



**BACnet[®] TESTING LABORATORIES
ADDENDA**

**Addendum aj to
BTL Test Package 16.1**

**Revision 3
Revised May 5, 2020**

Approved by the BTL Working Group on April 20, 2020;
Approved by the BTL Working Group Voting Members on May 5, 2020.
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[This foreword and the “Overview” on the following pages are not part of this Test Package. They are merely informative and do not contain requirements necessary for conformance to the Test Package.]

FOREWORD

The purpose of this addendum is to present current changes being made to the BTL Test Package. These modifications are the result of change proposals made pursuant to the continuous maintenance procedures and of deliberations within the BTL-WG Committee. The changes are summarized below.

BTL-16.1aj-1: IPv6 Data Link Layer Tests - BTLWG-223 2

In the following document, language to be added to existing clauses within the BTL Test Package 16.1 is indicated through the use of *italics*, while deletions are indicated by ~~strike through~~. Where entirely new subclauses are proposed to be added, plain type is used throughout

In contrast, changes to BTL Specified Tests also contain a **yellow** highlight to indicate the changes made by this addendum. When this addendum is applied, all highlighting will be removed. Change markings on tests will remain to indicate the difference between the new test and an existing 135.1 test. If a test being modified has never existed in 135.1, the applied result should not contain any change markings. When this is the case, square brackets will be used to describe the changes required for this test.

Each addendum can stand independently unless specifically noted via dependency within the addendum. If multiple addenda change the same test or section, each future released addendum that changes the same test or section will note in square brackets whether or not those changes are reflected.

BTL-16.1aj-1: IPv6 Data Link Layer Tests - BTLWG-223

Overview:

Addendum 135-2012aj added support for IPv6.

Changes:

[In BTL Checklist, replace Data Link Layer - IPv6 section]

Support	Listing	Option
Data Link Layer - IPv6		
	R	Base Requirements
	C ¹	Is able to operate in Normal mode
	C ¹	Is able to operate in Foreign mode
	C ²	Is able to operate in BBMD mode
¹ Required if the device does not support BBMD mode. ² Required if the device does not support Foreign mode.		

[In BTL Test Plan, replace section 9.9 Data Link Layer - IPv6]

9.9 Data Link Layer - IPv6

9.9.1 Base Requirements

Base requirements must be met by any IUT that can act, or can be made to act, as a BACnet/IPv6 device in a non-BBMD mode.

BTL - 12.X.1.1 - Execute Original-Unicast-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.1.2 - Execute Virtual-Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	

9.9.2 Is Able to Operate in Normal Mode

The IUT supports NORMAL mode.

BTL - 12.X.2.1.1 - Initiate Original-Broadcast-NPDU		
	Test Conditionality	If the IUT does not initiate broadcasts, this test shall be skipped.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.1.2 - Execute Original-Broadcast-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.1.3 - Execute Forwarded-NPDU		

	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.1.4 - Execute Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.1.5 - Execute Forwarded-Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.2.1 - Reject Register-Foreign-Device		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.2.2 - Reject Delete-Foreign-Device-Table-Entry		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.2.2.3 - Reject Distribute-Broadcast-To-Network		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	

9.9.3 Is Able to Operate in Foreign Mode

The IUT supports FOREIGN mode.

BTL - 12.X.3.1.1 - Initiate Distribute-Broadcast-To-Network-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.1.2 - Execute Forwarded-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.1.3 - Execute Forwarded-Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.2.1 - Ignores Original-Broadcast-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.2.2 - Ignore Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.2.3 - Reject Register-Foreign-Device		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.2.4 - Reject Delete-Foreign-Device-Table-Entry		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.3.2.5- Reject Distribute-Broadcast-To-Network		
	Test Conditionality	Must be executed.

	Test Directives	
	Testing Hints	

9.9.4 Is Able to Operate in BBMD Mode

The IUT supports BBMD mode.

