2.2.5).

To stop changing the Generic Level state of a Generic Level Server without acknowledgment, a Generic Level Client shall send a Generic Move Set Unacknowledged message, setting the Delta Level field to 0x0000.

To retransmit the message, a Generic Level Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Generic Move Set message or a Generic Move Set Unacknowledged message is an implementation detail.

An element, typically as a result of user interaction, may send a Generic Delta Set message or a Generic Delta Set Unacknowledged message at any time.

### 3.4.2.2.5 Receiving a Generic Level Status message

Upon receiving a Generic Level Status message, a Generic Level Client can determine the Generic Level state of a Generic Level Server, which is indicated by the Level field of the message.

If the Generic Level Server is in a process of changing the Generic Level state, the Generic Level Client can determine the target Generic Level state that is indicated by the Target Level field of the message as well as the remaining transition time that is indicated by the Remaining Time field of the message.

## 3.4.3 Generic Default Transition Time Client

### 3.4.3.1 Description

The Generic Default Transition Time Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model may operate on states defined by the Generic Default Transition Time Server model (Section 3.3.3) via Generic Default Transition Time messages (Section 3.2.3).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1005	Generic Default Transition Time	Generic Default Transition Time Get		O
			Generic Default Transition Time Set		O
			Generic Default Transition Time Set Unacknowledged		O
			Generic Default Transition Time Status	C.1	

C.1: If any of the messages: Generic Default Transition Time Get, Generic Default Transition Time Set are supported, the Generic Default Transition Time Status message shall also be supported; otherwise support for the Generic Default Transition Time Status message is optional.

Table 3.118: Generic Default Transition Time Client elements and messages

### 3.4.3.2 Generic Default Transition Time procedure

#### 3.4.3.2.1 Sending a Generic Default Transition Time message

To determine the Generic Default Transition Time state of a Generic Default Transition Time Server, a Generic Default Transition Time Client shall send a Generic Default Transition Time Get message. The response is a Generic Default Transition Time Status message (see Section 3.4.3.2.3).

#### 3.4.3.2.2 Sending Generic Default Transition Time Set / Generic Default Transition Time Unacknowledged messages

To set the Generic Default Transition Time state of a Generic Default Transition Time Server with acknowledgment, a Generic Default Transition Time Client shall send a Generic Default Transition Time Set message, setting the Transition Time field to the required value. The response is a Generic Default Transition Time Status message (see Section 3.4.3.2.3).

To set the Generic Default Transition Time state of a Generic Default Transition Time Server without acknowledgment, a Generic Default Transition Time Client shall send a Generic Default Transition Time Set Unacknowledged message, setting the Transition Time field to the required value.

The choice to use a Generic Default Transition Time Set message or a Generic Default Transition Time Set Unacknowledged message is an implementation detail.

#### 3.4.3.2.3 Receiving a Generic Default Transition Time Status message

Upon receiving a Generic Default Transition Time Status message, a Generic Default Transition Time Client can determine the Generic Default Transition Time state of a Generic Default Transition Time Server.

### 3.4.4 Generic Power OnOff Client

#### 3.4.4.1 Description

The Generic Power OnOff Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model may operate on states defined by the Generic Power OnOff Server model (see Section 3.3.4) and Generic OnPowerUp messages (see Section 3.2.4).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1008	Generic OnPowerUp	Generic OnPowerUp Get		O
			Generic OnPowerUp Set		O
			Generic OnPowerUp Set Unacknowledged		O
			Generic OnPowerUp Status	C.1	

C.1: If any of the messages: Generic OnPowerUp Get, Generic OnPowerUp Set are supported, the Generic OnPowerUp Status message shall also be supported; otherwise support for the Generic OnPowerUp Status message is optional.

Table 3.119: Generic Power OnOff Client elements and messages

#### 3.4.4.2 Generic OnPowerUp procedure

##### 3.4.4.2.1 Sending a Generic OnPowerUp Get message

To determine the Generic OnPowerUp state of a Generic Power OnOff Server, a Generic OnOff Client shall send a Generic OnPowerUp Get message. The response is a Generic OnPowerUp Status message (see Section 3.4.4.2.3).

##### 3.4.4.2.2 Sending Generic OnPowerUp Set / Generic OnPowerUp Set Unacknowledged messages

To set the Generic OnPowerUp state of a Generic Power OnOff Server with acknowledgment, a Generic OnOff Client shall send a Generic OnPowerUp Set message, setting the OnPowerUp field to the required value. The response is a Generic OnPowerUp Status message (see Section 3.4.4.2.3).

To set the Generic OnPowerUp state of a Generic Power OnOff Server without acknowledgment, a Generic OnOff Client shall send a Generic OnPowerUp Set Unacknowledged message, setting the OnPowerUp field to the required value.

The choice to use a Generic OnPowerUp Set or Generic OnPowerUp Set Unacknowledged message is an implementation detail.

### 3.4.4.2.3 Receiving a Generic OnPowerUp Status message

Upon receiving a Generic OnPowerUp Status message, a Generic OnOff Client can determine the Generic OnPowerUp state of a Generic Power OnOff Server, which is indicated by the OnPowerUp field of the message.

## 3.4.5 Generic Power Level Client

### 3.4.5.1 Description

The Generic Power Level Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Generic Power Level Server model (see Section 3.3.6) via Generic Power Level messages (see Section 3.2.5).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x100B	Generic Power Actual	Generic Power Level Get		O
			Generic Power Level Set		O
			Generic Power Level Set Unacknowledged		O
			Generic Power Level Status	C.1	
		Generic Power Last	Generic Power Last Get		O
			Generic Power Last Status	C.2	
		Generic Power Default	Generic Power Default Get		O
			Generic Power Default Set		O
			Generic Power Default Set Unacknowledged		O
			Generic Power Default Status	C.3	
		Generic Power Range	Generic Power Range Get		O
			Generic Power Range Set		O
			Generic Power Range Set Unacknowledged		O
			Generic Power Range Status	C.4	

C.1: If any of the messages: Generic Power Level Get, Generic Power Level Set are supported, the Generic Power Level Status message shall also be supported; otherwise support for the Generic Power Level Status message is optional.

C.2: If the Generic Power Last Get message is supported, the Generic Power Last Status message shall also be supported; otherwise support for the Generic Power Last Status message is optional.

C.3: If any of the messages: Generic Power Default Get, Generic Power Default Set are supported, the Generic Power Default Status message shall also be supported; otherwise support for the Generic Power Default Status message is optional.

C.4: If any of the messages: Generic Power Range Get, Generic Power Range Set are supported, the Generic Power Range Status message shall also be supported; otherwise support for the Generic Power Range Status message is optional.

Table 3.120: Generic Power Level Client elements and messages

### 3.4.5.2 Generic Power Actual procedure

#### 3.4.5.2.1 Sending a Generic Power Level Get message

To determine the Generic Power Actual state of a Generic Power Level Server, a Generic Power Level Client shall send a Generic Power Level Get message. The response is a Generic Power Level Status message (see Section 3.4.5.2.3).

#### 3.4.5.2.2 Sending Generic Power Level Set / Generic Power Level Set Unacknowledged messages

To set the Generic Power Actual state of a Generic Power Level Server with acknowledgment, a Generic Power Level Client shall send a Generic Power Level Set message, setting the Power field to the required value and the TID field to the least recently used value. The response is a Generic Power Level Status message (see Section 3.4.5.2.3).

To set the Generic Power Actual state of a Generic Power Level Server without acknowledgment, a Generic Power Level Client shall send a Generic Power Level Set Unacknowledged message, setting the Power field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay, which represents the time interval between when a model received the message and when the associated model behaviors were executed.

To retransmit the message, a Generic Power Level Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

An element, typically as a result of a user interaction, may send a Generic Power Level Set message at any time. The choice to use a Generic Power Level Set message or a Generic Power Level Set Unacknowledged message is an implementation detail.

#### 3.4.5.2.3 Receiving a Generic Power Level Status message

Upon receiving a Generic Power Level Status message, a Generic Power Level Client can determine the Generic Power Actual state of a Generic Power Level Server, which is indicated by the Power field of the message.

If the Generic Power Level Server is in a process of changing the Generic Power Actual state, the Generic Power Level Client can determine the target Generic Power Actual state, which is indicated by the Target Power field of the message, as well as the remaining transition time, which is indicated by the Remaining Time field of the message.

### 3.4.5.3 Generic Power Last procedure

#### 3.4.5.3.1 Sending a Generic Power Last Get message

To determine the Generic Power Last state of a Generic Power Level Server, a Generic Power Level Client shall send a Generic Power Last Get message. The response is a Generic Power Last Status message (see Section 3.4.5.3.2).



### 3.4.5.3.2 *Receiving a Generic Power Last Status message*

Upon receiving a Generic Power Last Status message, a Generic Power Level Client can determine the Generic Power Last state of a Generic Power Level Server, which is indicated by the Power field of the message.

## 3.4.5.4 **Generic Power Default procedure**

### 3.4.5.4.1 *Sending a Generic Power Default Get message*

To determine the Generic Power Default state of a Generic Power Level Server, a Generic Power Level Client shall send a Generic Power Default Get message. The response is a Generic Power Default Status message (see Section 3.4.5.4.3).

### 3.4.5.4.2 *Sending Generic Power Default Set / Generic Power Default Set Unacknowledged messages*

To set the Generic Power Default state of a Generic Power Level Server with acknowledgment, a Generic Power Level Client shall send a Generic Power Default Set message, setting the Power field to the required value. The response is a Generic Power Default Status message (see Section 3.4.5.4.3).

To set the Generic Power Default state of a Generic Power Level Server without acknowledgment, a Generic Power Level Client shall send a Generic Power Default Set Unacknowledged message, setting the Power field to the required value.

The choice to use a Generic Power Default Set message or a Generic Power Default Set Unacknowledged message is an implementation detail.

### 3.4.5.4.3 *Receiving a Generic Power Default Status message*

Upon receiving a Generic Power Default Status message, a Generic Power Level Client can determine the Generic Power Default state of a Generic Power Level Server, which is indicated by the Power field of the message.

## 3.4.5.5 **Generic Power Range procedure**

### 3.4.5.5.1 *Sending a Generic Power Range Get message*

To determine the Generic Power Range state of a Generic Power Level Server, a Generic Power Level Client shall send a Generic Power Range Get message. The response is a Generic Power Range Status message (see Section 3.4.5.5.3).

### 3.4.5.5.2 *Sending Generic Power Range Set / Generic Power Range Set Unacknowledged messages*

To set the Generic Power Range state of a Generic Power Level Setup Server with acknowledgment, a Generic Power Level Client shall send a Generic Power Range Set message, setting the Range Min and Range Max fields to the required values. The response is a Generic Power Range Status message (see Section 3.4.5.5.3).

To set the Generic Power Range state of a Generic Power Level Setup Server without acknowledgment, a Generic Power Level Client shall send a Generic Power Range Set Unacknowledged message, setting the Range Min and Range Max fields to the required values.

The choice to use a Generic Power Range Set or a Generic Power Range Set Unacknowledged message is an implementation detail.

An element, typically as a result of user interaction, may send a Generic Power Range Set message or a Generic Power Range Set Unacknowledged message at any time.



### 3.4.5.5.3 Receiving a Generic Power Range Status message

Upon receiving a Generic Power Range Status message, a Generic Power Level Client can determine the Generic Power Range state of a Generic Power Level Server, which is indicated by the Range Min and the Range Max fields of the message.

## 3.4.6 Generic Battery Client

### 3.4.6.1 Description

The Generic Battery Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can monitor another element of a peer device that exposes a Generic Battery Server model (see Section 3.3.8) via Generic Battery messages (see Section 3.2.6). A typical use case is an information display collecting and displaying status information received from battery powered network nodes.

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x100D	Generic Battery	Generic Battery Get		O
			Generic Battery Status	C.1	

C.1: If the Generic Battery Get message is supported, the Generic Battery Status message shall also be supported; otherwise support for the Generic Battery Status message is optional.

Table 3.121: Generic Battery Client elements and messages

### 3.4.6.2 Generic Battery procedure

#### 3.4.6.2.1 Sending a Generic Battery Get message

To determine the Generic Battery state of a Generic Battery Server, a Generic Battery Client shall send a Generic Battery Get message. The response is a Generic Battery Status message (see Section 3.4.6.2.2).

#### 3.4.6.2.2 Receiving a Generic Battery Status message

Upon receiving a Generic Battery Status message, a Generic Battery Client can determine the Generic Battery state of a Sensor Server.

## 3.4.7 Generic Location Client

### 3.4.7.1 Description

The Generic Location Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Generic Location Server model (see Section 3.3.9) via Generic Location messages (see Section 3.2.7).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1010	Generic Location	Generic Location Global Get		O
			Generic Location Global Set		O
			Generic Location Global Set Unacknowledged		O
			Generic Location Global Status	C.1	
			Generic Location Local Get		O
			Generic Location Local Set		O
			Generic Location Local Set Unacknowledged		O
			Generic Location Local Status	C.2	

C.1: If any of the messages: Generic Location Global Get, Generic Location Global Set are supported, the Generic Location Global Status message shall also be supported; otherwise support for the Generic Location Global Status message is optional.

C.2: If any of the messages: Generic Location Local Get, Generic Location Local Set are supported, the Generic Location Local Status message shall also be supported; otherwise support for the Generic Location Local Status message is optional.

Table 3.122: Generic Location Client elements and messages

### 3.4.7.2 Generic Location Global procedure

#### 3.4.7.2.1 Sending a Generic Location Global Get message

To determine the Global Latitude, Global Longitude, and Global Altitude fields of the Generic Location state of a Generic Location Server, a Generic Location Client shall send a Generic Location Global Get message. The response is a Generic Location Global Status message (see Section 3.4.7.2.3).

#### 3.4.7.2.2 Sending Generic Location Global Set / Generic Location Global Set Unacknowledged messages

To set the Global Latitude, Global Longitude, and Global Altitude fields of the Generic Location state of a Generic Location Server with acknowledgment, a Generic Location Client shall send a Generic Location Global Set message, setting the Global Latitude, Global Longitude, and Global Altitude fields to the required values. The response is a Generic Location Global Status message (see Section 3.4.7.2.3).

To set the Global Latitude, Global Longitude, and Global Altitude fields of the Generic Location state of a Generic Location Server without acknowledgment, a Generic Location Client shall send a Generic Location Global Set Unacknowledged message, setting the Global Latitude, Global Longitude, and Global Altitude fields to the required values.

#### 3.4.7.2.3 Receiving a Generic Location Global Status message

Upon receiving a Generic Location Global Status message, a Generic Location Client can determine the values of the Generic Location Global Latitude, Generic Location Global Longitude, and Generic Location Global Altitude fields of the Generic Location state of a Generic Location Server, which are indicated by the Global Latitude, Global Longitude, and Global Altitude fields of the message.

### 3.4.7.3 Generic Location Local procedure

#### 3.4.7.3.1 Sending a Generic Location Local Get message

To determine the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields of the Generic Location state of a Generic Location Server, a Generic Location Client shall send a Generic

Location Local Get message. The response is a Generic Location Local Status message (see Section 3.4.7.3.3).

### 3.4.7.3.2 *Sending Generic Location Local Set / Generic Location Local Set Unacknowledged messages*

To set the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields of the Generic Location state of a Generic Location Server with acknowledgment, a Generic Location Client shall send a Generic Location Local Set message, setting the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields to the required values. The response is a Generic Location Global Status message (see Section 3.4.7.3.3).

To set the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields of the Generic Location state of a Generic Location Server without acknowledgment, a Generic Location Client shall send a Generic Location Local Set Unacknowledged message, setting the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields to the required values.

The choice to use a Generic Location Local Set message or a Generic Location Local Set Unacknowledged message is an implementation detail.

### 3.4.7.3.3 *Receiving a Generic Location Global Status message*

Upon receiving a Generic Location Global Status message, a Generic Location Client can determine the values of the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields of the Generic Location state of a Generic Location Server, which are indicated by the Local North, Local East, Floor Number, Local Altitude, and Uncertainty fields of the message.

## 3.4.8 Generic Property Client

### 3.4.8.1 Description

The Generic Property Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can consume the state of an element of a peer device that exposes a Generic User Property Server model (see Section 3.3.11) or a Generic Admin Property Server model (see Section 3.3.12) via Generic Property messages (see Section 3.2.8).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1015	Generic User	Generic User Properties Get		O
			Generic User Properties Status	C.1	
			Generic User Property Get		O
			Generic User Property Set		O
			Generic User Property Set Unacknowledged		O
			Generic User Property Status	C.2	
		Generic Admin	Generic Admin Properties Get		O
			Generic Admin Properties Status	C.3	
			Generic Admin Property Get		O
			Generic Admin Property Set		O

Element	SIG Model ID	Procedure	Messages	Rx	Tx
			Generic Admin Property Set Unacknowledged		O
			Generic Admin Property Status	C.4	
		Generic Manufacturer	Generic Manufacturer Properties Get		O
			Generic Manufacturer Properties Status	C.5	
			Generic Manufacturer Property Get		O
			Generic Manufacturer Property Set		O
			Generic Manufacturer Property Set Unacknowledged		O
			Generic Manufacturer Property Status	C.6	
		Generic Client	Generic Client Properties Get		O
			Generic Client Properties Status	C.7	

C.1: If the Generic User Properties Get message is supported, the Generic User Properties Status message shall also be supported; otherwise support for the Generic User Properties Status message is optional.

C.2: If any of the messages: Generic User Property Get, Generic User Property Set are supported, the Generic User Property Status message shall also be supported; otherwise support for the Generic User Property Status message is optional.

C.3: If the Generic Admin Properties Get message is supported, the Generic Admin Properties Status message shall also be supported; otherwise support for the Generic Admin Properties Status message is optional.

C.4: If any of the messages: Generic Admin Property Get, Generic Admin Property Set are supported, the Generic Admin Property Status message shall also be supported; otherwise support for the Generic Admin Property Status message is optional.

C.5: If the Generic Manufacturer Properties Get message is supported, the Generic Manufacturer Properties Status message shall also be supported; otherwise support for the Generic Manufacturer Properties Status message is optional.

C.6: If any of the messages: Generic Manufacturer Property Get, Generic Manufacturer Property Set are supported, the Generic Manufacturer Property Status message shall also be supported; otherwise support for the Generic Manufacturer Property Status message is optional.

C.7: If the Generic Client Properties Get message is supported, the Generic Client Properties Status message shall also be supported; otherwise support for the Generic Client Properties Status message is optional.

Table 3.123: Generic Property Client elements and messages

### 3.4.8.2 Generic User procedure

#### 3.4.8.2.1 Sending a Generic User Properties Get message

To determine the list of Generic User Property states of a Generic User Property Server, a Generic Property Client shall send a Generic User Properties Get message. The response is a Generic User Properties Status message (see Section 3.4.8.2.2).

#### 3.4.8.2.2 Receiving a Generic User Properties Status message

Upon receiving a Generic User Properties Status message, a Generic Property Client can determine the list of Generic User Property states (see Section 3.1.8) of a Generic User Property Server.

### 3.4.8.2.3 *Sending a Generic User Property Get message*

To determine the Generic User Property state of a Generic User Property Server, a Generic Property Client shall send a Generic User Property Get message, setting the User Property ID field to the value identifying the device property. The response is a Generic User Property Status message (see Section 3.4.8.2.5).

### 3.4.8.2.4 *Sending Generic User Property Set / Generic User Property Set Unacknowledged messages*

To set the Generic User Property state of a Generic User Property Server with acknowledgment, a Generic Property Client shall send a Generic User Property Set message, setting the User Property ID field to the value identifying the property and the User Property Value field to the required value. The response is a Generic User Property Status message (see Section 3.4.8.2.5).

To set the Generic User Property state of a Generic User Property Setting Server without acknowledgment, a Generic Property Client shall send a Generic User Property Set Unacknowledged message, setting the User Property ID field to the value identifying the device property and the User Property Value field to the required value.

The choice to use a Generic User Property Set message or a Generic User Property Set Unacknowledged message is an implementation detail.

### 3.4.8.2.5 *Receiving a Generic User Property Status message*

Upon receiving a Generic User Property Status message, a Generic Property Client can determine the User Access state (see Section 3.1.8.1.2) and the User Property Value state (see Section 3.1.8.1.3) of a Generic User Property Server, for a device property identified by the User Property ID field.

## 3.4.8.3 **Generic Admin procedure**

### 3.4.8.3.1 *Sending a Generic Admin Properties Get message*

To determine the list of Generic Admin Property states of a Generic Admin Property Server, a Generic Property Client shall send a Generic Admin Properties Get message. The response is a Generic Admin Properties Status message (see Section 3.4.8.3.2).

### 3.4.8.3.2 *Receiving a Generic Admin Properties Status message*

Upon receiving a Generic Admin Properties Status message, a Generic Property Client can determine the list of Generic Admin Property states (see Section 3.1.8.2) of a Generic Admin Property Server.

### 3.4.8.3.3 *Sending a Generic Admin Property Get message*

To determine the Generic Admin Property state of a Generic Admin Property Server, a Generic Property Client shall send a Generic Admin Property Get message, setting the Admin Property ID field to the value identifying the device property. The response is a Generic Admin Property Status message (see Section 3.4.8.3.5).

### 3.4.8.3.4 *Sending Generic Admin Property Set / Generic Admin Property Set Unacknowledged messages*

To set the Generic Admin Property state of a Generic Admin Property Server with acknowledgment, a Generic Property Client shall send a Generic Admin Property Set message, setting the Admin Property ID field to the value identifying the device property, and setting the Admin User Access field and the Admin Property Value field to the required values. The response is a Generic Admin Property Status message (see Section 3.4.8.3.5).

To set the Generic Admin Property state of a Generic Admin Property Server without acknowledgment, a Generic Property Client shall send a Generic Admin Property Set Unacknowledged message, setting the Admin Property ID field to the value identifying the device

property and setting the Admin User Access field and the Admin Property Value field to the required values.

The choice to use a Generic Admin Property Set message or a Generic Admin User Property Set Unacknowledged message is an implementation detail.

#### **3.4.8.3.5 *Receiving a Generic Admin Property Status message***

Upon receiving a Generic Admin Property Status message, a Generic Property Client can determine the Admin User Access state (see Section 3.1.8.2.2) and the Admin Property Value state (see Section 3.1.8.2.3) of a Generic Admin Property Server for a device property identified by the Admin Property ID field.

### **3.4.8.4 Generic Manufacturer procedure**

#### **3.4.8.4.1 *Sending a Generic Manufacturer Properties Get message***

To determine the list of Generic Manufacturer Property states of a Generic Manufacturer Property Server, a Generic Property Client shall send a Generic Manufacturer Properties Get message. The response is a Generic Manufacturer Properties Status message (see Section 3.4.8.4.2).

#### **3.4.8.4.2 *Receiving a Generic Manufacturer Properties Status message***

Upon receiving a Generic Manufacturer Properties Status message, a Generic Property Client can determine the list of Generic Manufacturer Property states (see Section 3.1.8.3) of a Generic Manufacturer Property Server.

#### **3.4.8.4.3 *Sending a Generic Manufacturer Property Get message***

To determine the Generic Manufacturer Property state of a Generic Manufacturer Property Server, a Generic Property Client shall send a Generic Manufacturer Property Get message, setting the Manufacturer Property ID field to the value identifying the device property. The response is a Generic Manufacturer Property Status message (see Section 3.4.8.4.5).

#### **3.4.8.4.4 *Sending Generic Manufacturer Property Set / Generic Manufacturer Property Set Unacknowledged messages***

To set the Generic Manufacturer Property state of a Generic Manufacturer Property Server with acknowledgment, a Generic Property Client shall send a Generic Manufacturer Property Set message, setting the Manufacturer Property ID field to the value identifying the device property, and setting the Manufacturer User Access field to the required value. The response is a Generic Manufacturer Property Status message (see Section 3.4.8.4.5).

To set the Generic Manufacturer Property state of a Generic Manufacturer Property Server without acknowledgment, a Generic Property Client shall send a Generic Manufacturer Property Set Unacknowledged message, setting the Manufacturer Property ID field to the value identifying the device property and setting the Manufacturer User Access field to the required value.

The choice to use a Generic Manufacturer Property Set message or a Generic Manufacturer User Property Set Unacknowledged message is an implementation detail.

#### **3.4.8.4.5 *Receiving a Generic Manufacturer Property Status message***

Upon receiving a Generic Manufacturer Property Status message, a Generic Property Client can determine the Manufacturer User Access state (see Section 3.1.8.3.2) and the Manufacturer Property Value state (see Section 3.1.8.3.3) of a Generic Manufacturer Property Server for a device property identified by the Manufacturer Property ID field.

### 3.4.8.5 Generic Client procedure

#### 3.4.8.5.1 *Sending a Generic Client Properties Get message*

To determine the list of Generic Client Property states of a Generic Client Property Server, a Generic Property Client shall send a Generic Client Properties Get message, setting the Client Property ID field to a required Property ID. The response is a Generic Client Properties Status message (see Section 3.4.8.5.2).

#### 3.4.8.5.2 *Receiving a Generic Client Properties Status message*

Upon receiving a Generic Client Properties Status message, a Generic Property Client can determine the list of Generic Client Property states (see Section 3.1.9) of a Generic Client Property Server.

## 3.5 Summary of generic models

Figure 3.5 illustrates the relationships between generic models.

The following types of relations are illustrated: interactions via messages between client models (represented by blue rectangles) and server models (represented by dark blue rectangles), hierarchy of models extending other models, server models serving states (represented by red rounded rectangles), and bindings between states.



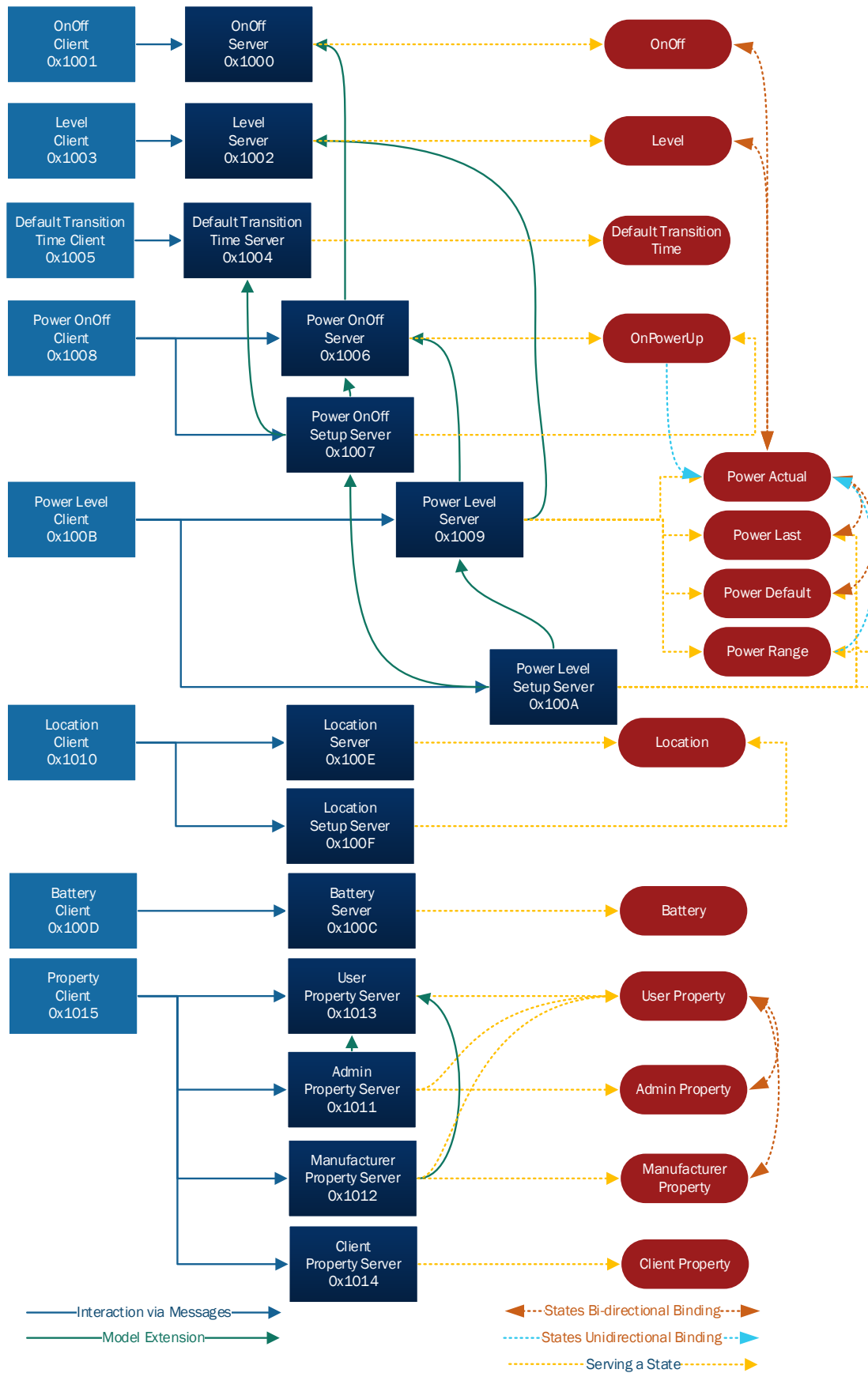


Figure 3.5: Relationships between generic models



## 4 Sensors

This section of the specification defines a standard way of interfacing with sensors. This allows any device to expose any set of sensors that can be used without having specific states, messages, and models defined for each application area.

### 4.1 Sensor states

The Sensor state is a composite state that consists of four states: the **Sensor Descriptor state** (see Section 4.1.1), which is constant throughout the lifetime of an element; the **Sensor Setting and Sensor Cadence states**, which can be configured; and the **measurement value**, which may be represented as a single data point **Sensor Data state** (see Section 4.1.4) or as a column of a series of data points, such as a histogram **Sensor Series Column state** (see Section 4.1.5). The measurement value can change over time.

Multiple instances of the Sensor states may be present within the same model, provided that each instance has a unique value of the Sensor Property ID (see Section 4.1.1.1) to allow the instances to be differentiated. This allows a sensor to collect and send multiple measurements (e.g., a room sensor may send temperature, humidity, and occupancy information in a single message) or to report its readings in more than one way (e.g., a temperature sensor may provide both instantaneous and daily average readings). Such sensors are known as multisensors.

**Note:** The number of sensors within a multisensor is limited by the size of the message payload for the Sensor Descriptor Status message. A single Sensor Descriptor may be sent using a single Unsegmented Access message. Using Segmentation and Reassembly (SAR), up to 38 Sensor Descriptor states may be sent.

#### 4.1.1 Sensor Descriptor

The **Sensor Descriptor state** represents the attributes describing the sensor data. This state does not change throughout the lifetime of an element.

The Sensor Descriptor state is defined as follows:

Field	Size (bits)	Notes
Sensor Property ID	16	Defined in Section 4.1.1.1.
Sensor Positive Tolerance	12	Defined in Section 4.1.1.2.
Sensor Negative Tolerance	12	Defined in Section 4.1.1.3.
Sensor Sampling Function	8	Defined in Section 4.1.1.4.
Sensor Measurement Period	8	Defined in Section 4.1.1.5.
Sensor Update Interval	8	Defined in Section 4.1.1.6.

Table 4.1: Sensor Descriptor states

##### 4.1.1.1 Sensor Property ID

The Sensor Property ID field is a 2-octet value referencing a device property that describes the meaning and the format of data reported by a sensor (see Section 2). A measurement reported by a sensor may be represented as a single data point (see Section 4.1.4) or as a column of a series of data points, such as a histogram (see Section 4.1.5). This representation is also determined by the device property.

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 4.2: Sensor Property ID field values

#### 4.1.1.2 Sensor Positive Tolerance

The Sensor Positive Tolerance field is a 12-bit value representing the magnitude of a possible positive error associated with the measurements that the sensor is reporting. For cases in which the tolerance information is not available, a special number has been assigned to indicate “Unspecified”.

The values for the state are defined in the following table.

Value	Description
0x000	Unspecified
0x001–0xFFF	The positive tolerance of the sensor. See Note below.

Table 4.3: Sensor Positive Tolerance states

Note: The magnitude of a possible positive error associated with the reported data (expressed as a percentage) is derived using the following formula:

$$\text{Possible Positive Error [\%]} = 100 [\%] * \frac{\text{Positive Tolerance}}{4095}$$

#### 4.1.1.3 Sensor Negative Tolerance

The Sensor Negative Tolerance field is a 12-bit value representing the magnitude of a possible negative error associated with the measurements that the sensor is reporting. When the tolerance information is not available, a special number is assigned indicating the value is Unspecified.

The values for the state are defined in the following table.

Value	Description
0x000	Unspecified
0x001–0xFFF	The negative tolerance of the sensor. See Note below.

Table 4.4: Sensor Negative Tolerance states

Note: The magnitude of a possible negative error associated with the reported data (expressed as a percentage) is derived using the following formula:

$$\text{Possible Negative Error [\%]} = 100 [\%] * \frac{\text{Negative Tolerance}}{4095}$$

#### 4.1.1.4 Sensor Sampling Function

This Sensor Sampling Function field specifies the averaging operation or type of sampling function applied to the measured value. For example, this field can identify whether the measurement is an arithmetic mean value or an instantaneous value. The values for this field are enumerated in Table 4.5.

For cases in which the sampling function is not made available, a special number has been assigned to indicate the value is Unspecified. The values for the state are defined in the following table.

Value	Description
0x00	Unspecified
0x01	Instantaneous
0x02	Arithmetic Mean
0x03	RMS
0x04	Maximum
0x05	Minimum
0x06	Accumulated. (See note below.)
0x07	Count. (See note below.)
0x08–0xFF	Reserved for Future Use

Table 4.5: Sensor sampling functions

Note: The Count sampling function can be used for a discrete variable such as the number of lightning discharges detected by a lightning detector. The Sensor Measurement Period (see Section 4.1.1.5) in this case would state the length of the period over which a counted number of lightning strikes was detected. The Accumulated sampling function is intended to represent a cumulative moving average. The measurement value would be a cumulative moving average value that was continually updated with a frequency indicated by the Sensor Update Interval (see Section 4.1.1.6).

#### 4.1.1.5 Sensor Measurement Period

This Sensor Measurement Period field specifies a uint8 value  $n$  that represents the averaging time span, accumulation time, or measurement period in seconds over which the measurement is taken, using the formula:

$$\text{represented value} = 1.1^{n-64}$$

For example, it can specify the length of the period used to obtain an average reading.

For those cases where a value for the measurement period is not available or is not applicable, a special number has been assigned to indicate Not Applicable. The values for the state are defined in the following table.

Value $n$	Represented Value	Description
0x00	Not Applicable	Not Applicable
0x01–0xFF	$1.1^{n-64}$	Time period in seconds

Table 4.6: Sensor Measurement Period field values

#### 4.1.1.6 Sensor Update Interval

The measurement reported by a sensor is internally refreshed at the frequency indicated in the Sensor Update Interval field (e.g., a temperature value that is internally updated every 15 minutes). This field specifies a uint8 value  $n$  that determines the interval (in seconds) between updates, using the formula:

$$\text{represented value} = 1.1^{n-64}$$

For those cases where a value for the Sensor Update Interval is not available or is not applicable, a special number has been assigned to indicate Not Applicable. The values for the state are defined in the following table.

Value n	Represented Value	Description
0x00	Not Applicable	Not Applicable
0x01–0xFF	$1.1^{n-64}$	Update interval in seconds.

Table 4.7: Sensor Update Interval field values

### 4.1.2 Sensor Setting

The Sensor Setting state controls parameters of a sensor.

For example, an occupancy sensor may have a “sensitivity” setting that controls the sensitivity of the sensor. Sensitivity may be adjusted to prevent small animals from triggering the sensor.

The state is a list of device properties, as shown in Table 4.8.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID of a sensor
Sensor Setting Property ID	2	Property ID of a setting within a sensor
Sensor Setting Access	1	Read/Write access rights for the setting
Sensor Setting Raw	variable	Raw value of a setting within a sensor

Table 4.8: Sensor Setting state

Multiple Sensor Setting states may be present for each sensor. The Sensor Setting Property ID values shall be unique for each Sensor Property ID that identifies a sensor within an element.

#### 4.1.2.1 Sensor Property ID

The Sensor Property ID field identifies the device property of a sensor. It matches the Sensor Property ID field of the Sensor Descriptor state (see Section 4.1.1.1).

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 4.9: Sensor Property ID field values

#### 4.1.2.2 Sensor Setting Property ID

The Sensor Setting Property ID field identifies the device property of a setting, including the size, format, and representation of the Sensor Setting Raw field.

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 4.10: Sensor Setting Property ID field values

#### 4.1.2.3 Sensor Setting Access

The Sensor Setting Access field is an enumeration indicating whether the device property can be read or written. The values for the field are defined in the following table.

Value	Meaning
0x00	Prohibited
0x01	The device property can be read.
0x02	Prohibited
0x03	The device property can be read and written.
0x04–0xFF	Prohibited

Table 4.11: Sensor Setting Access field values

#### 4.1.2.4 Sensor Setting Raw

The Sensor Setting Raw field has a size and representation defined by the Sensor Setting Property ID and represents a setting of a sensor.

#### 4.1.3 Sensor Cadence

The Sensor Cadence state controls the cadence of sensor reports. It allows a sensor to be configured to send measured values using Sensor Status messages (see Section 4.2.14) at a different cadence for a range of measured values. It also allows a sensor to be configured to send measured values when the value changes up or down by more than a configured delta value.

If the Fast Cadence High value is equal or higher than the Fast Cadence Low value, and the measured value is within the closed interval of [Fast Cadence Low, Fast Cadence High], the Sensor Status messages are published more frequently. The messages shall be published every Publish Period (configured for the model) divided by the Fast Cadence Period Divisor state (see Section 4.1.3.1).

If the Fast Cadence High value is lower than the Fast Cadence Low value, and the measured value is lower than the Fast Cadence High value or is higher than the Fast Cadence Low value, the Sensor Status messages are published more frequently. The messages shall be published every Publish Period (configured for the model) divided by the Fast Cadence Period Divisor state (see Section 4.1.3.1).

Figure 4.1 illustrates how the cadence of sent messages varies based on a measured quantity. If the measured value is within the range defined by the Fast Cadence High and the Fast Cadence Low values, messages are sent more frequently. While measured values exceed the Fast Cadence High value or when they fall below the Fast Cadence Low value, messages are sent less frequently until the measured value is again within the specified range.

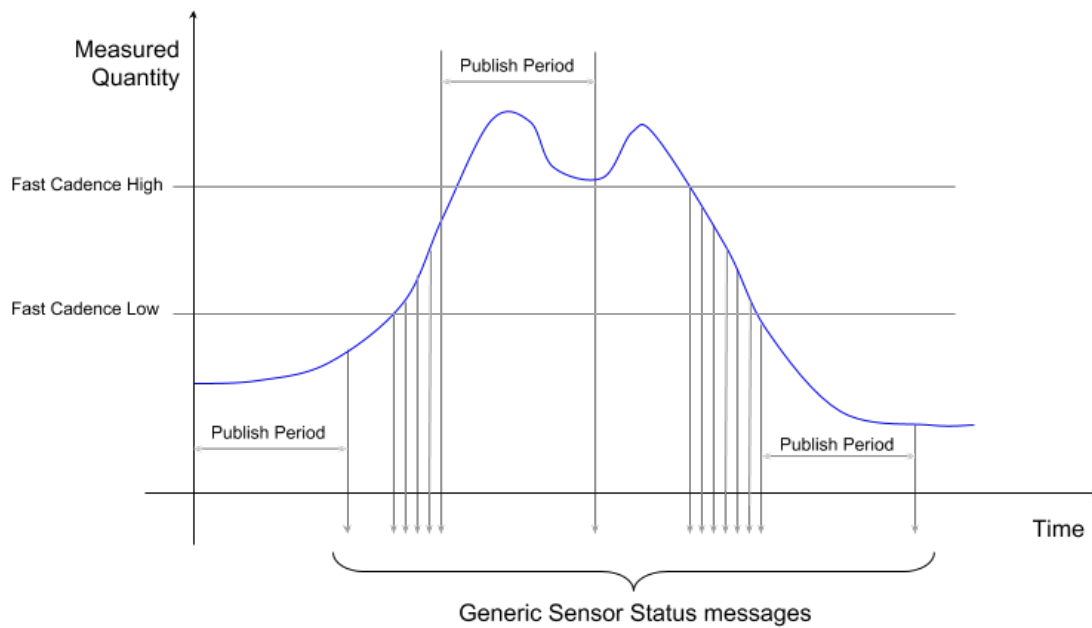


Figure 4.1: Publishing of Sensor Status messages at a fast cadence within a certain range of values

If the change of the measured value is more rapid, the Sensor Status messages may be published more frequently. A value represented by the Fast Cadence Period Divisor state (see Section 4.1.3.1) is used as a divider for the Publish Period (configured for the model) if the change exceeds the conditions determined by the Status Trigger Type (see Section 4.1.3.2), Status Trigger Delta Down (see Section 4.1.3.3), and the Status Trigger Delta Up (see Section 4.1.3.4).

Figure 4.2 illustrates sending Sensor Status messages triggered by the measured quantity change exceeding the configured Status Trigger Delta Down value.

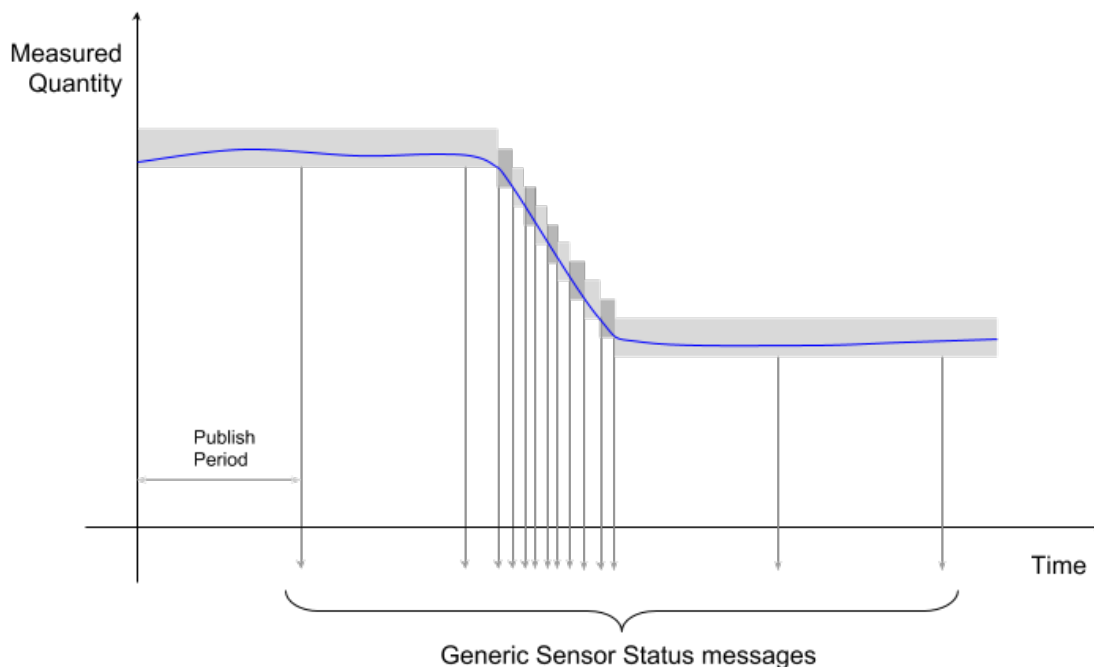


Figure 4.2: Publishing of Sensor Status messages triggered by changes of the measured quantity

The Sensor Cadence state is defined in Table 4.12.

Field	Size (bits)	Notes
Sensor Property	16	Defined in Section 4.1.1.1.
Fast Cadence Period Divisor	7	Divisor for the Publish Period (see Mesh Profile specification [2]).
Status Trigger Type	1	Defines the unit and format of the Status Trigger Delta fields.
Status Trigger Delta Down	variable	Delta down value that triggers a status message.
Status Trigger Delta Up	variable	Delta up value that triggers a status message.
Status Min Interval	8	Minimum interval between two consecutive Status messages.
Fast Cadence Low	variable	Low value for the fast cadence range.
Fast Cadence High	variable	High value for the fast cadence range.

Table 4.12: Sensor Cadence states

The Sensor Cadence state may be not supported by sensors based on device properties referencing non- scalar characteristics such as histograms or composite characteristics.

#### 4.1.3.1 Fast Cadence Period Divisor

The Fast Cadence Period Divisor field is a 7-bit value that shall control the increased cadence of publishing Sensor Status messages. The value is represented as a 2<sup>n</sup> divisor of the Publish Period (see Mesh Profile specification [2]). For example, the value 0x04 would have a divisor of 16, and the value 0x00 would have a divisor of 1 (i.e., the Publish Period would not change).

The valid range for the Fast Cadence Period Divisor state is 0–15 and other values are Prohibited.

#### 4.1.3.2 Status Trigger Type

The Status Trigger Type field shall define the unit and format of the Status Trigger Delta Down and the Status Trigger Delta Up fields.

- The value of 0b0 means that the format shall be defined by the Format Type of the characteristic that the Sensor Property ID state references (see Section 4.1.1.1).
- The value of 0b1 means that the unit is «unitless», the format type is 0x06 (uint16), and the value is represented as a percentage change with a resolution of 0.01 percent.

#### 4.1.3.3 Status Trigger Delta Down

The Status Trigger Delta Down field shall control the negative change of a measured quantity that triggers publication of a Sensor Status message. The setting is calculated based on the value of the Status Trigger Type field:

- If the value of the Status Trigger Type field is 0b0, the setting is calculated as defined by the Sensor Property ID state (see Section 4.1.1.1).
- If the value of the Status Trigger Type field is 0b1, the setting is calculated using the following formula:

$$\text{represented value} = \text{Status Trigger Delta Down} / 100$$

#### 4.1.3.4 Status Trigger Delta Up

The Status Trigger Delta Up field shall control the positive change of a measured quantity that triggers publication of a Sensor Status message. The setting is calculated based on the value of the Status Trigger Type field:

- If the value of the Status Trigger Type field is 0b0, the setting is calculated as defined by the Sensor Property ID state (see Section 4.1.1.1).

- If the value of the Status Trigger Type field is 0b1, the setting is calculated using the following formula:

$$\text{represented value} = \text{Status Trigger Delta Up} / 100$$

#### 4.1.3.5 Status Min Interval

The Status Min Interval field is a 1-octet value that shall control the minimum interval between publishing two consecutive Sensor Status messages. The value is represented as  $2^n$  milliseconds. For example, the value 0x0A would represent an interval of 1024ms.

The valid range for the Status Min Interval is 0–26 and other values are Prohibited.

#### 4.1.3.6 Fast Cadence Low

The Fast Cadence Low field shall define the lower boundary of a range of measured quantities when the publishing cadence is increased as defined by the Fast Cadence Period Divisor field. The represented value is calculated as defined by the Sensor Property ID state (see Section 4.1.1.1).

Note: The Fast Cadence Low may be set to a value higher than the Fast Cadence High. In such cases, the increased cadence will occur outside the range (Fast Cadence High, Fast Cadence Low).

#### 4.1.3.7 Fast Cadence High

The Fast Cadence High field shall define the upper boundary of a range of measured quantities when the publishing cadence is increased as defined by the Fast Cadence Period Divisor field. The represented value is calculated as defined by the Sensor Property ID state (see Section 4.1.1.1).

Note: The Fast Cadence High may be set to a value lower than the Fast Cadence Low. In such cases, the increased cadence will occur outside the range (Fast Cadence High, Fast Cadence Low).

### 4.1.4 Sensor Data

Multiple instances of Sensor states may be present within the same model, provided that each instance has a unique value of the Sensor Property ID (see Section 4.1.1.1) to allow the instances to be differentiated.

The Sensor Data state is a sequence of one or more pairs of Sensor Property ID and Raw Value fields, with each Raw Value field size and representation defined by the characteristics referenced by the Sensor Property ID (see Section 2.1).

When the Sensor Property refers multiple characteristics or a composite characteristic (i.e., a characteristic that contains other characteristics), the associated Raw Value field is a concatenated sequence of all formats defined by all characteristics.

The pairs are organized in ascending order based on the value of the Property ID  $n$  field.

Note: The ascending order provides backward compatibility when new numbers for device properties are assigned. A client may stop parsing the structure on the first device property that it does not recognize.

Field	Size (octets)	Notes
Property ID 1	2	ID of the 1 <sup>st</sup> device property of the sensor
Raw Value 1	variable	Raw Value field with a size and representation defined by the 1 <sup>st</sup> device property
Property ID 2	2	ID of the 2 <sup>nd</sup> device property of a sensor



Field	Size (octets)	Notes
Raw Value 2	variable	Raw Value field with a size and representation defined by the 2 <sup>nd</sup> property
...		
Property ID <i>n</i>	2	ID of the <i>n</i> <sup>th</sup> device property of the sensor
Raw Value <i>n</i>	variable	Raw Value field with a size and representation defined by the <i>n</i> <sup>th</sup> device property

Table 4.13: Sensor Data state

The maximum number of pairs of Property ID and Raw Value fields within a multisensor depends on their size. The combined size of the Sensor Data state shall not exceed the message payload size.

#### 4.1.5 Sensor Series Column

Values measured by sensors may be organized as arrays (and represented as series of columns, such as histograms, as illustrated by Figure 4.3). Table 4.14 summarizes the Sensor Series Column states. Each Sensor Series Column state represents a column of a series.

Field	Size (octets)	Notes
Sensor Property ID	2	Property describing the data series of the sensor
Sensor Raw Value X	variable	Raw value representing the left corner of a column on the X axis
Sensor Column Width	variable	Raw value representing the width of the column
Sensor Raw Value Y	variable	Raw value representing the height of the column on the Y axis

Table 4.14 Sensor Series Column states

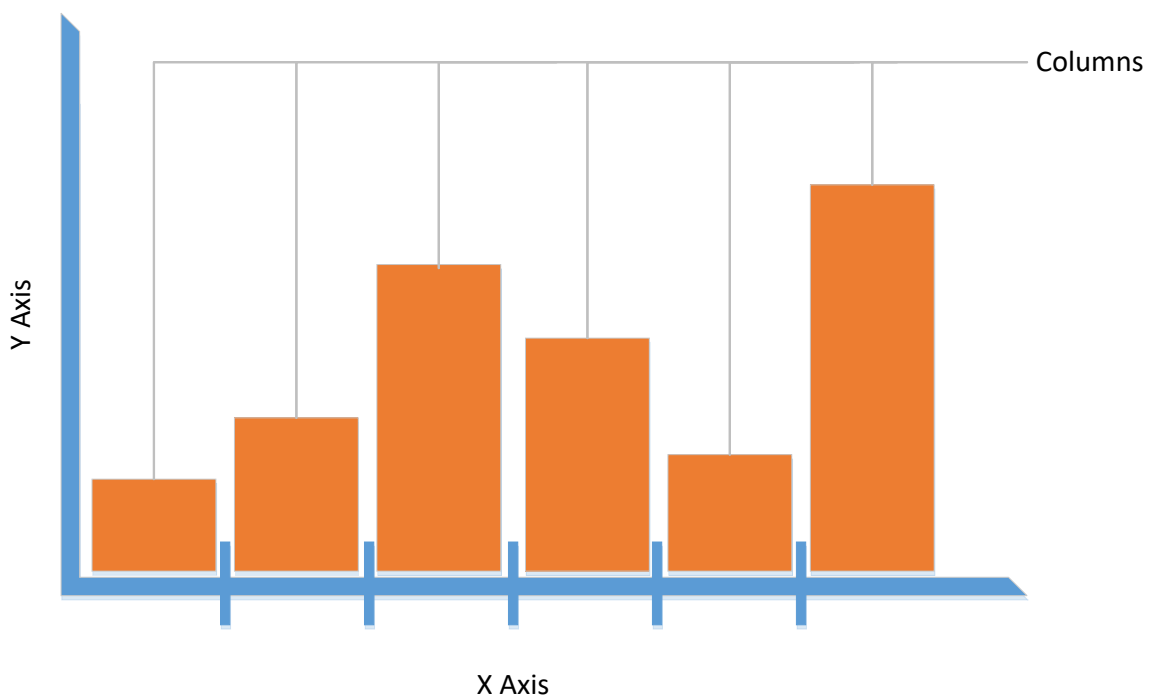


Figure 4.3: Sensor Series Column example

#### 4.1.5.1 Sensor Property ID

The Sensor Property ID field identifies the device property of a sensor and describes the meaning and context of both the X and Y axes of the series. It matches the Sensor Property ID field of the Sensor Descriptor state (see Section 4.1.1.1).

The values for the field are defined in the following table.

Value	Meaning
0x0000	Prohibited
0x0001–0xFFFF	Identifier of a device property (see Section 2.1)

Table 4.15: Sensor Property ID field values

#### 4.1.5.2 Sensor Raw Value X

The Sensor Raw Value X field has a size and representation defined by the Sensor Property ID and represents the left corner of the column on the X axis.

#### 4.1.5.3 Sensor Column Width

The Sensor Column Width field has a size and representation defined by the Sensor Property ID and represents the width of the column on the X axis.

#### 4.1.5.4 Sensor Raw Value Y

The Sensor Raw Value Y field has a size and representation defined by the Sensor Property ID and represents the height of the column on the Y axis.

Note: Values outside the bins defined by a Sensor Property are not included. For example, if the histogram is defined as 3 bins representing “lamp operating hours in a given temperature range” and the bins are [40,60), [60, 80), and [80,100], then any hours outside that [40, 100] range would not be included.

## 4.2 Sensor messages

### 4.2.1 Sensor Descriptor Get

Sensor Descriptor Get is an acknowledged message used to get the Sensor Descriptor state of all sensors within an element (see Section 4.1.1).

The response to a Sensor Descriptor Get message is a Sensor Descriptor Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Property ID	2	Property ID for the sensor (Optional)

Table 4.16: Sensor Descriptor Get message parameters

If present, the Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

### 4.2.2 Sensor Descriptor Status

The Sensor Descriptor Status is an unacknowledged message used to report a sequence of the Sensor Descriptor states of an element (see Section 4.1.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Descriptor	8*N or 2	Sequence of 8-octet Sensor Descriptors

Table 4.17: Sensor Descriptor Status message parameters

The message uses a single-octet Opcode to maximize the payload size.

The Descriptor field shall contain a sequence of 1 or more Sensor Descriptor states as defined in Section 4.1.1.

When the message is a response to a Sensor Descriptor Get message that identifies a sensor descriptor property that does not exist on the element, the Descriptor field shall contain the requested Property ID value and the other fields of the Sensor Descriptor state shall be omitted.

### 4.2.3 Sensor Cadence Get

Sensor Cadence Get is an acknowledged message used to get the Sensor Cadence state of an element (see Section 4.1.3).

The response to the Sensor Cadence Get message is a Sensor Cadence Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Property ID	2	Property ID for the sensor.

Table 4.18: Sensor Cadence Get message parameters

The Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

### 4.2.4 Sensor Cadence Set

Sensor Cadence Set is an acknowledged message used to set the Sensor Cadence state of an element (see Section 4.1.3).

The response to the Sensor Cadence Set message is a Sensor Cadence Status message.

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
Property ID	16	Property ID for the sensor.
Fast Cadence Period Divisor	7	Divisor for the Publish Period (see Mesh Profile specification [2]).
Status Trigger Type	1	Defines the unit and format of the Status Trigger Delta fields.
Status Trigger Delta Down	variable	Delta down value that triggers a status message.
Status Trigger Delta Up	variable	Delta up value that triggers a status message.
Status Min Interval	8	Minimum interval between two consecutive Status messages.
Fast Cadence Low	variable	Low value for the fast cadence range.
Fast Cadence High	variable	High value for the fast cadence range.

Table 4.19: Sensor Cadence Set message parameters

The Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

The Fast Cadence Period Divisor field identifies a Fast Cadence Period Divisor state of an element (see Section 4.1.3.1).

The Status Trigger Type field identifies a Status Trigger Type state of an element (see Section 4.1.3.2).

The Status Trigger Delta Down field identifies a Status Trigger Delta Down state of an element (see Section 4.1.3.3).

The Status Trigger Delta Up field identifies a Status Trigger Delta Up state of an element (see Section 4.1.3.4).

The Status Min Interval field identifies a Status Min Interval state of an element (see Section 4.1.3.5).

The Fast Cadence Low field identifies a Fast Cadence Low state of an element (see Section 4.1.3.6).

The Fast Cadence High field identifies a Fast Cadence High state of an element (see Section 4.1.3.7).

## 4.2.5 Sensor Cadence Set Unacknowledged

Sensor Cadence Set Unacknowledged is an unacknowledged message used to set the Sensor Cadence state of an element (see Section 4.1.2).

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
Property ID	16	Property for the sensor.
Fast Cadence Period Divisor	7	Divisor for the Publish Period (see Mesh Profile specification [2]).
Status Trigger Type	1	Defines the unit and format of the Status Trigger Delta fields.
Status Trigger Delta Down	variable	Delta down value that triggers a status message.
Status Trigger Delta Up	variable	Delta up value that triggers a status message.
Status Min Interval	8	Minimum interval between two consecutive Status messages.
Fast Cadence Low	variable	Low value for the fast cadence range.
Fast Cadence High	variable	High value for the fast cadence range.

