Microphone Control Service (MICS)

***Bluetooth*® Test Suite**

- **Revision:** MICS.TS.p0 edition 2
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- **Group Prepared By:** Generic Audio Working Group

Contents

1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and test cases (TC) to test the implementation of the Bluetooth Microphone Control Service 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 Bluetooth document incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereinafter.

[1] Bluetooth Core Specification, Version 5.2 or later

[2] Test Strategy and Terminology Overview

[3] Bluetooth Microphone Control Service Specification, Version 1.0

[4] Microphone Control Service ICS (MICS.ICS)

[5] GATT Test Suite (GATT.TS)

[6] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers

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 from [1] and [2] apply.

3 Test Suite Structure (TSS)

3.1 Overview

The Microphone Control Service [3] requires the presence of GAP, SM (when used over LE transport), SDP (when used over BR/EDR transport), and GATT. EATT can optionally be used. This is illustrated in Figure 3.1.

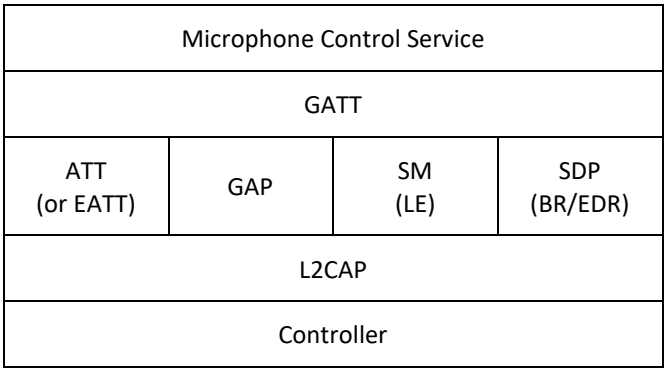

Figure 3.1: Microphone Control Service test model

3.2 Test strategy

The test objectives are to verify functionality of the specification within a Bluetooth Host and to enable interoperability between Bluetooth Hosts on different devices, specifically between a MICS server and a GATT-enabled client. The testing approach covers mandatory and optional requirements in the service specification and to match these to the support of the IUT as described in the ICS. Any test case defined in this document is applicable to the IUT if the ICS logical expression defined in the Test Case Mapping Table (TCMT) is valid.

The test equipment shall provide an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in the Microphone Control 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, an MMI, or another interface supported by the IUT.

The Microphone Control Service test suite contains Valid Behavior (BV) tests complemented with Invalid Behavior (BI) tests where required. Additionally, since Microphone Control Service is a GATT-based service, Generic GATT Integrated Tests (GGIT) are used to validate parts of the specification. The test coverage is logically grouped in test groups and described below after careful evaluation of requirements defined in the specification.

3.3 Test groups

The following test groups have been defined:

- Generic GATT Integrated Tests

  Verify the generic GATT behavior for discovery, characteristics, descriptors, indications, notifications, etc.

- Service Procedure – Error Handling

  Verify that the IUT correctly handles error conditions that result from the characteristic writes or failure to perform a requested operation due to rejection of the request by a Remote Device.

- Service Procedure – Notifications

  Verify that the IUT correctly handles updates of the characteristic and properly sends a Notification.

4 Test cases (TC)

4.1 Introduction

4.1.1 Test case identification conventions

Test cases shall be assigned unique identifiers per the conventions in [2]. The convention used here is **<spec abbreviation>/<IUT role>/**<class>/**<feat>**/<func>/<subfunc>**/**<cap>**/<xx>-<nn>-<y>**.

Additionally, testing of this specification includes a set of 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>**
MICS	Microphone Control Service
Identifier Abbreviation	**Role Identifier <IUT role>**
SR	Server
Identifier Abbreviation	**Feature Identifier <feat>**
SGGIT	Server Generic GATT Integrated Tests
SPE	Service Procedure - Error Handling
SPN	Service Procedure - Notifications
Identifier Abbreviation	**Function Identifier <func>**
CHA	Characteristic GGIT
SDP	SDP GGIT
SER	Service GGIT

Table 4.1: MICS 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 as information, as they are used by test equipment in achieving the initial conditions in certain tests.

