

Ranging Profile (RAP)

Bluetooth® Test Suite

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Contents

1	Scope	5
2	References, definitions, and abbreviations	6
2.1	References	6
2.2	Definitions	6
2.3	Acronyms and abbreviations	6
3	Test Suite Structure (TSS)	7
3.1	Overview	7
3.2	Test Strategy	7
3.2.1	Test database requirements	7
3.3	Test groups	8
4	Test cases (TC)	9
4.1	Introduction	9
4.1.1	Test case identification conventions	9
4.1.2	Conformance	9
4.1.3	Pass/Fail verdict conventions	10
4.2	Setup preambles	10
4.2.1	ATT Bearer on LE transport	10
4.2.2	EATT Bearer on LE transport	10
4.3	Generic GATT Integrated Tests	11
	RAP/REQ/CGGIT/SER/BV-01-C [Service GGIT - Ranging Service]	11
	RAP/REQ/CGGIT/CHA/BV-01-C [Characteristic GGIT - RAS Features]	11
	RAP/REQ/CGGIT/CHA/BV-02-C [Characteristic GGIT - Real-time Ranging Data]	11
	RAP/REQ/CGGIT/CHA/BV-03-C [Characteristic GGIT - On-demand Ranging Data]	11
	RAP/REQ/CGGIT/CHA/BV-04-C [Characteristic GGIT - RAS Control Point]	11
	RAP/REQ/CGGIT/CHA/BV-05-C [Characteristic GGIT - Ranging Data Ready]	11
	RAP/REQ/CGGIT/CHA/BV-06-C [Characteristic GGIT - Ranging Data Overwritten]	11
4.4	Ranging Responder profile features	12
	RAP/RES/RSPF/BV-01-C [Ranging Service UUID in AD]	12
	RAP/RES/RSPF/BV-02-C [On-demand Ranging Data to two Ranging Requesters]	12
	RAP/RES/RSPF/BV-03-C [On-demand Ranging Data and Real-time Ranging Data to two Ranging Requesters]	13
	RAP/RES/RSPF/BV-04-C [Filtered On-demand Ranging Data to two Ranging Requesters]	15
	RAP/RES/RSPF/BV-05-C [Aborting On-demand Ranging Data with two Ranging Requesters]	16
4.5	Real-time Ranging Data procedures	17
	RAP/REQ/RRD/BV-01-C [Real-time Ranging Data]	17
	RAP/REQ/RRD/BV-02-C [Real-time Ranging Data with Ranging Data Filter]	18
	RAP/REQ/RRD/BI-01-C [Real-time Ranging Data indication or notification timeout]	21
	RAP/REQ/RRD/BI-02-C [Real-time Ranging Data indication or notification segment timeout]	21
4.6	On-demand Ranging Data procedures	22
	RAP/REQ/ORD/BV-01-C [On-demand Ranging Data]	22
	RAP/REQ/ORD/BV-02-C [On-demand Ranging Data with Ranging Data Filter]	23
	RAP/REQ/ORD/BV-03-C [Retrieve Lost Ranging Data Segments]	26
	RAP/REQ/ORD/BV-04-C [Abort Operation]	28
4.6.1	Ranging Data Ready notifications	29
	RAP/REQ/ORD/BV-05-C [Ranging Data Ready, Notification]	30
	RAP/REQ/ORD/BV-06-C [Ranging Data Ready, Notification and Read]	30
4.6.2	Ranging Data Overwritten	30
	RAP/REQ/ORD/BV-07-C [Ranging Data Overwritten, Indication]	31



RAP/REQ/ORD/BV-08-C [Ranging Data Overwritten, Notification]31

RAP/REQ/ORD/BV-09-C [Ranging Data Overwritten, Notification and Read]31

RAP/REQ/ORD/BI-01-C [On-demand Ranging Data indication or notification timeout]31

RAP/REQ/ORD/BI-02-C [On-demand Ranging Data indication or notification segment timeout]32

RAP/REQ/ORD/BI-03-C [Ignore errant Response Codes].....33

4.7 Security features 34

4.7.1 OOB pairing 34

RAP/REQ/SEC/BV-01-C [OOB pairing - Ranging Requester]34

RAP/RES/SEC/BV-01-C [OOB pairing - Ranging Responder].....34

5 Test case mapping 36

6 Revision history and acknowledgments 38



1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and test cases to test the implementation of the Bluetooth Ranging 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 abbreviates can be found in [1] and [2].

- [1] Bluetooth Core Specification, Version 6.0 or later
- [2] Test Strategy and Terminology Overview
- [3] Ranging Profile Specification, Version 1.0
- [4] Ranging Service Specification, Version 1.0
- [5] ICS Proforma for Ranging Profile
- [6] Characteristic and Descriptor descriptions are accessible via the [Bluetooth SIG Assigned Numbers](#)
- [7] GATT Test Suite, GATT.TS
- [8] Document Naming and Marking Document
- [9] Channel Sounding Input Test Data for Filtering:
<https://files.bluetooth.com/download/channel-sounding-input-test-data-for-filtering/>
- [10] Range Profile Implementation eXtra Information for Test, IXIT

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 Ranging Profile [3] requires the presence of GAP, SM, L2CAP, and GATT. This is illustrated in Figure 3.1.

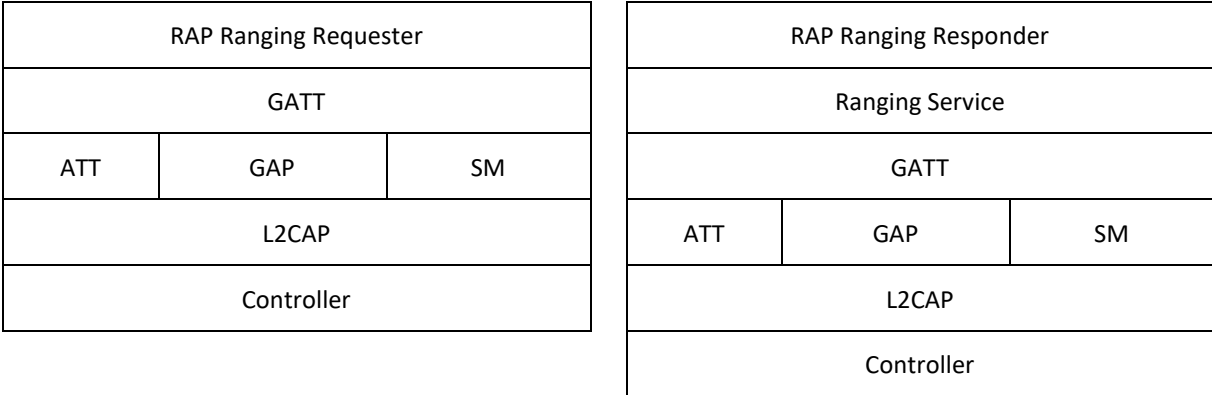


Figure 3.1: Ranging Profile test model

3.2 Test Strategy

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

Some test cases here may require two Lower Testers operating as Ranging Requesters.

