Ambient Light Sensor NLC Profile

***Bluetooth*®** **Profile Specification**

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Abstract:

The Ambient Light Sensor NLC Profile specifies the requirements for a product acting as an ambient light sensor in a Bluetooth mesh system.

Version History

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Contents

1 Introduction

The light level reported by ambient light sensors can be used to turn off or dim down the lights to save energy when daylight is sufficient.

The Ambient Light Sensor NLC Profile specifies the requirements for a networked lighting control (NLC) product acting as an ambient light sensor in a Bluetooth mesh system. The Ambient Light Sensor NLC Profile standardizes the use cases and implementation patterns of ambient light sensors to help improve interoperability and performance of systems based on Bluetooth mesh, such as networked lighting control systems or sensor networks.

A common use case for the Ambient Light Sensor NLC Profile is a sensor reporting the ambient light level in a given space.

1.1 Language

1.1.1 Language conventions

In the development of a specification, the Bluetooth SIG has established the following conventions for use of the terms *"shall"*, *"shall not"*, *"should"*, *"should not"*, *"may"*, *"must"*, and *"can"*. In this Bluetooth specification, the terms in Table 1.1 have the specific meanings given in that table, irrespective of other meanings that exist.

Term	Definition
shall	—used to express what is required by the specification and is to be implemented exactly as written without deviation
shall not	—used to express what is forbidden by the specification
should	—used to express what is recommended by the specification without forbidding anything
should not	—used to indicate that something is discouraged but not forbidden by the specification
may	—used to indicate something that is permissible within the limits of the specification
must	—used to indicate either: 1. an indisputable statement of fact that is always true regardless of the circumstances 2. an implication or natural consequence if a separately-stated requirement is followed
can	—used to express a statement of possibility or capability

Table 1.1: Language conventions terms and definitions

1.1.1.1 Implementation alternatives
When specification content indicates that there are multiple alternatives to satisfy specification requirements, if one alternative is explained or illustrated in an example it is not intended to limit other alternatives that the specification requirements permit.

1.1.1.2 Discrepancies
It is the goal of Bluetooth SIG that specifications are clear, unambiguous, and do not contain discrepancies. However, members can report any perceived discrepancy by filing an erratum and can request a test case waiver as appropriate.

1.1.2 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.

1.1.3 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.

1.2 Table requirements

Requirements in this specification are defined as "Mandatory" (M), "Optional" (O), "Excluded" (X), "Not Applicable" (N/A), or "Conditional" (C.n). Conditional statements (C.n) are listed directly below the table in which they appear.

1.3 Conformance

Each capability of this specification shall be supported in the specified manner. This specification may provide options for design flexibility, because, for example, some products do not implement every portion of the specification. For each implementation option that is supported, it shall be supported as specified.

2 Configuration

2.1 Identification

The Ambient Light Sensor NLC Profile shall be identified by the «Ambient Light Sensor» mesh profile UUID (see [4]) in Composition Data Page 2 (see [1]).

2.2 NLC profile relationships

A device implementing the Ambient Light Sensor NLC Profile interacts with devices implementing the Basic Lightness Controller NLC Profile [5] as defined in Mesh Model [2] Section 6.5.1.7.1, "Receiving a Sensor Status message", and shown in Figure 2.1.
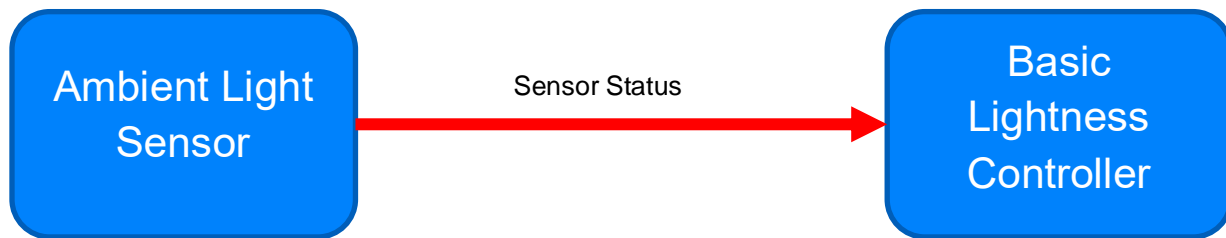

Figure 2.1: Interaction of an Ambient Light Sensor with a Basic Lightness Controller

Note: See Section 6.2.2 in [2] and Section 9 in [6] for a broader discussion on lighting control scenarios utilizing an ambient light sensor.