BTL - 12.X.4.1.1 - Original-Broadcast-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.1.2 - Forwarded-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.1.3 - Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.1.4 - Forwarded-Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.1.5 - Distribute-Broadcast-To-Network		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.2.1 - Reject Forwarded-NPDU		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.2.2 - Reject Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.2.3 - Reject Forwarded-Address-Resolution		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.2.4 - Reject Distribute-Broadcast-To-Network		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.4.3.1 - Verify writability of the BDT		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.5.1 - Execute Register-Foreign-Device		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.5.2 - Execute Delete-Foreign-Device-Table-Entry		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.5.3.1 - Non-Zero-Duration Foreign Device Table Timer Operations		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	

BTL - 12.X.5.3.2 - Zero-Duration Foreign Device Timer Operations		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	
BTL - 12.X.5.4 - Delete-Foreign-Device-Table-Entry For A Non-existent Entry		
	Test Conditionality	Must be executed.
	Test Directives	
	Testing Hints	

[In BTL Specified Tests, Insert new **Clause 12**, p. 643]

12.X BACnet/IPv6 Functionality Tests

This clause defines the tests necessary to demonstrate BACnet/IPv6 functionality, as defined in Annex U of the BACnet Standard. For each test case a sequence of one or more messages that are to be exchanged are described. A passing result occurs when the IUT and TD exchange messages as described in the test case. Any other combinations of messages constitute a failure of the test. Some test cases are not valid unless some other test defined in this standard has already been executed and the IUT passed this test. These dependencies are noted in the test case description.

For the tests in this clause references to the virtual address mean the 3-octet virtual address. For example, Source-Virtual-Address = TD means Source-Virtual-Address = (the 3-octet VMAC of TD).

12.X.1 Common Tests

This group of tests verifies that a B/IPv6 device will respond correctly to incoming B/IPv6 messages. All B/IPv6 devices shall execute these tests.

Configuration Requirements: The IUT's Network Port object that represents the B/IPv6 port under test shall be configured as follows:

- **BACnet_IPv6_Multicast_Address is FF02::BAC0 (Link Local Multicast Address)**

12.X.1.1 Execute Original-Unicast-NPDU

Purpose: To verify that an IUT will process an Original-Unicast-NPDU message.

Test Steps:

1. TRANSMIT DA = IUT, SA = TD,
Original-Unicast-NPDU,
Source-Virtual-Address = TD,
Destination-Virtual-Address = IUT,
ReadProperty-Request,
'Object Identifier' = X,
'Property Identifier' = Y
2. RECEIVE DA = TD, SA = IUT
Original-Unicast-NPDU,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = TD,
ReadProperty-ACK,
'Object Identifier' = X,
'Property Identifier' = Y

12.X.1.2 Execute Virtual-Address-Resolution

Purpose: To verify that an IUT will process a Virtual-Address-Resolution message.

Test Steps:

1. TRANSMIT DA = IUT, SA = TD,
Virtual-Address-Resolution,

- Source-Virtual-Address = TD
- 2. RECEIVE DA = TD,
Virtual-Address-Resolution-ACK,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = TD

12.X.2 IPv6 Normal Mode Tests

This group of tests verifies that a B/IPv6 device that is operating in normal mode (not a BACnet Broadcast Management Device (BBMD), and not a Foreign Device) will respond correctly to incoming B/IPv6 messages.

Configuration Requirements: The IUT's Network Port object that represents the B/IPv6 port under test shall be configured as follows:

- **BACnet_IPv6_Mode is NORMAL**
- **BACnet_IPv6_Multicast_Address is FF02::BAC0 (Link Local Multicast Address)**

12.X.2.1 Positive Tests

12.X.2.1.1 Initiate Original-Broadcast-NPDU

Purpose: To verify that an IUT, operating in normal IPv6 mode, will correctly initiate an Original-Broadcast-NPDU message.

Test Steps:

1. MAKE(the IUT send a broadcast)
2. RECEIVE DA=Link Local Multicast Address, SA = IUT
Original-Broadcast-NPDU,
Source-Virtual-Address = IUT,
(any valid BACnet-Unconfirmed-Request-PDU, with any valid broadcast network options)

12.X.2.1.2 Execute Original-Broadcast-NPDU

Purpose: To verify that an IUT, operating in normal IPv6 mode, will process an Original-Broadcast-NPDU message.

Test Steps:

1. TRANSMIT DA = B/IPv6 Link Local Multicast Address, SA = TD,
Original-Broadcast-NPDU,
Source-Virtual-Address = TD,
Who-Is-Request
2. If (the IUT responds with Unicast I-Am) THEN
RECEIVE DA = TD, SA = IUT,
Original-Unicast-NPDU,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = TD,
I-Am-Request
ELSE
RECEIVE DA=Link Local Multicast Address, SA = IUT
Original-Broadcast-NPDU,
Source-Virtual-Address = IUT,
I-Am-Request
3. CHECK (The IUT does not issue any Forwarded-NPDUs)

12.X.2.1.3 Execute Forwarded-NPDU

Purpose: To verify that an IUT, operating in normal IPv6 mode, will process a Forwarded-NPDU.

