Reference Time Update Service (RTUS)

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 Reference Time Update Service Specification.
### Revision History

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<td>1.0.1r00</td>
<td>2016-05-26</td>
<td>Converted to new Test Case ID conventions as defined in TSTO v4.1.</td>
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<td>1.0.1r01</td>
<td>2016-06-03</td>
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<tbody>
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1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the Bluetooth Reference Time Update 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

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

![Reference Time Update Service Test Model](image)

*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 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 Reference Time Update 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 Reference Time Update 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 catalogued 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 and is 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 additional 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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<tr>
<td>RTUS</td>
<td>Reference Time Update Service</td>
</tr>
<tr>
<td>SR</td>
<td>Server Role</td>
</tr>
<tr>
<td>SD</td>
<td>Service Definition</td>
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<tr>
<td>DEC</td>
<td>Characteristic Declaration</td>
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<tr>
<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: Reference Time Update 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.

4.3 Service Definition
Verify the service definition.

4.3.1 RTUS/SR/SD/BV-01-C [Service Definition]
• Test Purpose
  Verify the IUT has one instantiation of the Reference Time Update 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.

**Test Procedure**

Discover all primary services by executing the test procedure of GATT test case GATT/SR/GAD/BV-01-C in [5] or primary services by service UUID by executing the test procedure of GATT test case GATT/SR/GAD/BV-02-C in [5] with the service UUID set to «Reference Time Update Service».

**Expected Outcome**

Pass verdict

One attribute handle range is returned, containing the starting handle and the ending handle of the service definition.

### 4.4 Characteristic Declaration

**Test Purpose**

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

**Reference**

[3] 3.1, 3.2

**Initial Condition**

The handle range of the service has been previously discovered by the Lower Tester in test case RTUS/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.

**Test Procedure**

The following test procedure applies to the test cases listed in Table 4.2.

1. Discover all characteristics of the Reference Time Update service by executing the test procedure of GATT test case TP/GAD/SR/BV-04-C in [5].

2. For a discovered characteristic that is listed in Table 4.2, verify the characteristic properties field of the characteristic declaration meets the requirements of the service.

**Expected Outcome**

The following pass and fail verdicts apply to the test cases listed in Table 4.2:

Pass verdict
The characteristic is discovered and the characteristic properties field of the attribute value of the characteristic declaration ([2] Section 3.3.1.1) meets the requirements of the service as shown in Table 4.2.

Only one instance of the characteristic is found.

### Characteristic Declaration Test Cases

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Characteristic Properties Value (Requirements)</th>
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<tr>
<td>4.4.1 RTUS/SR/DEC/BV-01-C [Characteristic Declaration – Time Update Control Point]</td>
<td>0x04 ([3] 3.1)</td>
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<tr>
<td>4.4.2 RTUS/SR/DEC/BV-02-C [Characteristic Declaration – Time Update State]</td>
<td>0x02 ([3] 3.2)</td>
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</table>

*Table 4.2: Characteristic Declaration Test Cases*

### 4.5 Characteristic Read

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

#### 4.5.1 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 4.4 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.

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

- **Test Procedure**
Read the Time Update State characteristic value by executing the test procedure of GATT test case GATT/SR/GAR/BV-01-C in [5].

- 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).

### 4.6 Characteristic Write without Response

This test group contains test cases to write without response to characteristic values and verify that the values written by the service are compliant with the specification.

#### 4.6.1 RTUS/SR/CW/BV-01-C [Characteristic Write – Time Update Control Point]

- **Test Purpose**

  Write characteristic value.

- **Reference**

  [3] 3.1

- **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 4.4 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.

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

- **Test Procedure**

  Select a value that is valid for the characteristic. Write the Time Update Control Point characteristic value by executing the test procedure of GATT test case GATT/SR/GAW/BV-01-C in [5].

- **Expected Outcome**

  **Pass verdict**

  The Time Update Control Point characteristic value is successfully 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 RTUS/SR/SP/BV-01-C [Writing Time Update Control Point]

• Test Purpose

Verify 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. Run test case RTUS/SR/CW/BV-01-C [Characteristic Write – Time Update Control Point], Procedure B 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.

4.7.2 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 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 Reference Time Update Service (RTUS) [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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<td>Reference Time Update Service</td>
<td>RTUS/SR/SD/BV-01-C</td>
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</tr>
<tr>
<td>RTUS 2/2</td>
<td>Time Update Control Point Characteristic</td>
<td>RTUS/SR/DEC/BV-01-C</td>
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<tr>
<td>RTUS 2/3</td>
<td>Time Update State Characteristic</td>
<td>RTUS/SR/DEC/BV-02-C</td>
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<td>Write Time Update Control Point Characteristic</td>
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<td>Read Time Update State Characteristic</td>
<td>RTUS/SR/CR/BV-01-C</td>
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Table 5.1: Test Case Mapping