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HEART RATE PROFILE

Abstract:

This profile enables a Collector device to connect and interact with a Heart Rate Sensor for use in fitness applications.

Revision History

Revision	Date	Comments
D09r00	2011-02-18	Initial Draft from Heart Rate UCRDD.
D09r01	2011-03-14	Update to align with latest Thermometer Profile changes.
D09r02	2011-03-23	Incorporated feedback from MED WG reviews.
D09r03	2011-04-01	Incorporated feedback from BARB and MED WG reviews. Incorporated feedback from Bob and Guillaume.
D09r04	2011-04-09	Accepted all changes. Prepared for BARB review. Incorporated BARB and MED WG feedback. Prepared for IOP. Version used at IOP.
D09r05	2011-05-11	Accepted all changes. Prepared for resubmission to BARB. Changes to allow only Single Instance of Service. Limited use to single HR service. Added table 4-1 and section 4.7 as in HTP. Adapted connection procedure from HTP. Mandated encryption for bonded devices.
D09r06	2011-05-11	Accepted all changes. Resubmitted to BARB.
D09r07	2011-05-18	Incorporated feedback from BARB and MED WG reviews. Incorporated recent fixes from HTP reviews.
D09r08	2011-05-20	Incorporated BARB feedback. Version approved by BARB and Board.
D10r00	2011-06-22	Updated to draft 1.0. Changed names of Control Point and Sensor Location characteristics. Made formatting changes recommended by tech pubs. Incorporated recent changes to adopted HTP.
D10r01	2011-06-28	Version submitted to BARB for approval. Incorporated feedback from BTI and GPA WG.
D10r02	2011-06-28	Accepted all changes.
V10r00	2011-07-12	Adopted by the Bluetooth SIG Board of Directors

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The Bluetooth SIG has adopted Section 13.1 of the IEEE Standards Style Manual, which dictates use of the words ``shall'', ``should'', ``may'', and ``can'' in the development of documentation, as follows:

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*).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

Table of Contents

1 Introduction

The Heart Rate Profile is used to enable a data collection device to obtain data from a Heart Rate Sensor that exposes the Heart Rate Service [1].

1.1 Profile Dependencies

This profile requires the Generic Attribute Profile (GATT).

1.2 Conformance

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

1.3 Bluetooth Specification Release Compatibility

This specification is compatible with any *Bluetooth* Core Specification [2] that includes the Generic Attribute Profile (GATT) specification and the Bluetooth Low Energy Controller specification.

2 Configuration

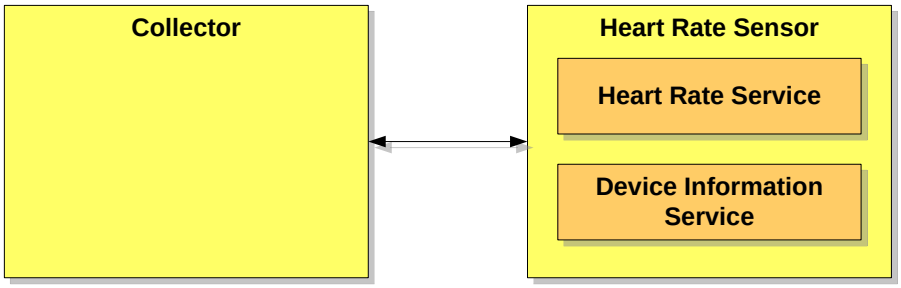
2.1 Roles

The profile defines two roles: Heart Rate Sensor and Collector. The Heart Rate Sensor is the device that measures heart rate and other information and the Collector is the device that receives the measurement and other data from a Heart Rate Sensor.

- The Heart Rate Sensor shall be a GATT Server.
- The Collector shall be a GATT Client.

2.2 Role/Service Relationships

The following diagram shows the relationships between services and the two profile roles.



Note: Profile roles are represented by yellow boxes and services are represented by orange boxes.

