Automation IO Profile (AIOP)

*Bluetooth®* Test Suite

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- **Group Prepared By**: Automation Working Group
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**Abstract:**
This document defines test structures and procedures for conformance test of products implementing the Automation IO Profile Specification.
Revision History

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1 Scope

This Bluetooth document contains the Test Suite Structure (TSS) and Test Cases (TC) to test the Automation IO Profile Specification.

The objective of this test suite is to provide a basis for interoperability tests for Bluetooth devices giving a high probability of air interface interoperability between different manufacturers’ Bluetooth devices.
2 References, Definitions, and Abbreviations

2.1 References

This Bluetooth document incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. Additional definitions and abbreviations can be found in [1] and [2].

[1] Test Strategy and Terminology Overview
[2] Bluetooth Core Specification, 4.0 or later
[4] Automation IO Profile ICS, AIOP.ICS
[5] GATT Test Suite GATT.TS
[8] Automation IO Service Implementation extra Information for Test, IXIT
[9] Characteristic and Descriptor descriptions are accessible via the Bluetooth SIG Assigned Numbers
3 Test Suite Structure (TSS)

3.1 Overview

The Automation IO Profile requires the presence of GAP, SM (for LE), SDP (for BR/EDR), and GATT. This is illustrated in Figure 3.1.

![Automation IO Test Model]

3.2 Test Strategy

The test objectives are to verify functionality of the Automation IO Profile within a Bluetooth Host and enable interoperability between Bluetooth Hosts on different devices. The testing approach is to cover mandatory and optional requirements in the profile specification and to match these to the support of the IUT as described in the ICS Proforma [4].

The basis for the test approach is the general concepts and conformance testing principles defined in ISO/IEC 9646-1 and ISO/IEC 9646-2; both are part of the OSI Conformance Testing Methodology and Framework (CTMF).

The conformance test equipment shall provide an implementation of the Radio Controller and the parts of the Host needed to perform the test cases defined in the Automation IO Profile 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 Automation IO Profile 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 Cases.

3.3 Test Groups

The following test groups have been defined:

3.3.1 Discovery of Services and Characteristics

This group tests IUT discovery of the Automation IO Service and characteristics.

3.3.2 Features

This group tests IUT implementation of Automation IO Profile Features.
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>`. Bolded ID parts shall appear in the order prescribed. Non-bolded ID parts (if applicable) shall appear between the bolded parts. The order of the non-bolded parts may vary from test suite to test suite, but shall be consistent within each individual test suite.

<table>
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<tr>
<th>Identifier Abbreviation</th>
<th>Spec Abbreviation Identifier &lt;spec abbreviation&gt;</th>
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<td>AIOP</td>
<td>Automation IO Profile</td>
</tr>
<tr>
<td>Identifier Abbreviation</td>
<td>Role Abbreviation Identifier &lt;IUT role&gt;</td>
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<tr>
<td>CL</td>
<td>Client Role</td>
</tr>
<tr>
<td>SR</td>
<td>Server Role</td>
</tr>
<tr>
<td>Identifier Abbreviation</td>
<td>Feature Abbreviation Identifier &lt;feat&gt;</td>
</tr>
<tr>
<td>AIOD</td>
<td>Discovery of Services and Characteristics</td>
</tr>
<tr>
<td>AIOF</td>
<td>Features</td>
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Table 4.1: Automation IO TC Class Naming Convention

4.1.2 Conformance

When conformance is claimed, all capabilities indicated as mandatory for this Specification shall be supported in the specified manner (process-mandatory). This also applies for all optional and conditional capabilities for which support is indicated. All mandatory capabilities, and optional and conditional capabilities for which support is indicated are subject to verification as part of the Bluetooth Qualification program.

The Bluetooth Qualification Program may employ tests to verify implementation robustness. The level of implementation robustness that is verified varies from one Specification to another and may be revised for cause based on interoperability issues found in the market.

Such tests may verify

- that claimed capabilities may be used in any order and any number of repetitions that are not excluded by the Specification, OR

- that capabilities enabled by the implementations are sustained over durations expected by the use case, OR

- that the implementation gracefully handles any quantity of data expected by the use case, OR
• that the implementation gracefully rejects any attempt to exercise capabilities which were declared as not supported. Graceful rejection means that the implementation demonstrates uninterrupted conformance to the specification immediately after rejecting such attempts without any need to be externally reset or adjusted, OR

• 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 OR

• that the implementation is immune to attempted security exploits

A single execution of each of the required tests is required in order to constitute a pass verdict. However, it is noted that in order to provide a foundation for interoperability, it is necessary that a qualified implementation consistently and repeatedly pass any of the applicable tests.

In any case, where a member finds an issue with the Test Plan Generator, the test case as described in the test 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, which outlines all the detailed pass criteria conditions that shall be met by the IUT to merit a Pass Verdict.

The convention in this test 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 shall be the Fail Verdict.

4.2 Setup Preambles

The procedures defined in this section are provided for information, as they are used by test equipment in achieving the initial conditions in certain tests.

4.2.1 Set up LE Transport

Use GATT.TS [5] Section 4.2.1.2: Preamble [Set up ATT Bearer over LE].

4.2.2 Set up BR/EDR/HS Transport

Use GATT.TS [5] Section 4.2.1.1: Preamble [Setup ATT Bearer over BR/EDR].

4.3 Discover Services and Characteristics

The procedures defined in this test group verify discovery of services and characteristics by an Automation IO Client IUT, and verify discovery of services and characteristics exposed by an Automation IO Server IUT.

4.3.1 AIOP/CL/AIOD/BV-01-I [Discover Automation IO Service over LE]

• Test Purpose

Verify that the Automation IO Service can be discovered by an Automation IO Client IUT over the LE Transport.
• Reference
   [3] 4.2

• Initial Condition

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

The Lower Tester includes one instantiation of the Automation IO Service [6].

• Test Procedure

The Upper Tester issues a command to the IUT to discover primary services. There are two alternatives:

1. Execute the procedure included in GATT.TS [5] Discover All Primary Services, GATT/CL/GAD/BV-01-C, once, with the database specified in [6].