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 Test database requirements

The following requirements apply to the set of databases used by the Lower Tester for testing of GATT client functionality:

- The Lower Tester includes one instantiation of each of the services used by this profile, including all defined characteristics.

- Each service instantiation also contains two «future» characteristics.
 - If possible, with one inserted before the first characteristic defined
 - If possible, with one appended after the last characteristic defined
- Each «future» characteristic has a 16-bit UUID randomly selected from unassigned UUIDs at the time of the test.

3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests
- Ranging Responder profile features
- Real-time Ranging Data procedures
- On-demand Ranging Data procedures
- Security 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>
RAP	Ranging Profile
Identifier Abbreviation	Role Identifier <IUT role>
REQ	Ranging Requester role
RES	Ranging Responder 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	Features and Behaviors Identifier <feat>
ORD	On-demand Ranging Data procedures
RRD	Real-time Ranging Data procedures
RSPF	Ranging Responder profile features
SEC	Security features

Table 4.1: RAP 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

- Preamble Procedure
 1. Establish an LE transport connection between the IUT and the Lower Tester.
 2. Establish an L2CAP channel 0x0004 between the IUT and the Lower Tester over that LE transport.

4.2.2 EATT Bearer on LE transport

- Preamble procedure:
 1. Establish an LE transport connection between the IUT and the Lower Tester.
 2. Establish an L2CAP channel 0x0005 for signaling and one or more L2CAP channels (for ATT bearers) with EATT PSM (as defined in Assigned Numbers) between the IUT and the Lower Tester over that LE transport.

4.3 Generic GATT Integrated Tests

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

TCID	Service / Characteristic	Reference	Properties	Value Length (Octets)	Service Type
RAP/REQ/CGGIT/SER/BV-01-C [Service GGIT - Ranging Service]	Ranging Service	[3] 4.3	-	-	Primary Service
RAP/REQ/CGGIT/CHA/BV-01-C [Characteristic GGIT - RAS Features]	RAS Features characteristic	[3] 4.3.2	0x02 (Read)	4	-
RAP/REQ/CGGIT/CHA/BV-02-C [Characteristic GGIT - Real-time Ranging Data]	Real-time Ranging Data characteristic	[3] 4.4.1	0x30 (Notify, Indicate)	Skip	-
RAP/REQ/CGGIT/CHA/BV-03-C [Characteristic GGIT - On-demand Ranging Data]	On-demand Ranging Data characteristic	[3] 4.4.2	0x30 (Notify, Indicate)	Skip	-
RAP/REQ/CGGIT/CHA/BV-04-C [Characteristic GGIT - RAS Control Point]	RAS Control Point characteristic	[3] 4.5	0x24 (Write Without Response, Indicate)	Skip	-
RAP/REQ/CGGIT/CHA/BV-05-C [Characteristic GGIT - Ranging Data Ready]	Ranging Data Ready characteristic	[3] 4.4.3	0x32 (Notify, Indicate, Read)	Skip	-
RAP/REQ/CGGIT/CHA/BV-06-C [Characteristic GGIT - Ranging Data Overwritten]	Ranging Data Overwritten characteristic	[3] 4.4.4	0x32 (Notify, Indicate, Read)	Skip	-

Table 4.2: Input for the GGIT Client test procedure

4.4 Ranging Responder profile features

RAP/RES/RSPF/BV-01-C [Ranging Service UUID in AD]

- Test Purpose

Verify that the Ranging Service UUID is included in the AD from the Ranging Responder IUT.
- Reference

[3] 3.1.1
- Initial Condition
 - The IUT is powered on in GAP Discoverable Mode.
 - The IUT is induced to generate Advertising Packets.
- Test Procedure
 1. 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 «Ranging Service».

RAP/RES/RSPF/BV-02-C [On-demand Ranging Data to two Ranging Requesters]

- Test Purpose

Verify that the Ranging Responder IUT can send On-demand Ranging Data to two Lower Testers operating as Ranging Requesters.
- Reference

[3] 3.2.1
- Initial Condition
 - A bearer connection between each of the two Lower Testers and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
 - Each of the two Lower Testers has discovered the Ranging Service [4] and characteristics.
 - Each of the two Lower Testers has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
 - The connection is encrypted.
- Test Procedure
 1. Perform an action that will induce the IUT to receive CS Subevent Data based on the TSPX_test_method [10] IXIT entry for Lower Tester 1.
 2. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 1.
 3. Perform an action that will induce the IUT to receive CS Subevent Data based on the TSPX_test_method [10] IXIT entry for Lower Tester 2 that is different from the CS Subevent Data generated in Step 1.

4. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 2.
5. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
6. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
7. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 1.
8. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 2.
9. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 2 to Lower Tester 1.
10. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 4 to Lower Tester 2.
11. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
12. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
13. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 1.
14. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 2.

- Expected Outcome

Pass verdict

The IUT successfully sends Ranging Data Ready indications, RAS Control Point indications, and On-demand Ranging Data notifications or indications independently to each Lower Tester to fulfill each Get Ranging Data request.

The Ranging Data sent to each Lower Tester is unique and matches what was requested in Steps 1 and 3.

RAP/RES/RSPF/BV-03-C [On-demand Ranging Data and Real-time Ranging Data to two Ranging Requesters]

- Test Purpose

Verify that the Ranging Responder IUT can send On-demand Ranging Data to a Ranging Requester while sending Real-time Ranging Data to a different Ranging Requester.

- Reference

[3] 3.2.1

- Initial Condition
 - A bearer connection between each of the Lower Testers and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
 - Each of the Lower Testers has discovered the Ranging Service [4] and characteristics.
 - Lower Tester 2 has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
 - The connection is encrypted.
- Test Procedure
 1. Lower Tester 1 enables notifications or indications for the Real-time Ranging Data characteristic.
 2. Perform an action that will induce the IUT to receive CS Subevent Data based on the TSPX_test_method [10] IXIT entry for Lower Tester 1 such that Real-time Ranging Data is continuously being sent throughout the test procedure.
 3. The IUT begins sending Real-time Ranging Data notifications or indications to Lower Tester 1.
 4. As the IUT sends Real-time Ranging Data notifications or indications, perform an action that will induce the IUT to receive CS Subevent Data based on the TSPX_test_method [10] IXIT entry for Lower Tester 2 that is different from the CS Subevent Data generated in Step 1.
 5. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 2.
 6. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 5.
 7. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 2.
 8. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 5 to Lower Tester 2.
 9. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 5.
 10. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 2.
 11. Lower Tester 1 writes 0x0000 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to disable notifications and indications.