Table 4.20: Sensor Cadence Set Unacknowledged message parameters

The Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

The Fast Cadence Period Divisor field identifies a Fast Cadence Period Divisor state of an element (see Section 4.1.3.1).

The Status Trigger Type field identifies a Status Trigger Type state of an element (see Section 4.1.3.2).

The Status Trigger Delta Down field identifies a Status Trigger Delta Down state of an element (see Section 4.1.3.3).

The Status Trigger Delta Up field identifies a Status Trigger Delta Up state of an element (see Section 4.1.3.4).

The Status Min Interval field identifies a Status Min Interval state of an element (see Section 4.1.3.5).

The Fast Cadence Low field identifies a Fast Cadence Low state of an element (see Section 4.1.3.6).

The Fast Cadence High field identifies a Fast Cadence High state of an element (see Section 4.1.3.7).

#### 4.2.6 Sensor Cadence Status

The Sensor Cadence Status is an unacknowledged message used to report the Sensor Cadence state of an element (see Section 4.1.2).

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
Property ID	16	Property for the sensor.
Fast Cadence Period Divisor	7	Divisor for the Publish Period (see Mesh Profile specification [2]). (Optional)
Status Trigger Type	1	Defines the unit and format of the Status Trigger Delta fields. (C.1)
Status Trigger Delta Down	variable	Delta down value that triggers a status message. (C.1)
Status Trigger Delta Up	variable	Delta up value that triggers a status message. (C.1)
Status Min Interval	8	Minimum interval between two consecutive status messages. (C.1)
Fast Cadence Low	variable	Low value for the fast cadence range. (C.1)
Fast Cadence High	variable	High value for the fast cadence range. (C.1)

C.1: If the Fast Cadence Period Divisor field is present, the Status Trigger Type, Status Trigger Delta Down, Status Trigger Delta Up, Status Min Interval, Fast Cadence Low, and Fast Cadence High fields shall also be present; otherwise these fields shall not be present.

Table 4.21: Sensor Cadence Status message parameters

The Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

If present, the Fast Cadence Period Divisor field identifies a Fast Cadence Period Divisor state of an element (see Section 4.1.3.1).

If present, the Status Trigger Type field identifies a Status Trigger Type state of an element (see Section 4.1.3.2).

If present, the Status Trigger Delta Down field identifies a Status Trigger Delta Down state of an element (see Section 4.1.3.3).

If present, the Status Trigger Delta Up field identifies a Status Trigger Delta Up state of an element (see Section 4.1.3.4).

If present, the Status Min Interval field identifies a Status Min Interval state of an element (see Section 4.1.3.5).

If present, the Fast Cadence Low field identifies a Fast Cadence Low state of an element (see Section 4.1.3.6).

If present, the Fast Cadence High field identifies a Fast Cadence High state of an element (see Section 4.1.3.7).

#### 4.2.7 Sensor Settings Get

Sensor Settings Get is an acknowledged message used to get the list of Sensor Setting states of an element (see Section 4.1.2).

The response to the Sensor Settings Get message is a Sensor Settings Status message (see Section 4.2.8).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID identifying a sensor.

Table 4.22: Sensor Settings Get message parameters

The Sensor Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

## 4.2.8 Sensor Settings Status

The Sensor Settings Status is an unacknowledged message used to report a list of the Sensor Setting states of an element (see Section 4.1.2).

The message is sent as a response to the Sensor Settings Get message or is sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID identifying a sensor.
Sensor Setting Property IDs	2*N	A sequence of N Sensor Setting Property IDs identifying settings within a sensor, where N is the number of property IDs included in the message. (Optional)

Table 4.23: Sensor Setting Status message parameters

The Sensor Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

If present, the Sensor Setting Property IDs field contains a sequence of all Sensor Setting Property ID states of a sensor (see Section 4.1.2).

## 4.2.9 Sensor Setting Get

Sensor Setting Get is an acknowledged message used to get the Sensor Setting state of an element (see Section 4.1.2).

The response to the Sensor Setting Get message is a Sensor Setting Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID identifying a sensor.
Sensor Setting Property ID	2	Setting Property ID identifying a setting within a sensor.

Table 4.24: Sensor Setting Get message parameters

The Sensor Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

The Sensor Setting Property ID field identifies a Sensor Setting Property ID state of a sensor (see Section 4.1.2).

## 4.2.10 Sensor Setting Set

Sensor Setting Set is an acknowledged message used to set the Sensor Setting state of an element (see Section 4.1.2).

The response to the Sensor Setting Set message is a Sensor Setting Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID identifying a sensor.
Sensor Setting Property ID	2	Setting ID identifying a setting within a sensor.
Sensor Setting Raw	variable	Raw value for the setting.

Table 4.25: Sensor Setting Set message parameters

The Sensor Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.2.1).

The Sensor Setting Property ID field identifies a Sensor Setting Property ID state of a sensor (see Section 4.1.2.2).

The Sensor Setting Raw field identifies a Sensor Setting Raw state of a sensor (see Section 4.1.2.4).

### 4.2.11 Sensor Setting Set Unacknowledged

Sensor Setting Set Unacknowledged is an unacknowledged message used to set the Sensor Setting state of an element (see Section 4.1.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID identifying a sensor.
Sensor Setting Property ID	2	Setting ID identifying a setting within a sensor.
Sensor Setting Raw	variable	Raw value for the setting.

Table 4.26: Sensor Setting Set Unacknowledged message parameters

The Sensor Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.2.1).

The Sensor Setting Property ID field identifies a Sensor Setting Property ID state of a sensor (see Section 4.1.2.2).

The Sensor Setting Raw field identifies a Sensor Setting Raw state of a sensor (see Section 4.1.2).

### 4.2.12 Sensor Setting Status

Sensor Setting Status is an unacknowledged message used to report the Sensor Setting state of an element (see Section 4.1.2).

The message is sent as a response to the Sensor Setting Get and Sensor Setting Set messages or sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Sensor Property ID	2	Property ID identifying a sensor.
Sensor Setting Property ID	2	Setting ID identifying a setting within a sensor.

Field	Size (octets)	Notes
Sensor Setting Access	1	Read / Write access rights for the setting. (Optional)
Sensor Setting Raw	variable	Raw value for the setting. (C.1)

C.1: If the Sensor Setting Access field is present, the Sensor Setting Raw field shall also be present; otherwise this field shall not be present.

*Table 4.27: Sensor Setting Status message parameters*

The Sensor Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.2.1).

The Sensor Setting Property ID field identifies a Sensor Setting Property ID state of a sensor (see Section 4.1.2.2).

If present, the Sensor Setting Access field identifies a Sensor Setting Access state of a sensor (see Section 4.1.2.3).

If present, the Sensor Setting Raw field identifies a Sensor Setting Raw state of a sensor (see Section 4.1.2.4).

### 4.2.13 Sensor Get

Sensor Get is an acknowledged message used to get the Sensor Data state (see Section 4.1.4).

The response to the Sensor Get message is a Sensor Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Property ID	2	Property for the sensor. (Optional)

*Table 4.28: Sensor Get message parameters*

If present, the Property ID field identifies a Sensor Property ID state of an element (see Section 4.1.1.1).

### 4.2.14 Sensor Status

Sensor Status is an unacknowledged message used to report the Sensor Data state of an element (see Section 4.1.4).

The message contains a Sensor Data state, defined by the Sensor Descriptor state (see Section 4.1.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Marshaled Sensor Data	variable	The Sensor Data state.

*Table 4.29: Sensor Status message parameters*

The message shall be sent as a response to the Sensor Get message (see Section 4.2.13) or as an unsolicited message.

The Marshalled Sensor Data field represents the marshalled Sensor Data state (see Section 4.1.4).

Special marshalling is used in order to facilitate forward compatibility and to optimize the payload of the message, as illustrated by the figure below.



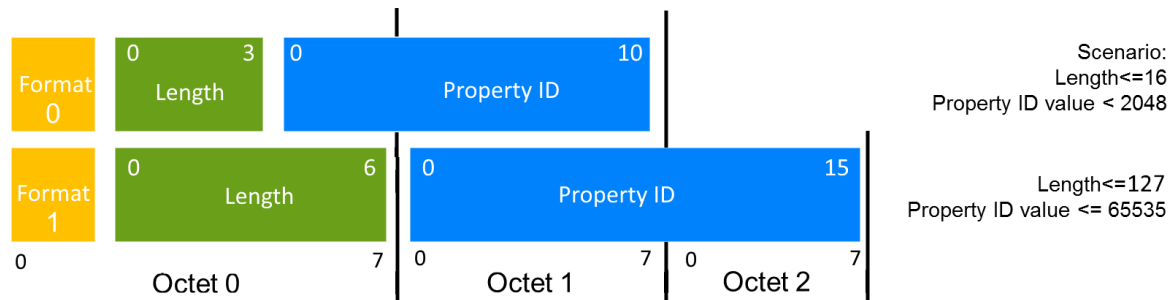


Figure 4.4: Sensor data marshalling

Marshalling is based on a Tag-Length-Value (TLV) concept. A Marshalled Property ID (MPID) is a concatenation of a 1-bit Format field, a 4-bit or 7-bit Length of the Property Value field, and an 11-bit or 16-bit Property ID.

The format of the Marshalled Sensor Data field is shown in the table below.

Field	Size (octets)	Notes
MPID 1	2 or 3	TLV of the 1 <sup>st</sup> device property of the sensor.
Raw Value 1	variable	Raw Value field with a size and representation defined by the 1 <sup>st</sup> device property.
MPID 2	2 or 3	TLV of the 2 <sup>nd</sup> device property of a sensor.
Raw Value 2	variable	Raw Value field with a size and representation defined by the 2 <sup>nd</sup> device property.
...		
MPID <i>n</i>	2 or 3	TLV of the <i>n</i> <sup>th</sup> device property of the sensor.
Raw Value <i>n</i>	variable	Raw Value field with a size and representation defined by the <i>n</i> <sup>th</sup> device property.

Table 4.30: Marshalled Sensor Data field

The Format field is a 1-bit field that identifies the format of the Length and Property ID fields, as defined by the following table:

Value	Description
0b0	Format A
0b1	Format B

Table 4.31: Sensor Data Format values

Format A is defined as a 4-bit Length field and an 11-bit Property ID field, as defined in [Table 4.32](#). This format may be used for Property Values that are not longer than 16 octets and for Property IDs less than 0x0800.

Field	Size (bits)	Notes
Format	1	Format A tag, 0b0
Length	4	Length of the Property Value
Property ID	11	Property identifying a sensor

Table 4.32: Format A of the Marshalled Property ID (MPID) field

The Format field is 0b0 and indicates that Format A is used.

The Length field is a 1-based uint4 value (valid range 0x0–0xF, representing range of 1–16).

The Property ID is an 11-bit bit field representing 11 LSb of a Property ID.

Format B is defined as a 7-bit Length field and a 16-bit Property ID field, as described in [Table 4.33](#). This format may be used for Property Values not longer than 128 octets and for any Property IDs.

Field	Size (bits)	Notes
Format	1	Format B tag, 0b1
Length	7	Length of the Property Value
Property ID	16	Property identifying a sensor (Optional)

Table 4.33: Format B of the Marshalled Property ID (MPID) field

The Format field is 0b1 and indicates Format B is used.

The Length field is a 1-based uint7 value (valid range 0x0–0x7F, representing range of 1–127). The value 0x7F represents a length of zero.

The Property ID is a 16-bit bit field representing a Property ID.

Property values longer than 128 octets are not supported by the Sensor Status message.

#### 4.2.15 Sensor Column Get

Sensor Column Get is an acknowledged message used to get the Sensor Series Column state (see [Section 4.1.5](#)).

The response to the Sensor Column Get message is a Sensor Column Status message (see [Section 4.2.16](#)).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Property ID	2	Property identifying a sensor
Raw Value X	variable	Raw value identifying a column

Table 4.34: Sensor Column Get message parameters

The Property ID field identifies a sensor within an element (see [Section 4.1.5.1](#)).

The Raw Value X field identifies a column of a sensor's series within an element (see [Section 4.1.5.2](#)).

#### 4.2.16 Sensor Column Status

Sensor Column Status is an unacknowledged message used to report the Sensor Series Column state of an element (see [Section 4.1.5](#)).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Property ID	2	Property identifying a sensor and the Y axis.
Raw Value X	variable	Raw value representing the left corner of the column on the X axis.
Column Width	variable	Raw value representing the width of the column. (Optional)

Field	Size (octets)	Notes
Raw Value Y	variable	Raw value representing the height of the column on the Y axis. (C.1)

C.1: If the Column Width field is present, the Raw Value Y field shall also be present; otherwise this field shall not be present.

*Table 4.35: Sensor Column Status message parameters*

The message shall be sent as a response to the Sensor Column Get message (see Section 4.2.15) or as an unsolicited message.

The Property ID field shall contain the Sensor Property ID state (see Section 4.1.5.1).

The Raw Value X field shall contain the Sensor Raw Value X state (see Section 4.1.5.2).

The Column Width field shall contain the Sensor Column Width state (see Section 4.1.5.3).

The Raw Value Y field shall contain the Sensor Raw Value Y state (see Section 4.1.5.4).

### 4.2.17 Sensor Series Get

Sensor Series Get is an acknowledged message used to get a sequence of the Sensor Series Column states (see Section 4.1.5).

The response to the Sensor Series Get message is a Sensor Series Status message (see Section 4.2.18).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Property ID	2	Property identifying a sensor.
Raw Value X1	variable	Raw value identifying a starting column. (Optional)
Raw Value X2	variable	Raw value identifying an ending column. (C.1)

C.1: If the Raw Value X1 field is present, the Raw Value X2 field shall also be present; otherwise this field shall not be present.

*Table 4.36: Sensor Series Get message parameters*

The Property ID field identifies a sensor within an element (see Section 4.1.5.1).

The Raw Value X1 field identifies a starting column of a sensor's series within an element (see Section 4.1.5.2).

The Raw Value X2 field identifies an ending column of a sensor's series within an element (see Section 4.1.5.2).

### 4.2.18 Sensor Series Status

Sensor Series Status is an unacknowledged message used to report a sequence of the Sensor Series Column states of an element (see Section 4.1.5).

The structure of the message is defined in the following table. The Raw Value X [n], Column Width [n], and Raw Value Y [n] fields are a triplet that may be repeated multiple times within the message. The Raw Value X [n] field is followed by the Column Width [n] field, which is followed by the Raw Value Y [n], which is followed by the Raw Value X [n+1], and so forth.

Field	Size (octets)	Notes
Property ID	2	Property identifying a sensor and the Y axis.
Raw Value X [n]	variable	Raw value representing the left corner of the n <sup>th</sup> column on the X axis. (Optional)
Column Width [n]	variable	Raw value representing the width of the n <sup>th</sup> column. (C.1)
Raw Value Y [n]	variable	Raw value representing the height of the n <sup>th</sup> column on the Y axis. (C.1)

C.1: If Raw Value X [n] field is present, the Column Width [n], Raw Value Y [n] fields shall also be present; otherwise these fields shall not be present.

Table 4.37: Sensor Series Status message parameters

The message shall be sent as a response to the Sensor Series Get message (see Section 4.2.17) or as an unsolicited message.

The Property ID field shall contain the Sensor Property ID state (see Section 4.1.5.1).

If present, the Raw Value X [n] field shall contain the n<sup>th</sup> Sensor Raw Value X state (see Section 4.1.5.2).

If present, the Column Width [n] field shall contain the n<sup>th</sup> Sensor Column Width state (see Section 4.1.5.3).

If present, the Raw Value Y [n] field shall contain the n<sup>th</sup> Sensor Raw Value Y state (see Section 4.1.5.4).

## 4.3 Sensor server models

### 4.3.1 Sensor Server

#### 4.3.1.1 Description

The Sensor Server model is a root model (it does not extend any other models). When this model is present on an element, the corresponding Sensor Setup Server model (see Section 4.3.2) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model defines the following state instances:

Sensor Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Sensor	Main	No	-	-	-

Table 4.38: Sensor Server states and bindings

Table 4.39 shows the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1100	Sensor Descriptor (see Section 4.1.1) and Sensor Data (see Section 4.1.4)	Sensor Descriptor Get	M	
			Sensor Descriptor Status		M
			Sensor Get	M	
			Sensor Status		M
			Sensor Column Get	M	
			Sensor Column Status		M
			Sensor Series Get	M	
			Sensor Series Status		M

Table 4.39: Sensor Server elements, states, and messages

### 4.3.1.2 Sensor state behavior

#### 4.3.1.2.1 Receiving a Sensor Descriptor Get message

Upon receiving a Sensor Descriptor Get message with the Property ID field present, the Sensor Server shall respond with a Sensor Descriptor Status message (see Section 4.3.1.2.2) containing the Sensor Descriptor states for the sensor identified by the Property ID field.

Upon receiving a Sensor Descriptor Get message with the Property ID field omitted, the Sensor Server shall respond with a Sensor Descriptor Status message (see Section 4.3.1.2.2) containing the Sensor Descriptor states for all sensors within the Sensor Server.

#### 4.3.1.2.2 Sending a Sensor Descriptor Status message

A Sensor Server shall send a Sensor Descriptor Status message as a response to the Sensor Descriptor Get message (see Section 4.2.1) or at any time as an unsolicited message.

When the message is sent as a response to the Sensor Descriptor Get message with an unknown Property ID field, the Descriptor field shall be omitted.

#### 4.3.1.2.3 Receiving a Sensor Get message

Upon receiving a Sensor Get message, the Sensor Server shall respond with a Sensor Status message (see Section 4.3.1.2.4).

#### 4.3.1.2.4 Sending a Sensor Status message

A Sensor Server shall send a Sensor Status message as a response to a Sensor Get message or at any time as an unsolicited message. It is recommended to send a Sensor Status message when a new value is read from the physical sensor or periodically when the newly read value is not changed from the previously read value.

The cadence of publishing unsolicited messages is controlled by the Publish Period state defined in the Mesh Profile specification [2]. If the Fast Cadence High value (see Section 4.1.3.7) is equal to or higher than the Fast Cadence Low value (see Section 4.1.3.6) and the measured value is within the closed interval of [Fast Cadence Low, Fast Cadence High], the messages shall be published with a Publish Period divided by the value represented by the Fast Cadence Period Divisor state (see Section 4.1.3.1). If the Fast Cadence High value (see Section 4.1.3.7) is lower than the Fast Cadence Low value (see Section 4.1.3.6) and the measured value either is lower than the Fast Cadence High value or higher than the Fast Cadence Low value, the messages shall be published with a Publish Period divided by the value represented by the Fast Cadence Period Divisor state (see Section 4.1.3.1).

The message shall be published when the value of the measured quantity is lower than the previously published value decremented by the value of the Status Trigger Delta Down state (see Section

4.1.3.3) or when it is higher than the previously published value incremented by the value of the Status Trigger Delta Up state (see Section 4.1.3.4).

If the message is sent as a response to the Sensor Get message, and if the Property ID field of the incoming message is omitted, the Marshalled Sensor Data field shall contain data for all device properties within a sensor; otherwise, the Marshalled Sensor Data field shall contain data for the requested device property only, or the Length shall represent the value of zero and the Raw Value field shall contain only the Property ID if the requested device property is not recognized by the Sensor Server.

#### 4.3.1.2.5 *Receiving a Sensor Column Get message*

Upon receiving a Sensor Column Get message, the Sensor Server shall respond with a Sensor Column Status message (see Section 4.3.1.2.6).

#### 4.3.1.2.6 *Sending a Sensor Column Status message*

A Sensor Server shall send a Sensor Column Status message, setting the Property ID field to the value of the Sensor Property ID state, the Raw Value X to the value of the Sensor Raw Value X state, the Column Width field to the value of the Sensor Column Width state, and the Raw Value Y field to the value of the Sensor Raw Value Y state.

If there is no Sensor Raw Value Y state present that matches the Raw Value X state as defined by the referenced device property, the Column Width field and the Raw Value Y field shall be omitted.

The message shall be sent as a response to a Sensor Column Get message (see Section 4.2.15) or may be sent at any time as an unsolicited message.

#### 4.3.1.2.7 *Receiving a Sensor Series Get message*

Upon receiving a Sensor Series Get message, the Sensor Server shall respond with a Sensor Series Status message (see Section 4.3.1.2.8).

#### 4.3.1.2.8 *Sending a Sensor Series Status message*

A Sensor Server shall send a Sensor Series Status message, setting the Property ID field to the value of the Property ID state, the following triplets of the Raw Value X to the value of the Sensor Raw Value X state, the Column Width field to the value of the Sensor Column Width state, and the Raw Value Y field to the value of the Sensor Raw Value Y state for each value of Raw Value X that is within the inclusive range from Raw Value X1 through Raw Value X2 field value of the requesting message. When the Raw Value X1 and Raw Value X2 fields are not present in the incoming message, the Sensor Server shall report all columns of the Property ID state. If the requested Property ID is not recognized by the Sensor Server or if there is no Sensor Series Column state for requested Property ID, then the Raw Value X field, the Sensor Column Width field, and the Raw Value Y field shall be omitted.

### 4.3.2 **Sensor Setup Server**

#### 4.3.2.1 **Description**

The Sensor Setup Server model extends the Sensor Server model (see Section 4.3.1).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model defines the states listed in Table 4.40 and messages listed in Table 4.41 to the model it extends.

Sensor Setup Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Sensor Cadence	Main	No	-	-	-
Sensor Setting	Main	No	-	-	-

Table 4.40: Sensor Setup Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1101	Sensor Cadence (see Section 4.1.3)	Sensor Cadence Get	M	
			Sensor Cadence Set	M	
			Sensor Cadence Set Unacknowledged	M	
			Sensor Cadence Status		M
		Sensor Setting (see Section 4.1.2)	Sensor Settings Get	M	
			Sensor Settings Status		M
			Sensor Setting Get	M	
			Sensor Setting Set	M	
			Sensor Setting Set Unacknowledged	M	
			Sensor Setting Status		M

Table 4.41: Sensor Setup Server messages

Table 4.42 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1100	Sensor Descriptor (see Section 4.1.1) and Sensor Data (see Section 4.1.4)	Sensor Descriptor Get	M	
			Sensor Descriptor Status		M
			Sensor Get	M	
			Sensor Status		M
			Sensor Column Get	M	
			Sensor Column Status		M
	0x1101	Sensor Cadence (see Section 4.1.3)	Sensor Cadence Get	M	
			Sensor Cadence Set	M	
			Sensor Cadence Set Unacknowledged	M	
			Sensor Cadence Status		M
		Sensor Setting (see Section 4.1.2)	Sensor Settings Get	M	
			Sensor Settings Status		M
			Sensor Setting Get	M	
			Sensor Setting Set	M	
			Sensor Setting Set Unacknowledged	M	
			Sensor Setting Status		M

Table 4.42: Sensor Server elements, states, and messages

### 4.3.2.2 Sensor Cadence state behavior

#### 4.3.2.2.1 Receiving a Sensor Cadence Get message

Upon receiving a Sensor Cadence Get message, the Sensor Setup Server shall respond with a Sensor Cadence Status message (see Section 4.3.2.2.3).

#### 4.3.2.2.2 Receiving Sensor Cadence Set / Sensor Cadence Set Unacknowledged messages

Upon receiving a Sensor Cadence Set or a Sensor Cadence Set Unacknowledged message, the Sensor Setup Server shall set the Fast Cadence Period Divisor state to the value of the Fast Cadence Period Divisor field, the Status Trigger Type state to the value of the Status Trigger Type field, the Status Trigger Delta Down state to the value of the Status Trigger Delta Down field, the Status Trigger Delta Up state to the value of the Status Trigger Delta Up field, the Status Min Interval state to the value of the Status Min Interval field, the Fast Cadence Low state to the value of the Fast Cadence Low field, and the Fast Cadence High state to the value of the Fast Cadence High field for a sensor identified by the Property ID field.

If the received message is a Sensor Cadence Set message, the Sensor Setup Server shall respond with a Sensor Cadence Status message (see Section 4.2.6).

#### 4.3.2.2.3 Sending a Sensor Cadence Status message

A Sensor Setup Server shall send a Sensor Cadence Status message as a response to the Sensor Cadence Get message (see Section 4.2) or at any-time as an unsolicited message, setting the Fast Cadence Period Divisor field to the value of the Fast Cadence Period Divisor state, the Status Trigger Type field to the value of the Status Trigger Type state, the Status Trigger Delta Down field to the value of the Status Trigger Delta Down state, the Status Trigger Delta Up field to the value of the Status Trigger Delta Up state, the Status Min Interval field to the value of the Status Min Interval state, the Fast Cadence Low field to the value of the Fast Cadence Low state, and the Fast Cadence High field to the value of the Fast Cadence High state of a sensor identified by the Property ID field.

When the message is sent as a response to the Sensor Cadence Get message or a Sensor Cadence Set message with an unknown Property ID field or the Sensor Server does not support the Sensor Cadence state for the sensor referred by the Property ID, the following fields shall be omitted:

- Fast Cadence Period Divisor
- Status Trigger Type
- Status Trigger Delta Down
- Status Trigger Delta Up
- Status Min Interval
- Fast Cadence Low
- Fast Cadence High

### 4.3.2.3 Sensor Setting state behavior

#### 4.3.2.3.1 Receiving a Sensor Settings Get message

Upon receiving a Sensor Settings Get message, the Sensor Setup Server shall respond with a Sensor Settings Status message (see Section 4.3.2.3.2).



#### 4.3.2.3.2 *Sending a Sensor Settings Status message*

A Sensor Setup Server shall send a Sensor Settings Status message as a response to the Sensor Settings Get message (see Section 4.2.7) or at any time as an unsolicited message, setting the Sensor Property ID field to the value of the Sensor Property ID state, and the Sensor Setting Property IDs field to the concatenated sequence of all Sensor Setting Property ID states for a sensor identified by the Sensor Property ID field.

When the message is sent as a response to a Sensor Settings Get message with an unknown Sensor Property IDs field, the Sensor Setting Property IDs field shall be omitted.

#### 4.3.2.3.3 *Receiving a Sensor Setting Get message*

Upon receiving a Sensor Setting Get message, the Sensor Setup Server shall respond with a Sensor Setting Status message (see Section 4.3.2.3.5).

#### 4.3.2.3.4 *Receiving Sensor Setting Set / Sensor Setting Set Unacknowledged messages*

Upon receiving a Sensor Setting Set or a Sensor Setting Set Unacknowledged message for a Sensor Setting that has the value of the Sensor Setting Access field equal to 0x03 (read/write), the Sensor Setup Server shall set the Sensor Setting Raw state to the value of the Sensor Setting Raw field for a setting identified by the Sensor Setting Property ID field and for a sensor identified by the Sensor Property ID field.

If the received message is a Sensor Setting Set message, the Sensor Setup Server shall respond with a Sensor Setting Status message (see Section 4.3.2.3.5).

#### 4.3.2.3.5 *Sending a Sensor Setting Status message*

A Sensor Setup Server shall send a Sensor Setting Status message as a response to the Sensor Setting Get message (see Section 4.2.9), a Sensor Setting Set message (see Section 4.2.10), or at any time as an unsolicited message. It shall set the Sensor Property ID field to the value of the Sensor Property ID state, the Sensor Setting Property ID field to the value of the Sensor Setting Property ID state, the Sensor Setting Access field to the value of the Sensor Setting Access state, and the Sensor Setting Raw field to the value of the Sensor Setting Raw state for a setting identified by the Sensor Setting Property ID field and for a sensor identified by the Sensor Property ID field.

If the message is sent as a response to the Sensor Setting Get message or a Sensor Setting Set message with an unknown Sensor Property ID field or an unknown Sensor Setting Property ID field, the Sensor Setting Access field and the Sensor Setting Raw field shall be omitted.

If the message is sent as a response to the Sensor Setting Set message with a Sensor Setting Property ID field that identifies an existing Sensor Setting, and the value of the Sensor Setting Access state is 0x01 (can be read), the Sensor Setting Property ID field shall be set to the value of the Sensor Setting Property ID field of the incoming message, the Sensor Setting Access field shall be set to the value of the Sensor Setting Access state field, and the Sensor Setting Raw field shall be omitted.

## 4.4 Sensor client models

### 4.4.1 Sensor Client

#### 4.4.1.1 Description

The Sensor Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can consume the state of an element of a peer device that exposes a Sensor Server model (see Section 4.3.1) or Sensor Setup Server model (see Section 4.3.2) via Sensor messages (see Section 4.2).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1102	Sensor	Sensor Descriptor Get		O
			Sensor Descriptor Status	C.1	
			Sensor Cadence Get		O
			Sensor Cadence Set		O
			Sensor Cadence Set Unacknowledged		O
			Sensor Cadence Status	C.2	
			Sensor Settings Get		O
			Sensor Settings Status	C.3	
			Sensor Setting Get		O
			Sensor Setting Set		O
			Sensor Setting Set Unacknowledged		O
			Sensor Setting Status	C.4	
			Sensor Get		O
			Sensor Status	C.5	
			Sensor Column Get		O
			Sensor Column Status	C.6	
			Sensor Series Get		O
			Sensor Series Status	C.7	

C.1: If the Sensor Descriptor Get message is supported, the Sensor Descriptor Status message shall also be supported; otherwise support for the Sensor Descriptor Status message is optional.

C.2: If any of the messages: Sensor Cadence Get, Sensor Cadence Set are supported, the Sensor Cadence Status message shall also be supported; otherwise support for the Sensor Cadence Status message is optional.

C.3: If the Sensor Settings Get message is supported, the Sensor Settings Status message shall also be supported; otherwise support for the Sensor Settings Status message is optional.

C.4: If any of the messages: Sensor Setting Get, Sensor Setting Set are supported, the Sensor Setting Status message shall also be supported; otherwise support for the Sensor Setting Status message is optional.

C.5: If the Sensor Get message is supported, the Sensor Status message shall also be supported; otherwise support for the Sensor Status message is optional.

C.6: If the Sensor Column Get message is supported, the Sensor Column Status message shall also be supported; otherwise support for the Sensor Column Status message is optional.

C.7: If the Sensor Series Get message is supported, the Sensor Series Status message shall also be supported; otherwise support for the Sensor Series Status message is optional.

Table 4.43: Sensor Client elements and messages



### 4.4.1.2 Sensor procedure

#### 4.4.1.2.1 Sending a Sensor Descriptor Get message

To determine the Sensor Descriptor state of Sensor Sever, a Sensor Client shall send a Sensor Descriptor Get message, setting the Property ID field to the value identifying the sensor or omitting the Property ID field to get descriptors for all sensors within an element. The response is a Sensor Descriptor Status message (see Section 4.4.1.2.2).

#### 4.4.1.2.2 Receiving a Sensor Descriptor Status message

Upon receiving a Sensor Descriptor Status message, a Sensor Client can determine the Sensor Descriptor states of a Sensor Server.

#### 4.4.1.2.3 Sending a Sensor Cadence Get message

To determine the Sensor Cadence of a Sensor Server, a Sensor Client shall send a Sensor Cadence Get message, setting the Property ID field to the value identifying the sensor. The response is a Sensor Cadence Status message (see Section 4.4.1.2.5).

#### 4.4.1.2.4 Sending Sensor Cadence Set / Sensor Cadence Set Unacknowledged messages

To set the Sensor Cadence state of a Sensor Sever with acknowledgment, a Sensor Client shall send a Sensor Cadence Set message, setting the Property ID field to the value identifying the sensor. The response is a Sensor Cadence Status message (see Section 4.4.1.2.5).

To set the Sensor Cadence state of a Sensor Sever without acknowledgment, a Sensor Client shall send a Sensor Cadence Set Unacknowledged message, setting the Property ID field to the value identifying the sensor.

The choice to use a Sensor Cadence Set or a Sensor Cadence Set Unacknowledged message is an implementation detail.

#### 4.4.1.2.5 Receiving a Sensor Cadence Status message

Upon receiving a Sensor Cadence Status message, a Sensor Client can determine the Sensor Cadence state (see Section 4.1.2) of a Sensor Server for a sensor identified by the Property ID field.

#### 4.4.1.2.6 Sending a Sensor Settings Get message

To determine the list of Sensor Setting states of a Sensor Setup Server, a Sensor Client shall send a Sensor Settings Get message, setting the Sensor Property ID field to the value identifying the sensor. The response is a Sensor Settings Status message (see Section 4.4.1.2.7).

#### 4.4.1.2.7 Receiving a Sensor Settings Status message

Upon receiving a Sensor Settings Status message, a Sensor Client can determine the list of Sensor Setting states (see Section 4.1.2) of a Sensor Setup Server for a sensor identified by the Property ID field.

#### 4.4.1.2.8 Sending a Sensor Setting Get message

To determine the Sensor Setting state of a Sensor Setting Server, a Sensor Client shall send a Sensor Setting Get message, setting the Sensor Property ID field to the value identifying the sensor. The response is a Sensor Setting Status message (see Section 4.4.1.2.10).

#### 4.4.1.2.9 Sending Sensor Setting Set / Sensor Setting Set Unacknowledged messages

To set the Sensor Setting state of a Sensor Setting Sever with acknowledgment, a Sensor Client shall send a Sensor Setting Set message, setting the Sensor Property ID field to the value identifying the sensor, the Sensor Setting Property ID field to the value identifying the setting, and the Sensor Setting

Raw field to the required value. The response is a Sensor Setting Status message (see Section 4.4.1.2.10).

To set the Sensor Setting state of a Sensor Setting Server without acknowledgment, a Sensor Client shall send a Sensor Setting Set Unacknowledged message, setting the Sensor Property ID field to the value identifying the sensor, the Sensor Setting Property ID field to the value identifying the setting, and the Sensor Setting Raw field to the required value.

Setting a Sensor Setting state is possible only for Sensor Settings that have the value of the Sensor Setting Access state equal to 0x03 (read/write).

The choice to use a Sensor Setting Set message or a Sensor Setting Set Unacknowledged message is an implementation detail.

#### 4.4.1.2.10 Receiving a Sensor Setting Status message

Upon receiving a Sensor Setting Status message, a Sensor Client can determine the Sensor Setting Raw state (see Section 4.1.2) of a Sensor Setting Server for a setting identified by the Sensor Setting Property ID field and for a sensor identified by the Sensor Property ID field.

#### 4.4.1.2.11 Sending a Sensor Get message

To determine the Sensor Data state reported by a Sensor Server, a Sensor Client shall send a Sensor Get message, setting the Property ID field to the value identifying the sensor or omitting the Property ID field to get values for all sensors within an element. The response is a Sensor Status message (see Section 4.4.1.2.12).

#### 4.4.1.2.12 Receiving a Sensor Status message

Upon receiving a Sensor Status message, a Sensor Client can determine the Sensor Data state of a Sensor Server and compute the represented values of the Sensor Server.

#### 4.4.1.2.13 Sending a Sensor Column Get message

To determine the Sensor Series Column state reported by a Sensor Server for a given series column of a sensor, a Sensor Client shall send a Sensor Column Get message, setting the Property ID field to the value identifying the sensor within an element and setting the Raw Value X field to the value identifying the column. The response is a Sensor Column Status message (see Section 4.4.1.2.14).

#### 4.4.1.2.14 Receiving a Sensor Column Status message

Upon receiving a Sensor Column Status message, a Sensor Client can determine the Sensor Property ID, Raw Value X, Column Width, and Raw Value Y states of a Sensor Server and calculate the respective represented values of the Sensor Server for a given column.

#### 4.4.1.2.15 Sending a Sensor Series Get message

To determine the Sensor Series Column states reported by a Sensor Server for a given range of columns of a sensor, a Sensor Client shall send a Sensor Series Get message, setting the TID field to a least recently used value, the Property ID field to the value identifying the sensor within an element, and the Raw Value X1 and Raw Value X2 fields to the values identifying the range of columns. The response is a Sensor Series Status message (see Section 4.4.1.2.16).

#### 4.4.1.2.16 Receiving a Sensor Series Status message

Upon receiving a Sensor Series Status message, a Sensor Client can determine the Sensor Property ID and a series of triplets of Raw Value X, Column Width, and Raw Value Y states of a Sensor Server and calculate the respective represented values of the Sensor Server for each given column.

## 4.5 Summary of sensor models

Figure 4.5 illustrates the relationships between sensor models.

The following types of relations are illustrated: interactions via messages between client models (represented by blue rectangles) and server models (represented by dark blue rectangles), hierarchy of models extending other models, server models serving states (represented by red rounded rectangles), and bindings between states.

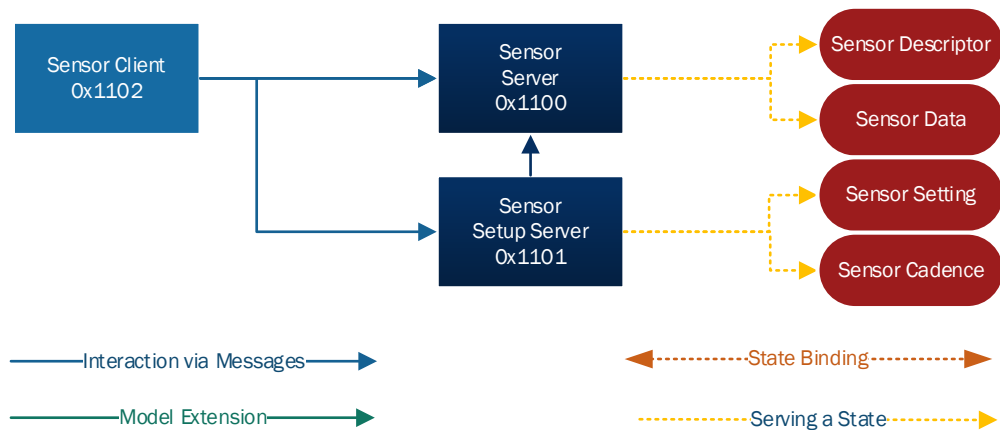


Figure 4.5: Relationships between sensor models

## 5 Time and Scenes

This section of the specification defines a set of functionalities related to time and saved states on devices. This allows any device to have a concept of time and execute a defined scene at a given time. Scenes are the stored states of a device that can be recalled using messages or at a given time.

### 5.1 Time and Scenes states

Time and Scenes states are used for memorizing device states and retrieving them on demand or based on preset time-based schedules.

#### 5.1.1 Time

Mesh defines times based on International Atomic Time (TAI). The base representation of times is the number of seconds after 00:00:00 TAI on 2000-01-01 (that is, 1999-12-31T23:59:28 UTC). A fairly simple formula is used to convert this representation to a human-readable form with dates, hours, minutes, and seconds.

**Note:** For background information on TAI and UTC, see Appendix [A.1](#). For a detailed analysis of the differences between TAI and UTC, including the important concept of leap seconds, see NIST Time Frequently Asked Questions (FAQ) [\[16\]](#), from the Physical Measurement Laboratory of the National Institute of Standards and Technology of the U.S. Department of Commerce.

To allow Mesh devices to refer to UTC or local times, devices need to be aware of the past, present, and predicted changes to the TAI-UTC Delta (the number of seconds between TAI and UTC) and to the local time zone offset (e.g., in Seattle, USA, the local time is exactly 7 hours behind UTC for part of the year and 8 hours behind UTC for the rest of the year). Because these two values can change at any time for physical or political reasons, they are not hard-coded into this specification. Instead, they are communicated to all nodes in the mesh provided that at least one device has the information.

The Time state represents the present TAI time, the current TAI-UTC Delta and local time zone offset, and the next change to each of the latter (e.g., because of a switch from winter to summer time or an announced leap second). It consists of 10 fields with a total size of 183 bits. The values for the state are defined in the following table.

Name	Size (bits)	Valid Range	Remarks
TAI Seconds	40	0–max	Current TAI time in seconds since the epoch.
Subsecond	8	0–255	The sub-second time in units of 1/256s.
Uncertainty	8	0–255	Estimated uncertainty in 10-millisecond steps.
Time Authority	1	0–1	0 = No Time Authority. The element does not have a trusted OOB source of time, such as GPS or NTP. 1 = Time Authority. The element has a trusted OOB source of time, such as GPS or NTP or a battery-backed, properly initialized RTC.
Time Zone Offset Current	8	-64 – +191	Current local time zone offset.
Time Zone Offset New	8	-64 – +191	Upcoming local time zone offset.
TAI of Zone Change	40	0–max	Absolute TAI time when the Time Zone Offset will change from Current to New.

Name	Size (bits)	Valid Range	Remarks
TAI-UTC Delta Current	15	-255 – +32512	Current difference between TAI and UTC in seconds.
TAI-UTC Delta New	15	-235 – +32512	Upcoming difference between TAI and UTC in seconds.
TAI of Delta Change	40	0–max	Absolute TAI time when the TAI-UTC Delta will change from Current to New.

Table 5.1: Time state fields

**Note:** The following algorithm may be used to convert TAI to UTC:

All numbers are non-negative. "int(x)" means round x down to the nearest integer less than or equal to x. % is modulo; that is,  $x\%y$  is  $x - \text{int}(x/y) * y$ . Logical operators, including  $?:$ , and operator precedence are as in C.

```

Let T be a TAI time in seconds past the epoch.
Let E be TAI-UTC Delta Current if  $T < \text{TAI of Delta Change}$ , and TAI-UTC Delta New if  $T \geq \text{TAI of Delta Change}$ .
Let F be 1 if  $T+1 = \text{TAI of Delta Change}$  AND  $\text{TAI-UTC Delta Current} < \text{TAI-UTC Delta New}$ , and 0 otherwise.
Let L =  $T - E - F$ .
Let D =  $\text{int}(L / 86400)$ .
Let H =  $\text{int}((L - D * 86400) / 3600)$ .
Let M =  $\text{int}((L - D * 86400 - H * 3600) / 60)$ .
Let S =  $L - D * 86400 - H * 3600 - M * 60 + F$ .

```

Then the time of day is H:M:S and D is the number of days since 2000-01-01. Note that F will only equal 1 at a positive leap second; if  $F = 1$  and S is not 60, the value of TAI of Delta Change is wrong.

Converting D to a date is then done as follows.

```

Let B =  $D + 730119$ .
Let Q =  $B \% 146097$ .
Let C =  $\text{int}(Q / 36524)$ .
Let H =  $Q \% 36524$ .
Let X =  $\text{int}((H \% 1461) / 365)$ .
Then YEAR =  $\text{int}(B / 146097) * 400 + C * 100 + \text{int}(H / 1461) * 4 + X + (!((C == 4) || (X == 4)) ? 1 : 0)$ .
Let Z =  $\text{YEAR} - 1$ .
Let V =  $B - 365 * Z - \text{int}(Z / 4) + \text{int}(Z / 100) - \text{int}(Z / 400)$ .
Let A be 1 if  $\text{YEAR} \% 4$  is zero and either  $\text{YEAR} \% 100$  is non-zero or  $\text{YEAR} \% 400$  is zero (that is, it is a leap year), and 2 otherwise.
Let J be 0 if  $V + A < 61$ , and be equal to A otherwise.
Then MONTH =  $\text{int}(((V + J) * 12 + 373) / 367)$ .
Let K be 0 if  $\text{MONTH} \leq 2$  (i.e. January or February), and be equal to A otherwise.
Let DAY =  $V + K + 1 - \text{int}((367 * \text{MONTH} - 362) / 12)$ .

```

### 5.1.1.1 TAI Seconds

The TAI Seconds state is the current TAI time in seconds after the epoch 2000-01-01T00:00:00 TAI (1999-12-31T23:59:28 UTC).

For example, the value 0x20E5369D represents the 2017-06-27T15:30:37 TAI (15:30:00 UTC).

When an element does not know the time, a special value of 0x0000000000 is used.

### 5.1.1.2 Subsecond

The Subsecond is a fractional part of the TAI time, in units of  $1/256^{\text{th}}$  seconds. An implementation may increment this field by more than one unit (i.e. the mechanism it uses may have a larger granularity) and/or by different amounts at each increment.

### 5.1.1.3 Uncertainty

The Uncertainty field represents the accumulated uncertainty of the Mesh Timestamp in 10-millisecond steps. It includes the Uncertainty of the time source and the accumulated uncertainty resulting from the local clock drift since the last update. Value 255 represents uncertainty of 2.55 seconds or more.

#### 5.1.1.3.1 Accumulating Uncertainty behavior

The value of the Uncertainty state shall be periodically updated to represent the accumulated uncertainty of time resulting from a drift of a local time source.

### 5.1.1.4 Time Authority

The Time Authority bit represents whether the element has a reliable source of TAI, such as a GPS receiver or an NTP-synchronized clock. Time Authority = 1 is when the device itself has access to a reliable and trusted time source, such as NTP or GPS, or has been given the TAI time by a Provisioner (using the Time Setup Server model and a DevKey – see Section 5.3.2).

Note: Many time sources do not provide TAI directly, but it can be derived from UTC (if the current TAI-UTC Delta is known) or from GPS time (which is always 19 seconds behind TAI).

### 5.1.1.5 Time Zone Offset Current

The Time Zone Offset Current field represents the current zone offset in 15-minute increments. The value is the number of 15-minute increments from UTC. Positive numbers are eastwards. The state is a uint8 value representing the valid range of -64 through +191 (i.e., 0x40 represents a value of 0 and 0xFF represents a value of 191).

Note: The offset representation with a range -64 through +191 (-16 through +47.75 hours) is in anticipation of proposals dealing with the leap seconds issue by replacing the leap seconds with local zone changes, which means that by the year 5000 the UK will be in zone +8 in the winter while New Zealand will be +21 in the summer with some places +22 or more.

### 5.1.1.6 Time Zone Offset New

The Time Zone Offset New state reflects the information on the upcoming Time Zone change. This usually informs about an upcoming Daylight Saving Time change or other change planned by local or regional regulatory bodies. By being aware of the upcoming change, devices can automatically execute the change even without the presence of a change coordinator.

The Time Zone Offset New field represents the new zone offset in 15-minute increments. The value is the number of 15-minute increments from UTC. Positive numbers are eastwards.

### 5.1.1.7 TAI of Zone Change

The TAI of Zone Change field represents the time (using the TAI Seconds format) when the Time Zone Offset New shall be applied.

The valid range is 0 to 0xFFFFFFFF. When an element does not know the TAI of Zone Change, a special value of 0x00000000 is used.



#### 5.1.1.7.1 Zone Change behavior

If the value of the TAI Seconds state is equal to the value of the TAI of Zone Change state the Time Zone Offset Current state (see Section 5.1.1.5) shall be set to the value of the Time Zone Offset New state (see Section 5.1.1.6).

If the element does not know of any scheduled change but knows that there will be no change before a certain time, the element should set this field to that time and set Time Zone Offset New to the same value as Time Zone Offset Current.

If the element does not know of any scheduled change and does not know if there will be any change, the element should set this field to 0x0000000000 and set Time Zone Offset New to the same value as Time Zone Offset Current.

#### 5.1.1.8 TAI-UTC Delta Current

The TAI-UTC Delta Current state represents the value: current\_TAI minus current\_UTC. For example, on 2017-01-19, this value equals +37. The valid range is -255 through +32512 (i.e., 0x00FF represents a value of 0 and 0x7FFF represents a value of 32512).

#### 5.1.1.9 TAI-UTC Delta New

The TAI-UTC Delta New state represents the upcoming difference in seconds between TAI and UTC, as published in the IERS Bulletins [14]. By being aware of the upcoming leap second change, devices can automatically accommodate the leap second even without the presence of a change coordinator. The valid range is -255 through +32512 (i.e., 0x00FF represents a value of 0 and 0x7FFF represents a value of 32512).

#### 5.1.1.10 TAI of Delta Change

The TAI of Delta Change field represents the time (using the TAI Seconds format) when the TAI-UTC Delta New shall be applied. The valid range is 0 through 0xFFFFFFFF. When an element does not know the TAI of Delta Change, a special value of 0x0000000000 is used.

##### 5.1.1.10.1 TAI of Delta Change behavior

If the value of the TAI Seconds state is equal to the value of the TAI of Delta Change state, the TAI-UTC Delta Current state (see Section 5.1.1.8) shall be set to the value of the TAI to UTC Delta New state (see Section 5.1.1.9).

If the element does not know of any scheduled change, but it knows that there will be no change before a certain time, the device should set this field to that time and set TAI-UTC Delta New to the same value as TAI-UTC Delta Current.

If the element does not know of any scheduled change and does not know if there will be any change, the element should set this field to 0x0000000000 and set TAI-UTC Delta New to the same value as TAI-UTC Delta Current.

### 5.1.2 Time Role

Time Role is an enumeration state that defines the role of a node in propagation of time information in a mesh network. The values for the state are defined in the following table.

Value	Role	Description
0x00	None	The element does not participate in propagation of time information.
0x01	Mesh Time Authority	The element publishes Time Status messages but does not process received Time Status messages.
0x02	Mesh Time Relay	The element processes received and publishes Time Status messages.

Value	Role	Description
0x03	Mesh Time Client	The element does not publish but processes received Time Status messages.
0x04–0xFF	Prohibited	Prohibited.

Table 5.2: Time Role states

### 5.1.3 Scenes

Scenes serve as memory banks for storage of states (e.g., a power level or a light level/color). Values of states of an element can be stored as a scene and can be recalled later from the scene memory. A scene is represented by a Scene Number, which is a 16-bit non-zero, mesh-wide value. (There can be a maximum of 65535 scenes in a mesh network.) The meaning of a scene, as well as the state storage container associated with it, are determined by a model.

The Scenes state is a composite state that includes the Scene Register state, the Current Scene state, and the Target Scene state.

The Scenes state change may start numerous parallel model transitions. In that case, each individual model handles the transition internally. The scene transition is defined as a group of individual model transitions started by a Scene Recall operation. The scene transition is in progress when at least one transition from the group of individual model transitions is in progress.

#### 5.1.3.1 Scene Register

The Scene Register state is a 16-element array of 16-bit values representing a Scene Number. Each array element is associated with a storage container that stores state information associated with a scene. The format of a storage container is determined by a model and matches the states defined for the element. The values for the Scene Number are defined in the following table.

Value	Description
0x0000	Prohibited
0x0001–0xFFFF	Scene Number value

Table 5.3: Scene Number values

##### 5.1.3.1.1 Scene Store operation

Scene Store is an operation of storing values of a present state of an element. The structure and meaning of the stored state is determined by a model. States to be stored are specified by each model. The Scene Store operation shall persistently store all values of all states marked as Stored with Scene for all models present on all elements of a node. If a model is extending another model, the extending model shall determine the Stored with Scene behavior of that model.

A scene is referenced in memory by a Scene Number, which is stored in Scene Register state. Values in the Scene Register state are compared with the Scene Number that is to be stored. If a matching Scene Number is found, the container for the first scene with a matching Scene Number is updated, and the operation completes with success. If no matching Scene Number is found, the first Scene Register entry with an unset value is used and is assigned to the Scene Number of the stored scene, and the operation completes with success. If there is no available entry in the Scene Register to store the scene, the scene is not stored, and the operation completes with failure.

When the scene transition is in progress, the target state of the transition for each model is stored.

##### 5.1.3.1.2 Scene Recall operation

Scene Recall is an operation of recalling stored values of states and applying them to the state of an element. The structure and meaning of the stored state is determined by a model. States to be recalled are specified by each model. The Scene Recall operation shall recall all values for all states specified as “Stored with Scene” for all models present on an element.

A scene is recalled from memory by referencing the Scene Number. Values in the Scene Register state are compared with the Scene Number value that is to be recalled. If a matching Scene Number is found, the first matching scene is recalled by starting the transition of all models present on an element to the recalled states, and the operation completes with success. If there is no matching Scene Number in the Scene Register state, the operation completes with failure.

#### 5.1.3.1.3 Scene Delete operation

A scene is deleted from memory by referencing the Scene Number. Values in the Scene Register state are compared with the Scene Number of the scene that is to be deleted, and the first matching scene is deleted from the Scene Register state.

When a scene is deleted when a scene transition to the deleted Scene Number is in progress, the scene transition shall be terminated, but individual model transitions shall not be terminated.

#### 5.1.3.2 Current Scene

The Current Scene state is a 16-bit value that contains either the Scene Number of the currently active scene or a value of 0x0000 when no scene is active.

##### 5.1.3.2.1 Current Scene behavior

When a Scene Store operation or a Scene Recall operation completes with success, the Current Scene state value shall be to the Scene Number used during that operation.

When the Current Scene Number is deleted from a Scene Register state as a result of Scene Delete operation, the Current Scene state shall be set to 0x0000.

When any of the element's state that is marked as "Stored with Scene" has changed not as a result of a Scene Recall operation, the value of the Current Scene state shall be set to 0x0000.

When a scene transition is in progress, the value of the Current Scene state shall be set to 0x0000.

#### 5.1.3.3 Target Scene

The Target Scene state is a 16-bit value that contains the target Scene Number when a scene transition is in progress. When the scene transition is in progress and the target Scene Number is deleted from a Scene Register state as a result of Scene Delete operation, the Target Scene state shall be set to 0x0000. When the scene transition is in progress and a new Scene Number is stored in the Scene Register as a result of Scene Store operation, the Target Scene state shall be set to the new Scene Number.

When the scene transition is not in progress, the value of the Target Scene state shall be set to 0x0000.

### 5.1.4 Scheduler

#### 5.1.4.1 Scheduler overview

Scheduler provides a means of autonomous change of states of a device based on the notion of UTC time and the ISO 8601 calendar [15] and a register of defined time points with associated state-changing actions. For example, a lamp may automatically turn off every day at 2AM, or a coffee machine may make coffee at 6:30AM.

The scheduler is based on a register (see Section 5.1.4.2) that is capable of storing up to sixteen scheduled entries, each containing a starting point in local time, that may include values that represent multiple values, and an associated action to perform.

### 5.1.4.2 Schedule Register

The Schedule Register state is a 16-entry, zero-based, indexed array of 76-bit values formatted as Scheduled Time. Each entry represents a state-changing event. Time and date fields represent local time. The values for the state are defined in the following table.

Name	Size (bits)	Notes
Year	7	Scheduled year for the action (see <a href="#">Table 5.5</a> )
Month	12	Scheduled month for the action (see <a href="#">Table 5.6</a> )
Day	5	Scheduled day of the month for the action (see <a href="#">Table 5.7</a> )
Hour	5	Scheduled hour for the action (see <a href="#">Table 5.8</a> )
Minute	6	Scheduled minute for the action (see <a href="#">Table 5.9</a> )
Second	6	Scheduled second for the action (see <a href="#">Table 5.10</a> )
DayOfWeek	7	Schedule days of the week for the action (see <a href="#">Table 5.11</a> )
Action	4	Action to be performed at the scheduled time (see <a href="#">Table 5.12</a> )
Transition Time	8	Transition time for this action (see <a href="#">Section 3.1.3</a> )
Scene Number	16	Scene number to be used for some actions (see <a href="#">Table 5.13</a> )

Table 5.4: Schedule Register fields

The Year, Month, Day, Hour, Minute, and Second fields represent local time (i.e., after the TAI-UTC Delta and Time Zone Offset have been applied). The fields have the meaning defined in ISO 8601 [15] (which replicates the "Gregorian" calendar in common use). Some of these values can either represent an exact value or a range of values when the scheduled action is performed.

The minute and second field values have an enumerated value that represents 'at a random' value. This scheduled action shall be triggered once within the corresponding hour or minute.

The Year field represents 2 least significant digits of the year of the occurrence of the scheduled event.

Value	Description
0x00–0x63	2 least significant digits of the year
0x64	Any year
All other values	Prohibited

Table 5.5: Year field values

The Month field represents the months of the occurrences of the scheduled event.

Bit	Description
0	Scheduled in January
1	Scheduled in February
2	Scheduled in March
3	Scheduled in April
4	Scheduled in May
5	Scheduled in June
6	Scheduled in July
7	Scheduled in August
8	Scheduled in September
9	Scheduled in October

Bit	Description
10	Scheduled in November
11	Scheduled in December

Table 5.6: Month field values

The Day field represents the day the month of the occurrence of the scheduled event. If the day of the month has a number that is larger than the number of days in the month, then the event occurs in the last day of the month. For example, in February if the day field holds the value 29, the action is triggered on February 28<sup>th</sup> in a non-leap year or February 29<sup>th</sup> in a leap year.

Value	Description
0x00	Any day
0x01–0x1F	Day of the month

Table 5.7: Day field values

The Hour field represents the hour of the occurrence of the scheduled event.

Value	Description
0x00–0x17	Hour of the day (00 to 23 hours)
0x18	Any hour of the day
0x19	Once a day (at a random hour)
All other values	Prohibited

Table 5.8: Hour field values

The Minute field represents the minute of the occurrence of the scheduled event.

Value	Description
0x00–0x3B	Minute of the hour (00 to 59)
0x3C	Any minute of the hour
0x3D	Every 15 minutes (minute modulo 15 is 0) (0, 15, 30, 45)
0x3E	Every 20 minutes (minute modulo 20 is 0) (0, 20, 40)
0x3F	Once an hour (at a random minute)

Table 5.9: Minute field values

The Second field represents the second of the occurrence of the scheduled event.

