HID Service Specification

Bluetooth® Service Specification

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Abstract

This service exposes HID reports and other HID data intended for HID Hosts and HID Devices.

Version History

Version	Date (yyyy-mm-dd)	Comments
V10r00	2011-12-27	Adopted by the Bluetooth SIG Board of Directors.
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Contents

1 Introduction

The HID Service exposes control, data, and associated formatting for HID Devices and HID Hosts.

1.1 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.

1.2 Service dependency

This service is not dependent upon any other services.

1.3 Core Configuration dependencies

Enabling Bluetooth wireless technology end-to-end in an implementation of this service requires an implementation of a Core Configuration that supports the LE transport.

1.4 GATT sub-procedure requirements

Requirements in this section represent a minimum set of requirements for a HID Device (GATT Server). Other GATT sub-procedures may be used if supported by both Client and Server.

Table 1.1 below summarizes additional GATT sub-procedure requirements beyond those required by all GATT Servers.

GATT Sub-Procedure	Requirement
Read Long Characteristic Value	M
Write Without Response	M
Write Characteristic Value	M
Notifications	M
Read Characteristic Descriptors	M
Write Characteristic Descriptors	M

Table 1.1: GATT sub-procedure requirements

1.5 Inter-layer dependencies

This service shall operate over the LE transport only. For BR/EDR, the HID Profile [5] shall be used.

HID Device implementations that support the Shorter Connection Intervals (SCI) feature depend on both Host support and Controller support for Shorter Connection Intervals.

1.6 Error codes

This service does not define any application error codes that are used in Attribute Protocol.

1.7 Byte transmission order

All characteristics used with this service shall be transmitted with the least significant octet first (i.e., little endian). The least significant octet is identified in the characteristic definitions in this document.

1.8 Change history

This section summarizes changes at a moderate level of detail and should not be considered representative of every change made.

1.8.1 Changes from Version 1.0 to Version 1.1

1.8.1.1 New and updated features

Feature Name	Description	Location
HID Shorter Connection Intervals (SCI)	The HID Shorter Connection Intervals feature reduces latency below 7.5 ms while preserving low power for common HID devices.	Many

Table 1.2: New and/or updated features

1.8.1.2 Removed features

No features were removed in this version.

1.8.1.3 Errata incorporated in v1.1

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2.7: Boot Keyboard Input Report characteristic	28630, 28781
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Table 1.3: Errata incorporated in v1.1

1.9 Language

1.9.1 Language conventions

In the development of a specification, the Bluetooth SIG has established the following conventions for use of the terms "*shall*", "*mandatory*", "*shall not*", "*should*", "*should not*", "*may*", "*optional*", "*must*", and "*can*". In this Bluetooth specification, the terms in Table 1.4 have the specific meanings given in that table, irrespective of other meanings that exist.

Term	Definition
shall *or* mandatory	—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 *or* may *or* optional	— not mandatory. Used to express either: 1. what is recommended by the specification without forbidding anything ("should") 2. what is permissible within the limits of the specification ("may" or "optional")
should not	—used to indicate that something is discouraged but not forbidden by the specification

Term	Definition
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 1.4: Language conventions terms and definitions

Where more than one item is permitted but not required, the choices to include or support those items are independent from one another unless the specification explicitly states otherwise. Each item that is implemented shall be implemented exactly as written without deviation.

1.9.1.1 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.

1.9.1.2 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.

1.9.2 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.

1.9.3 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.

1.10 Requirements in tables

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

- "M” for mandatory. See Table 1.4: Language conventions terms and definitions.
- "O" for optional. See Table 1.4: Language conventions terms and definitions.
- “E” for excluded. “Excluded” means not permitted in this context; cannot be supported or included for this purpose. The item can still be supported or included if allowed for some other purpose (e.g., a feature can be mandatory for one role and excluded for another; a device that supports both roles must support this feature).
- “C.#” for conditional. “Conditional” means that an item is required, optional, or prohibited based on whether one or more other items are supported or included (# represents any number). Within the definition of the condition, if those other items mean that “not permitted” applies, it has the same meaning as “E”.

1.10.1 Table requirements for unused cells

An unused cell is a table cell without a value or content, which is indicated with either the word “none” (without quotation marks) or a hyphen (i.e., a “minus” sign).

To use an additional form of notation in this specification’s tables—such as an ellipsis (...) to indicate a gap in a series of values—add an explanation of that notation in the specification’s section on table conventions for requirements and unused cells. If a particular table uses a notation that differs from the initially expressed table conventions for unused cells, explain this additional notation in the introduction of the table to which it applies.

2 Service requirements

2.1 Service declaration

The service UUID shall be set to ‹‹HID Service››.

The UUID assigned to ‹‹HID Service›› is defined in [4].

2.2 Characteristic overview

The HID Service is composed of the following characteristics used to provide access to HID data. Unless otherwise specified, only one instance of each characteristic is permitted within a HID Service.

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
Protocol Mode	C.4	Read / WriteWithoutResponse	–	None
Report	O	–	–	–
Report: Input Report Type	C.1	Read/Notify	Write	None
Report: Output Report Type	C.1	Read/Write/Write Without Response	–	None
Report: Feature Report Type	C.1	Read/Write	–	None
Report Map	M	Read	–	None
Boot Keyboard Input Report	C.2	Read/Notify	Write	None
Boot Keyboard Output Report	C.2	Read/Write/Write Without Response	–	None
Boot Mouse Input Report	C.3	Read/Notify	Write	None
HID Information	M	Read	–	None
HID Control Point	M	WriteWithoutResponse	–	None
HID SCI Information	C.5	Read	–	None
HID SCI Mode	C.5	Read/Notify	–	None

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
C.1: Mandatory to support at least one Report Type if the Report characteristic is supported				
C.2: Mandatory for HID Devices operating as keyboards, else excluded.				
C.3: Mandatory for HID Devices operating as mice, else excluded.				
C.4: Mandatory for HID Devices supporting Boot Protocol Mode, otherwise optional.				
C.5: Mandatory for devices that support the HID SCI feature (see Volume 6, Part B, Section 4.6.50 of [3]), otherwise excluded.				