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 ATT Bearer on BR/EDR Transport

Preamble procedure:

1. Establish a BR/EDR transport connection between the IUT and the Lower Tester.
2. Establish an L2CAP channel (PSM 0x001F) between the IUT and the Lower Tester over that BR/EDR transport.

4.2.3 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 L2CAP channel (for ATT bearers) with EATT PSM (as defined in Assigned Numbers) between the IUT and the Lower Tester over that LE transport.

4.2.4 EATT Bearer on BR/EDR Transport

Preamble procedure:

1. Establish a BR/EDR transport connection between the IUT and the Lower Tester.

2. Establish an L2CAP channel 0x0001 for signaling and one L2CAP channel (for ATT bearers) with EATT PSM (as defined in Assigned Numbers) between the IUT and the Lower Tester over that BR/EDR transport.

4.3 Generic GATT Integration Tests

Execute the Generic GATT Integrated Tests defined in [5] 6.3 Server Test Procedures using Table 4.2 below as input:

TCID	Service / Characteristic / Descriptor	Reference	Properties	Value Length (Octets)
MICS/SR/SGGIT/SER/BV-01-C [Service GGIT – Microphone Control]	Microphone Control Service	[3] 2	-	-
MICS/SR/SGGIT/SDP/BV-01-C [SDP Record]	Microphone Control Service	[3] 4	-	-
MICS/SR/SGGIT/CHA/BV-01-C [Characteristic GGIT – Mute]	Mute	[3] 3.1.1	0x1A (Read, Write, Notify)	1

Table 4.2: Input for the GGIT Server test procedure

4.4 Service Procedure – Notifications

MICS/SR/SPN/BV-01-C [Update Mute Characteristic]

- Test Purpose

  Verify the behavior of the IUT when it updates the Mute characteristics while a Client is connected.

- Reference

  [3] 3.1.1

- Initial Condition

  - Establish a Bearer connection between the Lower Tester and the IUT as described in Section 4.2.1, if using ATT over an LE transport, or 4.2.2 if using ATT over a BR/EDR transport, or 4.2.3 if using EATT over an LE transport, or 4.2.4 if using EATT over a BR/EDR transport.
  - The Lower Tester has cached the MICS service and characteristics handles (e.g., by running the procedures in Section 4.3).
  - The Lower Tester enables notification for the Mute characteristic by writing the value 0x0001 to the Mute CCCD using the GATT Write Characteristic Descriptor sub-procedure.
  - The IUT's Mute characteristic is initially set to 0 or 1.

- Test Procedure

  1. The Lower Tester reads the characteristic value for the Mute characteristic by executing the GATT Read Characteristic Value sub-procedure.
  2. The Upper Tester commands the IUT to update the Mute characteristic to 0 or 1, whichever is different than the value in step 1.
  3. The IUT sends a notification containing the updated value of the Mute characteristic.
  4. The Lower Tester executes the GATT Write Characteristic Value sub-procedure to 0 or 1, whichever is different than the value in step 3.
  5. The IUT sends a notification containing the updated value of the Mute characteristic.

- Expected Outcome

  Pass verdict

  In step 3, the characteristic value is correctly formatted and is different from the one received in step 1.

  In step 5, the characteristic value is correctly formatted and is different from the one received in step 3.

4.5 Service Procedure Error Handling

MICS/SR/SPE/BI-01-C [Invalid Mute Value]

- Test Purpose

  Verify that the IUT responds with an error when writing a Mute value that is not valid.

- Reference

  [3] 3.1.1

- Initial Condition

  - Establish a Bearer connection between the Lower Tester and the IUT as described in Section 4.2.1, if using ATT over an LE transport, or 4.2.2 if using ATT over a BR/EDR transport, or 4.2.3 if using EATT over an LE transport, or 4.2.4 if using EATT over a BR/EDR transport.
  - The handle of the Mute characteristic has been previously discovered by the Lower Tester during a test procedure in Section 4.3 or is known to the Lower Tester by other means.
  - If the IUT requires bonding, then the Lower Tester performs a bonding procedure.

