Time Profile (TIP)

***Bluetooth*® Test Suite**

- **Revision:** TIP.TS.p5
- **Revision Date:** 2024-07-01
- **Prepared By:** BTI
- **Published during TCRL:** TCRL.2024-1

Contents

1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and test cases to test the implementation of the Bluetooth Time Profile 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 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] Test Strategy and Terminology Overview

[2] Bluetooth Core Specification, Version 4.0 or later

[3] ICS Proforma for Time Profile, TIP.ICS

[4] Time Profile Specification, Version 1.0

[5] GAP Test Suite, GAP.TS

[6] SM Test Suite, SM.TS

[7] GATT Test Suite, GATT.TS

[8] Current Time Service Specification, Version 1.0

[9] Reference Time Update Service Specification, Version 1.0

[10] Next DST Change Service Specification, Version 1.0

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 Time Profile is a client of the Generic Attribute Profile (GATT). This is illustrated in Figure 3.1.

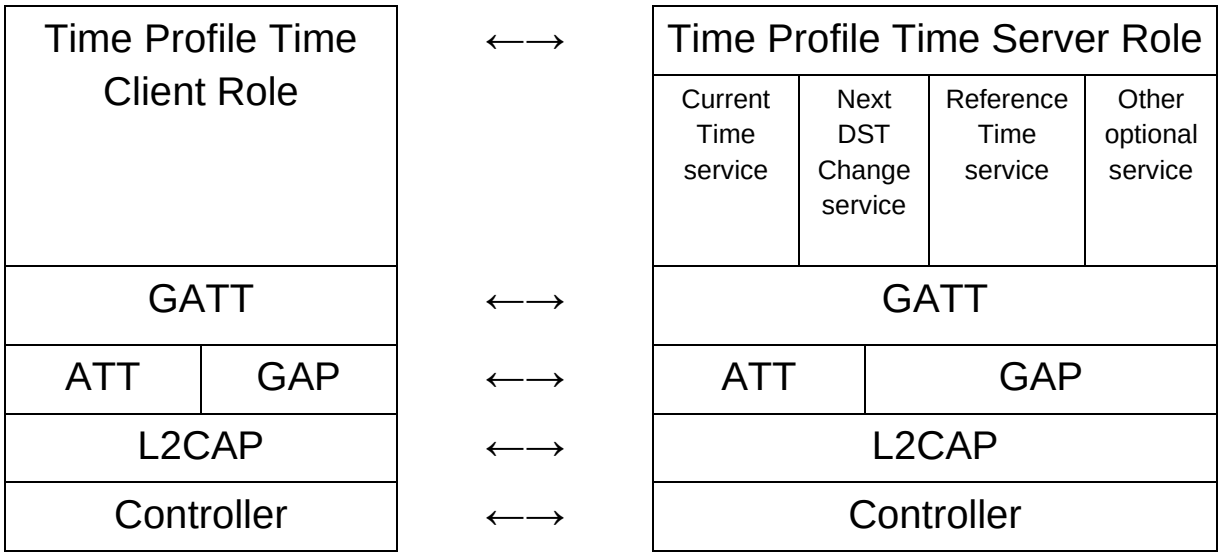

Figure 3.1: Time Profile test model

3.2 Test Strategy

The test objectives are to verify the functionality of the Time 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.

3.2.1 Time Server testing configuration

The following configuration is recommended for testing Time Server IUT:

