Reference Time Update Service (RTUS)

***Bluetooth*® Test Suite**

- **Revision:** RTUS.TS.p2
- **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 Reference Time Update 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 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 hereafter. 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] Reference Time Update Service Specification, Version 1.0

[4] ICS Proforma for Reference Time Update Service

[5] 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 Reference Time Update Service requires the presence of GAP, SM (LE), SDP (BR/EDR), and GATT. This is illustrated in Figure 3.1.

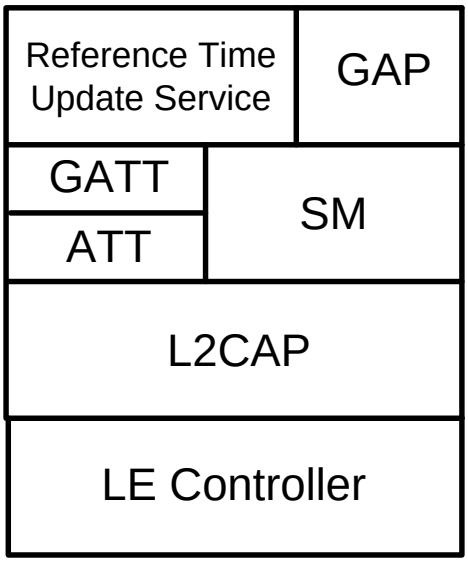

Figure 3.1: Reference Time Update Service Test Model

3.2 Test Strategy

The test objectives are to verify functionality of the Reference Time Update 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
- 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 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>**
RTUS	Reference Time Update 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
DEC	Characteristic Declaration
SD	Service Definition
SP	Service Procedures

Table 4.1: RTUS 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 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 Section 6.3, Server test procedures (SGGIT), in [5] using Table 4.2 below as input.

TCID	Service / Characteristic / Descriptor	Reference	Properties	Value Length (Octets)	Service Type
RTUS/SR/SGGIT/SER/BV-01-C [Service GGIT – Reference Time Update Service]	Reference Time Update Service	[3] 2	-	-	Primary Service
RTUS/SR/SGGIT/CHA/BV-01-C [Characteristic GGIT – Time Update Control Point]	Time Update Control Point Characteristic	[3] 3.1	0x04 (Write without Response)	Skip	-
RTUS/SR/SGGIT/CHA/BV-02-C [Characteristic GGIT – Time Update State]	Time Update State Characteristic	[3] 3.2	0x02 (Read)	Skip	-

Table 4.2: Input for the GGIT Server test procedure

4.4 Characteristic Read

This test group contains test cases to verify the characteristics which support reading can be read.

RTUS/SR/CR/BV-01-C [Characteristic Read – Time Update State]

- Test Purpose

  Read using the GATT Read Characteristic Value sub-procedure and verify characteristic value.

- Reference

  [3] 3.2

- Initial Condition

  - The handle of the characteristic value referenced in the test case below 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 sends an ATT_Read_Request to the IUT to read the Time Update State characteristic value.
  2. The IUT sends an ATT_Read_Response to the Lower Tester.
  3. Verify that the Time Update State characteristic value meets the requirements of the service.

- Expected Outcome

  Pass verdict

  The Time Update State characteristic is successfully read and the characteristic value meets the requirements of the service (two octets, first octet is zero or 1; second octet is 0, 1, 2, 3, 4, or 5).

4.5 Service Procedures

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

RTUS/SR/SP/BV-01-C [Writing Time Update Control Point]

- Test Purpose

  Verify that the IUT changes its status based on [3] 4.1 “Time Update State Machine”.

- Reference

  [3] 4.1

- Initial Condition
  - Perform a bonding procedure if required by the IUT.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
- Test Procedure
  1. Execute the GATT Write Without Response sub-procedure on the Time Update Control Point characteristic with the Command ID set to "Get Reference Update" or "Cancel Reference Update".
  2. Verify that the IUT changes it state defined in [3] 4.1, Time Update State Machine. (Note: To verify the status of the IUT, the Lower Tester can run test case RTUS/SR/CR/BV-01-C [Characteristic Read – Time Update State]. Whether TimeUpdateComplete occurs or is successful is up to the IUT implementation.).
- Expected Outcome

  Pass verdict

  The IUT changes its status based on the [3] 4.1 Time Update State Machine when written and exposes its status into Time Update State characteristic.

RTUS/SR/SP/BI-01-C [Time Update Control Point characteristic – Receive the unsupported command]

- Test Purpose

  Verify that the IUT does nothing even if the value written in the Time Update Control Point is not supported.
- Reference

  [3] 4
- Initial Condition
  - Perform a bonding procedure if required by the IUT.
  - Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
- Test Procedure

  The Lower Tester writes any invalid values or invalid length of the commands into the Time Update Point Characteristic in the IUT.
- Expected Outcome

  Pass verdict

  The Time Update State of the IUT never changes.

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 Reference Time Update Service (RTUS) [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)
RTUS 2/1	Reference Time Update Service	RTUS/SR/SGGIT/SER/BV-01-C
RTUS 2/2	Time Update Control Point Characteristic	RTUS/SR/SGGIT/CHA/BV-01-C
RTUS 2/3	Time Update State Characteristic	RTUS/SR/SGGIT/CHA/BV-02-C
RTUS 2/4	Write Time Update Control Point Characteristic	RTUS/SR/SP/BV-01-C RTUS/SR/SP/BI-01-C
RTUS 2/5	Read Time Update State Characteristic	RTUS/SR/CR/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
	1.0.1r00	2016-05-26	Converted to new Test Case ID conventions as defined in TSTO v4.1.
	1.0.1r01	2016-06-03	Converted to current test specification template
1	1.0.1	2016-07-14	Prepared for TCRL 2016-1 publication.
	1.0.1 edition 2r00	2018-11-29	Editorial changes only. Template updated. Revision History and contributors moved to the end of the document.
	1.0.1 edition 2	2020-01-09	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.
	p2r00	2023-12-12 – 2023-12-13	TSE 24592 (rating 2): Converted the following 3 test cases to GGIT: RTUS/SR/SD/BV-01-C and RTUS/SR/DEC/BV-01-C and -02-C. The 3 new converted TCIDs are: RTUS/SR/SGGIT/SER/BV-01-C and RTUS/SR/SGGIT/CHA/BV-01-C and -02-C. Deleted TC RTUS/SR/CW/BV-01-C. Updated the TCMT accordingly. Updated the test procedure for RTUS/SR/SP/BV-01-C. TSE 24593 (rating 1): Updated the test procedure for RTUS/SR/CR/BV-01-C to remove direct GATT reference. Performed editorials to align the document with the latest TS template, including updates to the scope, Test Strategy, test groups, TCID conventions sections, conformance, Pass/Fail verdict conventions, setup preambles, test case mapping, and revision history and acknowledgments sections. Converted single-TC section headings from Heading 3 to Heading 8 and TCIDs in tables to Heading 9 style. Replaced Bluetooth logo in footer and updated the copyright page to align with the latest version of the DNMD.
2	p2	2024-07-01	Approved by BTI on 2024-04-21. Prepared for TCRL 2024-1 publication.

Acknowledgments

Name	Company
Bob Hughes	Intel
Leif-Alexandre Aschehoug	Nordic
Guillaume Schatz	Polar