Link Loss Service

*Bluetooth® Test Specification*

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- **Group Prepared by**: BTI
- **Feedback Email**: bti-main@bluetooth.org
- **Abstract**
  
  This document defines test structures and procedures for conformance test of products implementing the Link Loss Service Specification.
### Revision History

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<td>2011-01-11</td>
<td>Initial draft (based on Immediate Alert Service TS)</td>
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1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the Bluetooth Link Loss Service Specification.

The objective of this test specification is to provide a basis for interoperability tests for Bluetooth devices giving a high probability of air interface interoperability between different manufacturers' Bluetooth devices.
2 References, Definitions, and Abbreviations

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

[1] Bluetooth Test Strategy and Terminology Overview
[2] Bluetooth Core Specification, Version 4.0 or later
[3] Link Loss Service Specification v1.0 or later

2.2 Definitions
For the purpose of this Bluetooth document, the definitions from [1] and [2] apply.

2.3 Abbreviations
For the purpose of this Bluetooth document, the definitions from [1] and [2] 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.

<table>
<thead>
<tr>
<th>Link Loss Service</th>
<th>GAP</th>
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<tr>
<td>GATT</td>
<td>SM</td>
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<td>ATT</td>
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<tr>
<td>L2CAP</td>
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<td>LE Controller</td>
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</table>

*Figure 3.1: Link Loss Service Test Model*

3.2 Test Strategy

The test objectives are to verify functionality of the Link Loss 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 Proforma.

The basis for the test approach is the general concepts and conformance testing principles defined in ISO/IEC 9646-1 and ISO/IEC 9646-2; both are part of the OSI Conformance Testing Methodology and Framework (CTMF).

The conformance test equipment shall provide an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in the Link Loss Service Test Specification. 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, an MMI, or another interface supported by the IUT.

The Link Loss Service 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 cataloged specification requirements that were logically grouped and assessed for testability enabling coverage in defined test purposes.
The test suite structure is a tree with the first level representing the protocol groups as listed in section 3.3.

### 3.3 Test Groups

The following test groups have been defined.

**3.3.1 Service Definition**
Verify the service definition.

**3.3.2 Characteristic Declaration**
Verify the presence and contents of characteristic declarations.

**3.3.3 Characteristic Read**
Verify characteristics which support reading can be read. Verify the format and value of characteristic values.

**3.3.4 Characteristic Write**
Verify characteristics which support writing can be written.

**3.3.5 Service Procedures**
Verify the operation of procedures defined in the service specification.
4 Test Cases

4.1 Introduction

4.1.1 Test Case Identification Conventions

Test cases shall be assigned unique identifiers per the conventions in [1]. The convention used here is <spec abbreviation>/<IUT role>/<class>/<xx>-<nn>-<y>.

Test group abbreviations for class, feature, function, sub-function or capability (as applicable to this test specification) are defined in Table 4.1.

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Class Identifier &lt;class&gt;</th>
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<td>LLS</td>
<td>Link Loss Service</td>
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<td>SR</td>
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<td>SD</td>
<td>Service Definition</td>
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<td>DEC</td>
<td>Characteristic Declaration</td>
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<td>CR</td>
<td>Characteristic Read</td>
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<tr>
<td>CW</td>
<td>Characteristic Write</td>
</tr>
<tr>
<td>SP</td>
<td>Service Procedures</td>
</tr>
</tbody>
</table>

Table 4.1: Link Loss Service TC Class Naming Convention

4.1.2 Conformance

When conformance is claimed, all capabilities indicated as mandatory for this Specification 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 certification program.

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, OR
- That capabilities enabled by the implementations are sustained over durations expected by the use case, OR
- That the implementation gracefully handles any quantity of data expected by the use case, OR
• That in cases where more than one valid interpretation of the Specification exist, the implementation complies with at least one interpretation and gracefully handles other interpretations OR

• 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 Generator, the Test Case as described in the Test Specification, 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, which outlines all the detailed pass criteria conditions that shall be met by the IUT to merit a Pass Verdict.

The convention in this test specification is that, unless there are 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 and in case this occurs the outcome of the test shall be the Fail Verdict.

4.2 Setup Preambles

The procedures defined in this section are provided for information, as they are used by test equipment in achieving the initial conditions in certain tests.