- Expected Outcome

Pass verdict

The IUT successfully sends Ranging Data Ready indications, RAS Control Point indications, and On-demand Ranging Data notifications or indications to Lower Tester 2 while sending Real-time Ranging Data notifications or indications to Lower Tester 1.

The Ranging Data sent to each Lower Tester is unique and matches what was requested in Steps 2 and 4.

RAP/RES/RSPF/BV-04-C [Filtered On-demand Ranging Data to two Ranging Requesters]

- Test Purpose

Verify that the Ranging Responder IUT can send filtered On-demand Ranging Data to a Ranging Requester and un-filtered On-demand Ranging Data to another Ranging Requester.

- Reference

[3] 3.2.1

- Initial Condition

- A bearer connection between each of the Lower Testers and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- Each of the Lower Testers has discovered the Ranging Service [4] and characteristics.
- Each of the Lower Testers has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, and Ranging Data Overwritten characteristic indications.
- Lower Tester 2 has registered for On-demand Ranging Data characteristic notifications or indications.
- The connection is encrypted.

- Test Procedure

1. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x04 (Set Filter) and Parameter #1 set to any value in Table 4.7.
2. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) or Parameter #1 set to 0x04 (Success/Persisted) to Lower Tester 1.
3. Lower Tester 1 writes 0x0001 or 0x0002 to the On-demand Ranging Data characteristic's Client Characteristic Configuration descriptor on the IUT to enable notifications or indications.
4. The Upper Tester sends the IUT the Channel Sounding Input Test Data [9] based on the TSPX_test_method IXIT entry [10] set to "Pre-generated CS data" for Lower Tester 1.
5. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 1.
6. The Upper Tester sends the IUT the Channel Sounding Input Test Data [9] based on the TSPX_test_method IXIT entry [10] set to "Pre-generated CS data" for Lower Tester 2.
7. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 2.
8. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 5.
9. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 7.
10. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 1.
11. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 2.

12. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 5 to Lower Tester 1.
13. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 7 to Lower Tester 2.
14. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 5.
15. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 7.
16. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 1.
17. If the IUT deletes the previously sent data from its database, then the IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 2.

- Expected Outcome

Pass verdict

The IUT successfully sends Ranging Data to Lower Tester 1 with the parameters specified in Step 1 filtered out.

The IUT successfully sends Ranging Data to Lower Tester 2 with no parameters filtered out.

- Notes

The Channel Sounding Input Test Data [9] contains invalid Channel Sounding Procedure Data as it includes data for all Modes in one Procedure so that Ranging Data Filtering can be tested more efficiently. The Selected TX power field of the Ranging Header should have the value of 0x7F.

RAP/RES/RSPF/BV-05-C [Aborting On-demand Ranging Data with two Ranging Requesters]

- Test Purpose

Verify that the Ranging Responder IUT continues sending On-demand Ranging Data to a Ranging Requester after aborting an in-progress Get Ranging Data request from another Ranging Requester.

- Reference

[3] 3.2.1

- Initial Condition

- A bearer connection between each of the Lower Testers and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- Each of the Lower Testers has discovered the Ranging Service [4] and characteristics.
- Each of the Lower Testers has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
- The connection is encrypted.

- Test Procedure
 1. Perform an action that will induce the IUT to receive CS Subevent Data based on the TSPX_test_method IXIT entry [10] for Lower Tester 1.
 2. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 1.
 3. Perform an action that will induce the IUT to receive CS Subevent Data based on the TSPX_test_method IXIT entry [10] for Lower Tester 2 that is different from the CS Subevent Data generated in Step 1.
 4. When the Ranging Data is ready, the IUT sends an indication of the Ranging Data Ready characteristic to Lower Tester 2.
 5. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
 6. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
 7. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 1.
 8. The IUT sends one or more On-demand Ranging Data notifications or indications to Lower Tester 2.
 9. Lower Tester 1 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic and Op Code set to 0x03 (Abort Operation).
 10. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 1.
 11. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 4 to Lower Tester 2.
 12. Lower Tester 2 executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
 13. The IUT sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success) to Lower Tester 2.

- Expected Outcome

Pass verdict

The IUT successfully stops sending On-demand Ranging Data notifications or indications and does not send the RAS Control Point indication with the Complete Ranging Data Response Op Code after sending the RAS Control Point indication with the Success response code value to Lower Tester 1 indicating that the Abort Operation process has completed.

The IUT successfully finishes sending Ranging Data and sends a RAS Control Point indication with Op Code set to 0x00 (Complete Ranging Data response) to Lower Tester 2.

4.5 Real-time Ranging Data procedures

RAP/REQ/RRD/BV-01-C [Real-time Ranging Data]

- Test Purpose

Verify that the Ranging Requester IUT enables and receives Real-time Ranging Data notifications or indications.



- Reference

[3] 4.4.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [4] and characteristics.
- The connection is encrypted.
- The Lower Tester indicates support for Real-time Ranging Data in the RAS Features characteristic and the IUT has read the RAS Features characteristic.

- Test Procedure

Execute Steps 1–6 for each round in Table 4.3:

1. The Upper Tester orders the IUT to enable Real-time Ranging Data notifications or indications.
2. The IUT writes the value in Table 4.3 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
3. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
4. The Lower Tester sends one or more Real-time Ranging Data notifications or indications to the IUT.
5. The Upper Tester orders the IUT to disable Real-time Ranging Data notifications or indications.
6. The IUT writes 0x0000 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to disable notifications or indications.

Round	Real-time Ranging Data Characteristic CCCD Write Value
1	0x0001 (Notification)
2	0x0002 (Indication)

Table 4.3: Real-time Ranging Data rounds

- Expected Outcome

Pass verdict

The IUT successfully enables Real-time Ranging Data notifications or indications, receives Real-time Ranging Data notifications or indications, and disables Real-time Ranging Data notifications or indications.

RAP/REQ/RRD/BV-02-C [Real-time Ranging Data with Ranging Data Filter]

- Test Purpose

Verify that the Ranging Requester IUT can enable the Ranging Data Filter before enabling Real-time Ranging Data notifications or indications and disables the Real-time Ranging Data notifications or indications when changes to filter settings are needed.