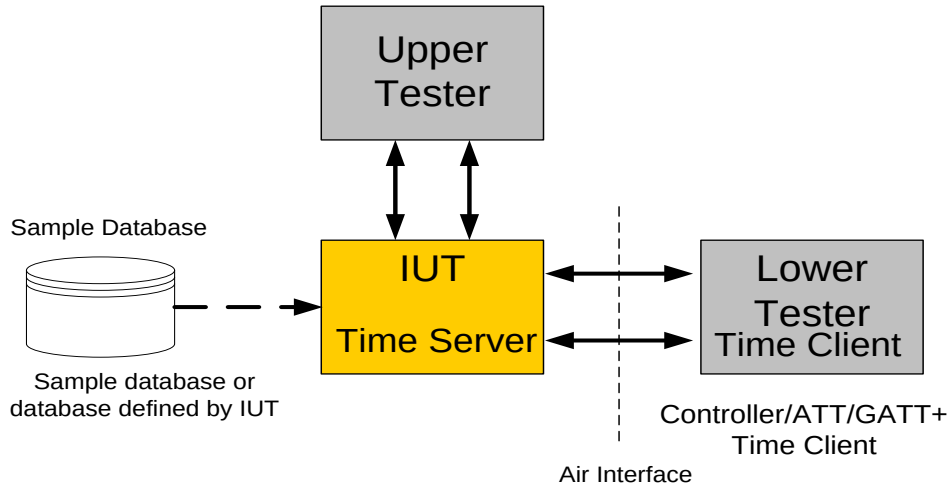

Figure 3.2: Time Server testing configuration

3.2.2 Time Client testing configuration

The following configuration is recommended for testing Time Client IUT:

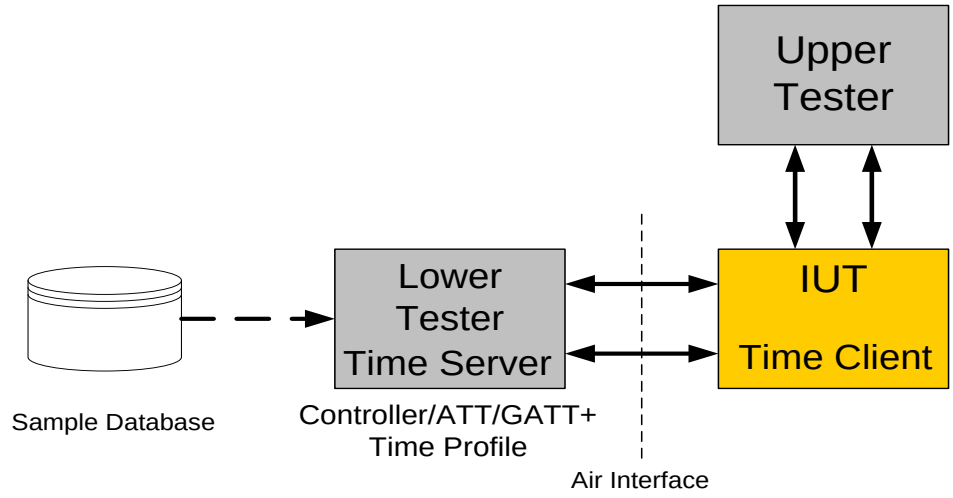

Figure 3.3: Time Client testing configuration

The sample database of Characteristics used by the Lower Tester is specified in each test case.

All Time client test cases, which use a configuration as show in Figure 3.3, contain test procedure descriptions and expected results. These in turn use example message syntax between the Upper Tester and the IUT. Those example messages are generic; there is no specification for these messages. The specifications are the functional descriptions for the test procedures and the expected results.

3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests
- Configuration Features
- Write Features
- Notify 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 [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 [7] 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	**Spec Identifier <spec abbreviation>**
TIP	Time Profile
Identifier Abbreviation	**Role Identifier <IUT role>**
CL	Time Profile Time Client role
SR	Time Profile Time Server role
Identifier Abbreviation	**Reference Identifier <GGIT test group>**
CGGIT	Client Generic GATT Integrated Tests
Identifier Abbreviation	**Reference Identifier <GGIT class>**
CHA	Characteristic
SER	Service
Identifier Abbreviation	**Feature Identifier <feat>**
TPCF	Time Profile Configure Features
TPCN	Time Profile Connection Features
TPNF	Time Profile Notify Features
TPWF	Time Profile Write Features

Table 4.1: TIP 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, then the outcome of the test is a 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 [7] Section 4.2.1.2.