Table 2.1: HID Service characteristics

Notes:

- Security Permissions of “None” means that this service does not impose any requirements.
- Profiles utilizing this Service may impose security requirements beyond those defined in Table 2.1 for all characteristics defined in Table 2.1.
- Properties not listed as mandatory (M) or optional (O) are excluded.

2.3 Overview of mapping between USB HID and HID Service

This specification maps features from the USB HID Specification [2] onto GATT characteristics and characteristic descriptors, and the GATT sub-procedures used to access them. Figure 2.1 shows the main characteristics used to provide this mapping for HID Devices transferring data while operating in Report Protocol Mode (Section 2.4.1.1):

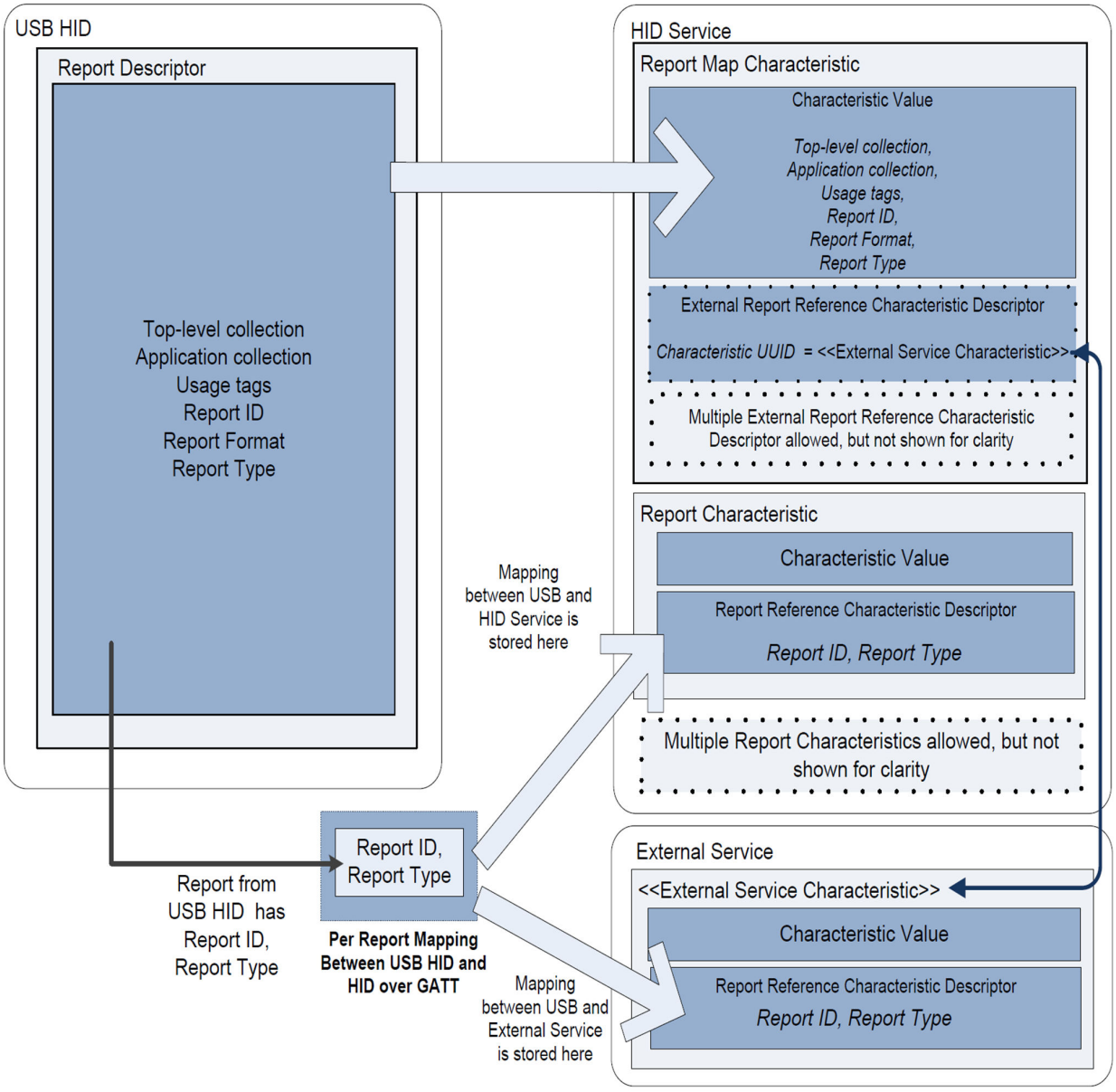

Figure 2.1: Mapping between USB HID features and HID Service characteristics: Report Protocol Mode

The “Report Descriptor” is defined in the USB HID Specification [2] and its contents map to the HID Service Report Map characteristic value (Section 2.6). The External Report Reference characteristic descriptor (Section 2.6.3.1) is used to provide further information to the HID Host for non-HID Service characteristics whose values are described in the Report Map characteristic value.