Test Steps:

1. TRANSMIT DA = Link Local Multicast Address, SA = TD,
Forwarded-NPDU,
Original-Source-Virtual-Address = D2,
Original-Source-B/IPv6-Address = D2,

Who-Is-Request

2. If (the IUT responds with Unicast I-Am) THEN
RECEIVE DA = D2, SA = IUT,
Original-Unicast-NPDU,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = D2,
I-Am-Request
ELSE
RECEIVE DA=Link Local Multicast Address, SA = IUT
Original-Broadcast-NPDU,
Source-Virtual-Address = IUT,
I-Am-Request
3. CHECK (The IUT does not issue any Forwarded-NPDU BVLCs)

12.X.2.1.4 Execute Address-Resolution

Purpose: To verify that an IUT, operating in normal IPv6 mode, will process an Address-Resolution message.

Test Steps:

1. TRANSMIT DA = B/IPv6 Link Local Multicast Address, SA = TD,
Address-Resolution,
Source-Virtual-Address = TD,
Target-Virtual-Address = IUT
2. RECEIVE DA = TD,
Address-Resolution-ACK,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = TD
3. CHECK (The IUT does not issue any Forwarded-Address-Resolution BVLCs)

12.X.2.1.5 Execute Forwarded-Address-Resolution

Purpose: To verify that an IUT, operating in normal IPv6 mode, will process a Forwarded-Address-Resolution message.

Test Concept: The TD, acting as a BBMD, sends a Forwarded-Address-Resolution message to the IUT on behalf of device D2. It is verified that the IUT responds to D2 with an Address-Resolution message.

1. TRANSMIT DA = IUT, SA = TD,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = D2,
Target-Virtual-Address = IUT
Original-Source-B/IPv6-Address = D2
2. RECEIVE
DA = D2, SA = IUT
Address-Resolution-ACK,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = D2
3. CHECK (The IUT does not issue any Forwarded-Address-Resolution BVLCs).

12.X.2.2 Negative Tests

12.X.2.2.1 Reject Register-Foreign-Device

Purpose: To verify that an IUT, operating in normal IPv6 mode, will reject a Register-Foreign-Device request.

Test Steps:

1. TRANSMIT DESTINATION = IUT, SA = TD,
Register-Foreign-Device,
Source-Virtual-Address = TD
Time-To-Live = 60
2. RECEIVE DESTINATION = TD,

BVLC-Result,
Source-Virtual-Address = IUT
'Result Code' = Register-Foreign-Device NAK

12.X.2.2.2 **Reject Delete-Foreign-Device-Table-Entry**

Purpose: To verify that an IUT, operating in normal IPv6 mode, will reject a Delete-Foreign-Device-Table-Entry request.

Test Steps:

1. TRANSMIT DESTINATION = IUT, SA = TD,
Delete-Foreign-Device-Table-Entry,
Source-Virtual-Address = TD
FDT Entry = TD
2. RECEIVE DESTINATION = TD,
BVLC-Result,
Source-Virtual-Address = IUT
'Result Code' = Delete-Foreign-Device-Table-Entry NAK

12.X.2.2.3 **Reject Distribute-Broadcast-To-Network**

Purpose: To verify that an IUT, operating in normal IPv6 mode, will reject a Distribute-Broadcast-To-Network request.

Test Steps:

1. TRANSMIT DESTINATION = IUT, SA = TD,
Distribute-Broadcast-To-Network,
Original-Source-Virtual-Address = TD
Who-Is-Request
2. RECEIVE DESTINATION = TD,
BVLC-Result,
Source-Virtual-Address = IUT
'Result Code' = Distribute-Broadcast-To-Network NAK

12.X.3 **Foreign Device Tests**

This group of tests verifies that a B/IPv6 device that is configured as a Foreign Device is able to register with a BBMD and send and receive broadcast messages through the BBMD.

Configuration Requirements: The IUT's Network Port object that represents the B/IPv6 port under test shall be configured as follows:

- **BACnet_IPv6_Mode is FOREIGN**
- **BACnet_IPv6_Multicast_Address is FF02::BAC0 (Link Local Multicast Address)**

12.X.3.1 **Positive Tests**

12.X.3.1.1 **Initiate Distribute-Broadcast-To-Network-NPDU**

Purpose: To verify that an IUT, configured as a Foreign Device, will correctly initiate an Distribute-Broadcast-To-Network - NPDU message.