4.3 Generic GATT Integrated Tests

Execute the Generic GATT Integrated Tests defined in [7] in Section 6.4, Client test procedures (CGGIT), using Table 4.2 below as input:

TCID	Service / Characteristic	Reference	Properties	Value Length (Octets)	Service Type
TIP/CL/CGGIT/SER/BV-01-C [Service GGIT – Current Time]	Current Time Service	[4] 4.1	-	-	Primary Service
TIP/CL/CGGIT/SER/BV-02-C [Service GGIT – Next DST Change]	Next DST Change Service	[4] 4.1	-	-	Primary Service
TIP/CL/CGGIT/SER/BV-03-C [Service GGIT – Reference Time Update]	Reference Time Update Service	[4] 4.1	-	-	Primary Service
TIP/CL/CGGIT/CHA/BV-01-C [Characteristic GGIT – Current Time]	Current Time Characteristic	[4] 4.2, 4.3, 4.4, 4.5	0x12 (Read, Notify)	10	-
TIP/CL/CGGIT/CHA/BV-02-C [Characteristic GGIT – Local Time Information]	Local Time Information Characteristic	[4] 4.6	0x02 (Read)	2	-
TIP/CL/CGGIT/CHA/BV-03-C [Characteristic GGIT – Reference Time Information]	Reference Time Information Characteristic	[4] 4.7	0x02 (Read)	4	-
TIP/CL/CGGIT/CHA/BV-04-C [Characteristic GGIT – Time with DST]	Time with DST Characteristic	[4] 4.8	0x02 (Read)	8	-
TIP/CL/CGGIT/CHA/BV-05-C [Characteristic GGIT – Time Update State]	Time Update State Characteristic	[4] 4.9	0x02 (Read)	Variable	-
TIP/CL/CGGIT/CHA/BV-06-C [Characteristic GGIT – Time Update Control Point]	Time Update Control Point Characteristic	[4] 4.10	0x04 (Write Without Response)	Skip	-

Table 4.2: Input for the GGIT Client test procedure

4.4 Configuration Feature

Verify Time Server IUT implementation of the Features defined in the Time Profile Specification [4] by a Time Server IUT, and usage of the same features by a Time Client IUT.

TIP/CL/TPCF/BV-01-C [Current Time Characteristic Configuration, write with 0x0001]

- Test Purpose

  Verify that the Time Client IUT can configure the Client Characteristic Configuration of Current Time in a Time Server.

- Reference

  [4] 4.4

- Initial Condition

  - A preamble procedure defined in Section 4.2.1 is used to set up the transport and L2CAP channel.
  - The Lower Tester includes one instantiation of the Current Time Service [8].
  - The IUT has executed TIP/CL/CGGIT/CHA/BV-01-C [Characteristic GGIT – Current Time], and has saved the handle of a Client Characteristic Configuration for Current Time.

- Test Procedure

  The Upper Tester issues a command to the IUT to configure to receive Current Time.

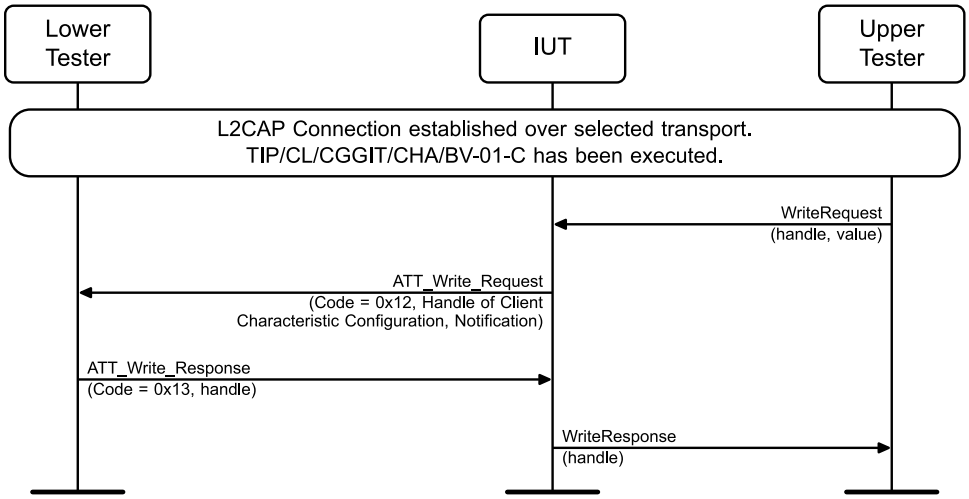

Figure 4.1: TIP/CL/TPCF/BV-01-C [Current Time Characteristic Configuration, write with 0x0001] – MSC

- Expected Outcome

  Pass verdict

  The IUT sends a correctly formatted ATT_Write_Request to the Lower Tester, containing the handle specified by the Upper Tester, and the value set to <0x0001, Notification>.