Data transfers are carried in “Reports” in USB HID; these “Reports” are differentiated by their Report ID and Report Type. The HID Service Report characteristic is used to transfer HID Service data. The Report Reference characteristic descriptor (Section 2.5) is used to provide Report ID and Report Type.

There are three different types of data transfers (Report Types):

1. Input Reports (control data from HID Device to HID Host such as a keypress). Input Reports are normally sent from the HID Device to the HID Host, however there are occasions where a HID Host may set the value of an Input Report on a HID Device.
2. Output Reports (control data from HID Host to HID Device such as an 'LED on' signal). Output Reports are normally sent from the HID Host to the HID Device; however there are occasions where a HID Host may read the value of an Output Report back from the HID Device.
3. Feature Reports (configuration or application-specific data in either direction).

The USB HID Specification [2] also defines an operating mode for HID Devices, Boot Protocol Mode, with data transfers of fixed format and length. Since their format and lengths are fixed, they are not required to be included within the Report Descriptor hence they are not defined within the Report Map characteristic; separate characteristics are used for Boot Protocol Mode Report data.

Figure 2.2 shows the mapping between USB HID features and the main HID Service characteristics for HID Devices transferring data while operating in Boot Protocol Mode:

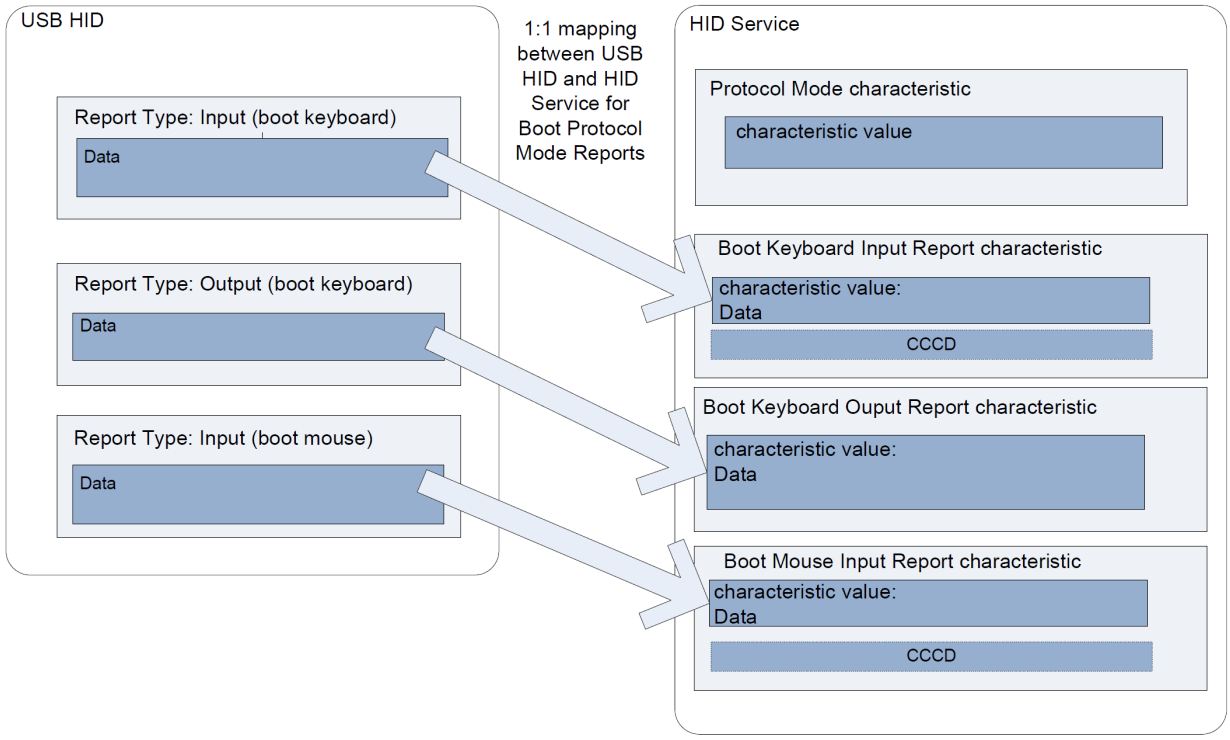

Figure 2.2: Mapping USB HID features and HID Service characteristics: Boot Protocol Mode.

2.4 Protocol Mode characteristic

The Protocol Mode characteristic is used to expose the current protocol mode of the HID Service with which it is associated, or to set the desired protocol mode of the HID Service.

Only a single instance of this characteristic shall exist as part of the HID Service.

2.4.1 Protocol Mode characteristic behavior

The Protocol Mode characteristic contains the current protocol mode of the HID Service.

The Protocol Mode characteristic value can be read using either the GATT Read Characteristic Value or Read Using Characteristic UUID sub-procedures and is written using the GATT Write Without Response sub-procedure.

2.4.1.1 Protocol Mode characteristic value

The Protocol Mode characteristic value can have the values shown in Table 2.2 representing the current Protocol Mode of the HID Service.

Value	Protocol Mode	Comments
0x00	Boot Protocol Mode	A HID Service shall only enter Boot Protocol Mode after this value has been written.
0x01	Report Protocol Mode	Default Protocol Mode of all HID Devices.
0x02 – 0xFF	N/A	Reserved for Future Use.

Table 2.2: Protocol Mode characteristic value

The Protocol Mode characteristic value shall be reset to the default value following connection establishment.