A Heart Rate Sensor instantiates one and only one Heart Rate Service [1] and instantiates one Device Information Service [3].

2.3 Concurrency Limitations and Restrictions

There are no concurrency limitations or restrictions for the Collector and Heart Rate Sensor roles imposed by this profile.

For cases where bonding is supported multiple bonds may be supported, but is outside the scope of this profile.

2.4 Topology Limitations and Restrictions

The Heart Rate Sensor shall use the GAP Peripheral role.

The Collector shall use the GAP Central role.

2.5 Transport Dependencies

This profile shall operate over an LE transport.

3 Heart Rate Sensor Role Requirements

The Heart Rate Sensor shall instantiate one and only one Heart Rate Service [1].

The Heart Rate Sensor shall instantiate the Device Information Service [3].

Service	Heart Rate Sensor
Heart Rate Service	M
Device Information Service	M

Table 3.1: Heart Rate Sensor Service Requirements

See Sections 5.1 and 6.1 for additional requirements for the Heart Rate Sensor role.

3.1 Incremental Heart Rate Service Requirements

This section describes additional Heart Rate Sensor requirements beyond those defined in the Heart Rate Service.

3.1.1 Service UUIDs AD Type

While in a GAP Discoverable Mode for initial connection to a Collector, the Heart Rate Sensor should include the Heart Rate Service UUID defined in [4] in the Service UUIDs AD type field of the advertising data. This enhances the user experience as a Heart Rate Sensor may be identified by the Collector before initiating a connection.

3.1.2 Local Name AD Type

For enhanced user experience a Heart Rate Sensor should include the Local Name in its Advertising data or Scan Response data.

3.1.3 GAP Device Name characteristic

The Heart Rate Sensor may support the write property for the Device Name characteristic in order to allow a Collector to write a device name to the Heart Rate Sensor.

3.2 Incremental Device Information Service Requirements

The table below shows additional requirements beyond those defined in the Device Information Service.

Device Information Service Characteristic	Requirement
Manufacturer Name String	M

Table 3.2: Device Information Service Requirements

Some characteristics in this service may be transcoded for use in an ISO/IEEE 11073 ecosystem. See the Personal Health Devices Transcoding White Paper [6] for more information. Since strings in this service are encoded as UTF-8, and IEEE 11073-20601 [5] specifies that strings are encoded as ASCII printable characters (a subset of UTF-8), string characteristics that are to be transcoded for use in an ISO/IEEE 11073 ecosystem must restrict their values to the printable ASCII character set.

4 Collector Role Requirements

The Collector shall support the Heart Rate Service [1].

The Collector may support the Device Information Service [3].

Service	Collector
Heart Rate Service	M
Device Information Service	O

Table 4.1: Collector Service Requirements

This section describes the profile procedure requirements for a Collector.

Profile Requirement	Section	Support in Collector
Service Discovery	4.2	M
Heart Rate Service Discovery	4.2.1	M
Device Information Service Discovery	4.2.2	O
Characteristic Discovery	4.3	M
Heart Rate Service Characteristic Discovery	4.3.1	M
Device Information Service Characteristic Discovery	4.3.2	O
Heart Rate Measurement	4.4	M
Body Sensor Location	4.5	O
Heart Rate Control Point	4.6	C.1

Table 4.2: Collector Requirements

C.1: Mandatory if the Reset Energy Expended Control Point is supported.

4.1 GATT Sub-Procedure Requirements

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

The table below summarizes *additional* GATT sub-procedure requirements beyond those required by all GATT Clients.