  The IUT receives a correctly formatted ATT_Write_Response from the Lower Tester and sends the WriteResponse to the Upper Tester.

4.5 Write Feature

Verify Time Server IUT implementation of the Features defined in the Time Profile Specification [4] by a Time Server IUT, and usage of the same features by a Time Client IUT.

TIP/CL/TPWF/BV-01-C [Time Update Control Point Characteristic, write with 0x01]

- Test Purpose

  Verify that the Time Client IUT can write the Time Update Control Point characteristic in a Time Server.

- Reference

  [4] 4.9

- Initial Condition

  - A preamble procedure defined in Section 4.2.1 is used to set up the transport and L2CAP channel.
  - The Lower Tester includes one instantiation of the Reference Time Update Service [9].
  - The IUT has executed TIP/CL/CGGIT/CHA/BV-06-C [Characteristic GGIT – Time Update Control Point], and has saved the handle of a Time Update Control Point characteristic.

- Test Procedure

  The Upper Tester issues a command to the IUT to write:

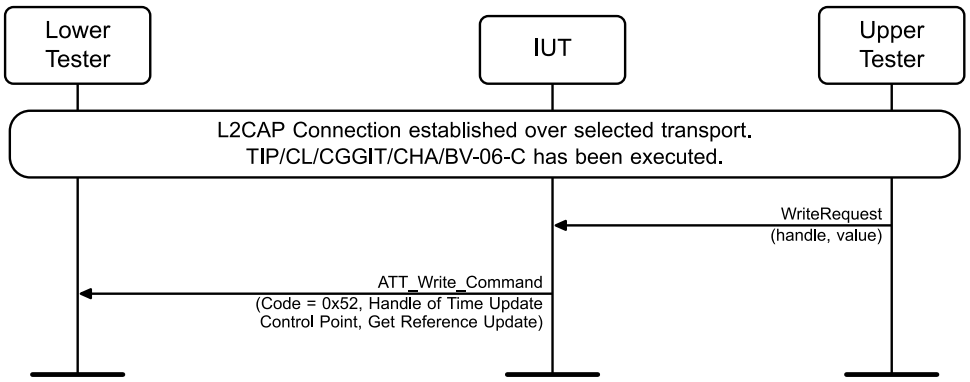

Figure 4.2: TIP/CL/TPWF/BV-01-C [Time Update Control Point Characteristic, write with 0x01] – MSC

- Expected Outcome

  Pass verdict

  The IUT sends a correctly formatted ATT_Write_Command Lower Tester, containing the handle specified by the Upper Tester, and the value set to <0x01, Get Reference Update>.

  The Lower Tester confirms the written Time Update Control Point characteristic matches the one sent by the IUT.

TIP/CL/TPWF/BV-02-C [Time Update Control Point Characteristic, write with 0x02]

- Test Purpose

  Verify that the Time Client IUT can write the Time Update Control Point characteristic in a Time Server.

- Reference

  [4] 4.9

- Initial Condition

  - A preamble procedure defined in Section 4.2.1 is used to set up the transport and L2CAP channel.
  - The Lower Tester includes one instantiation of the Reference Time Update Service [9].
  - The IUT has executed TIP/CL/CGGIT/CHA/BV-06-C [Characteristic GGIT – Time Update Control Point], and has saved the handle of a Time Update Control Point characteristic.

- Test Procedure

  The Upper Tester issues a command to the IUT to write:

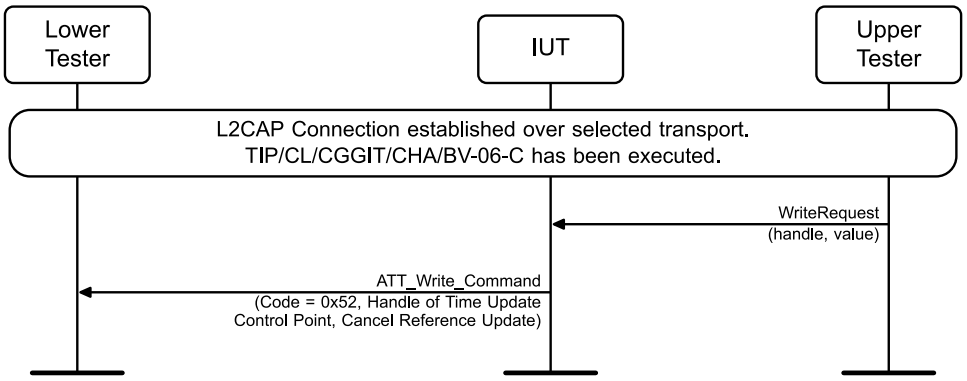

Figure 4.3: TIP/CL/TPWF/BV-02-C [Time Update Control Point Characteristic, write with 0x02] – MSC