A write to the Protocol Mode characteristic is analogous to sending the “Set Protocol” request defined in the USB HID Specification [2].

A read of the Protocol Mode characteristic is analogous to sending the “Get Protocol” request defined in the USB HID Specification [2].

2.5 Report characteristic

Table 2.3 shows the *Report* characteristic declaration

Attribute Handle	Attribute Type	Attribute Value			Attribute Permissions
0xNNNN	0xuuuu – UUID for ‹‹Characteristic››	Characteristic Properties	Characteristic Value Attribute Handle	Characteristic UUID for ‹‹Report››	Read Only, No Authentication, No Authorization

Table 2.3: Report characteristic declaration

The characteristic properties of the Report characteristic are dependent on the Report Type the data contained in the characteristic value refers to, and are shown in Table 2.4.

Report Type	Requirement	Read	Write	Write Without Response	Notify
Input Report	C.1	M	O	E	M
Output Report	C.1	M	M	M	E
Feature Report	C.1	M	M	E	E
C.1: Mandatory to support at least one Report Type if the Report characteristic is supported.					

Table 2.4: Report characteristic properties

Requirements marked with 'M' are mandatory, 'O' are optional and 'E' are excluded (not permitted).

2.5.1 Report characteristic behavior

The Report characteristic is used to exchange data between a HID Device and a HID Host.

Note: The USB HID Specification [2] defines a Control endpoint and an Interrupt endpoint. Low-latency data transfers are carried via the Interrupt endpoint and less time-critical requests/responses are carried via the Control endpoint. A single fixed L2CAP channel exists for GATT, thus different GATT characteristic properties are used to map different functions, as shown in Table 2.5:

Report Type	Read	Write	Write Without Response	Notify
Input Report	Get_Report (Input) (Section 7.2.1 [2])	Set_Report (Output) (Section 7.2.2 [2])	–	Data Input (Section 4.4 [2])
Output Report	Get_Report (Output) (Section 7.2.1 [2])	Set_Report (Output) (Section 7.2.2 [2])	Data Output (Section 4.4 [2])	–
Feature Report	Get_Report (Feature) (Section 7.2.1 [2])	Set_Report (Feature) (Section 7.2.2 [2])	–	–

Table 2.5: Function mapping between USB HID and HID Service Report characteristic properties

The GATT Read Characteristic Value or Read Long Characteristic Value sub-procedures are used to read a Report characteristic containing Input Report data. This procedure maps to a Get_Report (Input) request in USB HID [2].

The GATT Write Characteristic Value sub-procedure is used to write to a Report characteristic containing Input Report data. This procedure maps to a Set_Report (Input) request in USB HID [2].

For all Report characteristics containing Input Report data, a Client Characteristic Configuration descriptor shall exist and, if the Client Characteristic Configuration descriptor is configured for notifications, the HID Device shall notify the HID Host when the characteristic value changes, using the GATT Notification sub-procedure. This procedure maps to Data Input in USB HID [2].

Note: Notification of characteristic values can contain at most [ATT_MTU-3] bytes of data by definition (see [3], Volume 3, Part F, Section 3.4.7.1). Data beyond [ATT_MTU-3] bytes long is not included in a notification, and must instead be read using the GATT Read Long Characteristic Value sub-procedure. The possibility that data to be notified in a Report characteristic value could change before the HID Host completed an outstanding Read Long Characteristic Value sub-procedure, and therefore be lost, exists. For this reason it is strongly recommended that HID Devices support an ATT_MTU large enough to transfer their largest possible Report characteristic value in a single transaction.

No Client Characteristic Configuration descriptor shall exist for a Report characteristic containing Output Report data or Feature Report data.

The GATT Read Characteristic Value or Read Long Characteristic Value sub-procedures are used to read a Report characteristic containing Output Report data. This procedure maps to a Get_Report (Output) request in USB HID [2].

The GATT Write Characteristic Value sub-procedure is used to write to a Report characteristic containing Output Report data. This procedure maps to a Set_Report (Output) request in USB HID [2]. The GATT Write Without Response sub-procedure is also used to write to a Report characteristic containing Output Report data, and this procedure maps to Data Output in USB HID [2].

The GATT Read Characteristic Value or Read Long Characteristic Value sub-procedures are used to read a Report characteristic containing Feature Report data. This procedure maps to a Get_Report (Feature) request in USB HID [2].

The GATT Write Characteristic Value sub-procedure is used to write to a Report characteristic containing Feature Report data. This procedure maps to a Set_Report (Feature) request in USB HID [2].

2.5.2 Report characteristic value

The Report characteristic value contains Input Report, Output Report, or Feature Report data to be transferred between the HID Device and HID Host.

2.5.3 Report characteristic descriptors

2.5.3.1 Client Characteristic Configuration descriptor

A Client Characteristic Configuration descriptor shall be included in each Report characteristic definition where the data contained in the Report characteristic value refers to an Input Report.

2.5.3.2 Report Reference Characteristic descriptor

The Report Reference characteristic descriptor is used to provide the Report ID and Report Type for the Report characteristic value.

Table 2.6 shows the declaration of the Report Reference characteristic descriptor.

Attribute Handle	Attribute Type	Attribute Value	Attribute Permissions
0xNNNN	0xuuuu – 16 bit Bluetooth UUID for ‹‹Report Reference››	Report Reference	Read only, No Authentication, No Authorization

Table 2.6: Report Reference characteristic descriptor declaration

Table 2.7 shows the definition of the Report Reference characteristic descriptor Attribute Value field:

Name	Size	Value
Report ID	1 octet	0x00 – 0xFF
Report Type	1 octet	0x00: Prohibited. 0x01: Input Report 0x02: Output Report 0x03: Feature Report 0x04 – 0xFF: Reserved for Future Use.