GATT Sub-Procedure	Collector (Client) Requirements
Discover All Primary Services	C.1
Discover Primary Services by Service UUID	C.1
Discover All Characteristics of a Service	C.2
Discover Characteristics by UUID	C.2
Discover All Characteristic Descriptors	M
Read Characteristic Value	C.3
Write Characteristic Value	C.4
Notification	M
Read Characteristic Descriptors	M
Write Characteristic Descriptors	M

Table 4.3: Additional GATT Sub-Procedure Requirements

C.1: Mandatory to support at least one of these sub-procedures.
C.2: Mandatory to support at least one of these sub-procedures.
C.3: Mandatory if the Body Sensor Location characteristic is supported.
C.4: Mandatory if the Heart Rate Control Point characteristic is supported.

4.2 Service Discovery

The Collector shall perform primary service discovery using either the GATT *Discover All Primary Services* sub-procedure or the GATT *Discover Primary Services by Service UUID* sub-procedure. Recommended fast connection parameters and procedures for connection establishment are defined in Section 5.2.4.

4.2.1 Heart Rate Service Discovery

The Collector shall perform primary service discovery to discover the Heart Rate Service.

4.2.2 Device Information Service Discovery

The Collector may perform primary service discovery to discover the Device Information Service.

4.3 Characteristic Discovery

As required by GATT, the Collector must be tolerant of additional optional characteristics in the service records of services used with this profile.

4.3.1 Heart Rate Service Characteristic Discovery

The Collector shall use either the GATT *Discover All Characteristics of a Service* sub-procedure or the GATT *Discover Characteristics by UUID* sub-procedure to discover the characteristics of the service.

The Collector shall use the GATT *Discover All Characteristic Descriptors* sub-procedure to discover the characteristic descriptors described in the following sections.

4.3.1.1 Heart Rate Measurement Characteristic

The Collector shall discover the Heart Rate Measurement characteristic.

The Collector shall discover the *Client Characteristic Configuration* descriptor of the Heart Rate Measurement characteristic.

4.3.1.2 Body Sensor Location Characteristic

The Collector may discover the Body Sensor Location characteristic.

4.3.1.3 Heart Rate Control Point Characteristic

The Collector may discover the Heart Rate Control Point characteristic.

4.3.2 Device Information Service Characteristic Discovery

The Collector may discover the characteristics of the Device Information Service.

In order for the Collector to discover the characteristics of the Device Information Service, it shall use either the GATT *Discover All Characteristics of a Service* sub-procedure or the GATT *Discover Characteristics by UUID* sub-procedure.

4.4 Heart Rate Measurement

The Collector shall control the configuration of notifications (i.e., via the Client Characteristic Configuration descriptor) of the Heart Rate Measurement characteristic.

The Collector shall be able to receive multiple notifications of the Heart Rate Measurement characteristic from the Heart Rate Sensor.

When a Collector requires a connection to a Heart Rate Sensor to receive heart rate measurements it shall follow the connection procedures described in Section 5.

The Collector shall determine the contents of the Heart Rate Measurement characteristic structure based on the contents of the Flags field. This allows the Collector to determine the data format of the Heart Rate Value field, whether or not an Energy Expended field is present and whether or not the RR-Interval values are present.

The Collector shall support receiving the Heart Rate Measurement characteristic both with and without the following fields: Energy Expended and RR-Interval.

The length of the RR-Interval field depends upon the transmission interval and the Heart Rate Value. The higher the Heart Rate value, the larger the number of RR-Interval events per second and the larger the number of RR-Interval sub-fields in the characteristic. For example, if the Heart Rate Measurement Value format of UINT8 is

used with a 23-octet ATT_MTU, the maximum number of RR-Interval Values that can be notified if Energy Expended is present is 8 and the maximum number of RR-Interval Values that can be notified if Energy Expended is not present is 9.

If the Collector receives a Heart Rate Measurement characteristic with bits of the Flags field value that are designated as Reserved for Future Use (RFU), it shall ignore those bits and continue to process the Heart Rate Measurement characteristic normally.

4.5 Body Sensor Location

The Body Sensor Location characteristic describes the location on a body where the device is intended to be worn. The value of the Body Sensor Location characteristic is static.

