Blood Pressure Service (BLS)

***Bluetooth*® Test Suite**

- **Revision:** BLS.TS.p7
- **Revision Date:** 2022-01-25
- **Group Prepared By:** Medical Devices Working Group

Contents

1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and test cases to test the implementation of the Bluetooth Blood Pressure Service Specification with the objective to provide a high probability of air interface interoperability between the tested implementation and other manufacturers' Bluetooth devices.

2 References, definitions, and abbreviations

2.1 References

This document incorporates, by dated or undated reference, provisions from other publications. These references are cited at the appropriate places in the text, and the publications are listed hereinafter.

[1] Test Strategy and Terminology Overview

[2] Bluetooth Core Specification, Version 4.0 or later

[3] Blood Pressure Service Specification, Version 1.0 or later

[4] ICS Proforma for Blood Pressure Service, BLS.ICS

[5] GATT Test Suite, GATT.TS

[6] Blood Pressure Service Specification, Version 1.1 or later

[7] GATT Specification Supplement

2.2 Definitions

In this Bluetooth document, the definitions from [1] and [2] apply.

2.3 Acronyms and abbreviations

In this Bluetooth document, the definitions, acronyms, and abbreviations from [1] and [2] apply.

3 Test Suite Structure (TSS)

3.1 Overview

The Blood Pressure Service requires the presence of GAP, SM, and GATT. This is illustrated in Figure 3.1.

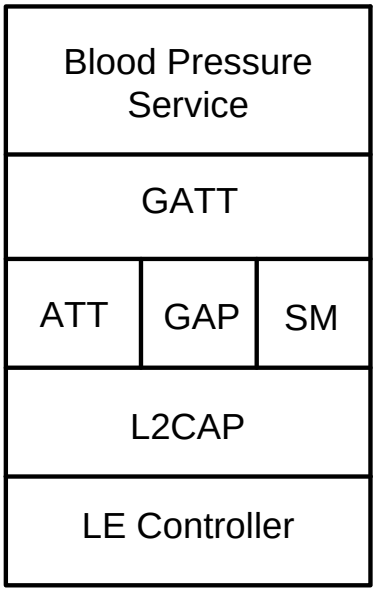

Figure 3.1: Blood Pressure Service test model

3.2 Test strategy

The test objectives are to verify functionality of the Blood Pressure Service within a Bluetooth Host and enable interoperability between Bluetooth Hosts on different devices. The testing approach is to cover mandatory and optional requirements in the service specification and to match these to the support of the IUT as described in the ICS. Any defined test herein is applicable to the IUT, if the ICS logical expression defined in the Test Case Mapping Table (TCMT) evaluates to true.

The test equipment provides an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in this Test Suite. A Lower Tester acts as the IUT's peer device and interacts with the IUT over-the-air interface. The configuration including the IUT needs to implement similar capabilities to communicate with the test equipment. For some test cases, it is necessary to stimulate the IUT from an Upper Tester. In practice, this could be implemented as a special test interface, a Man Machine Interface (MMI), or another interface supported by the IUT.

This Test Suite contains Valid Behavior (BV) tests complemented with Invalid Behavior (BI) tests where required. The test coverage mirrored in the Test Suite Structure is the result of a process that started with catalogued specification requirements that were logically grouped and assessed for testability enabling coverage in defined test purposes.

3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests
- Characteristic Read
- Configure Indication and Notification
- Characteristic Indication
- Characteristic Notification
- Service Procedures
- RACP Procedures

4 Test cases (TC)

4.1 Introduction

4.1.1 Test case identification conventions

Test cases are assigned unique identifiers per the conventions in [1]. The convention used here is: **<spec abbreviation>/<IUT role>/**<class>/**<feat>**/<func>/<subfunc>**/**<cap>**/<xx>-<nn>-<y>**.

Additionally, testing of this specification includes tests from the GATT Test Suite [5] referred to as Generic GATT Integrated Tests (GGIT); when used, the GGIT tests are referred through a TCID string using the following convention:
<Spec abbreviation>/<IUT role>/<GGIT test group>/< GGIT class >/<xx>-<nn>-<y>.

Identifier Abbreviation	**Spec Identifier <spec abbreviation>**
BLS	Blood Pressure Service
Identifier Abbreviation	**Role Identifier <IUT role>**
SEN	Sensor Role
Identifier Abbreviation	**Reference Identifier <GGIT test group>**
SGGIT	Server Generic GATT Integrated Tests
Identifier Abbreviation	**Reference Identifier <GGIT class>**
CHA	Characteristic
ISFC	Indication Supported Features Characteristic
SER	Service
CP	Control Point
Identifier Abbreviation	**Feature and Behaviors Identifier <feat>**
CR	Characteristic Read
CON	Configure Indication and Notification
CI	Characteristic Indication
CN	Characteristic Notification
RAA	RACP – Abort procedure
RAD	RACP – Delete Stored Records procedure
RAE	RACP – Error Handling
RAN	RACP – Report Number of Stored Records procedure
RAR	RACP – Report Stored Records procedure
SP	Service Procedures

Table 4.1: BLS TC feature naming convention

4.1.2 Conformance

When conformance is claimed for a particular specification, all capabilities are to be supported in the specified manner (process-mandatory). The mandated tests from this Test Suite depend on the capabilities to which conformance is claimed.

The Bluetooth Qualification Program may employ tests to verify implementation robustness. The level of implementation robustness that is verified varies from one specification to another and may be revised for cause based on interoperability issues found in the market.

Such tests may verify:

- That claimed capabilities may be used in any order and any number of repetitions that is not excluded by the specification
- That capabilities enabled by the implementations are sustained over durations expected by the use case
- That the implementation gracefully handles any quantity of data expected by the use case
- That in cases where more than one valid interpretation of the specification exists, the implementation complies with at least one interpretation and gracefully handles other interpretations
- That the implementation is immune to attempted security exploits

A single execution of each of the required tests is required in order to constitute a Pass verdict. However, it is noted that in order to provide a foundation for interoperability, it is necessary that a qualified implementation consistently and repeatedly pass any of the applicable tests.

In any case, where a member finds an issue with the test plan generated by Launch Studio, the test case as described in the Test Suite, or with the test system utilized, the member is required to notify the responsible party via an errata request such that the issue may be addressed.

4.1.3 Pass/Fail verdict conventions

Each test case has an Expected Outcome section. The IUT is granted the Pass verdict when all the detailed pass criteria conditions within the Expected Outcome section are met.

The convention in this Test Suite is that, unless there is a specific set of fail conditions outlined in the test case, the IUT fails the test case as soon as one of the pass criteria conditions cannot be met. If this occurs, the outcome of the test is a Fail verdict.

4.2 Setup preambles

The procedures defined in this section are used to achieve specific conditions on the IUT and the test equipment within the tests defined in this document. The preambles here are commonly used to establish initial conditions.

4.2.1 ATT Bearer on LE Transport

- Preamble Procedure
  1. Establish an LE transport connection between the IUT and the Lower Tester.
  2. Establish an L2CAP channel 0x0004 between the IUT and the Lower Tester over that LE transport.
  3. If the IUT requires a bonding procedure, then perform a bonding procedure.

4.2.2 RACP Configuration Preamble

- Preamble Purpose

  This preamble procedure enables the IUT for use with the Record Access Control Point.

- Preamble Procedure

  1. Ensure an ATT Bearer connection is established between the Lower Tester and IUT as described in Section 4.2.1.
  2. The handles of the characteristic as well as the Client Characteristic Configuration descriptor of the RACP characteristic and the Blood Pressure Record characteristic have been previously discovered by the Lower Tester during the test procedures in Section 4.3.1 or are known to the Lower Tester by other means.
  3. The RACP characteristic is configured for indication, and the Blood Pressure Record characteristic is configured for notification.

