ANSI/ASHRAE Addendum g to
ANSI/ASHRAE Standard 135.1-2009

ASHRAE ADDENDA

Method of Test for Conformance to BACnet®

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[This foreword and the "rationales" on the following pages are not part of this standard. They are merely informative and do not contain requirements necessary for conformance to the standard.]

FOREWORD

Addendum 135.1*g* to ANSI/ASHRAE Standard 135.1-2009 contains a number of changes to the current standard. These modifications are the result of change proposals made pursuant to the ASHRAE continuous maintenance procedures and of deliberations within Standing Standard Project Committee 135. The changes are summarized below.

In the following document, language added to existing clauses of ANSI/ASHRAE 135.1-2009 and addenda is indicated through the use of *italics*, while deletions are indicated by ~~strikethrough~~. Where entirely new subclauses are added, plain type is used throughout.

135.1-2009*g*-1 Correct Test Step Indention.

Rationale
The test step 8 is incorrectly numbered and incorrectly indented.

[Change **Clause 8.2.7**, p 113]

8.2.7 Change of Value Notification from Loop Object Present_Value Property

Purpose: To verify that the IUT can initiate ConfirmedCOVNotification service requests conveying a change of the Present_Value property of a loop object.

Test Concept: A subscription for COV notifications is established. The Present_Value of the monitored object is changed by an amount less than the COV increment and it is verified that no COV notification is received. The Present_Value is then changed by an amount greater than the COV increment and a notification shall be received.

The Present_Value may be changed by placing the Loop Out_Of_Service and writing directly to the Present_Value. For implementations where this option is not ~~possible an~~ *possible, an* alternative trigger mechanism shall be provided to accomplish this task, such as changing the Setpoint or the Setpoint_Reference. All of these methods are equally acceptable.

The object identifier of the Loop object being tested is designated as L in the test steps below.

Test Steps:

1. TRANSMIT SubscribeCOV-Request,
   'Subscriber Process Identifier' = (any value > 0 chosen by the TD),
   'Monitored Object Identifier' = L,
   'Issue Confirmed Notifications' = TRUE,
   'Lifetime' = 0
2. RECEIVE BACnet-SimpleACK-PDU
3. RECEIVE ConfirmedCOVNotification-Request,
   'Subscriber Process Identifier' = (the same value used in step 1),
   'Initiating Device Identifier' = IUT,
   'Monitored Object Identifier' = L,
   'Time Remaining' = 0,
   'List of Values' = (the initial Present_Value, initial Status_Flags, initial Setpoint, and initial Controlled_Variable_Value)
4. TRANSMIT BACnet-SimpleACK-PDU
5. TRANSMIT ReadProperty-Request,
   'Object Identifier' = L,
   'Property Identifier' = COV_Increment
6. RECEIVE BACnet-ComplexACK-PDU,
   'Object Identifier' = L,
   'Property Identifier' = COV_Increment,
   'Property Value' = (a value "increment" that will be used below)
7. IF (Out_Of_Service is writable) THEN
   WRITE X, Out_Of_Service = TRUE
   ~~RECEIVE BACnet-SimpleACK-PDU~~
   BEFORE **Notification Fail Time**
   RECEIVE ConfirmedCOVNotification-Request,
   'Subscriber Process Identifier' = (the same value used in step 1),
   'Initiating Device Identifier' = IUT,
   'Monitored Object Identifier' = L,
   'Time Remaining' = 0,
   'List of Values' = (the initial Present_Value, new Status_Flags, initial Setpoint,

and initial Controlled_Variable_Value)

~~8.~~ TRANSMIT BACnet-SimpleACK-PDU

[the following steps have been renumbered]

8. IF (Present_Value is now writable) THEN
WRITE X, Present_Value = (any value that differs from "initial Present_Value" by less than "increment")
~~RECEIVE BACnet-SimpleACK-PDU~~
ELSE
MAKE (Present_Value = any value that differs from "initial Present_Value" by less than "increment")

9. WAIT **NotificationFailTime**

10. CHECK (verify that no COV notification was transmitted)

11. IF (Present_Value is now writable) THEN
WRITE X, Present_Value = (any value that differs from "initial Present_Value" by an amount greater than "increment")
~~RECEIVE BACnet-SimpleACK-PDU~~
ELSE
MAKE (Present_Value = any value that differs from "initial Present_Value" by an amount greater than "increment")

12. BEFORE **NotificationFailTime**
RECEIVE ConfirmedCOVNotification-Request,
'Subscriber Process Identifier' = (the same value used in step 1),
'Initiating Device Identifier' = IUT,
'Monitored Object Identifier' = L,
'Time Remaining' = 0,
'List of Values' = (the new Present_Value, new Status_Flags, initial Setpoint, and initial Controlled_Variable_Value)

13. TRANSMIT BACnet-SimpleACK-PDU

14. TRANSMIT SubscribeCOV-Request,
'Subscriber Process Identifier' = (the same value used in step 1),
'Monitored Object Identifier' = L

15. RECEIVE BACnet-SimpleACK-PDU

16. IF (Out_Of_Service is writable) THEN
WRITE L, Out_Of_Service = FALSE
~~RECEIVE BACnet-SimpleACK-PDU~~

135.1-2009*g*-2 Remove Recipient Test.

Rationale
The Recipient property was previously removed from the Event Enrollment object. The corresponding test should be removed from 135.1.

[Change **Clause 9.4.4**, p. 206]

9.4.4 ConfirmedEventNotification Without a Notification Class Parameter

This test has been removed.
~~Test Steps:~~

~~1. TRANSMIT ConfirmedEventNotification-Request,~~
~~'Process Identifier' = (any valid process identifier),~~
~~'Initiating Device Identifier' = TD,~~
~~'Event Object Identifier' = (any Event Enrollment object),~~
~~'Time Stamp' = (current time using the DateTime format),~~
~~'Priority' = (any valid priority),~~
~~'Event Type' = (any standard event type),~~
~~'Notify Type' = ALARM | EVENT,~~
~~'AckRequired' = FALSE,~~
~~'From State' = NORMAL,~~
~~'To State' = (any non-normal state appropriate to the event type),~~
~~'Event Values' = (any values appropriate to the event type)~~
~~2. RECEIVE BACnet-SimpleACK-PDU~~
~~3. CHECK (for any vendor-defined observable actions)~~

135.1-2009*g*-3 Correcting Errors in Routing Tests.