Configuration Requirements: The TD is operating as a BBMD, and the IUT has registered as a foreign device with it.

Test Steps:

1. MAKE(the IUT send a broadcast)
2. RECEIVE DA=IUT, SA = IUT
Distribute-Broadcast-To-Network-NPDU,
Source-Virtual-Address = IUT,
(any valid BACnet-Unconfirmed-Request-PDU, with any valid broadcast network options)

12.X.3.1.2 **Execute Forwarded-NPDU**

Purpose: To verify that an IUT, operating as a foreign device, will process a Forwarded-NPDU.

Configuration Requirements: The TD is operating as a BBMD, and the IUT has registered as a foreign device with it.

Test Steps:

1. TRANSMIT DA = IUT, SA = TD,
Forwarded-NPDU,
Original-Source-Virtual-Address = D2,
Original-Source-B/IPv6-Address = D2,
Who-Is-Request
2. If (the IUT responds with Unicast I-Am) THEN
RECEIVE DA = D2, SA = IUT,
Original-Unicast-NPDU,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = D2,
I-Am-Request
ELSE
RECEIVE DA=TD, SA = IUT
Distribute-Broadcast-To-Network-NPDU,
Source-Virtual-Address = IUT,
I-Am-Request
3. CHECK (The IUT does not issue any Forwarded-NPDU BVLCs)

12.X.3.1.3 Execute Forwarded-Address-Resolution

Purpose: To verify that an IUT, operating as a foreign device, will process a Forwarded-Address-Resolution message.

Test Concept: The TD, acting as a BBMD, sends a Forwarded-Address-Resolution message to the IUT on behalf of device D2. It is verified that the IUT responds to D2 with an Address-Resolution message.

1. TRANSMIT DA = IUT, SA = TD,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = D2,
Target-Virtual-Address = IUT
Original-Source-B/IPv6-Address = D2
2. RECEIVE
DA = D2, SA = IUT
Address-Resolution-ACK,
Source-Virtual-Address = IUT,
Destination-Virtual-Address = D2
3. CHECK (The IUT does not issue any Forwarded-Address-Resolution BVLCs).

12.X.3.2 Negative Tests

12.X.3.2.1 Ignores Original-Broadcast-NPDU

Purpose: To verify that an IUT, operating as a foreign device, will not process an Original-Broadcast-NPDU message.

Test Steps:

1. TRANSMIT DA = B/IPv6 Link Local Multicast Address, SA = D2,
Original-Broadcast-NPDU,
Source-Virtual-Address = D2,
Who-Is-Request
3. CHECK (The IUT does not issue any IAmS in response)

12.X.3.2.2 Ignore Address-Resolution

Purpose: To verify that an IUT, operating as a foreign device, will ignore multicast Address-Resolution messages.

Test Steps:

1. TRANSMIT DA = B/IPv6 Link Local Multicast Address, SA = D2,

Address-Resolution,
Source-Virtual-Address = D2,
Target-Virtual-Address = IUT

2. CHECK (The IUT does not issue any Address-Resolution-ACK BVLCs)

12.X.3.2.3 Reject Register-Foreign-Device

Purpose: To verify that an IUT, operating as a foreign device, will reject a Register-Foreign-Device request.

Test Steps:

1. TRANSMIT DESTINATION = IUT, SA = TD,
Register-Foreign-Device,
Source-Virtual-Address = TD
Time-To-Live = 60
2. RECEIVE DESTINATION = TD,
BVLC-Result,
Source-Virtual-Address = IUT
'Result Code' = Register-Foreign-Device NAK

12.X.3.2.4 Reject Delete-Foreign-Device-Table-Entry

Purpose: To verify that an IUT, operating as a foreign device, will reject a Delete-Foreign-Device-Table-Entry request.

Test Steps:

1. TRANSMIT DESTINATION = IUT, SA = TD,
Delete-Foreign-Device-Table-Entry,
Source-Virtual-Address = TD
FDT Entry = TD
2. RECEIVE DESTINATION = TD,
BVLC-Result,
Source-Virtual-Address = IUT
'Result Code' = Delete-Foreign-Device-Table-Entry NAK

12.X.3.2.5 Reject Distribute-Broadcast-To-Network

Purpose: To verify that an IUT, operating as a foreign device, will reject a Distribute-Broadcast-To-Network request.

