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BODY COMPOSITION SERVICE

Abstract:

This service exposes data related to body composition from a body composition analyzer intended for consumer healthcare and sports/fitness applications.

Revision History

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The word *shall* is used to indicate mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).

The use of the word *must* is deprecated and shall not be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

The use of the word *will* is deprecated and shall not be used when stating mandatory requirements; *will* is only used in statements of fact.

The word *should* is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is deprecated but not prohibited (*should* equals *is recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted*).

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The term *Reserved for Future Use (RFU)* is used to indicate Bluetooth SIG assigned values that are reserved by the Bluetooth SIG and are not otherwise available for use by implementations.

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1 Introduction

The Body Composition Service (BCS) exposes data related to body composition from a body composition analyzer (Server) intended for consumer healthcare as well as sports/fitness applications.

1.1 Conformance

If a device claims conformance to this service, all capabilities indicated as mandatory for this service shall be supported in the specified manner (process-mandatory). This also applies to all optional and conditional capabilities for which support is indicated. All mandatory capabilities, and optional and conditional capabilities for which support is indicated, are subject to verification as part of the Bluetooth qualification program.

1.2 Service Dependency

This service is not dependent upon any other services.

1.3 Bluetooth Specification Release Compatibility

This specification is compatible with Bluetooth Core Specification 4.0 or later version of the Core Specification [1].

1.4 GATT Sub-Procedure Requirements

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

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

GATT Sub-Procedure	Requirements
Indications	M
Read Characteristic Descriptors	M
Write Characteristic Descriptors	M

Table 1.1: GATT Sub-procedure Requirements

There are no transport restrictions imposed by this service specification.

Where the term BR/EDR is used throughout this document, this also includes the optional use of AMP.

1.5 Error Codes

This service does not define any Attribute Protocol Application Error codes.

1.6 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 [2].

2 Service Declaration

In most cases, the Body Composition Service should be instantiated as a «Primary Service»; however this is defined in an higher level specification.

The service UUID shall be set to «Body Composition» defined in [\[2\]](#).

3 Service Characteristics

The following characteristics are exposed in the Body Composition Service. Only one instance of each characteristic is permitted within this service. The characteristic formats and UUIDs are defined in [2].

Where a characteristic can be indicated, a Client Characteristic Configuration descriptor shall be included in that characteristic as required by the Core Specification [1].

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
Body Composition Feature	M	Read		None
Body Composition Measurement	M	Indicate		None

Table 3.1: Body Composition Service Characteristics

Notes:

- Properties not listed as Mandatory or Optional are excluded for this version of this service
- Security Permissions of “None” means that this service does not impose any requirements

3.1 Body Composition Feature

The Body Composition Feature characteristic shall be used to describe the supported features of the Server.

Reserved for Future Use (RFU) bits in the Body Composition Feature characteristic value shall be set to 0.

3.1.1 Characteristic Behavior

When read, the Body Composition Feature characteristic returns a value that is used by a Client to determine the supported features of the Server.

The bits of the Body Composition Feature characteristic may either be static for the lifetime of the device (i.e., static permanently or until Service Changed is indicated) or guaranteed to be static only during a connection. This requirement is defined in the table below on a bit-by-bit basis. Although all defined bits in this version of this specification are required to be static during the lifetime of a device, it is possible that some future bits will be defined as being static only during a connection.

Bit	Body Composition Feature Bit	Static Requirement
0 to 17	Various	Lifetime
18-31	Reserved for Future Use	Not defined.

Table 3.2: Static Requirements for Body Composition Feature Bits

When the Server supports a feature, the associated bit of the Body Composition Feature characteristic shall be set to 1 (Feature supported), otherwise, the associated bit shall be set to 0 (Feature not supported). The feature bits are defined in [2].

If the Height field of the Body Composition Measurement characteristic is not supported, then the corresponding resolution bits shall be set to 0.

3.2 Body Composition Measurement

The Body Composition Measurement characteristic is used to send body composition-related data to the Client. Included in the characteristic value are a Flags field (for showing the presence of optional fields and measurement units), a Body Fat Percentage field, and depending upon the contents of the Flags field, may include one or more optional fields defined in [2].