Table 2.7: Report Reference attributes value

The Report Type shall be set to indicate the type of Report characteristic value and set to the appropriate value defined in Table 2.7 for Input, Output, or Feature Report.

Report ID shall be nonzero in a Report Reference characteristic descriptor where there is more than one instance of the Report characteristic for any given Report Type.

HID Devices shall have a Report Reference characteristic descriptor in each Report characteristic definition for Report Protocol Mode.

2.6 Report Map characteristic

The Report Map characteristic is used to define formatting information for Input Report, Output Report, and Feature Report data transferred between a HID Device and HID Host. It also contains information on how this data can be used regarding physical aspects of the device (i.e., that the device functions as a keyboard, for example, or has multiple functions such as a keyboard and volume controls).

Only a single instance of this characteristic shall exist as part of a HID Service.

2.6.1 Report Map characteristic behavior

The GATT Read Characteristic Value or Read Long Characteristic Values sub-procedures are used to read the Report Map characteristic value.

The length of the Report Map characteristic value is limited to 512 octets.

2.6.2 Report Map characteristic value

Per Section 2.3, the Report Map characteristic value contains formatting and other information for Input Report, Output Report and Feature Report data transferred between a HID Device and HID Host.

2.6.3 Report Map characteristic descriptors

2.6.3.1 External Report Reference characteristic descriptor

The External Report Reference characteristic descriptor allows a HID Host to map information from the Report Map characteristic value for Input Report, Output Report or Feature Report data to the Characteristic UUID of external service characteristics used to transfer the associated data.

Table 2.8 shows the declaration of the External Report Reference characteristic descriptor.

Attribute Handle	Attribute Type	Attribute Value	Attribute Permissions
0xNNNN	0xuuuu – 16 bit Bluetooth UUID for ‹‹External Report Reference››	External Report Reference	Read only, No Authentication, No Authorization

Table 2.8: External Report Reference characteristic descriptor declaration

Table 2.9 shows the definition of the External Report Reference characteristic descriptor Attribute Value field:

Field	Size	Value
Characteristic UUID	2 octets	Characteristic UUID for externally referenced characteristic

Table 2.9: External Report Reference characteristic descriptor attribute value

The Characteristic UUID field is used to identify characteristics within external services that the HID Device uses to send the data to the HID host.

2.7 Boot Keyboard Input Report characteristic

Note: A HID Device operating in Boot Protocol Mode as a keyboard is referred to as a “boot keyboard.”

Table 2.10 shows the Boot Keyboard Input Report characteristic declaration.

Attribute Handle	Attribute Type	Attribute Value			Attribute Permissions
0xNNNN	0xuuuu – UUID for ‹‹Characteristic››	Characteristic Properties	Characteristic Value Attribute Handle	Characteristic UUID for ‹‹Boot Keyboard Input Report››	Read Only, No Authentication, No Authorization

Table 2.10: Boot Keyboard Input Report characteristic declaration

The Boot Keyboard Input Report characteristic is used to transfer fixed format and length Input Report data between a HID Host operating in Boot Protocol Mode and a HID Service corresponding to a boot keyboard.

Table 2.11 shows the characteristic properties of the Boot Keyboard Input Report characteristic.

Report Type	Read	Write	Write Without Response	Notify
Input Report	M	O	E	M

Table 2.11: Boot Keyboard Input Report characteristic properties

A single instance of this characteristic shall exist within a HID Service for a boot keyboard.

2.7.1 Boot Keyboard Input Report characteristic behavior

The Boot Keyboard Input Report characteristic value can be read using the GATT Read Using Characteristic UUID or Read Characteristic Value sub-procedures, written using the GATT Write Characteristic Value sub-procedure, and notified using the GATT Notification sub-procedure.

2.7.2 Boot Keyboard Input Report characteristic value

The Boot Keyboard Input Report characteristic value is an array of octets whose meaning is defined in the USB HID Usage Tables [1].

2.7.3 Boot Keyboard Input Report characteristic descriptors

2.7.3.1 Client Characteristic Configuration descriptor

A Client Characteristic Configuration descriptor shall exist for the Boot Keyboard Input Report characteristic and, if configured for notifications, the Boot Keyboard Input Report characteristic value shall send notifications to the HID Host when the characteristic value changes.

2.8 Boot Keyboard Output Report characteristic

Note: A HID Device operating in Boot Protocol Mode as a keyboard is referred to as a “boot keyboard.”

Table 2.12 shows the Boot Keyboard Output Report characteristic declaration.

Attribute Handle	Attribute Type	Attribute Value			Attribute Permissions
0xNNNN	0xuuuu – UUID for ‹‹Characteristic››	Characteristic Properties	Characteristic Value Attribute Handle	Characteristic UUID for ‹‹Boot Keyboard Output Report››	Read Only, No Authentication, No Authorization

Table 2.12: Boot Keyboard Output Report characteristic declaration

The Boot Keyboard Output Report characteristic is used to transfer fixed format and length Output Report data between a HID Host operating in Boot Protocol Mode and a HID Service corresponding to a boot keyboard.

Table 2.13 shows the characteristic properties of the Boot Keyboard Output Report characteristic.

Report Type	Read	Write	Write Without Response	Notify
OutputReport	M	M	M	E

Table 2.13: Boot Keyboard Output Report characteristic properties

A single instance of this characteristic shall exist within a HID Service definition for a boot keyboard.

