Asset Tracking Profile (ATP)

Bluetooth® Test Suite

- **Revision:** ATP.TS.p1
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- **Prepared By:** DFWG
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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 Asset Tracking Profile 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] and [2].

[1]   Bluetooth Core Specification, Version 5.1 or later

[2]   Test Strategy and Terminology Overview

[3]   Bluetooth Asset Tracking Profile Specification, Version 1.0

[4]   ICS Proforma for Asset Tracking Profile, ATP.ICS

[5]   Bluetooth Constant Tone Extension Service Specification, Version 1.0

[6]   Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers

[7]   Link Layer Test Suite, LL.TS

[8]   GATT Test Suite, GATT.TS

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 Asset Tracking Profile requires the presence of GAP, SM, and GATT. This is illustrated in Figure 3.1.

Asset Tracking Profile Locator Role		
GATT		
ATT	GAP	SM
L2CAP		
Controller		

Asset Tracking Profile Asset Tag Role		
Constant Tone Extension Service		
GATT		
ATT	GAP	SM
L2CAP		
Controller		
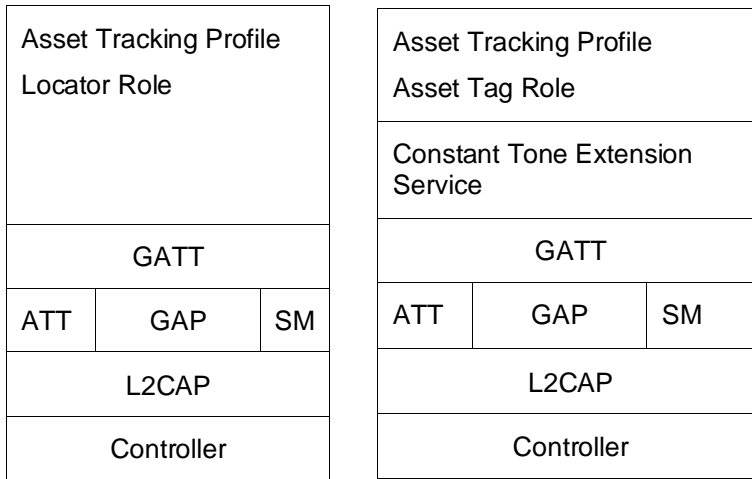
Figure 3.1: Asset Tracking Profile Test Model

3.2   Test Strategy

The test objectives are to verify functionality of the Asset Tracking Profile 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.
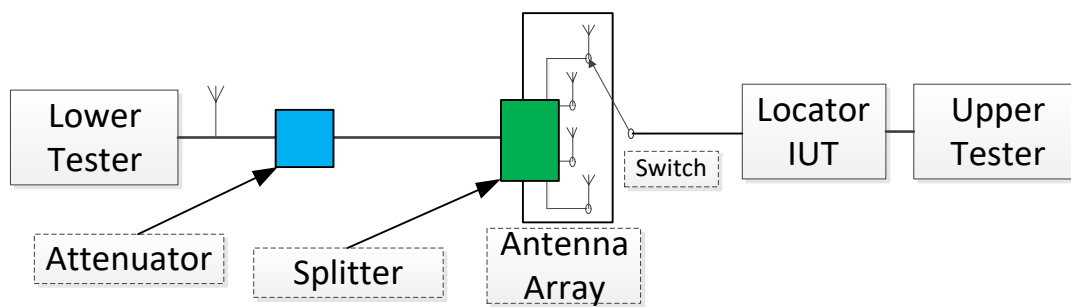
Figure 3.2: Asset Tracking Profile Test Equipment – Locator IUT
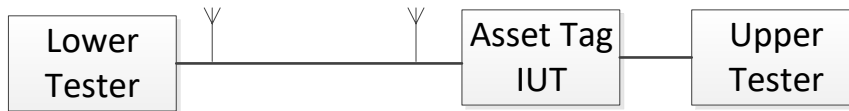
Figure 3.3: Asset Tracking Profile Test Equipment – Asset Tag IUT

The 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.

