IP Link Protocol

***Bluetooth*® Test Suite**

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1 Scope

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

[1] Core Specification, Version 6.0 or later
[2] Test Strategy and Terminology Overview
[3] IP Link, Version 1.0
[4] IP Link ICS
[5] 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, acronyms, and abbreviations from [1] and [2] apply.

3 Test suite structure (TSS)

3.1 Overview

The IP Link Protocol requires the presence of Advertising Extension Bearer and a L2CAP Bearer. This is illustrated in Figure 3.1 sits in between a IPv6 stack in the Application layer, and the AE/L2CAP bearers in the Controller. The payloads processed by IP Link stack have no IPv6 dependency and are treated as opaque blobs.

<table>
<tr><th>Number</th><th>ISO/IEC 7498-1 OSI model</th><th>IEEE 802.3-2018 standard for Ethernet</th><th colspan="2">IP Link</th><th></th></tr>
<tr><td>7</td><td>Application layer</td><td rowspan="4">–</td><td colspan="2" rowspan="4">–</td><td rowspan="6">Application</td></tr>
<tr><td>6</td><td>Presentation layer</td></tr>
<tr><td>5</td><td>Session layer</td></tr>
<tr><td>4</td><td>Transport layer</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Network layer</td><td rowspan="3">–</td><td colspan="2">IPv6 and network management</td></tr>
<tr><td colspan="2">6LoWPAN compression</td></tr>
<tr><td colspan="2">6LoWPAN adaptation</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Data link layer</td><td rowspan="2">Logical Link Control (LLC) sublayer</td><td colspan="2">IP Link PDU encoding/decoding</td><td rowspan="2">Host</td></tr>
<tr><td colspan="2">MAC layer multiplexing</td></tr>
<tr><td>Media Access Control (MAC) sublayer</td><td>Advertising Extensions (AE)</td><td>L2CAP</td><td rowspan="2">Controller</td></tr>
<tr><td>1</td><td>Physical layer</td><td>–</td><td colspan="2">Bluetooth LE PHY</td></tr>
</table>

Figure 3.1: IP Link Test Model

3.2 Test strategy

The test objectives are to verify functionality of the Bluetooth IP Link Protocol specifications that enable interoperability between Bluetooth IP Link nodes. The testing approach is to cover mandatory and optional requirements in the specifications and to match these to the support of the IUT as described in the ICS Proforma. Test cases are written as to ensure forward compatibility by the checking of RFU values.

Bluetooth IP Link defines a protocol which utilizes both an Advertising Extension bearer and L2CAP bearer that introduces behavior according to the data contained in the advertising packet. Conformance testing of the protocol is performed using a Lower Tester acting as a peer Bluetooth IP Link node.

The Bluetooth IP Link specification testing focuses on ensuring a Node IUT can correctly perform all the procedures and interactions required for participation in a Bluetooth IP Link network. This includes proper handling of all mandatory features of the Bluetooth IP Link specification, such as network and transport layer communication, network security and encryption, and configuration procedures.

Test cases in the Bluetooth IP Link specification are implemented using a test setup consisting of a Lower Tester, IUT, and Upper Tester. The Lower Tester utilizes the advertising bearer and/or L2CAP bearer to interact

with the IUT and emulates a peer Node. The Upper Tester is utilized to trigger certain actions on the IUT for a subset of test cases however because no fixed Upper Tester interface is defined, the exact mechanism of this interface is implementation dependent.

The IPLinkPayload max size is 249 bytes. The test cases use a TSPX_IPL_PAYLOAD IXIT Entry for the contents. To ensure the maximum size is used, when the Test Suite refers to the “TSPX_IPL_PAYLOAD IXIT Entry value”, that means the IUT or Lower Tester uses the IXIT entry and repeat its value until it makes a 249-byte array. i.e., if the IXIT Entry is “0xdeadbeef” it becomes 0xdeadbeefdeadbeefdeadbeefdeadbeefdeadbeef…

3.3 Test groups

The following test groups have been defined:

- AE Bearer
- L2CAP
- Security

4 Test cases (TC)

4.1 Introduction

4.1.1 Test case identification conventions

Test cases are 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>**.

Identifier Abbreviation	**Spec Identifier <spec abbreviation>**
IPL	IP Link
Identifier Abbreviation	**Role Identifier <IUT role>**
NOD	Node Role
Identifier Abbreviation	**Feature Identifier <feat>**
DLL	Data Link Layer
L2CAP	L2CAP
SEC	Security

Table 4.1: IP Link 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. 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 exist, 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, the outcome of the test is a Fail verdict.

4.2 AE Bearer

4.2.1 Sending and Receiving AE PDUs

- Test Purpose

  Verify that the IUT sends an AE PDU and processes a received AE PDU with the security and privacy fields set according to Table 4.2.

  Verify that the IUT sends payload with the SEQ field correctly incremented.

  The verification includes testing the combinations of Short and Long SRC addresses, Short, Long and Broadcast DST addresses.

- Reference

  [3] 3.3.1

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/DLL/BV-01-C [Sending and Receiving AE PDUs – Implicit Key ID]	0x0
IPL/NOD/DLL/BV-02-C [Sending and Receiving AE PDUs – One Byte Key ID]	0x1

Table 4.2: Sending AE PDUs Test Cases

- Test Procedure

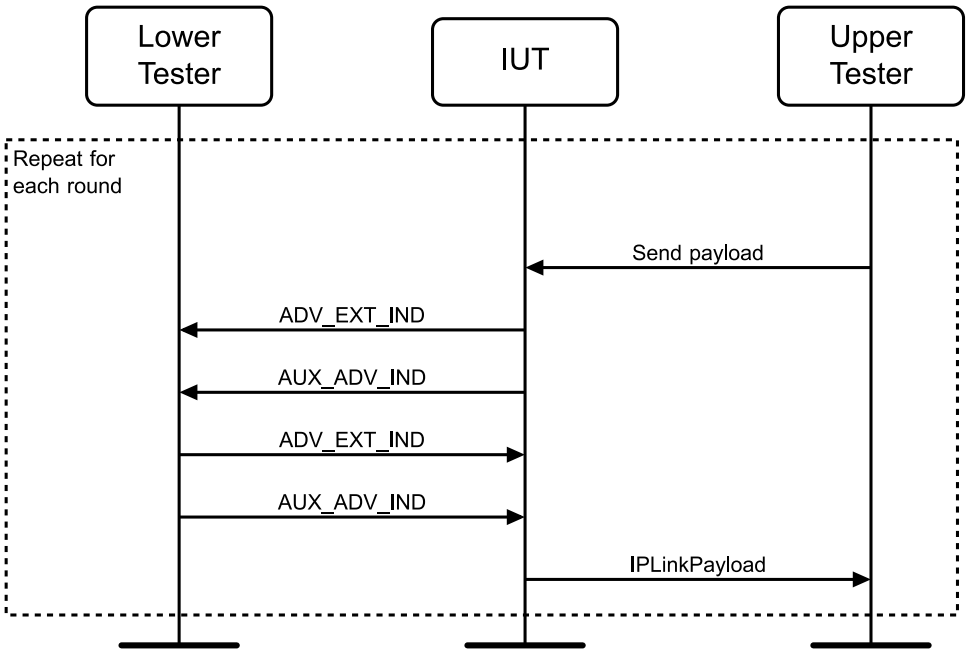


Figure 4.1: Sending AE PDUs

For each round in Table 4.3 execute Steps 1 – 6:

1. The Upper Tester commands the IUT to send a TSPX_IPL_PAYLOAD payload.
2. The IUT sends a Non-Connectable and Non-Scannable Undirected Advertisement with Decision Data and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	0	KIP as specified in Table 4.2	as specified by the SRC Address size in Table 4.3	as specified by the DST Address size in Table 4.3	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.2 is non-zero.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.3.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.

3. The Lower Tester receives the AUX_ADV_IND sent by the IUT. The Lower Tester decrypts the packet and confirms the NID and DST are known, and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
4. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	0	KIP as specified in Table 4.2	as specified by the SRC Address size in Table 4.3	as specified by the DST Address size in Table 4.3	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.2 is non-zero.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.3.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to the calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
5. The IUT receives the AUX_ADV_IND sent by the Lower Tester. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
6. The IUT confirms that a proper IPLinkPayload was received.

Round	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	16-bit Src Address	BROADCAST
4	64-bit Src Address	16-bit Dst Address
5	64-bit Src Address	64-bit Dst Address
6	64-bit Src Address	BROADCAST

Table 4.3: Input table for Send AE PDUs Test Cases

- Expected Outcome

Pass verdict

In Step 3, all IPLink PDUs sent by the IUT are received by the Lower Tester and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

In Step 5, all IPLink PDUs sent by the Lower Tester are received by the IUT and the fields are correct and authenticate correctly.

In Step 6, the IUT verifies the IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry

The MIC field is set correctly using the appropriate network security credentials.

The SEQ field value is incremented for each IPLink PDU.

4.2.2 Sending and Receiving AE PDUs - With ACK

- Test Purpose

  Verify that the IUT sends an AE PDU with the AR bit set, security and privacy fields set according to Table 4.4 and processes the ACKs.

  Verify that the IUT correctly sends payload with the SEQ field correctly incremented.

  Each round tests the combinations of Short and Long SRC addresses, Short, Long and Broadcast DST addresses.