4.3 Generic GATT Integrated Tests

4.3.1 Server Generic GATT Integrated Tests (SGGIT)

Execute the Generic GATT Integrated Tests defined in Section 6.3, Server test procedures (SGGIT), in [5] using Table 4.2 below as input:

- Additional Pass verdict

  All RFU bits set to 0.

TCID	Service / Characteristic	Reference	Properties	Value Length (Octets)	Type
BLS/SEN/SGGIT/SER/BV-01-C [Service GGIT – Blood Pressure]	Blood Pressure Service	[3] 2	-	-	Not defined
BLS/SEN/SGGIT/CHA/BV-02-C [Characteristic GGIT – Blood Pressure Measurement]	Blood Pressure Measurement characteristic	[3] 3, 3.1	0x20 (Indicate)	Skip	-
BLS/SEN/SGGIT/CHA/BV-03-C [Characteristic GGIT – Intermediate Cuff Pressure]	Intermediate Cuff Pressure characteristic	[3] 3, 3.2	0x10 (Notify)	Skip	-
BLS/SEN/SGGIT/CHA/BV-04-C [Characteristic GGIT – Blood Pressure Feature]	Blood Pressure Feature characteristic	[3] 3, 3.3	0x02 (Read)	2	-
BLS/SEN/SGGIT/CHA/BV-05-C [Characteristic GGIT – Enhanced Blood Pressure Measurement]	Enhanced Blood Pressure Measurement characteristic	[6] 3, 3.4	0x20 (Indicate)	Skip	-
BLS/SEN/SGGIT/CHA/BV-06-C [Characteristic GGIT – Enhanced Intermediate Cuff Pressure]	Enhanced Intermediate Cuff Pressure characteristic	[6] 3, 3.5	0x10 (Notify)	Skip	-
BLS/SEN/SGGIT/CHA/BV-07-C [Characteristic GGIT – Record Access Control Point]	Record Access Control Point (RACP) characteristic	[6] 3, 3.6	0x28 (Write, Indicate)	Skip	-
BLS/SEN/SGGIT/CHA/BV-08-C [Characteristic GGIT – Blood Pressure Record]	Blood Pressure Record characteristic	[6] 3, 3.7	0x10 (Notify)	Skip	-

TCID	Service / Characteristic	Reference	Properties	Value Length (Octets)	Type
BLS/SEN/SGGIT/CHA/BV-09-C [Characteristic GGIT – Blood Pressure Feature - Indicate]	Blood Pressure Feature characteristic	[3] 3, 3.3	0x22 (Read, Indicate)	2	-

Table 4.2: Input for the GGIT Server test procedure

4.3.2 Generic GATT Control Point Tests

Execute the Generic GATT Control Point Tests defined in Section 6.3, Server test procedures (SGGIT), in [5] using Table 4.3 below as input:

TCID	Control Point Characteristic	Reference	TC Configuration	Parameter(s)	Pass Verdict
BLS/SEN/SGGIT/CP/BI-01-C [RACP - Client Characteristic Configuration Descriptor Improperly Configured]	Record Access Control Point (RACP) Characteristic	[6] 3.6.3.1, 3.6.4	N/A	Opcode = 0x01 (Report Stored Records) Operator = A supported Operator and, if applicable, Operand	Client Characteristic Configuration Descriptor Improperly Configured

Table 4.3: Input table for GGIT Control Point tests

4.3.3 Generic GATT Indication Supported Features characteristic

Execute the Generic GATT Indication Supported Features Characteristic tests defined in Section 6.3, Server test procedures (SGGIT), in [5] using Table 4.4 below as input:

TCID	Characteristic	Reference	TC Configuration
BLS/SEN/SGGIT/ISFC/BV-01-C [Characteristic GGIT – Blood Pressure Feature indication]	Blood Pressure Feature	[6] 3.3.1	N/A

Table 4.4: GGIT Indication Supported Features Characteristic tests

4.4 Characteristic Read

- Test Purpose

  This test group contains test cases to read and verify that the characteristic values required by the service are compliant.

- Reference

  [3] 3.3

- Initial Condition

  - The handle of each characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Case Configuration

Test Case	Reference	Value (Requirements)
BLS/SEN/CR/BV-02-C [Characteristic Read – Blood Pressure Feature - Multiple Bonds]	[3] 3.6.1.6	Bit 5 of the Blood Pressure Feature characteristic set to 1 ([3] 3.3.1).
BLS/SEN/CR/BV-03-C [Characteristic Read – Blood Pressure Feature - E2E CRC]	[6] 3.6.1.7	Bit 6 of the Blood Pressure Feature characteristic set to 1 ([6] 3.3.1).
BLS/SEN/CR/BV-04-C [Characteristic Read – Blood Pressure Feature - User Data Service]	[6] 3.6.1.8	Bit 7 of the Blood Pressure Feature characteristic set to 1 ([6] 3.3.1).
BLS/SEN/CR/BV-05-C [Characteristic Read – Blood Pressure Feature - User Facing Time]	[6] 3.6.1.9	Bit 8 of the Blood Pressure Feature characteristic set to 1 ([6] 3.3.1).

Table 4.5: Characteristic Read Value test cases

- Test Procedure

  The following test procedure applies to the test cases listed in Table 4.5, for each characteristic referenced in a test case above:

  1. The Lower Tester sends an ATT_Read_Request to the IUT to read the characteristic value.
  2. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  The following verdicts apply to the test cases listed in Table 4.5:

  Pass verdict

  The characteristic is successfully read and the characteristic value meets the requirements of the service.

4.5 Configure Indication and Notification

- Test Purpose

  This test group verifies compliant operation in response to enable and disable characteristic indication or notification.

- Reference

  [3] 3.1.2, 3.2.2

  [6] 3

- Initial Condition

  - The handle of each characteristic value, as well as the handle of the client characteristic configuration descriptors referenced in the test cases below, has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the characteristic descriptor require a specific security mode or security level, establish a connection meeting those requirements.

- Test Case Configuration

Test Case	Value (Requirements)
BLS/SEN/CON/BV-01-C [Configure Indication - Blood Pressure Measurement]	0x0002 ([3] 3.1.2.1)
BLS/SEN/CON/BV-02-C [Configure Notification - Intermediate Cuff Pressure]	0x0001 ([3] 3.2.2.1)
BLS/SEN/CON/BV-03-C [Configure Indication – Enhanced Blood Pressure Measurement]	0x0002 ([6] 3, 3.4)
BLS/SEN/CON/BV-04-C [Configure Notification – Enhanced Intermediate Cuff Pressure]	0x0001 ([6] 3, 3.5)

Table 4.6: Configure Indication and Notification test cases

- Test Procedure

  The following test procedure applies to the test cases listed in Table 4.6:

  1. The Lower Tester sends an ATT_Write_Request, to disable indication or notification, by writing value 0x0000 to the client characteristic configuration descriptor of the characteristic.

2. If the test case is for notification, enable notification by writing value 0x0001 to the client characteristic configuration descriptor of the characteristic.
3. Otherwise, if the test case is for indication, enable indication by writing value 0x0002 to the client characteristic configuration descriptor of the characteristic.
4. The Lower Tester reads the value of the client characteristic configuration descriptor.

- Expected Outcome

  Pass verdict

  The characteristic descriptor is successfully written, and the value returned when read is consistent with the value written.

4.6 Characteristic Indication

- Test Purpose

  This test group contains test cases to verify compliant operation when the IUT sends indications of characteristic values.

- Reference

  [3] 3.1.1

  [6] 3, 3.4

- Initial Condition
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - The handle of each characteristic value referenced in the test cases below has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - For each selected test case in Table 4.7, the characteristic is configured for indication.
  - For the Enhanced Blood Pressure Measurement characteristic, the IUT is configured to send measurements to the Lower Tester.
  - The Lower Tester and the IUT are disconnected.