Test Steps:

1. TRANSMIT DESTINATION = IUT, SA = TD,
Distribute-Broadcast-To-Network,
Original-Source-Virtual-Address = TD
Who-Is-Request
2. RECEIVE DESTINATION = TD,
BVLC-Result,
Source-Virtual-Address = IUT
'Result Code' = Distribute-Broadcast-To-Network NAK

12.X.4 BBMD Tests

12.X.4.1 Positive Tests

This group of tests verifies that a B/IPv6 device that is configured as a BACnet Broadcast Management Device (BBMD) will correctly process incoming B/IPv6 messages that pertain to BBMDs. Only devices that are configured to support BBMD functionality shall execute these tests.

Configuration Requirements: The IUT's Network Port object that represents the B/IPv6 port under test shall be configured as follows:

- BACnet_IPv6_Mode is BBMD
- BACnet_IPv6_Multicast_Address is FF02::BAC0 (Link Local Multicast Address)
- BBMD_Broadcast_Distribution_Table shall contain:

bbmd-address
BBMD1
BBMD2
BBMD3

For purposes of these tests, TD shall be operating as BBMD1.

12.X.4.1.1 Original-Broadcast-NPDU

Purpose: To verify that the IUT, configured as a BBMD, will forward an Original-Broadcast-NPDU request.

Test Steps:

1. TRANSMIT

DA = B/IPv6 Link Local Multicast Address,
 SA = TD,
 Source-Virtual-Address = TD,
 Original-Broadcast-NPDU,
 Who-Is-Request

2. RECEIVE

DA = BBMD1,
 SA = IUT,
 Forwarded-NPDU,
 Original-Source-Virtual-Address = TD
 Original-Source-B/IPv6-Address = TD
 Who-Is-Request

3. RECEIVE

DA = BBMD2,
 SA = IUT,
 Forwarded-NPDU,
 Original-Source-Virtual-Address = TD
 Original-Source-B/IPv6-Address = TD
 Who-Is-Request

4. RECEIVE

DA = BBMD3,
 SA = IUT,
 Forwarded-NPDU,
 Original-Source-Virtual-Address = TD
 Original-Source-B/IPv6-Address = TD
 Who-Is-Request

12.X.4.1.2 Forwarded-NPDU

Purpose: To verify that the IUT, configured as a BBMD, will forward a Forwarded-NPDU request.

Configuration Requirements: Register FD1 as a foreign device with the IUT. FD3 is a registered foreign device with BBMD1.

Test Steps:

1. TRANSMIT

DA = IUT,
 SA = BBMD1,
 Forwarded-NPDU,
 Source-Virtual-Address = FD3,
 Original-Source-B/IPv6-Address = FD3
 I-Am-Request

2. RECEIVE

DA = B/IPv6 Link Local Multicast Address,
 SA = IUT
 Forwarded-NPDU,
 Source-Virtual-Address = FD3,

Original-Source-B/IPv6-Address = FD3
I-Am-Request

3. RECEIVE

DA = FD1,
SA = IUT
Forwarded-NPDU,
Source-Virtual-Address = FD3,
Original-Source-B/IPv6-Address = FD3
I-Am-Request

Notes to Tester: The order of the messages transmitted by the IUT is not significant.

12.X.4.1.3 Address-Resolution

Purpose: To verify that the IUT, configured as a BBMD, will process an Address-Resolution request when the target virtual address is not the virtual address of the IUT.

Configuration Requirements: TD shall be a registered foreign device (FD1) with the IUT.

1. TRANSMIT

DA = IUT,
SA = TD,
Address-Resolution,
Source-Virtual-Address = TD,
Target-Virtual-Address = FD2

2. RECEIVE

DA = B/IPv6 Link Local Multicast Address
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = TD,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = TD

3. RECEIVE

DA = BBMD1,
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = TD,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = TD

4. RECEIVE

DA = BBMD2,
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = TD,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = TD

5. RECEIVE

DA = BBMD3,
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = TD,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = TD

6. RECEIVE

DA = FD2,
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = TD,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = TD

7. TRANSMIT

DA = TD,
SA = FD2,
Address-Resolution-ACK,
Source-Virtual-Address = FD2,
Destination-Virtual-Address = TD

Notes to Tester: The execution of step 7 is not significant, but is shown here in order to demonstrate the completion of the BVLC.