- Test Procedure

  1. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Mute characteristic with a value of 2.
  2. The Lower Tester receives an Error Response with an error code from the IUT.
  3. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Mute characteristic with an RFU value.
  4. The Lower Tester receives an Error Response with an error code from the IUT.

- Expected Outcome

  Pass verdict

  The IUT sends an error response of “Value Not Allowed” (0x13) to the Lower Tester.

MICS/SR/SPE/BI-02-C [Invalid Writes While Disabled]

- Test Purpose

  Verify that the IUT responds with an error when writing to the Mute characteristic when the Server is in the Disabled state.

- Reference

  [3] 3.1.1

- Initial Condition
  - Establish a Bearer connection between the Lower Tester and the IUT as described in Section 4.2.1, if using ATT over an LE transport, or 4.2.2 if using ATT over a BR/EDR transport, or 4.2.3 if using EATT over an LE transport, or 4.2.4 if using EATT over a BR/EDR transport.
  - The handle of the Mute characteristic has been previously discovered by the Lower Tester during a test procedure in Section 4.3 or is known to the Lower Tester by other means.
  - If the IUT requires bonding, then the Lower Tester performs a bonding procedure.
  - The IUT has set its Mute state to Disabled (0x02).
- Test Procedure

  1. The Lower Tester executes the GATT Read Characteristic Value sub-procedure for the Mute characteristic.
  2. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Mute characteristic with a value of 0.
  3. The Lower Tester receives an Error Response with an error code from the IUT.
  4. The Lower Tester executes the GATT Write Characteristic Value sub-procedure for the Mute characteristic with a value of 1.
  5. The Lower Tester receives an Error Response with an error code from the IUT.
- Expected Outcome

  Pass verdict

  The Mute characteristic value is Disabled (0x02) from step 1.

  The IUT sends an error response of “Mute Disabled” to the Lower Tester, after steps 2 and 4.

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 Microphone Control Service (MICS) [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 the purpose and structure of the ICS/IXIT, refer to [2].

Item	Feature	Test Case(s)
MICS 1/1	Service Supported over BR/EDR	MICS/SR/SGGIT/SDP/BV-01-C
MICS 1/1 OR MICS 1/2	Microphone Control Service	MICS/SR/SGGIT/SER/BV-01-C
MICS 2/1	Mute Characteristic	MICS/SR/SGGIT/CHA/BV-01-C MICS/SR/SPN/BV-01-C MICS/SR/SPE/BI-01-C MICS/SR/SPE/BI-02-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
	d07r00–r09	2019-02-11 – 2020-04-03	Initial draft. Based on MicrophoneService_d07r01. Track MicrophoneControlService_d09r03. Track MicrophoneControlService_d07r04_ASA_MS_TLC_MR. Track MicrophoneControlService_d07r05. Address WG comments and track MicrophoneControlService_d07r06. Track MicrophoneControlService_d09r01. Address BTI comments and editorial changes.
	d09r00–r05	2020-04-24 – 2020-10-06	Track MicrophoneControlService_d09r02_CM_MR2. Track MicrophoneControlService_d09r03. Address WG comments and track MicrophoneControlService_d09r04. Address WG comments and track MicrophoneControlService_d09r05. Address BTI comments and track MICS_d09r07. Update Contributors.
	p0r00–r02	2020-10-28 – 2020-12-01	Editorial and formatting updates. Address BTI comments.
0	p0	2021-03-02	Approved by BTI on 2021-02-20. MICS v1.0 adopted by the BoD on 2021-02-23. Prepared for publication.
	p0ed2r00	2021-07-23	TSE 17213 (rating 1): Corrected error code in the pass verdict of TC MICS/SR/SPE/BI-01-C.
	p0 edition 2	2021-09-28	Approved by BTI on 2021-09-27. Prepared for edition 2 publication.

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