2. Execute the procedure included in GATT.TS [5] Discover Primary Services by Service UUID, GATT/CL/GAD/BV-02-C, once, with the service UUID set to «Automation IO Service», with the database specified in [6].

• Expected Outcome

Pass verdict

The IUT reports all attribute handle ranges returned to the Upper Tester.

At least one attribute handle range is returned, containing the starting handles and the ending handles of the Automation IO Service definition implemented in the Lower Tester.

4.3.2 AIOP/CL/AIOD/BV-02-I [SDP Service Discovery]

• Test Purpose

Verify that an Automation IO Client IUT can discover the SDP record for the Automation IO Service on the Lower Tester over the BR/EDR transport.

• Reference
   [3] 4.2

• Initial Condition

An ACL connection over BR/EDR is established between the Lower Tester and IUT.

The Lower Tester includes one instantiation of the Automation IO Service [6] and includes a corresponding SDP record for the Automation IO Service.

• Test Procedure

1. The Upper Tester issues a command to the IUT to perform SDP Service Discovery.

2. The IUT establishes an L2CAP connection on PSM 0x0001 (SDP) to the Lower Tester.

3. The IUT sends SDP requests to retrieve the SDP record from the Lower Tester.
• Expected Outcome

**Pass verdict**

The SDP record for the Automation IO Service is retrieved by the IUT and displayed to the Upper Tester.

### 4.3.3 **AIOP/SR/AIOD/BI-01-I [Automation IO Service not discoverable over BR/EDR]**

• **Test Purpose**

Verify that the Automation IO Service on a BR/EDR/LE Automation IO Server IUT that only supports the Automation IO Service over LE cannot be discovered by an Automation IO Client over the BR/EDR ATT Bearer.

• **Reference**

[3] 2.5

• **Initial Condition**

Establish a BR/EDR ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.2.

The IUT includes one instantiation of the Automation IO Service [6].

• **Test Procedure**

The Lower Tester sends an `ATT_Find_By_Type_Value_Request` (0x0001, 0xFFFF) to the IUT, with type set to the UUID for «Primary Service» and Value set to the UUID for «Automation IO Service».

• **Expected Outcome**

**Pass verdict**

The IUT does not report the instance of the Automation IO Service over BR/EDR to the Lower Tester.

### 4.3.4 **AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic]**

• **Test Purpose**

Verify that the Digital characteristics can be discovered by an Automation IO Client IUT.

• **Reference**

[3] 4.3.1.1

• **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.
The Lower Tester includes one instantiation of the Automation IO Service [6] which includes the Digital Characteristic.

The IUT has executed AIOP/CL/AIOD/BV-01-I [Discover Automation IO Service over LE] or AIOP/CL/AIOD/BV-02-I [SDP Service Discovery] and saved the handle range for the instantiation of the Automation IO Service. That instantiation contains at least one instance of a Digital characteristic.

• Test Procedure

1. The Upper Tester issues a command to the IUT to discover all Digital Characteristics.
2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C with the handle range specified in the initial conditions, or Discover Characteristics by UUID, GATT/CL/GAD/BV-05-C, with the characteristic UUID set to «Digital» and with the database specified in [6].

• Expected Outcome

Pass verdict

The IUT reports all attribute handle/value pairs returned to the Upper Tester.

One attribute handle/value pair is returned containing the UUID «Digital» and matches the instantiation of the Digital characteristic declaration implemented in the Lower Tester.

4.3.5 AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics]

• Test Purpose

Verify that Analog characteristics can be discovered by an Automation IO Client IUT.

• Reference

[3] 4.3.1.2

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of Automation IO Service [6] that contains at least one instantiation of the Analog characteristic. The IUT has executed AIOP/CL/AIOD/BV-01-I [Discover Automation IO Service over LE] or AIOP/CL/AIOD/BV-02-I [SDP Service Discovery] and saved the handle range for the instantiation of the Automation IO Service.

• Test Procedure

1. The Upper Tester issues a command to the IUT to discover all Analog Characteristics.
2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the handle range specified in the initial conditions, or Discover Characteristics by UUID, GATT/CL/GAD/BV-05-C, with the characteristic UUID set to «Analog» and using the database specified in [6].
• Expected Outcome

**Pass verdict**

The IUT reports all attribute handle/value pairs returned to the Upper Tester.

Each attribute handle/value pair returned containing the UUID «Analog» matches an Analog characteristic declaration implemented in the Lower Tester.

### 4.3.6 AIOP/CL/AIOD/BV-07-I [Discover Aggregate Characteristic]

**Test Purpose**

Verify that the Aggregate characteristic can be detected by an Automation IO Client IUT.

**Reference**

[3] 4.3.1.3

**Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of Automation IO Service [6] that contains a single instantiation of the Aggregate characteristic.

The IUT has executed AIOP/CL/AIOD/BV-01-I [Discover Automation IO Service over LE] or AIOP/CL/AIOD/BV-02-I [SDP Service Discovery] and saved the handle range for the instantiation of the Automation IO Service.

**Test Procedure**

1. The Upper Tester issues a command to the IUT to discover the Aggregate Characteristic.

2. The IUT executes either of the procedures included in GATT.TS [5]: Discover All Characteristics of a Service, GATT/CL/GAD/BV-04-C, with the handle range specified in the initial conditions, or Discover Characteristics by UUID, GATT/CL/GAD/BV-05-C, with the characteristic UUID set to «Aggregate» and using the database specified in [6].

**Expected Outcome**

**Pass verdict**

The IUT reports all returned attribute handle/value pairs to the Upper Tester.

One attribute handle/value pair is returned containing the UUID «Aggregate» and matches the Aggregate characteristic declaration implemented in the Lower Tester.

### 4.3.7 Discover Client Characteristic Configuration Descriptor

**Test Purpose**

Verify that an Automation IO Client IUT can discover Client Characteristic Configuration characteristic descriptors of the Digital, Analog and Aggregate characteristics.
• Reference

[3] 4.3.1.1, 4.3.1.2 and 4.3.1.3.