- Reference

[3] 4.4.1, 4.5.1.1

- Initial Condition
 - A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
 - The IUT has discovered the Ranging Service [4] and characteristics.
 - The IUT has registered for RAS Control Point characteristic indications.
 - The connection is encrypted.
 - The Lower Tester indicates support for Real-time Ranging Data and Filter Ranging Data in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.

- Test Procedure

Execute Steps 1–17 for each round in Table 4.4.

1. The Upper Tester orders the IUT to set the Ranging Data Filter with the value for the round defined in Table 4.4.
2. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x04 (Set Filter), Parameter #1 set to the value in Table 4.4.
3. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x04 (Success/Persisted).
4. The Upper Tester orders the IUT to enable Real-time Ranging Data notifications or indications.
5. The IUT writes the value in Table 4.4 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
6. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
7. The Lower Tester sends one or more Real-time Ranging Data notifications or indications to the IUT.
8. The IUT disconnects and reconnects with the Lower Tester. If the IUT does not support GATT attribute caching, it rediscovers the RAS service and characteristic handles after reconnection. If the IUT supports GATT attribute caching and has not received a Service Changed indication, rediscovery is not required.
9. The Upper Tester orders the IUT to enable Real-time Ranging Data notifications or indications.
10. The IUT writes the value in Table 4.4 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
11. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
12. The Lower Tester sends one or more Real-time Ranging Data notifications or indications to the IUT.
13. The Upper Tester orders the IUT to clear the Ranging Data Filter for each mode.
14. The IUT writes 0x0000 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to disable notifications or indications.

Execute Steps 15–16 for each round in Table 4.5:

15. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x04 (Set Filter), Parameter #1 set to the value in Table 4.5.
16. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x04 (Success/Persisted).
17. The IUT disconnects and reconnects with the Lower Tester. If the IUT does not support GATT attribute caching, it rediscovers the RAS service and characteristic handles after reconnection. If the IUT supports GATT attribute caching and has not received a Service Changed indication,

rediscovery is not required. The IUT reconfigures the RAS Control Point characteristic for indications.

Round	CCCD Write Value	Parameter #1
1	0x0001 (Notification)	0x28 (Mode 0; Filter: Packet Quality and Packet Antenna)
		0x31 (Mode 1; Filter: Packet Quality, Packet NADM, Packet Antenna, Packet PCT1 and PCT2)
		0x4E (Mode 2; Filter: Tone Quality Indicator, Antenna Path 1, Antenna Path 3, and Antenna Path 4)
		0x15A3 (Mode 3; Filter: Packet Quality, Packet NADM, Packet RSSI, Packet Antenna, Antenna Permutation Index, Tone Quality Indicator, Antenna Path 2-4)
2	0x0002 (Indication)	0x28 (Mode 0; Filter: Packet Quality and Packet Antenna)
		0x31 (Mode 1; Filter: Packet Quality, Packet NADM, Packet Antenna, Packet PCT1 and PCT2)
		0x4E (Mode 2; Filter: Tone Quality Indicator, Antenna Path 1, Antenna Path 3, and Antenna Path 4)
		0x15A3 (Mode 3; Filter: Packet Quality, Packet NADM, Packet RSSI, Packet Antenna, Antenna Permutation Index, Tone Quality Indicator, Antenna Path 2-4)
3	0x0001 (Notification)	0x20 (Mode 0; Filter: All but Measured Freq Offset)
		0x21 (Mode 1; Filter: All but ToD ToA)
		0x0A (Mode 2; Filter: All but Tone_PCT)
		0x423 (Mode 3; Filter: All but ToD ToA and Tone_PCT)
4	0x0002 (Indication)	0x20 (Mode 0; Filter: All but Measured Freq Offset)
		0x21 (Mode 1; Filter: All but ToD ToA)
		0x0A (Mode 2; Filter: All but Tone_PCT)
		0x423 (Mode 3; Filter: All but ToD ToA and Tone_PCT)

Table 4.4: Real-time Ranging Data with Ranging Data Filter outer rounds

Round	Parameter #1
1	0x3C
2	0x1FD
3	0x1FE
4	0xFFFF

Table 4.5: Real-time Ranging Data with Ranging Data Filter inner rounds

- Expected Outcome

Pass verdict

The IUT successfully sets the Mode's filter settings while Real-time Ranging Data notifications or indications are disabled or disables them before setting the filter settings.

The IUT successfully receives Real-time Ranging Data notifications or indications with the Parameters from [Table 4.4](#) filtered out.

RAP/REQ/RRD/BI-01-C [Real-time Ranging Data indication or notification timeout]

- Test Purpose

Verify that the Ranging Requester IUT disables Real-time Ranging Data notifications or indications after receiving no Real-time Ranging Data indications or notifications within 5 seconds after starting a CS procedure.

- Reference

[3] 4.4.1.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [4] and characteristics.
- The connection is encrypted.
- The Lower Tester indicates support for Real-time Ranging Data in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.

- Test Procedure

1. The Upper Tester orders the IUT to enable Real-time Ranging Data notifications or indications.
2. The IUT writes 0x0001 or 0x0002 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
3. Perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
4. The Lower Tester does not send any Real-time Ranging Data notifications or indications to the IUT.
5. The IUT writes 0x0000 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to disable notifications and indications.

- Expected Outcome

Pass verdict

The IUT successfully disables Real-time Ranging Data notifications or indications after starting a CS procedure but receiving no Real-time Ranging Data notifications or indications within 5 seconds.

RAP/REQ/RRD/BI-02-C [Real-time Ranging Data indication or notification segment timeout]

- Test Purpose

Verify that the Ranging Requester IUT disables Real-time Ranging Data notifications or indications if it does not receive a subsequent Real-time Ranging Data notification or indication within 1 second after the receipt of the previous notification or indication.

- Reference

[3] 4.4.1.1

- Initial Condition
 - A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
 - The IUT has discovered the Ranging Service [4] and characteristics.
 - The connection is encrypted.
 - The Lower Tester indicates support for Real-time Ranging Data in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.
- Test Procedure
 1. The Upper Tester orders the IUT to enable Real-time Ranging Data notifications or indications.
 2. The IUT writes 0x0001 or 0x0002 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
 3. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
 4. The Lower Tester sends only one Real-time Ranging Data notification or indication with the First Segment bit in the Segmentation Header set to 1 and the Last Segment bit set to 0.
 5. The IUT writes 0x0000 to the Real-time Ranging Data characteristic's Client Characteristic Configuration descriptor to disable notifications and indications.

- Expected Outcome

Pass verdict

The IUT successfully disables Real-time Ranging Data notifications or indications after receiving only the first Real-time Ranging Data notification or indication and not receiving another within 1 second of the previous one.