2.3 Concurrency limitations and restrictions

There are no concurrency limitations or restrictions imposed by this specification.

2.4 Topology limitations and restrictions

There are no topology limitations or restrictions imposed by this specification.

2.5 Bluetooth specification release compatibility

This specification is compatible with Mesh Protocol Version 1.1 [1] and Mesh Model Version 1.1 [2].

2.6 Mesh Protocol dependencies

This specification requires implementation of all mandatory requirements for an unprovisioned device and a node described in the Mesh Protocol specification [1].

3 Requirements and recommendations

The Ambient Light Sensor NLC Profile specifies the following requirements and recommendations.

3.1 Provisioning

The following requirements are related to provisioning:

- The PB-GATT provisioning bearer shall be supported. See Section 5.2.2 in [1].

- Either the device «Complete Local Name» advertising data (AD) type or the device «Shortened Local Name» AD type shall be included in scan response data when advertising the Mesh Provisioning Service. See Section 7.1.2.2.1 in [1].

- Visual attention indication for all instances of the Attention Timer shall be supported. The visual attention indication may be shared among multiple instances of the Attention Timer. See Section 4.2.10 in [1].

3.2 Bearers

The following requirements are related to bearers:

- The advertising bearer shall be supported. See Section 3.3.1 in [1].

- The Generic Attribute Profile (GATT) bearer shall be supported in the GATT Bearer Server role. See Section 3.3.2 in [1].

3.3 Features

The following requirements are related to features:

- The Relay feature shall be supported. See Section 3.4.6.1 in [1].

- The Proxy feature shall be supported. See Section 3.4.6.2 in [1].

3.4 Performance

The following requirements are related to performance:

- At least two network keys shall be supported. See Section 3.9.6.3 in [1].

- At least three application keys shall be supported. See Section 3.9.6.2 in [1].

- At least 32 entries in the replay protection list shall be supported. See Section 4.2.2.1 in [1].

- At least 8 entries per connection in the proxy filter list shall be supported. See Section 6.4 in [1].

- At least 64 entries in the network message cache shall be supported. See Section 3.4.6.5 in [1].

3.5 Models

The following requirements are related to models:

- The Sensor Server model shall be supported. See Section 4.3.1 in [2].

- The Sensor Descriptor state shall include a Sensor Property ID field value referencing the Present Ambient Light Level device property.

  Other values for the Sensor Property ID fields for the instances of the Sensor Descriptor state shall not be present on the Sensor Server model for the Ambient Light Sensor NLC Profile. See Section 4.1.1 in [2] and the Present Ambient Light Level property in [3].

- The Sensor Setting state shall include Sensor Property ID fields referencing the following device properties:

  - A value referencing the Present Ambient Light Level device property and the value of the Sensor Setting Access field equal to 0x03 (read/write).

  - A value referencing the Sensor Gain device property and the value of the Sensor Setting Access field equal to 0x03 (read/write).

  See Section 4.1.2 in [2], the Present Ambient Light Level property in [3], and the Sensor Gain property in [3].

- An ambient light sensor shall support calibration, which consists of the following prerequisites, formula, and methods:

  Prerequisites: The following prerequisites shall be supported:

  - The sensor is installed and provisioned in the target environment.

  - The ambient light level remains constant during the calibration procedure.

  - The ambient light level is measured using a reference meter.