- Expected Outcome

  Pass verdict

  The IUT sends a correctly formatted ATT_Write_Command Lower Tester, containing the handle specified by the Upper Tester, and the value set to <0x02, Cancel Reference Update>.

  The Lower Tester confirms the written Time Update Control Point characteristic matches the one sent by the IUT.

4.6 Notify Feature

Verify Time Server IUT implementation of the Features defined in the Time Profile Specification [4] by a Time Server IUT, and usage of the same features by a Time Client IUT.

TIP/CL/TPNF/BV-01-C [Notify Current Time Characteristic, Notify]

- Test Purpose

  Verify that the Time Client IUT can receive notification of the Current Time characteristic in a Time Server.

- Reference

  [4] 4.4

- Initial Condition

  - A preamble procedure defined in Section 4.2.1 is used to set up the transport and L2CAP channel.
  - The Lower Tester includes one instantiation of the Current Time Service [8].
  - The IUT has executed TIP/CL/CGGIT/CHA/BV-01-C [Characteristic GGIT – Current Time], and has saved the handle of a Current Time characteristic.
  - The IUT has executed TIP/CL/TPCF/BV-01-C [Current Time Characteristic Configuration, write with 0x0001] to expect Current Time Notification.

- Test Procedure

  The Lower Tester sends an ATT_Handle_Value_Notification containing a Current Time characteristic value to the IUT.

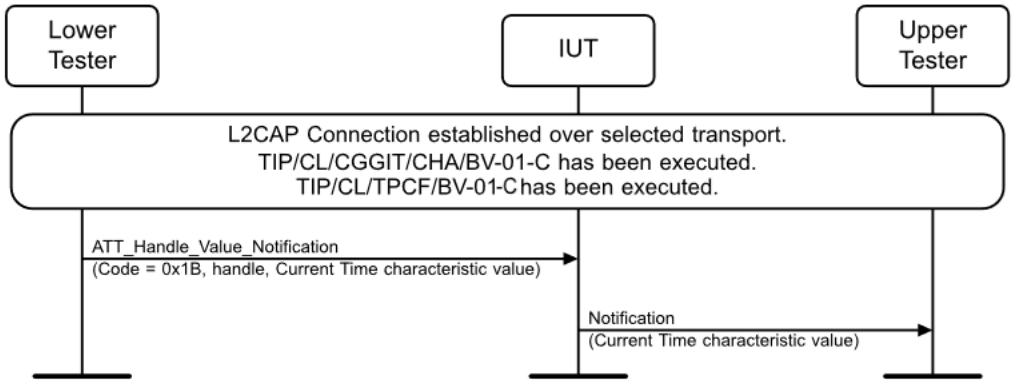

Figure 4.4: TIP/CL/TPNF/BV-01-C [Notify Current Time Characteristic, Notify] – MSC

- Expected Outcome

  Pass verdict

  The IUT indicated the received Current Time value to the Upper Tester, e.g., Notification (Current Time value). The reported Current Time value matches the one sent by the Lower Tester.

4.7 Connection Features

Verify Time Server IUT implementation of the Features defined in the Time Profile Specification [4] by a Time Server IUT, and usage of the same features by a Time Client IUT.

4.7.1 Verify Bond Status on Reconnection

- Test Purpose

  Verify that the Central starts encryption with a previously bonded Peripheral on reconnection, and success.

- Reference

  [4] 5.2.3

- Initial Condition

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

- Test Case Configuration

TCID	Role
TIP/CL/TPCN/BV-01-C	Client
TIP/SR/TPCN/BV-01-C	Server

Table 4.3: Verify Bond Status on Reconnection test cases

- 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.

  Encryption is successfully done.