- Reference

  [3] 3.3.1

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT cannot support a new connection.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/DLL/BV-03-C [Sending and Receiving AE PDUs With ACK, Implicit Key ID]	0x0
IPL/NOD/DLL/BV-04-C [Sending and Receiving AE PDUs With ACK, One Byte Key ID]	0x1

Table 4.4: Sending AE PDUs With ACK Test Cases

- Test Procedure

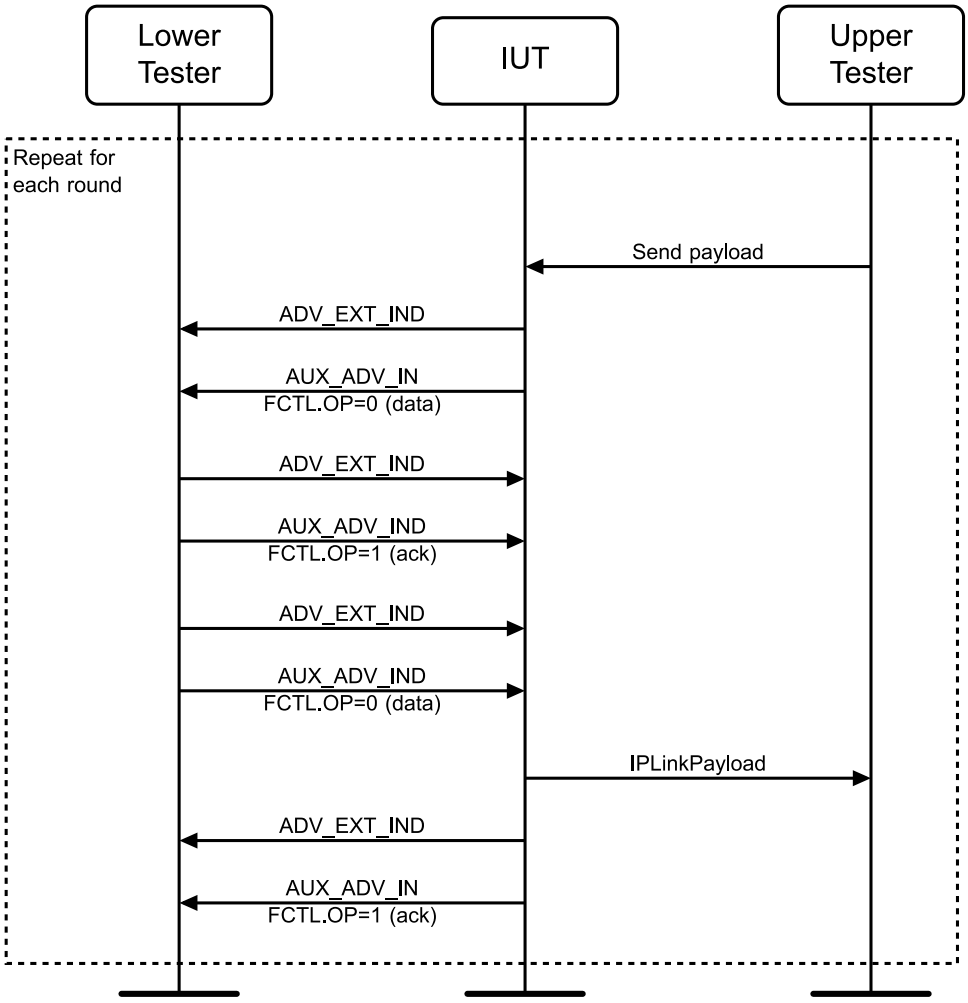


Figure 4.2: Sending AE PDUs with ACK

For each round in Table 4.5 execute Steps 1 – 11:

1. The Upper Tester commands the IUT to send a TSPX_IPL_PAYLOAD payload.
2. The IUT sends a Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	MD as specified in Table 4.5	KIP as specified in Table 4.4	as specified by the SRC Address size in Table 4.5	as specified by the DST Address size in Table 4.5	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.4 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.

- SRC field set to the IUT's address IXIT Entry as specified in Table 4.5.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

3. The Lower Tester receives the AUX_ADV_IND sent by the IUT. The Lower Tester decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
4. The Lower Tester sends a Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set ACK directed to the SRC field received in Step 3, and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	1	0	0	KIP as specified in Table 4.4	matching the size of DST field received in Step 3	matching the size of SAZ field received in Step 3	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.4 is non-zero.
   - FID field is set to match FID received in Step 3
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.5.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to match the PDU received in Step 3.
5. The IUT receives the ACK PDU.
6. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	MD as specified in Table 4.5	KIP as specified in Table 4.4	as specified by the SRC Address size in Table 4.5	as specified by the DST Address size in Table 4.5	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.4 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.5.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.

- NID field set to the TSPX_NID IXIT Entry.

7. The IUT receives the AUX_ADV_IND sent by the Lower Tester. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct
8. The IUT ACKs the PDU received in Step 7 by sending a Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set ACK directed to the SRC field received in Step 8, and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	1	0	0	KIP as specified in Table 4.4	matching the size of DST field received in Step 7	matching the size of SAZ field received in Step 7	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.4 is non-zero.
   - FID field set to match FID received in Step 7.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.5.
   - MIC field set to the calculated value for the entire IPLink PDU.
   - NID field set to match the PDU received in Step 7.
9. The Lower Tester receives the ACK PDU.

Round	MD	Src Address	Dst Address
1	0	16-bit Src Address	16-bit Dst Address
2	0	16-bit Src Address	64-bit Dst Address
3	0	64-bit Src Address	16-bit Dst Address
4	0	64-bit Src Address	64-bit Dst Address
5	1	16-bit Src Address	16-bit Dst Address
6	1	16-bit Src Address	64-bit Dst Address
7	1	64-bit Src Address	16-bit Dst Address
8	1	64-bit Src Address	64-bit Dst Address

Table 4.5: Input table for Send AE PDUs With ACK Test Cases

- Expected Outcome

Pass verdict

In Step 3, all IPLink PDUs sent by the IUT are received by the Lower Tester and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

In Step 5, all ACK PDUs sent by the Lower Tester are received by the IUT and are valid and correctly formed for the Data PDU the IUT sent.

In Step 7, all IPLink PDUs sent by the Lower Tester are received by the IUT and the fields are correct and authenticate correctly.

In Step 8, all IPLink PDUs sent by the Lower Tester are ACKed by the IUT with proper fields set and the DST and SRC fields reversed.

In Step 9, the IUT verifies the received IPLinkPayload is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry

The MIC field is set correctly using the appropriate network security credentials.

The SEQ field value is unique for each IPLink PDU.

4.2.3 Sending AE PDUs - Retry

- Test Purpose

  Verify that the IUT sends an AE PDU with a known NID and the security and privacy fields.

  Verify that the IUT correctly retries sending when AR=1.

  Each Row tests the combinations of Short and Long SRC addresses, Short and Long DST addresses.

- Reference

  [3] 3.1.3.4

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT has an IPLink Address set to the TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.
  - The IUT has an IPL_RETRY_COUNT set to TSPX_IPL_RETRY_COUNT.

- Test Case Configuration

Test Case	KIP
IPL/NOD/DLL/BV-05-C [Sending AE PDUs - Retry – Implicit Key ID]	0x0
IPL/NOD/DLL/BV-06-C [Sending AE PDUs - Retry – One Byte Key ID]	0x1

Table 4.6: Sending AE PDUs - Retry Test Cases

- Test Procedure

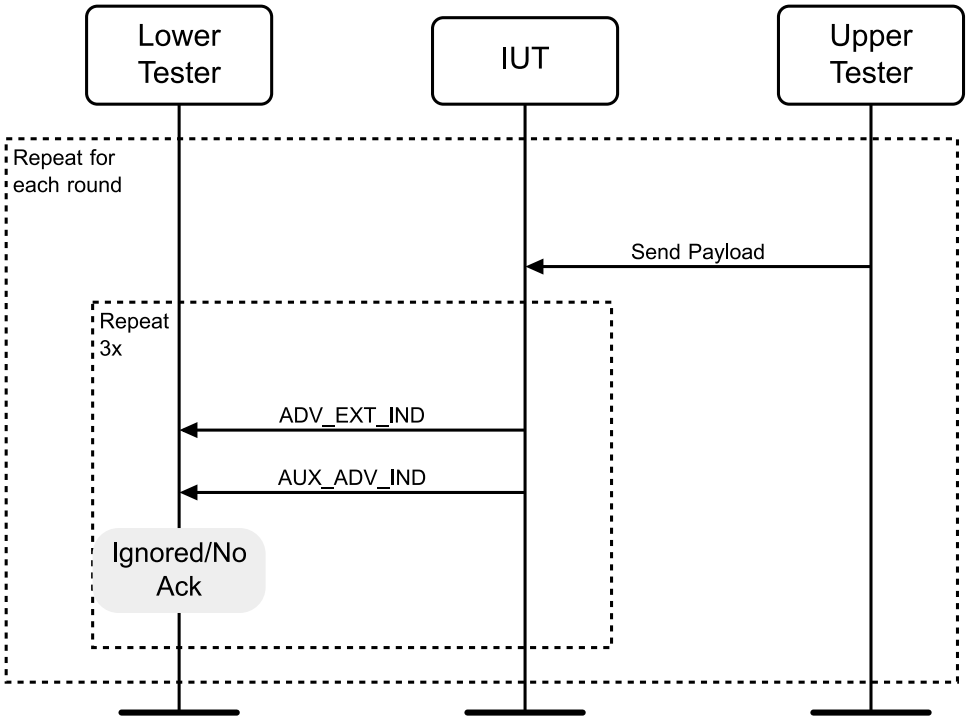


Figure 4.3: Sending AE PDUs - Retry

For each round in Table 4.7 execute Steps 1 – 6:

1. The Upper Tester commands the IUT to send a TSPX_IPL_PAYLOAD payload.
2. The IUT sends a Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	0	KIP as specified in Table 4.6	as specified by the SRC Address size in Table 4.7	as specified by the Dst Address size in Table 4.7	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.6 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.7.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
3. The Lower Tester receives the PDU sent in Step 2 but does not ACK it and starts a timer for the max *t* value.

   Repeat Steps 4-6 three times:

4. The IUT resends the PDU from Step 2 with the same FID value and an incremented SEQ field.
5. The Lower Tester receives the PDU sent in Step 4 but does not ACK it.
6. The Lower Tester adjusts the max *t* value based on transmission count.

Round	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	64-bit Src Address	16-bit Dst Address
4	64-bit Src Address	64-bit Dst Address

Table 4.7: Input table for Send AE PDUs - Retry Test Cases

- Expected Outcome

  Pass verdict

  In Step 3, all IPLink PDUs sent by the IUT are received by the Lower Tester and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

  The MIC field is set correctly using the appropriate network security credentials.

  The FID field is the same for each IPLink PDU.

  The SEQ field value is unique for each IPLink PDU.

  The IUT sends the same IPLinkPayload TSPX_IPL_RETRY_COUNT IXIT Entry times within the max *t* value.

4.2.4 Ignore Invalid Values

- Test Purpose

  Verify that the IUT processes or ignores received messages according to the receive action in Table 4.9 when RFU, reserved, or invalid field values are present.