The Collector may read the value of the Body Sensor Location characteristic to determine the Body Sensor Location value on the Heart Rate Sensor.

If the Collector reads a Body Sensor Location value that is designated as Reserved for Future Use (RFU), it shall discard the value.

4.6 Heart Rate Control Point

The Heart Rate Control Point characteristic enables a Collector to write a Heart Rate Control Point value to a Heart Rate Sensor supporting this characteristic.

4.6.1 Reset Energy Expended

If the Heart Rate Sensor supports reporting the Energy Expended field in the Heart Rate Measurement characteristic, the Collector may write a Heart Rate Control Point value to reset it to zero.

The Collector should reset the value of the Energy Expended only if directed by the user.

4.7 Device Information Service Characteristics

The Collector may read the value of Device Information Service characteristics.

5 Connection Establishment Procedures

This section describes the connection establishment and connection termination procedures used by a Heart Rate Sensor and Collector in certain scenarios.

The following scenario description is informative:

Once configured by the Collector, a Heart Rate Sensor will typically remain powered off between uses and will only advertise and allow a Collector to connect when it senses contact with a body and has data to send. In this scenario, the Heart Rate Sensor will enter a GAP Connectable Mode and start advertising when it has data to send to the Collector. The Collector will typically execute a GAP connection establishment procedure such that it is scanning for the Heart Rate Sensor. When a connection is established and Heart Rate Sensor is configured for the notifications by the Collector, the Heart Rate Sensor shall send notifications to the Collector at regular intervals. When the training session is ended on the Collector, the Collector typically terminates the connection. When the Heart Rate Sensor is removed from the body, the Heart Rate Sensor typically terminates the connection after a period of time.

5.1 Heart Rate Sensor Connection Establishment

This section describes connection procedures to address the following scenarios:

- Section 5.1.1 describes the connection procedure when the Heart Rate Sensor does not support bonding or if the Heart Rate Sensor supports bonding, but is not bonded with any Collectors.
- Section 5.1.2 describes the connection procedure when the Heart Rate Sensor is bonded with one or more Collectors.
- Section 5.1.3 is used when the established connection is broken after a link loss.

5.1.1 Connection Procedure for Unbonded Devices

This procedure is used for connection establishment when the Heart Rate Sensor is not bonded with any Collectors and ready for connection (e.g. when in contact with the body or when commanded by the user).

The Heart Rate Sensor should use the GAP General Discoverable Mode with connectable undirected advertising events when establishing a connection.

It is recommended that the Heart Rate Sensor advertises using the parameters in Table 5.1. The interval values in the first row are designed to attempt fast connection to devices during the first 30 seconds; however, if a connection is not established within that time, the interval values in the second row are designed to reduce power consumption for devices that continue to advertise.

Advertising Duration	Parameter	Value
First 30 seconds (fast connection)	Advertising Interval	20 ms to 30 ms
After 30 seconds (reduced power)	Advertising Interval	1 s to 2.5 s

Table 5.1: Recommended Advertising Interval Values

The advertising interval and time to perform advertising should be configured with consideration for user expectations of connection establishment time.

The Heart Rate Sensor shall accept any valid values for connection interval and connection latency set by the Collector until service discovery, bonding and/or encryption (if required) is complete. Only after that should the Heart Rate Sensor request to change to the preferred connection parameters that best suit its use case.

If a connection is not established within a time limit defined by the Heart Rate Sensor, the Heart Rate Sensor may exit the GAP Connectable Mode.

The Heart Rate Sensor may be in a bondable mode during this procedure to optimize the future connections to the Collector (e.g., a Watch or a Phone) using the procedure described in Section 5.1.2.

If a bond is created, the Heart Rate Sensor should write the Bluetooth device address of the Collector in the Heart Rate Sensor controller's White List and set the Heart Rate Sensor controller's advertising filter policy to 'process scan and connection requests only from devices in the White List.