- Test Case Configuration

Test Case	Value (Requirements)
BLS/SEN/CI/BV-01-C [Characteristic Indication - Blood Pressure Measurement]	7 to 19 Octets. Length corresponds to bits in Flags field. ([3] 3.1.1, [7])
BLS/SEN/CI/BV-06-C [Characteristic Indication – Enhanced Blood Pressure Measurement]	7 to 20 Octets. Length corresponds to bits in Flags field. ([6] 3.4.1.1, [7])

Table 4.7: Characteristic Indication Value test cases

- Test Procedure

  The following test procedure applies to the test cases listed in Table 4.7:

  1. Perform an action on the IUT that will induce it to make a new value of the characteristic available.
  2. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 meeting the security requirements of the IUT. If bonding is not supported, the Blood Pressure Measurement characteristic is configured for indication.
  3. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the characteristic handle and value.
  4. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  5. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  The following verdicts apply to the test cases listed in Table 4.7:

  Pass verdict

  The characteristic is successfully indicated, and the characteristic value meets the requirements of the service.

BLS/SEN/CI/BV-02-C [Blood Pressure Measurement Indications – Time Stamp]

- Test Purpose

  Verify that the IUT can send indications of the Blood Pressure Measurement characteristic that include Time Stamp values.

- Reference

  [3] 3.1.1.3

- Initial Condition

  - The handle of the Blood Pressure Measurement characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Blood Pressure Measurement characteristic is configured for indication.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Blood Pressure Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

  1. Perform an action on the IUT that will induce it to send indications of the Blood Pressure Measurement characteristic along with Time Stamp values.
  2. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Blood Pressure Measurement characteristic handle and value.

3. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
4. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more indications of the Blood Pressure Measurement characteristic that include the Time Stamp value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CI/BV-03-C [Blood Pressure Measurement Indications – Pulse Rate]

- Test Purpose

  Verify that the IUT can send indications of the Blood Pressure Measurement characteristic that include Pulse Rate values.

- Reference

  [3] 3.1.1.4

- Initial Condition
  - The handle of the Blood Pressure Measurement characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Blood Pressure Measurement characteristic is configured for indication.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Blood Pressure Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
- Test Procedure
  1. Perform an action on the IUT that will induce it to send indications of the Blood Pressure Measurement characteristic along with Pulse Rate values.
  2. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Blood Pressure Measurement characteristic handle and value.
  3. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  4. Verify that the characteristic value meets the requirements of the service.
- Expected Outcome

  Pass verdict

  The IUT sends one or more indications of the Blood Pressure Measurement characteristic that include the Pulse Rate value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CI/BV-04-C [Blood Pressure Measurement Indications – User ID]

- Test Purpose

  Verify that the IUT can send indications of the Blood Pressure Measurement characteristic that include User ID values.

- Reference

  [3] 3.1.1.5

- Initial Condition

  - The handle of the Blood Pressure Measurement characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Blood Pressure Measurement characteristic is configured for indication.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Blood Pressure Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

  1. Perform an action on the IUT that will induce it to send indications of the Blood Pressure Measurement characteristic along with User ID values.
  2. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Blood Pressure Measurement characteristic handle and value.
  3. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  4. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more indications of the Blood Pressure Measurement characteristic that include the User ID value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CI/BV-05-C [Blood Pressure Measurement Indications – Measurement Status]

- Test Purpose

  Verify that the IUT can send indications of the Blood Pressure Measurement characteristic that include Measurement Status values.

- Reference

  [3] 3.1.1.6

- Initial Condition
  - The handle of the Blood Pressure Measurement characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Blood Pressure Measurement characteristic is configured for indication.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Blood Pressure Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
- Test Procedure
  1. Perform an action on the IUT that will induce it to send indications of the Blood Pressure Measurement characteristic along with Measurement Status values.
  2. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Blood Pressure Measurement characteristic handle and value.
  3. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  4. Verify that the characteristic value meets the requirements of the service.
- Expected Outcome

  Pass verdict

  The IUT sends one or more indications of the Blood Pressure Measurement characteristic that include the Measurement Status value.

  The value of the characteristic meets the requirements of the service.

4.6.1 Enhanced Blood Pressure Measurement Indications – Field Values

- Test Purpose

  For each selected test case in Table 4.8, verify that the IUT can send indications of the Enhanced Blood Pressure Measurement characteristic that include the described <Field Values>.

- Reference

  [6] 3.4

- Initial Condition
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Enhanced Blood Pressure Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - The handle of the Enhanced Blood Pressure Measurement characteristic has been previously discovered by the Lower Tester using the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Enhanced Blood Pressure Measurement characteristic is configured for indication.
  - The IUT is configured to send measurements to the Lower Tester.

- Test Case Configuration

Test Case ID	Reference	Field Values
BLS/SEN/CI/BV-07-C [Enhanced Blood Pressure Measurement Indications – with Time Stamp]	[6] 3.1.1.3, 3.4.1.3	Time Stamp (Bit 1 of Flags field set to 1)
BLS/SEN/CI/BV-08-C [Enhanced Blood Pressure Measurement Indications – with Pulse Rate]	[6] 3.1.1.4, 3.4.1.4	Pulse Rate (Bit 2 of Flags field set to 1)
BLS/SEN/CI/BV-09-C [Enhanced Blood Pressure Measurement Indications – with User ID]	[6] 3.1.1.5, 3.4.1.5	User ID (Bit 3 of Flags field set to 1)
BLS/SEN/CI/BV-10-C [Enhanced Blood Pressure Measurement Indications – with Measurement Status]	[6] 3.1.1.6, 3.4.1.6	Measurement Status (Bit 4 of Flags field set to 1)
BLS/SEN/CI/BV-11-C [Enhanced Blood Pressure Measurement Indications – with Time Stamp and User Facing Time]	[6] 3.4.1.7	Time Stamp and User Facing Time (Bits 1 and 5 of Flags field set to 1)

Table 4.8: Enhanced Blood Pressure Measurement Indications test cases – field values

- Test Procedure

  For each selected test case in Table 4.8:

  1. Perform an action on the IUT that will induce it to send indications of the Enhanced Blood Pressure Measurement characteristic along with the described <Field Values> and applicable Flags field bit set.
  2. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Enhanced Blood Pressure Measurement characteristic handle and value.
  3. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.

- Expected Outcome

  Pass verdict

  For each selected test case in Table 4.8, the IUT sends one or more indications of the Enhanced Blood Pressure Measurement characteristic that include the described <Field values>.

  The applicable Enhanced Blood Pressure Measurement characteristic Flags field bit set, and the value of the characteristic meets the requirements of the service.

4.7 Characteristic Notification

This test group contains test cases to verify compliant operation when the IUT sends notification of characteristic values.

BLS/SEN/CN/BV-01-C [Intermediate Cuff Pressure Notifications]

- Test Purpose

  Verify that the IUT can send notifications of Intermediate Cuff Pressure values followed by the blood pressure measurement.

- Reference

  [3] 3.2.1

- Initial Condition

  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - The handle of the Intermediate Cuff Pressure characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Intermediate Cuff Pressure characteristic is configured for notification.
  - The Blood Pressure Measurement characteristic is configured for indication.
  - The Lower Tester and the IUT are disconnected.

- Test Procedure

  1. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 meeting the security requirements of the IUT. If bonding is not supported, the Blood Pressure Measurement characteristic is configured for indication and the Intermediate Cuff Pressure characteristic is configured for notification.
  2. Perform an action on the IUT that will induce it to make a new value of the Intermediate Cuff Pressure characteristic available.
  3. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the Intermediate Cuff Pressure characteristic handle and value.
  4. Verify that the characteristic value meets the requirements of the service.
  5. Repeat steps 3–4 for each received notification until the IUT stops sending notifications.
  6. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Blood Pressure Measurement characteristic handle and value.
  7. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  8. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the Intermediate Cuff Pressure characteristic.

