

# Transport Discovery Service (TDS)

## **Bluetooth® Test Suite**

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- **Group Prepared By:** Discovery of Things WG



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# 1 Scope

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This Bluetooth document contains the Test Suite Structure (TSS) and test cases (TC) to test the implementation of the Bluetooth Transport Discovery 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

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### 2.1 References

This 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 4.2 or later
- [3] Bluetooth Transport Discovery Service Specification, Version 1.0
- [4] ICS Proforma for Transport Discovery Service, TDS.ICS
- [5] GATT Test Suite, GATT.TS
- [6] Characteristic and Descriptor descriptions and fixed Protocol Service Multiplexer (PSM) values are accessible via the [Bluetooth SIG Assigned Numbers](#).
- [7] Transport Discovery Service Implementation eXtra Information for Test, IXIT
- [8] Bluetooth Transport Discovery Service Specification, Version 1.1

### 2.2 Definitions

For this Bluetooth document, the definitions from [1], [2], and [3] apply.

### 2.3 Abbreviations

For this Bluetooth document, the abbreviations from [1], [2], and [3] apply.

# 3 Test Suite Structure (TSS)

## 3.1 Overview

The Transport Discovery Service requires L2CAP, GAP, SM (for LE), SDP (for BR/EDR), ATT, and GATT. This is illustrated in [Figure 3.1](#).

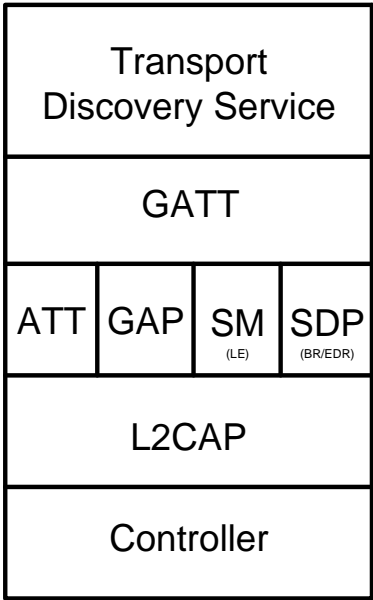


Figure 3.1: Transport Discovery Service Test Model

## 3.2 Test strategy

The test objectives are to verify the functionality of the Transport Discovery 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. Any defined test herein is applicable to the IUT, if the ICS logical expression defined in the test case mapping table (TCMT) is valid.

The test equipment provides an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in the Transport Discovery Service test suite. 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, or another interface supported by the IUT.

The Transport Discovery 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.

### 3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests
  - Verify that the IUT properly implements the GATT Server role for the supported service and characteristics.
- Transport Discovery Advertising Data
  - Verify the format of the Transport Discovery Data AD Type.
- Configure Indication
  - Verify that characteristics can be configured for indication.
- Service Procedures – TDS Control Point (CP)
  - Verify that the IUT properly handles the CP procedures.
  - Verify that the IUT generates the correct CP error responses when error conditions are presented to the IUT when using the TDS Control Point.

## 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 GGIT tests 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>
TDS	Transport Discovery 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
SDP	Service Discovery Protocol
SER	Service
Identifier Abbreviation	Feature Identifier <feat>
CON	Configure Indication
SP	(control point) Service Procedure
SPE	(control point) Service Procedure – Error handling
TDADV	Transport Discovery Advertising Data

Table 4.1: TDS TC feature naming convention

#### 4.1.2 Conformance

When conformance is claimed for a particular specification, all capabilities are to be supported in the specified manner (process-mandatory). 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 that is 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 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 generated by Launch Studio, 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 errata 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 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

If LE is specified, the setup procedure defined in Section 4.2.1.1 is executed.

If BR/EDR is specified, the setup procedure defined in Section 4.2.1.2 is executed.

#### 4.2.1.1 ATT Bearer on LE Transport

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

#### 4.2.1.2 ATT Bearer on BR/EDR Transport

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

### 4.2.2 Initial TDS Control Point Configuration

- Preamble Purpose

This preamble procedure enables the IUT for use with the TDS Control Point.