When the Heart Rate Sensor is no longer in contact with the skin or no longer senses heart rate activity for several seconds (e.g., 10 to 20 seconds), the Heart Rate Sensor should perform the GAP *Terminate Connection* procedure.

When the Heart Rate Sensor is disconnected by the Collector and it is ready for connection (e.g., when in contact with the body or when commanded by the user), the Heart Rate Sensor should reinitiate the connection procedure. This will enable reconnection and/or connection with other Collectors.

5.1.2 Connection Procedure for Bonded Devices

This procedure is used after the Heart Rate Sensor is bonded with one or more Collectors using the connection procedure in Section 5.1.1 and ready for connection (e.g., when in contact with the body or when commanded by the user).

The Heart Rate Sensor should use the GAP General Discoverable Mode with connectable undirected advertising events when establishing a connection.

For the first 10 seconds a White List containing addresses of only bonded devices should be used to allow only active bonded Collectors to establish a connection. After that, the white list should no longer be used to allow connection with other Collectors.

It is recommended that the Heart Rate Sensor advertises using the parameters in Table 5.1. The interval values in the first row are designed to attempt fast connection to devices during the first 30 seconds; however, if a connection is not established within that time, the interval values in the second row are designed to reduce power consumption for devices that continue to advertise.

The advertising interval and time to perform advertising should be configured with consideration for user expectations of connection establishment time.

The Heart Rate Sensor shall accept any valid values for connection interval and connection latency set by the Collector until service discovery, bonding and/or

encryption (if required) is complete. Only after that should the Heart Rate Sensor request to change to the preferred connection parameters that best suit its use case.

If a connection is not established within a time limit defined by the Heart Rate Sensor, the Heart Rate Sensor may exit the GAP Connectable Mode.

When the Heart Rate Sensor is no longer in contact with the skin or no longer senses heart rate activity for several seconds (e.g., 10 to 20 seconds), the Heart Rate Sensor should perform the GAP *Terminate Connection* procedure.

When the Heart Rate Sensor is disconnected by the Collector and it is ready for connection (e.g., when in contact with the body or when commanded by the user), the Heart Rate Sensor should reinitiate the connection procedure. This will enable reconnection and/or connection with other Collectors.

5.1.3 Link Loss Reconnection Procedure

When a connection is terminated due to link loss, a Heart Rate Sensor should attempt to reconnect to the Collector by entering a GAP Connectable Mode using the recommended advertising interval values shown in Table 5.1.

5.2 Collector Connection Establishment

This section describes connection procedures to address the following scenarios:

- Section 5.2.1 describes the connection procedure if the Collector does not support bonding or if the Collector supports bonding, but needs to create a new bond with a Heart Rate Sensor.
- Section 5.2.2 describes the connection procedure when the Collector needs to initiate a connection with a bonded Heart Rate Sensor.
- Section 5.2.3 is used when the established connection is broken after a link loss.

A Collector used in a public environment (e.g., a public fitness machine) is likely to connect to a large number of Heart Rate Sensors on a daily basis and is not expected to store connection information. A Collector used in this scenario will typically not bond with a Heart Rate Sensor.

A Collector used in a personal environment (e.g., a personal fitness machine, mobile phone or watch) is likely to connect frequently to a user's Heart Rate Sensor and is expected to store connection information. A Collector used in this scenario will typically bond with a Heart Rate Sensor during the initial connection.

5.2.1 Connection Procedure for Unbonded Devices

This procedure is used for connection establishment when the Collector connects to a Heart Rate Sensor to which it is not bonded. A Collector will typically execute a connection establishment procedure at the start of a training session such that it scans for a connectable Heart Rate Sensor in the background or when commanded by the user.

The Collector should use the GAP *General Discovery* procedure to discover a Heart Rate Sensor.