  The value of the Intermediate Cuff Pressure characteristic meets the requirements of the service (7–19 Octets in length; length corresponds to bits in Flags field).

  The IUT stops sending notifications of the Intermediate Cuff Pressure characteristic and sends an indication of the Blood Pressure Measurement characteristic.

  The value of the Blood Pressure Measurement characteristic meets the requirements of the service (7–19 Octets in length; length corresponds to bits in Flags field).

BLS/SEN/CN/BV-02-C [Intermediate Cuff Pressure Notifications – Time Stamp]

- Test Purpose

  Verify that the IUT can send notifications of the Intermediate Cuff Pressure characteristic that includes Time Stamp values.

- Reference

  [3] 3.2.1.3

- Initial Condition

  - The handle of the Intermediate Cuff Pressure characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Intermediate Cuff Pressure characteristic is configured for notification.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Intermediate Cuff Pressure characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

  1. Perform an action on the IUT that will induce it to send notifications of the Intermediate Cuff Pressure characteristic along with Time Stamp values.
  2. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the Intermediate Cuff Pressure characteristic handle and value.
  3. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the Intermediate Cuff Pressure characteristic that include the Time Stamp value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CN/BV-03-C [Intermediate Cuff Pressure Notifications – Pulse Rate]

- Test Purpose

  Verify that the IUT can send notifications of the Intermediate Cuff Pressure characteristic that include Pulse Rate values.

- Reference

  [3] 3.2.1.4

- Initial Condition

  - The handle of the Intermediate Cuff Pressure characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.

- The Intermediate Cuff Pressure characteristic is configured for notification.
- Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
- If IUT permissions for the Intermediate Cuff Pressure characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

  1. Perform an action on the IUT that will induce it to send notifications of the Intermediate Cuff Pressure characteristic along with Pulse Rate values.
  2. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the Intermediate Cuff Pressure characteristic handle and value.
  3. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the Intermediate Cuff Pressure characteristic that include the Pulse Rate value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CN/BV-04-C [Intermediate Cuff Pressure Notifications – User ID]

- Test Purpose

  Verify that the IUT can send notifications of the Intermediate Cuff Pressure characteristic that include User ID values.

- Reference

  [3] 3.2.1.5

- Initial Condition

  - The handle of the Intermediate Cuff Pressure characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Intermediate Cuff Pressure characteristic is configured for notification.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Intermediate Cuff Pressure characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

  1. Perform an action on the IUT that will induce it to send notifications of the Intermediate Cuff Pressure characteristic along with User ID values.
  2. The Lower Tester receives an *ATT_Handle_Value_Notification* from the IUT containing the Intermediate Cuff Pressure characteristic handle and value.
  3. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the Intermediate Cuff Pressure characteristic that include the User ID value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CN/BV-05-C [Intermediate Cuff Pressure Notifications – Measurement Status]

- Test Purpose

  Verify that the IUT can send notifications of the Intermediate Cuff Pressure characteristic that include Measurement Status values.

- Reference

  [3] 3.2.1.6

- Initial Condition

  - The handle of the Intermediate Cuff Pressure characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Intermediate Cuff Pressure characteristic is configured for notification.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Intermediate Cuff Pressure characteristic require a specific security mode or security level, establish a connection meeting those requirements.

- Test Procedure

  1. Perform an action on the IUT that will induce it to send notifications of the Intermediate Cuff Pressure characteristic along with Measurement Status values.
  2. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the Intermediate Cuff Pressure characteristic handle and value.
  3. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the Intermediate Cuff Pressure characteristic that include the Measurement Status value.

  The value of the characteristic meets the requirements of the service.

BLS/SEN/CN/BV-06-C [Enhanced Intermediate Cuff Pressure Notifications]

- Test Purpose

  Verify that the IUT can send notifications of the Enhanced Intermediate Cuff Pressure values followed by the enhanced blood pressure measurement.

- Reference

  [6] 3.5

- Initial Condition

  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - The handle of the Enhanced Intermediate Cuff Pressure characteristic and Enhanced Blood Pressure Measurement characteristic are discovered by the Lower Tester using the test procedure in Section 4.3.1 or are known to the Lower Tester by other means.
  - The Enhanced Intermediate Cuff Pressure characteristic is configured for notification.
  - The Enhanced Blood Pressure Measurement characteristic is configured for indication.
  - The IUT is configured to send measurements to the Lower Tester.
  - The Lower Tester and the IUT are disconnected.

- Test Procedure

  1. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 meeting the security requirements of the IUT. If bonding is not supported, configure the Enhanced Blood Pressure Measurement characteristic for indication and the Enhanced Intermediate Cuff Pressure characteristic for notification.
  2. Perform an action on the IUT that will induce a blood pressure measurement that makes one or more values of the Enhanced Intermediate Cuff Pressure characteristic available.
  3. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the Enhanced Intermediate Cuff Pressure characteristic handle and value.
  4. Verify that the characteristic value meets the requirements of the service.
  5. Repeat steps 3–4 for each received notification until the IUT stops sending notifications.
  6. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Enhanced Blood Pressure Measurement characteristic handle and value.
  7. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.

- Expected Outcome

  Pass verdict

  The IUT sends one or more notifications of the Enhanced Intermediate Cuff Pressure characteristic.

  The value of the Enhanced Intermediate Cuff Pressure characteristic meets the requirements of the service (3–16 Octets in length; length corresponds to bits in Flags field ([7])).

  The IUT stops sending notifications of the Enhanced Intermediate Cuff Pressure characteristic and sends an indication of the Enhanced Blood Pressure Measurement characteristic.

  The value of the Enhanced Blood Pressure Measurement characteristic meets the requirements of the service (7–20 Octets in length; length corresponds to bits in Flags field ([7])).

4.7.1 Enhanced Intermediate Cuff Pressure Notifications – Field Values

- Test Purpose

  For each selected test case in Table 4.9, verify that the IUT can send notifications of the Enhanced Intermediate Cuff Pressure characteristic that includes the described <Field Values>.

- Reference

  [6] 3.5

- Initial Condition

  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Enhanced Intermediate Cuff Pressure characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - The handle of the Enhanced Intermediate Cuff Pressure characteristic is discovered by the Lower Tester using the test procedure in Section 4.3 or is known to the Lower Tester by other means.
  - The Enhanced Intermediate Cuff Pressure characteristic is configured for notification.
  - The IUT is configured to send measurements to the Lower Tester.

- Test Case Configuration

Test Case ID	Reference	Field Values
BLS/SEN/CN/BV-07-C [Enhanced Intermediate Cuff Pressure Notifications – with Time Stamp]	[6] 3.5.1.3	Time Stamp (Bit 1 of Flags field set to 1)
BLS/SEN/CN/BV-08-C [Enhanced Intermediate Cuff Pressure Notifications – with Pulse Rate]	[6] 3.2.1.4, 3.5.1.4	Pulse Rate (Bit 2 of Flags field set to 1)
BLS/SEN/CN/BV-09-C [Enhanced Intermediate Cuff Pressure Notifications – with User ID]	[6] 3.2.1.5, 3.5.1.5	User ID (Bit 3 of Flags field set to 1)
BLS/SEN/CN/BV-10-C [Enhanced Intermediate Cuff Pressure Notifications – with Measurement Status]	[6] 3.2.1.6, 3.5.1.6	Measurement Status (Bit 4 of Flags field set to 1)
BLS/SEN/CN/BV-11-C [Enhanced Intermediate Cuff Pressure Notifications – with Time Stamp and User Facing Time]	[6] 3.5.1.7	Time Stamp and User Facing Time (Bits 1 and 5 of Flags field set to 1)

Table 4.9: Enhanced Intermediate Cuff Pressure Notifications test cases – field values

- Test Procedure

  For each selected test case in Table 4.9:

  1. Perform an action on the IUT that will induce it to send notifications of the Enhanced Intermediate Cuff Pressure characteristic along with the described <Field Values> and applicable Flags field bit set.
  2. The Lower Tester receives an ATT_Handle_Value_Notification from the IUT containing the Enhanced Intermediate Cuff Pressure characteristic handle and value.