3.2.1 Characteristic Behavior

When the Body Composition Measurement characteristic is configured for indications via the *Client Characteristic Configuration* descriptor, the following applies:

If a connection to a Client is not established and a new value for the Body Composition Measurement characteristic becomes available for this Client, the Server shall become connectable to allow the Client to create a link. Once connected, the Server shall indicate this characteristic and other unsent stored characteristics to the Client.

If a connection to a Client is established and a new value for the Body Composition Measurement characteristic becomes available for this Client, the Server shall indicate this characteristic to the Client.

For LE, not all the fields of this characteristic can be indicated simultaneously if using a default MTU size. If the required data exceeds the current MTU size, the remaining optional fields shall be sent in the subsequent indication (also known as a ‘continuation packet’) and shall not include the Time Stamp field or the User ID field. Where the measurement is required to be split across two separate packets, the Multiple Packet Measurement bit in the Flags field of **both packets** shall be set to 1.

For BR/EDR, this restriction does not exist due to a larger MTU size.

Once transfer of a measurement is successful, the measurement shall not be retransmitted. As such, the design of this Service is only suited to sending indications to a single Client for a given user.

The Body Composition Measurement characteristic contains time-sensitive data, thus the requirements for time-sensitive data and data storage defined in Section 3.3 apply.

3.2.1.1 Flags Field

The Flags field shall be included in the Body Composition Measurement characteristic.

Reserved for Future Use (RFU) bits in the Flags fields shall be set to 0.

The bits of the Flags field, their function, and relationship to bits in the Body Composition Feature characteristic are shown in Table 3.3.

Flags Bit Name	When Set to 0	When Set to 1	Corresponding Body Composition Feature Support bit (see Section 3.1)
Measurement Units (bit 0)	SI (Weight and Mass in units of kilogram (kg) and Height in units of	Imperial (Weight and Mass in units of pound (lb) and Height in units of	Mass Measurement Resolution bits (11-14) and Height Measurement Resolution bits (15-17)

Body Composition Service

	meter)	inch (in))	
Time Stamp Present (bit 1), see Section 3.2.1.3	Corresponding field not present	Corresponding field present	Time Stamp Supported (bit 0)
User ID Present (bit 2), see Section 3.2.1.4	Corresponding field not present	Corresponding field present	Multiple Users Supported (bit 1)
Basal Metabolism Present (bit 3), see Section 3.2.1.5	Corresponding field not present	Corresponding field present	Basal Metabolism Supported (bit 2)
Muscle Percentage Present (bit 4), see Section 3.2.1.6	Corresponding field not present	Corresponding field present	Muscle Percentage Supported (bit 3)
Muscle Mass Present (bit 5), see Section 3.2.1.7	Corresponding field not present	Corresponding field present	Muscle Mass Supported (bit 4)
Fat Free Mass Present (bit 6), see Section 3.2.1.8	Corresponding field not present	Corresponding field present	Fat Free Mass Supported (bit 5)
Soft Lean Mass Present (bit 7), see Section 3.2.1.9	Corresponding field not present	Corresponding field present	Soft Lean Mass Supported (bit 6)
Body Water Mass Present (bit 8), see Section 3.2.1.10	Corresponding field not present	Corresponding field present	Body Water Mass Supported (bit 7)
Impedance Present (bit 9), see Section 3.2.1.11	Corresponding field not present	Corresponding field present	Impedance Supported (bit 8)
Weight Present (bit 10), see Section 3.2.1.12	Corresponding field not present	Corresponding field present	Weight Supported (bit 9)
Height Present (bit 11), see Section 3.2.1.13	Corresponding field not present	Corresponding field present	Height Supported (bit 10)
Multiple Packet Measurement (bit 12)	Measurement contained in single packet	Measurement split across two consecutive packets	None

Table 3.3: Bit Definitions for the Body Composition Measurement Characteristic

The term ‘mass’ refers collectively to the following fields: Muscle Mass, Fat Free Mass, Soft Lean Mass, Body Water Mass.