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] that contains at least one instantiation of each characteristic with an associated Client Characteristic Configuration descriptor as in Table 4.2.

The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic], AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics], and/or AIOP/CL/AIOD/BV-07-I [Discover Aggregate Characteristic] and saved the handle range(s) for each supported Digital, Analog and/or Aggregate characteristic definition.

• Test Procedure

1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in the initial conditions.

2. The IUT executes one pass of the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [6].

3. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/CL/GAR/BV-06-C in GATT.TS [5].

• Expected Outcome

Pass verdict

For each supported characteristic:

No more than one attribute handle/value pair is returned containing the UUID «Client Characteristic Configuration Descriptor» and reported to the Upper Tester by the IUT.

Each attribute handle/value pair returned shall match a Client Characteristic Configuration descriptor implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.7.1</td>
<td>AIOP/CL/AIOD/BV-08-I [Discover Digital Client Characteristic Configuration Descriptor]</td>
</tr>
<tr>
<td>4.3.7.2</td>
<td>AIOP/CL/AIOD/BV-09-I [Discover Analog Client Characteristic Configuration Descriptor]</td>
</tr>
<tr>
<td>4.3.7.3</td>
<td>AIOP/CL/AIOD/BV-10-I [Discover Aggregate Client Characteristic Configuration Descriptor]</td>
</tr>
</tbody>
</table>

Table 4.2: Discover Client Characteristic Configuration Descriptor
4.3.8 Discover Value Trigger Setting Descriptor

• Test Purpose

Verify that an Automation IO Client IUT can discover Value Trigger Setting characteristic descriptors of the Digital and Analog characteristics.

• Reference

[3] 4.3.1.1 and 4.3.1.2.

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] and contains at least one instantiation of each characteristic and its associated Value Trigger Setting descriptor as in Table 4.3.

The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle range(s) of each supported Digital and/or Analog characteristic definition.

• Test Procedure

1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in the initial conditions.

2. The IUT executes the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [6].

3. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/CL/GAR/BV-06-C in GATT.TS [5].

• Expected Outcome

Pass verdict

For each supported characteristic:

One handle/value pair is returned containing the UUID «Value Trigger Setting Descriptor» and reported to the Upper Tester by the IUT.

The handle/value pair retrieved shall correspond to the Value Trigger Setting Descriptor implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.8.1</td>
<td>AIOP/CL/AIOD/BV-11-I [Discover Digital Value Trigger Setting Descriptor]</td>
</tr>
<tr>
<td>4.3.8.2</td>
<td>AIOP/CL/AIOD/BV-12-I [Discover Analog Value Trigger Setting Descriptor]</td>
</tr>
</tbody>
</table>

Table 4.3: Discover Value Trigger Setting Descriptor
4.3.9 **Discover Time Trigger Setting Descriptor**

- **Test Purpose**

  Verify that an Automation IO Client IUT can discover Time Trigger Setting characteristic descriptors of the Digital and Analog characteristics.

- **Reference**

  [3] 4.3.1.1 and 4.3.1.2.

- **Initial Condition**

  Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

  The Lower Tester includes one instantiation of the Automation IO Service [6] and contains at least one instantiation of each characteristic and its associated Time Trigger Setting descriptor as in Table 4.3.

  The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle range(s) of each supported Digital and/or Analog characteristic definition.

- **Test Procedure**

  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in the initial conditions.

  2. The IUT executes the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [7].

- **Expected Outcome**

  **Pass verdict**

  For each supported characteristic:

  One handle/value pairs is returned containing the UUID «Time Trigger Setting Descriptor» and reported to the Upper Tester by the IUT.

  The handle/value pair retrieved shall correspond to the Time Trigger Setting Descriptor implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.9.1</td>
<td>AIOP/CL/AIOD/BV-23-I [Discover Digital Time Trigger Setting Descriptor]</td>
</tr>
<tr>
<td>4.3.9.2</td>
<td>AIOP/CL/AIOD/BV-24-I [Discover Analog Time Trigger Setting Descriptor]</td>
</tr>
</tbody>
</table>

*Table 4.4: Discover Time Trigger Setting Descriptor*
4.3.10 Discover Characteristic Presentation Format Descriptor

- **Test Purpose**
  
  Verify that an Automation IO Client IUT can discover Characteristic Presentation Format descriptors of the Digital and Analog characteristics.

- **Reference**
  
  [3] 4.3.1.1 and 4.3.1.2.

- **Initial Condition**
  
  Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

  The Lower Tester includes one instantiation of the Automation IO Service [6] and at least one instantiation of each characteristic with associated Characteristic Presentation Format descriptor as in Table 4.5.

  The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle range for each supported Digital and/or Analog characteristic definition.

- **Test Procedure**
  
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in the initial conditions.

  2. The IUT executes one pass of the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [7].

  3. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/CL/GAR/BV-06-C in GATT.TS [5].

- **Expected Outcome**
  
  *Pass verdict*

  For each supported characteristic:

  At least one attribute handle/value pair is returned containing the UUID «Characteristic Presentation Format Descriptor» and reported to the Upper Tester by the IUT.

  Each attribute handle/value pair returned shall match an implementation of the Characteristic Presentation Format descriptor implemented in the Lower Tester.
4.3.11 Discover Characteristic User Description Descriptor

- **Test Purpose**
  Verify that an Automation IO Client IUT can discover the Characteristic User Description descriptors of the Digital and Analog characteristics.

- **Reference**
  [3] 4.3.1.1 and 4.3.1.2.

- **Initial Condition**
  Establish an ATT Bearer connection between the Lower Tester as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

  The Lower Tester includes one instantiation of the Automation IO Service [6] that contains at least one instantiation of each characteristic and its associated Characteristic User Description descriptor as in Table 4.6.

  The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle range of each supported Digital and/or Analog characteristic definition.

- **Test Procedure**
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in the initial conditions.
  2. The IUT executes one pass of the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [7].
  3. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/CL/GAR/BV-06-C in GATT.TS [5].