- Discover Services and Characteristics

- Asset Tracking Features

4   Test cases (TC)

4.1   Introduction

4.1.1   Test case identification conventions

Test cases are assigned unique identifiers per the conventions in [2]. 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 [8] referred to as Generic GATT Integrated Tests (GGIT); when used, the test cases in GGIT 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	Specification Identifier <spec abbreviation>
ATP	Asset Tracking Profile
Identifier Abbreviation	**Role Identifier <IUT role>**
LOC	Locator Role
TAG	Asset Tag Role
Identifier Abbreviation	**Class Identifier <class>**
ATF	Features
CGGIT	Client Generic GATT Integrated Tests
CHA	Characteristic GGIT
SER	Service GGIT

Table 4.1: Asset Tracking Profile 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 the Bluetooth SIG qualification tool, 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, the outcome of the test is a Fail verdict.

4.2   Generic GATT Integrated Tests

Execute the Generic GATT Integrated Tests defined in Section 6.4, Client test procedures (CGGIT), in [8] using Table 4.2 below as input:

TCID	Service / Characteristic / Descriptor	Reference	Properties	Value Length (Octets)
ATP/LOC/CGGIT/SER/BV-01-C [Service GGIT – Constant Tone Extension Service]	Constant Tone Extension Service	[8] 3		
ATP/LOC/CGGIT/CHA/BV-01-C [Characteristic GGIT – Constant Tone Extension Enable]	Constant Tone Extension Enable	[8] 4.3.1	0x0A (Read, Write)	1
ATP/LOC/CGGIT/CHA/BV-02-C [Service GGIT – Device Name]	Device Name	[8] 3.1.1.3	0x0A (Read, Write)	skip

Table 4.2: Input for the GGIT Server test procedure

4.3   Asset tracking features

The procedures defined in this test group verify Asset Tag Features both with the IUT in the Asset Tag and the Locator role.

ATP/TAG/ATF/BV-01-C [Constant Tone Extension Service UUID in AD]

- Test Purpose

  Verify that the Constant Tone Extension Service UUID is included in Advertising Data from the Asset Tag IUT.

- Reference

  [3] 3.1.1.1

- Initial Condition

  The IUT is powered on in GAP Discoverable Mode.

- Test Procedure

  1. The Upper Tester commands the IUT to generate advertising packets.
  2. The Lower Tester listens for advertising packets from the IUT.

- Expected Outcome

  Pass verdict

  At least one received advertising packet contains the defined Service UUID for «Constant Tone Extension Service».

ATP/TAG/ATF/BV-02-C [Local Name included in AD or Scan Response]

- Test Purpose

  Verify that the Local Name is included in Advertising Data or Scan Response Data from the Asset Tag IUT.

- Reference

  [3] 3.1.1.2

- Initial Condition

  The IUT is powered on in GAP Discoverable Mode.

- Test Procedure

  1. The Upper Tester commands the IUT to generate advertising packets.
  2. The IUT sends advertising packets.
  3. The Lower Tester sends a Scan Request to the IUT.
  4. The IUT sends Scan Response Data.

- Expected Outcome

  Pass verdict

  The IUT sends Advertising Data and Scan Response Data.

  The IUT includes the Local Name in either an advertising packet or Scan Response Data, but not both.

ATP/TAG/ATF/BV-03-C [Appearance included in AD or Scan Response]

- Test Purpose

  Verify that the value of the Appearance characteristic is included in Advertising Data or Scan Response Data from the Asset Tag IUT.

- Reference

  [3] 3.1.1.4

- Initial Condition

  The IUT is powered on in GAP Discoverable Mode.

- Test Procedure

  1. The Upper Tester commands the IUT to generate advertising packets.
  2. The IUT sends advertising packets.

3. The Lower Tester sends a Scan Request to the IUT.
4. The IUT responds with a Scan Response.

- Expected Outcome

  Pass verdict

  The IUT sends Advertising Data and Scan Response Data.

  The IUT includes the value of the Appearance characteristic in either an advertising packet or Scan Response Data, but not both.

ATP/TAG/ATF/BV-04-C [Connect and Bond to Locator]

- Test Purpose

  Verify that the Asset Tag IUT in GAP Peripheral mode connects and bonds to a Locator in GAP Central mode.

- Reference

  [3] 5, 6.1

- Initial Condition

  The IUT and the Lower Tester are not bonded.

  No connection is established between the IUT and the Lower Tester.

- Test Procedure

  1. The Upper Tester commands the IUT to enter the GAP bondable mode.
  2. The Upper Tester commands the IUT to begin advertising using GAP undirected connectable mode.
  3. The Lower Tester establishes a connection to the IUT.
  4. The Lower Tester initiates pairing and bonds to the IUT when the connection is established.
  5. The Lower Tester starts encryption.