- Reference

  [3] 3.1.2.1

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/DLL/BI-01-C [Ignore Invalid Values – Implicit Key ID]	0x0
IPL/NOD/DLL/BI-02-C [Ignore Invalid Values – One Byte Key ID]	0x1

Table 4.8: Ignore Invalid Values Test Cases

- Test Procedure

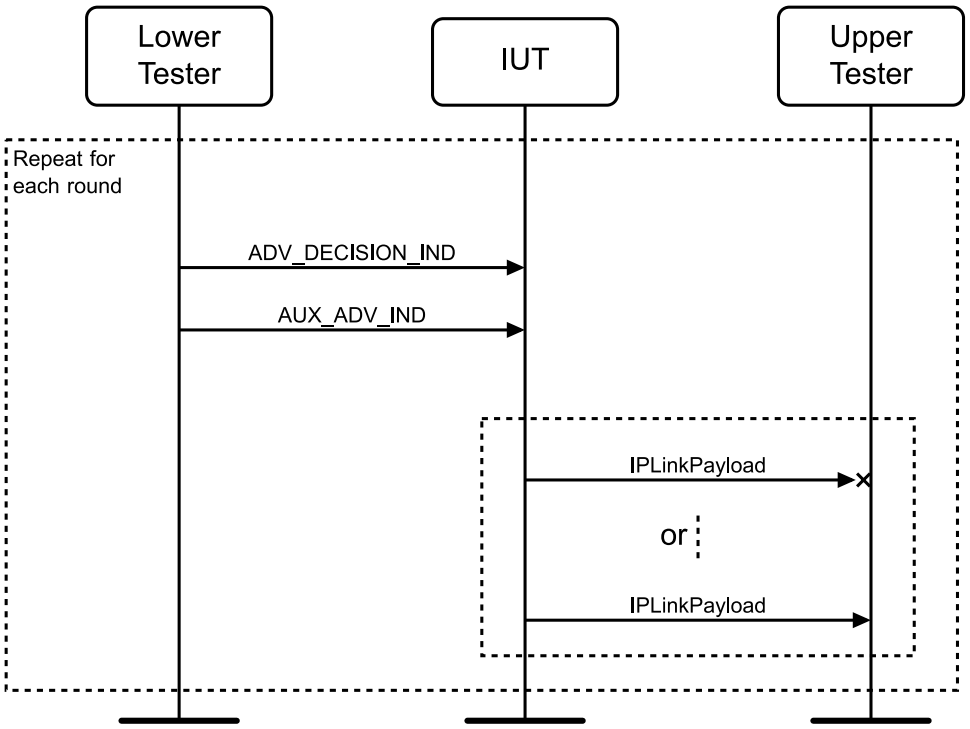


Figure 4.4: Ignore Invalid Values

For each round in Table 4.9 execute Steps 1 – 3:

1. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	RFU	AR	MD	KIP	SAZ	DAZ	BPREF
as specified in Table 4.9				0	KIP as specified in Table 4.8	as specified by the Table 4.9		

   - KEYID8 field is present if the value of KIP specified in Table 4.8 is non-zero.

- SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
- SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.9.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to the calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

2. The IUT receives the AUX_ADV_IND sent by the Lower Tester and confirms the NID is one known by the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
3. The Upper Tester confirms that the IPLink PDU was handled as specified by Receive Action in Table 4.9.

Round	Src Address	Op	AR	Ver	RFU	BPREF	Dst Address	Receive Action
1	16-bit Address	0x00	0	0b00	0b1	0b00	16-bit Address	Report
2	16-bit Address	0x00	0	0b01	0b0	0b00	64-bit Address	Ignore
3	16-bit Address	0x00	0	0b00	0b1	0b00	BROADCAST	Report
4	16-bit Address	0x00	0	0b01	0b0	0b00	BROADCAST	Ignore
5	16-bit Address	0x01	1	0b00	0b0	0b00	16-bit Address	Ignore
6	16-bit Address	0x01	1	0b00	0b0	0b00	64-bit Address	Ignore
7	16-bit Address	0x01	0	0b00	0b0	0b11	16-bit Address	Ignore
8	16-bit Address	0x01	0	0b00	0b0	0b11	64-bit Address	Ignore
9	16-bit Address	0x10	1	0b00	0b0	0b00	16-bit Address	Ignore
10	16-bit Address	0x10	1	0b00	0b0	0b00	64-bit Address	Ignore
11	16-bit Address	0x10	1	0b00	0b0	0b00	BROADCAST	Ignore
12	16-bit Address	0x10	0	0b00	0b0	0b11	16-bit Address	Ignore
13	16-bit Address	0x10	0	0b00	0b0	0b11	64-bit Address	Ignore
14	16-bit Address	0x10	0	0b00	0b0	0b11	BROADCAST	Ignore

Round	Src Address	Op	AR	Ver	RFU	BPREF	Dst Address	Receive Action
15	16-bit Address	0b011-0b111	0	0b00	0b0	0b00	16-bit Address	Ignore
16	16-bit Address	0b011-0b111	0	0b00	0b0	0b00	64-bit Address	Ignore
17	16-bit Address	0b011-0b111	0	0b00	0b0	0b00	BROADCAST	Ignore
18	64-bit Address	0x00	0	0b00	0b1	0b00	16-bit Address	Report
19	64-bit Address	0x00	0	0b01	0b0	0b00	64-bit Address	Ignore
20	64-bit Address	0x00	0	0b00	0b1	0b00	BROADCAST	Report
21	64-bit Address	0x00	0	0b01	0b0	0b00	BROADCAST	Ignore
22	64-bit Address	0x01	1	0b00	0b0	0b00	16-bit Address	Ignore
23	64-bit Address	0x01	1	0b00	0b0	0b00	64-bit Address	Ignore
24	64-bit Address	0x01	0	0b00	0b0	0b11	16-bit Address	Ignore
25	64-bit Address	0x01	0	0b00	0b0	0b11	64-bit Address	Ignore
26	64-bit Address	0x10	1	0b00	0b0	0b00	16-bit Address	Ignore
27	64-bit Address	0x10	1	0b00	0b0	0b00	64-bit Address	Ignore
28	64-bit Address	0x10	1	0b00	0b0	0b00	BROADCAST	Ignore
29	64-bit Address	0x10	0	0b00	0b0	0b11	16-bit Address	Ignore
30	64-bit Address	0x10	0	0b00	0b0	0b11	64-bit Address	Ignore
31	64-bit Address	0x10	0	0b00	0b0	0b11	BROADCAST	Ignore
32	64-bit Address	0b011-0b111	0	0b00	0b0	0b00	16-bit Address	Ignore

Round	Src Address	Op	AR	Ver	RFU	BPREF	Dst Address	Receive Action
33	64-bit Address	0b011-0b111	0	0b00	0b0	0b00	64-bit Address	Ignore
34	64-bit Address	0b011-0b111	0	0b00	0b0	0b00	BROADCAST	Ignore

Table 4.9: Input table for Ignore Invalid Values Test Cases

- Expected Outcome

  Pass verdict

  All IPLink PDUs sent by the Lower Tester are received but either ignored or delivered to the upper layer based on the Receive Action as specified in Table 4.9.

4.2.5 Ignore Invalid Address Key

- Test Purpose

  Verify that the IUT ignores a received message with an invalid Address Key.

- Reference

  [3] 3.3.4.1

- Initial Condition

  - The IUT and the Lower Tester share the KEYID32 value set to TSPX_KEYID32 IXIT Entry, and a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The Lower Tester uses a random AddressKey.
  - The Lower Tester has an IPLink Address set to TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.
  - The IUT has an IPLink Address set to the TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/DLL/BI-03-C [Ignore Invalid Address Key – Implicit Key ID]	0x0
IPL/NOD/DLL/BI-04-C [Ignore Invalid Address Key – One Byte Key ID]	0x1

Table 4.10: Ignore Invalid Address Key Test Cases

- Test Procedure

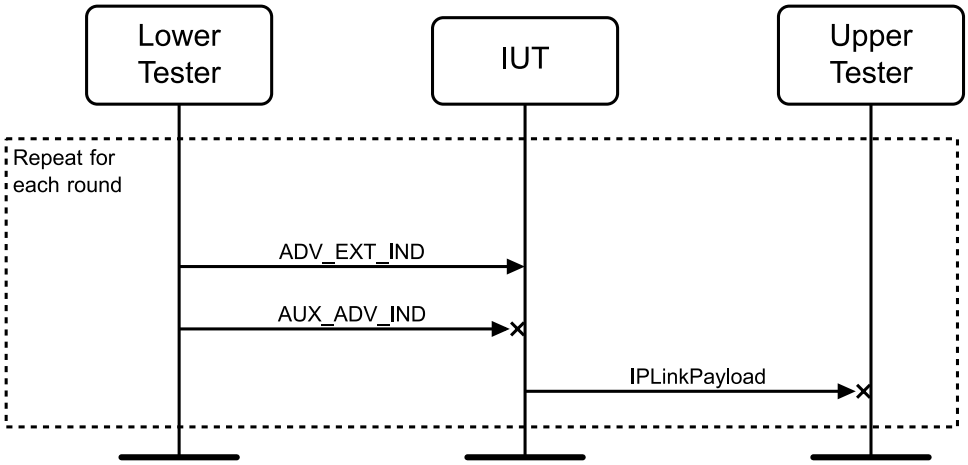


Figure 4.5: Ignore Invalid Address Key

1. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	0	KIP as specified in Table 4.10	as specified by the SRC Address size in Table 4.11	as specified by the Dst Address size in Table 4.11	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.10 is non-zero.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.11.
   - IPLinkPayload field set to the expanded TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to the calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
2. The IUT does not receive the AUX_ADV_IND sent by the Lower Tester.

Round	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	16-bit Src Address	BROADCAST
4	64-bit Src Address	16-bit Dst Address
5	64-bit Src Address	64-bit Dst Address
6	64-bit Src Address	BROADCAST

Table 4.11: Input table for Ignore Invalid Address Key Test Cases

- Expected Outcome

Pass verdict

All IPLink PDUs sent by the Lower Tester are not received and not processed nor sent to the Upper Tester.

4.3 Security

4.3.1 Sequence Number Rollover

- Test Purpose

  Verify that the IUT expires a key when the sequence number reaches the max value.

- Reference

  [3] 3.2.4.1

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/SEC/BV-01-C [Sequence Number Rollover – Implicit Key ID]	0x0
IPL/NOD/SEC/BV-02-C [Sequence Number Rollover – One Byte Key ID]	0x1

