Link Loss Service (LLS)

***Bluetooth*® Test Suite**

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Contents

1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and test cases to test the implementation of the Bluetooth Link Loss Service (LLS) 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 provisions from other publications by dated or undated reference. These references are cited at the appropriate places in the text, and the publications are listed hereinafter. Additional definitions and abbreviations can be found in [1], [2], and [3].

[1] Test Strategy and Terminology Overview

[2] Bluetooth Core Specification, Version 4.0 or later

[3] Link Loss Service Specification, Version 1.0 or later

[4] ICS Proforma for Link Loss Service (LLS)

[5] GATT Test Suite, GATT.TS

2.2 Definitions

In this Bluetooth document, the definitions from [1], [2], and [3] apply.

2.3 Acronyms and abbreviations

In this Bluetooth document, the acronyms and abbreviations from [1], [2], and [3] apply.

3 Test Suite Structure (TSS)

3.1 Overview

The Link Loss Service requires GAP, SM, and GATT. This is illustrated in Figure 3.1.

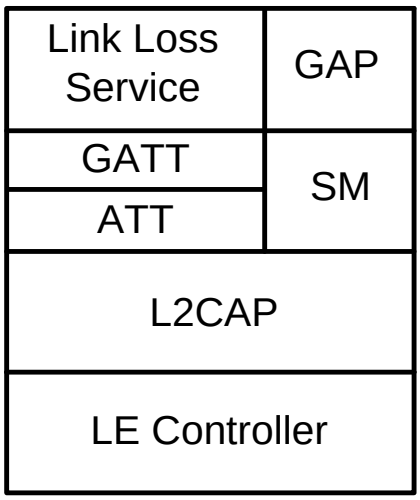

Figure 3.1: Link Loss Service test model

3.2 Test Strategy

The test objectives are to verify the functionality of the Link Loss Service within a Bluetooth Host and enable interoperability between Bluetooth Hosts on different devices. The testing approach covers mandatory and optional requirements in the specification and matches 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
- Characteristic Write
- Service 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 to 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>**
LLS	Link Loss Service
Identifier Abbreviation	**Role Identifier <IUT role>**
SR	Server Role
Identifier Abbreviation	**Reference Identifier <GGIT test group>**
SGGIT	Server Generic GATT Integrated Tests
Identifier Abbreviation	**Reference Identifier <GGIT class>**
CHA	Characteristic
SER	Service
Identifier Abbreviation	**Feature Identifier <feat>**
CR	Characteristic Read
CW	Characteristic Write
SP	Service Procedures

Table 4.1: LLS TC feature naming conventions

4.1.2 Conformance

When conformance is claimed for a particular specification, all capabilities are to be supported in the specified manner. 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 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 to constitute a Pass verdict. However, it is noted that 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, with 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 erratum 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, then 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

Follow the preamble procedure described in [5] Section 4.2.1.2.

4.3 Generic GATT Integrated Tests

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

TCID	Service / Characteristic	Reference	Properties	Value Length (Octets)	Service Type
LLS/SR/SGGIT/SER/BV-01-C [Service GGIT – Link Loss]	Link Loss Service	[3] 2	-	-	Primary Service, Unique
LLS/SR/SGGIT/CHA/BV-01-C [Characteristic GGIT – Alert Level]	Alert Level Characteristic	[3] 3	0x0A (Read, Write)	Skip	-

Table 4.2: Input for the GGIT Server test procedure

4.4 Characteristic Read

Verify that the characteristics that support read can be read and the value meets the requirements of the service.

LLS/SR/CR/BV-01-C [Characteristic Read – Alert Level]

- Test Purpose

  Read and verify characteristic value.

- Reference

  [3] 3.1.1

- Initial Condition

  - The handle of the Alert Level characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3 or is known to the Lower Tester by other means.
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - 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 Procedure

  1. The Lower Tester reads the Alert Level characteristic value by sending an ATT_READ_REQ to the IUT.
  2. Verify that the characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

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

4.5 Characteristic Write

Verify that the characteristics that support write can be written.

LLS/SR/CW/BV-01-C [Characteristic Write – Alert Level]

- Test Purpose

  Write characteristic value.

- Reference

  [3] 3.1.1

- Initial Condition

  - The handle of the Alert Level characteristic has been previously discovered by the Lower Tester during the test procedure in Section 4.3 or is known to the Lower Tester by other means.
  - If the IUT requires a bonding procedure then perform a bonding procedure.

- Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.

- Test Procedure

  1. Select a value that is valid for the characteristic. The Lower Tester writes a valid value to the Alert Level characteristic by sending an ATT_WRITE_REQ PDU to the IUT.
  2. Verify that the characteristic value is successfully written and that the value returned when read is consistent with the value written.

- Expected Outcome

  Pass verdict

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

4.6 Service Procedures

Verify the operation of additional procedures defined in the service specification.

LLS/SR/SP/BV-01-C [Disconnection Behavior: Mild Alert]

- Test Purpose

  Verify that the IUT starts alerting at a specific level when the connection is lost.