4.6 On-demand Ranging Data procedures

RAP/REQ/ORD/BV-01-C [On-demand Ranging Data]

- Test Purpose

Verify that the Ranging Requester IUT can request On-demand Ranging Data notifications or indications after Ranging Data Ready indications are received and can send ACK Ranging Data commands to confirm that Ranging Data has been received.
- Reference

[3] 4.4.2
- Initial Condition
 - A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
 - The IUT has discovered the Ranging Service [4] and characteristics.
 - The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, and Ranging Data Overwritten characteristic indications.
 - The connection is encrypted.

- Test Procedure

Execute Steps 1–10 for each round in [Table 4.6](#):

1. The Upper Tester orders the IUT to enable On-demand Ranging Data notifications or indications.
2. The IUT writes the value in [Table 4.6](#) to the On-demand Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
3. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
4. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
5. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 4.
6. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
7. The Lower Tester sends one or more On-demand Ranging Data notifications or indications.
8. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 4.
9. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
10. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success).

Round	On-demand Ranging Data CCCD Write Value
1	0x0001 (Notification)
2	0x0002 (Indication)

Table 4.6: On-demand Ranging Data rounds

- Expected Outcome

Pass verdict

The IUT successfully requests On-demand Ranging Data via the Get Ranging Data command, receives On-demand Ranging Data notifications or indications, and acknowledges data reception via the ACK Ranging Data command.

RAP/REQ/ORD/BV-02-C [On-demand Ranging Data with Ranging Data Filter]

- Test Purpose

Verify that the Ranging Requester IUT can enable the Ranging Data Filter before requesting On-demand Ranging Data and disables the On-demand Ranging Data notifications or indications when changes to filter settings are needed.

- Reference

[\[3\]](#) 4.4.2, 4.5.1.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in [Section 4.2.1](#), if using ATT over an LE transport, or [Section 4.2.2](#) if using EATT over an LE transport.

- The IUT has discovered the Ranging Service [4] and characteristics.
- The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, and Ranging Data Overwritten characteristic indications.
- The connection is encrypted.
- The Lower Tester indicates support for Filter Ranging Data in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.

- Test Procedure

Execute Steps 1–27 for each round in Table 4.7.

1. The Upper Tester orders the IUT to set the Ranging Data Filter with the Parameter #1 value for the round defined in Table 4.7.
2. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x04 (Set Filter), Parameter #1 set to the value in Table 4.7.
3. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x04 (Success/Persisted).
4. The Upper Tester orders the IUT to enable the On-demand Ranging Data characteristic for notifications or indications.
5. The IUT writes the value in Table 4.7 to the On-demand Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
6. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
7. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
8. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 7.
9. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 7.
10. The Lower Tester sends one or more On-demand Ranging Data notifications or indications.
11. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 7.
12. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 7.
13. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success).
14. The IUT disconnects and reconnects with the Lower Tester. If the IUT does not support GATT attribute caching, it rediscovers the RAS service and characteristic handles after reconnection. If the IUT supports GATT attribute caching and has not received a Service Changed indication, rediscovery is not required. The IUT reconfigures the Ranging Data Ready characteristic for indications, the RAS Control Point characteristic for indications, and the On-demand Ranging Data characteristic for the property in Table 4.7.
15. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
16. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
17. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 16.

18. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 16.
19. The Lower Tester sends one or more On-demand Ranging Data notifications or indications.
20. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 16.
21. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 16.
22. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success).
23. The Upper Tester orders the IUT to clear the Ranging Data Filter for each mode.
24. The IUT writes 0x0000 to the On-demand Ranging Data characteristic's Client Characteristic Configuration descriptor to disable notifications or indications.

Execute Steps 25–26 for each round in [Table 4.8](#):

25. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x04 (Set Filter), Parameter #1 set to the value in [Table 4.8](#).
26. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x04 (Success/Persisted).
27. The IUT disconnects and reconnects with the Lower Tester. If the IUT does not support GATT attribute caching, it rediscovers the RAS service and characteristic handles after reconnection. If the IUT supports GATT attribute caching and has not received a Service Changed indication, rediscovers is not required. The IUT reconfigures the Ranging Data Ready characteristic for indications and the RAS Control Point characteristic for indications.

Round	CCCD Write Value	Parameter #1
1	0x0001 (Notification)	0x28 (Mode 0; Filter: Packet Quality and Packet Antenna)
		0x31 (Mode 1; Filter: Packet Quality, Packet NADM, Packet Antenna, Packet PCT1 and PCT2)
		0x4E (Mode 2; Filter: Tone Quality Indicator, Antenna Path 1, Antenna Path 3, and Antenna Path 4)
		0x15A3 (Mode 3; Filter: Packet Quality, Packet NADM, Packet RSSI, Packet Antenna, Antenna Permutation Index, Tone Quality Indicator, Antenna Path 2-4)
2	0x0002 (Indication)	0x28 (Mode 0; Filter: Packet Quality and Packet Antenna)
		0x31 (Mode 1; Filter: Packet Quality, Packet NADM, Packet Antenna, Packet PCT1 and PCT2)
		0x4E (Mode 2; Filter: Tone Quality Indicator, Antenna Path 1, Antenna Path 3, and Antenna Path 4)
		0x15A3 (Mode 3; Filter: Packet Quality, Packet NADM, Packet RSSI, Packet Antenna, Antenna Permutation Index, Tone Quality Indicator, Antenna Path 2-4)
3	0x0001 (Notification)	0x20 (Mode 0; Filter: All but Measured Freq Offset)
		0x21 (Mode 1; Filter: All but ToD ToA)
		0x0A (Mode 2; Filter: All but Tone_PCT)
		0x423 (Mode 3; Filter: All but ToD ToA and Tone_PCT)

Round	CCCD Write Value	Parameter #1
4	0x0002 (Indication)	0x20 (Mode 0; Filter: All but Measured Freq Offset)
		0x21 (Mode 1; Filter: All but ToD ToA)
		0x0A (Mode 2; Filter: All but Tone_PCT)
		0x423 (Mode 3; Filter: All but ToD ToA and Tone_PCT)

Table 4.7: On-demand Ranging Data with Ranging Data Filter outer rounds

Round	Parameter #1
1	0x3C
2	0x1FD
3	0x1FE
4	0xFFFF

Table 4.8: On-demand Ranging Data with Ranging Data Filter inner rounds

- Expected Outcome

Pass verdict

The IUT successfully sets the Mode's filter settings while On-demand Ranging Data notifications or indications are disabled or disables them before setting the filter settings.