Rationale
Errors have identified in a number of routing tests in ANSI/ASHRAE Standard 135.1-2009. The most common types of errors are the following:

- Hop Count field present in a message when it should not be present
- Use of the DESTINATION keyword instead of DA
- Use of the SOURCE keyword instead of SA

Note that DA and SA specify the MAC addresses that should be present in a packet. It is often important to specify the MAC addresses in routing tests.

[Change **Clause 10.2.2.3**, p. 316]

10.2.2.3 Forward I-Could-Be-Router-To-Network

BACnet Reference Clause: 6.6.3.4.

Purpose: To verify that the IUT will forward a received I-Could-Be-Router-To-Network message to the intended recipient.

Test Steps:

1. TRANSMIT PORT B,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = HR2-4,
   DNET = 1,
   DADR = D1A,
   Hop Count = 255,
   I-Could-Be-Router-To-Network,
   Network Number = 4,
   Performance Index = 6
2. RECEIVE PORT A,
   ~~DESTINATION~~ *DA* = D1A,
   ~~SOURCE~~ *SA* = IUT,
   SNET = 2,
   SADR = HR2-4,
   ~~Hop Count = (any integer x: 0 < x < 255),~~
   I-Could-Be-Router-To-Network,
   Network Number = 4,
   Performance Index = 6

[Change **Clause 10.2.2.7.2**, p. 324]

10.2.2.7.2 Unknown Network Layer Message Type

Purpose: To verify that the IUT will reject a network layer message ~~with an unknown message type~~ *directed to the IUT that contains an unknown message type in the range of message types reserved for use by ASHRAE.*

Test Steps:

1. TRANSMIT PORT A,
   DESTINATION = IUT,
   SOURCE = ~~D1A~~ *TD*,
   Message Type = (any value ~~from X'0A' to X'7F~~ *in the range reserved for use by ASHRAE that is undefined in the protocol revision claimed by the device*)

2. RECEIVE PORT A,
   DESTINATION = ~~D1A~~ *TD*,
   SOURCE = IUT,
   Reject-Message-To-Network,
   Reject Reason = 3 (unknown network layer message type),
   DNET = ~~1~~ *any value*

[Change **Clause 10.2.3.2**, pp. 325]

10.2.3.2 Route Message from a Local Device to a Local Device

Purpose: To verify that the IUT can route a unicast message from a local device on Network 1 to a device on Network 2.

Test Steps:

1. TRANSMIT PORT A,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = D1A,
   DNET = 2,
   DADR = D2C,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (any object identifier),
   'Property Identifier' = (any property of the specified object)
2. RECEIVE PORT B,
   ~~DESTINATION~~ *DA* = D2C,
   ~~SOURCE~~ *SA* = IUT,
   SNET = 1,
   SADR = D1A,
   ~~Hop Count = (any integer x: 0 < x < 255),~~
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (the object identifier used in step 1),
   'Property Identifier' = (the property identifier used in step 1)
3. TRANSMIT PORT B,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = D2C,
   DNET = 1,
   DADR = D1A,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (any object identifier),
   'Property Identifier' = (any property of the specified object)
4. RECEIVE PORT A,
   ~~DESTINATION~~ *DA* = D1A,
   ~~SOURCE~~ *SA* = IUT,
   SNET = 2,
   SADR = D2C,
   ~~Hop Count = (any integer x: 0 < x < 255),~~
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (the object identifier used in step ~~1~~ *3*),
   'Property Identifier' = (the property identifier used in step ~~1~~ *3*)

[Change **Clause 10.2.3.5**, p. 327]

10.2.3.5 Route Message from a Router to a Local Device

Purpose: To verify that the IUT can route a unicast message from a peer router to the destination device on a local network.

Test Steps:

1. TRANSMIT PORT A,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = R1-5,
   DNET = 2,
   DADR = D2C,
   SNET = 5,
   SADR = D5F,
   Hop Count = 254,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (any object identifier),
   'Property Identifier' = (any property of the specified object)
2. RECEIVE PORT B,
   ~~DESTINATION~~ *DA* = D2C,
   ~~SOURCE~~ *SA* = IUT,
   SNET = 5,
   SADR = D5F,
   ~~Hop Count = (any integer x: 0 < x < 254),~~
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (the object identifier used in step 1),
   'Property Identifier' = (the property identifier used in step 1)

[Change **Clause 10.2.4.4**, p. 330]

10.2.4.4 Remote Broadcast from a Local Device to a Directly-Connected Network

Purpose: To verify that the IUT properly forwards remote broadcast messages that originate on a local network and are directed to another local network.

Test Steps:

1. TRANSMIT PORT B,
   ~~DESTINATION~~ *DA* = LOCAL BROADCAST,
   ~~SOURCE~~ *SA* = D2C,
   DNET = 1,
   DLEN = 0,
   Hop Count = 255,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = Who-Is
2. RECEIVE PORT A,
   ~~DESTINATION~~ *DA* = LOCAL BROADCAST,
   ~~SOURCE~~ *SA* = IUT,
   SNET = 2,
   SADR = D2C,
   ~~Hop Count = (any integer x: 0 < x < 255),~~

BACnet-Unconfirmed-Request-PDU,
'Service Choice' = Who-Is

[Change **Clause 10.2.4.6**, p. 331]

10.2.4.6 Remote Broadcast from a Remote Device to a Directly-Connected Network

Purpose: To verify that the IUT properly forwards remote broadcast messages that originate on a remote network and are directed to a directly-connected network.

Test Steps:

1. TRANSMIT PORT B,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = R2-3,
   DNET = 1,
   DLEN = 0,
   SNET = 3,
   SADR = D3D,
   Hop Count = 254,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = Who-Is
2. RECEIVE PORT A,
   ~~DESTINATION~~ *DA* = LOCAL BROADCAST,
   ~~SOURCE~~ *SA* = IUT,
   SNET = 3,
   SADR = D3D,
   ~~Hop Count = (any integer x,: 0 < x < 254),~~
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = Who-Is

[Change **Clause 10.2.4.8**, p. 332]

10.2.4.8 Remote Broadcast that Should Be Ignored

Purpose: To verify that the IUT ignores broadcast messages ~~that are~~ intended for a remote network that is reachable through the same port ~~that~~ the message was received from.