- Reference

  [3] 4.1

- Initial Condition

  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.

- Test Procedure

  1. Run the procedure described in test case LLS/SR/CW/BV-01-C [Characteristic Write – Alert Level] with the alert level set to “Mild Alert”.
  2. Disconnect the link by interrupting the radio communication between the two devices, without sending a disconnection command.

- Expected Outcome

  Pass verdict

  The IUT starts alerting with a Mild Alert when the connection is lost. (Note: The alerting action is implementation specific.)

LLS/SR/SP/BV-02-C [Disconnection Behavior: High Alert]

- Test Purpose

  Verify that the IUT starts alerting at a specific level when the connection is lost.

- Reference

  [3] 4.1

- Initial Condition
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
- Test Procedure
  1. Run the procedure described in test case LLS/SR/CW/BV-01-C [Characteristic Write – Alert Level] with the alert level set to “High Alert”.
  2. Disconnect the link by interrupting the radio communication between the two devices, without sending a disconnection command.
- Expected Outcome

  Pass verdict

  The IUT starts alerting with a High Alert when the connection is lost. (Note: The alerting action is implementation specific.)

LLS/SR/SP/BV-03-C [Disconnection Behavior: No Alert]

- Test Purpose

  Verify that the IUT starts alerting at a specific level when the connection is lost.
- Reference

  [3] 4.1
- Initial Condition
  - If the IUT requires a bonding procedure then perform a bonding procedure.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
- Test Procedure
  1. Run the procedure described in test case LLS/SR/CW/BV-01-C [Characteristic Write – Alert Level] with the alert level set to “No Alert”.
  2. Disconnect the link by interrupting the radio communication between the two devices, without sending a disconnection command.
- Expected Outcome

  Pass verdict

  The IUT does not start alerting when the connection is lost.

5 Test case mapping

The Test Case Mapping Table (TCMT) maps test cases to specific requirements in the ICS. The IUT is 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 Link Loss Service (LLS) [4].

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

Test Case(s): The applicable test case identifiers are required for Bluetooth Qualification if the corresponding y/x references defined in the Item column are supported. Further details about the function of the TCMT are elaborated in [1].

For the purpose and structure of the ICS/IXIT, refer to [1].

Item	Feature	Test Case(s)
LLS 2/1	Discover Link Loss Service	LLS/SR/SGGIT/SER/BV-01-C
LLS 2/2	Alert Level Characteristic	LLS/SR/SGGIT/CHA/BV-01-C
LLS 2/3	Alert Level Characteristic, Read	LLS/SR/CR/BV-01-C
LLS 2/4	Alert Level Characteristic, Write	LLS/SR/CW/BV-01-C
LLS 2/5	Disconnection Behavior	LLS/SR/SP/BV-01-C LLS/SR/SP/BV-02-C LLS/SR/SP/BV-03-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
0	1.0.0	2011-06-26	Prepare for publication.
	1.0.1.0	2015-05-20	ESR08: Incremented revision number to match spec (1.0.1) and added 4th digit for TS revision (1.0.1.0)
1	1.0.1.0	2015-07-14	Prepared for TCRL 2015-1 publication
	1.0.1.1r00	2016-05-25	Converted to new Test Case ID conventions as defined in TSTO v4.1.
	1.0.1.1r01	2016-06-02	Converted to current TS template
2	1.0.1.1	2016-07-14	Prepared for TCRL 2016-1 publication.
	1.0.1.2r00	2016-08-18	TSE 7368: Deleted test case LLS/SR/SDP/BV-01-C and its entry in the TCMT.
	1.0.1.2	2016-12-13	Approved by BTI. Prepared for TCRL 2016-2 publication.
	1.0.1.2 edition 2r00	2018-11-29	Editorial changes only. Template updated. Revision History and contributors moved to the end of the document.
	1.0.1.2 edition 2	2020-01-07	Updated copyright page and confidentiality markings to support new Documentation Marking Requirements, performed minor formatting updates, and accepted all tracked changes to prepare for edition 2 publication.
	p3r00–r02	2022-10-24 – 2022-11-14	TSE 20379 (rating 2): Removed references to ATT Bearer connection on BR/EDR transport. Updated to align with current TS conventions/template. Performed additional template-related formatting fixes. Replaced the Bluetooth logo in the footer and updated the copyright page to align with v2 of the DNMD. Changed section titles for single test cases to Heading 8 per TS template.
3	p3	2023-02-07	Approved by BTI on 2022-12-28. Prepared for TCRL 2022-2 publication.
	p4r00–r01	2023-05-04 – 2023-05-18	TSE 22814 (rating 2): Converted the following test cases to GGIT: LLS/SR/SD/BV-01-C and LLS/SR/DEC/BV-01-C. The new GGIT converted TCIDs are: LLS/SR/SGGIT/SER/BV-01-C and LLS/SR/SGGIT/CHA/BV-01-C. Updated the TCMT accordingly.
4	p4	2023-06-29	Approved by BTI on 2023-05-28. Prepared for TCRL 2023-1 publication.

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