Flags bits in the table above, other than the Time Stamp Present bit and User ID Present bit, may change during a connection if the corresponding support bit in the Body Composition Feature characteristic is set to 1, indicating that the feature is supported. However, if the corresponding Body Composition Feature support bit is set to 0, then the corresponding Flags bit shall also be set to 0 since the feature is not supported.

The Mass Measurement Resolution bits are only for the purpose of allowing the Client to determine the resolution of the Weight and Mass measurements. All supported Weight and Mass fields are assumed to have the same resolution. Similarly, the Height Measurement Resolution bits are only for the purpose of allowing the Client to determine the resolution of the Height measurements. The use of these bits may be required by some Clients that need to know the approximate precision of the data. Note that value of these bits has no impact on the value of 1 bit of the Weight, Mass or Height fields.

3.2.1.2 Body Fat Percentage Field

The Body Fat Percentage field shall be included in the Body Composition Measurement characteristic.

See [Table 3.3](#) for details on the relation between the unit of weight, mass and height, and bit 0 of the Flags field.

The special value of 0xFFFF can be used to indicate ‘Measurement Unsuccessful’ to the Client. If this is used, all optional fields other than the Time Stamp field and the User ID field shall be disabled.

3.2.1.3 Time Stamp Field

The Time Stamp field is optional, but shall be included in the Body Composition Measurement characteristic if the Server supports the Time Stamp feature (see [Table 3.3](#)) with the exception that it shall not be included in continuation packets (see Section [3.2.1](#)). The Time Stamp feature shall be supported if the device supports the storing of data.

The Time Stamp field is defined to use the same format as the Date Time characteristic defined in [\[2\]](#). However, a value of 0 for the year, month or day fields (meaning unknown) shall not be used for this service. It is left to the implementation to ensure the user sets the correct date and time before the Server is used.

The value of the Time Stamp field is derived from a source of date and time within the device at the time of measurement. If the Time Stamp feature is supported, a source of date and time is mandatory. The date and time of the device may be updated by various means such as via a simple user interface on the device, via the Current Time Service [\[3\]](#) or other method. Regardless of the method of updating the date and time, a method should be provided to allow the Client to verify the accuracy of the time base in the Server. This is a requirement for implementations needing to be compliant with guidelines set forth by the Continua Health Alliance (and hence those needing data to be transcoded to a format compliant with IEEE 11073-10420 [\[4\]](#)).

3.2.1.4 User ID Field

The User ID field shall be included in the Body Composition Measurement characteristic if the device supports the Multiple Users feature (see [Table 3.3](#)) with the exception that it shall not be included in continuation packets (see Section [3.2.1](#)). This field shall not be included if the Multiple Users feature is not supported.

The values used for User ID shall be unique per Server, but are otherwise left to the implementation. For example, if the Server supports two User IDs to distinguish between two users, the Server may use User ID 1 and 2 or User ID 35 and 97 or other unique combinations.

A special User ID value of 0xFF represents “unknown user”. This can be used for cases where a Body Composition Analyzer can be used for Guests.

3.2.1.5 Basal Metabolism

The Basal Metabolism field may be included in the Body Composition Measurement characteristic if the device supports the Basal Metabolism feature (see [Table 3.3](#)).

3.2.1.6 Muscle Percentage

The Muscle Percentage field may be included in the Body Composition Measurement characteristic if the device supports the Muscle Percentage feature (see [Table 3.3](#)).

3.2.1.7 Muscle Mass

The Muscle Mass field may be included in the Body Composition Measurement characteristic if the device supports the Muscle Mass feature (see [Table 3.3](#)).

See [Table 3.3](#) for details on the relation between the units of weight and height, and bit 0 of the Flags field.

3.2.1.8 Fat Free Mass

The Fat Free Mass field may be included in the Body Composition Measurement characteristic if the device supports the Fat Free Mass feature (see [Table 3.3](#)).

See [Table 3.3](#) for details on the relation between the units of weight and height, and bit 0 of the Flags field.

3.2.1.9 Soft Lean Mass

The Soft Lean Mass field may be included in the Body Composition Measurement characteristic if the device supports the Soft Lean Mass feature (see [Table 3.3](#)).