2.8.1 Boot Keyboard Output Report characteristic behavior

The Boot Keyboard Output Report characteristic value can be written using the GATT Write Characteristic Value or Write Without Response sub-procedures and read using either the GATT Read using Characteristic UUID or GATT Read Characteristic Value sub-procedures.

2.8.2 Boot Keyboard Output Report characteristic value

The Boot Keyboard Output Report characteristic value is an array of octets whose meaning is defined in the USB HID Usage Tables [1].

2.9 Boot Mouse Input Report characteristic

Note: A HID Device operating in Boot Protocol Mode as a mouse is referred to as a “boot mouse.”

Table 2.14 shows the Boot Mouse Input Report characteristic declaration.

Attribute Handle	Attribute Type	Attribute Value			Attribute Permissions
0xNNNN	0xuuuu – UUID for ‹‹Characteristic››	Characteristic Properties	Characteristic Value Attribute Handle	Characteristic UUID for ‹‹Boot Mouse Input Report››	Read Only, No Authentication, No Authorization

Table 2.14: Boot Mouse Input Report characteristic declaration

The Boot Mouse Input Report characteristic is used to transfer fixed format and length Input Report data between a HID Host operating in Boot Protocol Mode and a HID Service corresponding to a boot mouse.

Table 2.15 shows the characteristic properties of the Boot Mouse Input Report characteristic.

Report Type	Read	Write	Write Without Response	Notify
Input Report	M	O	E	M

Table 2.15: Boot Mouse Input Report characteristic properties

A single instance of this characteristic shall exist within a HID Service definition for a boot mouse.

2.9.1 Boot Mouse Input Report characteristic behavior

The Boot Mouse Input Report characteristic value can be read using the GATT Read Using Characteristic UUID or Read Characteristic Value sub-procedures, written using the GATT Write Characteristic Value sub-procedure, and notified using the GATT Notification sub-procedure.

2.9.2 Boot Mouse Input Report characteristic value

The Boot Mouse Input Report characteristic value is an array of octets whose meaning is defined in the USB HID Usage Tables [1].

2.9.3 Boot Mouse Input Report characteristic descriptors

2.9.3.1 Client Characteristic Configuration descriptor

A Client Characteristic Configuration descriptor shall exist for the Boot Mouse Input Report characteristic and, if configured for notifications, the Boot Mouse Input Report characteristic value shall send notifications to the HID Host when the characteristic value changes.

2.10 HID Information characteristic

The *HID Information* characteristic is used to hold a set of values known as the HID Device's HID Attributes. The HID Information characteristic is also used to hold flags that expose optional features of the HID Device.

Only a single instance of this characteristic shall exist as part of the HID Service.

Because the HID Information characteristic exposes properties of the HID Device, all instances of the HID Information characteristic in all HID services on the HID Device must contain the same values.

2.10.1 HID Information characteristic behavior

The GATT Read Characteristic Value sub-procedure is used to read the HID Information characteristic value from the HID Device.

2.10.2 HID Information characteristic value

The HID Information characteristic value contains a set of values which correspond to the HID Device's HID Attributes. The HID Information characteristic value is static and may be cached for the lifetime of a bond between the HID Device and the HID Host.

Table 2.16 shows the layout of the HID Information characteristic value field.

HID Attribute	Size	Description	Reference
bcdHID	2 octets	16-bit unsigned integer representing version number of base USB HID Specification implemented by HID Device	See Section 6.1.1 [2]
bCountryCode	1 octet	8-bit integer identifying country HID Device hardware is localized for. Most hardware is not localized (value 0x00)	See Section 6.2.1 [2]
Flags	1 octet	Bit 0: RemoteWake - Boolean value indicating whether HID Device is capable of sending a wake-signal to a HID Host. 0bXXXXXXX0 = FALSE 0bXXXXXXX1 = TRUE	See Section 7.11.10 [5]
		Bit 1: NormallyConnectable - Boolean value indicating whether HID Device will be advertising when bonded but not connected. 0bXXXXXX0X = FALSE 0bXXXXXX1X = TRUE	See Section 7.11.14 [5]
		Bit 2: SCI Supported - Boolean value indicating whether HID Device supports the HID SCI feature. 0bXXXXX0XX = FALSE 0bXXXXX1XX = TRUE	See Section 3
		Bit 3: SCI Low Power mode supported - Boolean value indicating whether HID Device supports the low power mode. 0bXXXX0XXX = FALSE 0bXXXX1XXX = TRUE	See Section 3

Table 2.16: HID Information characteristic value field

2.11 HID Control Point characteristic

The HID Control Point characteristic is a control-point attribute that defines the following HID Commands when written:

- Suspend (Section 7.4.2, Human Interface Device Profile [5])
- Exit Suspend (Section 7.4.2, Human Interface Device Profile [5])
- Enable SCI Default mode
- Enable SCI Fast mode
- Enable SCI Low Power mode
- Enable SCI Full Range mode

Only a single instance of this characteristic shall exist as part of the HID Service.

Because the HID Control Point characteristic provides control mechanisms for the HID Device, the behavior of HID Commands sent to a HID Control Point characteristic shall be the same regardless of which instance of the HID Service is associated with the HID Control Point.

2.11.1 HID Control Point characteristic behavior

The GATT Write Without Response sub-procedure is used to write to the HID Control Point characteristic.

2.11.2 HID Control Point characteristic value

The HID Control Point characteristic value contains an enumeration of values as shown in Table 2.17.