- Preamble Procedure
  1. Establish an ATT Bearer connection between the Lower Tester and IUT as described in Section 4.2.1.
  2. The handle of the TDS Control Point characteristic has been previously discovered by the Lower Tester as described in the test procedure in Section 4.3 or is known to the Lower Tester by other means.
  3. The handle of the Client Characteristic Configuration descriptor of the TDS Control Point has been previously discovered by the Lower Tester as described in the test procedure in Section 4.3 using the handle range of the characteristic or is known to the Lower Tester by other means.
  4. If the IUT requires bonding, then the Lower Tester performs a bonding procedure.
  5. The Lower Tester configures the TDS Control Point characteristic for indications by writing the value 0x0002 to the Client Characteristic Configuration descriptor of the characteristic as described in the test procedure of GATT test case GATT/SR/GAW/BV-08-C in [5].

### 4.3 Generic GATT Integrated Test Cases

Execute the Generic GATT Integrated Tests defined in Section 6.3 Server test procedures (SGGIT) of [5] using Table 4.2 below as input:

TCID	Service/ Characteristic/ Descriptor	Reference	Properties	Value Length (Octets)	Service Type
TDS/SR/SGGIT/SER/BV-01-C [Service GGIT – Transport Discovery]	Transport Discovery Service	[3] 2	-	-	Primary Service
TDS/SR/SGGIT/CHA/BV-02-C [Characteristic GGIT – TDS Control Point]	TDS Control Point	[3] 4.1	0x28 (Write, Indicate)	Skip	
TDS/SR/SGGIT/CHA/BV-03-C [Characteristic GGIT – BR-EDR Handover Data]	BR-EDR Handover Data	[8] 5, 5.1	0x02 (Read)	10	
TDS/SR/SGGIT/CHA/BV-04-C [Characteristic GGIT – Bluetooth SIG Data]	Bluetooth SIG Data	[8] 5, 5.2	0x00	Skip	
TDS/SR/SGGIT/DES/BV-05-C [Descriptor GGIT – Complete BR-EDR Transport Block Data]	Complete BR- EDR Transport Block Data descriptor	[8] 5, 5.2.1	0x02 (Read)	3 - 29	
TDS/SR/SGGIT/SDP/BV-06-C [SDP Record – Transport Discovery Service]	Transport Discovery Service	[3] 6	-	-	

Table 4.2: Input for the GGIT Server Test Procedure

### 4.4 Transport Discovery Advertising Data

This test group contains test cases to verify compliance of the Transport Discovery Advertising Data. Where the Transport Discovery Data AD Type contains multiple Transport Blocks, this verification is performed one block at a time.

**TDS/SR/TDADV/BV-01-C [Transport Discovery Data AD Type Format]**

- Test Purpose

Verify that the IUT sends valid Transport Discovery Data AD Type data in the advertising packet.

- Reference

[\[3\]](#) 3.1.1, 3.1.2

- Initial Condition

The Lower Tester is GAP Observer or GAP Central.

The contents of the Transport Discovery Data AD Type to be transmitted are known from the IXIT [\[7\]](#).

- Test Procedure

1. The Upper Tester orders the IUT to broadcast an advertising packet containing the Transport Discovery Data AD Type.
2. The IUT begins advertising using the Transport Discovery Data AD Type.

- Expected Outcome

Pass verdict

The advertising data from the IUT includes the Transport Discovery Data AD type as indicated by the use of Type Code «Transport Discovery Data».

The format and value meet the requirements of the service.

The value received is consistent with the value that is known from the IXIT.

The Organization ID field is included in the Transport Block with a valid 1 octet Organization ID value from the Assigned Numbers.

The TDS Flags field is included in the Transport Block with a valid 1 octet value that represents the role of the device and information about its state and supported features and with all RFU bits set to 0, and Role bits set to an appropriate value for the Transport Block, and the Transport Data Incomplete bit set to an appropriate value for the Transport Block, and the Transport State bits set to an appropriate value for the Transport Block.

The Transport Data Length field is included in the Transport Block with a valid 1 octet length value in accordance with the optional Transport Data field.

**TDS/SR/TDADV/BV-02-C [Transport Discovery Data AD Type Format]**

- Test Purpose

Verify that the IUT sends valid Transport Discovery Data AD Type data in the advertising packet that contains multiple Transport Blocks.

- Reference

[\[3\]](#) 3.1.2.5

- Initial Condition

The Lower Tester is GAP Observer or GAP Central.