Value	Description
0x00–0x3B	Second of the minute (00 to 59)
0x3C	Any second of the minute
0x3D	Every 15 seconds (minute modulo 15 is 0) (0, 15, 30, 45)
0x3E	Every 20 seconds (minute modulo 20 is 0) (0, 20, 40)
0x3F	Once an minute (at a random second)

Table 5.10: Second field values

The DayOfWeek field represents the days of the week that the scheduled event will trigger. When a bit is set to 1, the scheduled event is executed on that day.

Bit	Description
0	Scheduled on Mondays
1	Scheduled on Tuesdays
2	Scheduled on Wednesdays
3	Scheduled on Thursdays
4	Scheduled on Fridays
5	Scheduled on Saturdays
6	Scheduled on Sundays

Table 5.11: DayOfWeek field values

The Action field represents an action to be executed for a scheduled event as defined in the table below.

Value	Description
0x0	Turn Off
0x1	Turn On
0x2	Scene Recall
0xF	No action
All other values	Reserved for Future Use

Table 5.12: Action field values

When the Action field value is 0x0, this means an action that is an equivalent of receiving, sequentially by each element of the node, starting with the primary element, a Generic OnOff Set Unacknowledged message (see Section 3.2.1.3) with the OnOff field set to 0x00 and the Transition Time field set to the value of the Transition Time field of the Schedule Register.

When the Action field value is 0x1, this means an action that is an equivalent of receiving, sequentially by each element of the node, starting with the primary element, a Generic OnOff Set Unacknowledged message (see Section 3.2.1.3) with the OnOff field set to 0x01 and the Transition Time field set to the value of the Transition Time field of the Schedule Register.

When the Action field value is 0x2, this means an action that is an equivalent of receiving by the element a Scene Recall Unacknowledged message (see Section 5.2.2.4) with the Scene Number field set to the value of the Scene Number field of the Schedule Register and the Transition Time field set to the value of the Transition Time field of the Schedule Register.

When the Action field value is 0xF, this means no action is performed.

The Transition Time field represents a Transition Time to be used when an action triggered by the scheduler is executed. The format is defined in Section 3.1.3.

The Scene Number field represents a Scene to be recalled.

Value	Description
0x0000	No scene
All other values	Scene number

Table 5.13: Scene Number field values

The following table illustrates several examples of Schedule Register values.

Year	Month	Day	Hour	Minute	Second	DayOfWeek	Action	Notes
100	11	5	20	0	0	0x7F	1	Turn On at 8PM on November 5 <sup>th</sup> every year.
100	0	0	9	0	0	0x1F	0	Turn Off lights at 9AM every Monday, Tuesday, Wednesday, Thursday, Friday.
100	7	11	7	30	0	0x7F	2	Recall a scene for anniversary celebration of adoption of the Mesh Profile specification, every year on July 11 <sup>th</sup> , at 7:30AM. This text and this values may need to change based on the final adoption date of this specification.
100	0	5	1	0	0	0x7F	1	Start bacteria removal procedure in a hot tub by turning on a special 65C mode every 5 <sup>th</sup> day of a month at 1AM.
100	0	5	4	0	0	0	0	Stop bacteria removal procedure in a hot tub by turning off a special 65C mode every 5 <sup>th</sup> day of a month at 4AM.
100	0	0	18	0x3F	0x3F	0x7F	2	Turn on lights and television randomly every day between 6PM and 7PM whilst on vacation.
100	0	0	22	0x3F	0x3F	0x7F	2	Turn off lights and television randomly every day between 10PM and 11PM whilst on vacation.
19	6	27	16	30	0x3F	0x7F	0	Start the 2-year party celebrating the Mesh specification release at just after 4:30PM.

Table 5.14: Examples for a Schedule Register

#### 5.1.4.2.1 Schedule Register behavior

When the current time is known to the device, which is indicated by a value of the TAI Seconds state (see Section 5.1.1.1) that is greater than zero, the entries in the Schedule Register are tracked. If there is a match between the Time state (see Section 5.1.1) and an entry in the Schedule Register, a corresponding Action indicated by the values in the Action and Scene fields shall be executed.

Note: A recommended implementation of the Scheduler should calculate the value of the TAI Seconds (see Section 5.1.1.1) of the next scheduled event and put it in a queue of scheduled events sorted by time. Every second, the first event in the queue is compared with the value of the Time state (see Section 5.1.1). The first event is executed if it is less than or equal to the Time state and then removed from the queue. After execution, the Repeat Flag shall be checked, and the next occurrence of the scheduled event is calculated and put in the queue.

## 5.2 Time and Scenes messages

Scene Messages operate on Time and Scenes states (see Section 5.1).

### 5.2.1 Time messages

#### 5.2.1.1 Time Get

Time Get is a message used to get the Time state (see Section 5.1.1) of neighbor nodes.

The response to the Time Get message is a Time Status message.

There are no parameters for this message.

### 5.2.1.2 Time Set

Time Set is an acknowledged message used to set the Time state of an element (see Section 5.1.1).

The response to the Time Set message is a Time Status message.

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
TAI Seconds	40	The current TAI time in seconds
Subsecond	8	The sub-second time in units of 1/256 <sup>th</sup> second
Uncertainty	8	The estimated uncertainty in 10 millisecond steps
Time Authority	1	0 = No Time Authority, 1 = Time Authority
TAI-UTC Delta	15	Current difference between TAI and UTC in seconds
Time Zone Offset	8	The local time zone offset in 15-minute increments

Table 5.15: Time Set message parameters

The TAI Seconds field identifies the TAI Seconds state (see Section 5.1.1.1).

The Subsecond field identifies the Subsecond state (see Section 5.1.1.2).

The Uncertainty field identifies the Time Uncertainty state (see Section 5.1.1.3).

The Time Authority field identifies the Time Authority state (see Section 5.1.1.4).

The TAI-UTC Delta field identifies the TAI-UTC Delta Current state (see Section 5.1.1.8).

The Time Zone Offset field shall be set to the Time Zone Offset Current state (see Section 5.1.1.5).

### 5.2.1.3 Time Status

Time Status is an unacknowledged message used to report the Time state of an element (see Section 5.1.1).

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
TAI Seconds	40	The current TAI time in seconds
Subsecond	8	The sub-second time in units of 1/256 <sup>th</sup> second (C.1)
Uncertainty	8	The estimated uncertainty in 10-millisecond steps (C.1)
Time Authority	1	0 = No Time Authority, 1 = Time Authority (C.1)
TAI-UTC Delta	15	Current difference between TAI and UTC in seconds (C.1)
Time Zone Offset	8	The local time zone offset in 15-minute increments (C.1)

C.1: If the TAI Seconds field is 0x0000000000 the Subsecond, Uncertainty, Time Authority, TAI-UTC Delta and Time Zone Offset fields shall be omitted; otherwise these fields shall be present.

Table 5.16: Time Status message parameters

The TAI Seconds field identifies the TAI Seconds state (see Section 5.1.1.1).

The Subsecond field identifies the Subsecond state (see Section 5.1.1.2).

The Uncertainty field identifies the Time Uncertainty state (see Section 5.1.1.3).



The Time Authority field identifies the Time Authority state (see Section 5.1.1.4).

The TAI-UTC Delta field identifies the TAI-UTC Delta Current state (see Section 5.1.1.8).

The Time Zone Offset field shall be set to the Time Zone Offset Current state (see Section 5.1.1.5).

#### 5.2.1.4 Time Zone Get

Time Zone Get is an acknowledged message used to get the Time Zone Offset Current state (see Section 5.1.1.5), the Time Zone Offset New state (see Section 5.1.1.6), and the TAI of Zone Change state (see Section 5.1.1.7).

The response to the Time Zone Get message is a Time Zone Status message.

There are no parameters for this message.

#### 5.2.1.5 Time Zone Set

Time Zone Set is an acknowledged message used to set the Time Zone Offset New state (see Section 5.1.1.6) and the TAI of Zone Change state (see Section 5.1.1.7).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Time Zone Offset New	1	Upcoming local time zone offset
TAI of Zone Change	5	TAI Seconds time of the upcoming Time Zone Offset change

Table 5.17: Time Zone Set message parameters

The Time Zone Offset New field identifies the Time Zone Offset New state (see Section 5.1.1.6).

The TAI of Zone Change field identifies the TAI of Zone Change state (see Section 5.1.1.7).

#### 5.2.1.6 Time Zone Status

Time Zone Status is an unacknowledged message used to report the Time Zone Offset Current state (see Section 5.1.1.5), the Time Zone Offset New state (see Section 5.1.1.6), and the TAI of Zone Change state (see Section 5.1.1.7).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Time Zone Offset Current	1	Current local time zone offset
Time Zone Offset New	1	Upcoming local time zone offset
TAI of Zone Change	5	TAI Seconds time of the upcoming Time Zone Offset change

Table 5.18: Time Zone Status message parameters

The Time Zone Offset Current field identifies the Time Zone Offset Current state (see Section 5.1.1.5).

The Time Zone Offset New field identifies the Time Zone Offset New state (see Section 5.1.1.6).

The TAI of Zone Change field identifies the TAI of Zone Change state (see Section 5.1.1.7).

### 5.2.1.7 TAI-UTC Delta Get

TAI-UTC Delta Get is an acknowledged message used to get the TAI-UTC Delta Current state (see Section 5.1.1.8), the TAI-UTC Delta New state (see Section 5.1.1.9), and the TAI of Delta Change state (see Section 5.1.1.10).

The response to the TAI-UTC Delta Get message is a TAI-UTC Delta Status message.

There are no parameters for this message.

### 5.2.1.8 TAI-UTC Delta Set

TAI-UTC Delta Set is an acknowledged message used to set the TAI-UTC Delta New state (see Section 5.1.1.9) and the TAI of Delta Change state (see Section 5.1.1.10).

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
TAI-UTC Delta New	15	Upcoming difference between TAI and UTC in seconds
Padding	1	Always 0b0. Other values are Prohibited.
TAI of Delta Change	40	TAI Seconds time of the upcoming TAI-UTC Delta change

Table 5.19: TAI-UTC Delta Set message parameters

The TAI-UTC Delta New field identifies the TAI-UTC Delta New state (see Section 5.1.1.9).

The TAI of Delta Change field identifies the TAI of Delta Change state (see Section 5.1.1.10).

### 5.2.1.9 TAI-UTC Delta Status

TAI-UTC Delta Status is an unacknowledged message used to report the TAI-UTC Delta Current state (see Section 5.1.1.8), the TAI-UTC Delta New state (see Section 5.1.1.9), and the TAI of Delta Change state (see Section 5.1.1.10).

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
TAI-UTC Delta Current	15	Current difference between TAI and UTC in seconds
Padding 1	1	Always 0b0. Other values are Prohibited.
TAI-UTC Delta New	15	Upcoming difference between TAI and UTC in seconds
Padding 2	1	Always 0b0. Other values are Prohibited.
TAI of Delta Change	40	TAI Seconds time of the upcoming TAI-UTC Delta change

Table 5.20: TAI-UTC Delta Status message parameters

The TAI-UTC Delta Current field identifies the TAI-UTC Delta Current state (see Section 5.1.1.8).

The TAI-UTC Delta New field identifies the TAI-UTC Delta New state (see Section 5.1.1.9).

The TAI Of Delta Change field identifies the TAI of Delta Change state (see Section 5.1.1.10).

### 5.2.1.10 Time Role Get

Time Role Get is an acknowledged message used to get the Time Role state of an element (see Section 5.1.2).

The response to the Time Role Get message is a Time Role Status message.

There are no parameters for this message.

### 5.2.1.11 Time Role Set

Time Role Set is an acknowledged message used to set the Time Role state of an element (see Section 5.1.2).

The response to the Time Role Set message is a Time Role Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Time Role	1	The Time Role for the element

Table 5.21: Time Role Set message parameters

The Time Role field identifies the Time Role state (see Section 5.1.2).

### 5.2.1.12 Time Role Status

Time Role Status is an unacknowledged message used to report the Time state of an element (see Section 5.1.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Time Role	1	The Time Role for the element

Table 5.22: Time Role Status message parameters

The Time Role field identifies the Time Role state (see Section 5.1.2).

## 5.2.2 Scene messages

### 5.2.2.1 Scene Store

Scene Store is an acknowledged message used to store the current state of an element as a Scene, which can be recalled later.

The response to the Scene Store message is a Scene Register Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Scene Number	2	The number of the scene to be stored.

Table 5.23: Scene Store message parameters

The Scene Number field identifies the intended scene. The value 0x0000 is Prohibited.

### 5.2.2.2 Scene Store Unacknowledged

Scene Store Unacknowledged is an unacknowledged message used to store the current state of an element as a Scene, which can be recalled later.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Scene Number	2	The number of the scene to be stored.

Table 5.24: Scene Store Unacknowledged message parameters

The Scene Number field identifies the intended scene. The value 0x0000 is Prohibited.

### 5.2.2.3 Scene Recall

Scene Recall is an acknowledged message that is used to recall the current state of an element from a previously stored scene.

The response to the Scene Recall message is a Scene Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Scene Number	2	The number of the scene to be recalled.
TID	1	Transaction Identifier.
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise this field shall not be present.

Table 5.25: Scene Recall message parameters

The Scene Number field identifies the intended Scene. The value 0x0000 is Prohibited.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 5.4.2.2.5.

If present, the Transition Time field identifies the time that an element will take to transition from the present states to the target states defined by the recalled Scene. The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 through 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, which represents a time interval between receiving the message by a model and executing the associated model behaviors.

### 5.2.2.4 Scene Recall Unacknowledged

Scene Recall Unacknowledged is an unacknowledged message used to recall the current state of an element from a previously stored Scene.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Scene Number	2	The number of the scene to be recalled.
TID	1	Transaction Identifier.
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise this field shall not be present.

Table 5.26: Scene Recall Unacknowledged message parameters

The Scene Number field identifies the intended Scene. The value 0x0000 is Prohibited.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 5.4.2.2.5.

If present, the Transition Time field identifies the time an element will take to transition from the present states to the target states defined by the recalled Scene. The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

#### 5.2.2.5 Scene Get

Scene Get is an acknowledged message used to get the current status of a currently active scene (see Section 5.1.3.2) of an element.

The response to the Scene Get message is a Scene Status message.

There are no parameters for this message.

#### 5.2.2.6 Scene Status

Scene Status is an unacknowledged message used to report the current status of a currently active scene (see Section 5.1.3.2) of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Defined in 5.2.2.11
Current Scene	2	Scene Number of a current scene.
Target Scene	2	Scene Number of a target scene. (Optional)
Remaining Time	1	Format as defined in Section 3.1.3. (C.1)

C.1: If the Target Scene field is present, the Remaining Time field shall also be present; otherwise the fields shall not be present.

Table 5.27: Scene Status message parameters

The Status Code field identifies the status code for the last operation. The allowed values for status codes and their meanings are documented in Section 5.2.2.11.

The Current Scene field identifies the Scene Number of the current Scene. If no scene is active, the Current Scene field value is 0.

When an element is in the process of changing the Scene state, the Target Scene field identifies the target Scene Number of the target Scene state the element is to reach.

When an element is not in the process of changing the Scene state, the Target Scene field shall be omitted.

If present, the Remaining Time field indicates the time it will take the element to complete the transition to the target Scene state of the element.

#### 5.2.2.7 Scene Register Get

Scene Register Get is an acknowledged message used to get the current status of the Scene Register (see Section 5.1.3.1) of an element.

The response to the Scene Register Get message is a Scene Register Status message.

There are no parameters for this message.

#### 5.2.2.8 Scene Register Status

Scene Register Status is an unacknowledged message that is used to report the current status of the Scene Register (see Section 5.1.3.1) of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Defined in Section 5.2.2.11.
Current Scene	2	Scene Number of a current scene
Scenes	variable	A list of scenes stored within an element

Table 5.28: Scene Register Status message parameters

The message uses a single-octet Opcode to maximize the payload size.

The Status Code field identifies the status code for the previous operation. The allowed values for status codes and their meanings are documented in Section 5.2.2.11.

The Current Scene field identifies the Scene Number of the current scene.

The Scenes field identifies the Scene Register state (see Section 5.1.3.1) of an element.

### 5.2.2.9 Scene Delete

Scene Delete is an acknowledged message used to delete a Scene from the Scene Register state (see Section 5.1.3.1) of an element.

The response to the Scene Delete message is a Scene Register Status message.

The Scene Delete message parameter is described in the following table.

Field	Size (octets)	Notes
Scene Number	2	The number of the scene to be deleted.

Table 5.29: Scene Delete message parameter

The Scene Number field identifies the Scene to be deleted.

### 5.2.2.10 Scene Delete Unacknowledged

Scene Delete Unacknowledged is an unacknowledged message used to delete a scene from the Scene Register state (see Section 5.1.3.1) of an element.

Field	Size (octets)	Notes
Scene Number	2	The number of the scene to be deleted.

Table 5.30: Scene Delete Unacknowledged message parameters

### 5.2.2.11 Summary of status codes

The following status code values are defined.

Value	Description
0x00	Success
0x01	Scene Register Full
0x02	Scene Not Found
0x03–0xFF	Reserved for Future Use

Table 5.31: Status code values

## 5.2.3 Scheduler messages

### 5.2.3.1 Scheduler Get

Scheduler Get is an acknowledged message used to get the current Schedule Register state of an element (see Section 5.1.4.2).

The response to the Scheduler Get message is a Scheduler Status message.

There are no parameters for this message.

### 5.2.3.2 Scheduler Status

Scheduler Status is an unacknowledged message used to report the current Schedule Register state of an element (see Section 5.1.4.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Schedules	2	Bit field indicating defined Actions in the Schedule Register

Table 5.32: Scheduler Status message parameters

The message shall be sent as a response to the Scheduler Get message (see Section 5.2.3.1).

Each bit of the Schedules field set to 1 identifies a corresponding entry of the Schedule Register.

### 5.2.3.3 Scheduler Action Get

Scheduler Action Get is an acknowledged message used to report the action defined by the entry of the Schedule Register state of an element (see Section 5.1.4.2), identified by the Index field.

The response to the Scheduler Action Get message is a Scheduler Action Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Index	1	Index of the Schedule Register entry to get

Table 5.33: Scheduler Action Get message parameters

The Index field identifies a single corresponding entry of the Schedule Register. The valid values for the Index field are 0x00–0x0F. Values 0x10–0xFF are Prohibited.

### 5.2.3.4 Scheduler Action Set

Scheduler Action Set is an acknowledged message used to set the entry of the Schedule Register state of an element (see Section 5.1.4.2), identified by the Index field.

The response to the Scheduler Action Set message is a Scheduler Action Status message.

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
Index	4	Index of the Schedule Register entry to set
Schedule Register	76	Bit field defining an entry in the Schedule Register (see Section 5.1.4.2)

Table 5.34: Scheduler Action Set message parameters

The Index field identifies a single corresponding entry of the Schedule Register. The valid values for the Index field are 0x0-0xF.

The Schedule Register bit field identifies the value of the entry of the Schedule Register that is indicated by the Index field.

### 5.2.3.5 Scheduler Action Set Unacknowledged

Scheduler Action Set Unacknowledged is an unacknowledged message used to set the entry of the Schedule Register state of an element (see Section 5.1.4.2), identified by the Index field.

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
Index	4	Index of the Schedule Register entry to set
Schedule Register	76	Bit field defining an entry in the Schedule Register (see Section 5.1.4.2)

Table 5.35: Scheduler Action Set Unacknowledged message parameters

The Index field identifies a single corresponding entry of the Schedule Register. The valid values for the Index field are 0x0-0xF.

The Schedule Register bit field identifies the value of the entry of the Schedule Register that is indicated by the Index field.

### 5.2.3.6 Scheduler Action Status

Scheduler Action Status is an unacknowledged message used to report the entry of the Schedule Register state of an element (see Section 5.1.4.2), identified by the Index field.

The structure of the message is defined in the following table.

Field	Size (bits)	Notes
Index	4	Enumerates (selects) a Schedule Register entry
Schedule Register	76	Bit field defining an entry in the Schedule Register (see Section 5.1.4.2)

Table 5.36: Scheduler Action Status message parameters

The Index field identifies a single corresponding entry of the Schedule Register. The valid values for the Index field are 0x0-0xF.

The Schedule Register bit field shall be set to the value of the entry of the Schedule Register that is indicated by the Index field.

## 5.3 Time and Scenes server models

### 5.3.1 Time Server

#### 5.3.1.1 Description

The Time Server model is a root model (i.e., it does not extend any other models). When this model is present on an Element, the corresponding Time Setup Server model (see Section 5.3.2) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.



The model defines the following state instances.

Time Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Time	Main	No	-	-	-

Table 5.37: Time Server states and bindings

Table 5.38 illustrates the complete structure of elements, states, and messages used by the model.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1200	Time (see Section 3.1.3)	Time Get	M	
			Time Status	M	M
			Time Zone Get	M	
			Time Zone Status		M
			TAI-UTC Delta Get	M	
			TAI-UTC Delta Status		M

Table 5.38: Time Server elements, states, and messages

### 5.3.1.2 Time state behavior

#### 5.3.1.2.1 Receiving a Time Get message

When a Time Server receives a Time Get message, it shall respond with a Time Status message (see Section 5.3.1.2.2).

#### 5.3.1.2.2 Sending a Time Status message

A Time Server shall send a Time Status message as a response to the Time Get message or Time Set message (see Section 5.2.1).

The message may be sent as an unsolicited message at any time if the value of the Time Role state (see Section 5.1.2) is 0x01 (Time Authority) or 0x02 (Time Relay) and the value of the TAI Seconds state is greater than 0x0000000000.

When sending a Time Status message the Time Server shall set the TAI Seconds field to the value of the TAI Seconds state, the Subsecond field to the value of the Subsecond state, the Time Zone Offset Current field to the value of the Time Zone Offset Current state, the Time Authority field to the value of the Time Authority state, the TAI-UTC Delta Current field to the value of the TAI-UTC Delta Current state and the Uncertainty field to a value that is a sum of the value of the Uncertainty state and an estimated time it will take the message to be processed before being sent on the radio interface.

If sent as an unsolicited message, the Time Status message shall be sent with TTL=0 to avoid building up cumulative time errors resulting from delays in processing the messages by relays.

It is recommended to transmit a Time Status message when the TAI Seconds, the Subsecond or the Time Zone Offset Current fields of the Time state of the Time Server (see Section 5.1.1) have been updated as a result of processing a Time Set message (see Section 5.2.1.2), a Time Status message (see Section 5.2.1.3) and the value of the Time Role state (see Section 5.1.2) is 0x01 (Time Authority) or 0x02 (Time Relay) or obtains a new Time state (see Section 5.1.1) from a trusted OOB source (such as a GPS or a mobile phone synchronized with a cellular network).

### 5.3.1.2.3 *Receiving a Time Status message*

A Time Server supports both receiving and sending a Time Status message to enable peer-to-peer time propagation in a mesh network. The propagation depends on Time Role state that is set up by a Provisioner.

Upon receiving a Time Status message a Time Server can determine the TAI Seconds, the Subsecond, the Uncertainty and the Time Zone Offset Current fields of a peer Time Server.

If the value of the Time Role state (see Section 5.1.2) of the element is 0x00 (None) or 0x01 (Time Authority), the message shall be ignored.

If the value of the Time Role state (see Section 5.1.2) of the element is 0x02 (Time Relay) or 0x03 (Time Client), the Time Server should synchronize the Time state (see Section 5.1.1) by setting the TAI Seconds state to the value of the TAI Seconds field and the Subsecond state to the value of the Subsecond field and the Uncertainty state to the value of the Uncertainty field and the Time Zone Offset Current state to the value of the Time Zone Offset field and the TAI-UTC Delta Current state to the value of the TAI-UTC Delta field of the message and shall publish a Time Status message using TTL=0 (see Section 5.3.1.2.2) if the value of the Time Role state is 0x02 (Time Relay) and the Publish Address for the Time Server model is not set to unassigned address [2].

### 5.3.1.2.4 *Receiving a Time Zone Get message*

When a Time Server receives a Time Zone Get message, it shall respond with a Time Zone Status message (see Section 5.3.1.2.5).

### 5.3.1.2.5 *Sending a Time Zone Status message*

When sending a Time Zone Status message, the Time Server shall set the Time Zone Offset Current field to the value of the Time Zone Offset Current state, the Time Zone Offset New field to the value of the Time Zone Offset New state, and the TAI of Zone Change field to the value of the TAI of Zone Change state.

A Time Server shall send the Time Zone Status message as a response to a Time Change Get message (see Section 5.2.1.4) or a Time Zone Set message (see Section 5.2.1.5) or as an unsolicited message.

### 5.3.1.2.6 *Receiving a TAI-UTC Delta Get message*

When a Time Server receives a TAI-UTC Delta Get message, it shall respond with a TAI-UTC Delta Status message (see Section 5.3.1.2.7).

### 5.3.1.2.7 *Sending a TAI-UTC Delta Status message*

When sending a TAI-UTC Delta Status message, the Time Server shall set the TAI-UTC Delta Current field to the value of the TAI-UTC Delta Current state, the TAI-UTC Delta New field to the value of the TAI-UTC Delta New state and the TAI of Delta Change field to the value of the TAI of Delta Change state.

A Time Server shall send the TAI-UTC Delta Status message as a response to a TAI-UTC Delta Get message (see Section 5.2.1.7) or a TAI-UTC Delta Set message (see Section 5.2.1.8) or as an unsolicited message.

## 5.3.2 Time Setup Server

### 5.3.2.1 Description

The Time Setup Server model extends the Time Server model (see Section 5.3.1).

Time is sensitive information that is propagated across a mesh network. Only an authorized Time Client should be allowed to change the Time and Time Role states. A dedicated application key

should be used on the Time Setup Server to restrict access to the server to only authorized Time Clients.

This model does not support subscribing nor publishing.

The model adds the messages listed in [Table 5.39](#) to the models it extends.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1201	Time (see <a href="#">Section 5.1.1</a> )	Time Set	M	
			Time Zone Set	M	
			TAI-UTC Delta Set	M	
		Time Role (see <a href="#">Section 5.1.2</a> )	Time Role Get	M	
			Time Role Set	M	
			Time Role Status		M

Table 5.39: Time Setup Server messages

## 5.3.2.2 Time state behavior

### 5.3.2.2.1 Receiving a Time Set message

When a Time Setup Server receives a Time Set message, it shall set the TAI Seconds state to the value of the TAI Seconds field, the Subsecond state to the value of the Subsecond field, the Uncertainty state to the value of the Uncertainty field, the Time Authority state to the value of the Time Authority field and the Time Zone Offset state to the value of the Time Zone Offset field and the Time Server shall respond with a Time Status message (see [Section 5.3.1.2.2](#)).

### 5.3.2.2.2 Receiving a Time Zone Set message

When a Time Setup Server receives a Time Zone Set message, it shall set the Time Zone Offset New state to the value of the Time Zone Offset New field and the TAI of Zone Change state to the value of the TAI of Zone Change field, and the Time Server shall respond with a Time Zone Status message (see [Section 5.3.1.2.5](#)).

### 5.3.2.2.3 Receiving a TAI-UTC Delta Set message

When a Time Setup Server receives a TAI-UTC Delta Set message, it shall set the TAI-UTC Delta New state to the value of the TAI-UTC Delta New field and the TAI of Delta Change state to the value of the TAI of Delta Change field, and the Time Server shall respond with a TAI-UTC Delta Status message (see [Section 5.3.1.2.7](#)).

## 5.3.2.3 Time Role behavior

### 5.3.2.3.1 Receiving a Time Role Get message

When a Time Setup Server receives a Time Role Get message, it shall respond with a Time Role Status message (see [Section 5.3.2.3.3](#)).

### 5.3.2.3.2 Receiving a Time Role Set / Time Role Set Unacknowledged message

When a Time Setup Server receives a Time Role Set message or a Time Role Set Unacknowledged message, it shall set the Time Role state to the value of the Time Role field.

If the message is the Time Role Set message, the Time Setup Server shall respond with a Time Role Status message (see [Section 5.3.2.3.3](#)).

It is recommended to transmit a Time Status message when the value of the Time Role state (see [Section 5.1.2](#)) has been changed to 0x01 (Time Authority).

### 5.3.2.3.3 Sending a Time Role Status message

A Time Setup Server shall send a Time Role Status message as a response to the Time Role Get message (see Section 5.2.1.10) or as an unsolicited message at any time, setting the Time Role field to the value of the Time Role state.

## 5.3.3 Scene Server

### 5.3.3.1 Description

The Scene Server model is a root model. When this model is present on an Element, the corresponding Scene Setup Server model (see Section 5.3.4) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model defines the state instances listed in Table 5.40 and messages listed in Table 5.41. The model may be present only on the Primary element of a node.

Scene Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Scene Register	Main	No	-	-	-

Table 5.40: Scene Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1203	Scene Register (see Section 5.1.3.1)	Scene Get	M	
			Scene Status		M
			Scene Register Get	M	
			Scene Register Status		M
			Scene Recall	M	
			Scene Recall Unacknowledged	M	

Table 5.41: Scene Server messages

### 5.3.3.2 Scene Register state behavior

#### 5.3.3.2.1 Receiving a Scene Get message

When a Scene Server receives a Scene Get message, it shall respond with a Scene Status message (see Section 5.3.3.2.3).

#### 5.3.3.2.2 Receiving a Scene Recall / Scene Recall Unacknowledged message

When a Scene Server receives a Scene Recall message with a Scene Number value that matches a Scene Number stored within the Scene Register state, it shall perform a Scene Recall operation (see Section 5.1.3.1.2) for a scene memory referred to by the Scene Number and shall respond with a Scene Status message (see Section 5.3.3.2.3), setting the Status Code field to Success.

When a Scene Server receives a Scene Recall message with a Scene Number value that does not match a Scene Number stored within the Scene Register state, it shall respond with the Scene Status message (see Section 5.3.3.2.3), setting the Status Code field to Scene Not Found).

When a Scene Server receives a Scene Recall Unacknowledged message with a Scene Number value that matches a Scene Number stored within the Scene Register state, it shall perform a Scene Recall operation (see Section 5.1.3.1.2) for a scene memory referred to by the Scene Number.

If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Delay field is included in the Scene Recall message or in the Scene Recall Unacknowledged message, and the field contains a non-zero value, the server shall wait for the indicated delay period (5-millisecond steps) before executing any state-changing behavior.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

#### 5.3.3.2.3 Sending a Scene Status message

A Scene Server shall send the Scene Status message as a response to a Scene Get and Scene Recall message, or as an unsolicited message.

It is recommended that the Scene Status message is sent whenever a Scene is recalled as a result of an action other than receiving the Scene Recall message (e.g., a predefined Scheduler action). See Section 5.1.4.

If the message is sent as a reply to the Scene Recall message, the Status Code field identifies the result of the related operation; otherwise, the Status Code field shall be set to Success.

#### 5.3.3.2.4 Receiving a Scene Register Get message

When a Scene Server receives a Scene Register Get message, it shall respond with a Scene Register Status message (see Section 5.3.3.2.5), setting the Status Code field to Success.

#### 5.3.3.2.5 Sending a Scene Register Status message

A Scene Server shall send the Scene Register Status message either as a response to a Scene Store message or a Scene Register Get message, or as an unsolicited message.

If the message is sent as a reply to a Scene Store message, the Status Code field identifies the result of the related operation; otherwise, the Status Code field shall be set to Success.

### 5.3.4 Scene Setup Server

#### 5.3.4.1 Description

The Scene Setup Server model extends the Scene Server model (see Section 5.3.3) and the Generic Default Transition Time Server model (see Section 3.3.3).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the state instances listed in Table 5.42 and messages listed in Table 5.43 to the models it extends. The model may be present only on the Primary element of a node.

Scene Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Scene Register	Main	No	-	-	-

Table 5.42: Scene Setup Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1204	Scene Register (see Section 5.1.3.1)	Scene Store	M	
			Scene Store Unacknowledged	M	
			Scene Delete	M	
			Scene Delete Unacknowledged	M	

Table 5.43: Scene Register messages

Table 5.44 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1004	Generic Default Transition Time (see Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1203	Scene Register (see Section 5.1.3.1)	Scene Get	M	
			Scene Status		M
			Scene Register Get	M	
			Scene Register Status		M
			Scene Recall	M	
			Scene Recall Unacknowledged	M	
	0x1204	Scene Register (see Section 5.1.3.1)	Scene Store	M	
			Scene Store Unacknowledged	M	
			Scene Delete	M	
			Scene Delete Unacknowledged	M	

Table 5.44: Scene Setup Server elements, states, and messages

### 5.3.4.2 Scene Register state behavior

#### 5.3.4.2.1 Receiving Scene Store / Scene Store Unacknowledged messages

When a Scene Setup Server receives a Scene Store message, it shall perform a Scene Store operation (see Section 5.1.3.1.1) for the scene referred to by the Scene Number and shall respond with the Scene Register Status message (see Section 5.3.3.2.5). If the Scene Store operation completed with success, the Status Code field shall be set to Success; otherwise the Status Code field shall be set to Scenes Register Full.

When a Scene Setup Server receives a Scene Store Unacknowledged message, it shall perform a Scene Store operation (see Section 5.1.3.1.1) for the scene referred to by the Scene Number.

#### 5.3.4.2.2 Receiving a Scene Delete / Scene Delete Unacknowledged message

When a Scene Server receives a Scene Delete message with a Scene Number value that matches a Scene Number stored within the Scene Register state, it shall perform a Scene Delete operation (see Section 5.1.3.1.3) for a scene memory referred to by the Scene Number and respond with a Scene Register Status message (see Section 5.3.3.2.5), setting the Status Code field to Success.

When a Scene Server receives a Scene Delete Unacknowledged message with the Scene Number value that matches a Scene Number stored within the Scene Register state, it shall perform a Scene Delete operation (see Section 5.1.3.1.3) for a scene memory referred to by the Scene Number.

When a Scene Server receives a Scene Delete message with the Scene Number value that does not match a Scene Number stored within the Scene Register state, it shall respond with the Scene Register Status message (see Section 5.3.3.2.5), setting the Status Code field to Success.

## 5.3.5 Scheduler Server

### 5.3.5.1 Description

The Scheduler Server model extends the Scene Server model (see Section 3.5). When this model is present on an Element, the corresponding Scheduler Setup Server model (see Section 5.3.6) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 5.45 and messages listed in Table 5.46 to the model it extends. The model may be present only on the Primary element of a node. The model requires the Time Server model shall be present on the element.

Scheduler Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Scheduler	Main	No	-	-	-

Table 5.45: Scheduler Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1206	Schedule Register (see Section 5.1.4.2)	Scheduler Get	M	
			Scheduler Status		M
			Scheduler Action Get	M	
			Scheduler Action Status		M

Table 5.46: Scheduler Server messages

Table 5.47 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1203	Scene Register (see Section 5.1.3.1)	Scene Get	M	
			Scene Status		M
			Scene Register Get	M	
			Scene Register Status		M
			Scene Recall	M	
			Scene Recall Unacknowledged	M	
Main	0x1206	Schedule Register (see Section 5.1.4.2)	Scheduler Get	M	
			Scheduler Status		M
			Scheduler Action Get	M	
			Scheduler Action Status		M

Table 5.47: Scheduler Server elements, states, and messages



### 5.3.5.2 Schedule Register state behavior

#### 5.3.5.2.1 Receiving a Scheduler Get message

When a Scheduler Server receives a Scheduler Get message, it shall respond with a Scheduler Status message (see Section 5.3.5.2.2).

#### 5.3.5.2.2 Sending a Scheduler Status message

A Scheduler Server shall send a Scheduler Status message, setting the Schedules bit field with each bit set to 1 when a corresponding entry of the Schedule Register state is defined.

#### 5.3.5.2.3 Receiving a Scheduler Action Get message

When a Scheduler Server receives a Scheduler Action Get message, it shall respond with a Scheduler Action Status message (see Section 5.3.5.2.4).

#### 5.3.5.2.4 Sending a Scheduler Action Status message

A Scheduler Server shall send the Scheduler Action Status message as a response to a Scheduler Action Get message (see Section 5.2.3.3) or a Scheduler Action Set message (see Section 5.2.3.4).

The Schedule Register bit field shall be set to the value of the entry of the Schedule Register state (see Section 5.1.4.2) indicated by the Index field of the received message.

## 5.3.6 Scheduler Setup Server

### 5.3.6.1 Description

The Scheduler Setup Server model extends the Scheduler Server (see Section 5.3.5) and the Scene Setup Server (see Section 5.3.4) models.

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds messages listed in Table 5.48 to the model it extends. The model may be present only on the Primary element of a node.

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1207	Schedule Register (see Section 5.1.4.2)	Scheduler Action Set	M	
			Scheduler Action Set Unacknowledged	M	

Table 5.48: Scheduler Setup Server messages

Table 5.49 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1203	Scene Register (see Section 5.1.3.1)	Scene Get	M	
			Scene Status		M
			Scene Register Get	M	
			Scene Register Status		M
			Scene Recall	M	
			Scene Recall Unacknowledged	M	
	0x1206		Scheduler Get	M	



Element	SIG Model ID	States	Messages	Rx	Tx
		Schedule Register (see Section 5.1.4.2)	Scheduler Status		M
			Scheduler Action Get	M	
			Scheduler Action Status		M
	0x1204	Scene Register (see Section 5.1.3.1)	Scene Store	M	
			Scene Store Unacknowledged	M	
	0x1207	Schedule Register (see Section 5.1.4.2)	Scheduler Action Set	M	
			Scheduler Action Set Unacknowledged	M	
	0x1004	Generic Default Transition Time (see Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1007	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	

Table 5.49: Scheduler Setup Server elements, states, and messages

### 5.3.6.2 Schedule Register state behavior

#### 5.3.6.2.1 Receiving Scheduler Action Set / Scheduler Action Set Unacknowledged messages

When a Scheduler Setup Server receives a Scheduler Action Set or a Scheduler Action Set Unacknowledged message, it shall set the entry of the Schedule Register state identified by the Index field (see Section 5.1.4.2) to the value of the Schedule Register field of the message.

If the received message is the Scheduler Action Set message, the Scheduler Server shall respond with a Scheduler Action Status message (see Section 5.3.5.2.4).

## 5.4 Time and Scenes client models

### 5.4.1 Time Client

#### 5.4.1.1 Description

The Time Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to synchronize an element's Time state (see Section 3.1.3) with a Time state of an element of a peer device that exposes a Time Server model (see Section 5.3.1) and a Time Setup Server model (see Section 5.3.2) via Time Messages (see Section 5.2.1).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1202	Time	Time Get		O
			Time Set		O
			Time Status	C.1	
			Time Zone Get		O
			Time Zone Set		O
			Time Zone Status	C.2	
			TAI-UTC Delta Get		O
			TAI-UTC Delta Set		O
			TAI-UTC Delta Status	C.3	
		Time Role	Time Role Get		O
			Time Role Set		O
			Time Role Status	C.4	

C.1: If any of the messages: Time Get, Time Set are supported, the Time Status message shall also be supported; otherwise support for the Time Status message is optional.

C.2: If any of the messages: Time Status, Time Change Get, Time Zone Set are supported, the Time Zone Status message shall also be supported; otherwise support for the Time Zone Status message is optional.

C.3: If any of the messages: Time Status, TAI-UTC Delta Get, TAI-UTC Delta Set are supported, the TAI-UTC Delta Status message shall also be supported; otherwise support for the TAI-UTC Delta Status message is optional.

C.4: If any of the messages: Time Role Get, Time Role Set are supported, the Time Role Status message shall also be supported; otherwise support for the Time Role Status message is optional.

Table 5.50: Time Client elements and messages

## 5.4.1.2 Time procedure

### 5.4.1.2.1 Sending a Time Get message

To determine the TAI Seconds, the Subsecond, the Time Authority, the Uncertainty and the Time Zone Offset Current fields of the Time state of a Time Sever, a Time Client shall send a Time Get message. The response is a Time Status message (see Section 5.4.1.2.2).

### 5.4.1.2.2 Sending a Time Set message

To set the TAI Seconds, the Subsecond, the Time Authority, the Uncertainty and the Time Zone Offset Current fields of the Time state of a Time Setup Server with acknowledgment, a Time Client shall send a Time Set message. The response is a Time Status message (see Section 5.4.1.2.2).

### 5.4.1.2.3 Receiving a Time Status message

Upon receiving a Time Status message, a Time Client can determine the Time state of a Time Server.

### 5.4.1.2.4 Sending a Time Zone Get message

To determine the upcoming change of the Time Zone Offset Current state of a Time Sever, a Time Client shall send a Time Zone Get message. The response is a Time Zone Status message (see Section 5.4.1.2.6).

#### 5.4.1.2.5 *Sending a Time Zone Set message*

To set the upcoming change of the Time Zone Offset Current state of a Time Server with acknowledgment, a Time Client shall send a Time Zone Set message. The response is a Time Zone Status message (see Section 5.4.1.2.6).

#### 5.4.1.2.6 *Receiving a Time Zone Status message*

Upon receiving a Time Zone Status message, a Time Client can determine the Time Zone Offset New and the TAI of Zone Change fields of the Time state of a Time Server (see Section 5.1.1).

#### 5.4.1.2.7 *Sending a TAI-UTC Get message*

To determine the upcoming change of the TAI-UTC Delta Current state of a Time Server, a Time Client shall send a TAI-UTC Delta Get message. The response is a TAI-UTC Delta Status message (see Section 5.4.1.2.9).

#### 5.4.1.2.8 *Sending a TAI-UTC Set message*

To set the upcoming change of the TAI-UTC Delta Current state of a Time Server with acknowledgment, a Time Client shall send a TAI-UTC Delta Set message. The response is a TAI-UTC Delta Status message (see Section 5.4.1.2.9).

#### 5.4.1.2.9 *Receiving a TAI-UTC Delta Status message*

Upon receiving a TAI-UTC Delta Status message, a Time Client can determine the TAI-UTC Delta New and the TAI of Delta Change fields of the Time state of a Time Server (see Section 5.1.1).

### 5.4.1.3 Time Role procedure

#### 5.4.1.3.1 *Sending a Time Role Get message*

To determine the Time Role state of a Time Setup Server, a Time Client shall send a Time Role Get message. The response is a Time Role Status message (see Section 5.4.1.3.3).

#### 5.4.1.3.2 *Sending a Time Role Set message*

To set the Time Role state of a Time Setup Server with acknowledgment, a Time Client shall send a Time Role Set message. The response is a Time Role Status message (see Section 5.4.1.3.3).

#### 5.4.1.3.3 *Receiving a Time Role Status message*

Upon receiving a Time Role Status message, a Time Client can determine the Time Role state of a Time Setup Server.

## 5.4.2 Scene Client

### 5.4.2.1 Description

The Scene Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Scene Server model (see Section 5.3.3) and a Scene Setup Server model (see Section 5.3.4) via Scene Register messages (see Section 5.2.1).

The following table illustrates the complete structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedures	Messages	Rx	Tx
Main	0x1205	Scene Register	Scene Get		O
			Scene Status	C.1	
			Scene Register Get		O
			Scene Register Status	C.2	
			Scene Store		O
			Scene Store Unacknowledged		O
			Scene Delete		O
			Scene Delete Unacknowledged		O
			Scene Recall		O
			Scene Recall Unacknowledged		O

C.1: If any of the messages: Scene Get, Scene Recall are supported, the Scene Status message shall also be supported; otherwise support for the Scene Status message is optional.

C.2: If any of the messages: Scene Register Get, Scene Store, Scene Delete are supported, the Scene Register Status message shall also be supported; otherwise support for the Scene Register Status message is optional.

Table 5.51: Scene Client elements and messages

## 5.4.2.2 Scene Register procedure

### 5.4.2.2.1 Sending a Scene Get message

To determine the current Scene state of a Scene Server, a Scene Client shall send a Scene Get message. The response is a Scene Status message (see Section 5.4.2.2.2).

### 5.4.2.2.2 Receiving a Scene Status message

Upon receiving a Scene Status message, a Scene Client can determine the current Scene state of a Scene Server.

### 5.4.2.2.3 Sending a Scene Register Get message

To determine the Scene Register state of a Scene Server, a Scene Client shall send a Scene Register Get message. The response is a Scene Register Status message (see Section 5.4.2.2.7).

### 5.4.2.2.4 Sending Scene Store / Scene Store Unacknowledged messages

To store the present state of an element as a memorized scene referenced by a Scene Number with acknowledgment, a Scene Client shall send a Scene Store message, setting the Scene Number field to the selected Scene Number. The response is a Scene Register Status message (see Section 5.4.2.2.7).

To store the present state of an element as a memorized scene referenced by a Scene Number without acknowledgment, a Scene Client shall send a Scene Store Unacknowledged message, setting the Scene Number field to the selected Scene Number.

The choice to use a Scene Store or a Scene Store Unacknowledged message is an implementation detail.

### 5.4.2.2.5 Sending Scene Recall / Scene Recall Unacknowledged messages

To recall the state of an element from a memorized scene that is referenced by a Scene Number with acknowledgment, a Scene Client shall send a Scene Recall message, setting the Scene Number field to the selected Scene Number and the TID field to the least recently used value. The response is a Scene Status message (see Section 5.4.2.2.2).

To recall the state of an element from a memorized scene that is referenced by a Scene Number without acknowledgment, a Scene Client shall send a Scene Recall Unacknowledged message, setting the Scene Number field to the selected Scene Number and the TID field to the least recently used value.

A Scene Recall message or a Scene Recall Unacknowledged message may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay, which represents the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Scene Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Scene Recall or a Scene Recall Unacknowledged message is an implementation detail.

#### 5.4.2.2.6 *Sending a Scene Delete / Scene Delete Unacknowledged message*

To delete the state of an element from a memorized scene referenced by a Scene Number with acknowledgment, a Scene Client shall send a Scene Delete message, setting the Scene Number field to the selected Scene Number. The response is a Scene Register Status message (see Section 5.4.2.2.7).

To recall the state of an element from a memorized scene referenced by a Scene Number without acknowledgment, a Scene Client shall send a Scene Delete Unacknowledged message, setting the Scene Register Status field to the selected Scene Number.

#### 5.4.2.2.7 *Receiving a Scene Register Status message*

Upon receiving a Scene Register Status message, a Scene Client can determine the Scene Register state of a Scene Server.

### 5.4.3 Scheduler Client

#### 5.4.3.1 Description

The Scheduler Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Scheduler Server model (see Section 5.3.5) and a Scheduler Setup Server model (see Section 5.3.6) via Scheduler messages (see Section 5.2.3).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1208	Scheduler	Scheduler Get		O
			Scheduler Status	C.1	
			Scheduler Action Get		O
			Scheduler Action Set		O

Element	SIG Model ID	Procedure	Messages	Rx	Tx
			Scheduler Action Set Unacknowledged		O
			Scheduler Action Status	C.2	

C.1: If the Scheduler Get message is supported, the Scheduler Status message shall also be supported; otherwise support for the Scheduler Status message is optional.

C.2: If any of the messages: Scheduler Action Get, Scheduler Action Set are supported, the Scheduler Action Status message shall also be supported; otherwise support for the Scheduler Action Status message is optional.

Table 5.52: Scheduler Client elements and messages

### 5.4.3.2 Scheduler procedure

#### 5.4.3.2.1 Sending a Scheduler Get message

To determine the Scheduler state of a Scheduler Server, a Scheduler Client shall send a Scheduler Get message. The response is a Scheduler Status message (see Section 5.4.3.2.2).

#### 5.4.3.2.2 Receiving a Scheduler Status message

Upon receiving a Scheduler Status message, a Scheduler Client can determine the Scheduler state of a Scheduler Server.

#### 5.4.3.2.3 Sending a Scheduler Action Get message

To determine the Scheduler Action state of a Scheduler Server, a Scheduler Client shall send a Scheduler Action Get message, setting the Index field to a value indicating a Scheduler entry. The response is a Scheduler Action Status message (see Section 5.4.3.2.4).

#### 5.4.3.2.4 Receiving a Scheduler Action Status message

Upon receiving a Scheduler Action Status message, a Scheduler Client can determine the Scheduler Action state entry of a Scheduler Server, indicated by the Index field.

#### 5.4.3.2.5 Sending Scheduler Action Set / Scheduler Action Set Unacknowledged messages

To set a Scheduler Action for a particular Index with acknowledgment, a Scheduler Client shall send a Scheduler Action Set message, setting the Index field to the selected value and the Schedule Register field to the bit field representing a Schedule Register entry. The response is a Scheduler Action Status message (see Section 5.4.3.2.4).

To set a Scheduler Action for a particular Index without acknowledgment, a Scheduler Client shall send a Scheduler Action Set Unacknowledged message, setting the Index field to the selected value and the Schedule Register field to the bit field representing a Schedule Register entry.

The choice to use a Scheduler Action Set or a Scheduler Action Set Unacknowledged message is an implementation detail.

## 5.5 Summary of Time and Scenes models

Figure 5.1 illustrates the relationship between Time and Scenes models.

The following types of relations are illustrated: interactions via messages between client models (represented by blue rectangles) and server models (represented by dark blue rectangles), hierarchy of models extending other models, server models serving states (represented by red rounded rectangles), and bindings between states.

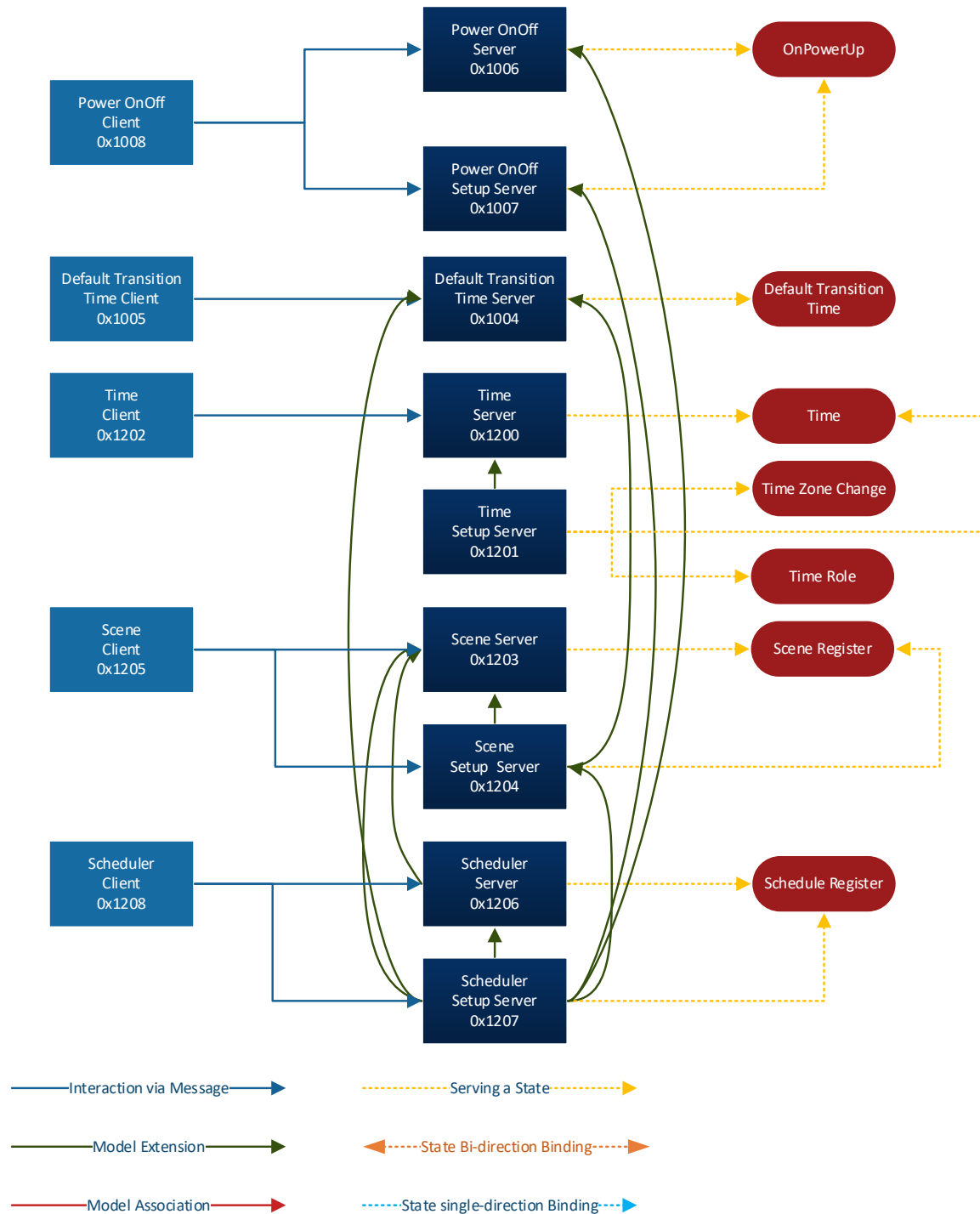


Figure 5.1: Relationships between Time and Scenes models

## 6 Lighting

This section of the specification defines a set of functionalities related to lighting control. This includes dimmable lights as well as tunable and color changing lights. It also includes a light control model that allows specific behaviors triggered by sensors, such as turning lights on based on occupancy or balancing a light level based on ambient light conditions, dimming lights after a period of inactivity and eventually turning lights off.

### 6.1 Lighting states

#### 6.1.1 Introduction

There are different types of light sources with different capabilities. Accordingly, there are different ways to express a state of a light.

The simplest way of controlling a light is turning it on or off. This is done by controlling the Generic OnOff state (see Section 3.1.1).

A more advanced method of controlling a light is changing the lightness. This is done by controlling the Light Lightness Actual state (see Section 6.1.2.1). For an informative discussion of lightness, see Section A.2.

If a light is a tunable white, meaning it is possible to control its color temperature, this is done by controlling the Light CTL state (see Section 6.1.3) along with the DUV (Delta UV). The color temperature corresponds to a particular locus (curve) on the color chart and is equivalent to “black body” radiation at different temperatures (expressed in Kelvin). Higher color temperatures are more bluish or cool and lower color temperatures are reddish or warm. Incandescent light is typically 2700K to 3000K, while daylight or fluorescent light is typically 5000K. DUV (Delta UV) is the distance from the Black Body curve. It is a range of -1.0 to 1.0 with a 16-bit resolution. The Color Temperatures all fall on the black body locus (curve) and some applications want to slightly deviate from the black body curve (e.g., to accentuate pinks/reds).

If a light is a color changing light, meaning it is possible to control all three dimensions (Hue, Saturation, and Lightness or HSL), this is done by controlling each state independently:

- Lightness is controlled by the Light Lightness Actual state (see Section 6.1.2.1).
- Hue is controlled by the Light HSL Hue state (see Section 6.1.4.1).
- Saturation is controlled by the Light HSL Saturation state (see Section 6.1.4.2).

The HSL model [4] is considered to be the default model for controlling color light in a mesh network. The RGB model used in computer monitors and printers has several flaws. For example, it depends on having a good source of primary colors. In today’s light sources, different primary colors other than RGB are used and often more than three are used; and three variables are required to mix to result in a final color. On the other hand, the HSL model makes it easy to implement in a variety of controllers (smart phone apps and physical color light controllers using so-called color wheels for Hue / Saturation selection and a linear slider for Lightness). It also fits in nicely with the concept of models extending other models. The HS extends L, forming a combined HSL color light control model.





Figure 6.1: Hue / Saturation color wheel

**Note:** The HSL color space can be converted to other color spaces. For example, the following code may be used when converting HSL to RGB:

```
H = Light HSL Hue / 65535
S = Light HSL Saturation / 65535
L = Light Lightness / 65535

if ( S == 0 )
{
    R = L
    G = L
    B = L
}
else
{
    if ( L < 0.5 ) var_2 = L * ( 1 + S )
    else          var_2 = ( L + S ) - ( S * L )

    var_1 = 2 * L - var_2

    R = Hue_2_RGB( var_1, var_2, H + ( 1/3 ) )
    G = Hue_2_RGB( var_1, var_2, H )
    B = Hue_2_RGB( var_1, var_2, H - ( 1/3 ) )
}

Hue_2_RGB( v1, v2, vH )           //Function Hue_2_RGB
{
    if ( vH < 0 ) vH += 1
    if ( vH > 1 ) vH -= 1
    if ( ( 6 * vH ) < 1 ) return ( v1 + ( v2 - v1 ) * 6 * vH )
    if ( ( 2 * vH ) < 1 ) return ( v2 )
    if ( ( 3 * vH ) < 2 ) return ( v1 + ( v2 - v1 ) * ( ( 2/3 ) - vH ) * 6 )
    return ( v1 )
}
```

Professional color light control applications use a CIE1931 [\[4\]](#) color chart system, created by the Commission on Illumination in 1931. It is the first mathematically defined color chart and can be used as an alternative to the HSL model. It defines human perceptible colors with x, y, and Y coordinates, where x and y are coordinates of the color on the chart, and Y represents luminance.

In a mesh network, the color light control model for professional applications is the xyL model, where x and y have the same meaning of chromaticity coordinates as in the xyY model. L is the perceived lightness, represented by the Light Lightness Actual state (see Section 6.1.2.1). The x and y are represented by the Light xyL x (see Section 6.1.5.1) and Light xyL y (see Section 6.1.5.2) states, extending the L by xy to form a combined Light xyL Server model.

It should be noted that the Light HSL Hue, Light HSL Saturation, and the Light xyL x and Light xyL y states are related. Changing one of them results in the others being changed.