- **Expected Outcome**
  **Pass verdict**

  For each supported characteristic:

  At least one attribute handle/value pair is returned containing the UUID «Characteristic User Description Descriptor» and reported to the Upper Tester by the IUT.
Each attribute handle/value pair returned shall match an implementation of the Characteristic User Description descriptor implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.11.1</td>
<td>AIOP/CL/AIOD/BV-15-I [Discover Digital User Description Descriptor]</td>
</tr>
<tr>
<td>4.3.11.2</td>
<td>AIOP/CL/AIOD/BV-16-I [Discover Analog User Description Descriptor]</td>
</tr>
</tbody>
</table>

Table 4.6: Discover User Description Descriptor

4.3.12 Discover Characteristic Extended Properties Descriptor

- Test Purpose
  Verify that an Automation IO Client IUT can discover Characteristic Extended Properties descriptors of the Digital and Analog characteristics.

- Reference
  [3] 4.3.1.1, 4.3.1.2.

- Initial Condition
  Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

  The Lower Tester includes one instantiation of the Automation IO Service [6] and at least one instantiation of each characteristic with associated Characteristic Extended Properties descriptor as in Table 4.7.

  The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle range of each supported Digital and/or Analog characteristic definition.

- Test Procedure
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in initial conditions.
  2. The IUT executes one pass of the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [7].
  3. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/CL/GAR/BV-06-C in GATT.TS [5].

- Expected Outcome
  Pass verdict

  For each supported characteristic:

  No more than one attribute handle/value pair is returned containing the UUID «Characteristic Extended Properties Descriptor» and reported to the Upper Tester by the IUT.
Each attribute handle/value pair returned shall match an implementation of the Characteristic Extended Properties descriptor implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.12.1  AIOP/CL/AIOD/BV-19-I [Discover Digital Characteristic Extended Properties Descriptor]</td>
</tr>
<tr>
<td>4.3.12.2  AIOP/CL/AIOD/BV-20-I [Discover Analog Characteristic Extended Properties Descriptor]</td>
</tr>
</tbody>
</table>

**Table 4.7: Discover Characteristic Extended Properties Descriptor**

### 4.3.13 Discover Number of Digitals Descriptor

- **Test Purpose**
  
  Verify that an Automation IO Client IUT can discover and read the Number of Digitals characteristic descriptor of the Digital characteristic.

- **Reference**
  

- **Initial Condition**
  
  Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

  The Lower Tester includes one instantiation of the Automation IO Service [6] and at least one instantiation of each characteristic with an associated «Number of Digitals» descriptor as in Table 4.8.

  The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle range of each supported Digital characteristic definition.

- **Test Procedure**
  
  1. The Upper Tester issues a command to the IUT to Discover All Characteristic Descriptors using the handle range of the characteristic definitions specified in initial conditions.

  2. The IUT executes one pass of the procedure included in GATT.TS [5] Discover all Characteristic Descriptors, GATT/CL/GAD/BV-06-C using the database specified in [7].

  3. If the UUID in a handle-UUID pair is for a characteristic descriptor referenced in a test case below, read the characteristic descriptor by executing the test procedure of GATT test case GATT/CL/GAR/BV-06-C in GATT.TS [5].

- **Expected Outcome**
  
  **Pass verdict**

  For each supported characteristic:

  No more than one attribute handle/value pair is returned containing the UUID «Number of Digitals» and reported to the Upper Tester by the IUT.
Each attribute handle/value pair returned shall match an implementation of the Number of Digitals descriptor implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.13.1  AIOU/CL/AIOD/BV-21-I [Discover Digital Characteristic Number of Digitals Descriptor]</td>
</tr>
</tbody>
</table>

Table 4.8: Discover Number of Digitals descriptor

4.4 Automation IO Features

4.4.1 Read

• Test Purpose

Verify that an Automation IO Client IUT can read Digital, Analog or Aggregate characteristic values.

• Reference


• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6]. That instantiation includes at least one instance of each of the Digital, Analog and Aggregate characteristics with its Read property set.

The IUT has executed AIOU/CL/AIOD/BV-03-I [Discover Digital Characteristic], AIOU/CL/AIOD/BV-05-I [Discover Analog Characteristics], and/or AIOU/CL/AIOD/BV-07-I [Discover Aggregate Characteristic] and saved the handle of each supported Digital, Analog and/or Aggregate characteristic definition with Read property set.

• Test Procedure

1. For each supported characteristic, send a command from Upper Tester to request the IUT to read the Digital, Analog or Aggregate characteristic values from the Lower Tester.
• Expected Outcome

**Pass verdict**

For each supported characteristic:

The IUT sends a correctly formatted `ATT_Read_Request (0x0A)` to the Lower Tester, containing the handle specified by the Upper Tester.

The IUT receives an `ATT_Read_Response (0x0B)` from the Lower Tester and reports the characteristic value received to the Upper Tester.

The characteristic value reported by the IUT matches the characteristic value implemented in the Lower Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.4.1.1</strong></td>
</tr>
<tr>
<td>AIOP/CL/AIOF/BV-01-I [Read Digital]</td>
</tr>
<tr>
<td><strong>4.4.1.2</strong></td>
</tr>
<tr>
<td>AIOP/CL/AIOF/BV-02-I [Read Analog]</td>
</tr>
<tr>
<td><strong>4.4.1.3</strong></td>
</tr>
<tr>
<td>AIOP/CL/AIOF/BV-19-I [Read Aggregate]</td>
</tr>
</tbody>
</table>

*Table 4.9: Read*

### 4.4.2 Configure Value Trigger Settings

• **Test Purpose**

Verify that an Automation IO Client IUT can configure the Value Trigger Settings Descriptors for the Digital or Analog characteristics.

• **Reference**

[3] Section 4.4 and 4.5.
• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instance of each of the Digital and Analog characteristics. The Digital and Analog characteristic definitions each contain an associated Value Trigger Setting characteristic descriptor.