A Collector may use one of the following GAP connection procedures based on its connectivity requirements:

- *General Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from one or more Heart Rate Sensors. This procedure allows a Collector to connect to a Heart Rate Sensor discovered during a scan without using the White List.
- *Direct Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from a single Heart Rate Sensor.
- *Auto Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from one or more Heart Rate Sensors. This procedure will automatically connect to a Heart Rate Sensor in the White List.
- *Selective Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from one or more Heart Rate Sensors. This procedure allows a Collector to connect to a Heart Rate Sensor discovered during a scan while using the White List.

A Collector should use the recommended scan interval values shown in Table 5.2. For the first 30 seconds (or optionally continuously for mains powered devices), the Collector should use the first scan window / scan interval pair to attempt fast connection. However, if a connection is not established within that time, the Collector should switch to one of the other scan window / scan interval options as defined below to reduce power consumption.

Scan Duration	Parameter	Value
First 30 seconds (fast connection)	Scan Interval	30 ms to 60 ms*
	Scan Window	30 ms
After 30 seconds (reduced power) - Option 1	Scan Interval	1.28 s
	Scan Window	11.25 ms
After 30 seconds (reduced power) - Option 2	Scan Interval	2.56 s
	Scan Window	11.25 ms

Table 5.2: Recommended Scan Interval and Scan Window Values

* A scan interval of 60 ms is recommended when the Collector is supporting other operations to provide a 50% scan duty cycle versus 100% scan duty cycle.

Option 1 in Table 5.2 uses the same background scanning interval used in BR/EDR so the power consumption for LE will be similar to the power consumption used for background scanning on BR/EDR. Option 2 uses a larger background scanning interval (e.g. twice as long) than used in BR/EDR so the power consumption for LE will be less than the power consumption used for background scanning on BR/EDR. Connection times during background scanning will be longer with Option 2.

The Collector should use a scan window and scan interval suitable to its power and connection time requirements. Increasing the scan window increases the power consumption, but decreases the connection time.

The scan interval and scan window should be configured with consideration for user expectations of connection establishment time.

When the connection is established, the Collector may bond with the Heart Rate Sensor during this procedure to optimize the future connections to the device using the procedure described in Section 5.2.2.

If a bond is created, the Collector should write the *Bluetooth* device address of the Heart Rate Sensor in the Collector controller's White List and set the Collector controller's initiator filter policy to 'process connectable advertisement packets'.

Once connected, the Collector should configure the Client Characteristic Configuration descriptor of the Heart Rate Sensor to enable notifications.

The Collector should terminate the connection when the measurement session is terminated at the Collector by the user. The Heart Rate Sensor will typically terminate the connection if the Heart Rate Sensor no longer senses contact with the skin or no longer senses heart rate activity for several seconds (e.g. 10 to 20 seconds).

When the Collector is disconnected, the Collector may reinitiate the connection procedure. This will enable reconnection and/or connection with other Heart Rate Sensors.

5.2.2 Connection Procedure for Bonded Devices

This procedure is used for connection establishment with a bonded Heart Rate Sensor. A Collector will typically execute a connection establishment procedure at the start of a training session such that it scans for a bonded connectable Heart Rate Sensor in the background or when commanded by the user.

The Collector should use the GAP *General Discovery* procedure to discover a Heart Rate Sensor.

A Collector may use one of the following GAP connection procedures based on its connectivity requirements:

- *General Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from one or more Heart Rate Sensors. This procedure allows a Collector to connect to a Heart Rate Sensor discovered during a scan without using the White List.
- *Direct Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from a single Heart Rate Sensor.
- *Auto Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from one or more Heart Rate Sensors. This procedure will automatically connect to a Heart Rate Sensor in the White List.
- *Selective Connection Establishment* procedure. The Collector may use this procedure when it requires measurements from one or more Heart Rate Sensors. This procedure allows a Collector to connect to a Heart Rate Sensor discovered during a scan while using the White List.