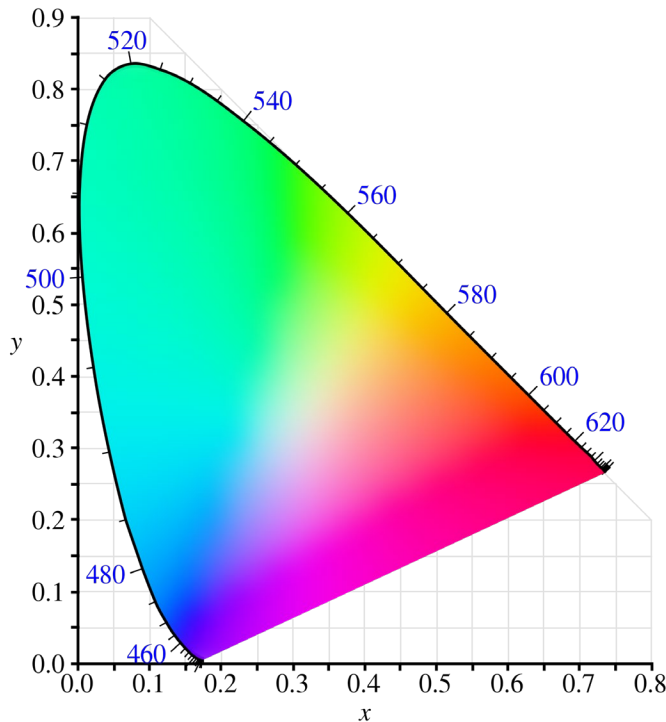


Figure 6.2: CIE1931 Color Space Chromaticity diagram

Since modern light sources and controllers allow for very precise light control, all the light control states have 16-bit precision.

## 6.1.2 Light Lightness state

The Light Lightness state is a composite state that includes the Light Lightness Linear, the Light Lightness Actual, the Light Lightness Last, and the Light Lightness Default states.

### 6.1.2.1 Light Lightness Linear

The Light Lightness Linear state represents the lightness of a light on a linear scale. The state is bound to the Light Lightness Actual state. The values for the state are defined in the following table.

Value	Description
0x0000	Light is not emitted by the element.
0x0001–0xFFFFE	The lightness of a light emitted by the element.
0xFFFF	The highest lightness of a light emitted by the element.

Table 6.1: Light Lightness Linear states

The linear lightness of a light is equal to the measured light intensity (Y), from 0 to 65535.

#### 6.1.2.1.1 Binding with the Light Lightness Actual state

The Light Lightness Linear state is bound to an instance of the Light Lightness Actual state (see Section 6.1.2.2), meaning that whenever the Light Lightness Linear state of an element changes as a

result of an action other than the change of the bound Light Lightness Actual state (see Section 6.1.2.2.1), the following calculation shall be performed:

$$\text{Light Lightness Actual} = 65535 \sqrt{\frac{\text{Light Lightness Linear}}{65535}}$$

### 6.1.2.2 Light Lightness Actual

The Light Lightness Actual state represents the lightness of a light on a perceptually uniform lightness scale [6]. The state is bound to the Generic Level state and the Generic OnOff state. The values for the state are defined in the following table.

Value	Description
0x0000	Light is not emitted by the element.
0x0001–0xFFFF	The perceived lightness of a light emitted by the element.
0xFFFF	The highest perceived lightness of a light emitted by the element.

Table 6.2: Light Lightness Actual states

The perceived lightness of a light (L) is the square root of the measured light intensity (Y):

$$L = 65535 \sqrt{\frac{Y}{65535}}$$

Where L is the perceived lightness and Y is the measured light intensity (from 0 to 65535).

Note: The scientific community's understanding of the exact relationship between the L and Y variables has changed over time. Appendix A.2 summarizes these changes. For a detailed history, see "The Basis of Physical Photometry" [17] from the International Commission of Illumination (CIE). The CIE works with the International Organization for Standardization (ISO) to define global standards for various types of illumination. The organization's published illumination standards and research publications are available on the CIE website.

#### 6.1.2.2.1 Binding with the Light Lightness Linear state

The Light Lightness Actual state is bound to an instance of the Light Lightness Linear state (see Section 6.1.2.1), meaning that whenever the Light Lightness Linear state of an element changes as a result of an action other than the change of the bound Light Lightness Linear state (see Section 6.1.2.1.1), the following calculation shall be performed:

$$\text{Light Lightness Linear} = \text{Ceiling} \left( 65535 \left( \frac{\text{Light Lightness Actual}}{65535} \right)^2 \right)$$

#### 6.1.2.2.2 Binding with the Generic Level state

The Light Lightness Actual state is bound to an instance of the Generic Level state (see Section 3.1.2), meaning that whenever the Generic Level state of an element changes, the following calculation shall be performed:

$$\text{Light Lightness Actual} = \text{Generic Level} + 32768$$

A reverse binding is also defined, meaning that whenever the Light Lightness Actual state of an element changes, the following calculation shall be performed:

$$\text{Generic Level} = \text{Light Lightness Actual} - 32768$$

The Light Lightness Actual state shall not wrap around when reaching the maximum or minimum values.

#### 6.1.2.2.3 Binding with the Generic OnOff state

The Light Lightness Actual state is bound to an instance of the Generic OnOff state (see Section 3.1.1), meaning that whenever the Generic OnOff state of an element is set, the following calculations shall be performed:

Light Lightness Actual = 0

for value of the Generic OnOff state equal to 0x00, or

Light Lightness Actual = Light Lightness Last

for value of the Generic OnOff state equal to 0x01, when value of the Light Lightness Default state is equal to 0x0000, or

Light Lightness Actual = Light Lightness Default

for value of the Generic OnOff state equal to 0x01, when value of the Light Lightness Default state is not equal to 0x0000.

A reverse binding is also defined, meaning that whenever the Light Lightness Actual state of an element changes, the following calculations shall be performed:

Generic OnOff = 0x00

for value of the Light Lightness Actual equal to 0, or

Generic OnOff = 0x01

for value of the Light Lightness Actual greater than 0.

#### 6.1.2.2.4 Binding with the Generic OnPowerUp state

The Light Lightness Actual state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

Light Lightness Actual = 0

for value of the Generic OnPowerUp state equal to 0x00, or

Light Lightness Actual = Light Lightness Default

for value of the Generic OnPowerUp state equal to 0x01 and Light Lightness Default not equal to zero, or

Light Lightness Actual = Light Lightness Last (see Section 6.1.2.3)

for value of the Generic OnPowerUp state equal to 0x01 and Light Lightness Default equal to zero, or

Light Lightness Actual = last known value (before powered down) of the Light Lightness Actual

for value of the Generic OnPowerUp state equal to 0x02.

#### 6.1.2.2.5 Binding with the Light Lightness Range state

The Light Lightness Actual state is bound to an instance of the Light Lightness Range state (see Section 6.1.2.5), meaning that whenever the Light Lightness Actual state of an element changes, the following calculations shall be performed:

Light Lightness Actual = Light Lightness Range Min

for non-zero values of the Light Lightness Actual state that are less than the value of the Light Lightness Range Min state

Light Lightness Actual = Light Lightness Range Max

for non-zero values of the Light Lightness Actual state that are greater than the value of the Light Lightness Range Max state

### 6.1.2.3 Light Lightness Last

The Light Lightness Last state represents the lightness of a light on a perceptually uniform lightness scale [6].

The purpose of the Light Lightness Last state is to store the last known non-zero value of the Light Lightness Actual state, which is a result of a completed transactional change of the state. This allows restoring the value of the Light Lightness Actual state to its previous non-zero value when the bound Generic OnOff state is set back to 1. Depending on the value of the Generic OnPowerUp state (see Section 3.1.4), It may also be used as a default value when an element is powered up.

Whenever the Light Lightness Actual state is changed with a non-transactional message or a completed sequence of transactional messages to a non-zero value, the value of the Light Lightness Last shall be set to the value of the Light Lightness Actual.

The default value for the Light Lightness Last is 0xFFFF. The values for the state are defined in the following table.

Value	Description
0x0000	Prohibited
0x0001–0xFFFFE	The perceived lightness of a light emitted by the element
0xFFFF	The highest perceived lightness of a light emitted by the element

Table 6.3: Light Lightness Last states

### 6.1.2.4 Light Lightness Default

The Light Lightness Default state is a value ranging from 0x0000 to 0xFFFF, representing a default lightness level for the Light Lightness Actual state. The purpose of the Light Lightness Default state is to determine the lightness level of an element when powered up and when the Generic OnPowerUp state (see Section 3.1.4) bound to the Light Lightness state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x0000	Use the Light Lightness Last value (see Section 6.1.2.3)
0x0001–0xFFFFE	The perceived lightness of a light emitted by the element
0xFFFF	The highest perceived lightness of a light emitted by the element

Table 6.4: Light Lightness Default states

The default value for the Light Lightness Default state is 0x0000.

### 6.1.2.5 Light Lightness Range

The Light Lightness Range state determines the minimum and maximum lightness of an element. This is a pair of 16-bit unsigned integers: Light Lightness Range Min and Light Lightness Range Max.

The Light Lightness Range Min state determines the minimum non-zero lightness an element is configured to emit. The Light Lightness Range Max state determines the maximum lightness an element is configured to emit. The values for the state are defined in the following table.

Value	Description
0x0000	Prohibited
0x0001–0xFFFF	The lightness of an element

Table 6.5: Light Lightness Min and Light Lightness Max states

The default values for the Light Lightness Range Min and Light Lightness Range Max are product specific and are decided by a vendor. The value of the Light Lightness Range Max state shall be greater than or equal to the value of the Light Lightness Range Min state.

### 6.1.3 Light CTL state

The Light CTL state is a composite state that includes the Light CTL Temperature, the Light CTL Temperature Range, the Light CTL Temperature Default, the Light CTL Delta UV, the Light CTL Delta UV Default, and the Light CTL Lightness states.

#### 6.1.3.1 Light CTL Temperature

The Light CTL Temperature state determines the color temperature of tunable white light emitted by an element. This is a 16-bit unsigned integer in Kelvin. The values for the state are defined in the following table.

Value	Description
0x0320–0x4E20	The color temperature of white light in Kelvin
All other values	Prohibited

Table 6.6: Light CTL Temperature states

##### 6.1.3.1.1 Binding with the Generic Level state

The Light CTL Temperature state is bound to an instance of the Generic Level state (see Section 3.1.2), meaning that whenever the Generic Level state of an element changes, the following calculations shall be performed:

$$\text{Light CTL Temperature} = T\_MIN + (\text{Generic Level} + 32768) * (T\_MAX - T\_MIN) / 65535$$

A reverse binding is also defined, meaning that whenever the Light CTL Temperature state of an element changes, the following calculation shall be performed:

$$\text{Generic Level} = (\text{Light CTL Temperature} - T\_MIN) * 65535 / (T\_MAX - T\_MIN) - 32768$$

In the above formulas, T\_MIN and T\_MAX are values representing the Light CTL Temperature Range Min and Light CTL Temperature Range Max states (see Section 6.1.3.3).

The Light CTL Temperature state shall not wrap around when reaching the maximum or minimum values.

##### 6.1.3.1.2 Binding with the Generic OnPowerUp state

The Light CTL Temperature state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

$$\text{Light CTL Temperature} = \text{Light CTL Temperature Default}$$

for values of the Generic OnPowerUp state equal to 0x00, or equal to 0x01, or

$$\text{Light CTL Temperature} = \text{last known value (before powered down) for the Light CTL Temperature}$$

for value of the Generic OnPowerUp state equal to 0x02.

### 6.1.3.1.3 Binding with the CTL Temperature Range state

The Light CTL Temperature state is bound to an instance of the Light CTL Temperature Range state (see Section 6.1.3.3), meaning that whenever the Light CTL Temperature state of an element changes, the following calculations shall be performed:

Light CTL Temperature = Light CTL Temperature Range Min

for values of the Light CTL Temperature state that are less than the value of the Light CTL Temperature Range Min state

Light CTL Temperature = Light CTL Temperature Range Max

for values of the Light CTL Temperature state that are greater than the value of the Light CTL Temperature Range Max state

### 6.1.3.2 Light CTL Temperature Default

The Light CTL Temperature Default state represents a default CTL temperature level for the Light CTL Temperature state. The purpose of the Light CTL Temperature Default state is to determine the color temperature level of an element when powered up and when the Generic OnPowerUp state (see Section 3.1.4) bound to the Light CTL Temperature state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x0320–0x4E20	The color temperature of white light in Kelvin (0x0320 = 800 Kelvin, 0x4E20 = 20000 Kelvin)
All other values	Prohibited

Table 6.7: Light CTL Temperature Default states

### 6.1.3.3 Light CTL Temperature Range

The Light CTL Temperature Range state determines the minimum and maximum color temperatures of tunable white light an element is capable of emitting. This is a pair of 16-bit unsigned integers: Light CTL Temperature Range Min and Light CTL Temperature Range Max with values in Kelvin.

The Light CTL Temperature Range Min state determines the minimum color temperature of tunable white light an element is capable of emitting. The Light CTL Temperature Range Max state determines the maximum color temperature of tunable white light an element is capable of emitting. The values for the state are defined in the following table.

Value	Description
0x0320–0x4E20	The color temperature of white light in Kelvin (0x0320 = 800 Kelvin, 0x4E20 = 20000 Kelvin)
0xFFFF	The color temperature of white light is unknown
All other values	Prohibited

Table 6.8: Light CTL Temperature Range Min and Light CTL Temperature Range Max states

### 6.1.3.4 Light CTL Delta UV

The Light CTL Delta UV state determines the distance from the Black Body curve. The color temperatures all fall on the black body locus (curve). Some applications want to slightly deviate from the black body curve (e.g., to accentuate pinks/reds).



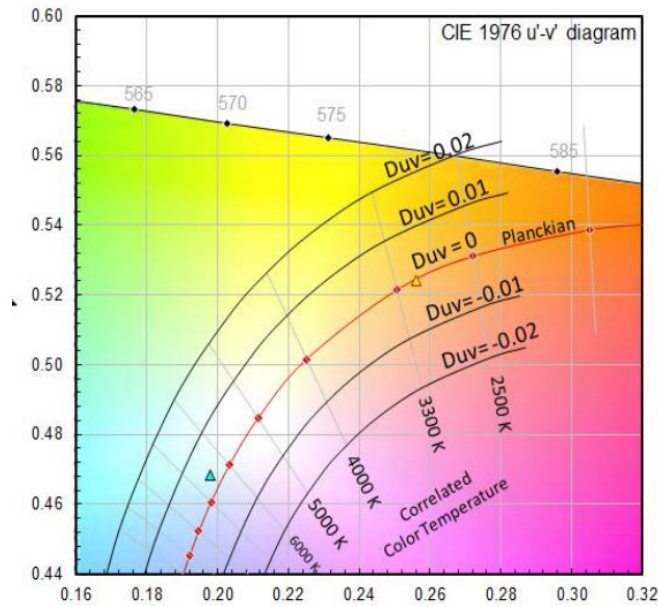


Figure 6.3: Delta UV scale illustration

This is a 16-bit signed integer representation of a -1 to +1 scale using the formula:

$$\text{Represented Delta UV} = (\text{Light CTL Delta UV}) / 32768$$

Value	Description
0x8000–0x7FFF	The 16-bit signed value representing the Delta UV of a tunable white light. A value of 0x0000 represents the Delta UV = 0 of a tunable white light.

Table 6.9: Light CTL Delta UV states

#### 6.1.3.4.1 Binding with the Generic OnPowerUp state

The Light CTL Delta UV state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

Light CTL Delta UV = Light CTL Delta UV Default

for values of the Generic OnPowerUp state equal to 0x00, or equal to 0x01, or

Light CTL Delta UV = last known value (before powered down) for the Light CTL Delta UV

for value of the Generic OnPowerUp state equal to 0x02.

#### 6.1.3.5 Light CTL Delta UV Default

The Light CTL Delta UV Default state represents a default Delta UV level for the Light CTL Delta UV state. The purpose of the Light CTL Delta UV Default state is to determine the delta UV level of an element when powered up and when the Generic OnPowerUp state (see Section 3.1.4) bound to the Light CTL state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x8000–0x7FFF	The 16-bit signed value representing the Delta UV of a tunable white light. A value of 0x0000 represents the Delta UV = 0 of a tunable white light.

Table 6.10: Light CTL Delta UV Default states



### 6.1.3.6 Light CTL Lightness

The Light CTL Lightness state determines the lightness of a tunable white light emitted by an element on a perceptually uniform lightness scale [6]. The values for the state are defined in the following table.

Value	Description
0x0000	Light is not emitted by the element
0x0001–0xFFFFE	The perceived lightness of a light emitted by the element
0xFFFF	The highest perceived lightness of a light emitted by the element

Table 6.11: Light CTL Lightness states

The perceived lightness of a light (L) is approximately the square root of the measured light intensity (Y)

$$L = 65535 \sqrt{\frac{Y}{65535}}$$

Where L is the perceived lightness and Y is the measured light intensity (from 0 to 65535).

Note: The scientific community's understanding of the exact relationship between the L and Y variables has changed over time. Appendix A.2 summarizes these changes. For a detailed history, see “The Basis of Physical Photometry” [17] from the International Commission of Illumination (CIE). The CIE works with the International Organization for Standardization (ISO) to define global standards for various types of illumination. The organization's published illumination standards and research publications are available on the CIE website.

#### 6.1.3.6.1 Binding with the Light Lightness Actual state

The Light CTL Lightness state is bound to an instance of the Light Lightness Actual state (see Section 6.1.2.1), meaning that whenever the Light Lightness Actual state of an element changes, the following calculation shall be performed:

Light CTL Lightness = Light Lightness Actual

A reverse binding is also defined, meaning that whenever the Light CTL Lightness state of an element changes, the following calculation shall be performed:

Light Lightness Actual = Light CTL Lightness

### 6.1.4 Light HSL

The Light HSL state is a composite state that includes the Light HSL Hue, the Light HSL Hue Default, the Light HSL Saturation, the Light HSL Saturation Default, and the Light HSL Lightness states.

#### 6.1.4.1 Light HSL Hue

The Light HSL Hue state determines the hue of a color light emitted by an element. This is a 16-bit unsigned integer representation of a 0–360° scale using the formula:

$$H \text{ (degrees)} = 360^\circ * (\text{Light HSL Hue}) / 65536$$

where H is the hue of a color light in degrees, as represented by the HSL (Hue / Saturation-Lightness) model. The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The 16-bit value representing the hue

Table 6.12: Light HSL Hue states

#### 6.1.4.1.1 Binding with the Generic Level state

The Light HSL Hue state is bound to an instance of the Generic Level state (see Section 3.1.2), meaning that whenever the Generic Level state of an element changes, the following calculation shall be performed:

$$\text{Light HSL Hue} = \text{Generic Level} + 32768$$

A reverse binding is also defined, meaning that whenever the Light HSL Hue state of an element changes, the following calculation shall be performed:

$$\text{Generic Level} = \text{Light HSL Hue} - 32768$$

The Light HSL Hue state shall wrap around when reaching the maximum or minimum values.

#### 6.1.4.1.2 Binding with the Generic OnPowerUp state

The Light HSL Hue state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

$$\text{Light HSL Hue} = \text{Light HSL Hue Default}$$

for values of the Generic OnPowerUp state equal to 0x00, or equal to 0x01, or

$$\text{Light HSL Hue} = \text{last known value (before powered down) for the Light HSL Hue}$$

for value of the Generic OnPowerUp state equal to 0x02.

#### 6.1.4.1.3 Binding with the HSL Hue Range state

The Light HSL Hue state is bound to an instance of the Light HSL Hue Range state (see Section 6.1.4.3), meaning that whenever the Light HSL Hue state of an element changes, the following calculations shall be performed:

$$\text{Light HSL Hue} = \text{Light HSL Hue Range Min}$$

for values of the Light HSL Hue state that are less than the value of the Light HSL Hue Range Min state

$$\text{Light HSL Hue} = \text{Light HSL Hue Range Max}$$

for values of the Light HSL Hue state that are greater than the value of the Light HSL Hue Range Max state

#### 6.1.4.2 Light HSL Hue Default

The Light HSL Hue Default state represents a default hue for the Light HSL Hue state. The purpose of the Light HSL Hue Default state is to determine the hue of an element when powered up and the Generic OnPowerUp state (see Section 3.1.4) bound to the Light HSL state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The 16-bit value representing the hue

Table 6.13: Light HSL Hue Default states

#### 6.1.4.3 Light HSL Hue Range

The Light HSL Hue Range state determines the minimum and maximum hue of an element. This is a pair of 16-bit unsigned integers: Light HSL Hue Range Min and Light HSL Hue Range Max.

The Light HSL Hue Range Min state determines the minimum value of a hue an element is configured to emit. The Light HSL Hue Range Max state determines the maximum value of a hue an element is configured to emit. The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The hue of an element

Table 6.14: Light HSL Hue Min and Light HSL Hue Max states

#### 6.1.4.4 Light HSL Saturation

The Light HSL Saturation state determines the saturation of a color light emitted by an element. The values for the state are defined in the following table.

Value	Description
0x0000	The lowest perceived saturation of a color light
0x0001–0xFFFF	The 16-bit value representing the saturation of a color light
0xFFFF	The highest perceived saturation of a color light

Table 6.15: Light HSL Saturation states

##### 6.1.4.4.1 Binding with the Generic Level state

The Light HSL Saturation state is bound to an instance of the Generic Level state (see Section 3.1.2), meaning that whenever the Generic Level state of an element changes, the following calculation shall be performed:

$$\text{Light HSL Saturation} = \text{Generic Level} + 32768$$

A reverse binding is also defined, meaning that whenever the Light HSL Saturation state of an element changes, the following calculation shall be performed:

$$\text{Generic Level} = \text{Light HSL Saturation} - 32768$$

The Light HSL Saturation state shall not wrap around when reaching the maximum or minimum values.

##### 6.1.4.4.2 Binding with the Generic OnPowerUp state

The Light HSL Saturation state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

$$\text{Light HSL Saturation} = \text{Light HSL Saturation Default}$$

for values of the Generic OnPowerUp state equal to 0x00, or equal to 0x01, or

$$\text{Light HSL Saturation} = \text{last known value (before powered down) for the Light HSL Saturation}$$

for value of the Generic OnPowerUp state equal to 0x02.

##### 6.1.4.4.3 Binding with the HSL Saturation Range state

The Light HSL Saturation state is bound to an instance of the Light HSL Saturation Range state (see Section 6.1.4.6), meaning that whenever the Light HSL Saturation state of an element changes, the following calculations shall be performed:

$$\text{Light HSL Saturation} = \text{Light HSL Saturation Range Min}$$

for values of the Light HSL Saturation state that are less than the value of the Light HSL Saturation Range Min state

Light HSL Saturation = Light HSL Saturation Range Max

for values of the Light HSL Saturation state that are greater than the value of the Light HSL Saturation Range Max state

#### 6.1.4.5 Light HSL Saturation Default

The Light HSL Saturation Default state represents a default hue for the Light HSL Saturation state. The purpose of the Light HSL Saturation Default state is to determine the saturation of an element when powered up and when the Generic OnPowerUp state (see Section 3.1.4) bound to the Light HSL state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The 16-bit value representing the saturation

Table 6.16: Light HSL Saturation Default states

#### 6.1.4.6 Light HSL Saturation Range

The Light HSL Saturation Range state determines the minimum and maximum saturation of an element. This is a pair of 16-bit unsigned integers: Light HSL Saturation Range Min and Light HSL Saturation Range Max.

The Light HSL Saturation Range Min state determines the minimum value of a saturation an element is configured to emit. The Light HSL Saturation Range Max state determines the maximum value of a saturation an element is configured to emit.

Value	Description
0x0000–0xFFFF	The saturation of an element

Table 6.17: Light HSL Saturation Min and Light HSL Saturation Max states

#### 6.1.4.7 Light HSL Lightness

The Light HSL Lightness state determines the lightness of a color light emitted by an element on a perceptually uniform lightness scale [6]. The values for the state are defined in the following table.

Value	Description
0x0000	Light is not emitted by the element
0x0001–0xFFFFE	The perceived lightness of a light emitted by the element
0xFFFF	The highest perceived lightness of a light emitted by the element

Table 6.18: Light HSL Lightness states

The perceived lightness of a light ( $L$ ) is approximately the square root of the measured light intensity ( $Y$ ):

$$L = 65535 \sqrt{\frac{Y}{65535}}$$

Where  $L$  is the perceived lightness and  $Y$  is the measured light intensity (from 0 to 65535).

**Note:** The scientific community's understanding of the exact relationship between the  $L$  and  $Y$  variables has changed over time. Appendix A.2 summarizes these changes. For a detailed history, see “The Basis of Physical Photometry” [17] from the International Commission of Illumination (CIE). The CIE works with the International Organization for Standardization (ISO) to define global standards for various types of illumination. The organization's published illumination standards and research publications are available on the CIE website.

#### 6.1.4.7.1 Binding with the Light Lightness Actual state

The Light HSL Lightness state is bound to an instance of the Light Lightness Actual state (see Section 6.1.2.1), meaning that whenever the Light Lightness Actual state of an element changes, the following calculation shall be performed:

$$\text{Light HSL Lightness} = \text{Light Lightness Actual}$$

A reverse binding is also defined, meaning that whenever the Light HSL Lightness state of an element changes, the following calculation shall be performed:

$$\text{Light Lightness Actual} = \text{Light HSL Lightness}$$

### 6.1.5 Light xyL

The Light xyL state is a composite state that includes the Light xyL x, the Light xyL x Default, the Light xyL y, the Light xyL y Default, and the xyL Lightness states. The state determines the xyL coordinates on the CIE1931 color space chart of a color light emitted by an element.

#### 6.1.5.1 Light xyL x

The Light xyL x state determines the x coordinate on the CIE1931 color space chart of a color light emitted by an element. This is a 16-bit unsigned integer representation of a scale from 0 to 1 using the formula:

$$\text{CIE1931\_x} = (\text{Light xyL x}) / 65535$$

where CIE1931\_x is the x coordinate on the CIE1931 color space chart of a color light, as represented by the CIE1931 (xy) model. The values for the state are defined in the following table.

Value	Description
0x0000	The value of 0 representing the x coordinate of a CIE1931 color light
0x0001–0xFFFFE	The 16-bit value representing the x coordinate of a CIE1931 color light
0xFFFF	The value of 1 representing the x coordinate of a CIE1931 color light

Table 6.19: Light xyL x states

#### 6.1.5.1.1 Binding with the Generic OnPowerUp state

The Light xyL x state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

$$\text{Light xyL x} = \text{Light xyL x Default}$$

for values of the Generic OnPowerUp state equal to 0x00, or equal to 0x01, or

$$\text{Light xyL x} = \text{last known value (before powered down) for the Light xyL x}$$

for value of the Generic OnPowerUp state equal to 0x02.

#### 6.1.5.1.2 Binding with the xyL x Range state

The Light xyL x state is bound to an instance of the Light xyL x Range state (see Section 6.1.5.3), meaning that whenever the Light xyL x state of an element changes, the following calculations shall be performed:

$$\text{Light xyL x} = \text{Light xyL x Range Min}$$

for values of the Light xyL x state that are less than the value of the Light xyL x Range Min state

Light xyL x = Light xyL x Range Max

for values of the Light xyL x state that are greater than the value of the Light xyL x Range Max state

### 6.1.5.2 Light xyL x Default

The Light xyL x Default state represents a default x value for the Light xyL x state. The purpose of the Light xyL x Default state is to determine the x value of an element when powered up and when the Generic OnPowerUp state (see Section 3.1.4) bound to the Light xyL state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The 16-bit value representing the x

Table 6.20: Light xyL x Default states

### 6.1.5.3 Light xyL x Range

The Light xyL x Range state determines the minimum and maximum values of the Light xyL x state of an element. This is a pair of 16-bit unsigned integers: Light xyL x Range Min and Light xyL x Range Max.

The Light xyL x Range Min state determines the minimum value of a Light xyL x state an element is configured to. The Light xyL x Range Max state determines the maximum value of a Light xyL x an element is configured to. The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The value of a Light xyL x state of an element

Table 6.21: Light xyL x Min and Light xyL x Max states

### 6.1.5.4 Light xyL y

The Light xyL y state determines the y coordinate on the CIE1931 color space chart of a color light emitted by an element. This is a 16-bit unsigned integer representation of a scale from 0 to 1 using the formula:

$$\text{CIE1931\_y} = (\text{Light xyL y}) / 65535$$

where CIE1931\_y is the y coordinate on the CIE1931 color space chart of a color light, as represented by the CIE1931 (xy) model. The values for the state are defined in the following table.

Value	Description
0x0000	The value of 0 representing the y coordinate of a CIE1931 color light
0x0001–0xFFFF	The 16-bit value representing the y coordinate of a CIE1931 color light
0xFFFF	The value of 1 representing the y coordinate of a CIE1931 color light

Table 6.22: Light xyL y states

#### 6.1.5.4.1 Binding with the Generic OnPowerUp state

The Light xyL y state is bound to an instance of the Generic OnPowerUp state (see Section 3.1.4), meaning that during a power up sequence (when an element is physically powered up), the following calculations shall be performed:

Light xyL y = Light xyL y Default

for values of the Generic OnPowerUp state equal to 0x00, or equal to 0x01, or

Light xyL y = last known value (before powered down) for the Light xyL y

for value of the Generic OnPowerUp state equal to 0x02.

#### 6.1.5.4.2 Binding with the xyL y Range state

The Light xyL y state is bound to an instance of the Light xyL y Range state (see Section 6.1.5.6), meaning that whenever the Light xyL y state of an element changes, the following calculations shall be performed:

Light xyL y = Light xyL y Range Min

for values of the Light xyL y state that are less than the value of the Light xyL y Range Min state

Light xyL y = Light xyL y Range Max

for values of the Light xyL y state that are greater than the value of the Light xyL y Range Max state

#### 6.1.5.5 Light xyL y Default

The Light xyL y Default state represents a default y value for the Light xyL y state. The purpose of the Light xyL y Default state is to determine the y value of an element when powered up and when the Generic OnPowerUp state (see Section 3.1.4) bound to the Light xyL state is set to 0x01 (Default). The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The 16-bit value representing the y

Table 6.23: Light xyL y Default states

#### 6.1.5.6 Light xyL y Range

The Light xyL y Range state determines the minimum and maximum values of the Light xyL y state of an element. This is a pair of 16-bit unsigned integers: Light xyL y Range Min and Light xyL y Range Max.

The Light xyL y Range Min state determines the minimum value of a Light xyL y state an element is configured to. The Light xyL y Range Max state determines the maximum value of a Light xyL y an element is configured to. The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	The value of a Light xyL y state of an element

Table 6.24: Light xyL y Min and Light xyL y Max states

#### 6.1.5.7 Light xyL Lightness

The Light xyL Lightness state determines the lightness of a color light emitted by an element on a perceptually uniform lightness scale [6]. The values for the state are defined in the following table.

Value	Description
0x0000	Light is not emitted by the element
0x0001–0xFFFF	The perceived lightness of a light emitted by the element
0xFFFF	The highest perceived lightness of a light emitted by the element.

Table 6.25: Light xyL Lightness states

The perceived lightness of a light ( $L$ ) is approximately the square root of the measured light intensity ( $Y$ )

$$L = 65535 \sqrt{\frac{Y}{65535}}$$

Where  $L$  is the perceived lightness and  $Y$  is the measured light intensity (from 0 to 65535).

Note: The scientific community's understanding of the exact relationship between the L and Y variables has changed over time. Appendix A.2 summarizes these changes. For a detailed history, see "The Basis of Physical Photometry" [17] from the International Commission of Illumination (CIE). The CIE works with the International Organization for Standardization (ISO) to define global standards for various types of illumination. The organization's published illumination standards and research publications are available on the CIE website.

### 6.1.5.8 Binding with the Light HSL state

When a node implements Light HSL Server (see Section 6.4.6) and Light xyL Server (see Section 6.4.10) located on the same element, the Light xyL state and the Light HSL state are bound indirectly via the Light Lightness Actual state. The Light xyL state is bound to the Light Lightness Actual state and the Light HSL state is bound to the same Light Lightness Actual state. This implies binding between the Light xyL Lightness and the Light HSL Lightness states.

When the Light xyL state is bound to an instance of a Light HSL state the following binding rules shall be implemented:

Whenever the Light xyL state of an element changes, the following calculation shall be performed:

$$\text{Light HSL Lightness} = \text{Light xyL Lightness}$$

Whenever the Light HSL state of an element changes, the following calculation shall be performed:

$$\text{Light xyL Lightness} = \text{Light HSL Lightness}$$

The Light xyL x state and Light xyL y state pair and Light HSL Hue state and Light HSL Saturation state pair shall be bound. This specification does not define binding formulas since the calculations depend on the actual implementation of a device (especially the spectral power distribution of a light source).

## 6.2 Lighting control

### 6.2.1 Introduction

Automated lighting control is handled by light controllers that are defined as state machines and feedback regulators.

Light controllers have inputs for collecting data from sensors, usually by receiving sensor messages (see Section 4.2).

Light controllers also have settings that are represented as Light Control Setting states exposed via Lighting Control models (see Section 6.5).

Outputs from light controllers are represented as states that are bound to other states within an element. For example, a controller that controls light level has its output state bound with the Light Lightness Linear state (see Section 6.1.2.1).

### 6.2.2 Light Lightness controller

The Light Lightness controller controls lightness of an element implementing a Light Lightness Server model through a binding with the Light Lightness Linear state of an element (see Section 6.1.2.1).

Figure 6.4 illustrates the principles of operation of a Light Lightness controller.



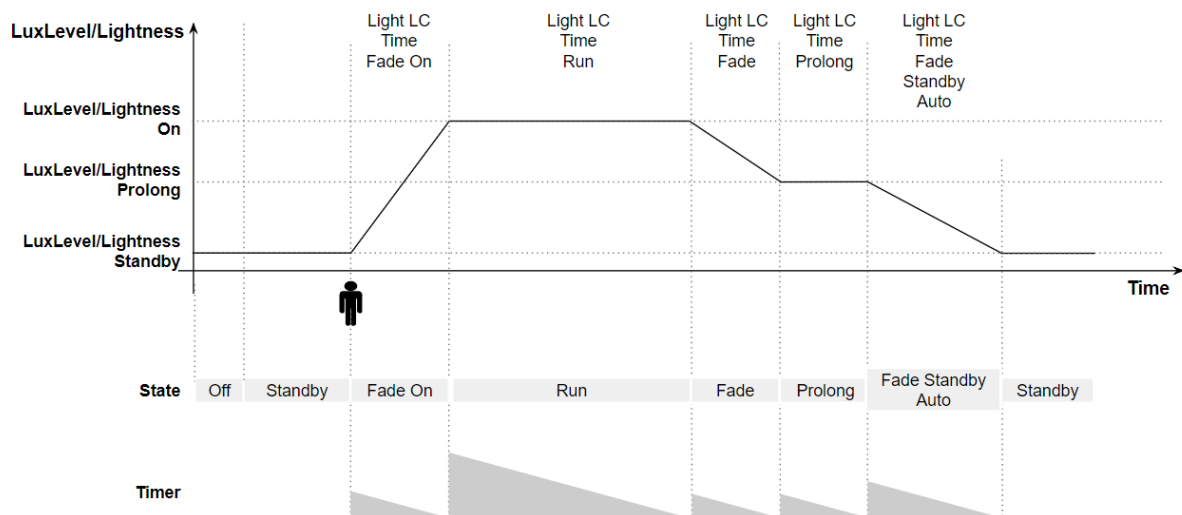


Figure 6.4: Operation of a Light Lightness controller

The controller has eight phases of operation:

1. Off – the controller is turned off and does not control lighting
2. Standby – the controller is turned on and awaits an event from an occupancy sensor or a manual switch
3. Fade On – the controller has been triggered and gradually transitions to the Run phase, gradually dimming the lights up.
4. Run – the lights are on and the timer counts down (but may be retriggered by a sensor or a switch event)
5. Fade – the Run timer has expired and the controller gradually transitions to the Prolong state
6. Prolong – the lights are at a lower level and the timer counts down (but may be retriggered by a sensor or a switch event)
7. Fade Standby Auto – the controller gradually returns to the Standby state
8. Fade Standby Manual – the controller gradually returns to the Standby state after external event

In the Standby, Run, and Prolong states, the light level may be a preset level or a level stabilized with an ambient light level sensor.

Figure 6.5 illustrates a structure of a Light Lightness controller.

The controller has 5 inputs to the Light LC state machine (see Section 6.2.5): Mode, Timer, Occupancy Mode, Occupancy and Light OnOff, and one input to the Light LC PI Feedback Regulator: Ambient LuxLevel Level.

The Mode input is represented by the Light LC Mode state (see Section 6.2.3.1). The state is controlled by Light LC Mode messages (see Section 6.3.5.1). The state is bound to the Light Lightness Linear state and changes when there is an unsolicited change of the bound Light Lightness Linear state.

The Timer is managed by the state machine. It is set to a starting value (time in seconds) and counts down to zero.

The Occupancy Mode input is represented by the Light LC Occupancy Mode state (see Section 6.2.3.2). The state is controlled by Light LC Occupancy Mode messages (see Section 6.3.5.2).

The Occupancy Input is represented by the Light LC Occupancy state (see Section 6.2.3.4) and accepts data reported by one or more sensors reporting the Occupancy Property [13] with Sensor Status messages (see Section 4.2.14).

The Light OnOff input is represented by the Light LC Light OnOff state (see Section 6.2.3.3). The state is controlled by Light LC Light OnOff messages (see Section 6.3.5.3) and can also be changed by the Light LC state machine (see Section 6.2.5).

The Ambient LuxLevel Input is represented by the Light LC Ambient LuxLevel state (see Section 6.2.3.4) and accepts data reported by zero or more sensors reporting the Ambient LuxLevel Property [13] with Sensor Status messages (see Section 4.2.14).

The Output from the Light LC controller is the Light LC Linear Output state (see Section 6.2.3.6) that is conditionally bound to the Light Lightness Linear state of an element (see Section 6.1.2.1).

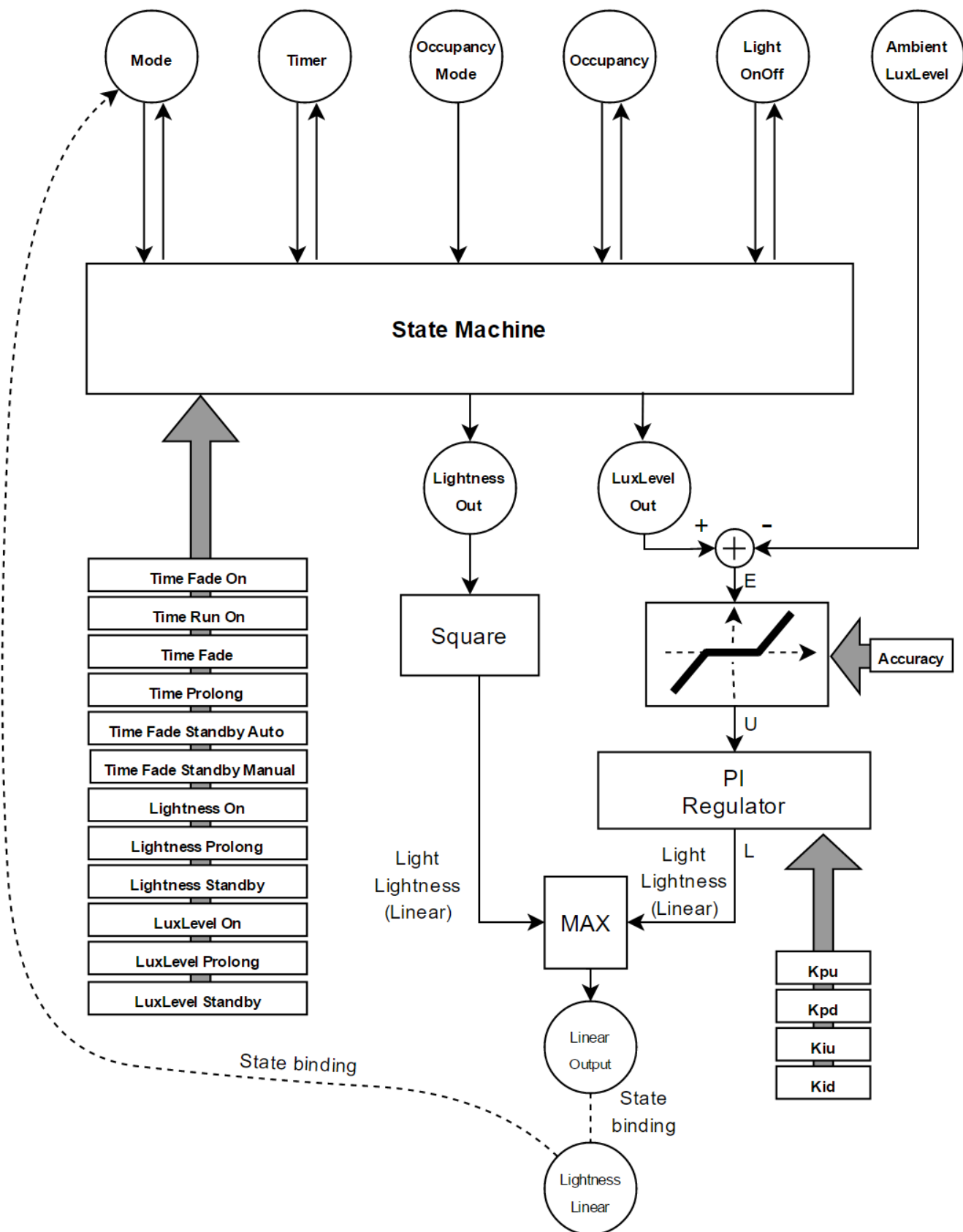


Figure 6.5: Light Lightness controller structure

## 6.2.3 Light LC states

### 6.2.3.1 Light LC Mode

Light LC Mode is a binary state that determines the mode of operation of the controller. The values for the state are defined in the following table. The default value is 0b0.

Value	Description
0b0	The controller is turned off. The binding with the Light Lightness state is disabled.
0b1	The controller is turned on. The binding with the Light Lightness state is enabled.

Table 6.26: Light LC Mode states

Value 0b0 represents the controller is turned off and the binding between the Light LC Linear Output state (see Section 6.2.3.6) and the Light Lightness Linear state (see Section 6.1.2.1) shall be disabled.

Value 0b1 represents the controller is turned on and the binding between the Light LC Linear Output state (see Section 6.2.3.6) and the Light Lightness Linear state (see Section 6.1.2.1) shall be enabled.

The Light LC Mode state is bound to an instance of the Light Lightness Linear state (see Section 6.1.2.1). Upon an unsolicited change of the Light Lightness Linear state (i.e., a change that is not a result of a change of the bound Light LC Linear Output state, see Section 6.2.3.6), the following operation shall be performed, disabling the binding between the Light LC Linear Output and the Light Lightness Linear state:

Light LC Mode = 0b0

### 6.2.3.2 Light LC Occupancy Mode

Light LC Occupancy Mode is a binary state that determines if a controller transitions from a standby state (see Section 6.2.5) when an occupancy sensor reports occupancy. The values for the state are defined in the following table. The default value is 0b1.

Value	Description
0b0	The controller does not transition from a standby state when occupancy is reported.
0b1	The controller may transition from a standby state when occupancy is reported.

Table 6.27: Light LC Occupancy Mode states

Value 0b0 represents the controller shall not transition from the standby state when an occupancy sensor reports occupancy.

Value 0b1 represents the controller may transition from the standby state when an occupancy sensor reports occupancy.

### 6.2.3.3 Light LC Light OnOff

Light LC Light OnOff is a binary state that represents the state of a Light Lightness controller. The values for the state are defined in the following table.

Value	Description
0b0	Light LC State Machine state is equal to Off or equal to Standby
0b1	Light LC State Machine state is not equal to Off and not equal to Standby

Table 6.28: Light LC Light OnOff states

Note: The Light LC Light OnOff acts as a control point. When the Light LC Light OnOff state is set to a new value (e.g., by a message or as a result of a bound state change), the Light LC

Light OnOff state value is not changed directly, but an event is generated (see Section 6.2.5.2). This event may change the Light LC State Machine state and thus the value of the Light LC Light OnOff may also change. The following table summarizes the described mechanism.

State value	Set to new state value	Event generated
0b0	0b0	Light Off
0b0	0b1	Light On
0b1	0b0	Light Off
0b1	0b1	Light On

Table 6.29: Setting the Light LC Light OnOff state summary

#### 6.2.3.3.1 Binding with the Generic OnOff state

The Light LC Light OnOff state is bound to an instance of the Generic OnOff state (see Section 3.1.1), meaning that whenever the Generic OnOff state of an element is set, the following calculations shall be performed:

Light LC Light OnOff = 0b0

for value of the Generic OnOff equal to 0b0, or

Light LC Light OnOff = 0b1

for value of the Generic OnOff equal 0b1.

A reverse binding is also defined, meaning that whenever the Light LC Light OnOff state of an element changes, the following calculations shall be performed:

Generic OnOff = 0b0

for value of the Light LC Light OnOff equal to 0b0, or

Generic OnOff = 0b1

for value of the Light LC Light OnOff equal to 0b1.

#### 6.2.3.4 Light LC Occupancy

Light LC Occupancy is a binary state that represents occupancy reported by an occupancy sensor. The values for the state are defined in the following table.

Value	Description
0b0	There is no occupancy reported by occupancy sensors.
0b1	There has been occupancy reported by occupancy sensors.

Table 6.30: Light LC Occupancy states

Value 0b0 represents no occupancy has been reported.

Value 0b1 represents occupancy has just been reported.

This state has a concept of time elapsing, meaning it notifies the Light LC state machine (see Section 6.2.5) on every change, including a change to the same value.

#### 6.2.3.5 Light LC Ambient LuxLevel

Light LC Ambient LuxLevel is a uint24 state that represents the Ambient LuxLevel level, with accuracy of 0.01 lux, reported by an ambient light sensor. The values for the state are defined in the following table.



Value	Description
0x000000–0xFFFFF	Illuminance from 0.00 to 167772.16 lux

Table 6.31: Light LC Ambient LuxLevel states

This state has a concept of time elapsing, meaning it notifies the Light LC state machine (see Section 6.2.5) on every change, including a change to the same value.

### 6.2.3.6 Light LC Linear Output

The Light LC Linear Output state, with a value ranging from 0x0000 to 0xFFFF, represents the lightness of a light on a linear scale. The state is bound to the Light Lightness Linear state (see Section 6.1.2.1). The values for the state are defined in the following table.

Value	Description
0x0000	Light is not emitted by the element.
0x0001–0xFFFFE	The lightness of a light emitted by the element.
0xFFFF	The highest lightness of a light emitted by the element.

Table 6.32: Light LC Linear Output states

The linear lightness of a light is equal to the measured light intensity (Y), from 0 to 65535.

The value of the state is calculated using the formula:

$$\text{Light LC Linear Output} = \max((\text{Lightness Out})^2/65535, \text{Regulator Output})$$

The Light Lightness Out state is defined in Section 6.2.5.13.2.

The Regulator Output is defined in Section 6.2.6.

#### 6.2.3.6.1 Binding with the Light Lightness Linear state

The Light LC Linear Output state is conditionally bound to an instance of the Light Lightness Linear state (see Section 6.1.2.1).

If the Light LC Mode state (see Section 6.2.3.1) is set to 0b1, the binding is enabled and upon a change of the Light LC Linear Output state, the following operation shall be performed:

$$\text{Light Lightness Linear} = \text{Light LC Linear Output}$$

If the Light LC Mode state (see Section 6.2.3.1) is set to 0b0, the binding is disabled (i.e., upon a change of the Light LC Linear Output state, no operation on the Light Lightness Linear state is performed).

## 6.2.4 Light LC Property states

The Light LC Property states are read / write states that determine the configuration of a Light Lightness Controller. Each state is represented by a device property and is controlled by Light LC Property messages (see Section 6.3.6).

### 6.2.4.1 Light LC Time Occupancy Delay

The Light LC Time Occupancy Delay is a timing state that determines the delay for changing the Light LC Occupancy state (see Section 6.2.3.4) upon receiving a Sensor Status message from an occupancy sensor (see Section 6.5.1.7.1). The state is represented by the Light Control Time Occupancy Delay Property [13].

#### 6.2.4.2 Light LC Time Fade On

The Light LC Time Fade On is a timing state that determines the time the controlled lights fade to the level determined by the Light LC Lightness On state (see Section 6.2.4.8). The state is represented by the Light Control Time Fade On Property [13].

#### 6.2.4.3 Light LC Time Run On

The Light LC Time Run On is a timing state that determines the time the controlled lights stay at the level determined by the Light LC Lightness On state (see Section 6.2.4.8) since the occupancy input stopped detecting active occupancy information. The state is represented by the Light Control Time Run On Property [13].

#### 6.2.4.4 Light LC Time Fade

The Light LC Time Fade is a timing state that determines the time the controlled lights fade from the level determined by the Light LC Lightness On state (see Section 6.2.4.8) to the level determined by the Light Lightness Prolong state (see Section 6.2.4.9). The state is represented by the Light Control Time Fade Property [13].

#### 6.2.4.5 Light LC Time Prolong

The Light LC Time Prolong is a timing state that determines the time the controlled lights stay at the level determined by the Light LC Lightness Prolong state (see Section 6.2.4.9).

#### 6.2.4.6 Light LC Time Fade Standby Auto

The Light LC Time Fade Standby Auto is a timing state that determines the time the controlled lights fade from the level determined by the Light LC Lightness Prolong state (see Section 6.2.4.9) to the level determined by the Light LC Lightness Standby state (see Section 6.2.4.10) when the transition is automatic. The state is represented by the Light Control Time Fade Standby Property [13].

#### 6.2.4.7 Light LC Time Fade Standby Manual

The Light LC Time Fade Standby Manual is a timing state that determines the time the controlled lights fade from the level determined by the Light LC Lightness Prolong state (see Section 6.2.4.9) to the level determined by the Light LC Lightness Standby state (see Section 6.2.4.10) when the transition is triggered by a change in the Light LC Light OnOff state (see Section 6.2.3.3). The state is represented by the Light Control Time Fade Standby Property [13].

#### 6.2.4.8 Light LC Lightness On

The Light LC Lightness On is a lightness state that determines the perceptive light lightness at the Occupancy and Run internal controller states. The state is represented by the Light Control Lightness On Property [13].

#### 6.2.4.9 Light LC Lightness Prolong

The Light LC Lightness Prolong is a lightness state that determines the light lightness at the Prolong internal controller state. The state is represented by the Light Control Lightness Prolong Property [13].

#### 6.2.4.10 Light LC Lightness Standby

The Light LC Lightness Standby is a lightness state that determines the light lightness at the Standby internal controller state. The state is represented by the Light Control Lightness Standby Property [13].

#### 6.2.4.11 Light LC Ambient LuxLevel On

The Light LC Ambient LuxLevel On is a uint16 state representing the Ambient LuxLevel level that determines if the controller transitions from the Light Control Standby state (see Section 6.2.3).

The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	Illuminance from 0 to 65535 lux

Table 6.33: Light LC Ambient LuxLevel On states

The state is represented by the Light Control Ambient LuxLevel On Property [13].

#### 6.2.4.12 Light LC Ambient LuxLevel Prolong

The Light LC Ambient LuxLevel Prolong is a uint16 state representing the required Ambient LuxLevel level in the Prolong state (see Section 6.2.3).

The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	Illuminance from 0 to 65535 lux

Table 6.34: Light LC Ambient LuxLevel Prolong states

The state is represented by the Light Control Ambient LuxLevel Prolong Property [13].

#### 6.2.4.13 Light LC Ambient LuxLevel Standby

The Light LC Ambient LuxLevel Standby is a uint16 state representing the required Ambient LuxLevel level in the Standby state (see Section 6.2.3).

The values for the state are defined in the following table.

Value	Description
0x0000–0xFFFF	Illuminance from 0 to 65535 lux

Table 6.35: Light LC Ambient LuxLevel Standby states

The state is represented by the Light Control Ambient LuxLevel Standby Property [13].

#### 6.2.4.14 Light LC Regulator Kiu

The Light LC Regulator Kiu is a float32 state representing the integral coefficient that determines the integral part of the equation defining the output of the Light LC PI Feedback Regulator (see Section 6.2.6), when Light LC Ambient LuxLevel is less than LuxLevel Out.

The values for the state are defined in the following table. The default value is 250.0.

Value	Description
0.0–1000.0	Integral coefficient when increasing output
All other values	Prohibited

Table 6.36: Light LC Regulator Kiu states

The state is represented by the Light Control Regulator Kiu Property [13].

Note: With the default value of 100.0 and 400 lux value on the regulator input the output will reach the value of 40000 (2/3 of the range) within approximately 1s.

#### 6.2.4.15 Light LC Regulator Kid

The Light LC Regulator Kid is a float32 state representing the integral coefficient that determines the integral part of the equation defining the output of the Light LC PI Feedback Regulator (see Section 6.2.6), when Light LC Ambient LuxLevel is greater than or equal to the value of the LuxLevel Out state.

The values for the state are defined in the following table. The default value is 25.0.



Value	Description
0.0–1000.0	Integral coefficient when decreasing output
All other values	Prohibited

Table 6.37: Light LC Regulator Kid states

The state is represented by the Light Control Regulator Kid Property [13].

#### 6.2.4.16 Light LC Regulator Kpu

The Light LC Regulator Kpu is a float32 state representing the proportional coefficient that determines the proportional part of the equation defining the output of the Light LC PI Feedback Regulator (see Section 6.2.6), when Light LC Ambient LuxLevel is less than the value of the LuxLevel Out state.

The values for the state are defined in the following table. The default value is 80.0.

Value	Description
0.0–1000.0	Proportional coefficient when increasing output
All other values	Prohibited

Table 6.38: Light LC Regulator Kpu states

The state is represented by the Light Control Regulator Kpu Property [13].

#### 6.2.4.17 Light LC Regulator Kpd

The Light LC Regulator Kpd is a float32 state representing the proportional coefficient that determines the proportional part of the equation defining the output of the Light LC PI Feedback Regulator (see Section 6.2.6), when Light LC Ambient LuxLevel is greater than or equal to the value of the LuxLevel Out state.

The values for the state are defined in the following table. The default value is 80.0.

Value	Description
0.0–1000.0	Proportional coefficient when decreasing output
All other values	Prohibited

Table 6.39: Light LC Regulator Kpd states

The state is represented by the Light Control Regulator Kpd Property [13].

#### 6.2.4.18 Light LC Regulator Accuracy

The Light LC Regulator Accuracy is a int8 state representing the percentage accuracy of the Light LC PI Feedback Regulator (see Section 6.2.6).

The values for the state are defined in the following table. The default value is 2.0.

Value	Description
0.0–100.0	Regulator accuracy (percentage)
All other values	Prohibited

Table 6.40: Light LC Regulator Accuracy states

The state is represented by the Light Control Regulator Accuracy Property [13].

### 6.2.5 Light LC State Machine

The behavior of the Light Lightness controller is described in terms of a finite state machine.

Figure 6.6 and Figure 6.7 illustrate the possible states and transitions of the state machine.

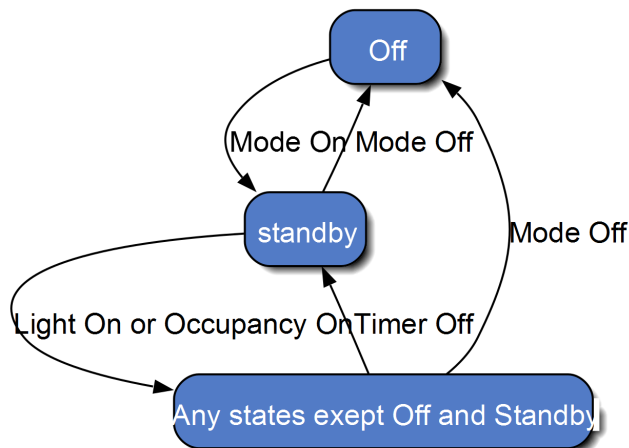


Figure 6.6: Light LC State Machine – Part 1

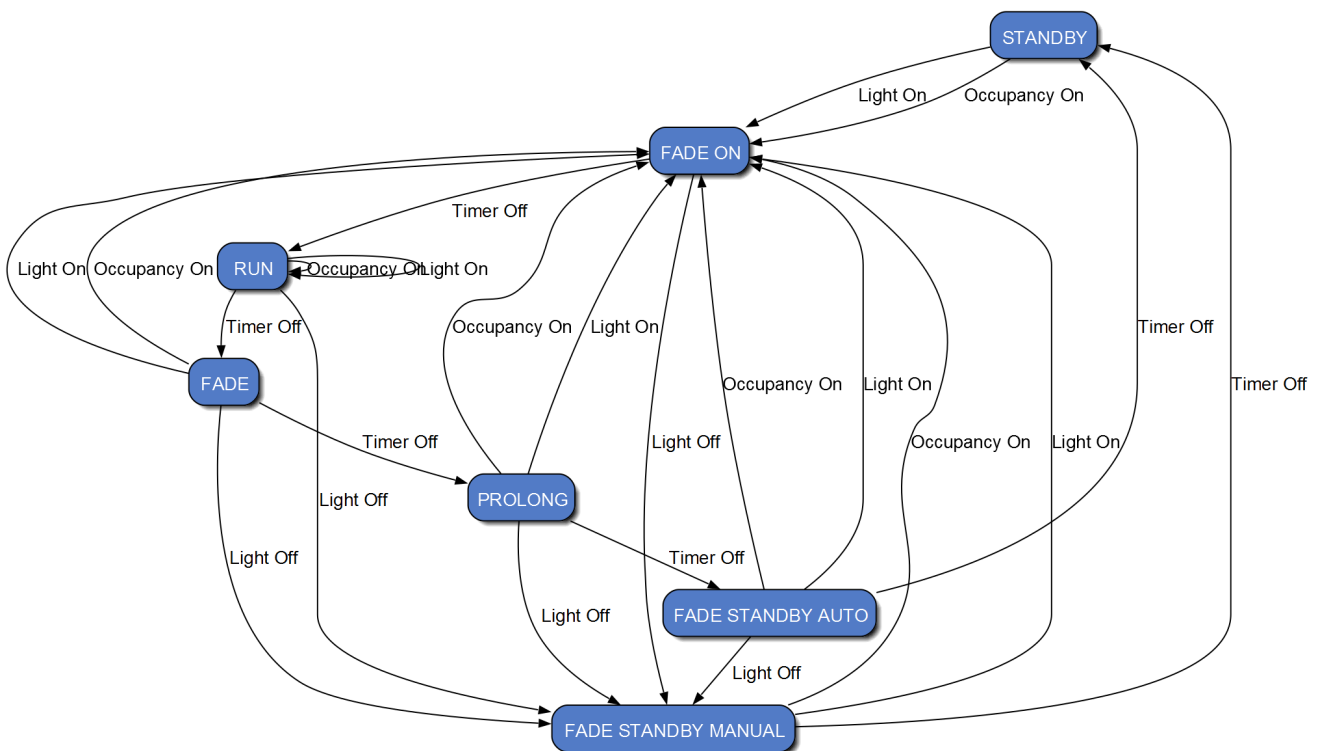


Figure 6.7: Light LC State Machine – Part 2

### 6.2.5.1 Light LC State Machine states

The following states are defined as Light LC State Machine states.