Test Steps:

1. TRANSMIT PORT B,
   ~~DESTINATION~~ *DA* = LOCAL BROADCAST,
   ~~SOURCE~~ *SA* = D2C,
   DNET = 3,
   DLEN = ~~(any valid MAC address length)~~ *0*,
   ~~DADR = (any valid MAC address the agrees with DLEN),~~
   Hop Count = 255,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = Who-Is
   ~~ReadProperty-Request ,~~
   ~~'Object Identifier' = (any BACnet object),~~
   ~~'Property Identifier' = (any property of the specified object)~~
2. CHECK (verify that the IUT does not forward~~ed~~ this message)

[Change **Clause 10.2.6**, pp. 333]

10.2.6 Network Layer Priority

BACnet Reference Clauses: 6.1, 6.2.2, and 6.5.4.

Purpose: To verify that the IUT can process and forward messages with all network priorities.

Test Steps:

1. TRANSMIT PORT A,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = D1A,
   Priority = B'00',
   DNET = 2,
   DADR = D2C,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (any object identifier),
   'Property Identifier' = (any property of the specified object)
2. RECEIVE PORT B,
   ~~DESTINATION~~ *DA* = D2C,
   ~~SOURCE~~ *SA* = IUT,
   Priority = B'00',
   SNET = 1,
   SDR = D1A,
   ~~Hop Count = (any integer x: 0 < x < 255),~~
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (the object identifier used in step 1),
   'Property Identifier' = (the property identifier used in step 1)
3. TRANSMIT PORT A,
   ~~DESTINATION~~ *DA* = IUT,
   ~~SOURCE~~ *SA* = D1A,
   Priority = B'01',
   DNET = 2,
   DADR = D2C,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (any object identifier),
   'Property Identifier' = (any property of the specified object)
4. RECEIVE PORT B,
   ~~DESTINATION~~ *DA* = D2C,
   ~~SOURCE~~ *SA* = IUT,
   Priority = B'01',
   SNET = 1,
   SDR = D1A,
   ~~Hop Count = (any integer x: 0 < x < 255),~~
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = (the object identifier used in step 3),
   'Property Identifier' = (the property identifier used in step 3)
5. TRANSMIT PORT A,
   ~~DESTINATION~~ *DA* = IUT,

~~SOURCE~~ *SA* = D1A,
Priority = B'10',
DNET = 2,
DADR = D2C,
Hop Count = 255,
BACnet-Confirmed-Request-PDU,
'Service Choice' = ReadProperty-Request,
'Object Identifier' = (any object identifier),
'Property Identifier' = (any property of the specified object)

6. RECEIVE PORT B,
~~DESTINATION~~ *DA* = D2C,
~~SOURCE~~ *SA* = IUT,
Priority = B'10',
SNET = 1,
SDR = D1A,
~~Hop Count = (any integer x: 0 < x < 255),~~
BACnet-Confirmed-Request-PDU,
'Service Choice' = ReadProperty-Request,
'Object Identifier' = (the object identifier used in step 5),
'Property Identifier' = (the property identifier used in step 5)
7. TRANSMIT PORT A,
~~DESTINATION~~ *DA* = IUT,
~~SOURCE~~ *SA* = D1A,
Priority = B'11',
DNET = 2,
DADR = D2C,
Hop Count = 255,
BACnet-Confirmed-Request-PDU,
'Service Choice' = ReadProperty-Request,
'Object Identifier' = (any object identifier),
'Property Identifier' = (any property of the specified object)
8. RECEIVE PORT B,
~~DESTINATION~~ *DA* = D2C,
~~SOURCE~~ *SA* = IUT,
Priority = B'11',
SNET = 1,
SDR = D1A,
~~Hop Count = (any integer x: 0 < x < 255),~~
BACnet-Confirmed-Request-PDU,
'Service Choice' = ReadProperty-Request,
'Object Identifier' = (the object identifier used in step 7),
'Property Identifier' = (the property identifier used in step 7)

135.1-2009*g*-4 Change the Ignore Process ID Test.

Rationale
Tests need to be updated as a result of changes made by Addendum 135-2004b-8.

[Delete **Clause 9.1.2.2,** Unsuccessful Alarm Acknowledgment of Confirmed Event Notifications Because the 'Acknowledging Process Identifier' is Invalid, p 196, renumbering subsequent clauses]

[Insert new **Clause 9.1.1.X1**, p.194, renumbering subsequent clauses]

9.1.1.X1 Successful Alarm Acknowledgment of Confirmed Event Notifications Using an Unknown 'Acknowledging Process Identifier' Parameter

Purpose: To verify the successful acknowledgment of an alarm signaled by a ConfirmedEventNotification when the acknowledgement contains a mismatched or unknown 'Acknowledging Process Identifier' parameter.

Test Concept: An alarm is triggered that causes the IUT to notify the TD and at least one other device. The TD acknowledges the alarm with a mismatched 'Acknowledging Process Identifier' (the Process Identifier associated with another recipient), or an unknown 'Acknowledging Process Identifier' (a Process Identifier not associated with any recipient), and verifies that the acknowledgment is properly noted by the IUT. This test should be performed twice, once with a mismatched Process Identifier and once with an unknown Process Identifier.

Configuration Requirements: The IUT shall be configured with at least one object, Object1, that can detect alarm conditions and send confirmed notifications. The Acked_Transitions property shall have the value (TRUE,TRUE,TRUE), indicating that all transitions have been acknowledged. The TD and at least one other BACnet device shall be recipients of the alarm notification and shall use different Process Identifiers.

This test is recommended for all BACnet devices that execute AcknowledgeAlarm but is required only for those that claim conformance to Protocol_Revision 5 or greater.