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 Time Profile (TIP) [3].

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)
TIP 8/1	Discover Current Time Service	TIP/CL/CGGIT/SER/BV-01-C
TIP 8/2	Discover Next DST Change Service	TIP/CL/CGGIT/SER/BV-02-C
TIP 8/3	Discover Reference Time Update Service	TIP/CL/CGGIT/SER/BV-03-C
TIP 8/4	Current Time Characteristic for Current Time Service	TIP/CL/CGGIT/CHA/BV-01-C
TIP 8/6	Local Time Information Characteristic for Current Time Service	TIP/CL/CGGIT/CHA/BV-02-C
TIP 8/7	Reference Time Information Characteristic for Current Time Service	TIP/CL/CGGIT/CHA/BV-03-C
TIP 8/8	Time with DST Characteristic for Next DST Change Service	TIP/CL/CGGIT/CHA/BV-04-C
TIP 8/9	Time Update Control Point Characteristic for Current Time Service	TIP/CL/CGGIT/CHA/BV-06-C
TIP 8/10	Time Update State Characteristic for Current Time Service	TIP/CL/CGGIT/CHA/BV-05-C
TIP 9/2 AND TIP 9/3	Configure Client Characteristic Configuration for Current Time	TIP/CL/TPCF/BV-01-C
TIP 9/8	Write without Response, Time Update Control Point	TIP/CL/TPWF/BV-01-C TIP/CL/TPWF/BV-02-C
TIP 9/3	Receive Notification of Current Time	TIP/CL/TPNF/BV-01-C
TIP 9/9 AND TIP 11/2	Verify Bond Status on Reconnection for Time Server (Client IUT)	TIP/CL/TPCN/BV-01-C
TIP 4/1	Verify Bond Status on Reconnection for Time Server (Server IUT)	TIP/SR/TPCN/BV-01-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
0	1.0.0	2011-09-15	Adopted by the Bluetooth SIG Board of Directors
	1.0.1r0	2012-05-21	TSE 4629: Delete TC TP/TPCF/TPC/BV-02-C; update TCMT for TP/TPCF/TPC/BV-01-C
1	1.0.1	2012-07-24	Prepare for publication.
	1.0.2r1	2012-09-06	TSE 4931: All test cases changed from –C to –I. TSE 4937: Editorial error in section 4.5.5. TP/TPD/TPC/BV-11-I changed to TP/TPD/TPC/BV-03-I.
2	1.0.2	2012-10-30	Prepare for Publication
	1.0.3r00	2016-05-21	Converted to new Test Case ID conventions as defined in TSTO v4.1.
	1.0.3r01	2016-06-09	TS Template Conversion
	1.0.3r02	2016-06-09	Reviewed by Magnus Sommansson
	1.0.3r03	2016-06-13	Split Verify Bond Status test case by role into two test cases (TIP/CL/TPCN/BV-01-I and TIP/SR/TPCN/BV-01-I) following conversion to new test case ID conventions
3	1.0.3	2016-07-14	Prepared for TCRL 2016-1 publication.
	1.0.3 edition 2r00	2018-11-29	Editorial changes only. Template updated. Revision History and contributors moved to the end of the document.
	1.0.3 edition 2	2020-01-10	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.
	p4r00–r01	2023-05-10 – 2023-05-17	TSE 22807 (rating 2): Converted the following test cases to GGIT: TIP/CL/TPD/BV-01-I – -10-I and TIP/CL/TPRF/BV-01-I – -05-I. The new GGIT converted TCIDs are: TIP/CL/CGGIT/CHA/BV-01-C – -06-C and TIP/CL/CGGIT/SER/BV-01-C – -03-C. Updated the TCMT accordingly. Editorials to align the document with the latest TS template and DNMD, including setting the previous v1.0.3 as p3.
4	p4	2023-06-29	Approved by BTI on 2023-05-28. Prepared for TCRL 2023-1 publication.
	p5r00	2023-11-02	TSE 23286 (rating 1): Converted -I tests to -C tests as appropriate; updated the TCMT and TCRL accordingly.
5	p5	2024-07-01	Approved by BTI on 2024-04-21. Prepared for TCRL 2024-1 publication.

Acknowledgments

Name	Company
Sadao Nagashima	Casio