- **Off:** the controller is disabled. Light Lightness is not controlled.
- **Standby:** no occupancy is detected; the lights are set to the level defined by the Light Lightness Standby state (see Section 6.2.4.10).
- **Fade On:** occupancy has been detected; the lights are transitioning to the level defined by the Light Lightness On state (see Section 6.2.4.8).
- **Run:** occupancy is not detected; the lights stay at the level defined by the Light Lightness On state (see Section 6.2.4.8).

- **Fade:** occupancy is not detected; the lights are transitioning to the level defined by the Light Lightness Prolong state (see Section 6.2.4.9).
- **Prolong:** occupancy is not detected; the lights stay at the level defined by the Light Lightness Prolong state (see Section 6.2.4.9).
- **Fade Standby Auto:** occupancy is not detected; the lights are transitioning to the level defined by the Light Lightness Standby state (see Section 6.2.4.10) using the Light LC Time Fade Standby Auto time setting.
- **Fade Standby Manual:** an external event (such as receiving a Light LC Light OnOff Set message) has been received; the lights are transitioning to the level defined by the Light Lightness Standby state (see Section 6.2.4.10) using the Light LC Time Fade Standby Manual time setting.

### 6.2.5.2 Light LC State Machine events

The following events may cause transitions in the state diagram.

- **Mode On:** the value of the Light LC Mode state has changed from 0b0 (Off) to 0b1 (On).
- **Mode Off:** the value of the Light LC Mode state has changed from 0b1 (On) to 0b0 (Off).
- **Occupancy On:** the value of the Light LC Occupancy state has been set to 0b1 (Occupancy)
- **Light On:** the value of the Light LC Light OnOff state has been set to 0b1 (On).
- **Light Off:** the value of the Light LC Light OnOff state has been set to 0b0 (Off).
- **Timer Off:** the value of the countdown Time Counter has reached 0

### 6.2.5.3 Light LC State Machine conditions

The following conditions are potential qualifiers for actions and state transitions to occur.

- **Auto Occupancy:** The value of the Light LC Occupancy Mode state is 0b1 and the value of the Light LC Ambient LuxLevel state is less than the value of the Light LC Ambient LuxLevel On state.
- **No Auto Occupancy:** The value of the Light LC Occupancy Mode state is equal to 0b0 or the value of the Light LC Ambient LuxLevel state is greater or equal to the value of the Light LC Ambient LuxLevel On state.
- **Occupancy On:** The value of the Light LC Occupancy state is 0b1.
- **Occupancy Off:** The value of the Light LC Occupancy state is 0b0.

### 6.2.5.4 Light LC State Machine actions

In some cases, a state transition causes one or more of the following actions to occur. The actions for a state transition shall occur in their entirety before any subsequent state transition occurs, as follows.

- **Set Light LC Light OnOff** to 0b0 or 0b1: sets the Light LC Light OnOff state. If the Next State is Fade On, Fade, Fade Standby Auto, Fade Standby Manual, the value provided is the target value of the Light LC OnOff state.
- **Set Timer** to Tn: Starts an internal countdown timer. The initial value Tn is in seconds. The timer runs down to 0 and can be restarted at any time. After reaching 0, the timer generates a Timer Off event.

The following defines values for Tn:

Tn	Value
T1	Light LC Time_Fade_On
T2	Light LC Time_Run_On
T3	Light LC Time_Fade
T4	Light LC Time_Prolong
T5	Light LC Time_Fade_Standby_Auto
T6	Light LC Time_Fade_Standby_Manual

Table 6.41: Tn values for Set Timer

### 6.2.5.5 Light LC State Machine Off state

Table 6.42 defines the events, conditions, actions and next states for the Off state.

Event	Condition	Action	Next State
Mode On	-	Abort Timer	Standby

Table 6.42: Off state event table

### 6.2.5.6 Light LC State Machine Standby state

Table 6.43 defines the events, conditions, actions and next states for the Standby state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light On	-	Set Light LC Light OnOff to 0b1 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade On
Occupancy On	Auto Occupancy	Set Light LC Light OnOff to 0b1 Set Timer to T1	Fade On

Table 6.43: Standby state event table

### 6.2.5.7 Light LC State Machine Fade On state

Table 6.44 defines the events, conditions, actions and next states for the Fade On state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light Off	-	Set Light LC Light OnOff to 0b0 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade Standby Manual
Timer Off	-	Set Timer to T2	Run

Table 6.44: On state event table

### 6.2.5.8 Light LC State Machine Run state

Table 6.45 defines the events, conditions, actions and next states for the Run state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light Off	-	Set Light LC Light OnOff to 0b0 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade Standby Manual
Occupancy On	-	Set Light LC Occupancy to 0b0 Set Timer to T2	Run
Light On	-	Set Timer to T2	Run
Timer Off	-	Set Timer to T3	Fade

Table 6.45: Run state event table

### 6.2.5.9 Light LC State Machine Fade state

Table 6.46 defines the events, conditions, actions and next states for the Fade state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light Off	-	Set Light LC Light OnOff to 0b0 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade Standby Manual
Occupancy On	-	Set Light LC Occupancy to 0b0 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade On
Light On	-	Set Timer to T1	Fade On
Timer Off	-	Set Timer to T4	Prolong

Table 6.46: Fade state event table

### 6.2.5.10 Light LC State Machine Prolong state

Table 6.47 defines the events, conditions, actions and next states for the Prolong state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light Off	-	Set Light LC Light OnOff to 0b0 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade Standby Manual
Occupancy On	-	Set Light LC Occupancy to 0b0 Set Timer to T1	Fade On
Light On	-	Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade On
Timer Off	-	Set Light LC Light OnOff to 0b0 Set Timer to T5	Fade Standby Auto

Table 6.47: Prolong state event table

### 6.2.5.11 Light LC State Machine Fade Standby Auto state

Table 6.48 defines the events, conditions, actions and next states for the Fade Standby Auto state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light Off	-	Set Light LC Light OnOff to 0b0 Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade Standby Manual
Occupancy On	-	Set Light LC Occupancy to 0b0 Set Timer to T1	Fade On
Light On	-	Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade On
Timer Off	-	Abort Timer	Standby

Table 6.48: Fade Standby Auto state event table

### 6.2.5.12 Light LC State Machine Fade Standby Manual state

Table 6.49 defines the events, conditions, actions and next states for the Fade Standby Manual state.

Event	Condition	Action	Next State
Mode Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Off
Light On	-	Set Timer to Transition Time (see Section 6.2.5.13.1)	Fade On
Timer Off	-	Set Light LC Light OnOff to 0b0 Abort Timer	Standby

Table 6.49: Fade Standby Manual state event table

### 6.2.5.13 Light LC State Machine outputs

The state machine defines two output states: the Lightness Level output state and the Light Level output state.

#### 6.2.5.13.1 Transition Time

The Fade On, Fade, Fade Standby Auto, and Fade Standby Manual states are transition states that define the transition of the Lightness Out and LuxLevel Out states. This transition can be started as a result of the Light LC State Machine change or as a result of receiving the Light LC Light OnOff Set or Light LC Light Set Unacknowledged message (see Section 6.5.1.6.2).

If the transition is started as a result of receiving the Light LC Light OnOff Set or Light LC Light Set Unacknowledged message (see Section 6.5.1.6.2), and the Transition Time field is present in this message, it shall be used as the Transition Time. Otherwise the Transition Time for each transition is defined in the table below:

State	Transition Time
Fade On	Light LC Time Fade On
Fade	Light LC Time Fade
Fade Standby Auto	Light LC Time Fade Standby Auto
Fade Standby Manual	Light LC Time Fade Standby Manual

Table 6.50: Transition Time values

### 6.2.5.13.2 Lightness Out state

Table 6.51 defines the formulas that shall be used when calculating the value of the Lightness Out state, depending on the state of the state machine.

The Initial Lightness is the initial value of the Lightness Out state when the transition to the target state starts.

State	Lightness Out formula
Off	0
Standby	Light LC Lightness Standby
Fade On	Light LC Lightness On – Timer / Transition Time * (Light LC Lightness On – Initial Lightness)
Run	Light LC Lightness On
Fade	Light LC Lightness Prolong - Timer / Transition Time * (Light LC Lightness Prolong – Initial Lightness)
Prolong	Light LC Lightness Prolong
Fade Standby Auto	Light LC Lightness Standby - Timer / Transition Time * (Light LC Lightness Standby – Initial Lightness)
Fade Standby Manual	Light LC Lightness Standby - Timer / Transition Time * (Light LC Lightness Standby – Initial Lightness)

Table 6.51: Lightness Out formulas

### 6.2.5.13.3 LuxLevel Out state

Table 6.52 defines the formulas that shall be used when calculating the value of the LuxLevel Out state, depending on the state of the state machine.

The Initial LuxLevel is the initial value of the LuxLevel Out state when the transition to the target state starts.

State	LuxLevel Out formula
Off	0
Standby	Light LC Ambient LuxLevel Standby
Fade On	Light LC Ambient LuxLevel On – Timer / Transition Time * (Light LC Ambient LuxLevel On - Initial LuxLevel)
Run	Light LC Ambient LuxLevel On
Fade	Light LC Ambient LuxLevel Prolong - Timer / Transition Time * (Light LC Ambient LuxLevel Prolong - Initial LuxLevel)
Prolong	Light LC Ambient LuxLevel Prolong
Fade Standby Auto	Light LC Ambient LuxLevel Standby - Timer / Transition Time * (Light LC Ambient LuxLevel Standby - Initial LuxLevel)
Fade Standby Manual	Light LC Ambient LuxLevel Standby - Timer / Transition Time * (Light LC Ambient LuxLevel Standby - Initial LuxLevel)

Table 6.52: LuxLevel Out formulas

## 6.2.6 Light LC PI Feedback Regulator

The purpose of the PI (Proportional-Integral) Feedback Regulator is setting the light to a level that ensures the value of the Light LC Ambient LuxLevel state (see Section 6.2.3.5) reported by an ambient light sensor is equal to the required value for a given state, as defined in Table 6.52.

Assuming the following notation:

E	adjustment error
U	regulator input
L	regulator output
I	Internal sum
T	Summation interval [s]
D	Accuracy
Kiu	value of the Light LC Regulator Kiu state
Kid	value of the Light LC Regulator Kid state
Piu	value of the Light LC Regulator Piu state
Pid	value of the Light LC Regulator Pid state

The following calculations are being performed at every interval T:

$$E = (\text{LuxLevel Out}) - (\text{Light LC Ambient LuxLevel})$$

$$D = (\text{Light LC Regulator Accuracy}) * (\text{LuxLevel Out}) / 2$$

$$\text{When } E \text{ is greater than } D, U = E - D$$

$$\text{When } E \text{ is less than } -D, U = E + D$$

$$\text{When } E \text{ is within the inclusive range } [-D, D], U = 0$$

$$I_n = I_{n-1} + U * T * Kiu, \text{ when } U \text{ is greater than or equal to } 0$$

$$I_n = I_{n-1} + U * T * Kid, \text{ when } U \text{ is less than } 0$$

$$L_n = I_n + U * Kpu, \text{ when } U \text{ is greater than or equal to } 0$$

$$L_n = I_n + U * Kpd, \text{ when } U \text{ is less than } 0$$

The values T and I are within the ranges defined in the following table:

Variable	Values
I	0–65535
T	0.01–0.1 s

Table 6.53: PI Feedback Regulator variables

## 6.3 Lighting messages

Lighting messages operate on Lighting states (see Section 6.1).

### 6.3.1 Light Lightness messages

#### 6.3.1.1 Light Lightness Get

Light Lightness Get is an acknowledged message used to get the Light Lightness Actual state of an element (see Section 6.1.2.1).

The response to the Light Lightness Get message is a Light Lightness Status message.

There are no parameters for this message.



### 6.3.1.2 Light Lightness Set

The Light Lightness Set is an acknowledged message used to set the Light Lightness Actual state of an element (see Section 6.1.2).

The response to the Light Lightness Set message is a Light Lightness Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The target value of the Light Lightness Actual state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.54: Light Lightness Set message parameters

The Lightness field identifies the Light Lightness Actual state of the element (see Section 6.1.2.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.1.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.1.3 Light Lightness Set Unacknowledged

The Light Lightness Set Unacknowledged is an unacknowledged message used to set the Light Lightness Actual state of an element (see Section 6.1.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The target value of the Light Lightness Actual state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.55: Light Lightness Set Unacknowledged message parameters

The Lightness field identifies the Light Lightness Actual state of the element (see Section 6.1.2.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.1.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

#### 6.3.1.4 Light Lightness Status

The Light Lightness Status is an unacknowledged message used to report the Light Lightness Actual state of an element (see Section 6.1.2.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Lightness	2	The present value of the Light Lightness Actual state.
Target Lightness	2	The target value of the Light Lightness Actual state. (Optional)
Remaining Time	1	Format as defined in Section 3.1.3. (C.1)

C.1: If the Target Lightness field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 6.56: Light Lightness Status message parameters

The Present Lightness field identifies the present Light Lightness Actual state of the element (see Section 6.1.2.1).

When an element is in the process of changing the Light Lightness Actual state, the Target Lightness field identifies the target Light Lightness Actual state that the element is to reach (see Section 6.1.2.1).

When an element is not in the process of changing the Light Lightness Actual state, the Target Lightness field shall be omitted.

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Light Lightness Actual state of the element (see Section 1.4.1.1 and Section 6.1.2.1).

#### 6.3.1.5 Light Lightness Linear Get

Light Lightness Linear Get is an acknowledged message used to get the Light Lightness Linear state of an element (see Section 6.1.2.1).

The response to the Light Lightness Linear Get message is a Light Lightness Linear Status message.

There are no parameters for this message.

#### 6.3.1.6 Light Lightness Linear Set

The Light Lightness Linear Set is an acknowledged message used to set the Light Lightness Linear state of an element (see Section 6.1.2.1).

The response to the Light Lightness Linear Set message is a Light Lightness Linear Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The target value of the Light Lightness Linear state.

Field	Size (octets)	Notes
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.57: Light Lightness Linear Set message parameters

The Lightness field identifies the Light Lightness Linear state of the element (see Section 6.1.2.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.4.1.2.5.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.1.7 Light Lightness Linear Set Unacknowledged

The Light Lightness Linear Set Unacknowledged is an unacknowledged message used to set the Light Lightness Linear state of an element (see Section 6.1.2.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The target value of the Light Lightness Linear state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.58: Light Lightness Linear Set Unacknowledged message parameters

The Lightness field identifies the Light Lightness Linear state of the element (see Section 6.1.2.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.4.1.2.5.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.1.8 Light Lightness Linear Status

The Light Lightness Linear Status is an unacknowledged message used to report the Light Lightness Linear state of an element (see Section 6.1.2.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Lightness	2	The present value of the Light Lightness Linear state
Target Lightness	2	The target value of the Light Lightness Linear state (Optional)
Remaining Time	1	Format as defined in Section 3.1.3 (C.1)

C.1: If the Target Lightness field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 6.59: Light Lightness Linear Status message parameters

The Present Lightness field identifies the present Light Lightness Linear state of the element (see Section 6.1.2.1).

When an element is in the process of changing the Light Lightness Linear state, the Target Lightness field identifies the target Light Lightness Linear state that the element is to reach (see Section 6.1.2.1).

When an element is not in the process of changing the Light Lightness Linear state, the Target Lightness field shall be omitted.

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Light Lightness Linear state of the element (see Section 1.4.1.1 and Section 6.1.2.1).

### 6.3.1.9 Light Lightness Last Get

Light Lightness Last Get is an acknowledged message used to get the Light Lightness Last state of an element (see Section 6.1.2.3).

The response to the Light Lightness Last Get message is a Light Lightness Last Status message.

There are no parameters for this message.

### 6.3.1.10 Light Lightness Last Status

Light Lightness Last Status is an unacknowledged message used to report the Light Lightness Last state of an element (see Section 6.1.2.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Last

Table 6.60: Light Lightness Last Status message parameters

The Lightness field identifies the Light Lightness Last state of the element (see Section 6.1.2.1).

### 6.3.1.11 Light Lightness Default Get

Light Lightness Default Get is an acknowledged message used to get the Light Lightness Default state of an element (see Section 6.1.2.4).

The response to the Light Lightness Default Get message is a Light Lightness Default Status message.

There are no parameters for this message.

#### 6.3.1.12 Light Lightness Default Set

The Light Lightness Default Set is an acknowledged message used to set the Light Lightness Default state of an element (see Section 6.1.2.4).

The response to the Light Lightness Default Set message is a Light Lightness Default Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state

Table 6.61: Light Lightness Default Set message parameters

The Lightness field identifies the Light Lightness Default state of the element (see Section 6.1.2.4).

#### 6.3.1.13 Light Lightness Default Set Unacknowledged

The Light Lightness Default Set Unacknowledged is an unacknowledged message used to set the Light Lightness Default state of an element (see Section 6.1.2.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state

Table 6.62: Light Lightness Default Set Unacknowledged message parameters

The Lightness field identifies the Light Lightness Default state of the element (see Section 6.1.2.4).

#### 6.3.1.14 Light Lightness Default Status

Light Lightness Default Status is an unacknowledged message used to report the Light Lightness Default state of an element (see Section 6.1.2.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state

Table 6.63: Light Lightness Default Status message parameters

The Lightness field identifies the Light Lightness Default state of the element (see Section 6.1.2.4).

#### 6.3.1.15 Light Lightness Range Get

The Light Lightness Range Get is an acknowledged message used to get the Light Lightness Range state of an element (see Section 6.1.2.5).

The response to the Light Lightness Range Get message is a Light Lightness Range Status message.

There are no parameters for this message.

#### 6.3.1.16 Light Lightness Range Set

Light Lightness Range Set is an acknowledged message used to set the Light Lightness Range state of an element (see Section 6.1.2.5).

The response to the Light Lightness Range Get message is a Light Lightness Range Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Range Min	2	The value of the Lightness Range Min field of the Light Lightness Range state
Range Max	2	The value of the Lightness Range Max field of the Light Lightness Range state

Table 6.64: Light Lightness Range Set message parameters

The Range Min field identifies the Lightness Range Min field of the Light Lightness Range state of the element (see Section 6.1.2.5).

The Range Max field identifies the Lightness Range Max field of the Light Lightness Range state of the element (see Section 6.1.2.5).

The value of the Range Max field shall be greater or equal to the value of the Range Min field.

#### 6.3.1.17 Light Lightness Range Set Unacknowledged

Light Lightness Range Set Unacknowledged is an unacknowledged message used to set the Light Lightness Range state of an element (see Section 6.1.2.5).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Range Min	2	The value of the Lightness Range Min field of the Light Lightness Range state
Range Max	2	The value of the Lightness Range Max field of the Light Lightness Range state

Table 6.65: Light Lightness Range Set Unacknowledged message parameters

The Range Min field identifies the Lightness Range Min field of the Light Lightness Range state of the element (see Section 6.1.2.5).

The Range Max field identifies the Lightness Range Max field of the Light Lightness Range state of the element (see Section 6.1.2.5).

The value of the Range Max field shall be greater or equal to the value of the Range Min field.

#### 6.3.1.18 Light Lightness Range Status

Light Lightness Range Status is an unacknowledged message used to report the Light Lightness Range state of an element (see Section 6.1.2.5).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Status Code for the requesting message.
Range Min	2	The value of the Lightness Range Min field of the Light Lightness Range state
Range Max	2	The value of the Lightness Range Max field of the Light Lightness Range state

Table 6.66: Light Lightness Range Status message parameters

The Status Code field identifies the Status Code for the last operation on the Light Lightness Range state. The allowed values for status codes and their meanings are documented in Section 7.2.

The Range Min field identifies the Lightness Range Min field of the Light Lightness Range state of the element (see Section 6.1.2.5).

The Range Max field identifies the Lightness Range Max field of the Light Lightness Range state of the element (see Section 6.1.2.5).

## 6.3.2 Light CTL Messages

### 6.3.2.1 Light CTL Get

Light CTL Get is an acknowledged message used to get the Light CTL state of an element (see Section 6.1.3).

The response to the Light CTL Get message is a Light CTL Status message.

There are no parameters for this message.

### 6.3.2.2 Light CTL Set

Light CTL Set is an acknowledged message used to set the Light CTL Lightness state, Light CTL Temperature state, and the Light CTL Delta UV state of an element (see Section 6.1.3.6, Section 6.1.3.1, and Section 6.1.3.4).

The response to the Light CTL Set message is a Light CTL Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
CTL Lightness	2	The target value of the Light CTL Lightness state.
CTL Temperature	2	The target value of the Light CTL Temperature state.
CTL Delta UV	2	The target value of the Light CTL Delta UV state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.67: Light CTL Set message parameters

The CTL Lightness field identifies the Light CTL Lightness state of the element.

The CTL Temperature field identifies the Light CTL Temperature state of the element.

The CTL Delta UV field identifies the Light CTL Delta UV state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.2.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.2.3 Light CTL Set Unacknowledged

Light CTL Set Unacknowledged is an unacknowledged message used to set the Light CTL Lightness state, Light CTL Temperature state, and the Light CTL Delta UV state of an element (see Section 6.1.3.6, Section 6.1.3.1, and Section 6.1.3.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
CTL Lightness	2	The target value of the Light CTL Lightness state.
CTL Temperature	2	The target value of the Light CTL Temperature state.
CTL Delta UV	2	The target value of the Light CTL Delta UV state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.68: Light CTL Set Unacknowledged message parameters

The CTL Lightness field identifies the Light CTL Lightness state of the element.

The CTL Temperature field identifies the Light CTL Temperature state of the element.

The CTL Delta UV field identifies the Light CTL Delta UV state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.2.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.2.4 Light CTL Status

The Light CTL Status is an unacknowledged message used to report the Light CTL Lightness and the Light CTL Temperature state of an element (see Section 6.1.3.6 and 6.1.3.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present CTL Lightness	2	The present value of the Light CTL Lightness state



Field	Size (octets)	Notes
Present CTL Temperature	2	The present value of the Light CTL Temperature state
Target CTL Lightness	2	The target value of the Light CTL Lightness state (Optional)
Target CTL Temperature	2	The target value of the Light CTL Temperature state (C.1)
Remaining Time	1	Format as defined in Section 3.1.3 (C.1)

C.1: If the Target CTL Lightness field is present, the Target CTL Temperature and the Remaining Time fields shall also be present; otherwise these fields shall not be present.

*Table 6.69: Light CTL Status message parameters*

The Present CTL Lightness field identifies the present Light CTL Lightness state of the element (see Section 6.1.3.4).

The Present CTL Temperature field identifies the present Light CTL Temperature state of the node (see Section 6.1.3.1).

If present, the Target CTL Lightness field identifies the target Light CTL Lightness state that the node is to reach (see Section 6.1.3.4).

If present, the Target CTL Temperature field identifies the target Light CTL Temperature state that the element is to reach (see Section 6.1.3.1).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Light CTL state of the element (see Section 1.4.1.1 and Section 6.1.3).

### 6.3.2.5 Light CTL Temperature Get

Light CTL Temperature Get is an acknowledged message used to get the Light CTL Temperature state of an element (see Section 6.1.3.1).

The response to the Light CTL Temperature Get message is a Light CTL Temperature Status message.

There are no parameters for this message.

### 6.3.2.6 Light CTL Temperature Set

The Light CTL Temperature Set is an acknowledged message used to set the Light CTL Temperature state and the Light CTL Delta UV state of an element (see Section 6.1.3.1 and 6.1.3.4).

The response to the Light CTL Temperature Set message is a Light CTL Temperature Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
CTL Temperature	2	The target value of the Light CTL Temperature state.
CTL Delta UV	2	The target value of the Light CTL Delta UV state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

*Table 6.70: Light CTL Temperature Set message parameters*

The CTL Temperature field identifies the Light CTL Temperature state of the element.

The CTL Delta UV field identifies the Light CTL Delta UV state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.2.4.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.2.7 Light CTL Temperature Set Unacknowledged

The Light CTL Temperature Set Unacknowledged is an unacknowledged message used to set the Light CTL Temperature state and the Light CTL Delta UV state of an element (see Section 6.1.3.1 and 6.1.3.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
CTL Temperature	2	The target value of the Light CTL Temperature state.
CTL Delta UV	2	The target value of the Light CTL Delta UV state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.71: Light CTL Temperature Set Unacknowledged message parameters

The CTL Temperature field identifies the Light CTL Temperature state of the element.

The CTL Delta UV field identifies the Light CTL Delta UV state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.2.4.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.2.8 Light CTL Temperature Status

Light CTL Temperature Status is an unacknowledged message used to report the Light CTL Temperature and Light CTL Delta UV state of an element (see Section 6.1.3.1 and 6.1.3.4).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present CTL Temperature	2	The present value of the Light CTL Temperature state
Present CTL Delta UV	2	The present value of the Light CTL Delta UV state
Target CTL Temperature	2	The target value of the Light CTL Temperature state (Optional)
Target CTL Delta UV	2	The target value of the Light CTL Delta UV state (C.1)
Remaining Time	1	Format as defined in Section 3.1.3 (C.1)

C.1: If the Target CTL Temperature field is present, the Target CTL Delta UV field and the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 6.72: Light CTL Temperature Status message parameters

The Present CTL Temperature field identifies the present Light CTL Temperature state of the element (see Section 6.1.3.1).

The Present CTL Delta UV field identifies the present Light CTL Delta UV state of the element (see Section 6.1.3.4).

If present, the Target CTL Temperature field identifies the target Light CTL Temperature state that the element is to reach (see Section 6.1.3.1).

If present, the Target CTL Delta UV field identifies the target Light CTL Delta UV state that the element is to reach (see Section 6.1.3.4).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target state of the element (see Section 1.4.1.1 and Section 6.1.3).

### 6.3.2.9 Light CTL Temperature Range Get

The Light CTL Temperature Range Get is an acknowledged message used to get the Light CTL Temperature Range state of an element (see Section 6.1.3.3).

The response to the Light CTL Temperature Range Get message is a Light CTL Temperature Range Status message.

There are no parameters for this message.

### 6.3.2.10 Light CTL Temperature Range Set

Light CTL Temperature Range Set is an acknowledged message used to set the Light CTL Temperature Range state of an element (see Section 6.1.3.3).

The response to the Light CTL Temperature Range Get message is a Light CTL Temperature Range Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Range Min	2	The value of the Temperature Range Min field of the Light CTL Temperature Range state
Range Max	2	The value of the Temperature Range Max field of the Light CTL Temperature Range state

Table 6.73: Light CTL Temperature Range Set message parameters

The Range Min field identifies the Temperature Range Min field of the Light CTL Temperature Range state of the element (see Section 6.1.3.3).

The Range Max field identifies the Temperature Range Max field of the Light CTL Temperature Range state of the element (see Section 6.1.3.3).

The value of the Range Max field shall be greater or equal to the value of the Range Min field.

#### 6.3.2.11 Light CTL Temperature Range Set Unacknowledged

Light CTL Temperature Range Set Unacknowledged is an unacknowledged message used to set the Light CTL Temperature Range state of an element (see Section 6.1.3.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Range Min	2	The value of the Temperature Range Min field of the Light CTL Temperature Range state
Range Max	2	The value of the Temperature Range Max field of the Light CTL Temperature Range state

Table 6.74: Light CTL Temperature Range Set Unacknowledged message parameters

The Range Min field identifies the Temperature Range Min field of the Light CTL Temperature Range state of the element (see Section 6.1.3.3).

The Range Max field identifies the Temperature Range Max field of the Light CTL Temperature Range state of the element (see Section 6.1.3.3).

The value of the Range Max field shall be greater or equal to the value of the Range Min field.

#### 6.3.2.12 Light CTL Temperature Range Status

Light CTL Temperature Range Status is an unacknowledged message used to report the Light CTL Temperature Range state of an element (see Section 6.1.3.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Status Code for the requesting message.
Range Min	2	The value of the Temperature Range Min field of the Light CTL Temperature Range state
Range Max	2	The value of the Temperature Range Max field of the Light CTL Temperature Range state

Table 6.75: Light CTL Temperature Range Status message parameters

The Status Code field identifies the Status Code for the last operation on the Light CTL Temperature Range state. The allowed values for status codes and their meanings are documented in Section 7.2.

The Range Min field identifies the Temperature Range Min field of the Light CTL Temperature Range state of the element (see Section 6.1.3.3).

The Range Max field identifies the Temperature Range Max field of the Light CTL Temperature Range state of the element (see Section 6.1.3.3).

### 6.3.2.13 Light CTL Default Get

Light CTL Default Get is an acknowledged message used to get the Light CTL Temperature Default and Light CTL Delta UV Default states of an element (see Section 6.1.3).

The response to the Light CTL Default Get message is a Light CTL Default Status message.

There are no parameters for this message.

### 6.3.2.14 Light CTL Default Set

The Light CTL Default Set is an acknowledged message used to set the Light CTL Temperature Default state and the Light CTL Delta UV Default state of an element (see Section 6.1.3.2 and 6.1.3.5).

The response to the Light CTL Set message is a Light CTL Status message.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
Temperature	2	The value of the Light CTL Temperature Default state
Delta UV	2	The value of the Light CTL Delta UV Default state

Table 6.76: Light CTL Default Set message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The Temperature field identifies the Light CTL Temperature Default state of the element.

The Delta UV field identifies the Light CTL Delta UV Default state of the element.

### 6.3.2.15 Light CTL Default Set Unacknowledged

The Light CTL Default Set Unacknowledged is an unacknowledged message used to set the Light CTL Temperature Default state and the Light CTL Delta UV Default state of an element (see Section 6.1.3.2 and 6.1.3.5).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
Temperature	2	The value of the Light CTL Temperature Default state
Delta UV	2	The value of the Light CTL Delta UV Default state

Table 6.77: Light CTL Default Set Unacknowledged message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The Temperature field identifies the Light CTL Temperature Default state of the element.

The Delta UV field identifies the Light CTL Delta UV Default state of the element.

### 6.3.2.16 Light CTL Default Status

The Light CTL Default Status is an unacknowledged message used to report the Light CTL Temperature Default and the Light CTL Delta UV Default states of an element (see Section 6.1.3.2 and 6.1.3.5).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
Temperature	2	The value of the Light CTL Temperature Default state
Delta UV	2	The value of the Light CTL Delta UV Default state

Table 6.78: Light CTL Default Status message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The Temperature field identifies the Light CTL Temperature Default state of the element.

The Delta UV field identifies the Light CTL Delta UV Default state of the element.

### 6.3.3 Light HSL messages

#### 6.3.3.1 Light HSL Get

The Light HSL Get is an acknowledged message used to get the Light HSL Lightness (see Section 6.1.4.5), Light HSL Hue (see Section 6.1.4.1), and Light HSL Saturation (see Section 6.1.4.2) states of an element.

The response to the Light HSL Get message is a Light HSL Status message.

There are no parameters for this message.

#### 6.3.3.2 Light HSL Set

The Light HSL Set is an acknowledged message used to set the Light HSL Lightness (see Section 6.1.4.5) state, Light HSL Hue state (see Section 6.1.4.1), and the Light HSL Saturation state (see Section 6.1.4.2) of an element.

The response to the Light HSL Set message is a Light HSL Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
HSL Lightness	2	The target value of the Light HSL Lightness state
HSL Hue	2	The target value of the Light HSL Hue state
HSL Saturation	2	The target value of the Light HSL Saturation state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.79: Light HSL Set message parameters

The HSL Lightness field identifies the Light HSL Lightness state of the element.

The HSL Hue field identifies the Light HSL Hue state of the element.

The HSL Saturation field identifies the Light HSL Saturation state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.3.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.3.3 Light HSL Set Unacknowledged

The Light HSL Set Unacknowledged is an unacknowledged message used to set the Light HSL Lightness (see Section 6.1.4.5) state, Light HSL Hue state (see Section 6.1.4.1), and the Light HSL Saturation state (see Section 6.1.4.2) of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
HSL Lightness	2	The target value of the Light HSL Lightness state
HSL Hue	2	The target value of the Light HSL Hue state
HSL Saturation	2	The target Light HSL Saturation state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.80: Light HSL Set Unacknowledged message parameters

The HSL Lightness field identifies the Light HSL Lightness state of the element.

The HSL Hue field identifies the Light HSL Hue state of the element.

The HSL Saturation field identifies the Light HSL Saturation state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.3.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.3.4 Light HSL Status

Light HSL Status is an unacknowledged message used to report the Light HSL Lightness, Light HSL Hue, and Light HSL Saturation states of an element (see Section 6.1.4.5, 6.1.4.1, and 6.1.4.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
HSL Lightness	2	The present value of the Light HSL Lightness state
HSL Hue	2	The present value of the Light HSL Hue state

Field	Size (octets)	Notes
HSL Saturation	2	The present value of the Light HSL Saturation state
Remaining Time	1	Format as defined in Section 3.1.3. (Optional)

Table 6.81: Light HSL Status message parameters

The HSL Lightness field identifies the present Light HSL Lightness state of the element (see Section 6.1.4.5).

The HSL Hue field identifies the present Light HSL Hue state of the element (see Section 6.1.4.1).

The HSL Saturation field identifies the present Light HSL Saturation state of the element (see Section 6.1.4.2).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target state of the element (see Section 1.4.1.1).

### 6.3.3.5 Light HSL Target Get

Light HSL Target Get is an acknowledged message used to get the target Light HSL Lightness (see Section 6.1.4.5), Light HSL Hue (see Section 6.1.4.1), and Light HSL Saturation (see Section 6.1.4.2) states of an element.

For example, it may be used when an element reports it is in transition to target Light HSL Lightness (see Section 6.1.4.5), Light HSL Hue (see Section 6.1.4.1), or Light HSL Saturation (see Section 6.1.4.2) states by including a positive Remaining Time field in the Light HSL Status message (see Section 6.3.3.4), the Light Lightness Status message (see Section 6.3.1.4), or the Light xyL Status message (see Section 6.3.4.4).

The response to the Light HSL Target Get message is a Light HSL Target Status message.

There are no parameters for this message.

### 6.3.3.6 Light HSL Target Status

The Light HSL Target Status is an unacknowledged message used to report the target Light HSL Lightness, Light HSL Hue, and Light HSL Saturation states of an element (see Section 6.1.4.5, 6.1.4.1 and 6.1.4.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
HSL Lightness Target	2	The target value of the Light HSL Lightness state
HSL Hue Target	2	The target value of the Light HSL Hue state
HSL Saturation Target	2	The target Light HSL Saturation state
Remaining Time	1	Format as defined in Section 3.1.3. (Optional)

Table 6.82: Light HSL Target Status message parameters

The HSL Lightness Target field identifies the target Light HSL Lightness state of the element (see Section 6.1.4.5).

The HSL Hue Target field identifies the target Light HSL Hue state of the element (see Section 6.1.4.1).

The HSL Saturation Target field identifies the target Light HSL Saturation state of the element (see Section 6.1.4.2).



If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target state of the element.

### 6.3.3.7 Light HSL Hue Get

The Light HSL Hue Get is an acknowledged message used to get the Light HSL Hue state of an element (see Section 6.1.4.1).

The response to the Light HSL Hue Get message is a Light HSL Hue Status message.

There are no parameters for this message.

### 6.3.3.8 Light HSL Hue Set

The Light HSL Hue Set is an acknowledged message used to set the target Light HSL Hue state of an element (see Section 6.1.4.1).

The response to the Light HSL Hue Set message is a Light HSL Hue Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Hue	2	The target value of the Light HSL Hue state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.83: Light HSL Hue Set message parameters

The Hue field identifies the Light HSL Hue of the element (see Section 6.1.4.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.3.5.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.3.9 Light HSL Hue Set Unacknowledged

The Light HSL Hue Set Unacknowledged is an unacknowledged message used to set the target Light HSL Hue state of an element (see Section 6.1.4.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Hue	2	The target value of the Light HSL Hue state.
TID	1	Transaction Identifier

Field	Size (octets)	Notes
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

*Table 6.84: Light HSL Hue Set Unacknowledged message parameters*

The Hue field identifies the Light HSL Hue of the element (see Section 6.1.4.1).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.3.5.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.3.10 Light HSL Hue Status

The Light HSL Hue Status is an unacknowledged message used to report the Light HSL Hue state of an element (see Section 6.1.4.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Hue	2	The present value of the Light HSL Hue state
Target Hue	2	The target value of the Light HSL Hue state (Optional)
Remaining Time	1	Format as defined in Section 3.1.3 (C.1)

C.1: If the Target Hue field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

*Table 6.85: Light HSL Hue Status message parameters*

The Present Hue field identifies the present Light HSL Hue state of the element (see Section 6.1.4.1).

If present, the Target Hue field identifies the target Light HSL Hue state that the element is to reach (see Section 6.1.4.1).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Light HSL Hue state of the element (see Section 1.4.1.1 and Section 6.1.2).

### 6.3.3.11 Light HSL Saturation Get

The Light HSL Saturation Get is an acknowledged message used to get the Light HSL Saturation state of an element (see Section 6.1.4.2).

The response to the Light HSL Saturation Get message is a Light HSL Saturation Status message.

There are no parameters for this message.

### 6.3.3.12 Light HSL Saturation Set

The Light HSL Saturation Set is an acknowledged message used to set the target Light HSL Saturation state of an element (see Section 6.1.4.2).

The response to the Light HSL Saturation Set message is a Light HSL Saturation Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Saturation	2	The target value of the Light HSL Saturation state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

*Table 6.86: Light HSL Saturation Set message parameters*

The Saturation field identifies the Light HSL Saturation the element (see Section 6.1.4.2).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.3.6.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.3.13 Light HSL Saturation Set Unacknowledged

The Light HSL Saturation Set Unacknowledged is an unacknowledged message used to set the target Light HSL Saturation state of an element (see Section 6.1.4.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Saturation	2	The target value of the Light HSL Saturation state.
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps. (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

*Table 6.87: Light HSL Saturation Set Unacknowledged message parameters*

The Saturation field identifies the Light HSL Saturation of the element (see Section 6.1.4.2).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.3.6.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.3.14 Light HSL Saturation Status

The Light HSL Saturation Status is an unacknowledged message used to report the Light HSL Saturation state of an element (see Section 6.1.4.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Saturation	2	The present value of the Light HSL Saturation state.
Target Saturation	2	The target value of the Light HSL Saturation state. (Optional)
Remaining Time	1	Format as defined in Section 3.1.3. (C.1)

C.1: If the Target Saturation field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 6.88: Light HSL Saturation Status message parameters

The Present Saturation field identifies the present Light HSL Saturation state of the element (see Section 6.1.4.2).

If present, the Target Saturation field identifies the target Light HSL Saturation state that the element is to reach (see Section 6.1.4.2).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Light HSL Saturation state of the element (see Section 1.4.1.1 and Section 6.1.2).

### 6.3.3.15 Light HSL Default Get

Light HSL Default Get is an acknowledged message used to get the Light Lightness Default (see Section 6.1.2.4), the Light HSL Hue Default (see Section 6.1.4.2), and Light HSL Saturation Default (see Section 6.1.4.5) states of an element.

The response to the Light HSL Default Get message is a Light HSL Default Status message.

There are no parameters for this message.

### 6.3.3.16 Light HSL Default Set

Light HSL Default Set is an acknowledged message used to set the Light Lightness Default (see Section 6.1.2.4), the Light HSL Hue Default (see Section 6.1.4.2), and Light HSL Saturation Default (see Section 6.1.4.5) states of an element.

The response to the Light HSL Default Set message is a Light HSL Default Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
Hue	2	The value of the Light HSL Hue Default state
Saturation	2	The value of the Light HSL Saturation Default state

Table 6.89: Light HSL Default Set message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The Hue field identifies the Light HSL Hue Default state of the element.

The Saturation field identifies the Light HSL Saturation Default state of the element.

### 6.3.3.17 Light HSL Default Set Unacknowledged

Light HSL Default Set Unacknowledged is an unacknowledged message used to set the Light Lightness Default (see Section 6.1.2.4), the Light HSL Hue Default (see Section 6.1.4.2), and Light HSL Saturation Default (see Section 6.1.4.5) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
Hue	2	The value of the Light HSL Hue Default state
Saturation	2	The value of the Light HSL Saturation Default state

Table 6.90: Light HSL Default Set Unacknowledged message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The Hue field identifies the Light HSL Hue Default state of the element.

The Saturation field identifies the Light HSL Saturation Default state of the element.

### 6.3.3.18 Light HSL Default Status

Light HSL Default Status is an unacknowledged message used to report the Light Lightness Default (see Section 6.1.2.4), the Light HSL Hue Default (see Section 6.1.4.2), and Light HSL Saturation Default (see Section 6.1.4.5) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
Hue	2	The value of the Light HSL Hue Default state
Saturation	2	The value of the Light HSL Saturation Default state

Table 6.91: Light HSL Default Status message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The Hue field identifies the Light HSL Hue Default state of the element.

The Saturation field identifies the Light HSL Saturation Default state of the element.

### 6.3.3.19 Light HSL Range Get

The Light HSL Range Get is an acknowledged message used to get the Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6) states of an element.

The response to the Light HSL Range Get message is a Light HSL Range Status message.

There are no parameters for this message.

### 6.3.3.20 Light HSL Range Set

Light HSL Range Set is an acknowledged message used to set the Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6) states of an element.

The response to the Light HSL Range Set message is a Light HSL Range Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Hue Range Min	2	The value of the Hue Range Min field of the Light HSL Hue Range state
Hue Range Max	2	The value of the Hue Range Max field of the Light HSL Hue Range state
Saturation Range Min	2	The value of the Saturation Range Min field of the Light HSL Saturation Range state
Saturation Range Max	2	The value of the Saturation Range Max field of the Light HSL Saturation Range state

Table 6.92: Light HSL Range Set message parameters

The Hue Range Min field identifies the Light HSL Hue Range Min field of the Light HSL Hue Range state of the element (see Section 6.1.4.3).

The Hue Range Max field identifies the Light HSL Hue Range Max field of the Light HSL Hue Range state of the element (see Section 6.1.4.3).

The value of the Hue Range Max field shall be greater or equal to the value of the Hue Range Min field.

The Saturation Range Min field identifies the Light HSL Saturation Range Min field of the Light HSL Saturation Range state of the element (see Section 6.1.4.6).

The Saturation Range Max field identifies the Light HSL Saturation Range Max field of the Light HSL Saturation state of the element (see Section 6.1.4.6).

The value of the Saturation Range Max field shall be greater or equal to the value of the Saturation Range Min field.

### 6.3.3.21 Light HSL Range Set Unacknowledged

Light HSL Range Set Unacknowledged is an unacknowledged message used to set the Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Hue Range Min	2	The value of the Hue Range Min field of the Light HSL Hue Range state
Hue Range Max	2	The value of the Hue Range Max field of the Light HSL Hue Range state
Saturation Range Min	2	The value of the Saturation Range Min field of the Light HSL Saturation Range state
Saturation Range Max	2	The value of the Saturation Range Max field of the Light HSL Saturation Range state

Table 6.93: Light HSL Range Set Unacknowledged message parameters

The Hue Range Min field identifies the Light HSL Hue Range Min field of the Light HSL Hue Range state of the element (see Section 6.1.4.3).

The Hue Range Max field identifies the Light HSL Hue Range Max field of the Light HSL Hue Range state of the element (see Section 6.1.4.3).

The value of the Hue Range Max field shall be greater or equal to the value of the Hue Range Min field.

The Saturation Range Min field identifies the Light HSL Saturation Range Min field of the Light HSL Saturation Range state of the element (see Section 6.1.4.6).

The Saturation Range Max field identifies the Light HSL Saturation Range Max field of the Light HSL Saturation state of the element (see Section 6.1.4.6).

The value of the Saturation Range Max field shall be greater or equal to the value of the Saturation Range Min field.

### 6.3.3.22 Light HSL Range Status

Light HSL Range Status is an unacknowledged message used to report the Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Status Code for the requesting message.
Hue Range Min	2	The value of the Hue Range Min field of the Light HSL Hue Range state
Hue Range Max	2	The value of the Hue Range Max field of the Light HSL Hue Range state
Saturation Range Min	2	The value of the Saturation Range Min field of the Light HSL Saturation Range state
Saturation Range Max	2	The value of the Saturation Range Max field of the Light HSL Saturation Range state

Table 6.94: Light HSL Range Status message parameters

The Status Code field identifies the Status Code for the last operation on the Light HSL Hue Range and Light HSL Saturation Range states. The allowed values for status codes and their meanings are documented in Section 7.2.

The Hue Range Min field identifies the Light HSL Hue Range Min field of the Light HSL Hue Range state of the element (see Section 6.1.4.3).

The Hue Range Max field identifies the Light HSL Hue Range Max field of the Light HSL Hue Range state of the element (see Section 6.1.4.3).

The Saturation Range Min field identifies the Light HSL Saturation Range Min field of the Light HSL Saturation Range state of the element (see Section 6.1.4.6).

The Saturation Range Max field identifies the Light HSL Saturation Range Max field of the Light HSL Saturation state of the element (see Section 6.1.4.6).

## 6.3.4 Light xyL messages

### 6.3.4.1 Light xyL Get

The Light xyL Get is an acknowledged message used to get the Light xyL Lightness (see Section 6.1.5.5), Light xyL x (see Section 6.1.5.1), and Light xyL y (see Section 6.1.5.2) states of an element.

Upon receiving a Light xyL Get message, the element shall respond with a Light xyL Status message.

The response to the Light xyL Get message is a Light xyL Status message.

There are no parameters for this message.

### 6.3.4.2 Light xyL Set

The Light xyL Set is an acknowledged message used to set the Light xyL Lightness (see Section 6.1.5.5), Light xyL x state (see Section 6.1.5.1), and the Light xyL y states (see Section 6.1.5.2) of an element.

The response to the Light xyL Set message is a Light xyL Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
xyL Lightness	2	The target value of the Light xyL Lightness state
xyL x	2	The target value of the Light xyL x state
xyL y	2	The target value of the Light xyL y state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.95: Light xyL Set message parameters

The xyL Lightness field identifies the Light xyL Lightness state of the element.

The xyL x field identifies the Light xyL x state of the element.

The xyL y field identifies the Light xyL y state of the element.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

### 6.3.4.3 Light xyL Set Unacknowledged

The Light xyL Set Unacknowledged is an unacknowledged message used to set the Light xyL Lightness (see Section 6.1.5.5), Light xyL x (see Section 6.1.5.1), and the Light xyL y states (see Section 6.1.5.2) of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
xyL Lightness	2	The target value of the Light xyL Lightness state
xyL x	2	The target value of the Light xyL x state
xyL y	2	The target value of the Light xyL y state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.96: Light xyL Set Unacknowledged message parameters





The xyL Lightness field identifies the Light xyL Lightness state of the element.

The xyL x field identifies the Light xyL x state of the element.

The xyL y field identifies the Light xyL y state of the element.

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.4.2.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state, as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

#### 6.3.4.4 Light xyL Status

The Light xyL Status is an unacknowledged message used to report the Light xyL Lightness, Light xyL x, and Light xyL y states of an element (see Section 6.1.5.5, 6.1.5.1 and 6.1.5.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
xyL Lightness	2	The present value of the Light xyL Lightness state
xyL x	2	The present value of the Light xyL x state
xyL y	2	The present value of the Light xyL y state
Remaining Time	1	Format as defined in Section 3.1.3. (Optional)

Table 6.97: Light xyL Status Unacknowledged message parameters

The xyL Lightness field identifies the present Light xyL Lightness state of the element (see Section 6.1.5.5).

The xyL x field identifies the present Light xyL x state of the element (see Section 6.1.5.1).

The xyL y field identifies the present Light xyL y state of the element (see Section 6.1.5.2).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.4.2.2.

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target state of the element (see Section 1.4.1.1).

#### 6.3.4.5 Light xyL Target Get

The Light xyL Target Get is an acknowledged message used to get the target Light xyL Lightness (see Section 6.1.5.5), Light xyL x (see Section 6.1.5.1), and Light xyL y (see Section 6.1.5.2) states of an element.

For example, it may be used when an element reports it is in transition to new Light xyL Lightness (see Section 6.1.5.5), Light xyL x (see Section 6.1.5.1), or Light xyL y (see Section 6.1.5.2) states by including a positive Remaining Time field in the Light xyL Status message (see Section 6.3.4.4), Light Lightness Status message (see Section 6.3.1.4), or the Light HSL Status message (see Section 6.3.3.4).

The response to the Light xyL Target Get message is a Light xyL Target Status message.

There are no parameters for this message.

### 6.3.4.6 Light xyL Target Status

Light xyL Target Status is an unacknowledged message used to report the target Light xyL Lightness, Light xyL x, and Light xyL y states of an element (see Section 6.1.5.5, 6.1.5.1 and 6.1.5.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Target xyL Lightness	2	The target value of the Light xyL Lightness state
Target xyL x	2	The target value of the Light xyL x state
Target xyL y	2	The target value of the Light xyL y state
Remaining Time	1	Format as defined in Section 3.1.3. (Optional)

Table 6.98: Light xyL Target Status Unacknowledged message parameters

The Target xyL Lightness field identifies the target Light xyL Lightness state of the element (see Section 6.1.5.5).

The Target xyL x field identifies the target Light xyL x state of the element (see Section 6.1.5.1).

The Target xyL y field identifies the target Light xyL y state of the element (see Section 6.1.5.2).

The Remaining Time field identifies the time it will take the element to complete the transition to the target state of the element.

### 6.3.4.7 Light xyL Default Get

Light xyL Default Get is an acknowledged message used to get the Light Lightness Default (see Section 6.1.2.4), the Light xyL x Default (see Section 6.1.5.2), and Light xyL y Default (see Section 6.1.5.5) states of an element.

The response to the Light xyL Default Get message is a Light xyL Default Status message.

There are no parameters for this message.

### 6.3.4.8 Light xyL Default Set

Light xyL Default Set is an acknowledged message used to set the Light Lightness Default (see Section 6.1.2.4), the Light xyL x Default (see Section 6.1.5.2), and Light xyL y Default (see Section 6.1.5.5) states of an element.

The response to the Light xyL Default Set message is a Light xyL Default Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
xyL x	2	The value of the Light xyL x Default state
xyL y	2	The value of the Light xyL y Default state

Table 6.99: Light HSL Default Set message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The xyL x field identifies the Light xyL x Default state of the element.

The xyL y field identifies the Light xyL y Default state of the element.

#### 6.3.4.9 Light xyL Default Set Unacknowledged

Light xyL Default Set Unacknowledged is an unacknowledged message used to set the Light Lightness Default (see Section 6.1.2.4), the Light xyL x Default (see Section 6.1.5.2), and Light xyL y Default (see Section 6.1.5.5) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
xyL x	2	The value of the Light xyL x Default state
xyL y	2	The value of the Light xyL y Default state

Table 6.100: Light xyL Default Set Unacknowledged message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The xyL x field identifies the Light xyL x Default state of the element.

The xyL y field identifies the Light xyL y Default state of the element.

#### 6.3.4.10 Light xyL Default Status

Light xyL Default Status is an unacknowledged message used to report the Light Lightness Default (see Section 6.1.2.4), the Light xyL x Default (see Section 6.1.5.2), and Light xyL y Default (see Section 6.1.5.5) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Lightness	2	The value of the Light Lightness Default state
xyL x	2	The value of the Light xyL x Default state
xyL y	2	The value of the Light xyL y Default state

Table 6.101: Light xyL Default Status message parameters

The Lightness field identifies the Light Lightness Default state of the element.

The xyL x field identifies the Light xyL x Default state of the element.

The xyL y field identifies the Light xyL y Default state of the element.

#### 6.3.4.11 Light xyL Range Get

The Light xyL Range Get is an acknowledged message used to get the Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6) states of an element.

The response to the Light xyL Range Get message is a Light xyL Range Status message.

There are no parameters for this message.

#### 6.3.4.12 Light xyL Range Set

Light xyL Range Set is an acknowledged message used to set the Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6) states of an element.

The response to the Light xyL Range Set message is a Light xyL Range Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
xyL x Range Min	2	The value of the xyL x Range Min field of the Light xyL x Range state
xyL x Range Max	2	The value of the xyL x Range Max field of the Light xyL x Range state
xyL y Range Min	2	The value of the xyL y Range Min field of the Light xyL y Range state
xyL y Range Max	2	The value of the xyL y Range Max field of the Light xyL y Range state

Table 6.102: Light xyL Range Set message parameters

The xyL x Range Min field identifies the Light xyL x Range Min field of the Light xyL x Range state of the element (see Section 6.1.5.3).

The xyL x Range Max field identifies the Light xyL x Range Max field of the Light xyL x Range state of the element (see Section 6.1.5.3).

The value of the xyL x Range Max field shall be greater or equal to the value of the xyL x Range Min field.

The xyL y Range Min field identifies the Light xyL y Range Min field of the Light xyL y Range state of the element (see Section 6.1.5.6).

The xyL y Range Max field identifies the Light xyL y Range Max field of the Light xyL y Range state of the element (see Section 6.1.4.6).

The value of the xyL y Range Max field shall be greater or equal to the value of the xyL y Range Min field.

#### 6.3.4.13 Light xyL Range Set Unacknowledged

Light xyL Range Set Unacknowledged is an unacknowledged message used to set the Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
xyL x Range Min	2	The value of the xyL x Range Min field of the Light xyL x Range state
xyL x Range Max	2	The value of the xyL x Range Max field of the Light xyL x Range state
xyL y Range Min	2	The value of the xyL y Range Min field of the Light xyL y Range state
xyL y Range Max	2	The value of the xyL y Range Max field of the Light xyL y Range state

Table 6.103: Light xyL Range Set Unacknowledged message parameters

The xyL x Range Min field identifies the Light xyL x Range Min field of the Light xyL x Range state of the element (see Section 6.1.5.3).

The xyL x Range Max field identifies the Light xyL x Range Max field of the Light xyL x Range state of the element (see Section 6.1.5.3).

The value of the xyL x Range Max field shall be greater or equal to the value of the xyL x Range Min field.

The xyL y Range Min field identifies the Light xyL y Range Min field of the Light xyL y Range state of the element (see Section 6.1.5.6).

The xyL y Range Max field identifies the Light xyL y Range Max field of the Light xyL y Range state of the element (see Section 6.1.4.6).

The value of the xyL y Range Max field shall be greater or equal to the value of the xyL y Range Min field.

#### 6.3.4.14 Light xyL Range Status

Light xyL Range Status is an unacknowledged message used to report the Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6) states of an element.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Status Code	1	Status Code for the requesting message.
xyL x Range Min	2	The value of the xyL x Range Min field of the Light xyL x Range state
xyL x Range Max	2	The value of the xyL x Range Max field of the Light xyL x Range state
xyL y Range Min	2	The value of the xyL y Range Min field of the Light xyL y Range state
xyL y Range Max	2	The value of the xyL y Range Max field of the Light xyL y Range state

Table 6.104: Light xyL Range Status message parameters

The Status Code field identifies the Status Code for the last operation on the Light xyL x Range and Light xyL y Range states. The allowed values for status codes and their meanings are documented in Section 7.2.

The xyL x Range Min field identifies the Light xyL x Range Min field of the Light xyL x Range state of the element (see Section 6.1.5.3).

The xyL x Range Max field identifies the Light xyL x Range Max field of the Light xyL x Range state of the element (see Section 6.1.5.3).