- Expected Outcome

  Pass verdict

  The IUT bonds with the Lower Tester when the connection is established.

  The IUT uses an encrypted link after bonding.

ATP/TAG/ATF/BV-05-C [Reconnect to Bonded Locator]

- Test Purpose

  Verify that the Asset Tag IUT in GAP Peripheral mode reconnects to a previously bonded Locator in GAP Central mode.

- Reference

  [3] 5, 6.1

- Initial Condition

  The IUT and the Lower Tester are bonded.

  No connection is established between the IUT and the Lower Tester.

- Test Procedure

  1. The Upper Tester commands the IUT to begin advertising using GAP undirected connectable mode.
  2. The Lower Tester establishes a connection with the IUT.
  3. The Lower Tester starts encryption when the connection is established.

- Expected Outcome

  <u>Pass verdict</u>

  The IUT uses an encrypted link after the connection is established.

ATP/TAG/ATF/BV-06-C [Transmit Connection-Oriented AoA Constant Tone Extension Response]

- Test Purpose

  Verify that the Asset Tag IUT can transmit a Connection-Oriented AoA Constant Tone Extension to a Locator when AoA Constant Tone Extension is enabled via the Constant Tone Extension Enable characteristic.

- Reference

  [3] 3.1.1

  [1] 5.1.12

- Initial Condition

  No connection is established between the IUT and the Lower Tester.

  Bit 0 of the Constant Tone Extension Enable characteristic on the IUT has previously been set to 1 to enable AoA Constant Tone Extension responses.

- Test Procedure

  1. The Upper Tester commands the IUT to begin advertising using GAP undirected connectable mode.
  2. The Lower Tester establishes a connection with the IUT.
  3. The Lower Tester starts encryption.
  4. The Lower Tester initiates the Constant Tone Extension Request procedure with the IUT as Peripheral, as defined in [1] Vol. 6, Part B, Section 5.1.12.
  5. The IUT sends to the Lower Tester a Link Layer response packet with AoA Constant Tone Extension.
  6. The Lower Tester terminates the connection.

- Expected Outcome

  <u>Pass verdict</u>

  The IUT responds to the request for AoA Constant Tone Extension with a packet containing an AoA Constant Tone Extension.

ATP/TAG/ATF/BV-07-C [Reject Connection Constant Tone Extension Request – Responses Disabled]

- Test Purpose

  Verify that the Asset Tag IUT rejects a Connection Constant Tone Extension Request from a Locator when AoA Constant Tone Extension is disabled via the Constant Tone Extension Enable characteristic.

- Reference

  [3] 3.1.1

  [1] 5.1.12

- Initial Condition

  No connection is established between the IUT and the Lower Tester.

  Bit 0 of the Constant Tone Extension Enable characteristic on the IUT has previously been set to 0 to disable AoA Constant Tone Extension responses.

- Test Procedure

  1. The Lower Tester establishes a connection with the IUT.
  2. The Lower Tester starts encryption.
  3. The Lower Tester initiates the Constant Tone Extension Request procedure with the IUT as Peripheral, as defined in [1] Vol. 6, Part B, Section 5.1.12.
  4. The IUT sends to the Lower Tester a Link Layer response packet with a rejection PDU.
  5. The Lower Tester terminates the connection.

- Expected Outcome

  Pass verdict

  The IUT rejects the request for AoA Constant Tone Extension.

ATP/LOC/ATF/BV-08-C [Connect and Bond to Asset Tag]

- Test Purpose

  Verify that the Locator IUT in GAP Central mode connects and bonds to an Asset Tag in GAP Peripheral mode.

- Reference

  [3] 5, 6.2

- Initial Condition

  The IUT and the Lower Tester are not bonded.

  No connection is established between the IUT and the Lower Tester.

- Test Procedure

  1. The Upper Tester commands the IUT to enter the GAP bondable mode.
  2. The Lower Tester begins advertising using GAP undirected connectable mode.
  3. The IUT establishes a connection to the Lower Tester.
  4. The IUT initiates pairing and bonds to the Lower Tester when the connection is established.
  5. The IUT starts encryption.

- Expected Outcome

  Pass verdict

  The IUT initiates pairing and bonds with the Lower Tester when the connection is established.