Value	Command	Description
0x00	Suspend	Informs HID Device that HID Host is entering the Suspend State (as defined in Section 7.4.2, HID Profile Specification [5])
0x01	Exit Suspend	Informs HID Device that HID Host is exiting the Suspend State (as defined in Section 7.4.2, HID Profile Specification [5])
0x02	Enable SCI Default mode	Configures the HID Device that the HID Host is requesting to activate and use HID SCI Default mode
0x03	Enable SCI Fast mode	Configures the HID Device that the HID Host is requesting to activate and use HID SCI Fast mode
0x04	Enable SCI Low Power mode	Configures the HID Device that the HID Host is requesting to activate and use HID SCI Low Power mode

Value	Command	Description
0x05	Enable SCI Full Range mode	Configures the HID Device that the HID Host is requesting to activate and use HID SCI Full Range mode
0x06 – 0xFF	N/A	Reserved for Future Use.

Table 2.17: HID Control Point characteristic value field

There are no response codes defined for any of the commands in the HID Control Point characteristic. The HID Device may send a notification with the new value of the HID SCI Mode characteristic as a response to a HID Control Point command. The HID SCI Mode value change notification is sent by the HID Device if HID SCI Mode notifications are configured and the HID SCI mode changes successfully (see Section 2.12).

2.12 HID SCI Information characteristic

The HID SCI Information characteristic is used to hold a set of values known as the HID Device's HID SCI attributes.

Only a single instance of the HID SCI Information characteristic shall exist as part of the HID Service.

All instances of the HID SCI Information characteristic in all instances of the HID Service on the HID Device shall contain the same values.

2.12.1 HID SCI Information characteristic behavior

The GATT Read Characteristic Value or Read Long Characteristic Values sub-procedures are used to read the HID SCI Information characteristic value.

2.12.2 HID SCI Information characteristic value

The HID SCI Information characteristic value contains a set of values, which correspond to the HID Device's HID SCI attribute. The HID SCI Information characteristic value is static and can be cached by the HID Host for the lifetime of a bond between the HID Device and the HID Host.

The HID Device returns ranges of rounded connInterval values (RCV) and extended connInterval values (ECV) in groups. The format of the HID SCI Information characteristic is shown in Table 2.18.

Each field of the HID SCI Information characteristic has the same definition as the corresponding return parameter of the LE Read Minimum Supported Connection Interval command. See Volume 4, Part E, Section 7.8.156 of [3]. The HID Device may change the list of values to correspond to the latency requirements of the HID Device.

Field	Data Type	Size (in octets)	Description
Minimum Supported Connection Interval	uint8	1	Minimum supported value for the connection interval Unit: 125 µs Range: 0x03 to 0x3C (Time Range: 375 µs to 7.5 ms)
Num Groups	uint8	1	Number of groups of connection interval ranges Range 0x00 to 0xFF
Group Min[i]	uint16	2	Minimum supported connection interval in this group. Unit: 125 µs Range: 0x0003 to 0x7D00 (Time range: 375 µs to 4 s)
Group Max[i]	uint16	2	Maximum supported connection interval in this group. Unit: 125 µs Range: 0x0003 to 0x7D00 (Time range: 375 µs to 4 s)
Group Stride[i]	uint16	2	The connection interval resolution in this group. Unit: 125 µs Range: 0x0001 to 0x7D00 (Time range: 125 µs to 4 s)

Table 2.18: HID SCI Information characteristic

2.13 HID SCI Mode characteristic

The HID SCI Mode characteristic is used to hold the value representing the SCI Mode being used by the HID Device. The HID SCI Mode characteristic allows the HID Host to determine the HID SCI mode and to be notified of HID SCI mode changes from the HID Device.

Only a single instance of the HID SCI Mode characteristic shall exist as part of the HID Service.

All instances of the HID SCI Mode characteristic in all instances of the HID Service on the HID Device shall contain the same values.

2.13.1 HID SCI Mode characteristic behavior

The GATT Read Characteristic Value sub-procedure is used to read the HID SCI Mode characteristic value from the HID Device.

If the Client Characteristic Configuration descriptor is configured for notifications, then the HID Device shall notify the HID Host when the characteristic value changes using the GATT Notification sub-procedure.

2.13.2 HID SCI Mode characteristic value

The HID SCI Mode characteristic value shall have one of the values shown in Table 2.19. This value shall represent the HID SCI Mode being used by the HID Device.

Value	HID SCI Mode
0x00	None
0x01	Reserved for Future Use
0x02	SCI Default mode
0x03	SCI Fast mode
0x04	SCI Low Power mode
0x05	SCI Full Range mode
0x06-0xFF	Reserved for Future Use

Table 2.19: HID SCI Mode characteristic value field

The HID SCI Mode characteristic value shall be set to None following connection establishment. This value indicates that HID SCI is not being used.

When the HID SCI mode being used by the device changes, the HID SCI Mode characteristic value shall change to the value representing the new HID SCI mode being used. The new value change shall occur after the HID SCI mode change between the HID Host and HID Device completes successfully. If the HID SCI mode change cannot be completed successfully, then the HID SCI Mode characteristic value shall not change.

See Section 3 for a detailed description of each HID SCI Mode.

2.13.3 HID SCI Mode characteristic descriptors

2.13.3.1 Client Characteristic Configuration descriptor

A Client Characteristic Configuration descriptor shall exist for the HID SCI Mode characteristic to enable the activation of notifications.