The xyL y Range Min field identifies the Light xyL y Range Min field of the Light xyL y Range state of the element (see Section 6.1.5.6).

The xyL y Range Max field identifies the Light xyL y Range Max field of the Light xyL y Range state of the element (see Section 6.1.4.6).

### 6.3.5 Light LC messages

#### 6.3.5.1 Light LC Mode messages

##### 6.3.5.1.1 Light LC Mode Get

Light LC Mode Get is an acknowledged message used to get the Light LC Mode state of an element (see Section 6.2.3.1).

The response to the Light LC Mode Get message is a Light LC Mode Status message.

There are no parameters for this message.

##### 6.3.5.1.2 Light LC Mode Set

The Light LC Mode Set is an acknowledged message used to set the Light LC Mode state of an element (see Section 6.2.3.1).

The response to the Light LC Mode Set message is a Light LC Mode Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Mode	1	The target value of the Light LC Mode state

Table 6.105: Light LC Mode Set message parameters

The Mode field identifies the Light LC Mode state of the element (see Section 6.2.3.1).

#### 6.3.5.1.3 Light LC Mode Set Unacknowledged

The Light LC Mode Set Unacknowledged is an unacknowledged message used to set the Light LC Mode state of an element (see Section 6.2.3.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Mode	1	The target value of the Light LC Mode state

Table 6.106: Light LC Mode Set Unacknowledged message parameters

The Mode field identifies the Light LC Mode state of the element (see Section 6.2.3.1).

#### 6.3.5.1.4 Light LC Mode Status

The Light LC Mode Status is an unacknowledged message used to report the Light LC Mode state of an element (see Section 6.2.3.1).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Mode	1	The present value of the Light LC Mode state

Table 6.107: Light LC Mode Status message parameters

The Mode field identifies the present Light LC Mode state of the element (see Section 6.2.3.1).

### 6.3.5.2 Light LC Occupancy Mode messages

#### 6.3.5.2.1 Light LC OM Get

Light LC OM Get is an acknowledged message used to get the Light LC Occupancy Mode state of an element (see Section 6.2.3.2).

The response to the Light LC OM Get message is a Light LC OM Status message.

There are no parameters for this message.

#### 6.3.5.2.2 Light LC OM Set

The Light LC OM Set is an acknowledged message used to set the Light LC Occupancy Mode state of an element (see Section 6.2.3.2).

The response to the Light LC OM Set message is a Light LC OM Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Mode	1	The target value of the Light LC Occupancy Mode state

Table 6.108: Light LC OM Set message parameters

The Mode field identifies the Light LC Occupancy Mode state of the element (see Section 6.2.3.2).

#### 6.3.5.2.3 Light LC OM Set Unacknowledged

The Light LC OM Set Unacknowledged is an unacknowledged message used to set the Light LC Occupancy Mode state of an element (see Section 6.2.3.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Mode	1	The target value of the Light LC Occupancy Mode state

Table 6.109: Light LC OM Set Unacknowledged message parameters

The Mode field identifies the Light LC Occupancy Mode state of the element (see Section 6.2.3.2).

#### 6.3.5.2.4 Light LC OM Status

The Light LC OM Status is an unacknowledged message used to report the Light LC Occupancy Mode state of an element (see Section 6.2.3.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Mode	1	The present value of the Light LC Occupancy Mode state

Table 6.110: Light LC OM Status message parameters

The Mode field identifies the present Light LC Occupancy Mode state of the element (see Section 6.2.3.2).

### 6.3.5.3 Light LC Light OnOff messages

#### 6.3.5.3.1 Light LC Light OnOff Get

Light LC Light OnOff Get is an acknowledged message used to get the Light LC Light OnOff state of an element (see Section 6.2.3.3).

The response to the Light LC Light OnOff Get message is a Light LC Light OnOff Status message.

There are no parameters for this message.

#### 6.3.5.3.2 Light LC Light OnOff Set

The Light LC Light OnOff Set is an acknowledged message used to set the Light LC Light OnOff state of an element (see Section 6.2.3.3).

The response to the Light LC Light OnOff Set message is a Light LC Light OnOff Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Light OnOff	1	The target value of the Light LC Light OnOff state

Field	Size (octets)	Notes
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.111: Light LC Light OnOff Set message parameters

The Light OnOff field identifies the Light LC Light OnOff state of the element (see Section 6.2.3.3).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.5.4.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

#### 6.3.5.3.3 Light LC Light OnOff Set Unacknowledged

The Light LC Light OnOff Set Unacknowledged is an unacknowledged message used to set the Light LC Light OnOff state of an element (see Section 6.2.3.3).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Light OnOff	1	The target value of the Light LC Light OnOff state
TID	1	Transaction Identifier
Transition Time	1	Format as defined in Section 3.1.3. (Optional)
Delay	1	Message execution delay in 5 millisecond steps (C.1)

C.1: If the Transition Time field is present, the Delay field shall also be present; otherwise these fields shall not be present.

Table 6.112: Light LC Light OnOff Set Unacknowledged message parameters

The Light OnOff field identifies the Light LC Light OnOff state of the element (see Section 6.2.3.3).

The TID field is a transaction identifier indicating whether the message is a new message or a retransmission of a previously sent message, as described in Section 6.6.5.4.2.

If present, the Transition Time field identifies the time an element will take to transition to the target state from the present state (see Section 1.4.1.1). The format of the Transition Time field matches the format of the Generic Default Transition Time state as defined in Section 3.1.3. Only values of 0x00 to 0x3E shall be used to specify the Transition Number of Steps.

If present, the Delay field identifies the message execution delay, representing a time interval between receiving the message by a model and executing the associated model behaviors.

#### 6.3.5.3.4 Light LC Light OnOff Status

The Light LC Light OnOff Status is an unacknowledged message used to report the Light LC Light OnOff state of an element (see Section 6.2.3.3).



The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Present Light OnOff	1	The present value of the Light LC Light OnOff state
Target Light OnOff	1	The target value of the Light LC Light OnOff state (Optional)
Remaining Time	1	Format as defined in Section 3.1.3. (C.1)

C.1: If the Target Light OnOff field is present, the Remaining Time field shall also be present; otherwise these fields shall not be present.

Table 6.113: Light LC Light OnOff Status message parameters

The Present Light OnOff field identifies the present Light LC Light OnOff state of the element (see Section 6.2.3.3).

If present, the Target Light OnOff field identifies the target Light LC Light OnOff state that the element is to reach (see Section 6.2.3.3).

If present, the Remaining Time field identifies the time it will take the element to complete the transition to the target Light LC Light OnOff state of the node (see Section 1.4.1.1 and Section 6.2.3.3).

## 6.3.6 Light LC Property Messages

Light LC Property messages operate on Light LC states defined in Section 6.2.3 by referring to device properties defined by these states and providing Raw values for the device properties.

### 6.3.6.1 Light LC Property Get

Light LC Property Get is an acknowledged message used to get the Light LC Property state of an element (see Section 6.2).

The response to the Light LC Property Get message is a Light LC Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Light LC Property ID	2	Property ID identifying a Light LC Property.

Table 6.114: Light LC Property Get message parameters

The Light LC Property ID field identifies a Light LC Property ID state of an element (see Section 6.2).

### 6.3.6.2 Light LC Property Set

The Light LC Property Set is an acknowledged message used to set the Light LC Property state of an element (see Section 6.2).

The response to the Light LC Property Set message is a Light LC Property Status message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Light LC Property ID	2	Property ID identifying a Light LC Property.
Light LC Property Value	variable	Raw value for the Light LC Property

Table 6.115: Light LC Property Set message parameters

The Light LC Property ID field identifies a Light LC Property ID state of an element (see Section 6.2).

The Light LC Property Value field identifies a Light LC Property Value state of an element (see Section 6.2).

### 6.3.6.3 Light LC Property Set Unacknowledged

The Light LC Property Set Unacknowledged is an unacknowledged message used to set the Light LC Property state of an element (see Section 6.2).

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Light LC Property ID	2	Property ID identifying a Light LC Property.
Light LC Property Value	variable	Raw value for the Light LC Property

Table 6.116: Light LC Property Set Unacknowledged message parameters

The Light LC Property ID field identifies a Light LC Property ID state of an element (see Section 6.2).

The Light LC Property Value field identifies a Light LC Property Value state of an element (see Section 6.2).

### 6.3.6.4 Light LC Property Status

The Light LC Property Status is an unacknowledged message used to report the Light LC Property state of an element (see Section 6.2).

The message is sent as a response to the Light LC Property Get and Light LC Property Set messages or may be sent as an unsolicited message.

The structure of the message is defined in the following table.

Field	Size (octets)	Notes
Light LC Property ID	2	Property ID identifying a Light LC Property.
Light LC Property Value	variable	Raw value for the Light LC Property

Table 6.117: Light LC Property Status message parameters

The Light LC Property ID field identifies a Light LC Property ID state of an element (see Section 6.2).

The Light LC Property Value field identifies a Light LC Property Value state of an element (see Section 6.2).

## 6.4 Lighting server models

### 6.4.1 Light Lightness Server

#### 6.4.1.1 Description

The Light Lightness Server model extends the Generic Power OnOff Server model (see Section 3.3.4) and the Generic Level Server model (see Section 3.3.2). When this model is present on an Element, the corresponding Light Lightness Setup Server model (see Section 6.4.2) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 6.118 and messages listed in Table 6.119 to the model it extends:

Light Lightness Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light Lightness Actual	Main	Yes	Light Lightness Server	Generic Level	Main
				Generic OnOff	Main
				Light Lightness Last	Main
				Light Lightness Linear	Main
Light Lightness Linear	Main	Yes	Light Lightness Server	Light Lightness	Main
Generic Level	Main	Yes	Light Lightness Server	Light Lightness	Main
Generic OnOff	Main	Yes	Light Lightness Server	Light Lightness	Main
Light Lightness Last	Main	No	Light Lightness Server	Light Lightness Actual	Main
Light Lightness Default	Main	No	-	-	-
Light Lightness Range	Main	No			

Table 6.118: Light Lightness Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M

Table 6.119: Light Lightness Server messages

Table 6.120 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).



Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 6.1.2.2.3)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 6.1.2.2.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M

Table 6.120: Light Lightness Server elements, states, and messages

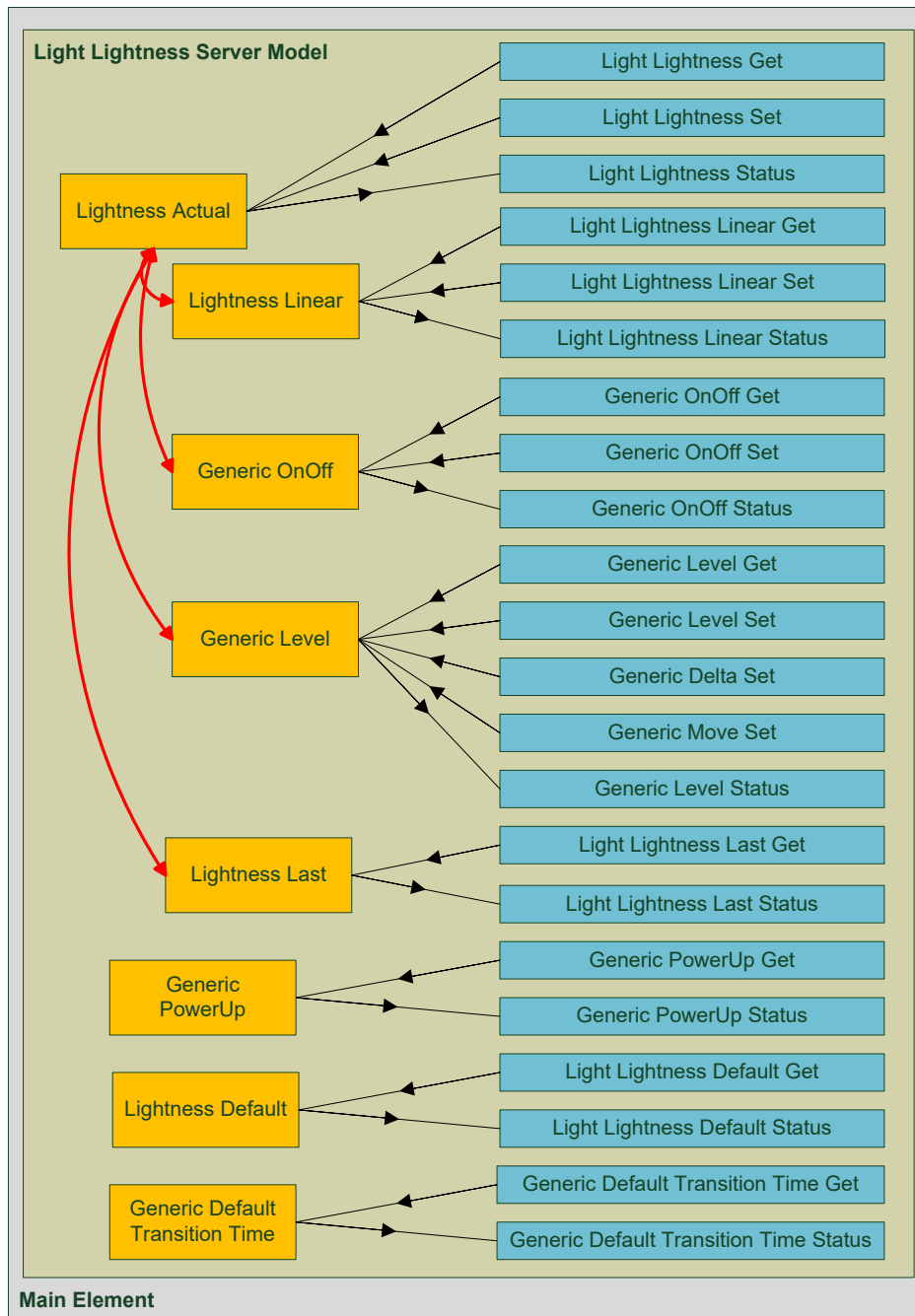


Figure 6.8: Light Lightness Server model

## 6.4.1.2 Light Lightness states behavior

### 6.4.1.2.1 Receiving a Light Lightness Get message

When a Light Lightness Server receives a Light Lightness Get message, it shall respond with a Light Lightness Status message (see Section 6.4.1.2.3).

### 6.4.1.2.2 Receiving Light Lightness Set / Light Lightness Set Unacknowledged messages

When a Light Lightness Server receives a Light Lightness Set message or a Light Lightness Set Unacknowledged message, it shall set the Light Lightness Actual state to the Lightness field of the

message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light Lightness Set message, the Light Lightness Server shall respond with a Light Lightness Status message (see Section 6.4.1.2.3).

#### 6.4.1.2.3 *Sending a Light Lightness Status message*

A Light Lightness Server shall send the Light Lightness Status message as a response to a Light Lightness Get message, a Light Lightness Set message, or as an unsolicited message at any time.

When sending a Light Lightness Status message, the Light Lightness Server shall set the Present Lightness field to the present Light Lightness Actual state.

If the Light Lightness Server is in the process of changing the Light Lightness Actual state, it shall set the Target Lightness field to the target Light Lightness Actual state and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target Level and Remaining Time fields shall be omitted.

When a Light Lightness Actual state change is completed as a result of processing an acknowledged message or a transaction of messages other than a Light Lightness Set message, a corresponding status message shall be sent to the originator to indicate the status change, and a separate Light Lightness Status message shall be published. It is recommended to transmit a Light Lightness Status message when the element has been physically turned on or off locally (as opposed to via the mesh network).

#### 6.4.1.2.4 *Receiving a Light Lightness Linear Get message*

When a Light Lightness Server receives a Light Lightness Linear Get message, it shall respond with a Light Lightness Linear Status message (see Section 6.4.1.2.6).

#### 6.4.1.2.5 *Receiving Light Lightness Linear Set / Light Lightness Linear Set Unacknowledged messages*

When a Light Lightness Server receives a Light Lightness Linear Set message or a Light Lightness Linear Set Unacknowledged message, it shall set the Light Lightness Linear state to the Lightness field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the received message is a Light Lightness Linear Set message, the Light Lightness Server shall respond with a Light Lightness Linear Status message (see Section 6.4.1.2.6).

#### 6.4.1.2.6 *Sending Light Lightness Linear Status message*

A Light Lightness Server shall send the Light Lightness Linear Status message as a response to a Light Lightness Linear Get message, a Light Lightness Linear Set message, or as an unsolicited message at any time.

When sending a Light Lightness Linear Status message, the Light Lightness Server shall set the Present Lightness field to the present Light Lightness Linear state.

If the Light Lightness Server is in the process of changing the Light Lightness Linear state, it shall set the Target Lightness field to the target Light Lightness Linear state and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target Level and Remaining Time fields shall be omitted.

#### 6.4.1.2.7 *Receiving a Light Lightness Last Get message*

When a Light Lightness Server receives a Light Lightness Last Get message, it shall respond with a Light Lightness Last Status message (see Section 6.4.1.2.8).

#### 6.4.1.2.8 *Sending Light Lightness Last Status message*

A Light Lightness Server shall send the Light Lightness Last Status message as a response to a Light Lightness Last Get message or as an unsolicited message at any time.

When sending a Light Lightness Last Status message, the Light Lightness Server shall set the Lightness field to the Light Lightness Last state.

#### 6.4.1.2.9 *Receiving a Light Lightness Default Get message*

When a Light Lightness Server receives a Light Lightness Default Get message, it shall respond with a Light Lightness Default Status message (see Section 6.4.1.2.10).

#### 6.4.1.2.10 *Sending a Light Lightness Default Status message*

A Light Lightness Server shall send the Light Lightness Default Status message as a response to a Light Lightness Default Get message, a Light Lightness Default Set message, or as an unsolicited message at any time.

When sending a Light Lightness Default Status message, the Light Lightness Server shall set the Lightness field to the Light Lightness Default state.

#### 6.4.1.2.11 *Receiving a Light Lightness Range Get message*

When a Light Lightness Server receives a Light Lightness Range Get message, it shall respond with a Light Lightness Range Status message (see Section 6.4.1.2.12).

#### 6.4.1.2.12 *Sending a Light Lightness Range Status message*

A Light Lightness Server shall send the Light Lightness Range Status message as a response to a Light Lightness Range Get message or as an unsolicited message at any time.

When sending a Light Lightness Range Status message, the Light Lightness Server shall set the Range Min field to the Light Lightness Range Min state, the Range Max field to the Light Lightness Range Max state, and the Status Code field to the status of the last operation on the Light Lightness Range state.

### 6.4.2 **Light Lightness Setup Server**

#### 6.4.2.1 **Description**

The Light Lightness Setup Server model extends the Light Lightness Server model (see Section 6.4.1) and the Generic Power OnOff Setup Server model (see Section 3.3.5).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in Table 6.121 to the models it extends:

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1301	Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Set	M	
			Light Lightness Default Set Unacknowledged	M	
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Set	M	
			Light Lightness Range Set Unacknowledged	M	

Table 6.121: Light Lightness Setup Server messages

Table 6.122 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 6.1.2.2.3)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1004	Generic Default Transition Time (see Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1007	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 6.1.2.2.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M



Element	SIG Model ID	States	Messages	Rx	Tx
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1301	Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Set	M	
			Light Lightness Default Set Unacknowledged	M	
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Set	M	
			Light Lightness Range Set Unacknowledged	M	

Table 6.122: Light Lightness Setup Server elements, states, and messages

### 6.4.2.2 Light Lightness Default state behavior

#### 6.4.2.2.1 Receiving Light Lightness Default Set / Light Lightness Default Set Unacknowledged messages

When a Light Lightness Setup Server receives a Light Lightness Default Set message or a Light Lightness Default Set Unacknowledged message, it shall set the Light Lightness Default state to the Lightness field of the message.

If the received message is a Light Lightness Default Set message, the Light Lightness Server shall respond with a Light Lightness Default Status message (see Section 6.4.1.2.10).

### 6.4.2.3 Light Lightness Range state behavior

#### 6.4.2.3.1 Receiving Light Lightness Range Set / Light Lightness Range Set Unacknowledged messages

When a Light Lightness Setup Server receives a Light Lightness Range Set message or a Light Lightness Range Set Unacknowledged message with values that can be accepted, it shall set the Light Lightness Range state fields to the corresponding fields of the message and the status of the operation to 0x00 (Success).

When a Light Lightness Setup Server receives a Light Lightness Range Set message or a Light Lightness Range Set Unacknowledged message with values that cannot be accepted, it shall set the status of the operation to a value representing the reason why the values cannot be accepted, as defined in Table 7.2.

If the received message is a Light Lightness Range Set message, the Light Lightness Setup Server shall respond with a Light Lightness Range Status message (see Section 6.4.1.2.12).

## 6.4.3 Light CTL Server

### 6.4.3.1 Description

The Light CTL Server model extends the Light Lightness Server model (see Section 6.4.1). When this model is present on an Element, the corresponding Light CTL Temperature Server model (see

Section 6.4.4) and the corresponding Light CTL Setup Server model (see Section 6.4.5) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 6.123 and messages listed in Table 6.124 to the model it extends. The model requires two elements: the main element and the Temperature element. The Temperature element contains the corresponding Light CTL Temperature Server model (see Section 6.4.4) and an instance of a Generic Level state bound to the Light CTL Temperature state on the Temperature element. The Light CTL Temperature state on the Temperature element is bound to the Light CTL state on the main element.

Light CTL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light CTL	Main	Yes	Light Lightness Server	Light Lightness	Main
			Light CTL Temperature Server	Light CTL Temperature	Temperature
Light CTL Delta UV		Yes	-	-	-
Light CTL Temperature Range		No	Light CTL Server	Light CTL	Main
Light CTL Temperature Default		No	-	-	-
Light CTL Delta UV Default		No	-	-	-
Light CTL Temperature	Temperature	Yes	Light CTL Server	Light CTL	Main
			Light CTL Temperature Server	Generic Level	Temperature
Generic Level		Yes	Light CTL Temperature Server	Light CTL Temperature	Temperature

Table 6.123: Light CTL Server states and bindings

Element	SIG Model ID	States		Rx	Tx
Main	0x1303	Light CTL (see Section 6.1.3)	Light CTL Get	M	
			Light CTL Set	M	
			Light CTL Set Unacknowledged	M	
			Light CTL Status		M
		Light CTL Temperature Range (see Section 6.1.3.1)	Light CTL Temperature Range Get	M	
			Light CTL Temperature Range Status		M
			Light CTL Default Get	M	

Element	SIG Model ID	States		Rx	Tx
		Light CTL Temperature Default (see Section 6.1.3.2) Light CTL Delta UV Default (see Section 6.1.3.5)	Light CTL Default Status		M
Temperature	0x1002	Generic Level (see Section 6.1.3.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1306	Light CTL Temperature (see Section 6.1.3.1)	Light CTL Temperature Get	M	
			Light CTL Temperature Set	M	
			Light CTL Temperature Set Unacknowledged	M	
			Light CTL Temperature Status		M

Table 6.124: Light CTL Server messages

Table 6.125 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States		Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 6.1.2.2.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	

Element	SIG Model ID	States		Rx	Tx
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1303	Light CTL (see Section 6.1.3)	Light CTL Get	M	
			Light CTL Set	M	
			Light CTL Set Unacknowledged	M	
			Light CTL Status		M
		Light CTL Temperature Range (see Section 6.1.3.3)	Light CTL Temperature Range Get	M	
			Light CTL Temperature Range Status		M
		Light CTL Temperature Default (see Section 6.1.3.2) Light CTL Delta UV Default (see Section 6.1.3.5)	Light CTL Default Get	M	
			Light CTL Default Status		M
Temperature	0x1002	Generic Level (see Section 6.1.3.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	

Element	SIG Model ID	States		Rx	Tx
	0x1306	Light CTL Temperature (see Section 6.1.3.1)	Generic Level Status		M
			Light CTL Temperature Get	M	
			Light CTL Temperature Set	M	
			Light CTL Temperature Set Unacknowledged	M	
			Light CTL Temperature Status		M

Table 6.125: Light CTL Server elements, states, and messages

### 6.4.3.2 Light CTL states behavior

#### 6.4.3.2.1 Receiving a Light CTL Get message

When a Light CTL Server receives a Light CTL Get message, it shall respond with a Light CTL Status message (see Section 6.4.3.2.3).

#### 6.4.3.2.2 Receiving Light CTL Set / Light CTL Set Unacknowledged messages

When a Light CTL Server receives a Light CTL Set message or a Light CTL Set Unacknowledged message, it shall set the Light CTL Lightness state to the CTL Lightness field of the message, the Light CTL Temperature state to the CTL Temperature field of the message, and the Light CTL Delta UV state to the CTL Delta UV field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light CTL Set message, the Light CTL Server shall respond with a Light CTL Status message (see Section 6.4.3.2.3).

#### 6.4.3.2.3 Sending Light CTL Status message

A Light CTL Server shall send the Light CTL Status message as a response to a Light CTL Get message, a Light CTL Set message, or as an unsolicited message at any time.

When sending a Light CTL Status message, the Light CTL Server shall set the Present CTL Lightness field to the present Light CTL Lightness state and the Present CTL Temperature field to the present Light CTL Temperature state.

If the Light CTL Server is in the process of changing the Light CTL state, it shall set the Target CTL Lightness field to the target Light CTL Lightness state, the Target CTL Temperature to the target Light CTL Temperature state, and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target CTL Lightness, the Target CTL Temperature, and the Remaining Time fields shall be omitted. When a Light CTL state change is completed as a result of processing an acknowledged message or a transaction of messages other than a Light CTL Set message, a corresponding status acknowledge message shall be sent to the originator and a separate Light CTL Status message shall be published.

It is recommended to transmit a Light CTL Status message when the element has been physically turned on or off locally (as opposed to via the mesh network).

#### 6.4.3.2.4 Receiving a Light CTL Default Get message

When a Light CTL Server receives a Light CTL Default Get message, it shall respond with a Light CTL Default Status message (see Section 6.4.3.2.5).

#### 6.4.3.2.5 Sending Light CTL Default Status message

A Light CTL Server shall send the Light CTL Default Status message as a response to a Light CTL Default Get message, a Light CTL Default Set message, or as an unsolicited message at any time.

When sending a Light CTL Default Status message, the Light CTL Server shall set the Lightness field to the bound Light Lightness Default state, the Temperature field to the Light CTL Temperature Default state, and the Delta UV field to the Light CTL Delta UV Default state.

### 6.4.3.3 Light CTL Temperature Range state behavior

#### 6.4.3.3.1 Receiving a Light CTL Temperature Range Get message

When a Light CTL Server receives a Light CTL Temperature Range Get message, it shall respond with a Light CTL Temperature Range Status message (see Section 6.4.3.3.2).

#### 6.4.3.3.2 Sending a Light CTL Temperature Range Status message

A Light CTL Server shall send the Light CTL Temperature Range Status message as a response to a Light CTL Temperature Range Get message or as an unsolicited message at any time.

When sending a Light CTL Temperature Range Status message, the Light CTL Server shall set the Range Min field to the Light CTL Temperature Range Min state, the Range Max field to the Light CTL Temperature Range Max state and the Status Code field to the status of the last operation on the Light CTL Temperature Range state.

### 6.4.4 Light CTL Temperature Server

#### 6.4.4.1 Description

The Light CTL Temperature Server model extends the Generic Level Server model (see Section 3.3.2).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 6.126 and messages listed in Table 6.127 to the model it extends.

Light CTL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light CTL Temperature	Temperature	Yes	Light CTL Server	Light CTL	Main
			Light CTL Temperature Server	Generic Level	Temperature
Generic Level	Temperature	Yes	Light CTL Temperature Server	Light CTL Temperature	Temperature

Table 6.126: Light CTL Temperature Server states and bindings

Element	SIG Model ID	States		Rx	Tx
Temperature	0x1002	Generic Level (see Section 6.1.3.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1306	Light CTL Temperature (see Section 6.1.3.1) Light CTL Delta UV (see Section 6.1.3.4)	Light CTL Temperature Get	M	
			Light CTL Temperature Set	M	
			Light CTL Temperature Set Unacknowledged	M	
			Light CTL Temperature Status		M

Table 6.127: Light CTL Temperature Server messages

#### 6.4.4.2 Light CTL Temperature states behavior

##### 6.4.4.2.1 Receiving a Light CTL Temperature Get message

When a Light CTL Temperature Server receives a Light CTL Temperature Get message, it shall respond with a Light CTL Temperature Status message (see Section 6.4.4.2.3).

##### 6.4.4.2.2 Receiving Light CTL Temperature Set / Light CTL Temperature Set Unacknowledged messages

When a Light CTL Temperature Server receives a Light CTL Temperature Set message or a Light CTL Temperature Set Unacknowledged message, it shall set the Light CTL Temperature state to the CTL Temperature field of the message and the Light CTL Delta UV state to the CTL Delta UV field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported on the main element, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light CTL Temperature Set message, the Light CTL Server shall respond with a Light CTL Temperature Status message (see Section 6.4.4.2.3).

#### 6.4.4.2.3 Sending a Light CTL Temperature Status message

A Light CTL Temperature Server shall send the Light CTL Temperature Status message as a response to a Light CTL Temperature Get message, a Light CTL Temperature Set message, or as an unsolicited message at any time.

When sending a Light CTL Temperature Status message, the Light CTL Temperature Server shall set the Present CTL Temperature field to the present Light CTL Temperature state and the Present CTL Delta UV field to the present Light CTL Delta UV state.

If the Light CTL Temperature Server is in the process of changing the Light CTL Temperature state, it shall set the Target CTL Temperature field to the target Light CTL Temperature state, the Target CTL Delta UV to the target Light CTL Delta UV state, and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target CTL Temperature, the Target CTL Delta UV, and the Remaining Time fields shall be omitted.

#### 6.4.5 Light CTL Setup Server

The Light CTL Setup Server model extends the Light CTL Server (see Section 6.4.3) and the Light Lightness Setup Server (see Section 6.4.4.2.1).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in Table 6.128 to the model it extends.

Element	SIG Model ID	States		Rx	Tx
Main	0x1304	Light CTL Temperature Default (see Section 6.1.3.2)	Light CTL Default Set	M	
			Light CTL Default Set Unacknowledged	M	
		Light CTL Temperature Range (see Section 6.1.3.1)	Light CTL Temperature Range Set	M	
			Light CTL Temperature Range Set Unacknowledged	M	

Table 6.128: Light CTL Setup Server messages

Table 6.129 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States		Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1004	Generic Default Transition Time (see Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1007		Generic OnPowerUp Get	M	



Element	SIG Model ID	States		Rx	Tx
		Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 6.1.2.2.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1301	Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Set	M	
			Light Lightness Default Set Unacknowledged	M	
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Set	M	
			Light Lightness Range Set Unacknowledged	M	
	0x1303	Light CTL (see Section 6.1.3)	Light CTL Get	M	
			Light CTL Set	M	
			Light CTL Set Unacknowledged	M	
			Light CTL Status		M
		Light CTL Temperature Range (see Section 6.1.3.1)	Light CTL Temperature Range Get	M	
			Light CTL Temperature Range Status		M
		Light CTL Temperature Default (see Section 6.1.3.2) Light CTL Delta UV Default (see Section 6.1.3.5)	Light CTL Default Get	M	
			Light CTL Default Status		M

Element	SIG Model ID	States		Rx	Tx
Temperature	0x1304	Light CTL Temperature Default (see Section 6.1.3.2)	Light CTL Default Set	M	
		Light CTL Delta UV Default (see Section 6.1.3.4)	Light CTL Default Set Unacknowledged	M	
		Light CTL Temperature Range (see Section 6.1.3.1)	Light CTL Temperature Range Set	M	
			Light CTL Temperature Range Set Unacknowledged	M	
			Generic Level Get	M	
			Generic Level Set	M	
Temperature	0x1002	Generic Level (see Section 6.1.3.1.1)	Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1306	Light CTL Temperature (see Section 6.1.3.1)	Light CTL Temperature Get	M	
			Light CTL Temperature Set	M	
			Light CTL Temperature Set Unacknowledged	M	
			Light CTL Temperature Status		M

Table 6.129: Light CTL Server elements, states, and messages

### 6.4.5.1 Light CTL Default state behavior

#### 6.4.5.1.1 Receiving Light CTL Default Set / Light CTL Default Set Unacknowledged messages

When a Light CTL Server receives a Light CTL Default Set message or a Light CTL Default Set Unacknowledged message, it shall set the bound Light Lightness Default state to the Lightness state, the Light CTL Temperature Default state to the Temperature field of the message, and the Light CTL Delta UV Default state to the Delta UV field of the message.

If the received message is a Light CTL Default Set message, the Light CTL Server shall respond with a Light CTL Default Status message (see Section 6.4.3.2.5).

### 6.4.5.2 Light CTL Temperature Range state behavior

#### 6.4.5.2.1 Receiving Light CTL Temperature Range Set / Light CTL Temperature Range Set Unacknowledged messages

When a Light CTL Temperature Setup Server receives a Light CTL Temperature Range Set message or a Light CTL Temperature Range Set Unacknowledged message with values that can be accepted, it shall set the Light CTL Temperature Range state fields to the corresponding fields of the message and set the status of the operation to 0x00 (Success).

When a Light CTL Temperature Setup Server receives a Light CTL Temperature Range Set message or a Light CTL Temperature Range Set Unacknowledged message with values that cannot be

accepted, it shall set the status of the operation to a value representing the reason why the values cannot be accepted, as defined in Table 7.2.

If the received message is a Light CTL Temperature Range Set message, the Light CTL Temperature Setup Server shall respond with a Light CTL Temperature Range Status message (see Section 6.4.3.3.2).

## 6.4.6 Light HSL Server

### 6.4.6.1 Description

The Light HSL Server model extends the Light Lightness Server model (see Section 6.4.1). When this model is present on an Element, the corresponding Light HSL Hue Server model (see Section 6.4.7) and the corresponding Light HSL Saturation Server model (see Section 6.4.8) and the corresponding Light HSL Setup Server model (see Section 6.4.9) shall also be present.

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 6.130 and messages listed in Table 6.131 to the model it extends. The model requires three elements: the main element and the Hue element and the Saturation element. The Hue element contains the corresponding Light HSL Hue Server model (see Section 6.4.7) and an instance of a Generic Level state bound to the Light HSL Hue state on the Hue element. The Saturation element contains the corresponding Light HSL Saturation Server model (see Section 6.4.8) and an instance of a Generic Level state bound to the Light HSL Saturation state on the Saturation element. The Light HSL Hue state on the Hue element is bound to the Light HSL state on the main element and the Light HSL Saturation state on the Saturation element is bound to the Light HSL state on the main element.

Light HSL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light HSL	Main	Yes	Light Lightness Server	Light Lightness Actual	Main
			Light HSL Hue Server	Light HSL Hue	Hue
			Light HSL Saturation Server	Light HSL Saturation	Saturation
Light HSL Hue Range		No	Light HSL Server	Light HSL	Main
Light HSL Hue Default		No	-	-	-
Light HSL Saturation Range		No	Light HSL Server	Light HSL	Main
Light HSL Saturation Default		No	-	-	-
Light HSL Hue	Hue	Yes	Light HSL Server	Light HSL	Main

Light HSL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
			Light HSL Hue Server	Generic Level	Hue
Generic Level		Yes	Light HSL Hue Server	Light HSL Hue	Hue
Light HSL Saturation	Saturation	Yes	Light HSL Server	Light HSL	Main
			Light HSL Saturation Server	Generic Level	Saturation
Generic Level		Yes	Light HSL Saturation Server	Light HSL Saturation	Saturation

Table 6.130: Light HSL Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1307	Light HSL (see Section 6.1.4)	Light HSL Get	M	
			Light HSL Set	M	
			Light HSL Set Unacknowledged	M	
			Light HSL Status		M
			Light HSL Target Get	M	
			Light HSL Target Status		M
		Light HSL Hue Default (see Section 6.1.4.2) and Light HSL Saturation Default (see Section 6.1.4.5)	Light HSL Default Get	M	
			Light HSL Default Status		M
Hue	0x1002	Generic Level (see Section 6.1.4.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130A	Light HSL Hue (see Section 6.1.4.1)	Light HSL Hue Get	M	
			Light HSL Hue Set	M	
			Light HSL Hue Set Unacknowledged	M	
			Light HSL Hue Status		M
Saturation	0x1002	Generic Level (see Section 6.1.4.4.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	

Element	SIG Model ID	States	Messages	Rx	Tx
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130B	Light HSL Saturation (see Section 6.1.4.2)	Light HSL Saturation Get	M	
			Light HSL Saturation Set	M	
			Light HSL Saturation Set Unacknowledged	M	
			Light HSL Saturation Status		M

Table 6.131: Light HSL Server messages

Table 6.132 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 6.1.2.2.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
			Light Lightness Last Get	M	

Element	SIG Model ID	States	Messages	Rx	Tx
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1307	Light HSL (see Section 6.1.4)	Light HSL Get	M	
			Light HSL Set	M	
			Light HSL Set Unacknowledged	M	
			Light HSL Status		M
			Light HSL Target Get	M	
			Light HSL Target Status		M
		Light HSL Hue Default (see Section 6.1.4.2) and Light HSL Saturation Default (see Section 6.1.4.5)	Light HSL Default Get	M	
			Light HSL Default Status		M
		Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6)	Light HSL Range Get	M	
			Light HSL Range Status		M
Hue	0x1002	Generic Level (see Section 6.1.4.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130A	Light HSL Hue (see Section 6.1.4.1)	Light HSL Hue Get	M	
			Light HSL Hue Set	M	
			Light HSL Hue Set Unacknowledged	M	
			Light HSL Hue Status		M
Saturation	0x1002	Generic Level (see Section 6.1.4.4.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	

Element	SIG Model ID	States	Messages	Rx	Tx
	0x130B	Light HSL Saturation (see Section 6.1.4.2)	Generic Level Status		M
			Light HSL Saturation Get	M	
			Light HSL Saturation Set	M	
			Light HSL Saturation Set Unacknowledged	M	
			Light HSL Saturation Status		M

Table 6.132: Light HSL Server elements, states, and messages

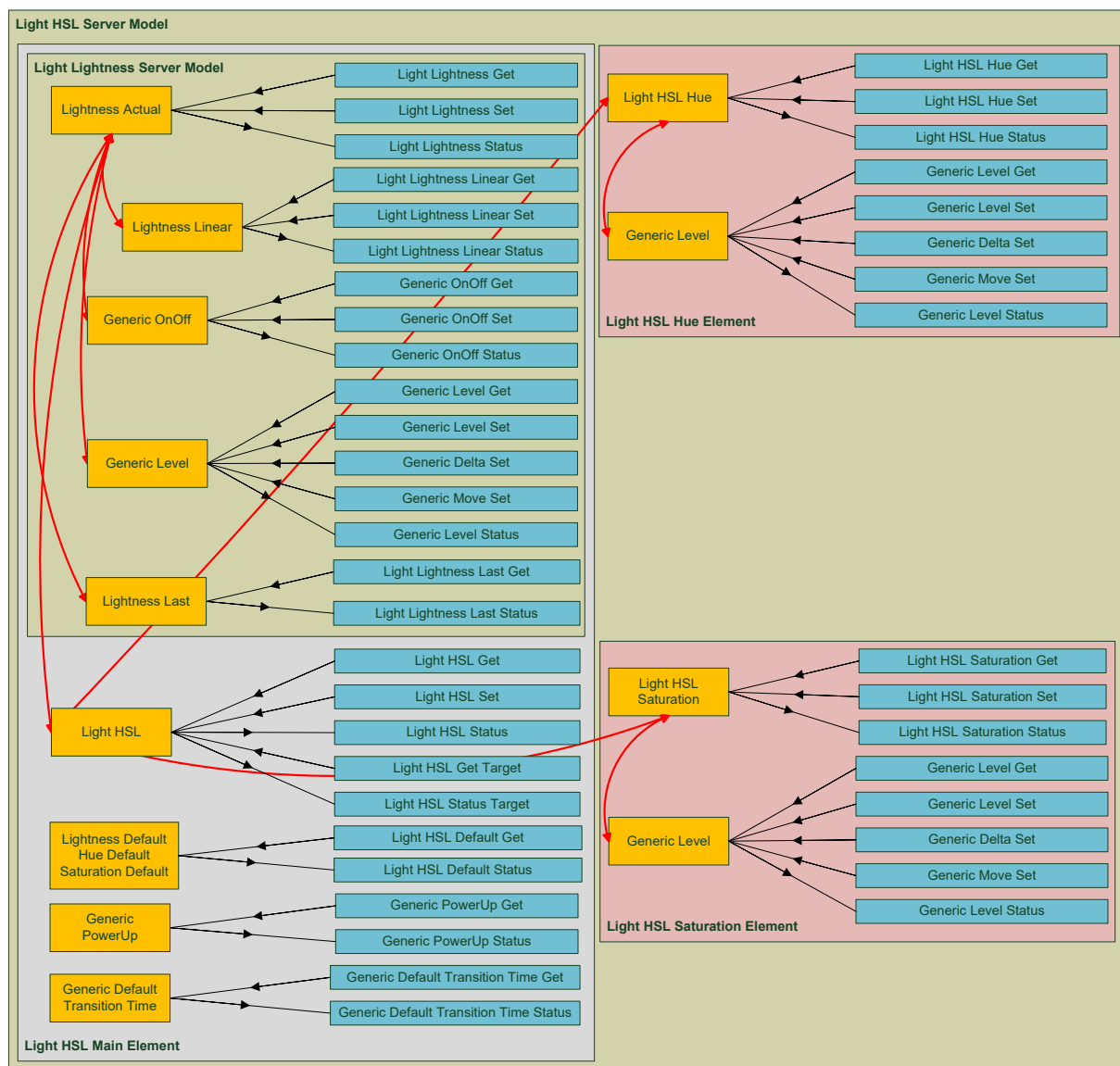


Figure 6.9: Element-model structure of Light HSL Server model (including the associated Light HSL Hue Server model and the Light HSL Saturation Server model)

## 6.4.6.2 Light HSL states behavior

### 6.4.6.2.1 Receiving a Light HSL Get message

When a Light HSL Server receives a Light HSL Get message, it shall respond with a Light HSL Status message (see Section 6.4.6.2.3).

### 6.4.6.2.2 Receiving Light HSL Set / Light HSL Set Unacknowledged messages

When a Light HSL Server receives a Light HSL Set message or a Light HSL Set Unacknowledged message, it shall set the Light HSL Lightness state to the HSL Lightness field of the message, the Light HSL Hue state to the HSL Hue field of the message, and the Light HSL Saturation state to the HSL Saturation field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light HSL Set message, the Light HSL Server shall respond with a Light HSL Status message (see Section 6.4.6.2.3).

### 6.4.6.2.3 Sending a Light HSL Status message

A Light HSL Server shall send the Light HSL Status message as a response to a Light HSL Get message, a Light HSL Set message, or as an unsolicited message at any time.

When sending a Light HSL Status message, the Light HSL Server shall set the HSL Lightness field to the present Light HSL Lightness state, the HSL Hue field to the present Light HSL Hue state, and the HSL Saturation field to the present Light HSL Saturation state.

If the Light HSL Server is in the process of changing the Light HSL state, it shall set the Remaining Time field to the time it will take to complete the transition; otherwise, the Remaining Time field shall be omitted. When a Light HSL state change is completed as a result of processing an acknowledged message or a transaction of messages other than a Light HSL Set message, a corresponding status acknowledge message shall be sent to the originator and a separate Light HSL Status message shall be published.

It is recommended to transmit a Light HSL Status message when the element has been physically turned on or off locally (as opposed to via the mesh network).

### 6.4.6.2.4 Receiving a Light HSL Target Get message

When a Light HSL Server receives a Light HSL Target Get message, it shall respond with a Light HSL Target Status message (see Section 6.4.6.2.5).

### 6.4.6.2.5 Sending Light HSL Target Status message

A Light HSL Server shall send the Light HSL Target Status message as a response to a Light HSL Get message or as an unsolicited message at any time.

When sending a Light HSL Target Status message, if the Light HSL Server is in the process of changing the Light HSL state, the Light HSL Server shall set the HSL Lightness Target field to the target Light HSL Lightness state, the HSL Hue Target field to the target Light HSL Hue state, the HSL



Saturation Target field to the target Light HSL Saturation state, and the Remaining Time field to the time it will take to complete the transition.

When sending a Light HSL Target Status message, if the Light HSL Server is not in the process of changing the Light HSL state, the Light HSL Server shall set the HSL Lightness Target field to the present Light HSL Lightness state, the HSL Hue Target field to the present Light HSL Hue state, the HSL Saturation Target field to the present Light HSL Saturation state, and the Remaining Time field shall be omitted.

#### 6.4.6.2.6 *Receiving a Light HSL Default Get message*

When a Light HSL Server receives a Light HSL Default Get message, it shall respond with a Light HSL Default Status message (see Section 6.4.6.2.7).

#### 6.4.6.2.7 *Sending a Light HSL Default Status message*

A Light HSL Server shall send the Light HSL Default Status message as a response to a Light HSL Default Get message, a Light HSL Default Set message, or as an unsolicited message at any time.

When sending a Light HSL Default Status message, the Light HSL Server shall set the Lightness field to the bound Light Lightness Default state, the Hue field to the Light HSL Hue Default state, and the Saturation field to the Light HSL Saturation Default state.

#### 6.4.6.2.8 *Receiving a Light HSL Range Get message*

When a Light HSL Server receives a Light HSL Range Get message, it shall respond with a Light HSL Range Status message (see Section 6.4.6.2.9).

#### 6.4.6.2.9 *Sending a Light HSL Range Status message*

A Light HSL Server shall send the Light HSL Range Status message as a response to a Light HSL Range Get message or as an unsolicited message at any time.

When sending a Light HSL Range Status message, the Light HSL Server shall set the Hue Range Min field to the Light Hue Range Min state, the Hue Range Max field to the Light Hue Range Max state, the Saturation Range Min field to the Light Saturation Range Min state, the Saturation Range Max field to the Light Saturation Range Max state, and the Status Code field to the status of the last operation on the Light HSL Hue Range and Light HSL Saturation Range states.

### 6.4.7 Light HSL Hue Server

#### 6.4.7.1 Description

The Light HSL Hue Server model extends the Generic Level Server model (see Section 3.3.2). This model is associated with the Light HSL Server model (see Section 6.4.6).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 6.133 and messages listed in Table 6.134 to the model it extends.

Light HSL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light HSL Hue	Hue	Yes	Light HSL Server	Light HSL	Main
			Light HSL Hue Server	Generic Level	Hue

Light HSL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Generic Level	Hue	Yes	Light HSL Hue Server	Light HSL Hue	Hue

Table 6.133: Light HSL Hue Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Hue	0x1002	Generic Level (see Section 3.1.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130A	Light HSL Hue (see Section 6.1.4.1)	Light HSL Hue Get	M	
			Light HSL Hue Set	M	
			Light HSL Hue Set Unacknowledged	M	
			Light HSL Hue Status		M

Table 6.134: Light HSL Hue Server messages

### 6.4.7.2 Light HSL Hue state behavior

#### 6.4.7.2.1 Receiving a Light HSL Hue Get message

When a Light HSL Hue Server receives a Light HSL Hue Get message, it shall respond with a Light HSL Hue Status message (see Section 6.4.7.2.3).

#### 6.4.7.2.2 Receiving Light HSL Hue Set / Light HSL Hue Set Unacknowledged messages

When a Light HSL Hue Server receives a Light HSL Hue Set message or a Light HSL Hue Set Unacknowledged message, it shall set the Light HSL Hue state to the Hue field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported on the main element, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light HSL Hue Set message, the Light HSL Hue Server shall respond with a Light HSL Hue Status message (see Section 6.4.7.2.3).

#### 6.4.7.2.3 Sending a Light HSL Hue Status message

A Light HSL Hue Server shall send the Light HSL Hue Status message as a response to a Light HSL Hue Get message, a Light HSL Hue Set message, or as an unsolicited message at any time.

When sending a Light HSL Hue Status message, the Light HSL Hue Server shall set the Hue field to the present Light HSL Hue state.

If the Light HSL Hue Server is in the process of changing the Light HSL Hue state, it shall set the Target Hue field to the target Light HSL Hue state and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target Hue and Remaining Time fields shall be omitted.

### 6.4.8 Light HSL Saturation Server

#### 6.4.8.1 Description

The Light HSL Saturation Server model extends the Generic Level Server model (see Section 3.3.2). This model is associated with the Light HSL Server model (see Section 6.4.6).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

The model adds the state instances listed in Table 6.135 and messages listed in Table 6.136 to the model it extends.

Light HSL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light HSL Saturation	Saturation	Yes	Light HSL Server	Light HSL	Main
			Light HSL Saturation Server	Generic Level	Saturation
Generic Level	Saturation	Yes	Light HSL Saturation Server	Light HSL Saturation	Saturation

Table 6.135: Light HSL Saturation Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Saturation	0x1002	Generic Level (see Section 3.1.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130B	Light HSL Saturation (see Section 6.1.4.4)	Light HSL Saturation Get	M	
			Light HSL Saturation Set	M	
			Light HSL Saturation Set Unacknowledged	M	
			Light HSL Saturation Status		M

Table 6.136: Light HSL Saturation Server messages

### 6.4.8.2 Light HSL Saturation state behavior

#### 6.4.8.2.1 Receiving a Light HSL Saturation Get message

When a Light HSL Saturation Server receives a Light HSL Saturation Get message, it shall respond with a Light HSL Saturation Status message (see Section 6.4.8.2.3).

#### 6.4.8.2.2 Receiving Light HSL Saturation Set / Light HSL Saturation Set Unacknowledged messages

When a Light HSL Saturation Server receives a Light HSL Saturation Set message or a Light HSL Saturation Set Unacknowledged message, it shall set the Light HSL Saturation state to the Saturation field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported on the main element, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light HSL Saturation Set message, the Light HSL Saturation Server shall respond with a Light HSL Saturation Status message (see Section 6.4.8.2.3).

#### 6.4.8.2.3 Sending Light HSL Saturation Status message

A Light HSL Saturation Server shall send the Light HSL Saturation Status message as a response to a Light HSL Saturation Get message, a Light HSL Saturation Set message, or as an unsolicited message at any time.

When sending a Light HSL Saturation Status message, the Light HSL Saturation Server shall set the Saturation field to the present Light HSL Saturation state.

If the Light HSL Saturation Server is in the process of changing the Light HSL Saturation state, it shall set the Target Saturation field to the target Light HSL Saturation state and the Remaining Time field to the time it will take to complete the transition. Otherwise, the Target Saturation and Remaining Time fields shall be omitted.

## 6.4.9 Light HSL Setup Server

### 6.4.9.1 Description

The Light HSL Setup Server model extends the Light HSL Server (see Section 6.4.6) and the Light Lightness Setup Server (see Section 6.4.4.2.1).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in Table 6.137 to the model it extends:

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1308	Light HSL Hue Default (see Section 6.1.4.2) and Light HSL Saturation Default (see Section 6.1.4.5)	Light HSL Default Set	M	
			Light HSL Default Set Unacknowledged	M	
		Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6)	Light HSL Range Set	M	
			Light HSL Range Set Unacknowledged	M	

Table 6.137: Light HSL Setup Server messages

Table 6.138 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1004	Generic Default Transition Time (see Section 3.1.3)	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1007	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	
	0x1002		Generic Level Get	M	

Element	SIG Model ID	States	Messages	Rx	Tx
		Generic Level (see Section 6.1.2.2.2)	Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1301	Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Set	M	
			Light Lightness Range Set Unacknowledged	M	
	0x1307	Light HSL (see Section 6.1.4)	Light HSL Get	M	
			Light HSL Set	M	
			Light HSL Set Unacknowledged	M	
			Light HSL Status		M
			Light HSL Target Get	M	
			Light HSL Target Status		M
		Light HSL Hue Default (see Section 6.1.4.2) and Light HSL Saturation Default (see Section 6.1.4.5)	Light HSL Default Get	M	
			Light HSL Default Set	M	
			Light HSL Default Set Unacknowledged	M	
			Light HSL Default Status		M
		Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6)	Light HSL Range Get	M	
			Light HSL Range Status		M
	0x1308	Light HSL Hue Range (see Section 6.1.4.3) and Light HSL Saturation Range (see Section 6.1.4.6)	Light HSL Range Set	M	
			Light HSL Range Set Unacknowledged	M	

Element	SIG Model ID	States	Messages	Rx	Tx
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Set	M	
			Light Lightness Default Set Unacknowledged	M	
Hue	0x1002	Generic Level (see Section 6.1.4.1.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130A	Light HSL Hue (see Section 6.1.4.1)	Light HSL Hue Get	M	
			Light HSL Hue Set	M	
			Light HSL Hue Set Unacknowledged	M	
			Light HSL Hue Status		M
Saturation	0x1002	Generic Level (see Section 6.1.4.4.1)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x130B	Light HSL Saturation (see Section 6.1.4.2)	Light HSL Saturation Get	M	
			Light HSL Saturation Set	M	
			Light HSL Saturation Set Unacknowledged	M	
			Light HSL Saturation Status		M

Table 6.138: Light HSL Setup Server elements, states, and messages

### 6.4.9.2 Light HSL Default state behavior

#### 6.4.9.2.1 Receiving Light HSL Default Set / Light HSL Default Set Unacknowledged messages

When a Light HSL Setup Server receives a Light HSL Default Set message or a Light HSL Default Set Unacknowledged message, it shall set the bound Light Lightness Default state to the Lightness field of the message, the Light HSL Hue state to the Hue field of the message, and the Light HSL Saturation state to the Saturation field of the message.

If the received message is a Light HSL Default Set message, the Light HSL Server shall respond with a Light HSL Default Status message (see Section 6.4.6.2.7).

### 6.4.9.3 Light HSL Range state behavior

#### 6.4.9.3.1 Receiving Light HSL Range Set / Light HSL Range Set Unacknowledged messages

When a Light HSL Setup Server receives a Light HSL Range Set message or a Light HSL Range Set Unacknowledged message with values that can be accepted, it shall set the Light HSL Hue Range state fields and the Light HSL Saturation Range state fields to the corresponding fields of the message and set the status of the operation to 0x00 (Success).

When a Light HSL Setup Server receives a Light HSL Range Set message or a Light HSL Range Set Unacknowledged message with values that cannot be accepted, it shall set the status of the operation to a value representing the reason why the values cannot be accepted, as defined in [Table 7.2](#).

If the received message is a Light HSL Range Set message, the Light HSL Setup Server shall respond with a Light HSL Range Status message (see [Section 6.4.6.2.9](#)).

### 6.4.10 Light xyL Server

#### 6.4.10.1 Description

The Light xyL Server model extends the Light Lightness Server model (see [Section 6.4.1](#)). When this model is present on an Element, the corresponding Light xyL Setup Server model (see [Section 6.4.11](#)) shall also be present.

This model shall support model publication, as defined in [Section 4.2.2](#) of the Mesh Profile specification [\[2\]](#), and model subscription, as defined in [Section 4.2.3](#) of the Mesh Profile specification.

The model adds the state instances listed in [Table 6.139](#) and messages listed in [Table 6.140](#) to the model it extends.

Light HSL Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light xyL	Main	Yes	Light Lightness Server	Light Lightness Actual	Main
Light xyL x		Yes	-	-	-
Light xyL x Range		No	Light xyL Server	Light xyL x	Main
Light xyL x Default		No	-	-	-
Light xyL y		Yes	-	-	-
Light xyL y Range		No	Light xyL Server	Light xyL y	Main
Light xyL y Default		No	-	-	-

Table 6.139: Light xyL Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x130C	Light xyL (see <a href="#">Section 6.1.5</a> )	Light xyL Get	M	
			Light xyL Set	M	
			Light xyL Set Unacknowledged	M	
			Light xyL Status		M
			Light xyL Target Get	M	
			Light xyL Target Status		M
			Light xyL Default Get	M	



Element	SIG Model ID	States	Messages	Rx	Tx
		Light xyL x Default (see Section 6.1.5.2) Light xyL y Default (see Section 6.1.5.5)	Light xyL Default Status		M

Table 6.140: Light xyL Server messages

Table 6.141 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 6.1.2.2.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section 6.1.2.1)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x130C	Light xyL (see Section 6.1.5)	Light xyL Get	M	
			Light xyL Set	M	

Element	SIG Model ID	States	Messages	Rx	Tx
			Light xyL Set Unacknowledged	M	
			Light xyL Status		M
			Light xyL Target Get	M	
			Light xyL Target Status		M
		Light xyL x Default (see Section 6.1.5.2) Light xyL y Default (see Section 6.1.5.5)	Light xyL Default Get	M	
			Light xyL Default Status		M
		Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6)	Light xyL Range Get	M	
			Light xyL Range Status		M

Table 6.141: Light xyL Server elements, states, and messages

## 6.4.10.2 Light xyL states behavior

### 6.4.10.2.1 Receiving a Light xyL Get message

When a Light xyL Server receives a Light xyL Get message, it shall respond with a Light xyL Status message (see Section 6.4.10.2.3).

### 6.4.10.2.2 Receiving Light xyL Set / Light xyL Set Unacknowledged messages

When a Light xyL Server receives a Light xyL Set message or a Light xyL Set Unacknowledged message, it shall set the Light xyL Lightness state to the xyL Lightness field of the message, the Light xyL x state to the xyL x field of the message, and the Light xyL y state to the xyL y field of the message, unless the message has the same values for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the target state is equal to the current state, the transition shall not be started and is considered complete.