4.2.1 ATT Bearer on LE Transport

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

4.2.2 ATT Bearer on BR/EDR Transport

Follow the preamble procedure described in [5] section 4.2.1.1.

4.3 Service Definition

Verify the service definition.

4.3.1 LLS/SR/SD/BV-01-C [Service Definition]

• Test Purpose

  Verify that the IUT has one instantiation of the Link Loss Service as a primary service.

• Reference

  [3] 2

• Initial Condition
Establish an ATT Bearer connection between the Lower Tester and IUT as described in section 4.2.1 or section 4.2.2.

- Test Procedure
  1. Discover all primary services by executing the test procedure of GATT test case GATT/SR/GAD/BV-01-C, Discover All Primary Services, in [5] or primary services by service UUID by executing the test procedure of GATT test case GATT/SR/GAD/BV-02-C, Discover Primary Services by Service UUID in [5] with the service UUID set to «Link Loss».
  2. Verify one attribute handle range with the service UUID set to «Link Loss» is returned, containing the starting handle and the ending handle of the service definition.

- Expected Outcome
  Pass verdict
  One attribute handle range with the service UUID set to «Link Loss» is returned, containing the starting handle and the ending handle of the service definition.

4.4 Characteristic Declaration

This test group contains test cases to verify that the characteristic property field of the characteristic declaration meets the requirements of the service.

4.4.1 LLS/SR/DEC/BV-01-C [Characteristic Declaration – Alert Level]

- Test Purpose
  Verify the presence of and contents of the characteristic declaration specified by the service.

- Reference
  [3] 3

- Initial Condition
  The handle range of the service has been previously discovered by the Lower Tester in test case LLS/SR/SD/BV-01-C [Service Definition].

  Establish an ATT Bearer connection between the Lower Tester and IUT as described in section 4.2.1 or section 4.2.2.

- Test Procedure
  1. Discover all characteristics of the service by executing the test procedure of GATT test case GATT/SR/GAD/BV-04-C, Discover All Characteristics of a Service, in [5].
  2. For a discovered Alert Level characteristic that, verify the characteristic properties field of the characteristic declaration meets the requirements of the service.
• Expected Outcome

Pass verdict
The characteristic is discovered and the characteristic properties field of the characteristic declaration meets the requirements of the service.
Only one instance of the characteristic is found.

4.5 Characteristic Read
This test group contains test cases to verify that the characteristics that support read can be read and the value meets the requirements of the service.

4.5.1 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 4.4 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 or section 4.2.2.
If IUT permissions for the characteristic require a specific security mode or security level, establish a connection meeting those requirements.

• Test Procedure
1. Read the characteristic value by executing the test procedure of GATT test case GATT/SR/GAR/BV-01-C, Read Characteristic Value - from Server, in [5].
2. Verify 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.
### 4.6 Characteristic Write

This test group contains test cases to verify that the characteristics that support write can be written.

#### 4.6.1 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 4.4 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 or section 4.2.2.

- **Test Procedure**
  
  1. Select a value that is valid for the characteristic. Write the characteristic value by executing the test procedure of GATT test case of GATT test case GATT/SR/GAW/BV-03-C, Write Characteristic Value - to Server, in [5].
  
  2. Verify 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.

### 4.7 Service Procedures

This test group contains test cases to verify the operation of additional procedures defined in the service specification.

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

- **Test Purpose**
  
  Verify 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 or section 4.2.2.

• 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.)

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

• Test Purpose

Verify 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 or section 4.2.2.

• 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.)

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

- Test Purpose
  Verify 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 or section 4.2.2.

- 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 capabilities in the ICS.

The columns for the TCMT are defined as follows:

- **Item**: contains an y/x reference, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS Proforma for Link Loss Service (LLS) [4]. If the item is defined with Protocol, Profile or Service abbreviation before y/x, the table and feature number referenced are defined in the abbreviated ICS proforma document.

- **Feature**: recommended to be the primary feature defined in the ICS being tested or may be the test case name.

- **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.

- **Test Case Applicable**: may be used to note if a test is required based on the supported features.

For purpose and structure of the ICS/IXIT proforma and instructions for completing the ICS/IXIT proforma refer to the Bluetooth ICS and IXIT proforma document.

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*Table 5.1: Test Case Mapping*