- Expected Outcome

  Pass verdict

  For each selected test case in Table 4.9, the IUT sends notifications of the Enhanced Intermediate Cuff Pressure characteristic that includes the described <Field Values>.

  The applicable Enhanced Intermediate Cuff Pressure characteristic Flags field bit is set, and the value of the characteristic meets the requirements of the service.

4.8 Service Procedures

BLS/SEN/SP/BV-01-C [Stored Blood Pressure Measurements]

- Test Purpose

  Verify that the IUT can send indications of stored Blood Pressure measurements.

- Reference

  [3] 3.1.1, 3.4

- Initial Condition

  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - The handle of the Blood Pressure Measurements characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Blood Pressure Measurement characteristic is configured for indication.
  - The Lower Tester and the IUT are disconnected.

- Test Procedure

  1. Perform an action on the IUT that will induce it to store several Blood Pressure measurements.
  2. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 meeting the security requirements of the IUT.
  3. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Blood Pressure Measurement characteristic handle and value.
  4. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  5. Repeat steps 3–4 until all stored measurements are received or the IUT terminates the connection.
  6. Verify that the characteristic value in each indication contains the time stamp field.
  7. Verify that the indications are received in order according to the time stamp, with the oldest measurement received first.

- Expected Outcome

  Pass verdict

  The IUT sends one or more indications of the Blood Pressure Measurement characteristic.

The Blood Pressure Measurement characteristic contains the time stamp field.

The indications are received with the oldest data being sent first, followed by the next oldest data (in FIFO order) until all stored data has been transferred.

4.8.1 Stored Enhanced Blood Pressure Measurements

- Test Purpose

  For each selected test case in Table 4.10, verify that the IUT can send indications of stored Enhanced Blood Pressure measurements comprising the <Included Field>, and as applicable with the listed <Epoch Start 2000 Flag value>.

- Reference

  [6] 3.1.1, 3.4, 3.8

- Initial Condition

  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  - If IUT permissions for the Enhanced Blood Pressure Measurement characteristic require a specific security mode or security level, establish a connection meeting those requirements.
  - The handle of the Enhanced Blood Pressure Measurements characteristic is discovered by the Lower Tester using the test procedure in Section 4.3.1 or is known to the Lower Tester by other means.
  - The Enhanced Blood Pressure Measurement characteristic is configured for indication.
  - The IUT is configured to send stored measurements to the Lower Tester.
  - The Lower Tester and the IUT are disconnected.

- Test Case Configuration

Test Case ID	Included Field	Epoch Start 2000 Flag value
BLS/SEN/SP/BV-02-C [Stored Enhanced Blood Pressure Measurements – Time Stamp]	Time Stamp (Bit 1 of Flags field set to 1 and Bit 5 set to 0)	Bit 6 of Flags field set to 0
BLS/SEN/SP/BV-03-C [Stored Enhanced Blood Pressure Measurements – Time Stamp with Epoch Start 2000]		Bit 6 of Flags field set to 1
BLS/SEN/SP/BV-04-C [Stored Enhanced Blood Pressure Measurements – Time Stamp and User Facing Time]	Time Stamp and User Facing Time (Bits 1 and 5 of Flags field set to 1)	Bit 6 of Flags field set to 0
BLS/SEN/SP/BV-05-C [Stored Enhanced Blood Pressure Measurements – Time Stamp and User Facing Time with Epoch Start 2000]		Bit 6 of Flags field set to 1

Table 4.10: Enhanced Stored Blood Pressure measurements test cases

- Test Procedure

  For the selected test case in Table 4.10:

  1. Perform an action on the IUT that will induce it to store several Enhanced Blood Pressure measurements with the <Included Field> and <Epoch Start 2000 Flag value> set as described in Table 4.10.
  2. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1 meeting the security requirements of the IUT. If bonding is not supported, configure the Enhanced Blood Pressure Measurement characteristic for indication.
  3. The Lower Tester receives an ATT_Handle_Value_Indication from the IUT containing the Enhanced Blood Pressure Measurement characteristic handle and value along with the <Included Field> and the appropriate User ID value.
  4. The Lower Tester sends an ATT_Handle_Value_Confirmation to the IUT.
  5. Repeat steps 3–4 until all stored measurements are received or the IUT terminates the connection.
  6. Verify that the characteristic value in each indication contains the <Included Field> and the appropriate User ID value.
  7. Verify that the indications are received in order according to the <Included Field>, with the oldest measurement received first.

- Expected Outcome

  Pass verdict

  For each selected test case in Table 4.10, the IUT sends one or more indications of the Enhanced Blood Pressure Measurement characteristic:

  - The Enhanced Blood Pressure Measurement characteristic contains the required <Included Field>.
  - The <Included Field> represents the time in seconds since the defined epoch start time.
  - If the feature flag for multi-user set, the User ID field is present in one or more received indications of the Enhanced Blood Pressure Measurement characteristic.
  - The indications are received with the oldest data sent first, followed by the next oldest data (in FIFO order) until all stored data has been transferred.

4.9 RACP Procedures

This test group contains test cases to verify that the IUT can be configured, conducts compliant operation, provides correctly formatted values of the Blood Pressure Record characteristic, and interprets correctly values of the RACP characteristic and error handling.

This test group uses the Operators and Operands listed in Table 4.11.

		Inner Loop: Operand Filter Type		
		Sequence Number	Base Time	User Facing Time
Outer Loop: Operator	All records	No Operand Used	No Operand Used	No Operand Used
	Less than or equal to	<Max filter value>	<Max filter value>	<Max filter value>
	Greater than or equal to	<Min filter value>	<Min filter value>	<Min filter value>
	Within range of (inclusive)	<Min filter value>, <Max filter value>	<Min filter value>, <Max filter value>	<Min filter value>, <Max filter value>
	First record	No Operand Used	No Operand Used	No Operand Used
	Last record	No Operand Used	No Operand Used	No Operand Used

Table 4.11: RACP – Operators and Operands

BLS/SEN/RAR/BV-01-C [Report Stored Records procedure]

- Test Purpose

  Verify that the IUT can perform the Report Stored Records procedure with the combination of Operators and Operands listed in Table 4.11.

- Reference

  [6] 3.6.2.1, 3.6.3.1

- Initial Condition

  - The Lower Tester does not permit an ATT_MTU size larger than the default ATT_MTU size for LE to be negotiated.
  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.
  - Perform an action on the IUT that will induce it to generate at least 3 records with stored measurements.

- Test Procedure

  1. For each <Outer Loop: Operator> in Table 4.11, perform the following steps:
     a. For each <Inner Loop: Operand Filter Type> in Table 4.11, perform the following steps:
        i. The Lower Tester writes the Report Stored Records Op Code (0x01) to the RACP characteristic using the listed <Outer Loop: Operator>, <Inner Loop: Operand Filter Type> and corresponding filter parameter(s).
        ii. IF the <Outer Loop: Operator> is NOT supported, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00) and an Operand representing the

Request Op Code (0x01) followed by the Response Code Value for Operator not supported (0x04).

iii. ELSE IF the <Inner Loop: Operand Filter Type> is NOT supported, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x01) followed by the Response Code Value for Operand not supported (0x09).

iv. ELSE IF for the <Inner Loop: Operand Filter Type> NO corresponding records exist for the filter value range, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06) an Operator of Null (0x00) and an Operand representing the Request Op Code (0x01) followed by the Response Code Value for No Records Found (0x06).

v. ELSE, the IUT sends one or more ATT_Handle_Value_Notification of the Blood Pressure Record characteristic. The number of notifications depend on the record length, <Outer Loop: Operator>, and, if applicable, <Inner Loop: Operand Filter Type> and corresponding filter parameter(s). Each notification contains a Segmentation Header field describing the segmentation information and the transported data.

a) The IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x01) followed by the Response Code Value for Success (0x01).

vi. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.

2. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  For each combination of <Outer Loop: Operator> and <Inner Loop: Operand Filter Type>, the IUT sends:

  - One or more notifications of the Blood Pressure Record,
    - Each notification of the Blood Pressure Record has the Segmentation Header field with the First Segment bit, Last Segment bit, and Rolling Segment Counter bits with appropriate values.
    - The first notification includes the transported data consisting of the Sequence Number, UUID of the contained characteristic, and a segment of the recorded characteristic value, while subsequent notification(s) contain only the additional segment(s) of the recorded characteristic and, if supported, optional E2E-CRC.
  - An indication with the Response Code for Success (Combination supported).

    OR
  - The appropriate error message (Combination not supported).

BLS/SEN/RAN/BV-01-C [Report Number of Stored Records procedure]

- Test Purpose

  Verify that the IUT can perform the Report Number of Stored Records procedure with the combination of Operators and Operands listed in Table 4.11.

- Reference

  [6] 3.6.2.1, 3.6.3.2

- Initial Condition

  - Perform an action on the IUT that will induce it to generate at least 3 records with stored measurements.
  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.

- Test Procedure

  1. For each <Outer Loop: Operator> in Table 4.11, perform the following steps:
     a. For each <Inner Loop: Operand Filter Type> in Table 4.11, perform the following steps:
        i. The Lower Tester writes the Report Number of Stored Records Op Code (0x04) to the RACP characteristic using the listed <Outer Loop: Operator>, <Inner Loop: Operand Filter Type>, and corresponding filter parameter(s).
        ii. IF the <Outer Loop: Operator> is NOT supported, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x04) followed by the Response Code Value for Operator not supported (0x04).
        iii. ELSE IF the <Inner Loop: Operand Filter Type> is NOT supported, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x04), followed by the Response Code Value for Operand not supported (0x09).
        iv. ELSE, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Number of Stored Records Response Op Code (0x05), an Operator of Null (0x00), and an Operand representing the number of records that were found.
        v. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.
  2. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  For each combination of <Outer Loop: Operator> and <Inner Loop: Operand Filter Type>, the IUT sends:

  - One indication of the RACP characteristic with the Number of Stored Records Response Op Code containing a valid Operator and Operand. The value of the Operand represents the correct number of available records (Combination supported).

OR

- The appropriate error message (Combination not supported).

BLS/SEN/RAN/BV-02-C [Report Number of Stored Records procedure - No records]

- Test Purpose

  Verify that the IUT responds properly if the Report Number of Stored Records procedure is performed with an Operator of Greater than or equal to and with a filter criteria not matching the available records.

- Reference

  [6] 3.6.2.1, 3.6.3.2

- Initial Condition

  - The Lower Tester knows the last sequence number by performing the Report Stored Records procedure with the Operator All records.
  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.

- Test Procedure

  1. The Lower Tester writes the Report Number of Stored Records Op Code (0x04) to the RACP characteristic using an Operator of Greater than or equal to (0x03), an Operand Sequence Number (0x01), and a filter value.
  2. The IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Number of Stored Records Response Op Code (0x05), an Operator of Null (0x00), and an Operand representing that no records were found (0x0000).
  3. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.

- Expected Outcome

  Pass verdict

  The IUT sends an indication of the RACP characteristic with the Number of Stored Records Response Op Code (0x05) and an Operand representing that no records were found (0x0000).

BLS/SEN/RAD/BV-01-C [Delete Stored Records procedure]

- Test Purpose

  Verify that the IUT can perform the Delete Stored Records procedure with the combination of Operators and Operands listed in Table 4.11.

- Reference

  [6] 3.6.2.1, 3.6.3.3

- Initial Condition

  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.

- Test Procedure

  1. Perform an action on the IUT that will induce it to generate at least 3 records.
  2. The Lower Tester knows the Sequence Number for the generated records.
  3. For each <Outer Loop: Operator> in Table 4.11, perform the following steps:

     a. For each <Inner Loop: Operand Filter Type> in Table 4.11, perform the following steps:

        i. The Lower Tester writes the Delete Stored Records Op Code (0x02) to the RACP characteristic using the listed <Outer Loop: Operator>, <Inner Loop: Operand Filter Type>, and corresponding filter parameter(s).

        ii. IF the <Outer Loop: Operator> is NOT supported, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x02), followed by the Response Code Value for Operator not supported (0x04).

        iii. ELSE IF the <Inner Loop: Operand Filter Type> is NOT supported, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x02), followed by the Response Code Value for Operand not supported (0x09).

        iv. ELSE IF for the <Inner Loop: Operand Filter Type> NO corresponding records exist in the requested filter value range, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x02), followed by the Response Code Value for No Records Found (0x06).

        v. ELSE, the IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x02), followed by the Response Code Value for Success (0x01).

        vi. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.

     b. The Lower Tester verifies that the required records have been deleted by performing the Report Stored Records (0x01) with Operator All records.

     c. Perform an action on the IUT that will induce it to generate at least 3 records.

     d. Verify that the Lower Tester knows the Sequence Number for the generated records.

  4. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  For each combination of <Outer Loop: Operator> and <Inner Loop: Operand Filter Type>, the IUT sends:

  - One indication of the RACP characteristic containing a valid Operator and Operand for each operation (Combination supported) and the required records are deleted.

    OR

  - The appropriate error message (Combination not supported).

BLS/SEN/RAA/BV-01-C [Abort Operation procedure]

- Test Purpose

  Verify that the IUT can perform an Abort Operation of the Report Stored Records procedure with a Null Operator and no Operand.

- Reference

  [6] 3.6.2.1, 3.6.3.4

- Initial Condition

  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.

- Test Procedure

  1. Perform an action on the IUT that will induce it to generate enough records such that the transmission is not able to complete before an abort procedure is attempted.
  2. The Lower Tester writes the Report Stored Records Op Code (0x01) to the RACP characteristic using an Operator of All records (0x01) and no Operand.
  3. The IUT starts to send ATT_Handle_Value_Notification of the Blood Pressure Record characteristic.
  4. The Lower Tester writes the Abort Operation Op Code (0x03) to the RACP characteristic with an Operator of Null (0x00) and no Operand.
  5. The IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x03), followed by the Response Code for Success (0x01).
  6. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.
  7. Verify that the notifications stop.

- Expected Outcome

  Pass verdict

  The IUT sends some, but not all, notifications of the Blood Pressure Record characteristic.

  The IUT sends one indication of the RACP characteristic with the Response Code Op Code containing a valid Operator and Operand for Abort Operation.

BLS/SEN/RAE/BI-01-C [RACP - Procedure Already in Progress]

- Test Purpose

  Verify that the IUT responds appropriately when a Lower Tester attempts to perform an RACP procedure before another RACP procedure is completed.

- Reference

  [6] 3.6.3.1, 3.6.4

- Initial Condition

  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.
  - Perform an action on the IUT that will induce it to generate several (~100) records.

- Test Procedure

  1. The Lower Tester writes the Report Stored Records Op Code (0x01) to the RACP characteristic using a combination of a supported Operator and, if applicable, Operand.
  2. Before the procedure is completed, the Lower Tester performs the same procedure again by writing the Report Stored Records Op Code (0x01) to the RACP characteristic using a combination of a supported Operator and, if applicable, Operand.
  3. The IUT sends an ATT_Error_Response with Error Code Procedure Already in Progress (0xFE).
  4. Verify that the IUT response meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The IUT rejects the Write Request to start the second procedure and responds with an ATT_Error_Response with Error Code set to Procedure Already in Progress (0xFE).