Table 4.12: Sequence Number Rollover Test Cases

- Test Procedure

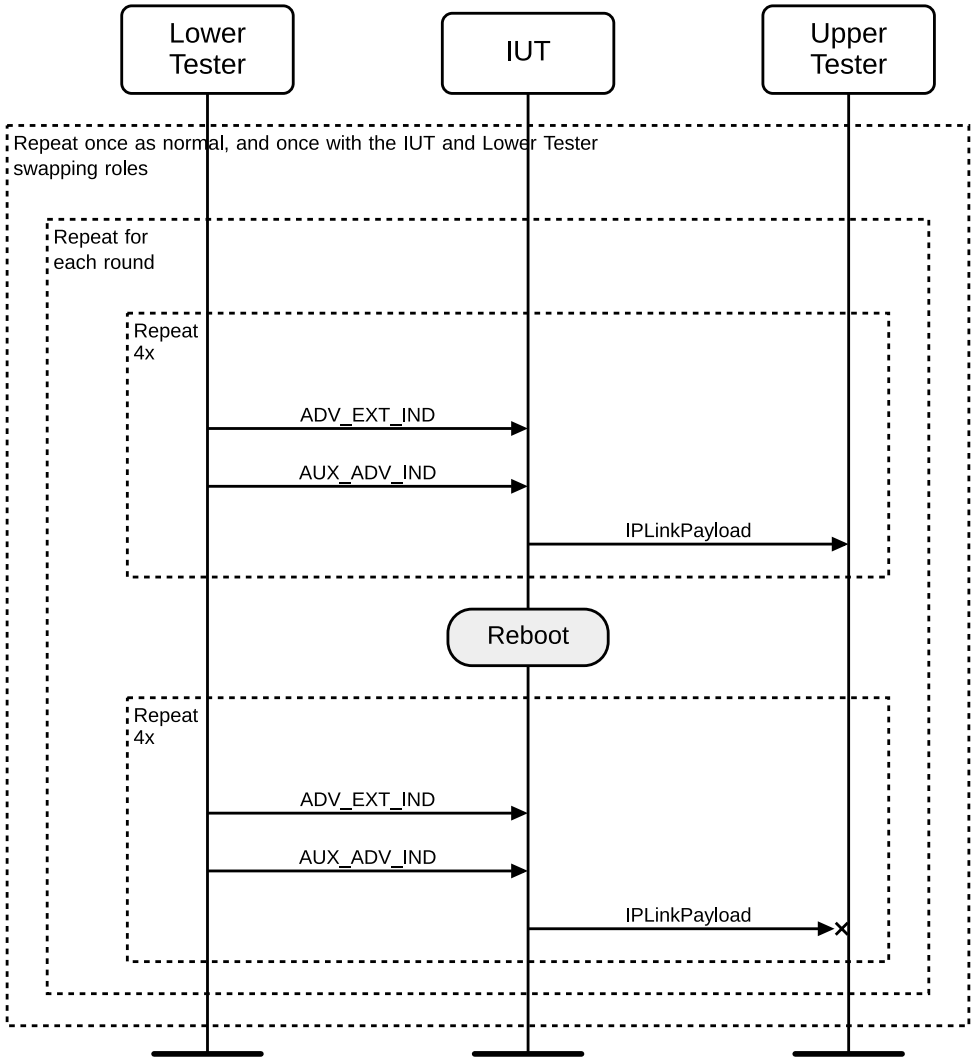


Figure 4.6: Sequence Number Rollover

Repeat test once as normal, and once with the IUT and Lower Tester swapping roles.

Repeat Steps 1-8 for each round in Table 4.13:

1. The Upper Tester sets the SEQ value to 0xFFFFFFFC for the NetKey for the Lower Tester address.

   Repeat Steps 2-3 four times:

2. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	0	KIP as specified in Table 4.12	as specified by the Src Address size in Table 4.13	as specified by the Dst Address size in Table 4.13	0b00

- KEYID8 field is present if the value of KIP specified in Table 4.12 is non-zero.
- SEQ field set to a monotonically incrementing number starting at 0xFFFFFFFC.
- SRC field set to the IUT's address IXIT Entry as specified in Table 4.13.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to the calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

3. The IUT receives the AUX_ADV_IND sent by the Lower Tester and confirms the NID is one known by the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
4. The Upper Tester confirms that the IPLinkPayload was received four times.
5. The Upper Tester reboots the IUT

   Repeat Steps 6-7 four times:

6. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	0	KIP as specified in Table 4.12	as specified by the Src Address size in Table 4.13	as specified by the Dst Address size in Table 4.13	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.12 is non-zero.
   - SEQ field set to a monotonically incrementing number starting at the last SEQ sent in Step 2.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.13.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to the calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
7. The IUT receives the AUX_ADV_IND sent by the Lower Tester and confirms the NID is one known by the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials.
8. The Upper Tester confirms that the IPLinkPayload was not processed

Round	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	16-bit Src Address	BROADCAST
4	64-bit Src Address	16-bit Dst Address
5	64-bit Src Address	64-bit Dst Address
6	64-bit Src Address	BROADCAST

Table 4.13: Input table for Sequence Number Rollover Test Cases

- Expected Outcome

  Pass verdict

  In Step 3, all IPLink PDUs sent by the Lower Tester are received and processed until the SEQ number rolls over, at which time they are no longer being processed.

  Validates that the SEQ number is not reset after the IUT is rebooted.

4.3.2 Ignore Replayed Message

- Test Purpose

  Verify that the IUT correctly performs replay protection when receiving messages from a node.

- Reference

  [3] 3.2.4.1, 3.2.4

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The IUT does not know the Sequence number for each source address on the Lower Tester.

- Test Case Configuration

Test Case	KIP
IPL/NOD/SEC/BI-01-C [Ignore Replayed Message – Implicit Key ID]	0x0
IPL/NOD/SEC/BI-02-C [Ignore Replayed Message – One Byte Key ID]	0x1

Table 4.14: Ignore Replayed Message Test Cases

- Test Procedure

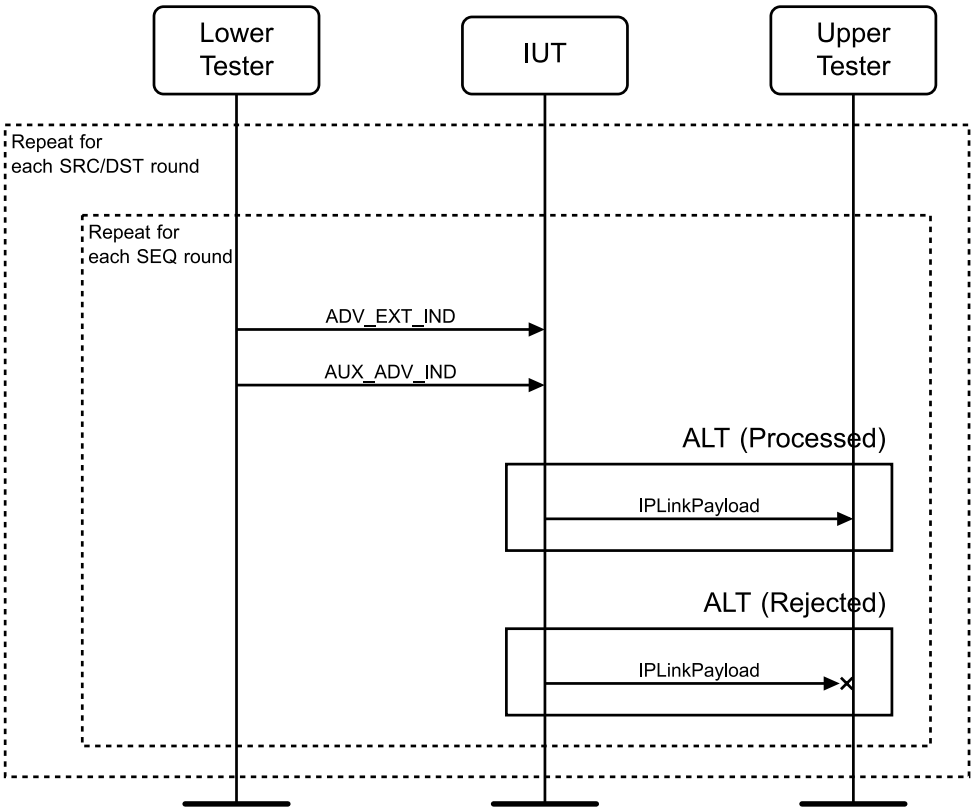


Figure 4.7: Ignore Replayed Message

Repeat Steps 1-4 for each round in Table 4.16:

1. A Random number between 0x00000000 and 0xEFFFFFFF is generated as the starting SEQ number for each source address.

   Repeat Steps 2-4 for each round in Table 4.15:

2. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	0	KIP as specified in Table 4.14	as specified by the Src Address size in Table 4.16	as specified by the Dst Address size in Table 4.16	0b00

- KEYID8 field is present if the value of KIP specified in Table 4.14 is non-zero.
- SEQ field set to the SEQ value as specified in Table 4.15.
- SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.16.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to the calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

3. The IUT receives the AUX_ADV_IND sent by the Lower Tester and confirms the NID is one known by the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
4. The Upper Tester confirms if the IPLinkPayload is processed as specified in Table 4.15.

Round	SEQ	Result
1	SEQ	Processed
2	SEQ-1	Rejected
3	SEQ	Rejected
4	SEQ+1	Processed

Table 4.15: Input table for SEQ Values

Round	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	16-bit Src Address	BROADCAST
4	64-bit Src Address	16-bit Dst Address
5	64-bit Src Address	64-bit Dst Address
6	64-bit Src Address	BROADCAST

Table 4.16: Input table for Ignore Replayed Message Test Cases

- Expected Outcome

Pass verdict

The PDU using SEQ is processed and forwarded.

The PDU using SEQ-1 is rejected and not forwarded.

The repeated PDU using SEQ is rejected and not forwarded.

The PDU using SEQ+1 is processed and forwarded.

4.4 L2CAP Bearer

4.4.1 IUT Receives over AE and Requests a L2CAP Connection

- Test Purpose

  Verify that the IUT, can receive PDU's over AE and send an acknowledgement using a L2CAP connection.

- Reference

  [3] 3.3.4.4

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT is in Peripheral-Preferred Mode.
  - The Lower Tester is in Central-Preferred or Either-Preferred mode as specified in Table 4.17.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP	BPREF
IPL/NOD/L2CAP/BV-01-C [IUT Receives over AE and Requests a L2CAP Connection, Implicit Key ID, Central Preferred]	0x0	0b10
IPL/NOD/L2CAP/BV-02-C [IUT Receives over AE and Requests a L2CAP Connection, One Byte Key ID, Central Preferred]	0x1	0b10
IPL/NOD/L2CAP/BV-03-C [IUT Receives over AE and Requests a L2CAP Connection, Implicit Key ID, Either Preferred]	0x0	0b11
IPL/NOD/L2CAP/BV-04-C [IUT Receives over AE and Requests a L2CAP Connection, One Byte Key ID, Either Preferred]	0x1	0b11