The contents of at least the first two blocks Transport Discovery Data AD Type to be transmitted are known from the IXIT [7].

- Test Procedure

1. The Upper Tester orders the IUT to broadcast an advertising packet containing the Transport Discovery Data AD Type.
2. The IUT begins advertising using the Transport Discovery Data AD Type.

- Expected Outcome

Pass verdict

The Transport Discovery Data AD type contains more than one Transport Block.

The format and value of each Transport Block meet the requirements of the service.

The values of the first two Transport Blocks received are consistent with the values that are known from the IXIT.

## 4.5 Configure Indication

This test group contains test cases to verify compliant operation in response to disabling and enabling characteristic indication.

### TDS/SR/CON/BV-01-C [Configure Indication – CP]

- Test Purpose

Verify that the Client Characteristic Configuration descriptor of the TDS Control Point characteristic can be disabled and enabled.

- Reference

[3] 4.1

- Initial Condition

The handle of the TDS Control Point characteristic 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.

The handle of the client characteristic configuration descriptor of the TDS Control Point characteristic 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 IUT permissions for the characteristic descriptor require a specific security mode or security level, establish a connection meeting those requirements.

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

- Test Procedure
  1. Disable indication by writing value 0x0000 to the Client Characteristic Configuration descriptor of the characteristic using the test procedure of GATT/SR/GAW/BV-08-C in [5].
  2. The Lower Tester reads the value of the Client Characteristic Configuration descriptor.
  3. Enable indication by writing value 0x0002 to the Client Characteristic Configuration descriptor of the characteristic using the test procedure of GATT/SR/GAW/BV-08-C in [5].
  4. The Lower Tester reads the value of the Client Characteristic Configuration descriptor.

- Expected Outcome

Pass verdict

The characteristic descriptor is successfully written, and the value returned when read in steps 2 and 4 is consistent with the value written.

## 4.6 Service Procedures – TDS Control Point

This test group contains test cases to verify compliant operation of the TDS Control Point procedures.

### TDS/SR/SP/BV-01-C [CP - Activate Transport]

- Test Purpose

Verify that the IUT can perform the CP Activate Transport procedure.

- Reference

[3] 4.1.3

- Initial Condition

Perform the preamble described in Section 4.2.2.

The supported parameter value for the TDS Control Point request and the supported Organization ID are known from the IXIT [7].

- Test Procedure

1. The Lower Tester writes the Activate Transport Op Code (0x01) to the TDS Control Point with a supported Organization ID and a Parameter value that is known from the IXIT.
2. The IUT, after sending a Write Response to acknowledge the write to the TDS Control Point, sends an indication of the TDS Control Point characteristic.
3. The Lower Tester receives an *ATT\_Handle\_Value\_Indication* from the IUT containing the TDS Control Point characteristic handle and value.
4. The Lower Tester sends an *ATT\_Handle\_Value\_Confirmation* to the IUT.

- Note

The actual activation of the alternate transport is beyond the scope of the TDS specification.

- Expected Outcome

Pass verdict

The IUT sends an indication of the TDS Control Point characteristic containing the Requested Op Code (0x01) followed by the Result Code for 'Success' (0x00) and, optionally, a Parameter value.

## 4.7 Service Procedures – TDS Control Point Error Handling

This test group contains test cases to verify compliant operation when the Lower Tester uses the TDS Control Point procedure and an error results.

### TDS/SR/SPE/BI-01-C [CP - Op Code Not Supported]

- Test Purpose

Verify that the IUT responds appropriately when a Client writes an unsupported Op Code to the TDS Control Point.

- Reference

[3] 4.1.4.2.1

- Initial Condition

Perform the preamble described in Section 4.2.2.

- Test Procedure

1. The Lower Tester writes an Op Code Value of 0x00 to the TDS Control Point with a Parameter Value to be determined by the Lower Tester.
2. The IUT, after sending a Write Response to acknowledge the write to the TDS Control Point, sends an indication of the TDS Control Point characteristic.
3. The Lower Tester receives an *ATT\_Handle\_Value\_Indication* from the IUT containing the TDS Control Point characteristic handle and value.
4. The Lower Tester sends an *ATT\_Handle\_Value\_Confirmation* to the IUT.
5. The Lower Tester writes an Op Code value from the Reserved for Future Use (RFU) range other than 0x00 to the TDS Control Point with a Parameter Value to be determined by the Lower Tester.
6. The IUT, after sending a Write Response to acknowledge the write to the TDS Control Point, sends an indication of the TDS Control Point characteristic.
7. The Lower Tester receives an *ATT\_Handle\_Value\_Indication* from the IUT containing the TDS Control Point characteristic handle and value.
8. The Lower Tester sends an *ATT\_Handle\_Value\_Confirmation* to the IUT.
9. Verify that the IUT indication meets the requirements of the service.