Test Steps:

1. VERIFY (Object1), Acked_Transitions = (TRUE,TRUE,TRUE)
2. MAKE (a change that triggers the detection of an alarm event in the IUT)
3. BEFORE **Notification-Fail-Time**
   RECEIVE ConfirmedEventNotification-Request,
   'Process Identifier' = (any Process ID),
   'Initiating Device Identifier' = IUT,
   'Event Object Identifier' = Object1,
   'Time Stamp' = (the current time or sequence number),
   'Notification Class' = (the Notification Class configured for this event),
   'Priority' = (the priority configured for this event),
   'Event Type' = (any valid event type),
   'Notify Type' = ALARM or EVENT,
   'AckRequired' = TRUE,
   'From State' = (any appropriate event state),
   'To State' = (any appropriate event state),
   'Event Values' = (values appropriate to the event type)
4. TRANSMIT BACnet-SimpleACK-PDU
5. RECEIVE
   DESTINATION = (at least one device other than the TD),
   SOURCE = IUT,
   ConfirmedEventNotification-Request,
   'Process Identifier' = (any Process ID),

'Initiating Device Identifier' = IUT,
'Event Object Identifier' = Object1,
'Time Stamp' = (the current time or sequence number),
'Notification Class' = (the notification class configured for this event),
'Priority' = (the priority configured for this event),
'Event Type' = (any valid event type),
'Notify Type' = ALARM | EVENT,
'AckRequired' = TRUE,
'From State' = (any appropriate event state),
'To State' = (any appropriate event state),
'Event Values' = (values appropriate to the event type)

6. TRANSMIT
   DESTINATION = IUT,
   SOURCE = (DESTINATION in step 5),
   BACnet-SimpleACK-PDU
7. VERIFY (Object1), Acked_Transitions = (one bit FALSE, the others TRUE)
8. TRANSMIT AcknowledgeAlarm-Request,
   'Acknowledging Process Identifier' = (Any mismatched or unknown value),
   'Event Object Identifier' = Object1,
   'Event State Acknowledged' = (the state specified in the 'To State' parameter of the notification),
   'Time Stamp' = (the timestamp conveyed in the notification),
   'Time of Acknowledgment' = (the current timestamp)
9. RECEIVE BACnet-SimpleACK-PDU
10. BEFORE **Notification-Fail-Time**
    RECEIVE ConfirmedEventNotification-Request,
    'Process Identifier' = (any Process ID),
    'Initiating Device Identifier' = IUT,
    'Event Object Identifier' = Object1,
    'Time Stamp' = (the current time or sequence number),
    'Notification Class' = (the Notification Class configured for this event),
    'Priority' = (the priority configured for this event),
    'Event Type' = (any valid event type),
    'Notify Type' = ACK_NOTIFICATION,
    'To State' = (any appropriate event state)
11. TRANSMIT BACnet-SimpleACK-PDU
12. RECEIVE
    DESTINATION = (at least one device other than the TD),
    SOURCE = IUT,
    ConfirmedEventNotification-Request,
    'Process Identifier' = (any Process ID),
    'Initiating Device Identifier' = IUT,
    'Event Object Identifier' = Object1,
    'Time Stamp' = (the current time or sequence number),
    'Notification Class' = (the notification class configured for this event),
    'Priority' = (the priority configured for this event),
    'Event Type' = (any valid event type),
    'Notify Type' = ACK_NOTIFICATION,
    'To State' = (any appropriate event state)
13. TRANSMIT
    DESTINATION = IUT,
    SOURCE = (DESTINATION in step 5),
    BACnet-SimpleACK-PDU
14. VERIFY (Object1), Acked_Transitions = (TRUE,TRUE,TRUE)

Notes to Tester: The ConfirmedEventNotification-Request messages can be received in either order.

[Insert new **Clause 9.1.1.X2**, p.194]

9.1.1.X2 Successful Alarm Acknowledgment of Unconfirmed Event Notifications Using an Unknown 'Acknowledging Process Identifier' Parameter

Purpose: To verify the successful acknowledgment of an alarm signaled by an UnconfirmedEventNotification when the acknowledgement contains a mismatched or unknown 'Acknowledging Process Identifier' parameter.

Test Concept: An alarm is triggered that causes the IUT to notify the TD and at least one other device. The TD acknowledges the alarm with a mismatched 'Acknowledging Process Identifier' (the Process Identifier associated with another recipient), or unknown (a Process Identifier not associated with any recipient), and verifies that the acknowledgment is properly noted by the IUT. This test should be performed twice, once with a mismatched Process Identifier and once with an unknown Process Identifier.

Configuration Requirements: The IUT shall be configured with at least one object, Object1, that can detect alarm conditions and send unconfirmed notifications. The Acked_Transitions property shall have the value (TRUE,TRUE,TRUE), indicating that all transitions have been acknowledged. The TD and at least one other BACnet device shall be recipients of the alarm notification, configured to receive different Process Identifiers.

This test is recommended for all BACnet devices that execute AcknowledgeAlarm but is required only for those that claim conformance to Protocol_Revision 5 or greater.

Test Steps:

1. VERIFY (Object1), Acked_Transitions = (TRUE,TRUE,TRUE)
2. MAKE (a change that triggers the detection of an alarm event in the IUT)
3. BEFORE **Notification-Fail-Time**

RECEIVE UnconfirmedEventNotification-Request,
'Process Identifier' = (any Process ID),
'Initiating Device Identifier' = IUT,
'Event Object Identifier' = Object1,
'Time Stamp' = (the current time or sequence number),
'Notification Class' = (the Notification Class configured for this event),
'Priority' = (the priority configured for this event),
'Event Type' = (any valid event type),
'Notify Type' = ALARM or EVENT,
'AckRequired' = TRUE,
'From State' = (any appropriate event state),
'To State' = (any appropriate event state),
'Event Values' = (values appropriate to the event type)
RECEIVE
DESTINATION = (at least one device other than the TD),
SOURCE = IUT,
UnconfirmedEventNotification-Request,
'Process Identifier' = (any Process ID),
'Initiating Device Identifier' = IUT,
'Event Object Identifier' = (the object detecting the alarm),
'Time Stamp' = (the current time or sequence number),
'Notification Class' = (the notification class configured for this event),
'Priority' = (the priority configured for this event),
'Event Type' = (any valid event type),
'Notify Type' = ALARM | EVENT,
'AckRequired' = TRUE,
'From State' = (any appropriate event state),
'To State' = (any appropriate event state),

'Event Values' = (values appropriate to the event type)