If the received message is a Light xyL Set message, the Light xyL Server shall respond with a Light xyL Status message (see Section 6.4.10.2.3).

### 6.4.10.2.3 Sending a Light xyL Status message

A Light xyL Server shall send the Light xyL Status message as a response to a Light xyL Get message, a Light xyL Set message, or as an unsolicited message at any time.

When sending a Light xyL Status message, the Light xyL Server shall set the xyL Lightness field to the present Light xyL Lightness state, the xyL x field to the present Light xyL x state, and the xyL y field to the present Light xyL y state.

If the Light xyL Server is in the process of changing the Light xyL state, it shall set the Remaining Time field to the time it will take to complete the transition; otherwise, the Remaining Time field shall be omitted.

#### **6.4.10.2.4 Receiving a Light xyL Target Get message**

When a Light xyL Server receives a Light xyL Target Get message, it shall respond with a Light xyL Target Status message (see Section 6.4.10.2.5).

#### **6.4.10.2.5 Sending a Light xyL Target Status message**

A Light xyL Server shall send the Light xyL Target Status message as a response to a Light xyL Get message or as an unsolicited message at any time.

When sending a Light xyL Target Status message, if the Light xyL Server is in the process of changing the Light xyL state, the Light xyL Server shall set the xyL Lightness field to the target Light xyL Lightness state, the xyL x field to the target Light xyL x state, the xyL y field to the target Light xyL y state, and the Remaining Time field to the time it will take to complete the transition.

When sending a Light xyL Target Status message, if the Light xyL Server is not in the process of changing the Light xyL state, the Light xyL Server shall set the xyL Lightness field to the present Light xyL Lightness state, the xyL x field to the present Light xyL x state, the xyL y field to the present Light xyL y state, and the Remaining Time field shall be omitted.

#### **6.4.10.2.6 Receiving a Light xyL Default Get message**

When a Light xyL Server receives a Light xyL Default Get message, it shall respond with a Light xyL Default Status message (see Section 6.4.10.2.7).

#### **6.4.10.2.7 Sending a Light xyL Default Status message**

A Light xyL Server shall send the Light xyL Default Status message as a response to a Light xyL Default Get message, a Light xyL Default Set message, or as an unsolicited message at any time.

When sending a Light xyL Default Status message, the Light xyL Server shall set the Lightness field to the bound Light Lightness Default state, the xyL x field to the Light xyL x state, and the xyL y field to the Light xyL y state.

#### **6.4.10.2.8 Receiving a Light xyL Range Get message**

When a Light xyL Server receives a Light xyL Range Get message, it shall respond with a Light xyL Range Status message (see Section 6.4.10.2.9).

#### **6.4.10.2.9 Sending a Light xyL Range Status message**

A Light xyL Server shall send the Light xyL Range Status message as a response to a Light xyL Range Get message or as an unsolicited message at any time.

When sending a Light xyL Range Status message, the Light xyL Server shall set the xyL x Range Min field to the Light xyL x Range Min state, the xyL x Range Max field to the Light xyL x Range Max state, xyL y Range Min field to the Light xyL y Range Min state, the xyL y Range Max field to the Light xyL y Range Max state, and the Status Code field to the status of the last operation on the Light xyL x Range or Light xyL y Range states.

### **6.4.11 Light xyL Setup Server**

#### **6.4.11.1 Description**

The Light xyL Setup Server model extends the Light xyL Server (see Section 6.4.10) and the Light Lightness Setup Server (see Section 6.4.4.2.1).

This model shall support model subscription, as defined in Section 4.2.3 of the Mesh Profile specification [2].

The model adds the messages listed in [Table 6.142](#) to the model it extends:

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x130D	Light xyL x Default (see Section <a href="#">6.1.5.2</a> ) Light xyL y Default (see Section <a href="#">6.1.5.5</a> )	Light xyL Default Set	M	
			Light xyL Default Set Unacknowledged	M	
		Light xyL x Range (see Section <a href="#">6.1.5.3</a> ) and Light xyL y Range (see Section <a href="#">6.1.5.6</a> )	Light xyL Range Set	M	
			Light xyL Range Set Unacknowledged	M	

Table 6.142: Light xyL Setup Server messages

[Table 6.143](#) illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States	Messages	Rx	Tx
Main	0x1000	Generic OnOff (see Section <a href="#">3.1.1</a> )	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1004	Generic Default Transition Time (see Section <a href="#">3.1.3</a> )	Generic Default Transition Time Get	M	
			Generic Default Transition Time Set	M	
			Generic Default Transition Time Set Unacknowledged	M	
			Generic Default Transition Time Status		M
	0x1007	Generic OnPowerUp (see Section <a href="#">3.1.4</a> )	Generic OnPowerUp Get	M	
			Generic OnPowerUp Set	M	
			Generic OnPowerUp Set Unacknowledged	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section <a href="#">6.1.2.2.2</a> )	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M
	0x1300	Light Lightness Actual (see Section <a href="#">6.1.2.1</a> )	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Last (see Section <a href="#">6.1.2.3</a> )	Light Lightness Last Get	M	
			Light Lightness Last Status		M

Element	SIG Model ID	States	Messages	Rx	Tx
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1301	Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Set	M	
			Light Lightness Default Set Unacknowledged	M	
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Set	M	
			Light Lightness Range Set Unacknowledged	M	
	0x130C	Light xyL (see Section 6.1.5)	Light xyL Get	M	
			Light xyL Set	M	
			Light xyL Set Unacknowledged	M	
			Light xyL Status		M
			Light xyL Target Get	M	
			Light xyL Target Status		M
		Light xyL x Default (see Section 6.1.5.2) Light xyL y Default (see Section 6.1.5.5)	Light xyL Default Get	M	
			Light xyL Default Set	M	
			Light xyL Default Set Unacknowledged	M	
			Light xyL Default Status		M
		Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6)	Light xyL Range Get	M	
			Light xyL Range Status		M
	0x130D	Light xyL x Range (see Section 6.1.5.3) and Light xyL y Range (see Section 6.1.5.6)	Light xyL Range Set	M	
			Light xyL Range Set Unacknowledged	M	

Table 6.143: Light xyL Setup Server elements, states, and messages

### 6.4.11.2 Light xyL Default state behavior

#### 6.4.11.2.1 Receiving Light xyL Default Set / Light xyL Default Set Unacknowledged messages

When a Light xyL Setup Server receives a Light xyL Default Set message or a Light xyL Default Set Unacknowledged message, it shall set the bound Light Lightness Default state to the Lightness field of the message, the Light xyL x state to the xyL x field of the message, and the Light xyL y state to the xyL y field of the message.

If the received message is a Light xyL Default Set message, the Light xyL Server shall respond with a Light xyL Default Status message (see Section 6.4.10.2.7).



### 6.4.11.3 Light xyL Range state behavior

#### 6.4.11.3.1 Receiving Light xyL Range Set / Light xyL Range Set Unacknowledged messages

When a Light xyL Setup Server receives a Light xyL Range Set message or a Light xyL Range Set Unacknowledged message with values that can be accepted, it shall set the Light xyL x Range state fields and the Light xyL y Range state fields to the corresponding fields of the message and the status of the operation to 0x00 (Success).

When a Light xyL Setup Server receives a Light xyL Range Set message or a Light xyL Range Set Unacknowledged message with values that cannot be accepted, it shall set the status of the operation to a value representing the reason why the values cannot be accepted, as defined in [Table 7.2](#).

If the received message is a Light xyL Range Set message, the Light xyL Server shall respond with a Light xyL Range Status message (see [Section 6.4.10.2.9](#)).

## 6.5 Lighting control models

### 6.5.1 Light LC Server

#### 6.5.1.1 Description

The Light LC (Lightness Control) Server model extends the Light Lightness Server model (see [Section 6.4.1](#)) and the Generic OnOff Server model (see [Section 3.3.1](#)). When this model is present on an Element, the corresponding Light LC Setup Server model (see [Section 6.5.2](#)) shall also be present.

This model shall support model publication, as defined in [Section 4.2.2](#) of the Mesh Profile specification [\[2\]](#), and model subscription, as defined in [Section 4.2.3](#) of the Mesh Profile specification.

This model may be used to represent an element that is a client to a Sensor Server model (see [Section 4.3.1](#)) and controls the Light Lightness Actual state (see [Section 6.1.2.1](#)) via defined state bindings.

The model adds the state instances listed in [Table 6.144](#) and messages listed in [Table 6.145](#) to the model it extends.

**Note:** Because the Light LC Linear Output state is bound to the Light Lightness Linear state (see [Section 6.2.3.6.1](#)), the Light LC Server model must be located on an element that is separate from the element the Light Lightness Server model is located on.

Light LC Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light LC Mode	Light LC	Yes	-	-	-
Light LC Occupancy Mode	Light LC	Yes	-	-	-
Light LC Light OnOff	Light LC	Yes	Generic OnOff	Generic OnOff	Light LC
Light LC Ambient LuxLevel	Light LC	No	-	-	-
Light LC Occupancy	Light LC	No	-	-	-
Generic OnOff	Light LC	Yes	Light LC Server	Light LC Light OnOff	Light LC

Table 6.144: Light LC Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Light LC	0x130F	Light LC Mode (see Section 6.2.3.1)	Light LC Mode Get	M	
			Light LC Mode Set	M	
			Light LC Mode Set Unacknowledged	M	
			Light LC Mode Status		M
		Light LC Occupancy Mode (see Section 6.2.3.2)	Light LC OM Get	M	
			Light LC OM Set	M	
			Light LC OM Set Unacknowledged	M	
			Light LC OM Status		M
		Light LC Light OnOff (see Section 6.2.3.3)	Light LC Light OnOff Get	M	
			Light LC Light OnOff Set	M	
			Light LC Light OnOff Set Unacknowledged	M	
			Light LC Light OnOff Status		M
		Light LC Occupancy (see Section 6.2.3.4) Light LC Ambient LuxLevel (see Section 6.2.3.4)	Sensor Status	M	

Table 6.145: Light LC Server messages

Table 6.146 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States		Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 3.1.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M

Element	SIG Model ID	States		Rx	Tx
	0x1300	Light Lightness Actual (see Section 6.1.2.2)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
Light LC	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x130F	Light LC Mode (see Section 6.2.3.1)	Light LC Mode Get	M	
			Light LC Mode Get	M	
			Light LC Mode Set	M	
			Light LC Mode Status		M
		Light LC Occupancy Mode (see Section 6.2.3.2)	Light LC OM Get	M	
			Light LC OM Get	M	
			Light LC OM Set	M	
			Light LC OM Status		M
		Light LC Light OnOff (see Section 6.2.3.3)	Light LC Light OnOff Get	M	
			Light LC Light OnOff Get	M	
			Light LC Light OnOff Set	M	
			Light LC Light OnOff Status		M
		Light LC Occupancy (see Section 6.2.3.4) Light LC Ambient LuxLevel (see Section 6.2.3.4)	Sensor Status	M	

Table 6.146: Light LC Server elements, states, and messages

### 6.5.1.2 PowerUp sequence behavior



At power-up, the model restores its states as defined in this section.

When the OnPowerUp state is equal to 0x00 or 0x01, the Light LC Server shall start execution of all other power-up sequences of other models that the Light LC Server extends, shall start the Light LC State Machine in the Off state, shall set the Light LC Mode state to 0b0, shall set the Light LC Occupancy Mode state to last known value, and shall set the Light LC Light OnOff state to 0b0.

When the OnPowerUp state is equal to 0x02 and the last known value of the Light LC Mode state (before power-down) is 0b0, the Light LC Server shall start execution of all other power-up sequences of other models that the Light LC Server extends, shall start the Light LC State Machine in the Off state, shall set Light LC Mode state to 0b0, and shall set Light LC Occupancy Mode state to its last known value. The Light LC Server shall not set the Light LC Light OnOff state to any value.

Note: Setting the Light LC Light OnOff state to a value generates an event, as described in Section 6.2.3.3, and that event will be ignored when the Light LC State Machine is in the Off state.

When the OnPowerUp state is equal to 0x02, and the last known value of the Light LC Mode (before power-down) is 0b1, the Light LC Server shall not execute any power-up sequences of the models the Light LC Server extends, shall start the Light LC State Machine in the Off state, and then shall set the following states in this order: the Light LC Mode state shall be set to 0b1, the Light LC Occupancy Mode state shall be set to the last known value before power-down, and the Light LC Light OnOff state shall be set to the last known value, as defined in Table 6.147.

Note: The reason for setting the values of the states in the order described is that setting the Light LC Mode might generate an event as described in Section 6.2.5.3 and setting the Light LC Light OnOff state will generate an event as described in Section 6.2.3.3.

Other models in this specification define the last known value as the target state during the transition (see Section 1.4.1). The Light LC Server model does not support target state transitions, but some of the Light LC State Machine states transition to another state upon timer expiration (the Timer Off event, as defined in Section 6.2.5.2). This mechanism is conceptually similar to target state transition behavior. The Light LC Server model implements this by setting the Light LC Light OnOff state last known value (before power-down) depending on the Light LC State Machine state.

When a power-down is executed, the Light LC Light OnOff state last known value shall be set according to the Light LC State Machine state, as defined in Table 6.147.

Light LC State Machine state	Light LC Light OnOff state last known value	Notes
Off	0b0	-
Standby	0b0	-
Fade On	0b1	Fade On will transition to Run.
Run	0b1	-
Fade	0b1	Fade will transition to Prolong.
Prolong	0b1	-
Fade Standby Auto	0b0	Fade Standby Auto will transition to Standby.
Fade Standby Manual	0b0	Fade Standby Manual will transition to Standby.

Table 6.147: Last known value of the Light LC Light OnOff state

Figure 6.10 illustrates the power-up sequence for the Light LC Server model combined with the power-up sequence for the Light Lightness Server mode that the Light LC Server model extends.

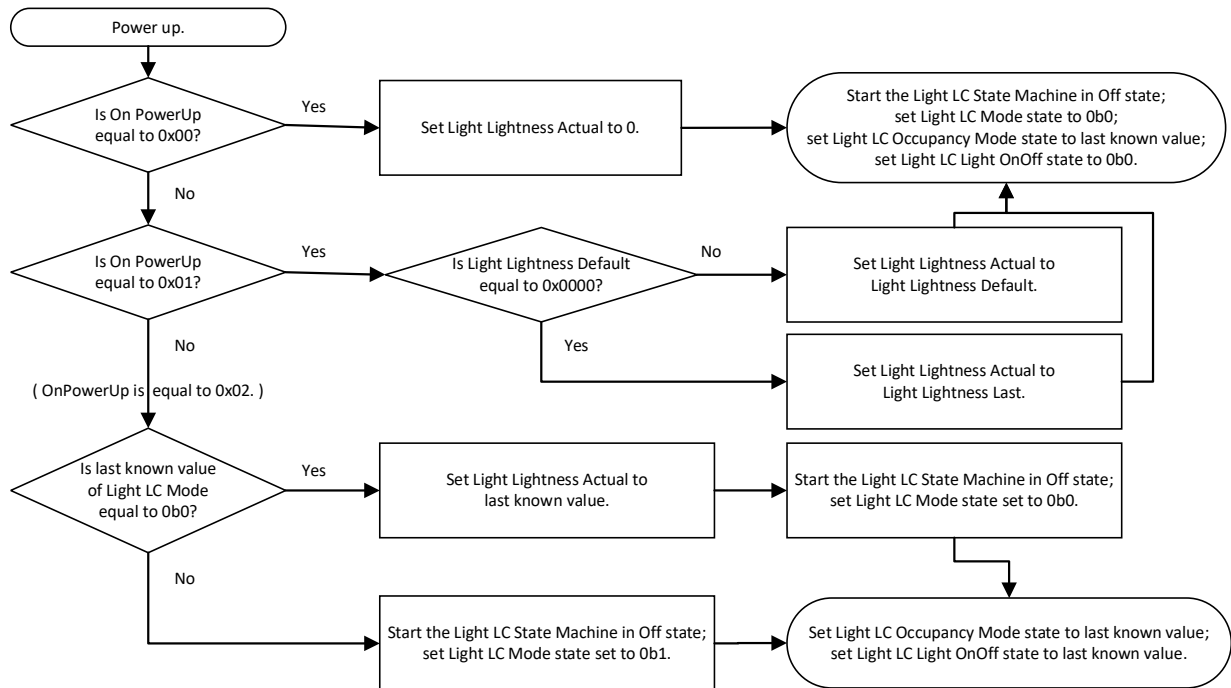


Figure 6.10: Power-up sequence of the Light LC Server and Light Lightness Server models

### 6.5.1.3 Scene Store and Scene Recall behavior

The Light LC Server model overrides some of the Scene Store and Scene Recall behaviors defined in Section 5.1.3.1.

#### 6.5.1.3.1 Scene Store behavior for the Light LC Server model

When the Scene Store operation is executed, the Light LC Light OnOff state value that is stored is set according to the Light LC State Machine state, as defined in Table 6.148.

Light LC State Machine state	Light LC Light OnOff state stored value	Notes
Off	0b0	-
Standby	0b0	-
Fade On	0b1	Fade On will transition to Run.
Run	0b1	-
Fade	0b1	Fade will transition to Prolong.
Prolong	0b1	-
Fade Standby Auto	0b0	Fade Standby Auto will transition to Standby.
Fade Standby Manual	0b0	Fade Standby Manual will transition to Standby.

Table 6.148: The Light LC Light OnOff state value stored by the Scene Store operation

#### 6.5.1.3.2 Scene Recall behavior for the Light LC Server model

When the Scene Recall operation is executed, and the stored value of the Light LC Mode is equal to 0b0, the Light LC Server shall start execution of the Scene Recall operation on all other models that the Light LC Server extends (including starting all state transitions), shall start the Light LC State Machine in the Off state, shall set the Light LC Mode state to 0b0, shall set Light LC Occupancy Mode

state to the stored value (as defined in [Table 6.143](#)), and shall set the Light LC Light OnOff state to the stored value as defined in [Table 6.148](#).

When the Scene Recall operation is executed, and the stored value of the Light LC Mode is equal to 0b1, the Light LC Server shall not execute any Scene Recall operation on the models that the Light LC Server extends, shall start the Light LC State Machine in the Off state, and then shall set the following states in this order: the Light LC Mode state shall be set to 0b1, and the Light LC Occupancy Mode state shall be set to the stored value (as defined in [Table 6.143](#)), and the Light LC Light OnOff state shall be set to the stored value as defined in [Table 6.148](#).

#### 6.5.1.4 Light LC Mode state behavior

##### 6.5.1.4.1 *Receiving a Light LC Mode Get message*

When a Light LC Server receives a Light LC Mode Get message, it shall respond with a Light LC Mode Status message (see Section [6.5.1.4.3](#)).

##### 6.5.1.4.2 *Receiving a Light LC Mode Set / Light LC Mode Set Unacknowledged message*

When a Light LC Server receives a Light LC Mode Set message or a Light LC Mode Set Unacknowledged message, it shall set the Light LC Mode state to the Mode field of the message.

If the received message is a Light LC Mode Set message, the Light LC Server shall respond with a Light LC Mode Status message (see Section [6.5.1.4.3](#)).

##### 6.5.1.4.3 *Sending a Light LC Mode Status message*

A Light LC Server shall send the Light LC Mode Status message as a response to a Light LC Mode Get message (see Section [6.3.5.1.1](#)) or to a Light LC Mode Set message (see Section [6.3.5.1.2](#)), or as an unsolicited message at any time.

When sending a Light LC Mode Status message, the Light LC Server shall set the Mode field to the present Light LC Mode state.

#### 6.5.1.5 Light LC Occupancy Mode state behavior

##### 6.5.1.5.1 *Receiving a Light LC OM Get message*

When a Light LC Server receives a Light LC OM Get message, it shall respond with a Light LC OM Status message (see Section [6.5.1.5.3](#)).

##### 6.5.1.5.2 *Receiving a Light LC OM Set / Light LC OM Set Unacknowledged message*

When a Light LC Server receives a Light LC OM Set message or a Light LC OM Set Unacknowledged message, it shall set the Light LC Occupancy Mode state to the Mode field of the message.

If the received message is a Light LC OM Set message, the Light LC Server shall respond with a Light LC OM Status message (see Section [6.5.1.5.3](#)).

##### 6.5.1.5.3 *Sending a Light LC OM Status message*

A Light LC Server shall send the Light LC OM Status message as a response to a Light LC OM Get message (see Section [6.3.5.2.1](#)) or to a Light LC OM Set message (see Section [6.3.5.2.2](#)), or as an unsolicited message at any time.

When sending a Light LC OM Status message, the Light LC Server shall set the Mode field to the present Light LC Occupancy Mode state.

### 6.5.1.6 Light LC Light OnOff state behavior

#### 6.5.1.6.1 Receiving a Light LC Light OnOff Get message

When a Light LC Server receives a Light LC Light OnOff Get message, it shall respond with a Light LC Light OnOff Status message (see Section 6.5.1.6.3).

#### 6.5.1.6.2 Receiving a Light LC Light OnOff Set / Light LC Light OnOff Set Unacknowledged message

When a Light LC Server receives a Light LC Light OnOff Set message or a Light LC Light OnOff Set Unacknowledged message, it shall set the Light LC Light OnOff state to the Light OnOff field of the message, unless the message has the same value for the SRC, DST, and TID fields as the previous message received within the last 6 seconds.

Both messages may optionally include a Transition Time field indicating the transition time to the target state. If the Transition Time is not included, the Light LC Server shall use its appropriate transition times defined by the Light LC Property states (see Section 6.2.4).

If the Transition Time field is included, the Delay field is included and indicates a delay in 5-millisecond steps the server shall wait before executing any state changing behavior for this message.

If the received message is a Light LC Light OnOff Set message, the Light LC Server shall respond with a Light LC Light OnOff Status message (see Section 6.5.1.6.3).

#### 6.5.1.6.3 Sending a Light LC Light OnOff Status message

A Light LC Server shall send the Light LC Light OnOff Status message as a response to a Light LC Light OnOff Get message (see Section 6.3.5.1) or to a Light LC Light OnOff Set message (see Section 6.3.5.3.2), or as an unsolicited message at any time.

When sending a Light LC Light OnOff Status message, the Light LC Server shall set the Light OnOff field to the present Light LC Light OnOff state. If the Light LC Server is in the process of changing the Light LC Light OnOff state, it shall set the Target Light OnOff field to the target Light LC Light OnOff state and the Remaining Time field to the time it will take to complete the transition; otherwise, the Target Level and Remaining Time fields shall be omitted.

It is recommended to transmit a Light LC Light OnOff Status message when the Light LC Light OnOff state has been changed locally (as opposed to via the mesh network).

### 6.5.1.7 Light LC Occupancy and Light LC Ambient LuxLevel states behavior

#### 6.5.1.7.1 Receiving a Sensor Status message

When a Light LC Server receives a Sensor Status message (see Section 4.2.14), and if the message Raw field contains a Raw Value for the Motion Sensed Property [13], and the value is greater than 0, or a Raw Value for the People Count Property [13], and the value is greater than 0, or a Raw Value for the Presence Detected Property [13], and the value is greater than 0, then it shall set the Light LC Occupancy state to 0b1.

If the message Raw field contains a Raw Value for the Time Since Motion Sensed device property [13], which represents a value less than or equal to the value of the Light LC Occupancy Delay state (see Section 6.2.4.1), it shall delay setting the Light LC Occupancy state to 0b1 by the difference between the value of the Light LC Occupancy Delay state and the received Time Since Motion value.

When a Light LC Server receives a Sensor Status message (see Section 4.2.14), and if the message Raw field contains a Raw Value for the Present Ambient Light Level device property [13], it shall set the Light LC Ambient LuxLevel state to the Represented Value of the received Present Ambient Light Level.

## 6.5.2 Light LC Setup Server

### 6.5.2.1 Description

The Light LC (Lightness Control) Setup model extends the Light LC Server model (see Section 6.5.1).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to configure setup parameters for the Light LC Server model.

The model adds the state instances listed in Table 6.149 and messages listed in Table 6.150 to the models it extends:

Light LC Setup Server States		Stored with Scene	Bound States		
State	Instance		Model	State	Instance
Light LC Property	Light LC	Yes	-	-	-

Table 6.149: Light LC Setup Server states and bindings

Element	SIG Model ID	States	Messages	Rx	Tx
Light LC	0x1310	Light LC Property	Light LC Property Get	M	
			Light LC Property Set	M	
			Light LC Property Set Unacknowledged	M	
			Light LC Property Status		M

Table 6.150: Light LC Setup Server messages

Table 6.151 illustrates the complete structure of elements, states, and messages used by the model (including the models it extends).

Element	SIG Model ID	States		Rx	Tx
Main	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x1006	Generic OnPowerUp (see Section 3.1.4)	Generic OnPowerUp Get	M	
			Generic OnPowerUp Status		M
	0x1002	Generic Level (see Section 3.1.2)	Generic Level Get	M	
			Generic Level Set	M	
			Generic Level Set Unacknowledged	M	
			Generic Delta Set	M	
			Generic Delta Set Unacknowledged	M	
			Generic Move Set	M	
			Generic Move Set Unacknowledged	M	
			Generic Level Status		M

Element	SIG Model ID	States		Rx	Tx
Light LC	0x1300	Light Lightness Actual (see Section 6.1.2.2)	Light Lightness Get	M	
			Light Lightness Set	M	
			Light Lightness Set Unacknowledged	M	
			Light Lightness Status		M
		Light Lightness Linear (see Section 6.1.2.1)	Light Lightness Linear Get	M	
			Light Lightness Linear Set	M	
			Light Lightness Linear Set Unacknowledged	M	
			Light Lightness Linear Status		M
		Light Lightness Last (see Section 6.1.2.3)	Light Lightness Last Get	M	
			Light Lightness Last Status		M
		Light Lightness Default (see Section 6.1.2.4)	Light Lightness Default Get	M	
			Light Lightness Default Status		M
		Light Lightness Range (see Section 6.1.2.5)	Light Lightness Range Get	M	
			Light Lightness Range Status		M
	0x1000	Generic OnOff (see Section 3.1.1)	Generic OnOff Get	M	
			Generic OnOff Set	M	
			Generic OnOff Set Unacknowledged	M	
			Generic OnOff Status		M
	0x130F	Light LC Mode (see Section 6.2.3.1)	Light LC Mode Get	M	
			Light LC Mode Get	M	
			Light LC Mode Set	M	
			Light LC Mode Status		M
		Light LC Occupancy Mode (see Section 6.2.3.2)	Light LC OM Get	M	
			Light LC OM Get	M	
			Light LC OM Set	M	
			Light LC OM Status		M
		Light LC Light OnOff (see Section 6.2.3.3)	Light LC Light OnOff Get	M	
			Light LC Light OnOff Get	M	
			Light LC Light OnOff Set	M	
			Light LC Light OnOff Status		M
		Light LC Occupancy (see Section 6.2.3.4) Light LC Ambient LuxLevel (see Section 6.2.3.5)	Sensor Status	M	
	0x1310	Light LC Property (see Section 6.2.4)	Light LC Property Get	M	
			Light LC Property Set	M	
			Light LC Property Set Unacknowledged	M	

Element	SIG Model ID	States		Rx	Tx
			Light LC Property Status		M

Table 6.151: Light LC Setup Server elements, states, and messages

### 6.5.2.2 Light LC Property Behavior

#### 6.5.2.2.1 Receiving a Light LC Property Get Message

Upon receiving a Light LC Property Get message, the Light LC Setup Server shall respond with a Light LC Property Status message (see Section 6.5.2.2.3).

#### 6.5.2.2.2 Receiving Light LC Property Set / Light LC Property Set Unacknowledged Messages

Upon receiving a Light LC Property Set or a Light LC Property Set Unacknowledged message, the Light LC Setup Server shall set the Light LC Property Value state to the value of the Light LC Property Value field for a property identified by the Light LC Property ID.

If the received message is a Light LC Property Set message, the Light LC Setup Server shall respond with a Light LC Property Status message (see Section 6.5.2.2.3).

#### 6.5.2.2.3 Sending a Light LC Property Status Message

A Light LC Setup Server shall send a Light LC Property Status message as a response to a Light LC Property Get message (see Section 6.3.6.1), a Light LC Property Set message (see Section 6.3.6.2), or at any time as an unsolicited message, setting the Light LC Property ID field to the value of the Light LC Property ID state and the Light LC Property Value field to the value of the Light LC Property Value state for a device property identified by the Light LC Property ID field.

## 6.6 Lighting client models

### 6.6.1 Light Lightness Client

#### 6.6.1.1 Description

The Light Lightness Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Light Lightness Server model (see Section 6.4.1) via Light Lightness messages (see Section 6.3.1).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1302	Light Lightness Actual	Light Lightness Get		O
			Light Lightness Set		O
			Light Lightness Set Unacknowledged		O
			Light Lightness Status	C.1	
			Light Lightness Linear Get		O



Element	SIG Model ID	Procedure	Messages	Rx	Tx
		Light Lightness Actual	Light Lightness Linear Set		O
			Light Lightness Linear Set Unacknowledged		O
			Light Lightness Linear Status	C.2	
		Light Lightness Last	Light Lightness Last Get		O
			Light Lightness Last Status	C.3	
		Light Lightness Default	Light Lightness Default Get		O
			Light Lightness Default Set		O
			Light Lightness Default Set Unacknowledged		O
			Light Lightness Default Status	C.4	
		Light Lightness Range	Light Lightness Range Get		O
			Light Lightness Range Set		O
			Light Lightness Range Set Unacknowledged		O
			Light Lightness Range Status	C.5	

C.1: If any of the messages: Light Lightness Get, Light Lightness Set are supported, the Light Lightness Status message shall also be supported; otherwise support for the Light Lightness Status message is optional.

C.2: If any of the messages: Light Lightness Linear Get, Light Lightness Linear Set are supported, the Light Lightness Linear Status message shall also be supported; otherwise support for the Light Lightness Linear Status message is optional.

C.3: If the Light Lightness Last Get message is supported, the Light Lightness Last Status message shall also be supported; otherwise support for the Light Lightness Last Status message is optional.

C.4: If any of the messages: Light Lightness Default Get, Light Lightness Default Set are supported, the Light Lightness Default Status message shall also be supported; otherwise support for the Light Lightness Default Status message is optional.

C.5: If any of the messages: Light Lightness Range Get, Light Lightness Range Set are supported, the Light Lightness Range Status message shall also be supported; otherwise support for the Light Lightness Range Status message is optional.

Table 6.152: Light Lightness Client elements and messages

## 6.6.1.2 Light Lightness Actual procedure

### 6.6.1.2.1 Sending a Light Lightness Get message

To determine the Light Lightness Actual state of a Light Lightness Server, a Light Lightness Client shall send a Light Lightness Get message. The response is a Light Lightness Status message (see Section 6.6.1.2.3).

### 6.6.1.2.2 Sending Light Lightness Set / Light Lightness Set Unacknowledged messages

To set the Light Lightness Actual state of a Light Lightness Server with acknowledgment, a Light Lightness Client shall send a Light Lightness Set message, setting the Lightness field to the required value and the TID field to the least recently used value. The response is a Light Lightness Status message (see Section 6.6.1.2.3).



To set the Light Lightness Actual state of a Light Lightness Server without acknowledgment, a Light Lightness Client shall send a Light Lightness Set Unacknowledged message, setting the Lightness field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light Lightness Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light Lightness Set or a Light Lightness Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light Lightness Set or a Light Lightness Set Unacknowledged message at any time.

#### 6.6.1.2.3 *Receiving Light Lightness Status message*

Upon receiving a Light Lightness Status message, a Light Lightness Client can determine the Light Lightness Actual state of a Light Lightness Server, which is indicated by the Lightness field of the message.

If the Light Lightness Server is in a process of changing the Light Lightness Actual state, the Light Lightness Client can determine the target Light Lightness Actual state that is indicated by the Target Lightness field of the message as well as the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.1.3 **Light Lightness Linear procedure**

#### 6.6.1.3.1 *Sending a Light Lightness Linear Get message*

To determine the Light Lightness Linear state of a Light Lightness Server, a Light Lightness Client shall send a Light Lightness Linear Get message. The response is a Light Lightness Linear Status message (see Section 6.6.1.3.3).

#### 6.6.1.3.2 *Sending Light Lightness Linear Set / Light Lightness Linear Set Unacknowledged messages*

To set the Light Lightness Linear state of a Light Lightness Server with acknowledgment, a Light Lightness Client shall send a Light Lightness Linear Set message, setting the Lightness field to the required value and the TID field to the least recently used value. The response is a Light Lightness Linear Status message (see Section 6.6.1.3.3).

To set the Light Lightness Linear state of a Light Lightness Server without acknowledgment, a Light Lightness Client shall send a Light Lightness Linear Set Unacknowledged message, setting the Lightness field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light Lightness Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light Lightness Linear Set or a Light Lightness Linear Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light Lightness Linear Set or a Light Lightness Linear Set Unacknowledged message at any time.

#### **6.6.1.3.3 *Receiving Light Lightness Linear Status message***

Upon receiving a Light Lightness Linear Status message, a Light Lightness Client can determine the Light Lightness Linear state of a Light Lightness Server, which is indicated by the Lightness field of the message.

If the Light Lightness Server is in a process of changing the Light Lightness Linear state, the Light Lightness Client can determine the target Light Lightness Linear state that is indicated by the Target Lightness field of the message as well as the remaining transition time that is indicated by the Remaining Time field of the message.

### **6.6.1.4 *Light Lightness Last procedure***

#### **6.6.1.4.1 *Sending a Light Lightness Last Get message***

To determine the Light Lightness Last state of a Light Lightness Server, a Light Lightness Client shall send a Light Lightness Last Get message. The response is a Light Lightness Last Status message (see Section 6.6.1.4.2).

#### **6.6.1.4.2 *Receiving Light Lightness Last Status message***

Upon receiving a Light Lightness Last Status message, a Light Lightness Client can determine the Light Lightness Last state of a Light Lightness Server, which is indicated by the Lightness field of the message.

### **6.6.1.5 *Light Lightness Default procedure***

#### **6.6.1.5.1 *Sending a Light Lightness Default Get message***

To determine the Light Lightness Default state of a Light Lightness Server, a Light Lightness Client shall send a Light Lightness Default Get message. The response is a Light Lightness Default Status message (see Section 6.6.1.4.2).

#### **6.6.1.5.2 *Sending Light Lightness Default Set / Light Lightness Default Set Unacknowledged messages***

To set the Light Lightness Default state of a Light Lightness Server with acknowledgment, a Light Lightness Client shall send a Light Lightness Default Set message, setting the Lightness field to the required value. The response is a Light Lightness Default Status message (see Section 6.6.1.4.2).

To set the Light Lightness Default state of a Light Lightness Server without acknowledgment, a Light Lightness Client shall send a Light Lightness Default Set Unacknowledged message, setting the Lightness field to the required value.

The choice to use a Light Lightness Default Set or a Light Lightness Default Set Unacknowledged message is an implementation detail.

### 6.6.1.5.3 Receiving Light Lightness Default Status message

Upon receiving a Light Lightness Default Status message, a Light Lightness Client can determine the Light Lightness Default state of a Light Lightness Server, which is indicated by the Lightness field of the message.

## 6.6.1.6 Light Lightness Range procedure

### 6.6.1.6.1 Sending a Light Lightness Range Get message

To determine the Light Lightness Range state of a Light Lightness Server, a Light Lightness Client shall send a Light Lightness Range Get message. The response is a Light Lightness Range Status message (see Section 6.6.1.6.3).

### 6.6.1.6.2 Sending Light Lightness Range Set / Light Lightness Range Set Unacknowledged messages

To set the Light Lightness Range state of a Light Lightness Setup Server with acknowledgment, a Light Lightness Client shall send a Light Lightness Range Set message, setting the Range Min and Range Max fields to the required values. The response is a Light Lightness Range Status message (see Section 6.6.1.6.3).

To set the Light Lightness Range state of a Light Lightness Setup Server without acknowledgment, a Light Lightness Client shall send a Light Lightness Range Set Unacknowledged message, setting the Range Min and Range Max fields to the required values.

The choice to use a Light Lightness Range Set or a Light Lightness Range Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light Lightness Range Set or a Light Lightness Range Set Unacknowledged message at any time.

### 6.6.1.6.3 Receiving a Light Lightness Range Status message

Upon receiving a Light Lightness Range Status message, a Light Lightness Client can determine the Light Lightness Range state of a Light Lightness Server, which is indicated by the Range Min and the Range Max fields of the message.

## 6.6.2 Light CTL Client

### 6.6.2.1 Description

The Light CTL Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Light CTL Server model (see Section 6.4.2) via Light CTL messages (see Section 6.3.2).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure		Rx	Tx
Main	0x1305	Light CTL Lightness	Light CTL Get		O
			Light CTL Set		O
			Light CTL Set Unacknowledged		O
			Light CTL Status	C.1	

Element	SIG Model ID	Procedure		Rx	Tx
		Light CTL Temperature	Light CTL Temperature Get		O
			Light CTL Temperature Set		O
			Light CTL Temperature Set Unacknowledged		O
			Light CTL Temperature Status	C.2	
		Light CTL Default	Light CTL Default Get		O
			Light CTL Default Set		O
			Light CTL Default Set Unacknowledged		O
			Light CTL Default Status	C.3	
		Light CTL Temperature Range	Light CTL Temperature Range Get		O
			Light CTL Temperature Range Set		O
			Light CTL Temperature Range Set Unacknowledged		O
			Light CTL Temperature Range Status	C.4	

C.1: If any of the messages: Light CTL Get, Light CTL Set are supported, the Light CTL Status message shall also be supported; otherwise support for the Light CTL Status message is optional.

C.2: If any of the messages: Light CTL Temperature Get, Light CTL Temperature Set are supported, the Light CTL Temperature Status message shall also be supported; otherwise support for the Light CTL Temperature Status message is optional.

C.3: If any of the messages: Light CTL Default Get, Light CTL Default Set are supported, the Light CTL Default Status message shall also be supported; otherwise support for the Light CTL Default Status message is optional.

C.4: If any of the messages: Light CTL Temperature Range Get, Light CTL Temperature Range Set are supported, the Light CTL Temperature Range Status message shall also be supported; otherwise support for the Light CTL Temperature Range Status message is optional.

Table 6.153: Light CTL Client elements and messages

## 6.6.2.2 Light CTL Lightness procedure

### 6.6.2.2.1 Sending a Light CTL Get message

To determine the Light CTL state of a Light CTL Server, a Light CTL Client shall send a Light CTL Get message. The response is a Light CTL Status message (see Section 6.6.2.2.3).

### 6.6.2.2.2 Sending Light CTL Set / Light CTL Set Unacknowledged messages

To set the Light CTL state of a Light CTL Server with acknowledgment, a Light CTL Client shall send a Light CTL Set message, setting the CTL Lightness and CTL Temperature fields to the required values and the TID field to the least recently used value. The response is a Light CTL Status message (see Section 6.6.2.2.3).

To set the Light CTL state of a Light CTL Server without acknowledgment, a Light CTL Client shall send a Light CTL Set Unacknowledged message, setting the CTL Lightness and CTL Temperature fields to the required values and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the

target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light CTL Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light CTL Set or a Light CTL Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light CTL Set or a Light CTL Set Unacknowledged message at any time.

#### 6.6.2.2.3 *Receiving a Light CTL Status message*

Upon receiving a Light CTL Status message, a Light CTL Client can determine the Light CTL state of a Light CTL Server, which is indicated by the CTL Lightness and the CTL Temperature fields of the message.

If the Light CTL Server is in a process of changing the Light CTL state, the Light CTL Client can determine the target Light CTL state that is indicated by the Target CTL Lightness and Target CTL Temperature fields of the message, as well as the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.2.3 **Light CTL Default procedure**

#### 6.6.2.3.1 *Sending a Light CTL Default Get message*

To determine the bound Light Lightness Default state and the Light CTL Temperature Default and Light CTL Delta UV Default states of a Light CTL Server, a Light CTL Client shall send a Light CTL Default Get message. The response is a Light CTL Default Status message (see Section 6.6.2.3.3).

#### 6.6.2.3.2 *Sending Light CTL Default Set / Light CTL Default Set Unacknowledged messages*

To set the bound Light Lightness Default state and the Light CTL Temperature Default and Light CTL Delta UV Default states of a Light CTL Server with acknowledgment, a Light CTL Client shall send a Light CTL Default Set message, setting the Lightness, Temperature, and Delta UV fields to the required values. The response is a Light CTL Default Status message (see Section 6.6.2.3.3).

To set the bound Light Lightness Default state and the Light CTL Temperature Default and Light CTL Delta UV Default states of a Light CTL Server without acknowledgment, a Light CTL Client shall send a Light CTL Default Set Unacknowledged message, setting the Lightness, Temperature, and Delta UV fields to the required values.

The choice to use a Light CTL Default Set or a Light CTL Default Set Unacknowledged message is an implementation detail.

#### 6.6.2.3.3 *Receiving a Light CTL Default Status message*

Upon receiving a Light CTL Default Status message, a Light CTL Client can determine the bound Light Lightness Default state and the Light CTL Temperature Default and Light CTL Delta UV Default states of a Light CTL Server, which are indicated by the Lightness, Temperature, and Delta UV fields of the message.

## 6.6.2.4 Light CTL Temperature procedure

### 6.6.2.4.1 *Sending a Light CTL Temperature Get message*

To determine the Light CTL Temperature state of a Light CTL Server, a Light CTL Client shall send a Light CTL Temperature Get message. The response is a Light CTL Temperature Status message (see Section 6.6.2.4.3).

### 6.6.2.4.2 *Sending Light CTL Temperature Set / Light CTL Temperature Set Unacknowledged messages*

To set the Light CTL Temperature state of a Light CTL Server with acknowledgment, a Light CTL Client shall send a Light CTL Temperature Set message, setting the CTL Temperature and CTL Delta UV fields to the required values and the TID field to the least recently used value. The response is a Light CTL Temperature Status message (see Section 6.6.2.4.3).

To set the Light CTL Temperature state of a Light CTL Server without acknowledgment, a Light CTL Client shall send a Light CTL Temperature Set Unacknowledged message, setting the CTL Temperature and CTL Delta UV fields to the required values and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light CTL Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light CTL Temperature Set or a Light CTL Temperature Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light CTL Temperature Set or a Light CTL Temperature Set Unacknowledged message at any time.

### 6.6.2.4.3 *Receiving a Light CTL Temperature Status message*

Upon receiving a Light CTL Temperature Status message, a Light CTL Client can determine the Light CTL Temperature state of a Light CTL Server, which is indicated by the CTL Temperature and the CTL Delta UV fields of the message.

If the Light CTL Server is in a process of changing the Light CTL Temperature state, the Light CTL Client can determine the target Light CTL Temperature state that is indicated by the Target CTL Temperature and Target CTL Delta UV fields of the message, as well as the remaining transition time that is indicated by the Remaining Time field of the message.

## 6.6.2.5 Light CTL Temperature Range procedure

### 6.6.2.5.1 *Sending a Light CTL Temperature Range Get message*

To determine the Light CTL Temperature Range state of a Light CTL Server, a Light CTL Client shall send a Light CTL Temperature Range Get message. The response is a Light CTL Temperature Range Status message (see Section 6.6.2.5.3).

### 6.6.2.5.2 Sending Light CTL Temperature Range Set / Light CTL Temperature Range Set Unacknowledged messages

To set the Light CTL Temperature Range state of a Light CTL Setup Server with acknowledgment, a Light CTL Client shall send a Light CTL Temperature Range Set message, setting the Range Min and Range Max fields to the required values. The response is a Light CTL Temperature Range Status message (see Section 6.6.2.5.3).

To set the Light CTL Temperature Range state of a Light CTL Setup Server without acknowledgment, a Light CTL Client shall send a Light CTL Temperature Range Set Unacknowledged message, setting the Range Min and Range Max fields to the required values.

The choice to use a Light CTL Temperature Range Set or a Light CTL Temperature Range Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light CTL Temperature Range Set or a Light CTL Temperature Range Set Unacknowledged message at any time.

### 6.6.2.5.3 Receiving a Light CTL Temperature Range Status message

Upon receiving a Light CTL Temperature Range Status message, a Light CTL Client can determine the Light CTL Temperature Range state of a Light CTL Server, which is indicated by the Range Min and the Range Max fields of the message.

## 6.6.3 Light HSL Client

### 6.6.3.1 Description

The Light HSL Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Light HSL Server model (see Section 6.4.3.3.1) via Light HSL messages (see Section 6.3.2.13).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x1309	Light HSL	Light HSL Get		O
			Light HSL Set		O
			Light HSL Set Unacknowledged		O
			Light HSL Status	C.1	
			Light HSL Target Get		O
			Light HSL Target Status	C.2	
		Light HSL Default	Light HSL Default Get		O
			Light HSL Default Set		O
			Light HSL Default Set Unacknowledged		O
			Light HSL Default Status	C.3	
		Light HSL Range	Light HSL Range Get		O
			Light HSL Range Set		O



Element	SIG Model ID	Procedure	Messages	Rx	Tx
			Light HSL Range Set Unacknowledged		O
			Light HSL Range Status	C.4	
		Light HSL Hue	Light HSL Hue Get		O
			Light HSL Hue Set		O
			Light HSL Hue Set Unacknowledged		O
			Light HSL Hue Status	C.5	
		Light HSL Saturation	Light HSL Saturation Get		O
			Light HSL Saturation Set		O
			Light HSL Saturation Set Unacknowledged		O
			Light HSL Saturation Status	C.6	

C.1: If any of the messages: Light HSL Get, Light HSL Set are supported, the Light HSL Status message shall also be supported; otherwise support for the Light HSL Status message is optional.

C.2: If the Light HSL Target Get message is supported, the Light HSL Target Status message shall also be supported; otherwise support for the Light HSL Target Status message is optional.

C.3: If any of the messages: Light HSL Default Get, Light HSL Default Set are supported, the Light HSL Default Status message shall also be supported; otherwise support for the Light HSL Default Status message is optional.

C.4: If any of the messages: Light HSL Range Get, Light HSL Range Set are supported, the Light HSL Range Status message shall also be supported; otherwise support for the Light HSL Range Status message is optional.

C.5: If any of the messages: Light HSL Hue Get, Light HSL Hue Set are supported, the Light HSL Hue Status message shall also be supported; otherwise support for the Light HSL Hue Status message is optional.

C.6: If any of the messages: Light HSL Saturation Get, Light HSL Saturation Set are supported, the Light HSL Saturation Status message shall also be supported; otherwise support for the Light HSL Saturation Status message is optional.

Table 6.154: Light HSL Client elements and messages

## 6.6.3.2 Light HSL procedure

### 6.6.3.2.1 Sending a Light HSL Get message

To determine the Light HSL state of a Light HSL Server, a Light HSL Client shall send a Light HSL Get message. The response is a Light HSL Status message (see Section 6.6.3.2.3).

### 6.6.3.2.2 Sending Light HSL Set / Light HSL Set Unacknowledged messages

To set the Light HSL state of a Light HSL Server with acknowledgment, a Light HSL Client shall send a Light HSL Set message, setting the HSL Lightness, HSL Hue, and HSL Saturation fields to the required values and the TID field to the least recently used value. The response is a Light HSL Status message (see Section 6.6.3.2.3).

To set the Light HSL state of a Light HSL Server without acknowledgment, a Light HSL Client shall send a Light HSL Set Unacknowledged message, setting the HSL Lightness, HSL Hue, and HSL Saturation fields to the required values and the TID field to the least recently used value.



Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light HSL Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light HSL Set or a Light HSL Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light HSL Set or a Light HSL Set Unacknowledged message at any time.

#### 6.6.3.2.3 *Receiving a Light HSL Status message*

Upon receiving a Light HSL Status message, a Light HSL Client can determine the Light HSL state of a Light HSL Server, which is indicated by the HSL Lightness, the HSL Hue, and the HSL Saturation fields of the message.

If the Light HSL Server is in a process of changing the Light HSL state, the Light HSL Client can determine the remaining transition time that is indicated by the Remaining Time field of the message.

#### 6.6.3.2.4 *Sending a Light HSL Target Get message*

To determine the target Light HSL state of a Light HSL Server that is in a process of changing the Light HSL state, a Light HSL Client shall send a Light HSL Target Get message. The response is a Light HSL Target Status message (see Section 6.6.3.2.5).

#### 6.6.3.2.5 *Receiving a Light HSL Target Status message*

Upon receiving a Light HSL Target Status message, a Light HSL Client can determine the target Light HSL state of a Light HSL Server, which is indicated by the HSL Lightness Target, the HSL Hue Target, and the HSL Saturation Target fields of the message.

If the Light HSL Server is in a process of changing the Light HSL state, the Light HSL Client can determine the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.3.3 **Light HSL Default procedure**

#### 6.6.3.3.1 *Sending a Light HSL Default Get message*

To determine the bound Light Lightness Default state and the Light HSL Hue Default and Light HSL Saturation Default states of a Light HSL Server, a Light HSL Client shall send a Light HSL Default Get message. The response is a Light HSL Default Status message (see Section 6.6.3.3.3).

#### 6.6.3.3.2 *Sending Light HSL Default Set / Light HSL Default Set Unacknowledged messages*

To set the bound Light Lightness Default state and the Light HSL Hue Default and Light HSL Saturation Default states of a Light HSL Server with acknowledgment, a Light HSL Client shall send a Light HSL Default Set message, setting the Lightness, Hue, and Saturation fields to the required values. The response is a Light HSL Default Status message (see Section 6.6.3.3.3).

To set the bound Light Lightness Default state and the Light HSL Hue Default and Light HSL Saturation Default states of a Light HSL Server without acknowledgment, a Light HSL Client shall

send a Light HSL Default Set Unacknowledged message, setting the Lightness, Hue, and Saturation fields to the required values.

The choice to use a Light HSL Default Set or a Light HSL Default Set Unacknowledged message is an implementation detail.

#### **6.6.3.3.3 *Receiving a Light HSL Default Status message***

Upon receiving a Light HSL Default Status message, a Light HSL Client can determine the bound Light Lightness Default state and the Light HSL Hue Default and Light HSL Saturation Default states of a Light HSL Server, which are indicated by the Lightness, Hue and Saturation fields of the message.

### **6.6.3.4 Light HSL Range procedure**

#### **6.6.3.4.1 *Sending a Light HSL Range Get message***

To determine the Light HSL Hue Range or Light Saturation Range states of a Light HSL Server, a Light HSL Client shall send a Light HSL Range Get message. The response is a Light HSL Range Status message (see Section 6.6.3.4.3).

#### **6.6.3.4.2 *Sending Light HSL Range Set / Light HSL Range Set Unacknowledged messages***

To set the Light HSL Hue Range or a Light HSL Saturation Range state of a Light HSL Setup Server with acknowledgment, a Light HSL Client shall send a Light HSL Range Set message, setting the Hue Range Min, Hue Range Max, Saturation Range Min and Saturation Range Max fields to the required values. The response is a Light HSL Range Status message (see Section 6.6.3.4.3).

To set the Light HSL Hue Range or a Light HSL Saturation Range state of a Light HSL Setup Server without acknowledgment, a Light HSL Client shall send a Light HSL Range Set Unacknowledged message, setting the Hue Range Min, Hue Range Max, Saturation Range Min, and Saturation Range Max fields to the required values.

The choice to use a Light HSL Range Set or a Light HSL Range Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light HSL Range Set or a Light HSL Range Set Unacknowledged message at any time.

#### **6.6.3.4.3 *Receiving Light HSL Range Status message***

Upon receiving a Light HSL Range Status message, a Light HSL Client can determine the Light HSL Hue Range and Light HSL Saturation Range states of a Light HSL Server, which is indicated by the Hue Range Min, Hue Range Max, Saturation Range Min, and the Saturation Range Max fields of the message.

### **6.6.3.5 Light HSL Hue procedure**

#### **6.6.3.5.1 *Sending a Light HSL Hue Get message***

To determine the Light HSL Hue state of a Light HSL Server, a Light HSL Client shall send a Light HSL Hue Get message. The response is a Light HSL Hue Status message (see Section 6.6.3.5.3).

#### **6.6.3.5.2 *Sending Light HSL Hue Set / Light HSL Hue Set Unacknowledged messages***

To set the Light HSL Hue state of a Light HSL Server with acknowledgment, a Light HSL Client shall send a Light HSL Hue Set message, setting the HSL Hue field to the required value and the TID field to the least recently used value. The response is a Light HSL Hue Status message (see Section 6.6.3.5.3).

To set the Light HSL Hue state of a Light HSL Server without acknowledgment, a Light HSL Client shall send a Light HSL Hue Set Unacknowledged message, setting the HSL Hue field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light HSL Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light HSL Hue Set or a Light HSL Hue Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light HSL Hue Set or a Light HSL Hue Set Unacknowledged message at any time.

#### 6.6.3.5.3 *Receiving a Light HSL Hue Status message*

Upon receiving a Light HSL Hue Status message, a Light HSL Client can determine the Light HSL Hue state of a Light HSL Server, which is indicated by the HSL Hue field of the message.

If the Light HSL Server is in a process of changing the Light HSL Hue state, the Light HSL Client can determine the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.3.6 **Light HSL Saturation procedure**

#### 6.6.3.6.1 *Sending a Light HSL Saturation Get message*

To determine the Light HSL Saturation state of a Light HSL Server, a Light HSL Client shall send a Light HSL Saturation Get message. The response is a Light HSL Saturation Status message (see Section 6.6.3.6.3).

#### 6.6.3.6.2 *Sending Light HSL Saturation Set / Light HSL Saturation Set Unacknowledged messages*

To set the Light HSL Saturation state of a Light HSL Server with acknowledgment, a Light HSL Client shall send a Light HSL Saturation Set message, setting the HSL Saturation field to the required value and the TID field to the least recently used value. The response is a Light HSL Saturation Status message (see Section 6.6.3.6.3).

To set the Light HSL Saturation state of a Light HSL Server without acknowledgment, a Light HSL Client shall send a Light HSL Saturation Set Unacknowledged message, setting the HSL Saturation field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light HSL Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light HSL Saturation Set or a Light HSL Saturation Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light HSL Saturation Set or a Light HSL Saturation Set Unacknowledged message at any time.

#### 6.6.3.6.3 Receiving a Light HSL Saturation Status message

Upon receiving a Light HSL Saturation Status message, a Light HSL Client can determine the Light HSL Saturation state of a Light HSL Server, which is indicated by the HSL Saturation field of the message.

If the Light HSL Server is in a process of changing the Light HSL Saturation state, the Light HSL Client can determine the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.4 Light xyL Client

#### 6.6.4.1 Description

The Light xyL Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can control an element of a peer device that exposes a Light xyL Server model (see Section 6.4.10) via Light xyL messages (see Section 6.3.4).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure	Messages	Rx	Tx
Main	0x130E	Light xyL	Light xyL Get		O
			Light xyL Set		O
			Light xyL Set Unacknowledged		O
			Light xyL Status	C.1	
			Light xyL Target Get		O
			Light xyL Target Status	C.2	
		Light xyL Default	Light xyL Default Get		O
			Light xyL Default Set		O
			Light xyL Default Set Unacknowledged		O
			Light xyL Default Status	C.3	
		Light xyL Range	Light xyL Range Get		O
			Light xyL Range Set		O
			Light xyL Range Set Unacknowledged		O
			Light xyL Range Status	C.4	

C.1: If any of the messages: Light xyL Get, Light xyL Set are supported, the Light xyL Status message shall also be supported; otherwise support for the Light xyL Status message is optional.

C.2: If the Light xyL Target Get message is supported, the Light xyL Target Status message shall also be supported; otherwise support for the Light xyL Target Status message is optional.

C.3: If any of the messages: Light xyL Default Get, Light xyL Default Set are supported, the Light xyL Default Status message shall also be supported; otherwise support for the Light xyL Default Status message is optional.

C.4: If any of the messages: Light xyL Range Get, Light xyL Range Set are supported, the Light xyL Range Status message shall also be supported; otherwise support for the Light xyL Range Status message is optional.

*Table 6.155: Light xyL Client elements and messages*

## 6.6.4.2 Light xyL procedure

### 6.6.4.2.1 Sending a Light xyL Get message

To determine the Light xyL state of a Light xyL Server, a Light xyL Client shall send a Light xyL Get message. The response is a Light xyL Status message (see Section 6.6.4.2.3).

### 6.6.4.2.2 Sending Light xyL Set / Light xyL Set Unacknowledged messages

To set the Light xyL state of a Light xyL Server with acknowledgment, a Light xyL Client shall send a Light xyL Set message, setting the xyL Lightness, xyL x and xyL y fields to the required values, and the TID field to the least recently used value. The response is a Light xyL Status message (see Section 6.6.4.2.3).

To set the Light xyL state of a Light xyL Server without acknowledgment, a Light xyL Client shall send a Light xyL Set Unacknowledged message, setting the xyL Lightness, xyL x and xyL y fields to the required values, and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field, indicating the transition time to the target state. If present, the Transition Time field value shall be used as the time for transition to the target state. If the Transition Time field is not present and the Generic Default Transition Time state (see Section 3.1.3) is supported, the Generic Default Transition Time state shall be used. Otherwise the transition shall be instantaneous.

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light xyL Client shall use the same value for the TID field as in the previously sent message, within 6 seconds from sending that message.