  Formula: The Present Ambient Light Level reported by the sensor in the Sensor Status message shall be calculated using the following formula:

  $$[value\ reported\ by\ the\ sensor] = [sensor\ gain]\ x\ [value\ read\ by\ the\ sensor]$$

  where:

  - *[value reported by the sensor]* is the value of the Present Ambient Light Level property referenced by the Sensor Property ID field of the Sensor Descriptor state;

  - *[sensor gain]* is the value of the Sensor Gain property referenced by the Sensor Setting Property ID field of the Sensor Setting State;

  - *[value read by the sensor]* is the value read internally by the sensing apparatus.

  Methods: The following two methods shall be supported:

  1 A user measures the ambient light level using a reference meter. The measured ambient light level value is written to the sensor by sending the Sensor Setting Set message or the Sensor Setting Set Unacknowledged message, setting the Sensor Property ID field to the value identifying the Present Ambient Light Level property, the Sensor Setting Property ID field to the value identifying the Present Ambient Light Level property, and the Sensor Setting Raw field to the measured ambient light level value. Upon receiving the message, the sensor shall calculate and update the *[sensor gain]* such that the *[value reported by the sensor]* matches the measured ambient light level value.

  2 The value of the *[sensor gain]* is written to the sensor by sending the Sensor Setting Set message or the Sensor Setting Set Unacknowledged message, with the Sensor Property ID field identifying the Present Ambient Light Level property, the Sensor Setting Property ID field identifying the Sensor Gain device property, and the Sensor Setting Raw field set to the *[sensor gain]* value.

3.6 Combinations of NLC profiles

The following requirements are related to combinations of the Ambient Light Sensor NLC Profile and combinations with other NLC profiles (see [4]):

- When multiple instances of the Ambient Light Sensor NLC Profile are combined on a device, the number of entries in the replay protection list on the device shall be at least the number of entries in the replay protection list required by the Ambient Light Sensor NLC Profile. See Section 4.2.2.1 in [1].

- When the Ambient Light Sensor NLC Profile is combined with other NLC profiles on a device, the number of entries in the replay protection list on the device shall be at least the highest required minimum number of entries among the NLC profiles. See Section 4.2.2.1 in [1].

- When multiple instances of the Ambient Light Sensor NLC Profile are combined on a device, the device shall support at least the minimum number of network keys defined for the Ambient Light Sensor NLC Profile. See Section 3.9.6.3 in [1].

- When the Ambient Light Sensor NLC Profile is combined with other NLC profiles on a device, the device shall support at least the highest minimum number of network keys defined among the NLC profiles. See Section 3.9.6.3 in [1].

- When multiple instances of the Ambient Light Sensor NLC Profile are combined on a device, the device shall support at least the minimum number of application keys defined for the Ambient Light Sensor NLC Profile. See Section 3.9.6.2 in [1].

- When the Ambient Light Sensor NLC Profile is combined with other NLC profiles on a device, the device shall support at least the highest minimum number of application keys defined among the NLC profiles. See Section 3.9.6.2 in [1].

3.7 Recommendations

Implementers should consider the following recommendations:

- If a blinking sequence on power-up in the unprovisioned state is supported, then it should be the Unprovisioned Blinking Sequence defined by the DiiA Part 341 specification [7].

- If a reset to factory default settings is supported, then a manual reset (i.e., physical interaction with the device) should be supported.

4   Acronyms and abbreviations

Acronym/Abbreviation	Meaning
AD	advertising data
GATT	Generic Attribute Profile
NLC	networked lighting control
PDU	Protocol Data Unit
RFU	Reserved for Future Use

Table 4.1: Acronyms and abbreviations

5 References

[1]   Mesh Protocol Specification, Version 1.1 or later

[2]   Mesh Model Specification, Version 1.1 or later

[3]   Device Properties

[4]   Bluetooth SIG Assigned Numbers, http://www.bluetooth.com/specifications/assigned-numbers

[5]   Basic Lightness Controller NLC Profile, Version 1.0

[6]   Building a Sensor-Driven Lighting Control System Based on Bluetooth Mesh – Bluetooth White Paper, Version 1.0

[7]   Digital Illumination Interface Alliance (DiiA), "Part 341 – Bluetooth Mesh to DALI Gateway", https://www.dali-alliance.org/specifications/download.html