5. VERIFY (Object1), Acked_Transitions = (one bit FALSE, the others TRUE)
6. TRANSMIT AcknowledgeAlarm-Request,
   'Acknowledging Process Identifier' = (Any mismatched or unknown value),
   'Event Object Identifier' = Object1,
   'Event State Acknowledged' = (the state specified in the 'To State' parameter of the notification),
   'Time Stamp' = (the timestamp conveyed in the notification),
   'Time of Acknowledgment' = (the current timestamp)
7. RECEIVE BACnet-SimpleACK-PDU
8. BEFORE **Notification-Fail-Time**
   RECEIVE UnconfirmedEventNotification-Request,
   'Process Identifier' = (any Process ID),
   'Initiating Device Identifier' = IUT,
   'Event Object Identifier' = Object1,
   'Time Stamp' = (the current time or sequence number),
   'Notification Class' = (the Notification Class configured for this event),
   'Priority' = (the priority configured for this event),
   'Event Type' = (any valid event type),
   'Notify Type' = ACK_NOTIFICATION,
   'To State' = (any appropriate event state)
   RECEIVE
   DESTINATION = (at least one device other than the TD),
   SOURCE = IUT,
   UnconfirmedEventNotification-Request,
   'Process Identifier' = (any Process ID),
   'Initiating Device Identifier' = IUT,
   'Event Object Identifier' = Object1,
   'Time Stamp' = (the current time or sequence number),
   'Notification Class' = (the notification class configured for this event),
   'Priority' = (the priority configured for this event),
   'Event Type' = (any valid event type),
   'Notify Type' = ACK_NOTIFICATION,
   'To State' = (any appropriate event state)
9. VERIFY (Object1), Acked_Transitions = (TRUE,TRUE,TRUE)

Note to Tester: The UnconfirmedEventNotification-Request messages can be received in either order.

135.1-2009*g*-5 Add Max Info Frames Check.

Rationale
There is no test that explicitly tests max-info-frame functionality. This test verifies that devices do not hog the token for too long.

[Add new **Clause 12.1.1.9.X**, p.389]

12.1.1.9.X Max Info Frame Check

Dependencies: None

BACnet Reference Clauses: 9.5.3 and 9.5.6.5

Purpose: This check verifies that the MS/TP Master Node State Machine does not issue more than $\mathbf{N_{max\_info\_frames}}$ information frames between the time the IUT receives a Token and either the time it passes the Token or it initiates a Poll For Master. Unlike tests, checks are not constructed of test steps, but rather conditions that must hold true through the complete testing process. As such, checks are periodically verified during or after the execution of tests.

Configuration Recommendations: If the Max_Info_Frames property of the Device object is configurable, it is recommended that this property be set to its minimum setting for the performance of at least some tests involving the MS/TP port being tested.

Check conditions: Monitor the MS/TP LAN during operations where the IUT would be expected to issue a number of information frames; if the IUT emits more information frames than:

a) the configured value for Max_Info_Frames in the interval between receiving and passing the Token (with multiple masters on the LAN), or
b) the configured value for Max_Info_Frames in the interval between receiving the Token and issuing PFM (with multiple masters on the LAN), or
c) the configured value for Max_Info_Frames in the interval between any two consecutive Poll For Master frames except the interval between the issuance of a Poll For Master to (TS-1) modulo Max_Master and a Poll For Master to (TS+1) modulo Max_Master, (with the IUT as the only master on the LAN), or
d) 52 times the configured value for Max_Info_Frames in the interval between a Poll For Master frame issued to (TS-1) modulo Max_Master, and the subsequent Poll For Master frame to (TS+1) modulo Max_Master (with the IUT as the only master on the LAN),

then the IUT shall fail this check.

Note to Tester: The value 52 is used in d) because an error in the MS/TP state machine originally defined in Standard 135-1995 caused the Token to be passed 52 times between Poll For Master cycles, instead of 50 times.

135.1-2009*g*-6 Add Test for Device Identifier Recipients.

Rationale
This test should be added because no relevant test for this function exists in ASHRAE Standard 135.1.
.

[Add new **Clause 7.3.2.21.3.X**, p. 80]

7.3.2.21.3.X Recipient_List Property Supports Device Identifier Recipients Test

Purpose: To verify that the Recipient_List property of the Notification Class object supports the device form of the Recipient component and that the IUT is able to associate a MAC address with the Device Identifier. The intent is to ensure that the IUT is able to locate the specified alarm recipient and send notification to the specified recipient. This test shall be run if the IUT's Notification Class object's Recipient_List property supports the BACnet object identifier form of BACnetRecipient.

Test Concept: The tester shall select a single event-generating object E in the IUT that references Notification Class object N. The tester shall add an entry into the Recipient_List of the associated Notification Class object that specifies a Device Identifier, D, for a device that the IUT is not already aware of. The TD, acting as device D, shall be located on a different network than the IUT to ensure that the IUT is capable of binding to recipients located on any network.

Configuration Requirements:The TD shall be configured so that it does not execute WhoHas.

Test Steps:

1. WRITE N.RecipientList = ({all days, all times, D, any process ID, FALSE, all transitions})
2. MAKE (the event generating object, E, transition)
3. BEFORE **Notification Fail Time** plus the amount of time the IUT takes to perform device discovery
   RECEIVE UnconfirmedEventNotification-Request,

'Process Identifier' =	(the valid process ID from step 1),
'Initiating Device Identifier' =	IUT,
'Event Object Identifier' =	E,
'Time Stamp' =	(any valid time stamp),
'Notification Class' =	(N's instance),
'Priority' =	(any valid priority),
'Event Type' =	(any valid event type),
'Notify Type' =	ALARM | EVENT,
'AckRequired' =	TRUE | FALSE,
'From State' =	(any valid event state),
'To State' =	(any valid event state),
'Event Values' =	(values appropriate to the event type)

Notes to Tester: The IUT is expected to initiate one or more range-restricted WhoIs requests after the modification of the Recipient_List but before the sending of the notification. The IUT might also need to perform other network discovery operations. Given that there are multiple approaches to the use of WhoIs for device discovery, the test only focuses on the IUT's ability to find device D and not on the specifics or timing of the WhoIs requests.

135.1-2009*g*-7 Add Test for Network Address Recipients.

Rationale
This test should be added because no relevant test for this function exists in ASHRAE Standard 135.1.
.

[Add new **Clause 7.3.2.21.3.X**, p. 80]

7.3.2.21.3.X Recipient_List Property Supports Network Address Recipients

Purpose: To verify that the Recipient_List property of the Notification Class object supports the address form of the Recipient component. The intent is to ensure that the IUT is able to send notifications to the specified recipient.

Test Concept: The tester shall select a single event-generating object E in the IUT that references Notification Class object N. The tester shall add an entry into the Recipient_List of the associated Notification Class object that specifies a BACnetAddress A, where A is a unicast or is a local, remote, or global broadcast address.