The IUT has executed AIOP/CL/AIOD/BV-11-I [Discover Digital Value Trigger Setting Descriptor] and/or AIOP/CL/AIOD/BV-12-I [Discover Analog Value Trigger Setting Descriptor] and saved the handle of each Value Trigger Setting descriptor.

• Test Procedure

1. For each supported characteristic, send an Upper Tester command to the IUT to update the associated Value Trigger Setting descriptor of the Digital and/or Analog characteristics.

   ![Diagram](https://via.placeholder.com/150)

   L2CAP Connection Established over selected channel.

   ATT_Write_Request
   (0x12, handle of Value Trigger descriptor, \textless\textless\textit{value}\textgreater\textgreater)

   ATT_Write_Response
   (0x13)

   UpdateValueTriggerValue
   (handle of Digital or Analog characteristic)

   Confirmation

• Expected Outcome

Pass verdict

For each supported characteristic:

The IUT sends a correctly formatted \textit{ATT_Write_Request} (0x12) to the Lower Tester, with the handle set to that of the associated Value Trigger Setting Descriptor.

The value requested by the IUT matches the value requested by the Upper Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.2.1</td>
<td>AIOP/CL/AIOF/BV-03-I [Digital Configure Value Trigger Settings]</td>
</tr>
<tr>
<td>4.4.2.2</td>
<td>AIOP/CL/AIOF/BV-04-I [Analog Configure Value Trigger Settings]</td>
</tr>
</tbody>
</table>

\textit{Table 4.10: Configure Value Trigger Settings}
### 4.4.3 Configure Time Settings

**Test Purpose**

Verify that an Automation IO Client IUT can configure the Time Settings Descriptors for the Digital or Analog characteristics.

**Reference**

[3] Section 4.4 and 4.5.

**Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital and Analog characteristics. The Digital and Analog characteristic definitions each contain an associated Value Trigger Setting characteristic descriptor.

The IUT has executed AIOP/CL/AIOD/BV-23-I [Discover Digital Time Trigger Setting Descriptor] and/or AIOP/CL/AIOD/BV-24-I [Discover Analog Time Trigger Setting Descriptor] and saved the handle of each Time Trigger Setting descriptor.

**Test Procedure**

1. For each supported characteristic, send an Upper Tester command to the IUT to update the associated Time Trigger Setting descriptor of the Digital and/or Analog characteristics.

**Expected Outcome**

**Pass verdict**

For each supported characteristic:

The IUT sends a correctly formatted `ATT_Write_Request` (0x12) to the Lower Tester, with the handle set to that of the associated Time Trigger Setting Descriptor.

The value requested by the IUT matches the value requested by the Upper Tester.
Table 4.11: Configure Time Trigger Settings

4.4.4 Configure Notification

- Test Purpose

Verify that an Automation IO Client IUT can configure the Digital, Analog or Aggregate characteristic values for notification.

- Reference

[3] Section 4.4, 4.5 and 4.6

- Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital, Analog and Aggregate characteristics. The Digital, Analog and Aggregate characteristic definitions each contain an associated Client Characteristic Configuration characteristic descriptor.

The IUT has executed AIOP/CL/AIOD/BV-08-I [Discover Digital Client Characteristic Configuration Descriptor], AIOP/CL/AIOD/BV-09-I [Discover Analog Client Characteristic Configuration Descriptor] and/or AIOP/CL/AIOD/BV-10-I [Discover Aggregate Client Characteristic Configuration Descriptor] and saved the handle of each Client Characteristic Configuration descriptor.

- Test Procedure

1. For each supported characteristic, send an Upper Tester command to the IUT to configure the characteristic value for notifications by writing 0x0001 to the associated Client Characteristic Configuration descriptor.
• Expected Outcome

**Pass verdict**

For each supported characteristic:

The IUT sends a correctly formatted *ATT_Write_Request* (0x12) to the Lower Tester, with the handle set to that of the associated Client Characteristic Configuration Descriptor, and the value matches the value requested by the Upper Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.4.1</td>
<td>AIOP/CL/AIOF/BV-05-I [Digital Configure Notification]</td>
</tr>
<tr>
<td>4.4.4.2</td>
<td>AIOP/CL/AIOF/BV-06-I [Analog Configure Notification]</td>
</tr>
<tr>
<td>4.4.4.3</td>
<td>AIOP/CL/AIOF/BV-07-I [Aggregate Configure Notification]</td>
</tr>
</tbody>
</table>

**Table 4.12: Configure Notification**

### 4.4.5 Receive Notifications

• Test Purpose

Verify that an Automation IO Client IUT can receive notifications of the Digital, Analog or Aggregate characteristic values.

• Reference


• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.


• Test Procedure

1. For each supported characteristic, the Lower Tester sends an *ATT_Handle_Value_Notification* containing the characteristic value to the IUT.
ATT_Handle_Value_Notification
(0x0A, handle,valid value)
Upper Tester
IUT
Lower Tester
L2CAP Connection Established over selected channel
IUT configured to expect Notification.
Valid Value based on Notification

• Expected Outcome

Pass verdict

For each supported characteristic:

The IUT reports the characteristic values received to the Upper Tester.

The characteristic values reported by the IUT match the values sent by the Lower Tester.

Test Case

| 4.4.5.1 | AIOP/CL/AIOF/BV-08-I [Digital Receive Notifications] |
| 4.4.5.2 | AIOP/CL/AIOF/BV-09-I [Analog Receive Notifications] |
| 4.4.5.3 | AIOP/CL/AIOF/BV-10-I [Aggregate Receive Notifications] |

Table 4.13: Receive Notifications

4.4.6 Configure for Indication

• Test Purpose

Verify that an Automation IO Client IUT can configure the Digital, Analog or Aggregate characteristic values for indication.

• Reference


• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital, Analog and Aggregate characteristics. The Digital, Analog and
Aggregate characteristic definitions each contain an associated Client Characteristic Configuration characteristic descriptor.

The IUT has executed AIOP/CL/AIOD/BV-08-I [Discover Digital Client Characteristic Configuration Descriptor], AIOP/CL/AIOD/BV-09-I [Discover Analog Client Characteristic Configuration Descriptor] and/or AIOP/CL/AIOD/BV-10-I [Discover Aggregate Client Characteristic Configuration Descriptor] and saved the handle of each Client Characteristic Configuration descriptor.