Table 4.17: IUT Receives over AE and Requests a L2CAP Connection Test Cases

- Test Procedure

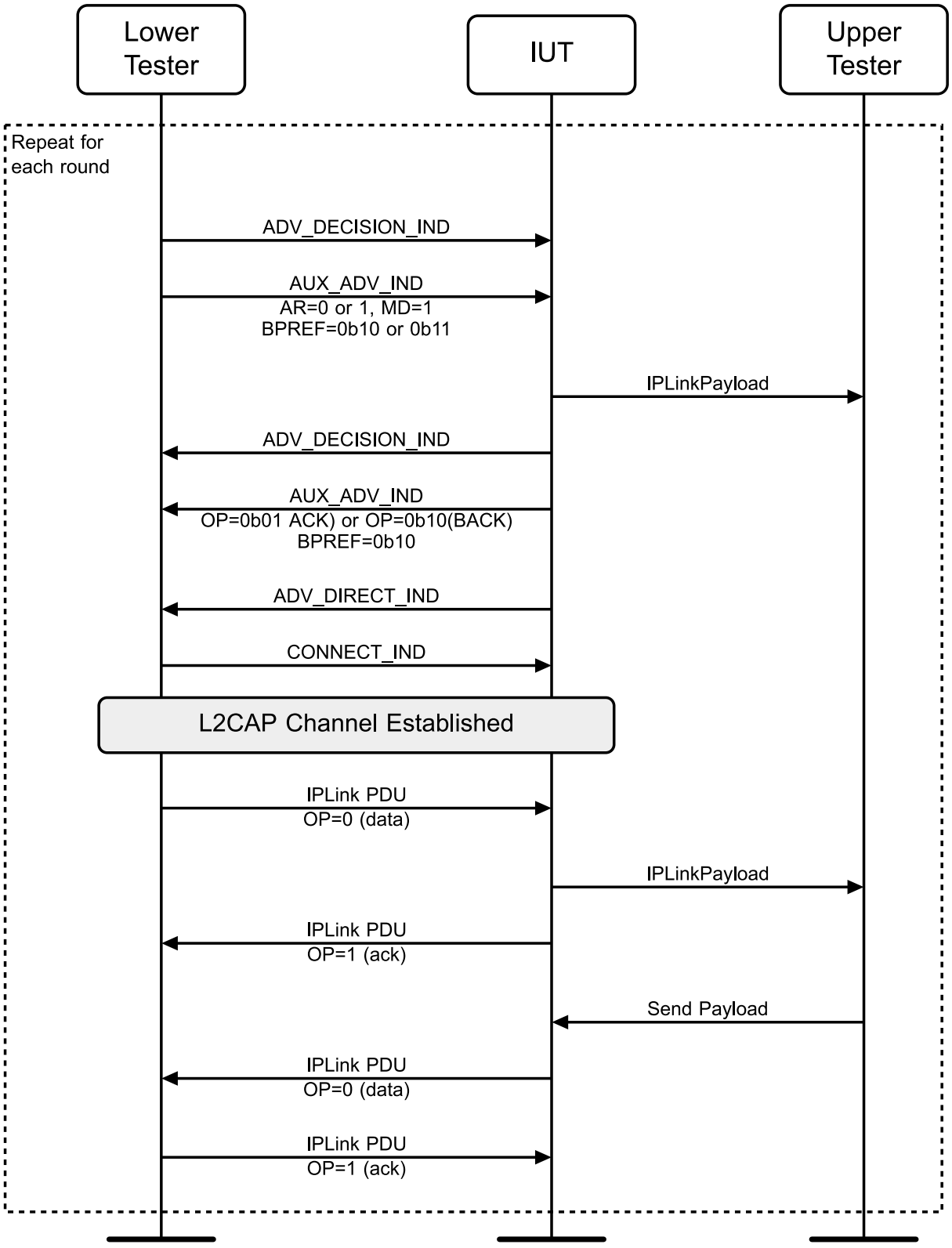


Figure 4.8: IUT Receives over AE and Requests a L2CAP Connection Test Case

Repeat Steps 1-18 for each round in Table 4.18

1. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	as specified in Table 4.18	1	KIP as specified in Table 4.17	as specified by the Src Address size in Table 4.18	as specified by the Dst Address size in Table 4.18	as specified in Table 4.17

   - KEYID8 field is present if the value of KIP specified in Table 4.17 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.18.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to the calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
2. The IUT receives the AUX_ADV_IND sent by the Lower Tester. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
3. The IUT sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01 or 0b10 as specified by ACK Op in Table 4.18	0	0	KIP as specified in Table 4.17	as specified by the Src Address size in Table 4.18	as specified by the Dst Address size in Table 4.18	0b01

   - KEYID8 field is present if the value of KIP specified in Table 4.17 is non-zero.
   - FID field set to match FID received in Step 2.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.18.
   - MIC field set to the calculated value for the entire IPLink PDU.
   - NID field set to match the PDU received in Step 2.
4. The Lower Tester receives the AUX_ADV_IND sent by the IUT. The Lower Tester decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.

5. The IUT sends a Directed Connectable Advertisement (ADV_DIRECT_IND) to the Lower Tester.
6. The Lower Tester responds with a CONNECT_IND response.
7. The Lower Tester establishes an L2CAP channel between the IUT and the Lower Tester over that LE transport.
8. The Lower Tester sends an IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	0	KIP as specified in Table 4.17	as specified by the Src Address size in Table 4.18	as specified by the Dst Address size in Table 4.18	0b00

   - KEYID8 field is present if the value of KIP specified in Table 4.17 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry as specified in Table 4.18.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
9. The IUT receives the IPLink PDU sent by the Lower Tester and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
10. The IUT sends an IPLink ACK PDU, and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01	0	0	KIP as specified in Table 4.17	matching the size of DST field received in Step 9	matching the size of SRC field received in Step 9	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.17 is non-zero.
    - FID field set to match FID received in Step 9.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the IUT's address IXIT Entry as specified in Table 4.18.
    - MIC field set to calculated value for the entire IPLink PDU.
    - NID field set to match the PDU received in Step 9.
11. The Lower Tester receives the IPLink PDU sent by the IUT and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
12. The Upper Tester confirms that the IPLinkPayload was received from Step 2 and 9.
13. The Upper Tester commands the IUT to sends a TSPX_IPL_PAYLOAD payload with the MD bit set and the DST as specified in Table 4.18.

14. The IUT sends an IPLink PDU, and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b00	1	1	KIP as specified in Table 4.17	as specified by the Src Address size in Table 4.18	as specified by the Dst Address size in Table 4.18	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.17 is non-zero.
    - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the IUT's address IXIT Entry as specified in Table 4.18.
    - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
    - MIC field set to the calculated value for the entire IPLink PDU.
    - NID field set to the TSPX_NID IXIT Entry.
15. The Lower Tester receives the IPLink PDU sent by the IUT and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
16. The Lower Tester sends an IPLink ACK PDU, and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01	0	0	KIP as specified in Table 4.17	matching the size of DST field received in Step 15	matching the size of SRC field received in Step 15	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.17 is non-zero.
    - FID field set to match FID received in Step 15.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the LT's address IXIT Entry as specified in Step 2.
    - MIC field set to calculated value for the entire IPLink PDU.
    - NID field set to match the PDU received in Step 15.
17. The IUT receives the IPLink ACK PDU sent by the Lower Tester and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
18. The Lower Tester disconnects from the IUT.

Round	Src Address	Dst Address	AR	ACK Op
1	16-bit Src Address	16-bit Dst Address	0	0b10 (BACK)
2	16-bit Src Address	64-bit Dst Address	0	0b10 (BACK)
3	64-bit Src Address	16-bit Dst Address	0	0b10 (BACK)
4	64-bit Src Address	64-bit Dst Address	0	0b10 (BACK)
5	16-bit Src Address	16-bit Dst Address	1	0b01 (ACK)
6	16-bit Src Address	64-bit Dst Address	1	0b01 (ACK)
7	64-bit Src Address	16-bit Dst Address	1	0b01 (ACK)
8	64-bit Src Address	64-bit Dst Address	1	0b01 (ACK)

Table 4.18: Input table for IUT Receives over AE and Requests a L2CAP Connection Test Cases

- Expected Outcome

  Pass verdict

  All IPLink PDUs sent by the Lower Tester are received by the IUT.

  The IUT ACKs each IPLink PDUs sent by the Lower Tester over the L2CAP connection.

  The MIC field is set correctly using the appropriate network security credentials.

  The SEQ field value is unique for each IPLink PDU.

  The IUT sends an IPLink PDU in Step 14.

4.4.2 IUT Sends over AE and Establishes a L2CAP Connection

- Test Purpose

  Verify that the IUT can send PDU's and process acknowledgments using a L2CAP connection started by the peer.

- Reference

  [3] 3.3.4.4

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT is in Central-Preferred mode.
  - The Lower Tester is in Peripheral-Preferred.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/L2CAP/BV-07-C [IUT Sends over AE and Establishes a L2CAP Connection, Implicit Key ID, Peripheral Preferred]	0x0
IPL/NOD/L2CAP/BV-08-C [IUT Sends over AE and Establishes a L2CAP Connection, One Byte Key ID, Peripheral Preferred]	0x1

Table 4.19: IUT Sends over AE and Establishes a L2CAP Connection Test Cases

- Test Procedure

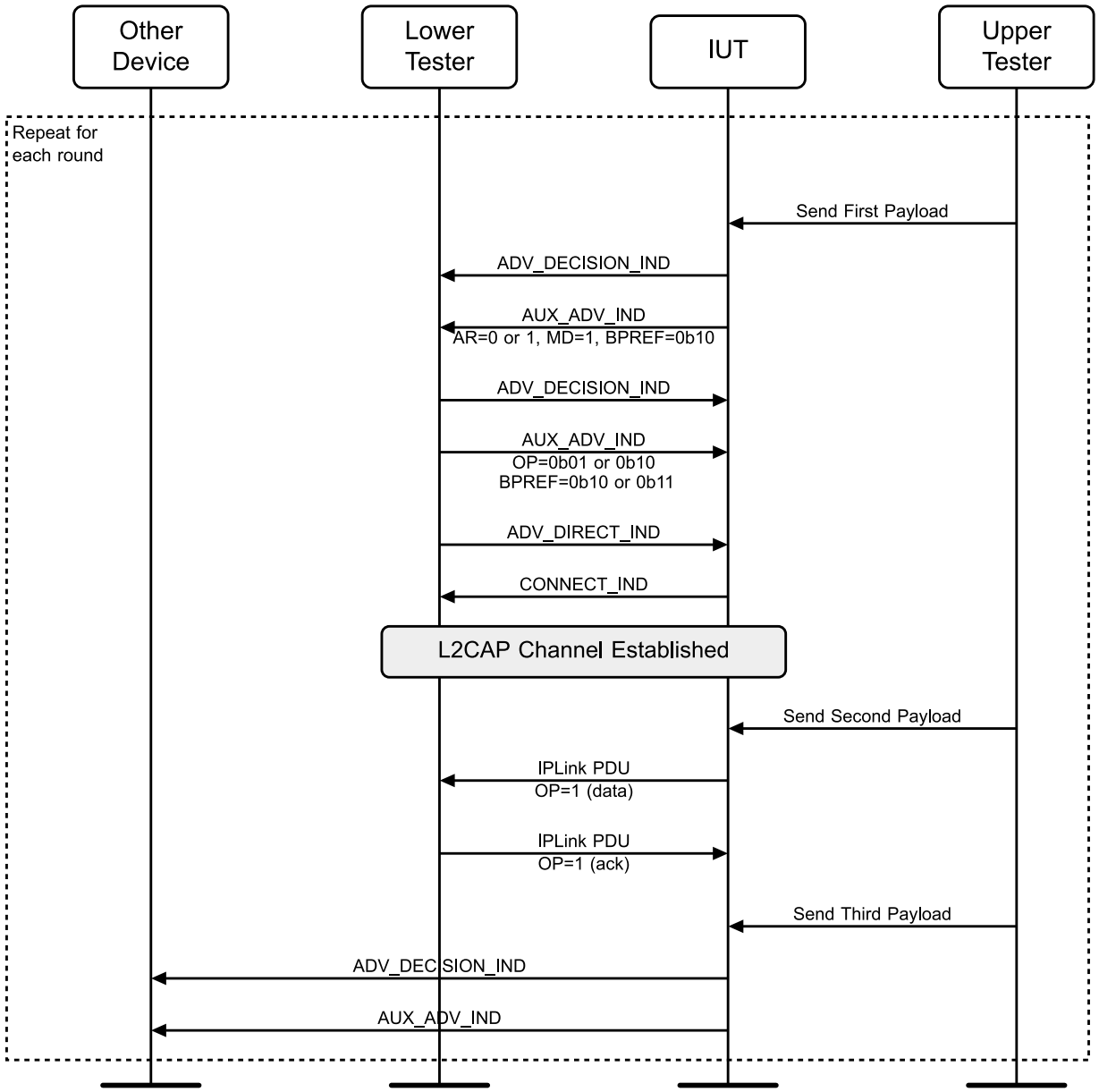


Figure 4.9: IUT Sends over AE and Establishes a L2CAP Connection Test Case

Repeat Steps 1-17 for each round in Table 4.20:

1. The Upper Tester commands the IUT to send a TSPX_IPL_PAYLOAD payload with the MD bit set and the DST as specified in Table 4.20.
2. The IUT sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	as specified by AR in Table 4.20	1	KIP as specified in Table 4.19	as specified by the Src Address size in Table 4.20	as specified by the Dst Address size in Table 4.20	0b10

   - KEYID8 field is present if the value of KIP specified in Table 4.19 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.20.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
3. The Lower Tester receives the AUX_ADV_IND sent by the IUT. The Lower Tester decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
4. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink ACK or BACK PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01 or 0b10 as specified by AR in Table 4.20	0	0	KIP as specified in Table 4.19	matching the size of DST field received in Step 3	matching the size of SRC field received in Step 3	0b01

   - KEYID8 field is present if the value of KIP specified in Table 4.19 is non-zero.
   - FID field set to match FID received in Step 2.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the LT's address IXIT Entry as specified in Step 2.
   - MIC field set to calculated value for the entire IPLink PDU.

- NID field set to match the PDU received in Step 3.

5. The IUT receives the IPLink ACK PDU sent by the Lower Tester and confirms the IRT is directed to the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
6. The Lower Tester sends a Directed Connectable Advertisement (ADV_DIRECT_IND) to the IUT
7. The IUT responds with a CONNECT_IND response.
8. The IUT establishes an L2CAP channel between the IUT and the Lower Tester over that LE transport.
9. The Upper Tester commands the IUT to sends a second TSPX_IPL_PAYLOAD payload with the MD bit set and the SRC and DST as specified in Table 4.20.
10. The IUT sends an IPLink PDU and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	0	KIP as specified in Table 4.19	as specified by the Src Address size in Table 4.20	as specified by the Dst Address size in Table 4.20	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.19 is non-zero.
    - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the IUT's address IXIT Entry as specified in Table 4.20.
    - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
    - MIC field set to calculated value for the entire IPLink PDU.
    - NID field set to the TSPX_NID IXIT Entry.
11. The Lower Tester receives the IPLink PDU sent by the IUT and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
12. The Lower Tester sends an IPLink ACK PDU, and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01	0	0	KIP as specified in Table 4.19	matching the size of DST field received in Step 11	matching the size of SRC field received in Step 11	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.19 is non-zero.
    - FID field set to match FID received in Step 11.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the LT's address IXIT Entry as specified in Step 10.
    - MIC field set to calculated value for the entire IPLink PDU.
    - NID field set to match the PDU received in Step 11.
13. The IUT receives the IPLink ACK PDU sent by the Lower Tester and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies

that the SEQ field value is correct.

14. The Upper Tester confirms that ACK PDUs is processed correctly.
15. The Upper Tester commands the IUT to sends a TSPX_IPL_PAYLOAD payload with the MD bit set and the DST set to the TSPX_IPL_ADDRESS address.
16. The IUT sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	1	KIP as specified in Table 4.19	as specified by the Src Address size in Table 4.20	as specified by the size of TSPX_IPL_ADDRESS	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.19 is non-zero.
    - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the IUT's address IXIT Entry as specified in Table 4.20.
    - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
    - MIC field set to calculated value for the entire IPLink PDU.
    - NID field set to the TSPX_NID IXIT Entry.
17. The Lower Tester waits 15 seconds before disconnecting from the IUT.

Round	First Payload			Second Payload	
	Src Address	Dst Address	AR	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address	0	16-bit Src Address	64-bit Dst Address
2			0	64-bit Src Address	16-bit Dst Address
3			0	64-bit Src Address	64-bit Dst Address
4	16-bit Src Address	64-bit Dst Address	0	16-bit Src Address	16-bit Dst Address
5			0	64-bit Src Address	16-bit Dst Address
6			0	64-bit Src Address	64-bit Dst Address

Round	First Payload			Second Payload	
7	64-bit Src Address	16-bit Dst Address	0	16-bit Src Address	16-bit Dst Address
8			0	16-bit Src Address	64-bit Dst Address
9			0	64-bit Src Address	64-bit Dst Address
10	64-bit Src Address	64-bit Dst Address	0	16-bit Src Address	16-bit Dst Address
11			0	16-bit Src Address	64-bit Dst Address
12			0	64-bit Src Address	16-bit Dst Address
13	16-bit Src Address	16-bit Dst Address	1	16-bit Src Address	64-bit Dst Address
14			1	64-bit Src Address	16-bit Dst Address
15			1	64-bit Src Address	64-bit Dst Address
16	16-bit Src Address	64-bit Dst Address	1	16-bit Src Address	16-bit Dst Address
17			1	64-bit Src Address	16-bit Dst Address
18			1	64-bit Src Address	64-bit Dst Address
19	64-bit Src Address	16-bit Dst Address	1	16-bit Src Address	16-bit Dst Address
20			1	16-bit Src Address	64-bit Dst Address
21			1	64-bit Src Address	64-bit Dst Address
22	64-bit Src Address	64-bit Dst Address	1	16-bit Src Address	16-bit Dst Address
23			1	16-bit Src Address	64-bit Dst Address
24			1	64-bit Src Address	16-bit Dst Address

Table 4.20: Input table for IUT Sends over AE and Establishes a L2CAP Connection Test Cases

- Expected Outcome

  Pass verdict

  In Steps 2 and 11, all IPLink PDUs sent by the IUT are received by the Lower Tester over an unencrypted connection and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

  The MIC field is set correctly using the appropriate network security credentials.

  The SEQ field value is unique for each IPLink PDU.

  In Steps 5 and 13 The IUT correctly processes the ACK PDU. The Lower Tester does not receive the IPLink PDU after Step 16.

4.4.3 IUT Sends over AE, ACK with MD, and Establishes a L2CAP Connection

- Test Purpose

  Verify that the IUT can send PDU's and process acknowledgments with the MD set using a L2CAP connection started by the peer.

- Reference

  [3] 3.3.4.4

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT is in Central-Preferred mode.
  - The Lower Tester is in Peripheral-Preferred.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/L2CAP/BV-05-C [IUT Sends over AE, ACK with MD and Establishes a L2CAP Connection, Implicit Key ID, Peripheral Preferred]	0x0
IPL/NOD/L2CAP/BV-06-C [IUT Sends over AE, ACK with MD and Establishes a L2CAP Connection, One Byte Key ID, Peripheral Preferred]	0x1

Table 4.21: IUT Sends over AE, ACK with MD and Establishes a L2CAP Connection Test Cases

- Test Procedure

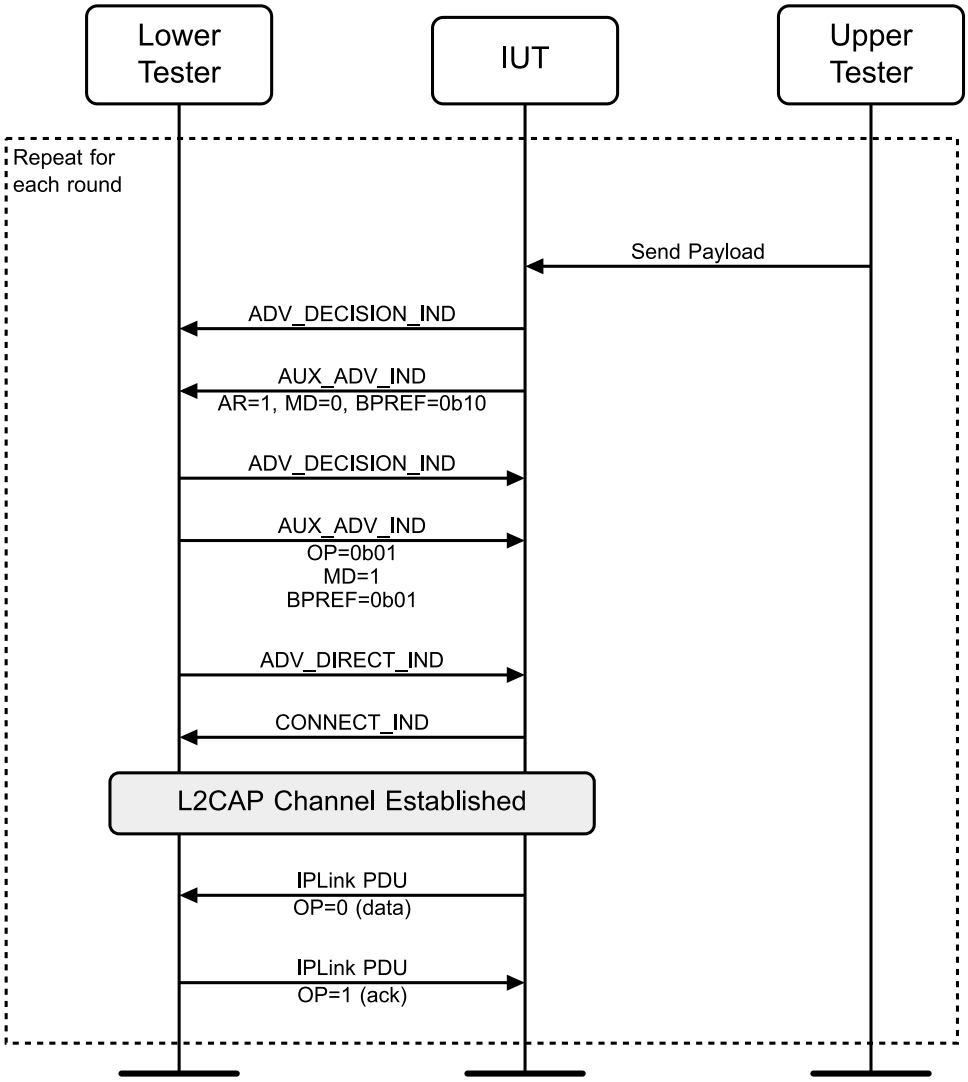


Figure 4.10: IUT Sends over AE with MD in ACK and Establishes a L2CAP Connection Test Case

Repeat Steps 1-14 for each round in Table 4.22:

1. The Upper Tester commands the IUT to send a TSPX_IPL_PAYLOAD payload with the DST set as specified in Table 4.22.
2. The Upper Tester commands the IUT to sends a second TSPX_IPL_PAYLOAD payload with the MD bit set and the SRC and DST as specified in Table 4.22.