3 SCI feature

This section describes the SCI feature, which allows the connection intervals to be shorter than 7.5 ms. The SCI feature introduces the HID SCI Mode characteristic that allows a HID Host to read the HID SCI mode and to be notified of HID SCI mode changes of the HID Device. In addition, the SCI feature introduces an optional Low Power mode. The SCI feature only applies to LE ACL connections.

The SCI feature adds the HID SCI Information characteristic for exposing supported connection intervals of the HID Device. The SCI feature also modifies the HID Information characteristic to add two new feature bits.

The SCI feature introduces the following HID SCI modes to control the HID Device:

- SCI Default mode – A mode with a latency similar to that of HID devices with a connection interval of 7.5 ms or longer
- SCI Fast mode - A mode that enables lower latency on a HID Device by reducing the connection interval below 7.5 ms
- SCI Low Power mode – An optional mode that enables low power on a HID Device
- SCI Full range mode – A mode that enables the HID Device to accept the broadest possible configuration from the shortest to the longest connection interval

The HID Control Point characteristic value is used by a HID Host to control the connection parameters of the HID Device by selecting one of four HID SCI modes. For each HID SCI mode, there is a set of Link Layer parameters that shall be applied:

- Connection Interval min and Connection Interval max
- Peripheral latency
- Subrate min and Subrate max
- Continuation number

The values of the connection parameters of the HID Device, for each HID SCI mode, may be defined in a higher-level profile.

The HID Device implementing the SCI feature may implement the HCI command, HCI_LE_Connection_Rate_Request (see Volume 4, Part E, Section 7.8.154 of [3] for the HCI command). The values of the connection parameters for each HID SCI mode may be defined in a higher-level profile.

If the HID Device supports HID SCI modes, then the HID Device shall set the SCI Supported bit to 1 in the HID Information characteristic value. For details, see Section 2.10.2. The HID Device shall also implement the SCI Default mode, SCI Fast mode, and SCI Full range mode.

If the HID Device supports the SCI Low Power mode, then the HID Device shall set the SCI Low Power mode supported bit in the HID Information characteristic value. For details, see Section 2.10.2.

4 Acronyms and abbreviations

Acronyms and Abbreviations	Meaning
ACL	Asynchronous Connection-oriented [logical transport]
BR/EDR	Basic Rate / Enhanced Data Rate
ECV	Extended connInterval values
GAP	Generic Access Profile
GATT	Generic Attribute Profile
HID	Human Interface Device
LE	Low Energy
RCV	Rounded connInterval values
SCI	Shorter Connection Intervals
UUID	Universally Unique Identifier
USB	Universal Serial Bus

Table 4.1: Acronyms and abbreviations

5 References

It is recommended to use the latest version of the Core Specification.

[1] USB Implementers Forum, Inc. (USB-IF), "Universal Serial Bus (USB) HID Usage Tables", January 2026, https://usb.org/document-library/hid-usage-tables-17

[2] USB Implementers Forum, Inc. (USB-IF), "Device Class Definition for Human Interface Devices (USB HID Specification), Version 1.11", May 2001, https://www.usb.org/document-library/device-class-definition-hid-111

[3] Bluetooth Core Specification, Version 6.2 or later

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

[5] Human Interface Device Profile, Version 1.1.2 or later

Appendix A. Example GATT database

Table A.1 shows a sample GATT database.

Attribute Handle	Attribute Type	Type Note	Attribute Value
0x0100	«Primary Service»	Declaration	«HID Service»
0x0101	«Include»	Declaration	“Battery Service”
0x0102	«Characteristic»	Declaration	r, «HID Information»
0x0103	«HID Information»	Value	(HID Attributes)
0x0104	«Characteristic»	Declaration	rwn, «Boot Keyboard Input Report»
0x0105	«Boot Keyboard Input Report»	Value	(boot keyboard input values)
0x0106	«Client Characteristic Configuration Descriptor»	Descriptor	0x0000
0x0107	«Characteristic»	Declaration	rwwrw, «Boot Keyboard Output Report»
0x0108	«Boot Keyboard Output Report»	Value	(boot keyboard output values)
0x0109	«Characteristic»	Declaration	r, «Report Map»
0x010A	«Report Map»	Value	HID Report Descriptor for this Device
0x010B	«External Report Reference»	Descriptor	r, «Battery Level»
0x0120	«Characteristic»	Declaration	rwn, 0x0121, «Report»
0x0121	«Report»	Value	(report protocol keyboard)
0x0122	«Client Characteristic Configuration Descriptor»	Descriptor	0x0000
0x0123	«Report Reference»	Descriptor	0x02, Input
0x0128	«Characteristic»	Declaration	rwwrw 0x0129, «Report»
0x0129	«Report»	Value	Keyboard LED bitmap
0x0130	«Report Reference»	Descriptor	0x01, Output
0x0131	«Characteristic»	Declaration	rw, 0x0132, «Report»

Attribute Handle	Attribute Type	Type Note	Attribute Value
0x0132	«Report»	Value	(data)
0x0133	«Report Reference»	Descriptor	0x01, Feature
0x0134	«Characteristic»	Declaration	wwr, 0x0135, «HID Control Point»
0x0135	«HID Control Point»	Value	(mode)
0x0138	«Characteristic»	Declaration	rwwr, «Protocol Mode»
0x0139	«Protocol Mode»	Value	(current protocol mode)
0x0140	«Primary Service»	Declaration	«Battery Service»
0x0141	«Characteristic»	Declaration	rn, 0x0142, «Battery Level»
0x0142	«Battery Level»	Value	(level)
0x0143	«Report Reference»	Descriptor	0x03, Input

Table A.1: A GATT database