- Expected Outcome

Pass verdict

In step 2, the IUT sends an indication of the TDS Control Point characteristic with the Requested Op Code (0x00), followed by the Result Code for 'Op Code not supported' (0x01) and, optionally, a Parameter value.

In step 6, the IUT sends an indication of the TDS Control Point characteristic with the Requested Op Code (i.e., the RFU value written in step 5), followed by the Result Code for 'Op Code not supported' (0x01) and, optionally, a Parameter value.

The IUT continues to perform normal operations.

**TDS/SR/SPE/BI-02-C [CP - Client Characteristic Configuration Descriptor Improperly Configured]**

- Test Purpose

Verify that the IUT responds appropriately when a Client attempts to perform a TDS Control Point procedure with a Client Characteristic Configuration descriptor that is improperly configured.

- Reference

[3] 4.1.4.1

- Initial Condition

Perform the preamble described in Section 4.2.2.

- Test Procedure

1. The Lower Tester resets the value of the Client Characteristic Configuration descriptor of the TDS Control Point characteristic to 0x0000.
2. The Lower Tester writes a valid Op Code to the TDS Control Point that is supported by the IUT.
3. Verify that the IUT response meets the requirements of the service.

- Expected Outcome

Pass verdict

The IUT rejects the Write Request by sending an Error Response with an Attribute Protocol Error Code set to “Client Characteristic Configuration Descriptor Improperly Configured” (0xFD).

The IUT continues to perform normal operations.

**TDS/SR/SPE/BI-03-C [CP – Invalid Parameter]**

- Test Purpose

Verify that the IUT responds appropriately when a Client requests a CP procedure with an Op Code that requires a parameter and the parameter is invalid.

- Reference

[3] 4.1.4.2.2

- Initial Condition

Perform the preamble described in Section 4.2.2.

A parameter value for the TDS Control Point request that is invalid for the implementation and the supported Organization ID are known from the IXIT [7].

- Test Procedure

1. The Lower Tester writes the Activate Transport Op Code to the TDS Control Point with a supported Organization ID and an invalid Parameter Value that is known from the IXIT.
2. The IUT, after sending a Write Response to acknowledge the write to the TDS Control Point, sends an indication of the TDS Control Point characteristic.

3. The Lower Tester receives an *ATT\_Handle\_Value\_Indication* from the IUT containing the TDS Control Point characteristic handle and value.
4. The Lower Tester sends an *ATT\_Handle\_Value\_Confirmation* to the IUT.

- Expected Outcome

Pass verdict

The IUT sends an indication of the TDS Control Point characteristic containing the Requested Op Code (0x01) followed by the Result Code for 'Invalid Parameter' (0x02) and, optionally, a Parameter value.

### TDS/SR/SPE/BI-04-C [CP – Unsupported Organization ID]

- Test Purpose

Verify that the IUT responds appropriately when a Client requests the Activate Transport Op Code with an unsupported Organization ID value.

- Reference

[3] 4.1.4.2.3

- Initial Condition

Perform the preamble described in Section 4.2.2.

A parameter value for the TDS Control Point request that is invalid for the implementation and an unsupported Organization ID are known from the IXIT [7].

- Test Procedure

1. The Lower Tester writes the Activate Transport Op Code to the TDS Control Point with an unsupported Organization ID and a Parameter value that is known from the IXIT.
2. The IUT, after sending a Write Response to acknowledge the write to the TDS Control Point, sends an indication of the TDS Control Point characteristic.
3. The Lower Tester receives an *ATT\_Handle\_Value\_Indication* from the IUT containing the TDS Control Point characteristic handle and value.
4. The Lower Tester sends an *ATT\_Handle\_Value\_Confirmation* to the IUT.