The IUT successfully receives On-demand Ranging Data notifications or indications with the Parameters from [Table 4.7](#) filtered out and acknowledges receiving the On-demand Ranging Data notifications or indications via the ACK Ranging Data command.

RAP/REQ/ORD/BV-03-C [Retrieve Lost Ranging Data Segments]

- Test Purpose

Verify that the Ranging Requester IUT requests retransmission of unreceived On-demand Ranging Data notifications or indications and sends the ACK Ranging Data command to confirm that the retransmitted Ranging Data segment has been received.

- Reference

[\[3\]](#) 4.4.2.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section [4.2.1](#), if using ATT over an LE transport, or Section [4.2.2](#) if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [\[4\]](#) and characteristics.
- The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, and Ranging Data Overwritten characteristic indications.
- The connection is encrypted.
- The Lower Tester indicates support for Retrieve Lost Ranging Data Segments in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.

- Test Procedure

Execute Steps 1–22 for each round in [Table 4.9](#):

1. The Upper Tester orders the IUT to enable On-demand Ranging Data notifications or indications.
2. The IUT writes the value in [Table 4.9](#) to the On-demand Ranging Data characteristic's Client Characteristic Configuration descriptor to enable notifications or indications.
3. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
4. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
5. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 4.
6. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
7. The Lower Tester sends one or more On-demand Ranging Data notifications or indications. The Lower Tester excludes sending two consecutive notifications or indications, a single notification or indication that is not consecutive with the two previously excluded notifications or indications, and the last notification or indication.
8. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 4.
9. The Upper Tester orders the IUT to execute the Retrieve Lost Ranging Data Segments command with the Ranging Counter value from Step 4 and the Start Segment and End Segment set to the one unsent notification or indication in Step 7.
10. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x02 (Retrieve Lost Ranging Data Segments), Parameter #1 set to the Ranging Counter value in Step 4, and Parameter #2 and Parameter #3 set to the unsent Segment Index value for the one notification or indication not sent in Step 7.
11. The Lower Tester sends an On-demand Ranging Data notification or indication with the Segment Index set to the value from Step 10.
12. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x01 (Complete Lost Ranging Data Segment Response), Parameter #1 set to the Ranging Counter value in Step 4, and Parameter #2 and Parameter #3 set to the values in Step 10.
13. The Upper Tester orders the IUT to execute the Retrieve Lost Ranging Data Segments command with the Ranging Counter value from Step 4 and the Start Segment and End Segment set to the consecutive unsent notifications or indications in Step 7.
14. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x02 (Retrieve Lost Ranging Data Segments), Parameter #1 set to the Ranging Counter value in Step 4, Parameter #2 set to the lowest Segment Index value not sent in Step 7, and Parameter #3 set to the next Segment Index value not sent in Step 7.
15. The Lower Tester sends multiple On-demand Ranging Data notifications or indications with Segment Index set to the Parameter #2 and Parameter #3 range requested in Step 14.
16. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x01 (Complete Lost Ranging Data Segment Response), Parameter #1 set to the Ranging Counter value in Step 4, and Parameter #2 and Parameter #3 set to the values in Step 14.
17. The Upper Tester orders the IUT to execute the Retrieve Lost Ranging Data Segments command with the Ranging Counter value from Step 4, the Start Segment set to the last received Segment Index value in Step 7, and the End Segment set to 0xFF.
18. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x02 (Retrieve Lost Ranging Data Segments), Parameter #1 set to

the Ranging Counter value in Step 4, Parameter #2 set to the last received Segment Index value in Step 7, and Parameter #3 set to 0xFF.

19. The Lower Tester sends multiple On-demand Ranging Data notifications or indications with Segment Index set to the Parameter #2 and Parameter #3 range requested in Step 18.
20. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x01 (Complete Lost Ranging Data Segment Response), Parameter #1 set to the Ranging Counter value in Step 4, Parameter #2 set to the value in Step 18, and Parameter #3 set to the final Segment Index value.
21. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 4.
22. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success).

Round	On-demand Ranging Data CCCD Write Value
1	0x0001 (Notification)
2	0x0002 (Indication)

Table 4.9: Retrieve Lost Ranging Data Segments rounds

- Expected Outcome

Pass verdict

The IUT successfully requests unsent On-demand Ranging Data via the Retrieve Lost Ranging Data Segments command and, after reception, acknowledges receiving all On-demand Ranging Data notifications or indications via the ACK Ranging Data command.

RAP/REQ/ORD/BV-04-C [Abort Operation]

- Test Purpose

Verify that the Ranging Requester IUT can request to abort the current RAS Control Point operation.

- Reference

[3] 4.5.1.2

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [4] and characteristics.
- The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
- The connection is encrypted.
- The Lower Tester indicates support for the Abort Operation in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.

- Test Procedure
 1. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
 2. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
 3. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 2.
 4. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
 5. The Lower Tester starts to send On-demand Ranging Data notifications or indications.
 6. As the Lower Tester is sending On-demand Ranging Data notifications or indications, the Upper Tester orders the IUT to execute the Abort Operation command.
 7. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x03 (Abort Operation).
 8. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success).

- Expected Outcome

Pass verdict

The IUT successfully requests to abort the ongoing Get Ranging Data operation using the Abort Operation command.

4.6.1 Ranging Data Ready notifications

- Test Purpose

Verify that the Ranging Requester IUT can enable and receive Ranging Data Ready notifications and can read the Ranging Data Ready characteristic when notifications are lost.

- Reference

[3] 4.4.3.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [4] and characteristics.
- The IUT has registered for RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications or notifications, if supported by the Lower Tester.
- The Ranging Data Ready characteristic is configured for the properties in Table 4.10.
- The connection is encrypted.

- Test Case Configuration

Test Case	Ranging Data Ready Property
RAP/REQ/ORD/BV-05-C [Ranging Data Ready, Notification]	Notification
RAP/REQ/ORD/BV-06-C [Ranging Data Ready, Notification and Read]	Notification and Read

Table 4.10: Ranging Data Ready notifications test cases

- Test Procedure

1. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
2. The Lower Tester sends a notification of the Ranging Data Ready characteristic to the IUT.
3. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
4. The Lower Tester sends an indication of the Ranging Data Overwritten characteristic and does not send a notification of the Ranging Data Ready characteristic to the IUT.
5. If supported in [Table 4.10](#): up to 5 seconds after Step 4, the IUT executes the GATT Read Characteristic Value sub-procedure for the Ranging Data Ready characteristic.

- Expected Outcome

Pass verdict

The IUT successfully receives a Ranging Data Ready notification.