12.X.4.1.4 Forwarded-Address-Resolution

Purpose: To verify that the IUT, configured as a BBMD, will process a Forwarded-Address-Resolution request when the target virtual address is not the virtual address of the IUT.

Configuration Requirements: TD shall operate as BBMD1 and listed in the IUTs Broadcast Distribution Table.

1. TRANSMIT

DA = IUT,
SA = TD,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = FD1,
Target-Virtual-Address = FD2
Original-Source-B/IPv6-Address = FD1

2. RECEIVE

DA = B/IPv6 Link Local Multicast Address,
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = FD1,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = FD1

3. RECEIVE

DA = FD2,
SA = IUT,
Forwarded-Address-Resolution,
Original-Source-Virtual-Address = FD1,
Target-Virtual-Address = FD2,
Original-Source-B/IPv6-Address = FD1

5. TRANSMIT

DA = TD,
SA = FD2,
Address-Resolution-ACK,
Source-Virtual-Address = FD2,
Destination-Virtual-Address = TD

Notes to Tester: The execution of step 7 is not significant, but is shown here in order to demonstrate the completion of the BVLC. The order of the messages transmitted by the IUT is not significant.

12.X.4.1.5 Distribute-Broadcast-To-Network

Purpose: To verify that the IUT, configured as a BBMD, will process a Distribute-Broadcast-To-Network request.

Configuration Requirements: Register FD1 as a foreign device with the IUT. FD2 is a registered foreign device with BBMD1. For purposes of this test, TD is acting as FD1.

Steps 1 6 are the processing of the Distributed-Broadcast-To-Network, Step 7 and on is the processing of the APDU service by the IUT.

1. TRANSMIT

DA = IUT,
SA = FD1,

Distribute-Broadcast-To-Network,
Who-Is-Request

2. RECEIVE

DA = B/IPv6 Link Local Multicast Address,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = FD1,
Original-Source-Virtual-Address = FD1,
Who-Is-Request

3. RECEIVE

DA = BBMD1,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = FD1,
Original-Source-Virtual-Address = FD1,
Who-Is-Request

4. RECEIVE

DA = BBMD2,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = FD1,
Original-Source-Virtual-Address = FD1,
Who-Is-Request

5. RECEIVE

DA = BBMD3,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = FD1,
Original-Source-Virtual-Address = FD1,
Who-Is-Request

6. RECEIVE

DA = FD2,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = FD1,
Original-Source-Virtual-Address = FD1,
Who-Is-Request

7. RECEIVE

DA = B/IPv6 Link Local Multicast Address,
SA = IUT,
Original-Broadcast-NPDU,
Original-Source-Virtual-Address = IUT,
I-Am-Request

8. RECEIVE

DA = BBMD1,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = IUT,
Original-Source-Virtual-Address = IUT,
I-Am-Request

9. RECEIVE DA = BBMD2,

SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = IUT,
Original-Source-Virtual-Address = IUT,
I-Am-Request

10. RECEIVE DA = BBMD3,

SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = IUT,

Original-Source-Virtual-Address = IUT,
I-Am-Request

11. RECEIVE

DA = FD1,
SA = IUT,
Forwarded-NPDU,
Source-Virtual-Address = IUT,
Original-Source-Virtual-Address = IUT,
I-Am-Request

12. RECEIVE

DA = FD2,
SA = IUT
Forwarded-NPDU,
Source-Virtual-Address = IUT,
Original-Source-Virtual-Address = IUT,
I-Am-Request

Notes to Tester: The order of the messages transmitted by the IUT is not significant.

12.X.4.2 Negative Tests

12.X.4.2.1 Reject Forwarded-NPDU

Purpose: To verify that the IUT, configured as a BBMD, will drop a Forwarded-NPDU request from a BBMD that's not in the IUT's BDT.

Configuration Requirements: Empty the IUT's BDT. FD3 is a foreign device registered with the IUT.

Test Steps:

1. TRANSMIT

DA = IUT,
SA = BBMD1,
Forwarded-NPDU,
Source-Virtual-Address = FD3,
Original-Source-B/IPv6-Address = FD3
I-Am-Request

2. CHECK (The IUT does not issue any Forwarded-NPDU BVLCs)

12.X.4.2.2 Reject Address-Resolution

Purpose: To verify that the IUT, configured as a BBMD, will not process an Address-Resolution request when the target virtual address is not the virtual address of the IUT and the SA is not from a device registered with the IUT.