  After bonding, the IUT starts encryption.

ATP/LOC/ATF/BV-09-C [Reconnect to Bonded Asset Tag]

- Test Purpose

  Verify that the Locator IUT in GAP Central mode reconnects to a previously bonded Asset Tag in GAP Peripheral mode.

- Reference

  [3] 5, 6.2

- Initial Condition

  The IUT and the Lower Tester are bonded.

  No connection is established between the IUT and the Lower Tester.

- Test Procedure

  1. The Lower Tester begins advertising using GAP undirected connectable mode.
  2. The IUT establishes a connection to the Lower Tester.
  3. The IUT starts encryption when the connection is established.

- Expected Outcome

  Pass verdict

  The IUT starts encryption when the connection is established.

ATP/LOC/ATF/BV-10-C [Request Connection-Oriented AoA Constant Tone Extension – Responses Disabled]

- Test Purpose

  Verify that the Locator IUT can request a Connection-Oriented AoA Constant Tone Extension from an Asset Tag when responses are disabled and handle a reject response.

- Reference

  [3] 4.4.1

  [1] 5.1.12

- Initial Condition

  - No connection is established between the IUT and the Lower Tester.

- Test Procedure

  1. The Lower Tester begins advertising using GAP undirected connectable mode.
  2. The Upper Tester commands the IUT to establish a connection with the Lower Tester.
  3. The Upper Tester commands the IUT to initiate the Constant Tone Extension Request procedure with the Lower Tester with the IUT as Central, as defined in [1] Vol. 6, Part B, Section 5.1.12.
  4. The IUT sends to the Lower Tester an AoA Constant Tone Extension Link Layer request.
  5. The Lower Tester transmits a Link Layer response packet with a rejection PDU.

6. The IUT reports to the Upper Tester the rejection with an error code.
7. The Lower Tester terminates the connection.

- Expected Outcome

Pass verdict

The IUT reports the rejected request to the Upper Tester with an error.

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 ATP [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 [2].

For the purpose and structure of the ICS/IXIT, refer to [2].

Item	Feature	Test Case(s)
ATP 5/1	Constant Tone Extension Service	ATP/LOC/CGGIT/SER/BV-01-C
ATP 5/2	Include Constant Tone Extension Service UUID in AD in GAP Discoverable Mode	ATP/TAG/ATF/BV-01-C
ATP 5/3	Include Local Name in AD or Scan Response	ATP/TAG/ATF/BV-02-C
ATP 5/5	Include Appearance in AD or Scan Response	ATP/TAG/ATF/BV-03-C
ATP 6/3	Bondable Mode (Asset Tag IUT in GAP Peripheral mode)	ATP/TAG/ATF/BV-04-C ATP/TAG/ATF/BV-05-C
ATP 8/1	Connection CTE Response	ATP/TAG/ATF/BV-06-C ATP/TAG/ATF/BV-07-C
ATP 10/2 OR ATP 11/1	Constant Tone Extension Enable Characteristic	ATP/LOC/CGGIT/CHA/BV-01-C
ATP 10/3	Device Name Characteristic	ATP/LOC/CGGIT/CHA/BV-02-C
ATP 13/10	Bondable Mode (Locator IUT in GAP Central mode)	ATP/LOC/ATF/BV-08-C
ATP 11/5	Verify Bond Status on Reconnection	ATP/LOC/ATF/BV-09-C
ATP 11/4	Request Connection Constant Tone Extension	ATP/LOC/ATF/BV-10-C

Table 5.1: Test case mapping

6   Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
0	p0	2021-01-19	Approved by BTI on 2020-12-06. ATP v1.0 adopted by BoD on 2021-01-12. Prepared for publication.
	p1r00–r01	2023-08-15 – 2023-09-08	TSE 23250 (rating 1): Converted the following TCs to -C tests: ATP/LOC/ATF/BV-08-I – -10-I and ATP/TAG/ATF/BV-01-I – -07-I. TSE 23346 (rating 2): Updated the Item and Feature values for ATP/TAG/ATF/BV-04-C and -05-C and ATP/LOC/ATF/BV-08-C in the TCMT. Editorials to align the document with the latest TS template. Deleted draft revision history comments prior to p0.
1	p1	2024-07-01	Approved by BTI on 2024-04-21. Prepared for TCRL 2024-1publication.

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