- **Test Procedure**
  1. For each supported characteristic, the Upper Tester sends a command to the IUT to configure the characteristic value for indications by writing 0x0002 to the associated Client Characteristic Configuration descriptor.

- **Expected Outcome**
  **Pass verdict**

  For each supported characteristic, the IUT sends a correctly formatted `ATT_Write_Request` (0x12) to the Lower Tester, with the handle set to that of the associated Client Configuration Descriptor, and the value matches the value requested by the Upper Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.6.1</td>
<td>AIOP/CL/AIOF/BV-11-I [Digital Configure Indication]</td>
</tr>
<tr>
<td>4.4.6.2</td>
<td>AIOP/CL/AIOF/BV-12-I [Analog Configure Indication]</td>
</tr>
<tr>
<td>4.4.6.3</td>
<td>AIOP/CL/AIOF/BV-13-I [Aggregate Configure Indication]</td>
</tr>
</tbody>
</table>

**Table 4.14: Configure Indication**

### 4.4.7 Receive Indications

- **Test Purpose**
  Verify that an Automation IO Client IUT can receive indications of the Digital, Analog or Aggregate characteristic values.
• Reference


• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital, Analog and Aggregate characteristics. The Digital, Analog and Aggregate characteristic definitions each contain an associated Client Characteristic Configuration characteristic descriptor which and the IUT has executed AIOP/CL/AIOF/BV-11-I [Digital Configure Indication], AIOP/CL/AIOF/BV-12-I [Analog Configure Indication] and/or AIOP/CL/AIOF/BV-13-I [Aggregate Configure Indication] to configure indications.

• Test Procedure

1. For each supported characteristic, the Lower Tester sends an ATT_Handle_Value_Indication containing the characteristic value to the IUT.
2. The IUT reports the received indication of the characteristic value to the Upper Tester.
3. The IUT sends an ATT_Handle_Value_Confirmation to the Lower Tester.

• Expected Outcome

Pass verdict

For each supported characteristic:

The IUT reports the received indication of the characteristic value to the Upper Tester.

The IUT sends a correctly formatted ATT_Handle_Value_Confirmation to the Lower Tester.

The characteristic values reported by the IUT match the values sent by the Lower Tester.
### Test Case

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.7.1</td>
<td>AIOP/CL/AIOF/BV-14-I [Digital Receive Indications]</td>
</tr>
<tr>
<td>4.4.7.2</td>
<td>AIOP/CL/AIOF/BV-15-I [Analog Receive Indications]</td>
</tr>
<tr>
<td>4.4.7.3</td>
<td>AIOP/CL/AIOF/BV-16-I [Aggregate Receive Indications]</td>
</tr>
</tbody>
</table>

**Table 4.15: Receive Indications**

### 4.4.8 Update Characteristic User Description descriptor

- **Test Purpose**
  
  Verify that an Automation IO Client IUT can update the Characteristic User Description descriptor of the Digital and Analog characteristics.

- **Reference**
  
  [3] Section 4.4 and 4.5.

- **Initial Condition**

  Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

  The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital and Analog characteristics. The Digital and Analog characteristic definitions each contain an associated Client User Description characteristic descriptor.

  The IUT has executed AIOP/CL/AIOD/BV-15-I [Discover Digital User Description Descriptor] and AIOP/CL/AIOD/BV-16-I [Discover Analog User Description Descriptor] and saved the handle of each Client User Description descriptor.

- **Test Procedure**
  
  1. For each supported characteristic, the Upper Tester sends a command to the IUT to write to the associated Characteristic User Description.

```plaintext
Upper Tester
IUT
Lower Tester
L2CAP Connection Established over selected channel.

ATT_Write_Request
(0x12, handle of User Description descriptor, "string")
ATT_Write_Response
(0x13)
Update User Description
(handle of User Description descriptor)
Confirmation
```
• Expected Outcome

Pass verdict

For each supported characteristic, the IUT sends a correctly formatted ATT_Write_Request (0x12) to the Lower Tester, with the handle set to that of the associated Characteristic User Description descriptor.

The value requested by the IUT matches the value requested by the Upper Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.8.1</td>
</tr>
<tr>
<td>4.4.8.2</td>
</tr>
</tbody>
</table>

Table 4.16: Update Characteristic User Description Descriptor

4.4.9 Write

• Test Purpose

Verify that an Automation Client IUT can write to the characteristic value of the Digital or Analog characteristics.

• Reference

[3] Section 4.4 and 4.5.

• Initial Condition

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital and Analog characteristics with Write property.

The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle ranges of each Digital and/or Analog characteristic definition with Write property.

• Test Procedure

1. For each supported characteristic, the Upper Tester sends a command to request the IUT to write to the characteristic value.
• **Expected Outcome**

**Pass verdict**

For each supported characteristic, the IUT sends a correctly formatted `ATT_Write_Request (0x12)` to the Lower Tester, containing the attribute handle specified by the Upper Tester.

The value requested by the IUT matches the value requested by the Upper Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.9.1</td>
<td>AIOP/CL/AIOF/BV-21-I [Write Digital]</td>
</tr>
<tr>
<td>4.4.9.2</td>
<td>AIOP/CL/AIOF/BV-22-I [Write Analog]</td>
</tr>
</tbody>
</table>

**Table 4.17:** Write

### 4.4.10  Write Without Response

- **Test Purpose**

Verify that an Automation Client IUT can send a write command to the Digital or Analog characteristic values.

- **Reference**

[3] Section 4.4 or 4.5.

- **Initial Condition**

Establish an ATT Bearer connection between the Lower Tester and IUT as defined in Section 4.2.1 if using the LE transport or Section 4.2.2 if using the BR/EDR transport.

The Lower Tester includes one instantiation of the Automation IO Service [6] which includes one instantiation of each of the Digital and Analog characteristics with Write without Response property set.