Test Steps:

1. WRITE N.RecipientList = ({all days, all times, A, any process ID, FALSE, all transitions})
2. MAKE (the event generating object, E, transition)
3. BEFORE **Notification Fail Time**
   RECEIVE DESTINATION = A,
   UnconfirmedEventNotification-Request,
   'Process Identifier' = (the valid process ID from step 1),
   'Initiating Device Identifier' = IUT,
   'Event Object Identifier' = E,
   'Time Stamp' = (the current local time),
   'Notification Class' = (N's instance),
   'Priority' = (any valid priority),
   'Event Type' = (any valid event type),
   'Notify Type' = ALARM | EVENT,
   'AckRequired' = TRUE | FALSE,
   'From State' = (any valid event state),
   'To State' = (any valid event state),
   'Event Values' = (values appropriate to the event type)

135.1-2009*g*-8 Add Tests for Disable Initiation.

Rationale
This test should be added because no relevant test for this function exists in ASHRAE Standard 135.1.
.

[Insert new **Clause 9.24.1.X1**, p 283]

9.24.1.X1 Disable of Service Initiation Restored by Time Duration

BACnet Reference Clause: 16.1.1.1.2.

Purpose: To verify the correct execution of the DeviceCommunicationControl service when DISABLE_INITIATION is requested with a finite time duration. Communication is restored when the DeviceCommunicationControl 'Time Duration' parameter expires.

Configuration Requirements: The IUT shall be configured to initiate client requests.

Test Steps:

1. MAKE (a condition that would normally cause the IUT to initiate requests)
2. CHECK (that the IUT is initiating requests)
3. TRANSMIT DeviceCommunicationControl-Request,
   'Time Duration' = (a value T > 1, in minutes, selected by the tester),
   'Enable/Disable' = DISABLE_INITIATION,
   'Password' = (any appropriate password if required)
4. RECEIVE BACnet-SimpleACK-PDU
5. MAKE (a condition that would normally cause the IUT to initiate requests)
6. CHECK (that the IUT has stopped initiating requests)
7. VERIFY (any supported property) = (any valid value)
8. TRANSMIT Who-Is-Request
9. RECEIVE I-Am-Request
10. WAIT (time T)
11. MAKE (a condition that would normally cause the IUT to initiate requests)
12. CHECK (that the IUT is initiating requests)

Notes to Tester: Steps 2 through 9 must be executed within time T.

[Insert new **Clause 9.24.1.X2**, p 283]

9.24.1.X2 Disable of Service Initiation Restored by DeviceCommunicationControl

BACnet Reference Clause: 16.1.1.1.2.

Purpose: To verify the correct execution of the DeviceCommunicationControl service when DISABLE_INITIATION is requested for a finite time duration. Communication is restored using the DeviceCommunicationControl service.

Configuration Requirements: The IUT shall be configured to initiate client requests.

Test Steps:

1. MAKE (a condition that would normally cause the IUT to initiate requests)
2. CHECK (that the IUT is initiating requests)
3. TRANSMIT DeviceCommunicationControl-Request,
   'Time Duration' = (a value in minutes > time required to execute all test steps),
   'Enable/Disable' = DISABLE_INITIATION,

'Password' = (any appropriate password if required)

4. RECEIVE BACnet-SimpleACK-PDU
5. MAKE (a condition that would normally cause IUT to initiate requests)
6. CHECK (that the IUT has stopped initiating requests)
7. VERIFY (any supported property) = (any valid value)
8. TRANSMIT Who-Is-Request
9. RECEIVE I-Am-Request
10. TRANSMIT DeviceCommunicationControl-Request,
    'Enable/Disable' = ENABLE,
    'Password' = (any appropriate password if required)
11. MAKE (a condition that would normally cause the IUT to initiate requests)
12. CHECK (that the IUT is initiating requests)

135.1-2009*g*-9 Change Tests for Out_Of_Service, Status_Flags, and Reliability.

Rationale
There is a mistake in the Clause 7.3.11 test in 135.1-2009, and one step could be removed.

The test concept states "...If the Reliability property is not supported, then step 4 shall be omitted." This should actually state that "...If the Reliability property is not supported, then step 6 shall be omitted". (Note that in this modified version of the test, step 6 is renumbered to be step 5.)

Step 5 says to "WRITE Present_Value = (any value that corresponds to an Event_State of NORMAL)" but then step 6 asks you to "VERIFY Status_Flags = (?, TRUE, ?, TRUE)". If the In_Alarm bit of the Status_Flags property is shown as "?" in step 6 , then step 5 can be removed.

This test verifies that when the Out_Of_Service property = True, the OUT_OF_SERVICE flag of the Status_Flags property is also true, but it does not test to see that when the Out_Of_Service property = False, the OUT_OF_SERVICE_ flag of the Status_Flags property is also False. This change provides a test for this with the addition of two further steps that parallel steps 2 and 3.

[Change **Clause 7.3.1.1**, p 32]

7.3.1.1 Out_Of_Service, Status_Flags, and Reliability Tests

Dependencies: ReadProperty Service Execution Tests, 9.18; WriteProperty Service Execution Tests, 9.22.

BACnet Reference Clauses: 12.1.7, 12.1.9, 12.1.10, 12.2.7, 12.2.9, 12.2.10, 12.3.7, 12.3.9, 12.3.10, 12.4.6, 12.4.8,12.4.9, -12.6.7, 12.6.9, 12.6.10, 12.7.7, 12.7.9, 12.7.10, 12.8.6, 12.8.8, 12.8.9, 12.15.8, 12.15.10, 12.15.11, 12.16.8, 12.16.10, 12.16.11, 12.17.6, 12.17.8, 12.17.9, 12.18.7, 12.18.9, 12.18.10, 12.19.7, 12.19.9, 12.19.10, 12.20.6, 12.20.8, 12.20.9, 12.23.7, 12.23.9, and 12.23.10.

Purpose: This test case verifies that Present_Value is writable when Out_Of_Service is TRUE. It also verifies the interrelationship between the Out_Of_Service, Status_Flags, and Reliability properties. If the PICS indicates that the Out_Of_Service property of the object under test is not writable, and if the value of the property cannot be changed by other means, then this test shall be omitted. This test applies to Accumulator, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Life Safety Point, Life Safety Zone, Multi-state Input, Multi-state Output, Multi-state Value, Loop and Pulse Converter objects.

Test Concept: The IUT will select one instance of each appropriate object type and test it as described. If the Reliability property is not supported then ~~step 4~~ *step 5* shall be omitted.