If Ranging Data Ready Read is supported in [Table 4.10](#): when notifications are lost, the IUT executes the GATT Read Characteristic Value sub-procedure on the Ranging Data Ready characteristic.

4.6.2 Ranging Data Overwritten

- Test Purpose

Verify that the Ranging Requester IUT can enable and receive Ranging Data Overwritten notifications or indications and can read the Ranging Data Overwritten characteristic when notifications are lost.

- Reference

[\[3\]](#) 4.4.4

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section [4.2.1](#), if using ATT over an LE transport, or Section [4.2.2](#) if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [\[4\]](#) and characteristics.
- The IUT has registered for RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Ready indications or notifications, if supported by the Lower Tester.
- The Ranging Data Overwritten characteristic is configured for the properties in [Table 4.11](#).
- The connection is encrypted.

- Test Case Configuration

Test Case	Ranging Data Overwritten Property
RAP/REQ/ORD/BV-07-C [Ranging Data Overwritten, Indication]	Indication
RAP/REQ/ORD/BV-08-C [Ranging Data Overwritten, Notification]	Notification
RAP/REQ/ORD/BV-09-C [Ranging Data Overwritten, Notification and Read]	Notification and Read

Table 4.11: Ranging Data Overwritten test cases

- Test Procedure

1. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
2. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
3. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
4. The Lower Tester sends a notification or indication of the Ranging Data Overwritten characteristic depending on the property listed in [Table 4.11](#) and an indication of the Ranging Data Ready characteristic to the IUT.

Execute Steps 5–7 if the Ranging Data Overwritten property in [Table 4.11](#) is Notification:

5. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [\[10\]](#).
6. The Lower Tester does not send a notification of the Ranging Data Overwritten characteristic and sends an indication of the Ranging Data Ready characteristic to the IUT.
7. If supported in [Table 4.11](#): the IUT executes the GATT Read Characteristic Value sub-procedure for the Ranging Data Overwritten characteristic.

- Expected Outcome

Pass verdict

The IUT successfully receives a Ranging Data Overwritten indication or notification.

If Ranging Data Overwritten Read is supported in [Table 4.11](#): when notifications are lost, the IUT executes the GATT Read Characteristic Value sub-procedure on the Ranging Data Overwritten characteristic.

[RAP/REQ/ORD/BI-01-C \[On-demand Ranging Data indication or notification timeout\]](#)

- Test Purpose

Verify that the Ranging Requester IUT sends the Abort Operation command after not receiving On-demand Ranging Data indications or notifications within 5 seconds after sending the Get Ranging Data command.

- Reference

[\[3\]](#) 4.5.4.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in [Section 4.2.1](#), if using ATT over an LE transport, or [Section 4.2.2](#) if using EATT over an LE transport.

- The IUT has discovered the Ranging Service [4] and characteristics.
- The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
- The connection is encrypted.
- The Lower Tester indicates support for the Abort Operation in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.
- Test Procedure
 1. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
 2. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
 3. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 2.
 4. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
 5. The Lower Tester does not send On-demand Ranging Data notifications or indications.
 6. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x03 (Abort Operation).

- Expected Outcome

Pass verdict

The IUT successfully requests to abort the ongoing Get Ranging Data operation using the Abort Operation command after initiating the Get Ranging Data operation but receiving no On-demand Ranging Data notifications or indications within 5 seconds.

RAP/REQ/ORD/BI-02-C [On-demand Ranging Data indication or notification segment timeout]

- Test Purpose

Verify that the Ranging Requester IUT issues the Abort Operation command if it does not receive a subsequent On-demand Ranging Data notification or indication within 1 second after the receipt of the previous notification or indication.

- Reference

[3] 4.5.4.1

- Initial Condition

- A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
- The IUT has discovered the Ranging Service [4] and characteristics.
- The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
- The connection is encrypted.

- The Lower Tester indicates support for the Abort Operation in the RAS Features characteristic, and the IUT has read the RAS Features characteristic.
- Test Procedure
 1. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
 2. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
 3. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 2.
 4. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
 5. The Lower Tester sends only one On-demand Ranging Data notification or indication with the First Segment bit in the Segmentation Header set to 1 and the Last Segment bit set to 0.
 6. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x03 (Abort Operation).

- Expected Outcome

Pass verdict

The IUT successfully requests to abort the ongoing Get Ranging Data operation using the Abort Operation command after receiving only the first On-demand Ranging Data notification or indication and not receiving another within 1 second of the previous one.

RAP/REQ/ORD/BI-03-C [Ignore errant Response Codes]

- Test Purpose

Verify that the Ranging Requester IUT ignores RAS Control Point Response Codes with RFU values and Complete Lost Ranging Data Segment responses when Retrieve Lost Ranging Data Segments was not requested.
- Reference

[3] 4.5.4.2
- Initial Condition
 - A bearer connection between the Lower Tester and the IUT is established as described in Section 4.2.1, if using ATT over an LE transport, or Section 4.2.2 if using EATT over an LE transport.
 - The IUT has discovered the Ranging Service [4] and characteristics.
 - The IUT has registered for Ranging Data Ready characteristic indications, RAS Control Point characteristic indications, On-demand Ranging Data characteristic notifications or indications, and Ranging Data Overwritten characteristic indications.
 - The connection is encrypted.
- Test Procedure
 1. If necessary, perform an action that will induce the IUT to begin a CS procedure based on the TSPX_test_method IXIT entry [10].
 2. The Lower Tester sends an indication of the Ranging Data Ready characteristic to the IUT.
 3. The Upper Tester orders the IUT to execute the Get Ranging Data command with the Ranging Counter value from Step 2.

4. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x00 (Get Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
 5. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x01 (Complete Lost Ranging Data Segment Response), Parameter #1 set to the Ranging Counter value in Step 2, and Parameter #2 and Parameter #3 set to any valid value.
 6. The Lower Tester sends one or more On-demand Ranging Data notifications or indications.
 7. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to an RFU value.
 8. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x00 (Complete Ranging Data Response) and Parameter #1 set to the Ranging Counter value in Step 2.
 9. The IUT executes the GATT Write Without Response sub-procedure with the RAS Control Point characteristic, Op Code set to 0x01 (ACK Ranging Data) and Parameter #1 set to the Ranging Counter value in Step 2.
 10. The Lower Tester sends an indication of the RAS Control Point characteristic with Op Code set to 0x02 (Response Code) and Parameter #1 set to 0x01 (Success).
- Expected Outcome

Pass verdict

The IUT successfully ignores the errant Complete Lost Ranging Data Segment Response and the RAS Control Point Response Code indication with an RFU value.