A Collector should use the recommended scan interval values shown in Table 5.2. For the first 30 seconds (or optionally continuously for mains powered devices), the Collector should use the first scan window / scan interval pair to attempt fast connection. However, if a connection is not established within that time, the Collector

should switch to one of the other scan window / scan interval options as defined in Table 5.2 to reduce power consumption.

The Collector should use a scan window and scan interval suitable to its power and connection time requirements. Increasing the scan window increases the power consumption, but decreases the connection time.

The scan interval and scan window should be configured with consideration for user expectations of connection establishment time.

The Collector shall start encryption after each connection creation to verify the status of the bond. If encryption fails upon connection establishment (i.e. the bond no longer exists), the Collector must, after user interaction, re-bond, perform service discovery (unless the Collector had previously determined that the Heart Rate Sensor did not have the <<Service Changed>> characteristic), and set the Heart Rate Sensor Client Characteristic Configuration descriptor again before using any of the services referenced by this profile in case the configuration was altered or lost.

The Collector should terminate the connection when the measurement session is terminated at the Collector by the user. The Heart Rate Sensor will typically terminate the connection if it no longer senses contact with the skin or no longer senses heart rate activity for several seconds (e.g., 10 to 20 seconds).

When the Collector is properly disconnected the Collector may reinitiate the connection procedure.

5.2.3 Link Loss Reconnection Procedure

When a connection is terminated due to link loss, a Collector should attempt to reconnect to the Heart Rate Sensor using any of the GAP connection procedures with the parameters in Table 5.2.

5.2.4 Fast Connection Interval

To avoid very long service discovery and encryption times, the Collector should use the connection intervals defined in Table 5.3 in the connection request.

Parameter	Value
Minimum Connection Interval	50 ms
Maximum Connection Interval	70 ms

Table 5.3: Recommended Fast Connection Interval Values

At any time a lower latency is required, for example to perform key refresh or encryption setup, this should be preceded with a connection parameter update to the minimum and maximum connection interval values defined in Table 5.3 and a connection latency of zero. This fast connection interval should be maintained as long as low latency is required. After that, it should switch to the preferred connection parameters as decided by the Heart Rate Sensor using the GAP *Connection Parameter Update* procedure.

6 Security Considerations

This section describes the security considerations for a Heart Rate Sensor and Collector.

6.1 Heart Rate Sensor Security Considerations

The Heart Rate Sensor may bond with the Collector.

When the Heart Rate Sensor does not use bonding:

- The Heart Rate Sensor should use the SM *Slave Security Request* procedure to inform the Collector of its security requirements.

When the Heart Rate Sensor uses bonding:

- The Heart Rate Sensor shall use LE Security Mode 1 and either Security Level 2 or 3.
- The Heart Rate Sensor shall use the SM *Slave Security Request* procedure.
- All supported characteristics specified by the Heart Rate Service shall be set to Security Mode 1 and either Security Level 2 or 3.

All supported characteristics specified by the Device Information Service should be set to the same security mode and level as the characteristics in the Heart Rate Service.

6.2 Collector Security Considerations

The Collector shall support LE Security Mode 1 and Security Levels 1, 2 and 3.

The Collector shall accept the LE Security Mode and Security Level combination requested by the Heart Rate Sensor.

7 Acronyms and Abbreviations

Acronyms and Abbreviations	Meaning
AD	Advertising Data
BR/EDR	Basic Rate / Enhanced Data Rate
GAP	Generic Access Profile
GATT	Generic Attribute Profile
LE	Low Energy
RFU	Reserved for Future Use
SM	Security Manager
UUID	Universally Unique Identifier

Table 7.1: Acronyms and Abbreviations

8 References

[1] Heart Rate Service
[2] Bluetooth Core Specification v4.0
[3] Device Information Service
[4] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers.
[5] IEEE Std 11073-20601™- 2008 Health Informatics - Personal Health Device Communication - Application Profile - Optimized Exchange Protocol - version 1.0 or later
[6] Personal Health Devices Transcoding White Paper v1.0 or later