Test Steps:

1. IF (Out_Of_Service is writable) THEN
   WRITE Out_Of_Service = TRUE
   ELSE
   MAKE (Out_Of_Service TRUE)
2. VERIFY Out_Of_Service = TRUE
3. VERIFY Status_Flags = (?, ~~FALSE~~*?*, ?, TRUE)
4. REPEAT X = (all values meeting the functional range requirements of 7.2.1) DO {
   WRITE Present_Value = X
   VERIFY Present_Value = X
   }

~~5. WRITE Present_Value = (any value that corresponds to an Event_State of NORMAL)~~

~~6.~~*5.* IF (Reliability is *present and* writable) THEN
   REPEAT X = (all values of the Reliability enumeration appropriate to the object type except
   NO_FAULT_DETECTED) DO {
   WRITE Reliability = X

VERIFY Reliability = X
VERIFY Status_Flags = (?, TRUE, ?, TRUE)
WRITE Reliability = NO_FAULT_DETECTED
VERIFY Reliability = NO_FAULT_DETECTED
VERIFY Status_Flags = (?, FALSE, ?, TRUE)
}

~~7.~~*6.* IF (Out_Of_Service is writable) THEN
WRITE Out_Of_Service = FALSE
ELSE
MAKE (Out_Of_Service FALSE)

7. VERIFY Out_Of_Service = FALSE

8. VERIFY Status_Flags = (?, ?, ?, FALSE)

Notes to Tester: If the object being tested is commandable and there is an internal process writing to the Present_Value ~~property~~ *property, then* each WriteProperty request shall contain a priority sufficient to override the internal process. After step 4 the priority array slot shall be relinquished.

135.1-2009*g*-10 Add Tests for Non-router Network Layer Messages.

Rationale
These tests should be added because no relevant tests exist in ASHRAE Standard 135.1.

[Insert new **Clause 10.X** and its subclauses, p 345]

10.X Non-Router Functionality Tests

This subclause defines the tests necessary to demonstrate the portion of BACnet Network Layer functionality that is unique to non-router nodes. These tests verify that the node correctly ignores messages that are reserved for routers. If the IUT can only be configured as a BACnet router, then these tests shall be omitted.

The tests assume that the IUT is located on network DNET1 and the TD appears to be a router to network DNET2. The value DNET3 is assigned a unique network number. If the IUT can initiate requests, it will be configured to send those requests to a device (D2A) on network DNET2. The IUT will also be expected to respond to requests from device D2A. The test descriptions assume that the TD will mimic device D2A.

Note to Tester: Clauses 6.5.1 and 6.5.3 indicate that there are only two ways for a non-router to transmit a request (on the local network and destined for a remote network), neither of which include network layer source routing information. If the IUT emits any NPDU with SNET/SADR fields during the tests in this subclause, then it shall fail.

Note to Tester: Clauses 6.6 and 6.6.3.3 define BACnet routers and the network layer services reserved for routers. If the IUT emits any I-Am-Router-To-Network or I-Could-Be-Router-To-Network NPDUs during the tests in this subclause (including during test 10.X.2), then it shall fail.

10.X.1 Ignore Remote packets

BACnet Reference Clauses: 6.5.2.1, 6.5.4

Purpose: This test case verifies that the non-router IUT will quietly accept and discard packets destined for remote networks.

Test Concept: The TD transmits both broadcast and directed requests to the IUT with DNET (not equal to x'FFFF') and DADR in the Network Layer header. The IUT is required to silently drop the requests because it is not a router.

Test Steps:

1. TRANSMIT
   DA = BROADCAST,
   SA = TD,
   DNET = DNET3,
   DADR= BROADCAST,
   Hop Count = 255,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = who-Is
2. WAIT **Internal Processing Fail Time**
3. CHECK (that the IUT did not send an I-Am)
4. TRANSMIT
   DA = IUT,
   SA = TD,
   DNET = DNET3,
   DADR = IUT,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = O2 (any BACnet standard object in IUT),
   'Property Identifier' = P2 (any required property of the specified object)

5. WAIT **Internal Processing Fail Time**
6. CHECK (that the IUT did not send a response to the ReadProperty)

10.X.2 Ignore Who-Is-Router-To-Network

BACnet Reference Clauses: 6.6, 6.6.3.2

Purpose: This test case verifies that the non-router IUT will quietly accept and discard the Who-Is-Router-To-Network service.

Test Concept: The TD transmits both the general query and the specific network number query form of the Who-Is-Router-To-Network service. The IUT is required to silently drop the requests because it is not a router.

Test Steps:

1. TRANSMIT
   DA = BROADCAST,
   SA = TD,
   Who-Is-Router-To-Network,
   DNET = DNET2
2. WAIT **Internal Processing Fail Time**
3. CHECK (that the IUT did not send any packets in response to the Who-Is-Router-To-Network)
4. TRANSMIT
   DA = BROADCAST,
   SA = TD,
   Who-Is-Router-To-Network
5. WAIT **Internal Processing Fail Time**
6. CHECK (that the IUT did not send any packets in response to the Who-Is-Router-To-Network)

10.X.3 Ignore Router Commands

BACnet Reference Clauses: 6.6, 6.6.3.8, 6.6.3.10, 6.6.3.11

Purpose: This test case verifies that the non-router IUT will quietly accept and discard network layer router services.

Test Concept: The TD transmits the Initialize-Routing-Table, Establish-Connection-To-Network, and Disconnect-Connection-To-Network services. The IUT is required to silently drop the requests because it is not a router.

Test Steps:

1. TRANSMIT
   DA = IUT,
   SA = TD,
   Initialize-Routing-Table
   Number of Ports = 0
2. WAIT **Internal Processing Fail Time**
3. CHECK (that the IUT did not send any packets in response to the Initialize-Routing-Table)
4. TRANSMIT
   DA = IUT,
   SA = TD,
   Establish-Connection-To-Network
   DNET = DNET3
   Termination Time Value = 0
5. WAIT **Internal Processing Fail Time**
6. CHECK (that the IUT did not send any packets in response to the Establish-Connection-To-Network)
7. TRANSMIT
   DA = IUT,
   SA = TD,

Disconnect-Connection-To-Network
DNET = NET3

8. WAIT Internal Processing Fail Time
9. CHECK(that the IUT did not send any packets in response to the Disconnect-Connection-To-Network)

[Insert new **Clause 10.Y**and its subclauses, p 345]

10.Y Route Binding Tests

This subclause defines the tests necessary to demonstrate the portion of BACnet Network Layer functionality that is used to determine network routes. These tests are generic and are meant to be applied to both router and non-router nodes.