BLS/SEN/RAE/BI-02-C [RACP - No Records Found]

- Test Purpose

  Verify that the IUT responds properly if the Report Stored Records procedure is performed using an Operator Greater than or equal to, which requests records that do not exist.

- Reference

  [6] 3.6.3.1, 3.6.4

- Initial Condition

  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.
  - The Lower Tester knows the last Sequence Number by performing the Report Stored Records procedure with the Operator All records.

- Test Procedure

  1. The Lower Tester writes the Report Stored Records Op Code (0x01) to the RACP characteristic using an Operator Greater than or equal to (0x03) and Operand Sequence Number (0x01), which request records that do not exist.
  2. The IUT sends an ATT_Handle_Value_Indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x01), followed by the Response Code Value for No Records Found (0x06).
  3. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.

- Expected Outcome

  Pass verdict

  The IUT sends an indication of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and an Operand representing the Request Op Code (0x01), followed by the Response Code Value for No Records Found (0x06).

4.9.1 RACP Opcode, Operator not supported, and Invalid Operand test cases

- Test Purpose

  For each selected test case in Table 4.12, verify that the IUT responds with the <Request Op Code, Response Code Value> when a Lower Tester writes the <Op Code, Operator and Operand>, described in Table 4.12, to the RACP characteristic.

- Reference

  [6] 3.6.3.1, 3.6.4

- Initial Condition

  - Perform the preamble described in Section 4.2.2 to enable the IUT for use with the RACP characteristic.

- Test Case Configuration

Test Case ID	Op Code, Operator and Operand	Request Op Code, Response Code Value
BLS/SEN/RAE/BI-03-C [RACP – Op Code not Supported]	Op Code = RFU value Operator = 0x01 (All records) Operand = N/A	Request Op Code = RFU value Response Code Value = 0x02 (Op Code Not Supported)
BLS/SEN/RAE/BI-04-C [RACP – Operator not Supported]	Op Code = 0x01 (Report Stored Records) Operator = RFU value Operand = 0x01 (Sequence Number)	Request Op Code = 0x01 (Report Stored Records) Response Code Value = 0x04 (Operator not supported)
BLS/SEN/RAE/BI-05-C [RACP – Invalid Operator]	Op Code = 0x01 (Report Stored Records) Operator = 0x00 (Null) Operand = 0x01 (Sequence Number)	Request Op Code = 0x01 (Report Stored Records) Response Code Value = 0x03 (Invalid Operator)

Table 4.12: RACP Op Code, Operator and Operand error handling test cases

- Test Procedure

  For each selected test case in Table 4.12, perform the following steps:

  1. The Lower Tester writes the <Op Code, Operator and Operand>, as described in Table 4.12, to the RACP characteristic.
  2. The IUT sends an *ATT_Handle_Value_Indication* of the RACP characteristic with the Response Code Op Code (0x06), an Operator of Null (0x00), and the Operand with the <Request Op Code, Response Code Value> described in Table 4.12.
  3. The IUT receives an ATT_Handle_Value_Confirmation from the Lower Tester.

- Expected Outcome

  Pass verdict

  For each selected test case, the IUT sends an indication of the RACP characteristic with <Request Op Code, Response Code Value> as described in Table 4.12.

5 Test case mapping

The Test Case Mapping Table (TCMT) maps test cases to specific requirements in the ICS. The IUT will be tested in all roles for which support is declared in the ICS document.

The columns for the TCMT are defined as follows:

Item: Contains a logical expression based on specific entries from the associated ICS document. Contains a logical expression (using the operators AND, OR, NOT as needed) based on specific entries from the applicable ICS document(s). The entries are in the form of y/x references, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS document for BLS [4].

Feature: A brief, informal description of the feature being tested.

Test Case(s): The applicable test case identifiers required for Bluetooth Qualification if the corresponding y/x references defined in the Item column are supported.

For the purpose and structure of the ICS/IXIT and instructions for completing the ICS/IXIT, refer to the Bluetooth ICS and IXIT Proforma documents .

Item	Feature	Test Case(s)
BLS 2/1	Blood Pressure Service	BLS/SEN/SGGIT/SER/BV-01-C
BLS 2/2	Blood Pressure Measurement Characteristic	BLS/SEN/SGGIT/CHA/BV-02-C BLS/SEN/CON/BV-01-C BLS/SEN/CI/BV-01-C
BLS 2/3	Time Stamp field of Blood Pressure Measurement Characteristic	BLS/SEN/CI/BV-02-C
BLS 2/4	Pulse Rate field of Blood Pressure Measurement Characteristic	BLS/SEN/CI/BV-03-C
BLS 2/5	User ID field of Blood Pressure Measurement Characteristic	BLS/SEN/CI/BV-04-C
BLS 2/6	Measurement Status field of Blood Pressure Measurement Characteristic	BLS/SEN/CI/BV-05-C
BLS 2/7	Intermediate Cuff Pressure Characteristic	BLS/SEN/SGGIT/CHA/BV-03-C BLS/SEN/CON/BV-02-C BLS/SEN/CN/BV-01-C
BLS 2/8	Time Stamp field of Intermediate Cuff Pressure Characteristic	BLS/SEN/CN/BV-02-C
BLS 2/9	Pulse Rate field of Intermediate Cuff Pressure Characteristic	BLS/SEN/CN/BV-03-C
BLS 2/10	User ID field of Intermediate Cuff Pressure Characteristic	BLS/SEN/CN/BV-04-C
BLS 2/11	Measurement Status field of Blood Pressure Characteristic	BLS/SEN/CN/BV-05-C
BLS 2/12 AND NOT BLS 2d/2	Blood Pressure Feature Characteristic	BLS/SEN/SGGIT/CHA/BV-04-C
BLS 2d/2	Blood Pressure Feature indication	BLS/SEN/SGGIT/CHA/BV-09-C BLS/SEN/SGGIT/ISFC/BV-01-C
BLS 2/13	Stored Measurements	BLS/SEN/SP/BV-01-C

Item	Feature	Test Case(s)
BLS 2/15	Multiple Bond	BLS/SEN/CR/BV-02-C
BLS 2/17	E2E CRC	BLS/SEN/CR/BV-03-C
BLS 2/18	User Data Service	BLS/SEN/CR/BV-04-C
BLS 2/19	User Facing Time	BLS/SEN/CR/BV-05-C
BLS 2/20	Enhanced Blood Pressure Measurement	BLS/SEN/SGGIT/CHA/BV-05-C BLS/SEN/CON/BV-03-C BLS/SEN/CI/BV-06-C
BLS 2a/1	Time Stamp field of Enhanced Blood Pressure Measurement characteristic	BLS/SEN/CI/BV-07-C BLS/SEN/SP/BV-02-C
BLS 2a/2	Pulse Rate field of Enhanced Blood Pressure Measurement characteristic	BLS/SEN/CI/BV-08-C
BLS 2a/3	User ID field of Enhanced Blood Pressure Measurement characteristic	BLS/SEN/CI/BV-09-C
BLS 2a/4	Measurement Status field of Enhanced Blood Pressure Measurement characteristic	BLS/SEN/CI/BV-10-C
BLS 2a/1 AND BLS 2a/5	Time Stamp and User Facing Time field of Enhanced Blood Pressure Measurement characteristic	BLS/SEN/CI/BV-11-C BLS/SEN/SP/BV-04-C
BLS 2/21	Enhanced Intermediate Cuff Pressure	BLS/SEN/SGGIT/CHA/BV-06-C BLS/SEN/CON/BV-04-C BLS/SEN/CN/BV-06-C
BLS 2b/1	Time Stamp field of Enhanced Intermediate Cuff Pressure characteristic	BLS/SEN/CN/BV-07-C
BLS 2b/2	Pulse Rate field of Enhanced Intermediate Cuff Pressure characteristic	BLS/SEN/CN/BV-08-C
BLS 2b/3	User ID field of Enhanced Intermediate Cuff Pressure characteristic	BLS/SEN/CN/BV-09-C
BLS 2b/4	Measurement Status field of Enhanced Intermediate Cuff Pressure characteristic	BLS/SEN/CN/BV-10-C
BLS 2b/1 AND BLS 2b/5	User Facing Time field of Enhanced Intermediate Cuff Pressure characteristic	BLS/SEN/CN/BV-11-C
BLS 2a/1 AND BLS 2/24	Stored Enhanced Blood Pressure Measurements – Time Stamp with Epoch Start 2000	BLS/SEN/SP/BV-03-C
BLS 2a/1 AND BLS 2a/5 AND BLS 2/24	Stored Enhanced Blood Pressure Measurements – Time Stamp and User Facing Time with Epoch Start 2000	BLS/SEN/SP/BV-05-C
BLS 2/22	RACP characteristic	BLS/SEN/SGGIT/CHA/BV-07-C BLS/SEN/RAE/BI-03-C
BLS 2/23	Blood Pressure Record characteristic	BLS/SEN/SGGIT/CHA/BV-08-C
BLS 2c/1	Report Stored Records	BLS/SEN/RAR/BV-01-C BLS/SEN/SGGIT/CP/BI-01-C BLS/SEN/RAE/BI-01-C BLS/SEN/RAE/BI-02-C BLS/SEN/RAE/BI-04-C BLS/SEN/RAE/BI-05-C