4.7 Security features

4.7.1 OOB pairing

- Test Purpose

Verify that the IUT sends the OOB Authentication Data to the Lower Tester with all mandatory AD types and successfully pairs with the Lower Tester.

- Reference

[3] 6.3

- Test Case Configuration

Test Case
RAP/REQ/SEC/BV-01-C [OOB pairing - Ranging Requester]
RAP/RES/SEC/BV-01-C [OOB pairing - Ranging Responder]

Table 4.12: OOB pairing test cases

- Initial Condition
 - The IUT is in pairing mode, but no connection has been established.
- Test Procedure
 1. The Lower Tester and the IUT exchange the required OOB data in at least one direction for LE Secure Connections pairing using the supported OOB method in the format defined in Section 6.3 in [3].
 2. The Lower Tester and the IUT pair using the exchanged OOB data.

- Expected Outcome

Pass verdict

The OOB Authentication Data sent by the IUT contains all mandatory AD types defined in Section 6.3 in [3].

The Lower Tester and the IUT successfully pair.

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 Ranging Profile [5].

If a test case is mandatory within the respective layer, then the y/x reference is omitted.

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)
RAP 5/1	Ranging Service UUID in AD	RAP/RES/RSPF/BV-01-C
RAP 4/1 AND RAP 5/5	On-demand Ranging Data to two Ranging Requesters	RAP/RES/RSPF/BV-02-C
RAP 5/2 AND RAP 5/5	On-demand Ranging Data and Real-time Ranging Data to two Ranging Requesters	RAP/RES/RSPF/BV-03-C
RAP 5/4 AND RAP 5/5	Filtered On-demand Ranging Data to two Ranging Requesters	RAP/RES/RSPF/BV-04-C
RAP 5/3 AND RAP 5/5	Aborting On-demand Ranging Data with two Ranging Requesters	RAP/RES/RSPF/BV-05-C
RAP 6/6 OR RAP 6/12	OOB pairing, Ranging Responder	RAP/RES/SEC/BV-01-C
RAP 7/1	Discover Ranging Service	RAP/REQ/CGGIT/SER/BV-01-C
RAP 8/1	RAS Features characteristic	RAP/REQ/CGGIT/CHA/BV-01-C
RAP 8/3	Real-time Ranging Data characteristic	RAP/REQ/CGGIT/CHA/BV-02-C RAP/REQ/RRD/BV-01-C RAP/REQ/RRD/BI-01-C RAP/REQ/RRD/BI-02-C
RAP 8/6	On-demand Ranging Data characteristic	RAP/REQ/CGGIT/CHA/BV-03-C RAP/REQ/ORD/BV-01-C RAP/REQ/ORD/BI-01-C RAP/REQ/ORD/BI-02-C RAP/REQ/ORD/BI-03-C
RAP 8/9	RAS Control Point characteristic	RAP/REQ/CGGIT/CHA/BV-04-C
RAP 8/12	Ranging Data Ready characteristic	RAP/REQ/CGGIT/CHA/BV-05-C
RAP 8/16	Ranging Data Overwritten characteristic	RAP/REQ/CGGIT/CHA/BV-06-C
RAP 8/3 AND RAP 9/5	Real-time Ranging Data with Ranging Data Filter	RAP/REQ/RRD/BV-02-C

Item	Feature	Test Case(s)
RAP 8/6 AND RAP 9/5	On-demand Ranging Data with Ranging Data Filter	RAP/REQ/ORD/BV-02-C
RAP 9/3	Retrieve Lost Ranging Data Segments	RAP/REQ/ORD/BV-03-C
RAP 9/4	Abort Operation	RAP/REQ/ORD/BV-04-C
RAP 8/14	Ranging Data Ready, Notification	RAP/REQ/ORD/BV-05-C
RAP 8/14 AND RAP 8/15	Ranging Data Ready, Notification and Read	RAP/REQ/ORD/BV-06-C
RAP 8/17	Ranging Data Overwritten, Indication	RAP/REQ/ORD/BV-07-C
RAP 8/18	Ranging Data Overwritten, Notification	RAP/REQ/ORD/BV-08-C
RAP 8/18 AND RAP 8/19	Ranging Data Overwritten, Notification and Read	RAP/REQ/ORD/BV-09-C
RAP 11/6 OR RAP 11/12	OOB pairing, Ranging Requester	RAP/REQ/SEC/BV-01-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
0	p0	2024-11-19	Approved by BTI on 2024-10-29. RAP v1.0 adopted by the BoD on 2024-11-12. Prepared for initial publication.
	p1r00–r02	2025-01-24 – 2025-04-28	TSE 26918 (rating 2): Updated the "Input for the GGIT Client test procedure" table's Properties column for RAP/REQ/CGGIT/CHA/BV-04-C to read "0x24 (Write Without Response, Indicate)". TSE 27149 (rating 2): Updated the TCMT to add Item RAP 5/5 to the mapping for RAP/RES/RSPF/BV-02-C – -05-C. TSE 27393 (rating 1): Added note to TC RAP/RES/RSPF/BV-04-C.
1	p1	2025-07-08	Approved by BTI on 2025-06-15. Prepared for TCRL pkg100 publication.
	p2r00	2025-07-11	TSE 27679 (rating 2): Deleted what was Step 8 from the test procedure in RAP/REQ/ORD/BV-04-C. TSE 27680 (rating 2): Updated the test procedure for RAP/REQ/RRD/BV-02-C and RAP/REQ/ORD/BV-02-C.
2	p2	2025-11-04	Approved by BTI on 2025-10-02. Prepared for TCRL pkg101 publication.
	p3r00–r03	2026-03-16 – 2026-05-08	TSE 28313 (rating 2): Updated the test procedure for RAP/RES/RSPF/BV-02-C – -05-C, RAP/REQ/RRD/BV-01-C – -02-C, RAP/REQ/RRD/BI-01-C – -02-C, RAP/REQ/ORD/BV-01-C – -09-C, RAP/REQ/ORD/BI-01-C – -03-C to add references to IXIT item TSPX_test_method. Updated the references list. TSE 28817 (rating 2): Changed certain characteristic requirements for "indications" to "notifications or indications" for RAP/REQ/ORD/BV-05-C and RAP/REQ/ORD/BV-08-C. TSE 28873 (rating 1): Updated note in RAP/RES/RSPF/BV-04-C regarding value for Selected TX power field of the Ranging Header.
3	p3	2026-06-23	Approved by BTI on 2026-05-28. Prepared for TCRL pkg104 publication.

Acknowledgments

Name	Company
Dejan Berec	Bluetooth SIG, Inc.