3. The IUT sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	0	KIP as specified in Table 4.21	as specified by the Src Address size in Table 4.22	as specified by the Dst Address size in Table 4.22	0b10

   - KEYID8 field is present if the value of KIP specified in Table 4.21 is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Table 4.22.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
4. The Lower Tester receives the AUX_ADV_IND sent by the IUT. The Lower Tester decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
5. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink ACK PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01	0	1	KIP as specified in Table 4.21	matching the size of DST field received in Step 4	matching the size of SRC field received in Step 4	0b01

   - KEYID8 field is present if the value of KIP specified in Table 4.21 is non-zero.
   - FID field set to match FID received in Step 4.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the LT's address IXIT Entry as specified in Step 2.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to match the PDU received in Step 4.
6. The IUT receives the IPLink ACK PDU sent by the Lower Tester and confirms the IRT is directed to the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
7. The Lower Tester sends a Directed Connectable Advertisement (ADV_DIRECT_IND) to the IUT
8. The IUT responds with a CONNECT_IND response.
9. The IUT establishes an L2CAP channel between the IUT and the Lower Tester over that LE transport.
10. The IUT sends an IPLink PDU and its fields set as follows:

- FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	1	0	KIP as specified in Table 4.21	as specified by the Src Address size in Table 4.22	as specified by the Dst Address size in Table 4.22	0b00

- KEYID8 field is present if the value of KIP specified in Table 4.21 is non-zero.
- FID field set to a monotonically incrementing number between 0x00 and 0xFF.
- SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
- SRC field set to the IUT's address IXIT Entry as specified in Table 4.22.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

11. The Lower Tester receives the IPLink PDU sent by the IUT and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
12. The Lower Tester sends an IPLink ACK PDU, and its fields set as follows:
    - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b01	0	0	KIP as specified in Table 4.21	matching the size of DST field received in Step 11	matching the size of SRC field received in Step 11	0b00

    - KEYID8 field is present if the value of KIP specified in Table 4.21 is non-zero.
    - FID field set to match FID received in Step 11.
    - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
    - SRC field set to the LT's address IXIT Entry as specified in Step 10.
    - MIC field set to calculated value for the entire IPLink PDU.
    - NID field set to match the PDU received in Step 11.
13. The IUT receives the IPLink ACK PDU sent by the Lower Tester and decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
14. The Upper Tester confirms that ACK PDUs is processed correctly.

Round	Second Payload	
	Src Address	**Dst Address**
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	64-bit Src Address	16-bit Dst Address
4	64-bit Src Address	64-bit Dst Address

Table 4.22: Input table for IUT Sends over AE and Establishes a L2CAP Connection Test Cases

- Expected Outcome

  Pass verdict

  In Steps 4 and 11, all IPLink PDUs sent by the IUT are received by the Lower Tester over an unencrypted connection and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

  The MIC field is set correctly using the appropriate network security credentials.

  The SEQ field value is unique for each IPLink PDU.

  In Steps 6 and 13 The IUT correctly processes the ACK PDU.

4.4.4 L2CAP Bearer Timeout - Sending

- Test Purpose

  Verify that the IUT can send PDU's if a L2CAP connection is not established back to the sender.

- Reference

  [3] 3.3.4.2

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT is in Peripheral-Preferred Mode or Either-Preferred Mode.
  - The Lower Tester is in Central-Preferred Mode
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- Test Case Configuration

Test Case	KIP
IPL/NOD/L2CAP/BV-09-C [L2CAP Bearer Timeout – Implicit Key ID]	0x0
IPL/NOD/L2CAP/BV-10-C [L2CAP Bearer Timeout – One Byte Key ID]	0x1

Table 4.23: L2CAP Bearer Timeout - Sending Test Cases

- Test Procedure

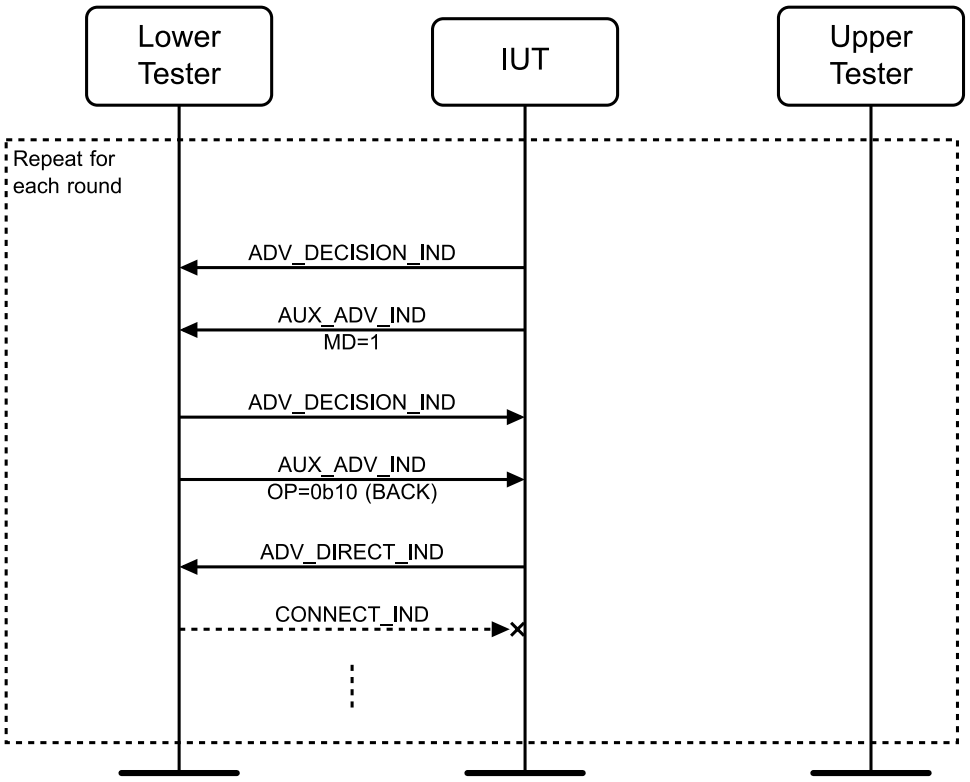


Figure 4.11: L2CAP Bearer Timeout Test Case

Repeat Steps 1-9 for each round in Table 4.24.

1. The Upper Tester commands the IUT to send a TSPX_IPL_PAYLOAD payload with the MD bit set, and the DST as specified in Table 4.24.
2. The IUT sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	1	KIP as specified in Table 4.23	as specified by the Src Address size in Table 4.24.	as specified by the Dst Address size in Table 4.24.	0b01

   - KEYID8 field is present if the value of KIP specified in Table 4.23 is non-zero.

- FID field set to a monotonically incrementing number between 0x00 and 0xFF.
- SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
- SRC field set to the IUT's address IXIT Entry as specified in Table 4.24.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

3. The Lower Tester receives the AUX_ADV_IND sent by the IUT. The Lower Tester decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The Lower Tester verifies that the SEQ field value is correct.
4. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink BACK PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b10	0	0	KIP as specified in Table 4.23	matching the size of DST field received in Step 3	matching the size of SRC field received in Step 3	0b10

   - KEYID8 field is present if the value of KIP specified in Table 4.23 is non-zero.
   - FID field set to match FID received in Step 2.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the LT's address IXIT Entry as specified in Step 2.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to match the PDU received in Step 3.
5. The IUT receives the IPLink BACK PDU sent by the Lower Tester and confirms the IRT is directed to the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
6. The IUT sends a Directed Connectable Advertisement (ADV_DIRECT_IND) to the Lower Tester
7. The Lower Tester does not initiate a connection to the IUT.
8. After the TSPX_IPL_P_CONN_TIMEOUT IXIT value has passed, the Lower Tester initiates a connection to the IUT.
9. The IUT doesn't establish a L2CAP connection

Round	Src Address	Dst Address
1	16-bit Src Address	16-bit Dst Address
2	16-bit Src Address	64-bit Dst Address
3	64-bit Src Address	16-bit Dst Address
4	64-bit Src Address	64-bit Dst Address

Table 4.24: Input table for L2CAP Bearer Timeout Test Cases

- Expected Outcome

Pass verdict

In Step 3, all IPLink PDUs sent by the IUT are received by the Lower Tester over the AE bearer, and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

The MIC field is set correctly using the appropriate network security credentials.

The SEQ field value is unique for each IPLink PDU.

In Step 9 a L2CAP Connection isn't established.

IPL/NOD/L2CAP/BI-01-C [Ignore Broadcast]

- Test Purpose

  Verify that the IUT correctly ignores a received message over a L2CAP connection with a broadcast destination address.