The IUT has executed AIOP/CL/AIOD/BV-03-I [Discover Digital Characteristic] and/or AIOP/CL/AIOD/BV-05-I [Discover Analog Characteristics] and saved the handle ranges of each Digital and/or Analog characteristic definition with Write without Response property set.
• **Test Procedure**

1. For each supported characteristic, the Upper Tester sends a command to the IUT to send a write without response command to the characteristic value.

   ![Diagram of test procedure](image)

   **ATT_Write_Command** (0x52, handle of Tested characteristic)

   **Write without response** (handle of tested characteristic)

   L2CAP Connection Established over selected channel.

• **Expected Outcome**

**Pass verdict**

For each supported characteristic, the IUT sends a correctly formatted `ATT_Write_Command (0x52)` to the Lower Tester, containing the attribute handle specified by the Upper Tester.

The value requested to be written by the IUT matches the value requested by the Upper Tester.

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.10.1</td>
<td>AIOP/CL/AIOF/BV-23-I [Write Digital without Response]</td>
</tr>
<tr>
<td>4.4.10.2</td>
<td>AIOP/CL/AIOF/BV-24-I [Write Analog without Response]</td>
</tr>
</tbody>
</table>

*Table 4.18: Write without Response*

### 4.5 Lost Bond Procedures

#### 4.5.1 AIOP/CL/AIOF/BV-25-I [Lost Bond Procedure when using LE Transport]

• **Test Purpose**

Verify that an Automation IO Client IUT can start encryption with a bonded Automation IO Server upon reconnection.

• **Reference**

[3] Section 5.2.2

• **Initial Condition**

The IUT and the Lower Tester have previously bonded.

The IUT has configured the Lower Tester to enable either indications or notifications of supported characteristic values. No connection is established between the IUT and Lower Tester.
The bond is deleted at the Lower Tester.

- **Test Procedure**
  1. The Lower Tester begins advertising using GAP undirected connectable mode.
  2. The IUT establishes a connection to the Lower Tester.
  3. The Lower Tester does not send any notifications or indications to the IUT.
  4. The IUT starts encryption when the connection is established.
  5. The IUT reconfigures the Client Characteristic Configuration descriptor of each supported characteristic for notifications or indications.

- **Expected Outcome**

  **Pass verdict**

  The IUT starts encryption when the connection is reestablished.

  The IUT reconfigures the Client Characteristic Configuration descriptors for each supported characteristic by writing a value of 0x0001 or 0x0002 respectively.

  The values written to the Client Characteristic Configuration descriptors match the previous values in initial conditions.

4.5.2 **AIOP/CL/AIOF/BV-26-I [Lost Bond Procedure when using BR/EDR transport]**

- **Test Purpose**

  Verify that an Automation IO Client IUT can reconfigure characteristic values on the Automation IO Server for notifications or indications if the bond is lost.

- **Reference**

  [3] Section 5.3.1.2

- **Initial Condition**

  The IUT and the Lower Tester have previously bonded.

  The IUT has configured the Lower Tester to enable either notifications or indications of supported characteristic values.

  No connection is established between the IUT and Lower Tester.

  The bond is deleted at the Lower Tester.

- **Test Procedure**

  1. The Lower Tester is in connectable mode.
  2. The IUT establishes a connection to the Lower Tester.
  3. The Lower Tester does not send any notifications to the UT.
  4. The IUT starts encryption when the connection is reestablished.
5. The IUT detects the lost bond and reconfigures Client Configuration descriptors in the Lower Tester by writing a value of 0x0001 or 0x0002 respectively.

• Expected Outcome

**Pass verdict**

The IUT starts encryption when the connection is established.

The IUT reconfigures the Client Characteristic Configuration descriptors for each supported characteristic by writing a value of 0x0001 or 0x0002 respectively.

The values requested by the IUT match the values previously configured in initial conditions.
## 5 Test Case Mapping

The Test Case Mapping Table (TCMT) maps test cases to specific capabilities in the ICS. Profiles, protocols and services may define multiple roles, and it is possible that a product may implement more than one role. The product shall be tested in all roles for which support is declared in the ICS document. For products which support more than one role, a separate TCMT shall be filled out for each role, and separate tests shall be conducted for each role.

The columns for the TCMT are defined as follows:

**Item:** contains an y/x reference, where y corresponds to the table number and x corresponds to the feature number as defined in the ICS Proforma for the Automation IO Profile (AIOP) [4]. If the item is defined with Protocol, Profile or Service abbreviation before y/x, the table and feature number referenced are defined in the abbreviated ICS proforma document.

**Feature:** recommended to be the primary feature defined in the ICS being tested or may be the test case name.

**Test Case(s):** the applicable test case identifiers required for Bluetooth Qualification if the corresponding y/x references defined in the Item column are supported.