- Expected Outcome

Pass verdict

The IUT sends an indication of the TDS Control Point characteristic containing the Requested Op Code (0x01) followed by the Result Code for 'Unsupported Organization ID' (0x03) and, optionally, a Parameter value.



## 5 Test case mapping

The test case mapping table (TCMT) maps test cases to specific requirements in the ICS. The IUT will be 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 TDS [4].

**Feature:** A brief, informal description of the feature being tested.

**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.

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

Item	Feature	Test Case(s)
(TDS 2/1 AND TDS 8/2) OR TDS 2/2	Transport Discovery Service	TDS/SR/SGGIT/SER/BV-01-C
TDS 4/2	BR-EDR Handover Data	TDS/SR/SGGIT/CHA/BV-03-C
TDS 4/3	Bluetooth SIG Data	TDS/SR/SGGIT/CHA/BV-04-C
TDS 4/3 AND TDS 4/4	Complete BR-EDR Transport Block Data descriptor	TDS/SR/SGGIT/DES/BV-05-C
TDS 2/1	Transport Discovery Data AD Type Format	TDS/SR/TDADV/BV-01-C
TDS 3/2	Multiple Transport Blocks	TDS/SR/TDADV/BV-02-C
TDS 4/1	TDS Control Point	TDS/SR/SGGIT/CHA/BV-02-C TDS/SR/CON/BV-01-C TDS/SR/SP/BV-01-C TDS/SR/SPE/BI-01-C TDS/SR/SPE/BI-02-C TDS/SR/SPE/BI-03-C TDS/SR/SPE/BI-04-C
TDS 2/2	Service Supported over BR/EDR	TDS/SR/SGGIT/SDP/BV-06-C

Table 5.1: Test case mapping

## 6 Revision history and acknowledgments

### Revision History

Publication Number	Revision Number	Date	Comments
0	1.0.0	2015-11-17	Spec adopted by BoD. Prepared for publication.
	1.0.1r00	2016-01-15	Converted test case IDs to new conventions as outlined in TSTO v4.1
	1.0.1r01	2016-02-23	Updated ID conventions following BTI review.
	1.0.1r02	2016-06-01	Review by Miles Smith
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.
2	1.0.1 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.
	1.1.0r00-CR – p3r07-CR	2019-07-29 – 2020-07-12	<p>Updated TS based on TDS d1.1 r05 by introducing TDS/SR/SGGIT/SER/BV-01-C, TDS/SR/SGGIT/CHA/BV-02-C, TDS/SR/SGGIT/CHA/BV-03-C, TDS/SR/SGGIT/DES/BV-04-C and updated TS to new template format.</p> <p>Updated TCMT by mapping TDS 4a/3 to TDS/SR/SGGIT/DES/BV-05-C.</p> <p>Per TSE 12668:</p> <p>Added TDS/SR/SGGIT/CHA/BV-02-C [Characteristic GGIT – TDS Control Point].</p> <p>Removed TDS/SR/SD/BV-01-C and TDS/SR/SD/BV-02-C as TCs are covered by TDS/SR/SGGIT/SER/BV-01-C.</p> <p>Removed TDS/SR/DEC/BV-01-C and TDS/SR/DES/BV-01-C as TCs are covered by TDS/SR/SGGIT/CHA/BV-02-C.</p> <p>Updated mapping to TDS/SR/TDADV/BV-01-C (TSE 12667).</p> <p>Updated TCMT and TS to latest template.</p> <p>Per PTS feedback updated TCMT for TDS/SR/SGGIT/DES/BV-05-C to include item TDS 4a/2.</p> <p>Updated the Revision History table by adding the Publication Number column.</p> <p>Updated document numbering.</p> <p>Resolved BTI comments.</p>
3	p3	2020-08-18	Set publication number for previous v1.0.1 edition 2 to publication 2. Replaced “Conformance” and “Pass/Fail verdict conventions” sections with text from the latest TS template. Approved by BTI on 2020-08-03. TDS

Publication Number	Revision Number	Date	Comments
			v1.1 specification adopted by BoD on 2020-08-11. Prepared for publication.
	p4r00	2021-03-24	TSE 15708 (rating 1): Added new TC TDS/SR/SGGIT/SDP/BV-06-C to Table 4.2. Updated TCMT accordingly.
4	p4	2021-07-13	Approved by BTI on 2021-06-03. Prepared for TCRL 2021-1 publication.

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