Item	Feature	Test Case(s)
BLS 2c/2	Report Number of Stored Records	BLS/SEN/RAN/BV-01-C BLS/SEN/RAN/BV-02-C
BLS 2c/3	Delete Stored Records	BLS/SEN/RAD/BV-01-C
BLS 2c/4	Abort Operation	BLS/SEN/RAA/BV-01-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
	D09R01	11-02-07	Initial draft for review.
	D09R02	11-04-09	Updated to synchronize with latest BP service. Corrected issues brought up at IOP. Version used for IOP.
	D09R03	11-08-28	Accepted all changes to address issues for IOP. Incorporated relevant changes from recent HRS.TS and HTS.TS changes since April 9. Updated to align with BLS D09r06. Incorporated feedback from MED WG reviews.
	D09R04	11-09-10	Accepted all changes. Submitted for BTI review. Incorporated feedback from BTI. Incorporated feedback from BARB review.
	D09R05	11-09-10	Accepted all changes. Version used at IOP.
	D1.0.0r1	11-09-29	Addressed BTI feedback received prior to IOP. Added two test cases for uncommon intermediate cuff pressure fields. Revise TP/SD/BV-01-C to look for primary or secondary service declarations. Added test case for multi-bond support bit. Updated for BTI review.
	D1.0.0r2	11-10-10	Incorporated BTI feedback. Updated TP/SD/BV-01-C. Added values in some tables.
	D1.0.0r3	11-10-10	Accepted all changes.
	D1.0.0r4	11-10-15	Incorporated BTI feedback.
0	1.0.0	11-10-25	Adopted by the Bluetooth SIG Board of Directors
	1.0.1r01	2013-08-15	TSE 5239: Edited Step 2 of the test procedure and updated the MSC for TP/SD/BV-01-C.
1	1.0.1	2013-12-03	Prepare for Publication
	1.0.2r00	2016-06-07	Converted to current document template. Removed “Otherwise” or similar Fail verdicts. Converted to new Test Case ID conventions as defined in TSTO v4.1.
2	1.0.2	2016-07-13	Prepared for TCRL 2016-1 publication.
	1.0.3r00	2018-03-14	TSE 10482 (rating 3): Template conversion. Revise TCMT for BLS/SEN/CR/BV-02-C to map to newly added ICS item 2/15. Add BLS/SEN/CR/BV-02-C to Table 4.4.
3	1.0.3	2018-06-27	Approved by BTI. Prepared for TCRL 2018-1 publication.
	1.0.4r00	2018-10-02	TSE 11005 (rating 1): Updated references for BLS/SEN/CN/BV-02-C – 05-C.
4	1.0.4	2018-11-21	Approved by BTI. Prepared for TCRL 2018-2 publication.

Publication Number	Revision Number	Date	Comments
	1.0.5r00–r02	2019-04-03 – 2019-05-31	TSE 11698 (rating 2): Updated test cases BLS/SEN/CN/BV-01-C – 05-C to change the order of steps 1 and 2. TSE 11697 (rating 2): Updated step 2 of test procedure for BLS/SEN/CI/BV-01-C. TSE 11698 (rating 2): Updated text to remove two instances of “Enhanced” from test case BLS/SEN/CN/BV-01-C per comment #46353.
5	1.0.5	2019-07-29	Approved by BTI. Prepared for TCRL 2019-1 publication.
	1.1.0r00–r15	2018-06-10 – 2020-06-03	Updated TS based on BLS v1.1 d03 CR. Updated TS based on BLS v1.1 d04 CR. Updated TS based on BLS v1.1 CR r07 specification with the updated segmentation scheme. Updated TS based on BLS v1.1 d08 CR and BLS.ICS 1.1.0r03. Added the Service GGIT test cases for the enhanced Blood Pressure characteristics. Removed the UDS consent requirement from test cases as the UDS consent requirement is tested in the BLP.TS and updated TCMT. Removed the Operator *Equal to* from RACP procedures as the Operator has been removed from BLS PS v1.1 specification. Editorial changes per feedback from the Formal IOP held in Chambery. TSE 11697 and TSE 11698. Proposed TS version for D1.1 review and approval. Incorporated feedback from BTI and Med WG. Updated applicable legacy test cases to GGIT test cases. Updated Section 4.6 by adding BLS/SEN/CI/BV-06-C to Table 4.5. Updated the GGIT tests to conform to TSE 13087. Updated TCMT. Updated TCIDs to Header 8 and TOC 8 style into the table of content. Clarified Pass verdict in BLS/SEN/CN/BV-06-C. Updated ICP GGIT test cases. Updated the TCIDs by introducing the new individual TCID and table/group TCID headings. Added TSE 13325 and 13326 comments to applicable test cases. Replaced SGGIT/ICP TCs with standalone TCs BLS/SEN/RAE/BI-03-I to 05-I (Errata ID 14849). Incorporated feedback from BTI. Added TSE 15066 and 15067.
6	p6	2020-12-22	Set publication number for previous v1.0.5 to p5. Approved by BTI on 2020-07-06. BLS v1.1 adopted by BoD on 2020-12-15. Prepared for publication.

Publication Number	Revision Number	Date	Comments
	p7r00–r06	2021-02-22 – 2021-12-13	TSE 16862 (rating 4): Implemented changes from E16461. Added new test group ISFC. New test cases added BLS/SEN/SGGIT/CHA/BV-09-C and BLS/SEN/SGGIT/ISFC/BV-01-C. Added TCMT for the new test cases and updated TCMT for BLS/SEN/SGGIT/CHA/BV-04-C. Minor editorial updates to the preambles. TSE 18043 (rating 1): Removed direct references to GATT test cases in the following test cases: BLS/SEN/CON/BV-01-C – -04-C, BLS/SEN/CR/BV-02-C – -05-C. Made editorial updates, including updating the copyright page to align with the latest DNMD. Updated Scope and the introduction text before the TCMT to align with the template.
7	p7	2022-01-25	Approved by BTI on 2022-01-06. Prepared for TCRL 2021-2 publication.

Acknowledgments

Name	Company
Jörg Brakensiek	Bluetooth SIG, Inc.
Ismail Mohamud	Bluetooth SIG, Inc.
Joe Decuir	CSR
Amit Gupta	CSR
Bob Hughes	Intel
Erik Moll	Koninklijke Philips N.V.
Huanchun Ye	Mediatek
Tetsu Nishimura	Murata
Greg Stewart	TI