See [Table 3.3](#) for details on the relation between the units of weight and height, and bit 0 of the Flags field.

3.2.1.10 Body Water Mass

The Body Water Mass field may be included in the Body Composition Measurement characteristic if the device supports the Body Water Mass feature (see [Table 3.3](#)).

See [Table 3.3](#) for details on the relation between the units of weight and height, and bit 0 of the Flags field.

3.2.1.11 Impedance

The Impedance field may be included in the Body Composition Measurement characteristic if the device supports the Impedance feature (see [Table 3.3](#)).

3.2.1.12 Weight

The Weight field may be included in the Body Composition Measurement characteristic if the device supports the Weight feature (see [Table 3.3](#)).

See [Table 3.3](#) for details on the relation between the units of weight and height, and bit 0 of the Flags field.

3.2.1.13 Height

The Height field may be included in the Body Composition Measurement characteristic if the device supports the Height feature (see [Table 3.3](#)).

See [Table 3.3](#) for details on the relation between the units of weight and height, and bit 0 of the Flags field.

3.3 Requirements for Time-Sensitive Data

The Body Composition Measurement characteristic contains time-sensitive data (i.e., the Body Composition values) and is considered a time-sensitive characteristic, thus the following requirements apply:

If the Time Stamp feature *is not* supported:

- The value of a time-sensitive characteristic shall be discarded either if the connection does not get established or if the indication is not successfully acknowledged by the Client in a timely manner as decided by the implementation (e.g., if the Server cannot send the data within 5 minutes of taking the measurement).

If the Time Stamp feature *is* supported:

- It is recommended that the value of a time-sensitive characteristic be stored if either the connection does not get established or if the indication is not successfully acknowledged by the Client during the connection.
- For basic scenarios, the Server should be able to store at least 25 data measurements (i.e., the Body Composition values). Multi-user devices should be able to store that number of measurements per supported user.
- If the maximum storage capacity in the Server is reached, the Server should overwrite the oldest measurement data first when acquiring new measurement data and should inform the user (e.g., via the UI of the device). For multi-user devices, the Server should purge the oldest data for a given user to make room for the most recent data for that user.
- When transmitting stored data, the oldest data shall be sent first followed by the next oldest data (in FIFO order) until all stored data (as controlled by the Client) has been transferred.

4 SDP Interoperability

If this service is exposed over BR/EDR then it shall have the following SDP record.

Item	Definition	Type	Value	Status
Service Class ID List				M
Service Class #0		UUID	«Body Composition»	M
Protocol Descriptor List				M
Protocol #0		UUID	L2CAP	M
Parameter #0 for Protocol #0	PSM	Uint16	PSM = ATT	M
Protocol #1		UUID	ATT	M
Parameter #0 for Protocol #1	GATT Start Handle	Uint16	First handle of this service in the GATT database	M
Parameter #1 for Protocol #1	GATT End Handle	Uint16	Last handle of this service in the GATT database	M
BrowseGroupList			PublicBrowseRoot*	M

Table 4.1: SDP Record

* PublicBrowseRoot shall be present; however, other browse UUIDs may also be included in the list.

5 Acronyms and Abbreviations

Acronyms and Abbreviations	Meaning
AMP	Alternate MAC/PHY
BCA	Body Composition Analyzer
BR/EDR	Basic Rate / Enhanced Data Rate
GAP	Generic Access Profile
GATT	Generic Attribute Profile
LE	Low Energy
MTU	Maximum Transmission Unit
RFU	Reserved for Future Use
SDP	Service Discovery Protocol
UUID	Universally Unique Identifier

Table 5.1: Acronyms and Abbreviations

6 References

- [1] Bluetooth Core Specification v4.0 or later version of the Core Specification.
- [2] Characteristic and Descriptor descriptions are accessible via the [Bluetooth SIG Assigned Numbers](#).
- [3] Current Time Service Specification v1.1 or later
- [4] IEEE 11073-10420 - 2010 (Health informatics—Personal health device communication - Part 10420: Device specialization— Body Composition Analyzer)