Configuration Requirements: TD shall not be a registered foreign device (FD1) with the IUT.

1. TRANSMIT

DA = IUT,
SA = TD,
Address-Resolution,
Source-Virtual-Address = TD,
Target-Virtual-Address = FD2

2. RECEIVE

DA = TD,
SA = IUT
BVLC-Result
Address-Resolution NAK

2. CHECK (The IUT does not issue any Forwarded-Address-Resolution BVLCs)

12.X.4.2.3 Reject Forwarded-Address-Resolution

Purpose: To verify that the IUT, configured as a BBMD, will not process a Forwarded-Address-Resolution request when the source a BBMD that is not present in the IUTs BDT.

Configuration Requirements: Empty the IUT's BDT.

1. TRANSMIT
 - DA = IUT,
 - SA = TD,
 - Forwarded-Address-Resolution,
 - Original-Source-Virtual-Address = FD1,
 - Target-Virtual-Address = FD2
 - Original-Source-B/IPv6-Address = FD1
2. CHECK (The IUT does not issue any Forwarded-Address-Resolution BVLCs)

12.X.4.2.4 Reject Distribute-Broadcast-To-Network

Purpose: To verify that the IUT, configured as a BBMD, will not process a Distribute-Broadcast-To-Network request from a device that is not registered as a foreign device with the IUT.

Configuration Requirements: Insure the TD is not registered as a foreign device with the IUT and that the TD is not listed in the IUTs FDT.

1. TRANSMIT
 - DA = IUT,
 - SA = TD,
 - Distribute-Broadcast-To-Network,
 - Who-Is-Request
2. RECEIVE
 - DA = TD
 - SA = IUT
 - BVLC-Result
 - Distribute-Broadcast-To-Network-NAK

12.X.4.3 Broadcast Distribution Table Operations

This group of tests verifies that a BACnet Broadcast Management Device will correctly perform BDT operations.

Configuration Requirements: The IUT's Network Port object that represents the B/IPv6 port under test shall be configured as follows:

- BACnet_IPv6_Mode is BBMD

12.X.4.3.1 Verify writability of the BDT

Purpose: To verify the contents of the broadcast distribution table.

1. TRANSMIT
 - WriteProperty-Request,
 - 'Object Identifier' = (Network Port Object that represents this port),
 - 'Property Identifier' = BBMD_Broadcast_Distribution_Table
 - 'Property Value' = (WrittenBDT: a list of valid BACnetBDTEntry)
2. RECEIVE
 - BACnetSimple-Ack,
3. ReadBDT = READ NP, BBMD_Broadcast_Distribution_Table
4. CHECK(ReadBDT contains the same entries as WrittenBDT, but not necessarily in the same order)

12.X.5 Foreign Device Management Tests

This group of tests verifies that a BBMD with an FDT will correctly perform FDT operations.

Configuration Requirements: The IUT's Network Port object, NP, that represents the B/IPv6 port under test shall be configured as follows:

- BACnet_IPv6_Mode is BBMD
- BACnet_IPv6_Multicast_Address is FF02::BAC0 (Link Local Multicast Address)
- BBMD_Accept_FD_Registrations is TRUE.

The TD's Network Port object that represents the B/IPv6 port being used shall be configured as follows:

- BACnet_IPv6_Mode is FOREIGN
- BACnet_IPv6_Multicast_Address is FF02::BAC0 (Link Local Multicast Address)

12.X.5.1 Execute Register-Foreign-Device

Purpose: To verify that the IUT, will handle a Register-Foreign-Device request.

Test Steps:

1. TRANSMIT
DA = IUT,
SA = TD,
Source-Virtual-Address = TD,
Register-Foreign-Device,
'Time-To-Live' = 60
2. RECEIVE
DA = TD,
SA = IUT,
Source-Virtual-Address = IUT,
BVLC-Result,
'Result Code' = 0
3. VERIFY NP, BBMD_Foreign_Device_Table = ((B/IPv6 address of FD2, 60, 90-execution time))

12.X.5.2 Execute Delete-Foreign-Device-Table-Entry

Purpose: To verify that the IUT will handle a Delete-Foreign-Device-Table-Entry message when a valid FDT entry is supplied.

Configuration Requirements: The TD shall take the role of foreign device FD1. The IUT's FDT must be empty.