The choice to use a Light xyL Set or a Light xyL Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light xyL Set or a Light xyL Set Unacknowledged message at any time.

### 6.6.4.2.3 Receiving a Light xyL Status message

Upon receiving a Light xyL Status message, a Light xyL Client can determine the Light xyL state of a Light xyL Server, which is indicated by the xyL Lightness and the xyL x and xyL y fields of the message.

If the Light xyL Server is in a process of changing the Light xyL state, the Light xyL Client can determine the remaining transition time that is indicated by the Remaining Time field of the message.

#### 6.6.4.2.4 *Sending a Light xyL Target Get message*

To determine the target Light xyL state of a Light xyL Server that is in a process of changing the Light xyL state, a Light xyL Client shall send a Light xyL Target Get message. The response is a Light xyL Target Status message (see Section 6.6.4.2.5).

#### 6.6.4.2.5 *Receiving a Light xyL Target Status message*

Upon receiving a Light xyL Target Status message, a Light xyL Client can determine the target Light xyL state of a Light xyL Server, which is indicated by the xyL Lightness, and the xyL x and xyL y fields of the message.

If the Light xyL Server is in a process of changing the Light xyL state, the Light xyL Client can determine the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.4.3 **Light xyL Default procedure**

#### 6.6.4.3.1 *Sending a Light xyL Default Get message*

To determine the bound Light Lightness Default state and the Light xyL x Default and Light xyL y Default states of a Light xyL Server, a Light xyL Client shall send a Light xyL Default Get message. The response is a Light xyL Default Status message (see Section 6.6.4.3.3).

#### 6.6.4.3.2 *Sending Light xyL Default Set / Light xyL Default Set Unacknowledged messages*

To set the bound Light Lightness Default state and the Light xyL x Default and Light xyL y Default states of a Light xyL Server with acknowledgment, a Light xyL Client shall send a Light xyL Default Set message, setting the Lightness and xyL x and xyL y fields to the required values. The response is a Light xyL Default Status message (see Section 6.6.4.3.3).

To set the bound Light Lightness Default state and the Light xyL x Default and Light xyL y Default states of a Light xyL Server without acknowledgment, a Light xyL Client shall send a Light xyL Default Set Unacknowledged message, setting the Lightness and xyL x and xyL y fields to the required values.

The choice to use a Light xyL Default Set or a Light xyL Default Set Unacknowledged message is an implementation detail.

#### 6.6.4.3.3 *Receiving a Light xyL Default Status message*

Upon receiving a Light xyL Default Status message, a Light xyL Client can determine the bound Light Lightness Default state and the Light xyL x Default and Light xyL y Default states of a Light xyL Server, which are indicated by the Lightness and xyL x and xyL y fields of the message.

### 6.6.4.4 **Light xyL Range procedure**

#### 6.6.4.4.1 *Sending a Light xyL Range Get message*

To determine the Light xyL x Range or Light xyL y Range states of a Light xyL Server, a Light xyL Client shall send a Light xyL Range Get message. The response is a Light xyL Range Status message (see Section 6.6.4.4.3).

#### 6.6.4.4.2 *Sending Light xyL Range Set / Light xyL Range Set Unacknowledged messages*

To set the Light xyL x Range or a Light xyL y Range state of a Light xyL Setup Server with acknowledgment, a Light xyL Client shall send a Light xyL Range Set message, setting the xyL x Range Min, xyL x Range Max, xyL y Range Min and xyL y Range Max fields to the required values. The response is a Light xyL Range Status message (see Section 6.6.4.4.3).

To set the Light xyL x Range or a Light xyL y Range state of a Light xyL Setup Server without acknowledgment, a Light xyL Client shall send a Light xyL Range Set Unacknowledged message, setting the xyL x Range Min, xyL x Range Max, xyL y Range Min, and xyL y Range Max fields to the required values.

The choice to use a Light xyL Range Set or a Light HSL Range Set Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light xyL Range Set or a Light xyL Range Set Unacknowledged message at any time.

#### 6.6.4.4.3 Receiving a Light xyL Range Status message

Upon receiving a Light xyL Range Status message, a Light xyL Client can determine the Light xyL x Range and Light xyL y Range states of a Light xyL Server, which are indicated by the xyL x Range Min, xyL x Range Max, xyL y Range Min, and the xyL y Range Max fields of the message.

### 6.6.5 Light LC Client

#### 6.6.5.1 Description

The Light LC (Lightness Control) Client model is a root model (i.e., it does not extend any other models).

This model shall support model publication, as defined in Section 4.2.2 of the Mesh Profile specification [2], and model subscription, as defined in Section 4.2.3 of the Mesh Profile specification.

This model may be used to represent an element that can configure an element of a peer device that exposes a Light LC (Lightness Control) Setup Server model (see Section 6.5.2) via Light Lightness Control messages (see Section 6.3.6).

The following table illustrates the structure of elements, procedures, and messages used by the model. At least one message listed in the table shall be supported by this model.

Element	SIG Model ID	Procedure		Rx	Tx
Main	0x1311	Light LC Mode	Light LC Mode Get		O
			Light LC Mode Set		O
			Light LC Mode Set Unacknowledged		O
			Light LC Mode Status	C.1	
		Light LC Occupancy Mode	Light LC OM Get		O
			Light LC OM Set		O
			Light LC OM Set Unacknowledged		O
			Light LC OM Status	C.2	
		Light LC Light OnOff	Light LC Light OnOff Get		O
			Light LC Light OnOff Set		O
			Light LC Light OnOff Set Unacknowledged		O
			Light LC Light OnOff Status	C.3	
		Light LC Property	Light LC Property Get		O
			Light LC Property Set		O
			Light LC Property Set Unacknowledged		O
			Light LC Property Status	C.4	



C.1: If any of the messages: Light LC Mode Get, Light LC Mode Set are supported, the Light LC Mode Status message shall also be supported; otherwise support for the Light LC Mode Status message is optional.

C.2: If any of the messages: Light LC OM Get, Light LC Mode Set are supported, the Light LC OM Status message shall also be supported; otherwise support for the Light LC OM Status message is optional.

C.3: If any of the messages: Light LC Light OnOff Get, Light LC Light OnOff Set are supported, the Light LC Light OnOff Status message shall also be supported; otherwise support for the Light LC Light OnOff Status message is optional.

C.4: If any of the messages: Light LC Property Get, Light LC Property Set are supported, the Light LC Property Status message shall also be supported; otherwise support for the Light LC Property Status message is optional.

*Table 6.156: Light LC Client procedures and messages*

## 6.6.5.2 Light LC Mode procedure

### 6.6.5.2.1 Sending a Light LC Mode Get message

To determine the Light LC Mode state of a Light LC Server, a Light LC Client shall send a Light LC Mode Get message. The response is a Light LC Mode Status message (see Section 6.6.5.2.3).

### 6.6.5.2.2 Sending Light LC Mode Set / Light LC Mode Set Unacknowledged messages

To set the Light LC Mode state of a Light LC Server with acknowledgment, a Light LC Client shall send a Light LC Mode Set message, setting the Mode field to the required value. The response is a Light LC Mode Status message (see Section 6.6.5.2.3).

To set the Light LC Mode state of a Light LC Server without acknowledgment, a Light LC Client shall send a Light LC Mode Set Unacknowledged message, setting the Mode field to the required value.

The choice to use a Light LC Mode Set or a Light LC Mode Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light LC Mode Set or a Light LC Mode Set Unacknowledged message at any time.

### 6.6.5.2.3 Receiving a Light LC Mode Status message

Upon receiving a Light LC Mode Status message, a Light LC Client can determine the Light LC Mode state of a Light LC Server, which is indicated by the Mode field of the message.

## 6.6.5.3 Light LC Occupancy Mode procedure

### 6.6.5.3.1 Sending a Light LC OM Get message

To determine the Light LC Occupancy Mode state of a Light LC Server, a Light LC Client shall send a Light LC OM Get message. The response is a Light LC OM Status message (see Section 6.6.5.3.3).

### 6.6.5.3.2 Sending Light LC OM Set / Light LC OM Set Unacknowledged messages

To set the Light LC Occupancy Mode state of a Light LC Server with acknowledgment, a Light LC Client shall send a Light LC OM Set message, setting the Mode field to the required value. The response is a Light LC OM Status message (see Section 6.6.5.3.3).

To set the Light LC Occupancy Mode state of a Light LC Server without acknowledgment, a Light LC Client shall send a Light LC OM Set Unacknowledged message, setting the Mode field to the required value.



The choice to use a Light LC OM Set or a Light LC OM Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light LC OM Set or a Light LC OM Set Unacknowledged message at any time.

#### 6.6.5.3.3 *Receiving a Light LC OM Status message*

Upon receiving a Light LC OM Status message, a Light LC Client can determine the Light LC Occupancy Mode state of a Light LC Server, which is indicated by the Mode field of the message.

### 6.6.5.4 **Light LC Light OnOff procedure**

#### 6.6.5.4.1 *Sending a Light LC Light OnOff Get message*

To determine the Light LC Light OnOff state of a Light LC Server, a Light LC Client shall send a Light LC Light OnOff Get message. The response is a Light LC Light OnOff Status message (see Section 6.6.5.4.3).

#### 6.6.5.4.2 *Sending Light LC Light OnOff Set / Light LC Light OnOff Set Unacknowledged messages*

To set the Light LC Light OnOff state of a Light LC Server with acknowledgment, a Light LC Client shall send a Light LC Light OnOff Set message, setting the Light OnOff field to the required value and the TID field to the least recently used value. The response is a Light LC Light OnOff Status message (see Section 6.6.5.4.3).

To set the Light LC Light OnOff state of a Light LC Server without acknowledgment, a Light LC Client shall send a Light LC Light OnOff Set Unacknowledged message, setting the Light OnOff field to the required value and the TID field to the least recently used value.

Both messages may optionally include a Transition Time field indicating the transition time to the target state. If the Transition Time is not included, the Light LC Server shall use its appropriate transition times defined by the Light LC Property states (see Section 6.2.4).

If a Transition Time is included, a Delay field shall be included indicating the message execution delay representing the time interval between receiving the message by a model and executing the associated model behaviors.

To retransmit the message, a Light LC Client shall use the same value for the TID field as in the previously sent message within 6 seconds from sending that message.

The choice to use a Light LC Light OnOff Set or a Light LC Light OnOff Unacknowledged message is an implementation detail.

An element, typically due to user interaction, may send a Light LC Light OnOff Set or a Light LC Light OnOff Set Unacknowledged message at any time.

#### 6.6.5.4.3 *Receiving a Light LC Light OnOff Status message*

Upon receiving a Light LC Light OnOff Status message, a Light LC Client can determine the Light LC Light OnOff state of a Light LC Server, which is indicated by the Light OnOff field of the message.

If the Light LC Server is in a process of changing the Light LC Light OnOff state, the Light LC Client can determine the target Light LC Light OnOff state that is indicated by the Target Light OnOff field of the message as well as the remaining transition time that is indicated by the Remaining Time field of the message.

### 6.6.5.5 Light LC Property procedure

#### 6.6.5.5.1 Sending a Light LC Property Get message

To determine the Light LC Property state of a Light LC Setup Server, a Light LC Client shall send a Light LC Property Get message, setting the Light LC Property ID field to the value identifying the property. The response is a Light LC Property Status message (see Section 6.6.5.5.3).

#### 6.6.5.5.2 Sending Light LC Property Set / Light LC Property Set Unacknowledged messages

To set the Light LC Property state of a Light LC Setup Server with acknowledgment, a Light LC Client shall send a Light LC Property Set message, setting the Light LC Property ID field to the value identifying the property and the Light LC Property Value field to the required value. The response is a Light LC Property Status message (see Section 6.6.5.5.3).

To set the Light LC Property state of a Light LC Setting Server without acknowledgment, a Light LC Client shall send a Light LC Property Set Unacknowledged message, setting the Light LC Property ID field to the value identifying the device property and the Light LC Property Value field to the required value.

The choice to use a Light LC Property Set or a Light LC Property Set Unacknowledged message is an implementation detail.

#### 6.6.5.5.3 Receiving a Light LC Property Status message

Upon receiving a Light LC Property Status message, a Light LC Client can determine the Light LC Property Value state (see Section 6.2.3) of a Light LC Setup Server, for a device property identified by the Light LC Property ID field.

## 6.7 Summary of lighting models

Figure 6.11 and Figure 6.12 illustrate the relationship between lighting models.

The following types of relations are illustrated: interactions via messages between client models (represented by blue rectangles) and server models (represented by dark blue rectangles), hierarchy of models extending other models, server models serving states (represented by red rounded rectangles), and bindings between states.

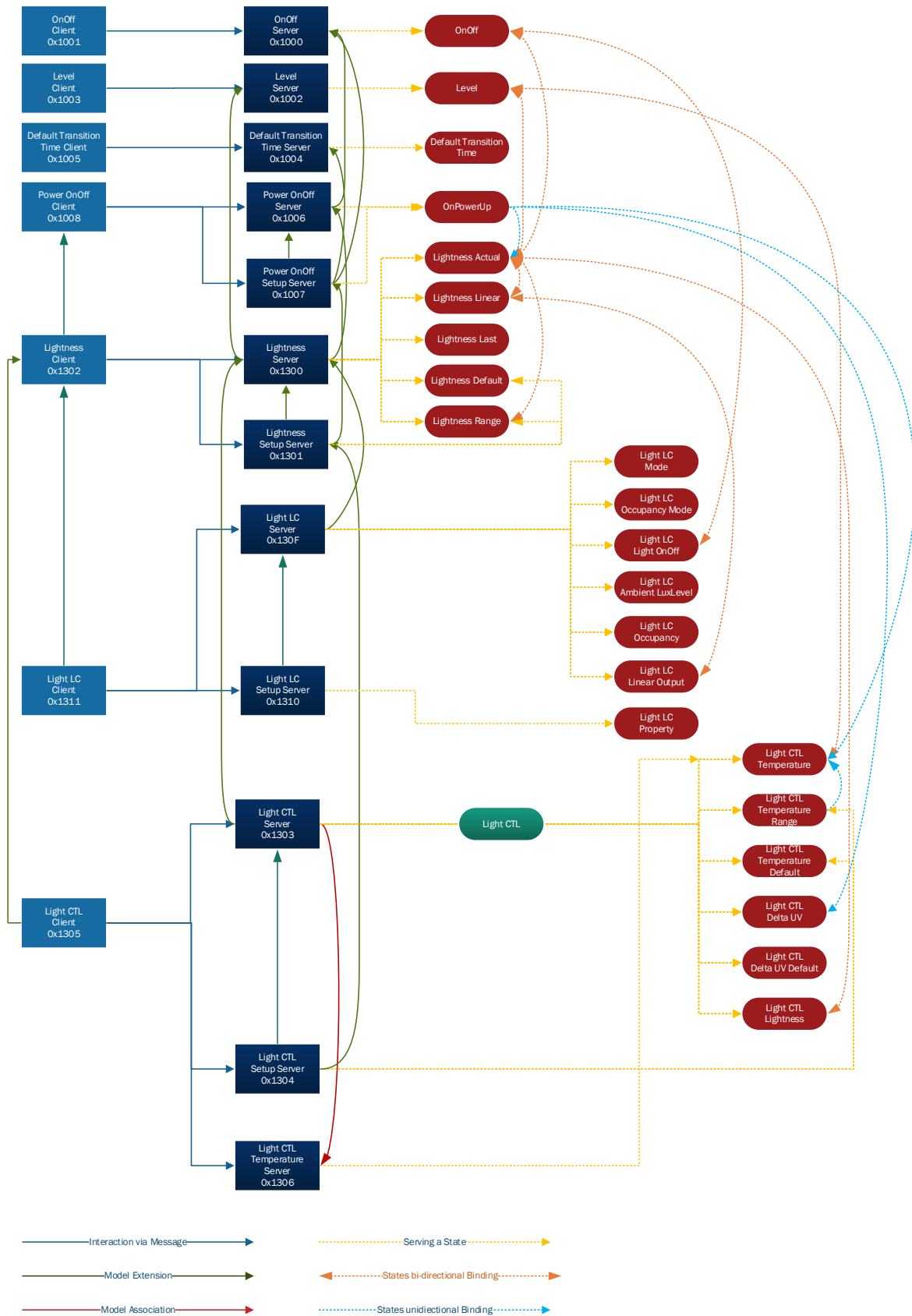


Figure 6.11: Relationships between lighting models – Part 1

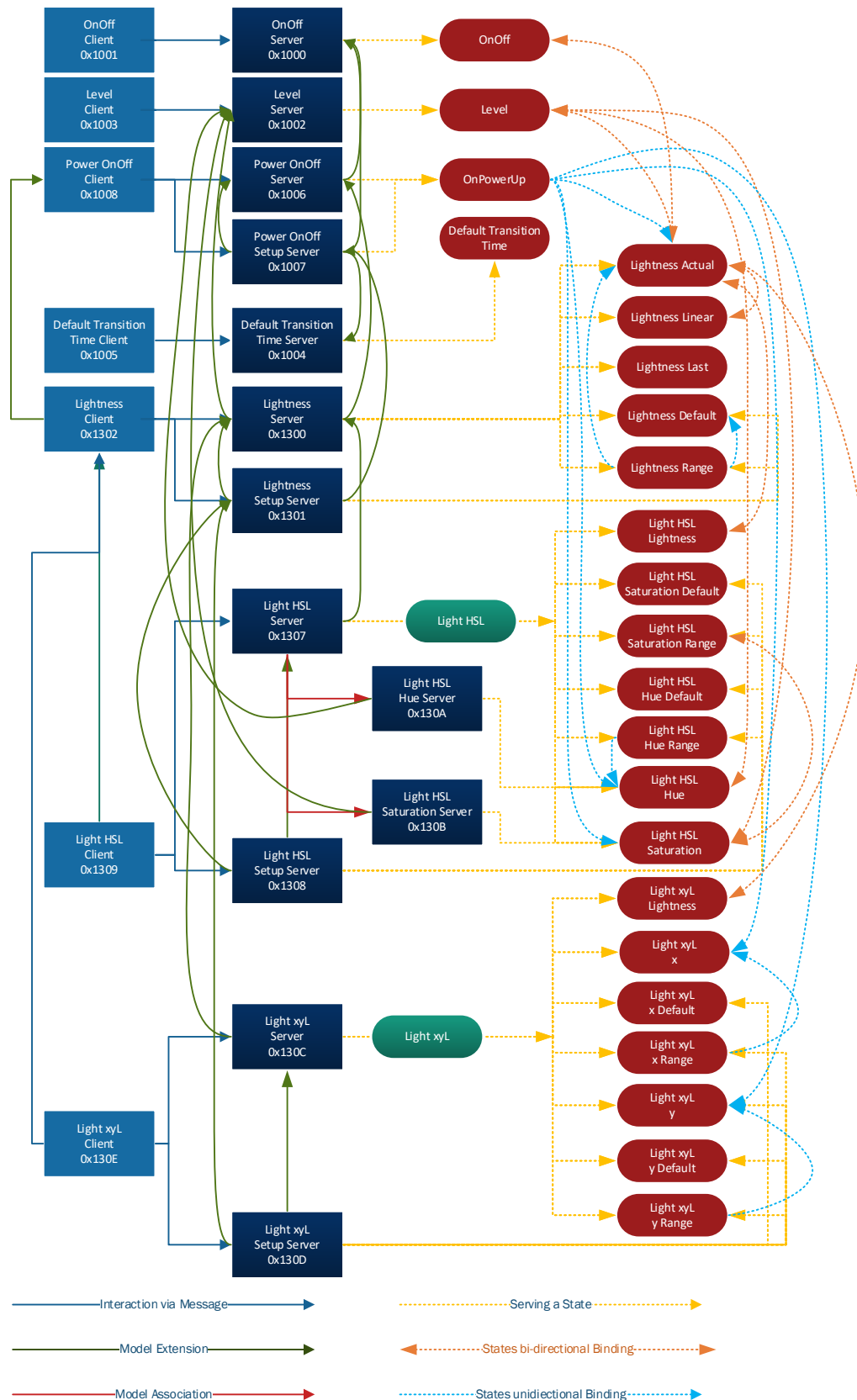


Figure 6.12: Relationships between Lighting models – Part 2

## 7 Summary

This section provides summaries of messages (and the associated opcodes) (see Section 7.1), status codes (see Section 7.2), models (see Section 7.3), and message flow sequences (see Section 7.4).

### 7.1 Messages summary

Table 7.1 is a list of the messages, and their opcodes, that are available for each of the mesh models.

Server Model	Message Name	Opcode
Generic OnOff	Generic OnOff Get	0x82 0x01
	Generic OnOff Set	0x82 0x02
	Generic OnOff Set Unacknowledged	0x82 0x03
	Generic OnOff Status	0x82 0x04
Generic Level	Generic Level Get	0x82 0x05
	Generic Level Set	0x82 0x06
	Generic Level Set Unacknowledged	0x82 0x07
	Generic Level Status	0x82 0x08
	Generic Delta Set	0x82 0x09
	Generic Delta Set Unacknowledged	0x82 0x0A
	Generic Move Set	0x82 0x0B
	Generic Move Set Unacknowledged	0x82 0x0C
Generic Default Transition Time	Generic Default Transition Time Get	0x82 0x0D
	Generic Default Transition Time Set	0x82 0x0E
	Generic Default Transition Time Set Unacknowledged	0x82 0x0F
	Generic Default Transition Time Status	0x82 0x10
Generic Power OnOff	Generic OnPowerUp Get	0x82 0x11
	Generic OnPowerUp Status	0x82 0x12
Generic Power OnOff Setup	Generic OnPowerUp Set	0x82 0x13
	Generic OnPowerUp Set Unacknowledged	0x82 0x14
Generic Power Level	Generic Power Level Get	0x82 0x15
	Generic Power Level Set	0x82 0x16
	Generic Power Level Set Unacknowledged	0x82 0x17
	Generic Power Level Status	0x82 0x18
	Generic Power Last Get	0x82 0x19
	Generic Power Last Status	0x82 0x1A
	Generic Power Default Get	0x82 0x1B
	Generic Power Default Status	0x82 0x1C
	Generic Power Range Get	0x82 0x1D
	Generic Power Range Status	0x82 0x1E
Generic Power Level Setup	Generic Power Default Set	0x82 0x1F
	Generic Power Default Set Unacknowledged	0x82 0x20
	Generic Power Range Set	0x82 0x21

Server Model	Message Name	Opcode
	Generic Power Range Set Unacknowledged	0x82 0x22
Generic Battery	Generic Battery Get	0x82 0x23
	Generic Battery Status	0x82 0x24
Generic Location	Generic Location Global Get	0x82 0x25
	Generic Location Global Status	0x40
	Generic Location Local Get	0x82 0x26
	Generic Location Local Status	0x82 0x27
Generic Location Setup	Generic Location Global Set	0x41
	Generic Location Global Set Unacknowledged	0x42
	Generic Location Local Set	0x82 0x28
	Generic Location Local Set Unacknowledged	0x82 0x29
Generic Manufacturer Property	Generic Manufacturer Properties Get	0x82 0x2A
	Generic Manufacturer Properties Status	0x43
	Generic Manufacturer Property Get	0x82 0x2B
	Generic Manufacturer Property Set	0x44
	Generic Manufacturer Property Set Unacknowledged	0x45
	Generic Manufacturer Property Status	0x46
Generic Admin Property	Generic Admin Properties Get	0x82 0x2C
	Generic Admin Properties Status	0x47
	Generic Admin Property Get	0x82 0x2D
	Generic Admin Property Set	0x48
	Generic Admin Property Set Unacknowledged	0x49
	Generic Admin Property Status	0x4A
Generic User Property	Generic User Properties Get	0x82 0x2E
	Generic User Properties Status	0x4B
	Generic User Property Get	0x82 0x2F
	Generic User Property Set	0x4C
	Generic User Property Set Unacknowledged	0x4D
	Generic User Property Status	0x4E
Generic Client Property	Generic Client Properties Get	0x4F
	Generic Client Properties Status	0x50
Sensor	Sensor Descriptor Get	0x82 0x30
	Sensor Descriptor Status	0x51
	Sensor Get	0x82 0x31
	Sensor Status	0x52
	Sensor Column Get	0x82 0x32
	Sensor Column Status	0x53
	Sensor Series Get	0x82 0x33
	Sensor Series Status	0x54

Server Model	Message Name	Opcode
Sensor Setup	Sensor Cadence Get	0x82 0x34
	Sensor Cadence Set	0x55
	Sensor Cadence Set Unacknowledged	0x56
	Sensor Cadence Status	0x57
	Sensor Settings Get	0x82 0x35
	Sensor Settings Status	0x58
	Sensor Setting Get	0x82 0x36
	Sensor Setting Set	0x59
	Sensor Setting Set Unacknowledged	0x5A
	Sensor Setting Status	0x5B
Time	Time Get	0x82 0x37
	Time Set	0x5C
	Time Status	0x5D
	Time Role Get	0x82 0x38
	Time Role Set	0x82 0x39
	Time Role Status	0x82 0x3A
	Time Zone Get	0x82 0x3B
	Time Zone Set	0x82 0x3C
	Time Zone Status	0x82 0x3D
	TAI-UTC Delta Get	0x82 0x3E
	TAI-UTC Delta Set	0x82 0x3F
	TAI-UTC Delta Status	0x82 0x40
Scene	Scene Get	0x82 0x41
	Scene Recall	0x82 0x42
	Scene Recall Unacknowledged	0x82 0x43
	Scene Status	0x5E
	Scene Register Get	0x82 0x44
	Scene Register Status	0x82 0x45
Scene Setup	Scene Store	0x82 0x46
	Scene Store Unacknowledged	0x82 0x47
	Scene Delete	0x82 0x9E
	Scene Delete Unacknowledged	0x82 0x9F
Scheduler	Scheduler Action Get	0x82 0x48
	Scheduler Action Status	0x5F
	Scheduler Get	0x82 0x49
	Scheduler Status	0x82 0x4A
Scheduler Setup	Scheduler Action Set	0x60
	Scheduler Action Set Unacknowledged	0x61
Light Lightness	Light Lightness Get	0x82 0x4B

Server Model	Message Name	Opcode
	Light Lightness Set	0x82 0x4C
	Light Lightness Set Unacknowledged	0x82 0x4D
	Light Lightness Status	0x82 0x4E
	Light Lightness Linear Get	0x82 0x4F
	Light Lightness Linear Set	0x82 0x50
	Light Lightness Linear Set Unacknowledged	0x82 0x51
	Light Lightness Linear Status	0x82 0x52
	Light Lightness Last Get	0x82 0x53
	Light Lightness Last Status	0x82 0x54
	Light Lightness Default Get	0x82 0x55
	Light Lightness Default Status	0x82 0x56
	Light Lightness Range Get	0x82 0x57
	Light Lightness Range Status	0x82 0x58
Light Lightness Setup	Light Lightness Default Set	0x82 0x59
	Light Lightness Default Set Unacknowledged	0x82 0x5A
	Light Lightness Range Set	0x82 0x5B
	Light Lightness Range Set Unacknowledged	0x82 0x5C
Light CTL	Light CTL Get	0x82 0x5D
	Light CTL Set	0x82 0x5E
	Light CTL Set Unacknowledged	0x82 0x5F
	Light CTL Status	0x82 0x60
	Light CTL Temperature Get	0x82 0x61
	Light CTL Temperature Range Get	0x82 0x62
	Light CTL Temperature Range Status	0x82 0x63
	Light CTL Temperature Set	0x82 0x64
	Light CTL Temperature Set Unacknowledged	0x82 0x65
	Light CTL Temperature Status	0x82 0x66
	Light CTL Default Get	0x82 0x67
	Light CTL Default Status	0x82 0x68
Light CTL Setup	Light CTL Default Set	0x82 0x69
	Light CTL Default Set Unacknowledged	0x82 0x6A
	Light CTL Temperature Range Set	0x82 0x6B
	Light CTL Temperature Range Set Unacknowledged	0x82 0x6C
Light HSL	Light HSL Get	0x82 0x6D
	Light HSL Hue Get	0x82 0x6E
	Light HSL Hue Set	0x82 0x6F
	Light HSL Hue Set Unacknowledged	0x82 0x70
	Light HSL Hue Status	0x82 0x71
	Light HSL Saturation Get	0x82 0x72



Server Model	Message Name	Opcode
	Light HSL Saturation Set	0x82 0x73
	Light HSL Saturation Set Unacknowledged	0x82 0x74
	Light HSL Saturation Status	0x82 0x75
	Light HSL Set	0x82 0x76
	Light HSL Set Unacknowledged	0x82 0x77
	Light HSL Status	0x82 0x78
	Light HSL Target Get	0x82 0x79
	Light HSL Target Status	0x82 0x7A
	Light HSL Default Get	0x82 0x7B
	Light HSL Default Status	0x82 0x7C
	Light HSL Range Get	0x82 0x7D
	Light HSL Range Status	0x82 0x7E
Light HSL Setup	Light HSL Default Set	0x82 0x7F
	Light HSL Default Set Unacknowledged	0x82 0x80
	Light HSL Range Set	0x82 0x81
	Light HSL Range Set Unacknowledged	0x82 0x82
Light xyL	Light xyL Get	0x82 0x83
	Light xyL Set	0x82 0x84
	Light xyL Set Unacknowledged	0x82 0x85
	Light xyL Status	0x82 0x86
	Light xyL Target Get	0x82 0x87
	Light xyL Target Status	0x82 0x88
	Light xyL Default Get	0x82 0x89
	Light xyL Default Status	0x82 0x8A
	Light xyL Range Get	0x82 0x8B
	Light xyL Range Status	0x82 0x8C
Light xyL Setup	Light xyL Default Set	0x82 0x8D
	Light xyL Default Set Unacknowledged	0x82 0x8E
	Light xyL Range Set	0x82 0x8F
	Light xyL Range Set Unacknowledged	0x82 0x90

Server Model	Message Name	Opcode
Light Control	Light LC Mode Get	0x82 0x91
	Light LC Mode Set	0x82 0x92
	Light LC Mode Set Unacknowledged	0x82 0x93
	Light LC Mode Status	0x82 0x94
	Light LC OM Get	0x82 0x95
	Light LC OM Set	0x82 0x96
	Light LC OM Set Unacknowledged	0x82 0x97
	Light LC OM Status	0x82 0x98
	Light LC Light OnOff Get	0x82 0x99
	Light LC Light OnOff Set	0x82 0x9A
	Light LC Light OnOff Set Unacknowledged	0x82 0x9B
	Light LC Light OnOff Status	0x82 0x9C
	Light LC Property Get	0x82 0x9D
	Light LC Property Set	0x62
	Light LC Property Set Unacknowledged	0x63
	Light LC Property Status	0x64

Table 7.1: Summary of opcodes grouped by model

## 7.2 Status codes summary

Table 7.2 defines status codes for messages that contain a Status parameter. All values that are not defined are Reserved for Future Use (RFU).

Status Code	Status Code Name	Description
0x00	Success	Command successfully processed
0x01	Cannot Set Range Min	The provided value for Range Min cannot be set
0x02	Cannot Set Range Max	The provided value for Range Max cannot be set
0x03–0xFF	RFU	Reserved for Future Use

Table 7.2: Summary of status codes

### 7.3 Models summary

Table 7.3 provides a summary of models within this specification, organized by model groups. All SIG Model IDs that are not defined by this specification or other Bluetooth specifications are Reserved for Future Use (RFU).

Model Group	Model Name	SIG Model ID
Generic	Generic OnOff Server	0x1000
	Generic OnOff Client	0x1001
	Generic Level Server	0x1002
	Generic Level Client	0x1003
	Generic Default Transition Time Server	0x1004
	Generic Default Transition Time Client	0x1005
	Generic Power OnOff Server	0x1006
	Generic Power OnOff Setup Server	0x1007
	Generic Power OnOff Client	0x1008
	Generic Power Level Server	0x1009
	Generic Power Level Setup Server	0x100A
	Generic Power Level Client	0x100B
	Generic Battery Server	0x100C
	Generic Battery Client	0x100D
	Generic Location Server	0x100E
	Generic Location Setup Server	0x100F
	Generic Location Client	0x1010
	Generic Admin Property Server	0x1011
	Generic Manufacturer Property Server	0x1012
	Generic User Property Server	0x1013
	Generic Client Property Server	0x1014
	Generic Property Client	0x1015
Sensors	Sensor Server	0x1100
	Sensor Setup Server	0x1101
	Sensor Client	0x1102
Time and Scenes	Time Server	0x1200
	Time Setup Server	0x1201
	Time Client	0x1202
	Scene Server	0x1203
	Scene Setup Server	0x1204
	Scene Client	0x1205
	Scheduler Server	0x1206
	Scheduler Setup Server	0x1207

Model Group	Model Name	SIG Model ID
	Scheduler Client	0x1208
Lighting	Light Lightness Server	0x1300
	Light Lightness Setup Server	0x1301
	Light Lightness Client	0x1302
	Light CTL Server	0x1303
	Light CTL Setup Server	0x1304
	Light CTL Client	0x1305
	Light CTL Temperature Server	0x1306
	Light HSL Server	0x1307
	Light HSL Setup Server	0x1308
	Light HSL Client	0x1309
	Light HSL Hue Server	0x130A
	Light HSL Saturation Server	0x130B
	Light xyL Server	0x130C
	Light xyL Setup Server	0x130D
	Light xyL Client	0x130E
	Light LC Server	0x130F
	Light LC Setup Server	0x1310
	Light LC Client	0x1311

Table 7.4: Summary of mesh models, grouped by model group

## 7.4 Message flows and example sequence charts

### 7.4.1 Message flows

A typical message flow involving a Get message is as follows:

1. An acknowledged Get message is transmitted.
2. A corresponding Status acknowledgment message is sent back to the originator.

A typical message flow involving a Set message is as follows:

1. A Set message is transmitted.
2. On receiving the message, the state is updated.
3. If the Set message in step (1) was acknowledged, a corresponding Status acknowledgment message is sent back to the originator.

#### 7.4.1.1 Asynchronous state change or upon receiving an unacknowledged message

When a state is changed asynchronously (as a result of an internal event like a scheduler action or some physical interaction with a device), an unacknowledged status message is published to a model's Publish Address.

### 7.4.1.2 State change on receiving an acknowledged state-changing message

When a state is changed as a result of an acknowledged Set message, a corresponding unacknowledged unicast Status acknowledgment message is sent back to the originator. Additionally, a second unacknowledged status message is published to the model's Publish Address to inform potential subscribers about the state change.

### 7.4.1.3 Publishing a status message upon a state change

If a model supports publishing and the Publish Address is not set to an unassigned address, it publishes a status message upon a state change, according to the following rules:

- An appropriate status message is published immediately after the state transition ends.
- It is recommended that an additional status message is published within 1 second after a state transition starts if the transition time is 2 seconds or longer.
- After a state transition ends, an element publishes a status message periodically. The publishing period is determined by the Model Publish Period state that is set by the Model Publication Set message (Mesh Profile specification [2]). A recommended value of the Model Publish Period state is 30 seconds. A value of zero means status messages are not published periodically by a model.

Note: When multiple bound states are involved in the transition, it is up to an implementation to decide which status message is the most appropriate to publish. It is recommended to use a single message that publishes the most complete information about the states being changed.

## 7.4.2 Example message sequence charts

This section shows some example message sequence charts (MSCs).

### 7.4.2.1 Generic OnOff Get

The message sequence chart below shows a client getting the state of a peer element using an acknowledged Generic OnOff Get message. The server responds with an associated Generic OnOff Status message.

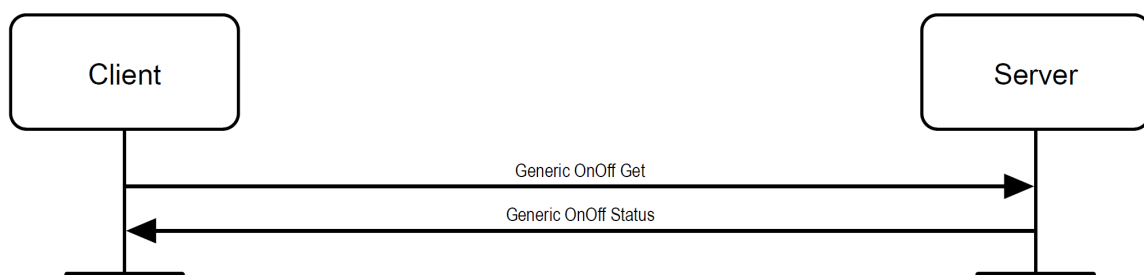


Figure 7.1: Generic OnOff Get

### 7.4.2.2 Generic OnOff Set

The message sequence chart below shows a client setting the state of a peer element with an acknowledged Set message. The server responds with an associated Generic OnOff Status message. The server publishes a Generic OnOff Status message to the group address configured as the model's Publish Address.

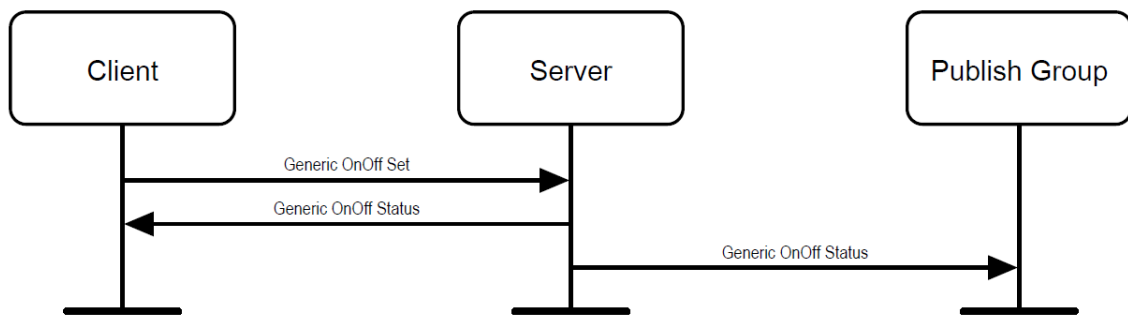


Figure 7.2: Generic OnOff Set

#### 7.4.2.3 Generic OnOff Set Unacknowledged

The message sequence chart below shows a client setting the state of a peer element. No response is sent to the originator, but the server publishes the new state information to the model's Publish Address.

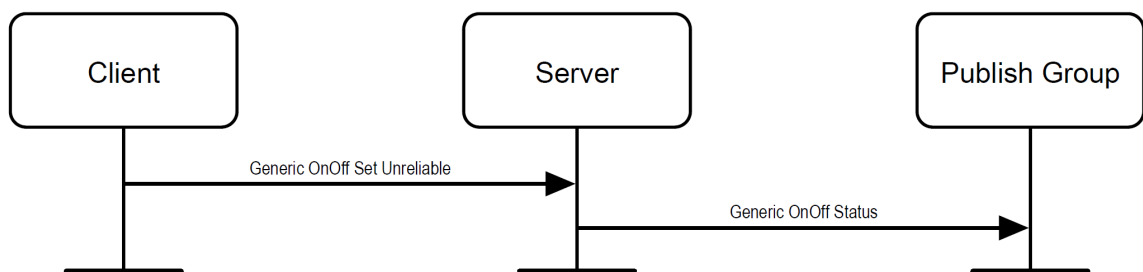


Figure 7.3: Generic OnOff Set Unacknowledged

#### 7.4.2.4 Generic OnOff Set on a Generic OnOff bound to a Light HSL

The message sequence chart below shows a client setting the state of a peer element. The client uses a Generic OnOff Set message to operate on a Generic OnOff state that is bound to a Light HSL state. The server responds with the associated Generic OnOff Status message to the client. As defined in the Section 6.4.6.2.3, the server publishes the Light HSL Status message to the group address configured as the model's Publish Address.

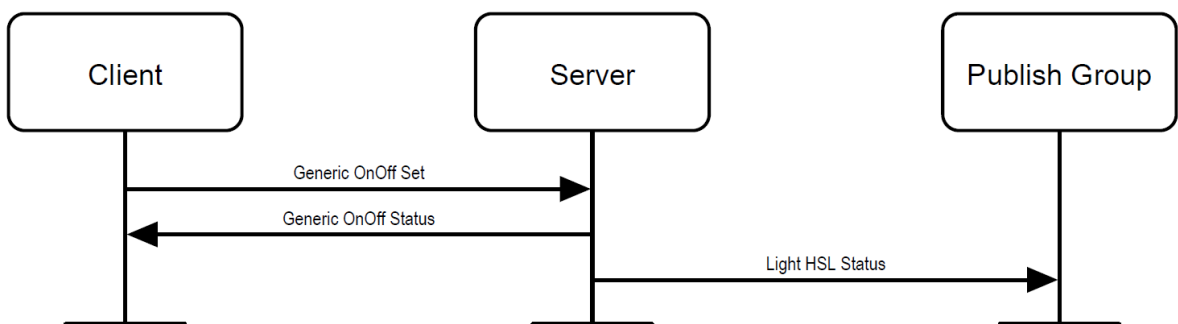


Figure 7.4: Generic OnOff Set

#### 7.4.2.5 Generic Level Get

The message sequence chart below shows a client getting the level of a peer element using an acknowledged Generic Level Get message. The server responds with a Generic Level Status message.

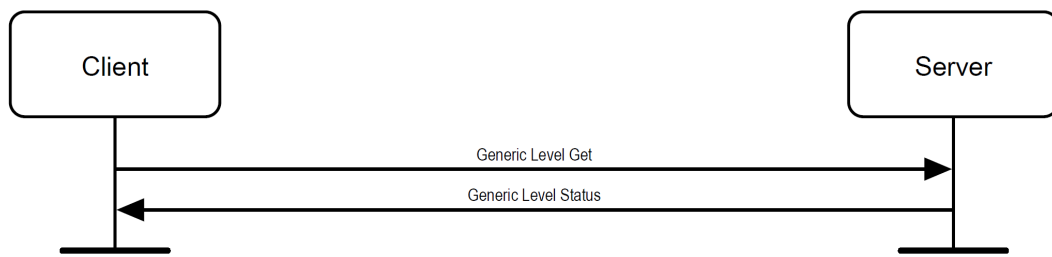


Figure 7.5: Generic Level Get

#### 7.4.2.6 Generic Level Set on a Generic Level bound to a Light Lightness Actual

The message sequence chart below shows a client setting the level of a peer element using the Generic Level Set message. The server responds with the Generic Level Status message. As defined in the Section 6.4.1.2.3, the server publishes the Light Lightness Status message to the group address configured as the model's Publish Address.

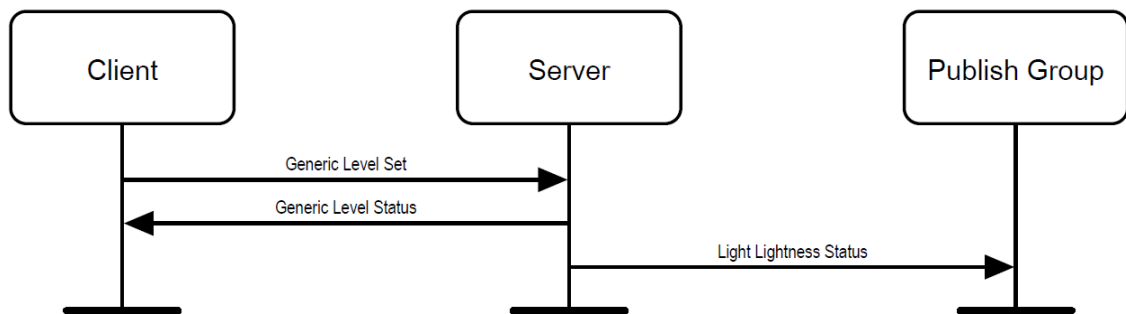


Figure 7.6: Generic Level Set on a Generic Level state bound to a Light Lightness Actual state

#### 7.4.2.7 Generic Delta Set on a Generic Level bound to a Light Lightness Actual

The message sequence chart below shows a client setting the Generic Level state of a peer element using the Generic Delta Set message with a TID field that is controlling the transaction. The client may send a number of messages with the changes from the start of this transaction using the same value for the TID field. The server responds with a Generic Level Status message if the message is acknowledged (usually this should be the last message in a transaction). Because the Generic Level state is bound to the Light Lightness Actual state, the server publishes a Light Lightness Status message to the group address configured as the model's Publish Address.

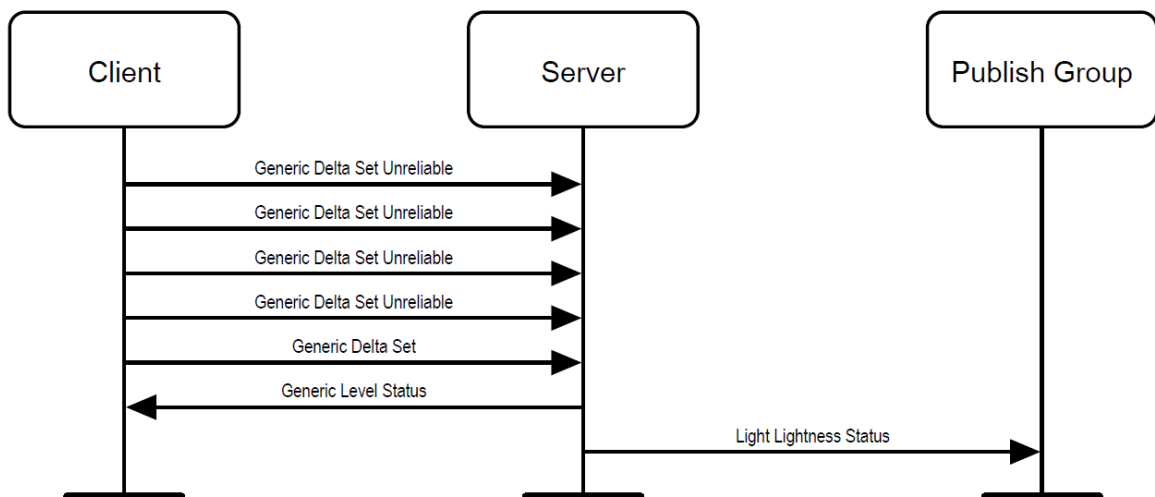


Figure 7.7: Generic Delta Set

#### 7.4.2.8 Status publishing after a Generic OnOff Set on a Generic OnOff bound to a Light HSL

The message sequence chart below shows a client setting the state of a peer element. The client uses a Generic OnOff Set message to operate on a Generic OnOff state that is bound to a Light HSL state. The server responds with the associated Generic OnOff Status message to the client. Because the transition time is greater than 2 seconds, the server publishes a Light HSL Status message to the model's Publish Address within 1 second after the transition has started. The server publishes a second Light HSL Status message to the model's Publish Address immediately after the transition ended. The server continues publishing Light HSL Status messages to the group address configured as the model's Publish Address every 30 seconds.

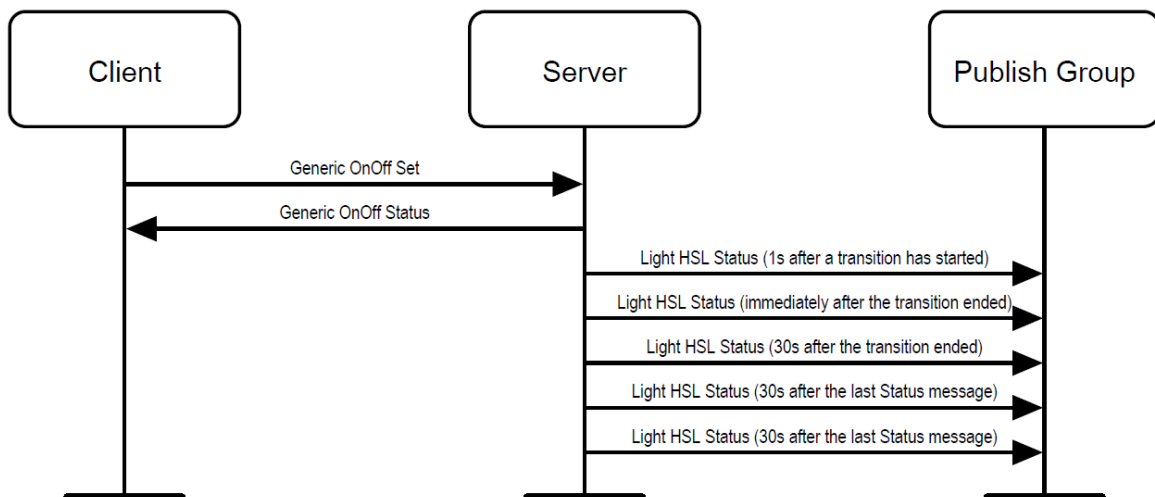


Figure 7.8: Status publishing after a state change with a Generic OnOff Set



## 8 Acronyms and abbreviations

Any abbreviation or acronym used in the document, but not defined in the common specification sections (e.g., Volume 1 Part B of the Bluetooth Core Specification [1]) is defined here. The list is alphabetized.

Abbreviation or Acronym	Meaning
CTL	Color Tunable Light
DST	Destination Address
DUV	Delta UV - the distance from the Block Body curve
GPS	Global Positioning System
HS	Hue and Saturation
HSL	Hue, Saturation and Lightness
IUT	Implementation Under Test
LSb	Least Significant bit
LSB	Least Significant Byte
LSO	Least Significant Octet
MSb	Most Significant bit
MSB	Most Significant Byte
MSC	Message Sequence Chart
MSO	Most Significant Octet
RFU	Reserved for Future Use
RGB	Red, Green, Blue
SAR	Segmentation and Reassembly
SRC	Source Address
TAI	International Atomic Time
TID	Transaction Identifier
TTL	Time To Live
UTC	Universal Coordinated Time
UUID	Universally Unique Identifier
WG	Working Group
WGS	World Geodetic System 1984

Table 8.1: Abbreviations and acronyms

## 9 References

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- [1] Bluetooth Core Specification, Version 5 or later
- [2] Bluetooth Mesh Profile specification, Version 1.0 or later
- [3] RFC-4493 (<http://www.ietf.org/rfc/rfc4493.txt>)
- [4] HSL and HSV (<http://www.poynton.com/PDFs/coloureq.pdf>)
- [5] CIE1931 (<http://eiv.cie.co.at/term/150>)
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- [11] Units (<https://www.bluetooth.com/specifications/assigned-numbers/units>)
- [12] Characteristic Format Types (<https://www.bluetooth.com/specifications/assigned-numbers/format-types>)
- [13] Mesh Device Properties, Version 1.0 or later
- [14] IERS Bulletin C – all available versions (<https://www.iers.org/ IERS/EN/Publications/Bulletins/bulletins.html>)
- [15] ISO 8601 date and time format (<http://www.iso.org/iso/iso8601>)
- [16] NIST Time Frequently Asked Questions (FAQ) (Physical Measurement Laboratory of the National Institute of Standards and Technology of the U.S. Department of Commerce) (<https://www.nist.gov/pml/time-and-frequency-division/nist-time-frequently-asked-questions-faq>)
- [17] Basis of Physical Photometry (International Commission of Illumination (CIE)) ([http://www.cie.co.at/index.php/index.php?i\\_ca\\_id=307](http://www.cie.co.at/index.php/index.php?i_ca_id=307))



## Appendix A: Background information

This informative appendix provides background information about representations of time and lightness in this specification.

### A.1 Time

Time can be represented in many different formats. Most commonly, it is represented either as a structure containing fields such as year, month, day, hours, minutes, and seconds, or as a simple count of seconds since a given epoch. For example, POSIX defines the `time_t` type as the number of seconds after the UTC time of 1970-01-01 at 00:00:00.

The earth's rotational speed changes irregularly for a number of reasons, though in the long term it is slowing down. This means that days are getting gradually longer, and a naïve approach of including 86400 seconds in each day will mean that the clock will drift out of synchronization with the sun and the stars, with 00:00 getting earlier and earlier in the night. There are two standard time scales used to address this point. The first is TAI, which ticks at a steady rate and always has exactly 60 seconds in a minute. A simple formula can be used to convert a TAI time to seconds past some epoch. However, on the other hand, TAI is not synchronized with the sun. The second is UTC, which sometimes has minutes of 61 seconds or (potentially) 59 seconds instead of the usual 60 seconds. These extra or missing seconds (known as "leap seconds") are introduced in order to keep 00:00 UTC in the middle of the night. Because the changes in rotational speed are irregular, they are introduced on an ad hoc basis rather than using a formula. In summary, TAI is always an integer representing a number of seconds different from UTC (at the beginning of 2000, it was 32 seconds), but the amount of the difference changes on an unpredictable schedule.

The POSIX `time_t` type was defined at a point when the issues with leap seconds were not well understood, and the conversion between dates and `time_t` ignores them: it assumes that every minute is exactly 60 seconds long. In the real world this means that the same `time_t` value will occur twice whenever there is a positive leap second (one resulting in a 61-second minute). There are also other issues that have to do with the meaning of "UTC" when applied to dates before 1977. These issues have resulted in a range of problems with no agreed to solution in sight.

To avoid all these problems, Mesh defines times based on TAI rather than UTC.

**Note:** For a detailed analysis of the differences between TAI and UTC, including the important concept of leap seconds, see NIST Time Frequently Asked Questions (FAQ) [16], from the Physical Measurement Laboratory of the National Institute of Standards and Technology of the U.S. Department of Commerce.

### A.2 Light in numbers

Light brightness can be generally defined in one of two ways, as summarized in this section.:

- **Perceived light** (called V or L) described by **Weber-Fechner** rule, which says the perceived lightness is proportional to a square root of actual intensity measured with an accurate nonhuman instrument.
- **Measured Light** (called Y) is a physical measure of visual stimulus. This is proportional to the number of nerve impulses per nerve fiber per unit time.

Over more than 100 years, the definition of the relation between V or L and Y has changed.

**Note:** For a full discussion of historic changes to the scientific community's understanding of the relationship between the L and Y variables, see "The Basis of Physical Photometry" [17] from the International Commission of Illumination (CIE). The CIE works with the International Organization for Standardization (ISO) to define global standards for various

types of illumination. The organization's published illumination standards and research publications are available on the CIE website.

1920

Priest et al. provided a basic estimate of the Munsell value (with Y running from 0 to 1 in this case):

$$V = 10\sqrt{Y}$$

1933

Munsell, Sloan, and Godlove launched a study on the Munsell neutral value scale, considering several proposals relating the relative luminance to the Munsell value and suggested:

$$V^2 = 1.4742Y - 0.004743Y^2$$

1943

Newhall, Nickerson, and Judd prepared a report for the [Optical Society of America](#). They suggested a quintic parabola (relating the reflectance in terms of the value):

$$Y = 1.2219V - 0.23111V^2 + 0.23951V^3 - 0.021009V^4 + 0.0008404V^5$$

1943

Using the Table II of the O.S.A. report, Moon and Spencer expressed the value in terms of the luminance:

$$V = 5(Y/19.77)^{0.426} = 1.4Y^{0.426}$$

1944

Saunderson and Milner introduced a subtractive constant in the previous expression for a better fit to the Munsell value. Later, [Jameson](#) and Hurvich claimed that this corrects for simultaneous [contrast effects](#).

$$V = 2.357Y^{0.343} - 1.52$$

1955

Ladd and Pinney of [Eastman Kodak](#) were interested in the Munsell value as a perceptually uniform lightness scale for use in [television](#). After considering one logarithmic and five [power-law](#) functions (per [Stevens' power law](#)), they related value to reflectance by raising the reflectance to the power of 0.352:

$$V = 2.217Y^{0.352} - 1.324$$

Realizing this is quite close to the cube root, they simplified it to:

$$V = 2.468Y^{1/3} - 1.636$$

1958

Glasser et al. defined the lightness as ten times the Munsell value (so that the lightness ranges from 0 to 100):

$$L^* = 25.29Y^{1/3} - 18.38$$

1964

Wyszecki simplified this to:

$$W^* = 25Y^{1/3} - 17$$

This formula approximates the Munsell value function for  $1\% < Y < 98\%$  (it is not applicable for  $Y < 1\%$ ) and is used for the [CIE 1964 color space](#).

1976

[CIELAB](#) used the following formula:

$$L^* = 116(Y/Y_n)^{1/3} - 16$$

where  $Y_n$  is the  $Y$  tristimulus value of a "specified white object" and is subject to the restriction of  $Y/Y_n > 0.01$ . Pauli removed this restriction by computing a [linear extrapolation](#) which maps  $Y/Y_n = 0$  to  $L^* = 0$  and is tangent to the formula above at the point at which the linear extension takes effect. First, the transition point is determined to be  $Y/Y_n = (6/29)^3 \approx 0.008856$ , then the slope of  $(29/3)^3 \approx 903.3$

is computed. This gives the two-part function:

$$f(Y/Y_n) = \begin{cases} \frac{841}{108}Y/Y_n + \frac{4}{29}, & Y/Y_n \leq (6/29)^3 \\ (Y/Y_n)^{1/3}, & Y/Y_n > (6/29)^3 \end{cases}$$

The lightness is then

$$L^* = 116f(Y/Y_n) - 16.$$

At first glance, you might approximate the lightness function by a cube root, an approximation that is found in much of the technical literature. However, the linear segment near black is significant; hence the 116 and 16 coefficients. The best-fit pure power function has an exponent of about 0.42, far from  $1/3$ .

An approximately 18% grey card, having an exact reflectance of  $(33/58)^3$ , has a lightness value of 50. It is called "mid grey" because its lightness is midway between black and white.