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Feature</th>
<th>Test Case(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIOP 1/2 AND AIOP 2/2 AND AIOP 7/1</td>
<td>Discover <strong>Automation IO Service</strong> over LE</td>
<td>AIOP/CL/AIOD/BV-01-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 2/1 AND AIOP 7/1</td>
<td>Discover <strong>Automation IO Service</strong> over BR/EDR using SDP</td>
<td>AIOP/CL/AIOD/BV-02-I</td>
</tr>
<tr>
<td>GATT 1a/4 AND GAP 0/3 AND AIOP 1/1 AND AIOP 2/2 AND NOT AIOP 2/1</td>
<td><strong>Automation IO Service</strong> discovery from Server – Invalid transport access over BR/EDR</td>
<td>AIOP/SR/AIOD/BI-01-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 7/2</td>
<td>Discover <strong>Digital</strong> Characteristic</td>
<td>AIOP/CL/AIOD/BV-03-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 7/10</td>
<td>Discover <strong>Analog</strong> Characteristic</td>
<td>AIOP/CL/AIOD/BV-05-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 7/17</td>
<td>Discover <strong>Aggregate</strong> Characteristic</td>
<td>AIOP/CL/AIOD/BV-07-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 7/4</td>
<td>Discover Digital Characteristic: <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOD/BV-08-I</td>
</tr>
<tr>
<td>Item</td>
<td>Feature</td>
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<td>-------------------------------</td>
<td>----------------------------------------------</td>
<td>---------------------------------------</td>
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<td>AIOP/CL/AIOD/BV-09-I</td>
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<td>Characteristic Configuration</td>
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</tr>
<tr>
<td></td>
<td>Descriptor</td>
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</tr>
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<td>Descriptor</td>
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<td>Descriptor</td>
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<tr>
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<td></td>
<td>Descriptor</td>
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</tr>
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<td></td>
<td>Descriptor</td>
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<td>Descriptor</td>
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<td>AIOP/CL/AIOD/BV-19-I</td>
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<td><strong>Characteristic Extended Properties</strong></td>
<td></td>
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<td>Characteristic Configuration</td>
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</tr>
<tr>
<td></td>
<td>Descriptor</td>
<td></td>
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<td>Characteristic Configuration</td>
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<td>Descriptor</td>
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<tr>
<td>AIOP 1/2 AND AIOP 7/16</td>
<td>Discover Analog Characteristic:</td>
<td>AIOP/CL/AIOD/BV-20-I</td>
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<td>Characteristic Configuration</td>
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</tr>
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<td></td>
<td>Descriptor</td>
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</tr>
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<td>Read <strong>Digital</strong> Characteristic value</td>
<td>AIOP/CL/AIOF/BV-01-I</td>
</tr>
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<td>Feature</td>
<td>Test Case(s)</td>
</tr>
<tr>
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<td>----------------------------------------------</td>
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</tr>
<tr>
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<td>Read <strong>Analog</strong> Characteristic value</td>
<td>AIOP/CL/AIOF/BV-02-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 10/1</td>
<td>Read <strong>Aggregate</strong> Characteristic value</td>
<td>AIOP/CL/AIOF/BV-19-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/4</td>
<td>Configure <strong>Digital</strong> Characteristic: Write to <strong>Value Trigger Settings</strong> Characteristic Descriptor</td>
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</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/5</td>
<td>Configure <strong>Digital</strong> Characteristic: Write to <strong>Time Trigger Settings</strong> Characteristic Descriptor</td>
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</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/4</td>
<td>Configure <strong>Analog</strong> Characteristic: Write to <strong>Value Trigger Settings</strong> Characteristic Descriptor</td>
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</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/5</td>
<td>Configure <strong>Analog</strong> Characteristic: Write to <strong>Time Trigger Settings</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-28-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/2</td>
<td>Configure <strong>Digital</strong> Characteristic for notifications: Write to <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-05-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/2</td>
<td>Configure <strong>Analog</strong> Characteristic for notifications: Write to <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-06-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 10/2</td>
<td>Configure <strong>Aggregate</strong> Characteristic for notifications: Write to <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-07-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/6</td>
<td>Receive <strong>Digital</strong> Characteristic notifications</td>
<td>AIOP/CL/AIOF/BV-08-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/6</td>
<td>Receive <strong>Analog</strong> Characteristic notifications</td>
<td>AIOP/CL/AIOF/BV-09-I</td>
</tr>
<tr>
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<td>Receive <strong>Aggregate</strong> Characteristic notifications</td>
<td>AIOP/CL/AIOF/BV-10-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/3</td>
<td>Configure <strong>Digital</strong> Characteristic for indications: Write to <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-11-I</td>
</tr>
<tr>
<td>Item</td>
<td>Feature</td>
<td>Test Case(s)</td>
</tr>
<tr>
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<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/3</td>
<td>Configure <strong>Analog</strong> Characteristic for indications: Write to <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-12-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 10/3</td>
<td>Configure <strong>Aggregate</strong> Characteristic for indications: Write to <strong>Client Characteristic Configuration</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-13-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/7</td>
<td>Receive <strong>Digital</strong> Characteristic indications</td>
<td>AIOP/CL/AIOF/BV-14-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/7</td>
<td>Receive <strong>Analog</strong> Characteristic indications</td>
<td>AIOP/CL/AIOF/BV-15-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 10/5</td>
<td>Receive <strong>Aggregate</strong> Characteristic indications</td>
<td>AIOP/CL/AIOF/BV-16-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/8</td>
<td><strong>Digital</strong> Characteristic: Write to <strong>Characteristic User Description</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-17-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/8</td>
<td><strong>Analog</strong> Characteristic: Write to <strong>Characteristic User Description</strong> Characteristic Descriptor</td>
<td>AIOP/CL/AIOF/BV-18-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/9</td>
<td>Write Request: <strong>Digital</strong> Characteristic value</td>
<td>AIOP/CL/AIOF/BV-21-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/9</td>
<td>Write Request: Analog Characteristic value</td>
<td>AIOP/CL/AIOF/BV-22-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 8/10</td>
<td>Write Command: <strong>Digital</strong> Characteristic value</td>
<td>AIOP/CL/AIOF/BV-23-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 9/10</td>
<td>Write Command: <strong>Analog</strong> Characteristic value</td>
<td>AIOP/CL/AIOF/BV-24-I</td>
</tr>
<tr>
<td>AIOP 1/2 AND AIOP 2/2 AND (AIOP 8/2 OR AIOP 8/3 OR AIOP 9/2 OR AIOP 9/3 OR AIOP 10/2 OR AIOP 10/3)</td>
<td>Lost bond procedure over LE transport</td>
<td>AIOP/CL/AIOF/BV-25-I</td>
</tr>
</tbody>
</table>
### Table 5.1: Test Case Mapping

<table>
<thead>
<tr>
<th>Item</th>
<th>Feature</th>
<th>Test Case(s)</th>
</tr>
</thead>
<tbody>
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<td>AIOI 1/2 AND AIOI 2/1 AND (AIOI 8/2 OR AIOI 8/3 OR AIOI 9/2 OR AIOI 9/3 OR AIOI 10/2 OR AIOI 10/3)</td>
<td>Lost bond procedure over BR/EDR transport</td>
<td>AIOI/CL/AIOF/BV-26-I</td>
</tr>
</tbody>
</table>