- Reference

  [3] 3.1.1.1, 3.3.4.1

- Initial Condition
  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT is in Central Preferred or, Peripheral Preferred Mode.
  - The Lower Tester is in Either-Preferred Mode.
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- Test Procedure

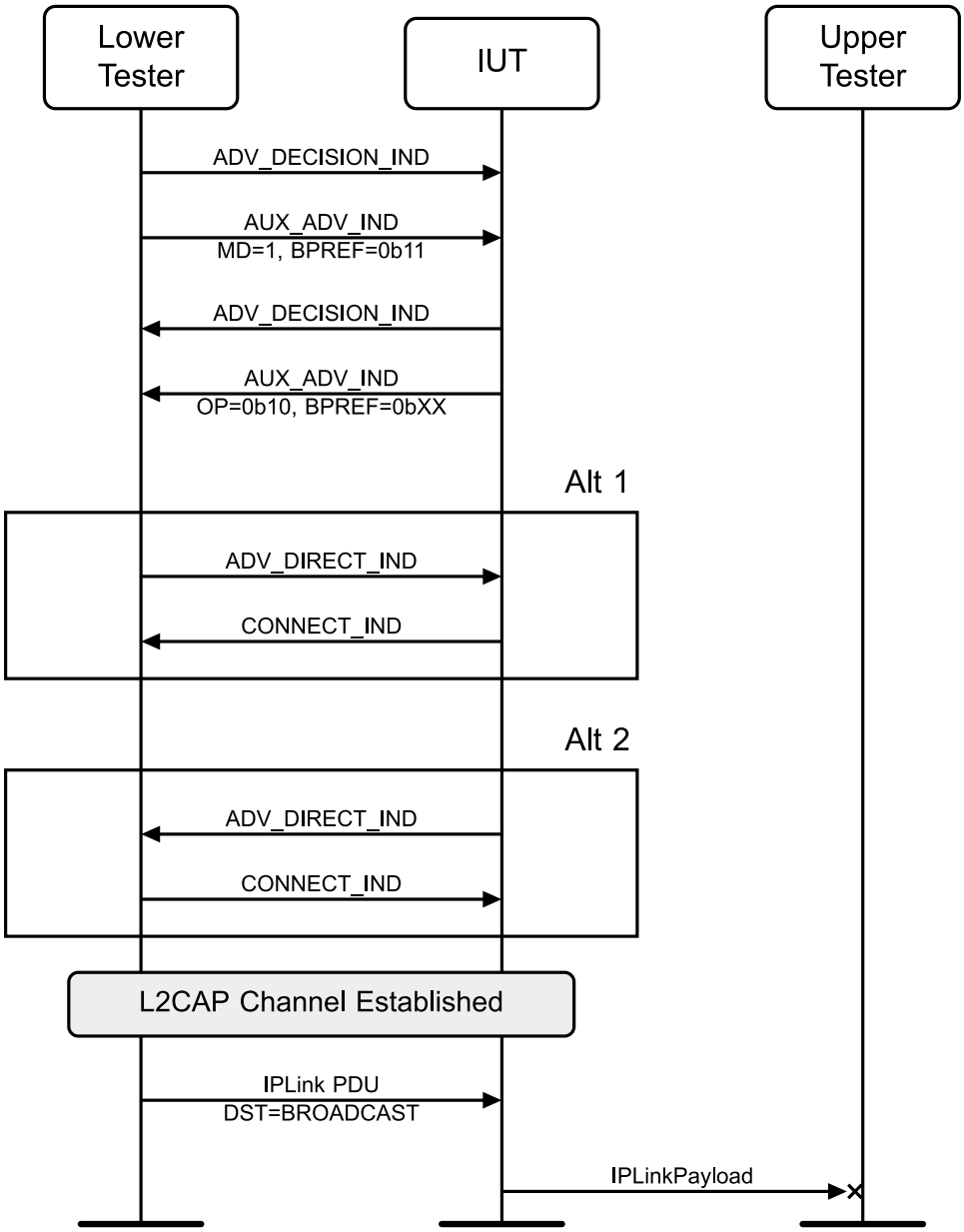


Figure 4.12: Ignore Broadcast

1. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	1	Any	Any size	Any size	0b11

   - KEYID8 field is present if the value of KIP is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.

- SRC field set to the IUT's address IXIT Entry.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

2. The IUT receives the AUX_ADV_IND sent by the Lower Tester. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
3. The IUT sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink BACK PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0b10	0	0	Any	Any Size	Any Size	0b00 or 0b01 or 0b10

   - KEYID8 field is present if the value of KIP is non-zero.
   - FID field set to match FID received in Step 2.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the IUT's address IXIT Entry as specified in Step 2.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to match the PDU received in Step 2.
4. The Lower Tester receives the IPLink BACK PDU sent by the IUT and confirms the IRT is directed to the IUT. The Lower Tester decrypts the packet and authenticates the MIC to confirm they are set using

   Alt 1:

   a. The Lower Tester sends a Directed Connectable Advertisement (ADV_DIRECT_IND) to the IUT.
   b. The IUT responds with a CONNECT_IND response.

   Alt 2:

   a. The IUT sends a Directed Connectable Advertisement (ADV_DIRECT_IND) to the Lower Tester.
   b. The Lower Tester responds with a CONNECT_IND response.

5. The IUT establishes an L2CAP channel IP_LINK between the IUT and the Lower Tester over that LE transport.
6. The Lower Tester sends an IPLink PDU and its fields set as follows:
   - DST with a BROADCAST destination address
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	1	Random KIP	random Dst Address size	random Dst Address size	0b00

- KEYID8 field is present if the value of KIP is non-zero.
- FID field set to a monotonically incrementing number between 0x00 and 0xFF.
- SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
- SRC field set to the IUT's address IXIT Entry.
- IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
- MIC field set to calculated value for the entire IPLink PDU.
- NID field set to the TSPX_NID IXIT Entry.

7. The IUT receives the PDU sent by the Lower Tester and confirms the NID is one known by the IUT. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
8. The Upper Tester confirms that the IPLink PDU was rejected.

- Expected Outcome

  Pass verdict

  All IPLink PDUs sent by the Lower Tester are received but rejected and not delivered to the upper layer.

IPL/NOD/L2CAP/BV-11-C [L2CAP Bearer Incompatibility]

- Test Purpose

  Verify that the IUT doesn't establish a L2CAP connection if there is an incompatible bearer preference received.

- Reference

  [3] 3.3.4.2

- Initial Condition

  - The IUT and the Lower Tester share the AddressKey value set to the TSPX_AddressKey IXIT entry, KEYID32 value set to TSPX_KEYID32 IXIT Entry, a NetKey value set to the TSPX_NetKey IXIT Entry, and a NID value set to the TSPX_NID IXIT Entry.
  - The IUT is in No Connections Mode (0b00).
  - The Lower Tester is in Central-Preferred (0b10) or Both-Preferred (0b11) Mode
  - The IUT has an IPLink Address set to TSPX_IUT_SHORT_ADDR and TSPX_IUT_LONG_ADDR IXIT Entries.
  - The Lower Tester has an IPLink Address set to the TSPX_LT_SHORT_ADDR and TSPX_LT_LONG_ADDR IXIT Entries.

- Test Procedure

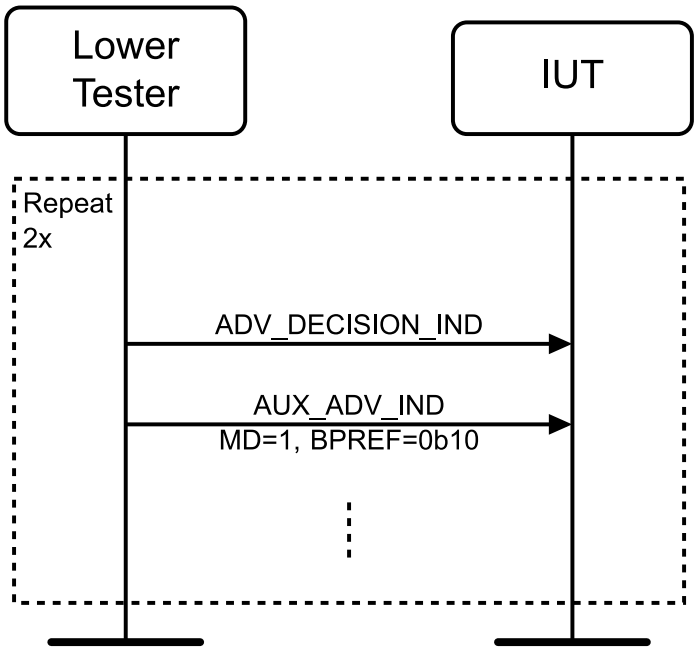


Figure 4.13: L2CAP Bearer Incompatibility Test Case

Repeat Steps 1-3 two times:

1. The Lower Tester sends Non-Connectable and Non-Scannable Undirected Advertisement with a Decision Data field and a Resolvable Tag set and containing the IPLink PDU and its fields set as follows:
   - FCTL fields set as follows:

Ver	OP	AR	MD	KIP	SAZ	DAZ	BPREF
0	0	0	1	Any KIP	Any	Any	0b10 or 0b11

   - KEYID8 field is present if the value of KIP specified is non-zero.
   - FID field set to a monotonically incrementing number between 0x00 and 0xFF.
   - SEQ field set to a monotonically incrementing number between 0x00000000 and 0xFFFFFFFF.
   - SRC field set to the Lower Tester's address IXIT Entry.
   - IPLinkPayload field set to TSPX_IPL_PAYLOAD IXIT Entry.
   - MIC field set to calculated value for the entire IPLink PDU.
   - NID field set to the TSPX_NID IXIT Entry.
2. The IUT receives the AUX_ADV_IND sent by the Lower Tester. The IUT decrypts the packet and authenticates the MIC to confirm they are set using the expected security credentials. The IUT verifies that the SEQ field value is correct.
3. The Lower Tester and IUT doesn't send anything until the TSPX_IPL_P_CONN_TIMEOUT has passed.

- Expected Outcome

  Pass verdict

In Step 2, all IPLink PDUs sent by the Lower Tester are received by the IUT over the AE bearer, and the fields are correct and authenticate correctly. The IPLinkPayload received is equal to the expanded TSPX_IPL_PAYLOAD IXIT Entry.

The Lower Tester and IUT don’t send anything after Step 2.

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 IPL [3].

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)
IPL 4/1	Sending and Receiving Data Link Layer message	IPL/NOD/DLL/BV-01-C IPL/NOD/DLL/BV-02-C IPL/NOD/DLL/BV-03-C IPL/NOD/DLL/BV-04-C IPL/NOD/DLL/BV-05-C IPL/NOD/DLL/BV-06-C IPL/NOD/DLL/BI-01-C IPL/NOD/DLL/BI-02-C IPL/NOD/DLL/BI-03-C IPL/NOD/DLL/BI-04-C IPL/NOD/SEC/BV-01-C IPL/NOD/SEC/BV-02-C IPL/NOD/SEC/BI-01-C IPL/NOD/SEC/BI-02-C

Item	Feature	Test Case(s)
IPL 4/2	L2CAP Bearer	IPL/NOD/L2CAP/BV-01-C IPL/NOD/L2CAP/BV-02-C IPL/NOD/L2CAP/BV-09-C IPL/NOD/L2CAP/BV-10-C IPL/NOD/L2CAP/BV-03-C IPL/NOD/L2CAP/BV-04-C IPL/NOD/L2CAP/BV-05-C IPL/NOD/L2CAP/BV-06-C IPL/NOD/L2CAP/BV-11-C
IPL 4/2 AND IPL 5/1	L2CAP Bearer - Full Featured Node	IPL/NOD/L2CAP/BV-07-C IPL/NOD/L2CAP/BV-08-C IPL/NOD/L2CAP/BI-01-C

Table 5.1: Test case mapping

6 Revision history and acknowledgments

Revision History

Publication Number	Revision Number	Date	Comments
p0	p0	2026-11-03	Approved by BTI 2026-10-12. IPL v1.0 adopted by the BoD on 2026-11-03. Prepared for TCRL pkg105-addition publication.

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