Test Steps:

1. TRANSMIT
DA = IUT,
SA = FD1,
Source-Virtual-Address = FD1,
Register-Foreign-Device,
'Time-To-Live' = 60
2. RECEIVE
DA = FD1,
SA = IUT,
Source-Virtual-Address = IUT,
BVLC-Result,
'Result Code' = 0
3. VERIFY NP, BBMD_Foreign_Device_Table = ((B/IPv6 address of FD1, 60, 90-execution time))
'Property Value' = ((B/IPv6 address of FD1, 60, 90-execution time))
4. TRANSMIT
DA = IUT,

SA = FD1,
Source-Virtual-Address = FD1,
Delete-Foreign-Device-Table-Entry,
'FDT Entry' = FD1

5. RECEIVE

DA = FD1,
SA = IUT,
Source-Virtual-Address = IUT,
BVLC-Result,
'Result Code' = Successful completion

6. VERIFY NP, BBMD_Foreign_Device_Table = ()

12.X.5.3 Foreign Device Table Timer Operations

12.X.5.3.1 Non-Zero-Duration Foreign Device Table Timer Operations

Purpose: To verify that the IUT will handle FDT timer operations: finite time Foreign Device registration, re-registration, adding grace period to the supplied Time-To-Live parameter and FDT entry clearing upon timer expiration.

Configuration Requirements: The TD shall take the role of foreign device FD2. The value of the IUT's BBMD_Foreign_Device Table must be empty.

Test Steps:

1. TRANSMIT

DA = IUT,
SA = FD2,
Register-Foreign-Device,
'Time-To-Live' = 60

2. RECEIVE

DA = FD2,
SA = IUT,
BVLC-Result,
'Result Code' = 0

3. VERIFY NP, BBMD_Foreign_Device_Table = ((B/IPv6 address of FD2, 60, 90-execution time))

4. TRANSMIT

DA = IUT,
SA = FD2,
Register-Foreign-Device,
'Time-To-Live' = 40

5. RECEIVE

DA = FD2,
SA = IUT,
BVLC-Result,
'Result Code' = 0

6. WAIT (30 seconds)

7. VERIFY NP, BBMD_Foreign_Device_Table = ((B/IPv6 address of FD2, 40, 40-execution time))

8. WAIT (50 seconds)

9. VERIFY NP, BBMD_Foreign_Device_Table = ()

12.X.5.3.2 Zero-Duration Foreign Device Timer Operations

Purpose: To verify that the IUT will handle Foreign Device registration with Time-To-Live parameter equal to zero and clears FDT entry upon timer expiration.

Configuration Requirements: The TD shall take the role of foreign device FD2. The IUTs FDT must be empty.

Test Steps:

1. TRANSMIT

- DA = IUT,
- SA = FD2,
- Register-Foreign-Device-Table,
- 'Time-To-Live' = 0
- 2. RECEIVE
 - DA = FD2,
 - SA = IUT,
 - BVLC-Result,
 - 'Result Code' = 0
- 3. WAIT (10 seconds)
- 4. VERIFY NP, BBMD_Foreign_Device_Table = ((B/IPv6 address of FD2, 0, 20-execution time))
- 5. WAIT (30 seconds)
- 6. VERIFY NP, BBMD_Foreign_Device_Table = ()

12.X.5.4 Delete-Foreign-Device-Table-Entry For A Non-existent Entry

Purpose: To verify that the IUT will handle a Delete-Foreign-Device-Table-Entry message when a non-existent FDT entry is supplied.

Test Concept: The IUT starts with a Foreign Device Table without an entry for FD1. The TD, acting as FD1, attempts to delete its entry from the IUT's Foreign Device Table. It is verified that the IUT returns a NAK to the request.

Configuration Requirements: The IUT's Foreign Device Table does not contain an entry for FD1.

Test Steps:

- 1. VERIFY NP, BBMD_Foreign_Device_Table = (a list of entries without an entry for FD1)
- 4. TRANSMIT
 - DA = IUT,
 - SA = FD1,
 - Source-Virtual-Address = FD1,
 - Delete-Foreign-Device-Table-Entry,
 - 'FDT Entry' = FD1
- 5. RECEIVE
 - DA = FD1,
 - SA = IUT,
 - Source-Virtual-Address = IUT
 - BVLC-Result,
 - 'Result Code' = Delete-Foreign-Device-Table-Entry NAK
- 6. VERIFY NP, BBMD_Foreign_Device_Table = (the previously read list but with updated lifetimes)