The tests assume that the IUT is located on network DNET1 and the TD appears to be a router to network DNET2. The value DNET3 is assigned a unique network number. If the IUT can initiate requests, it will be configured to send those requests to a device (D2A) on network DNET2. The IUT will also be expected to respond to requests from device D2A. The test descriptions assume that the TD will mimic device D2A.

Note: Clauses 6.5.1 and 6.5.3 indicate that there are only two ways for a non-router to transmit a request (on the local network and destined for a remote network), neither of which includes network layer source routing information. If the IUT is configured as a non-router and it emits any NPDU with SNET/SADR fields during the tests in this subclause, then it shall fail.

Note: Clauses 6.6 and 6.6.3.3 define BACnet routers and the network layer services reserved for routers. If the IUT is configured as a non-router and it emits any I-Am-Router-To-Network or I-Could-Be-Router-To-Network NPDUs during the tests in this subclause (including during test 10.X.2), then it shall fail.

10.Y.1 Static Router Binding

Dependencies: ReadProperty Service Initiation Tests, 8.15, ReadProperty Service Execution Tests, 9.15

BACnet Reference Clause: 6.5.3

Purpose: To verify that the IUT can initiate requests to a remote network when the IUT has been statically configured with the MAC address of the router to that remote network.

Test Concept: The IUT transmits a request to a device on the remote network without performing any form of dynamic router binding. If the IUT does not support static router binding or if the IUT cannot initiate a request, then this test shall be omitted. If the IUT cannot initiate a ReadProperty request, then another service can be substituted.

Test Configuration: The IUT is configured with the TD's MAC address as the router for network DNET2.

Test Steps:

1. MAKE (IUT transmit a ReadProperty request to the D2A device on the remote network)
2. RECEIVE
   DA = TD,
   SA = IUT,
   DNET = DNET2,
   DADR= D2A,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = O1 (any BACnet standard object in D2A),
   'Property Identifier' = P1 (any required property of the specified object)
3. TRANSMIT
   DA = IUT,
   SA = TD,

SNET = DNET2,
SADR = D2A,
BACnet-ComplexACK-PDU,
'Service ACK Choice' = ReadProperty-ACK,
'Object Identifier' = O1,
'Property Identifier' = P1,
'Property Value' = (any valid value)

10.Y.2 Router Binding via Application Layer Services

Dependencies: ReadProperty Service Initiation Tests, 8.18, ReadProperty Service Execution Tests, 9.18, Who-Is Service Initiation Tests, 8.34

BACnet Reference Clause: 6.5.3

Purpose: To verify that the IUT can initiate requests to a remote network and respond to requests from a remote network after the IUT uses the Who-Is and I-Am Application Layer services to discover the MAC address of the router to that remote network.

Test Concept: The IUT broadcasts a Who-Is request to discover device D2A and notes the MAC address of the intervening router in the corresponding I-Am reply. The TD transmits a request to a device on the remote network and responds to a request from the remote network without performing any further form of dynamic router binding. If the IUT does not support application layer router binding, then this test shall be omitted. If the IUT cannot initiate a ReadProperty request, then another confirmed service can be substituted. The IUT may use the deviceInstanceRange form of Who-Is.

Clause 6.5.3 specifically mentions router binding via Who-Is and does not mention router binding by initiating other application layer services (such as Who-Has) or by lurking and noting the router MAC addresses for incoming application layer requests. For this reason the test only allows for router binding via Who-Is.

Test Steps:

1. MAKE (IUT transmit Who-Is to discover the device on the remote network)
2. RECEIVE
   DA = BROADCAST,
   SA = IUT,
   DNET = GLOBAL BROADCAST,
   Hop Count = 255,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = who-Is
   | DA = BROADCAST,
   SA = IUT,
   DNET = DNET2,
   DADR= BROADCAST,
   Hop Count = 255,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = who-Is
3. TRANSMIT
   DA = BROADCAST,
   SA = TD,
   SNET = DNET2,
   SADR = D2A,
   BACnet-Unconfirmed-Request-PDU,
   'Service Choice' = I-Am,
   'I Am Device Identifier' = (device object, instance number of D2A),
   'Max APDU Length Accepted ' = (any valid value),
   'Segmentation Supported' = (any valid value),
   'Vendor ID ' = (any valid value)

4. MAKE (IUT transmit a ReadProperty request to the D2A device on the remote network)
5. RECEIVE
   DA = TD,
   SA = IUT,
   DNET = DNET2,
   DADR= D2A,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = O1 (any BACnet standard object in D2A),
   'Property Identifier' = P1 (any required property of the specified object)
6. TRANSMIT
   DA = IUT,
   SA = TD,
   SNET = DNET2,
   SADR = D2A,
   BACnet-ComplexACK-PDU,
   'Service ACK Choice' = ReadProperty-ACK,
   'Object Identifier' = O1,
   'Property Identifier' = P1,
   'Property Value' = (any valid value)

10.Y.3 Router Binding via Who-Is-Router-To-Network

Dependencies: ReadProperty Service Initiation Tests, 8.15, ReadProperty Service Execution Tests, 9.15, Locating Routers, 10.5.1

BACnet Reference Clause: 6.5.3

Purpose: To verify that the IUT can initiate requests to a remote network after the IUT uses the Who-Is-Router-To-Network Network Layer service to discover the MAC address of the router to that remote network.

Test Concept: The IUT broadcasts a Who-Is-Router-To-Network request to discover the router to the desired network. The TD transmits a request to a device on the remote network without performing any further form of dynamic router binding. If the IUT does not support Who-Is-Router-To-Network router binding, then this test shall be omitted. If the IUT cannot initiate a ReadProperty request, then another confirmed service can be substituted. The IUT may use either the general query or specific network number query form of the Who-Is-Router-To-Network service.

Note that Clause 6.5.3 specifically mentions router binding via Who-Is-Router-To-Network and does not mention router binding by lurking and noting unsolicited I-Am-Router-To-Network messages.

Test Steps:
1. MAKE (IUT transmit Who-Is-Router-To-Network to discover the router to DNET2)
2. RECEIVE
   DA = BROADCAST,
   SA = IUT,
   Who-Is-Router-To-Network,
   | DA = BROADCAST,
   SA = IUT,
   Who-Is-Router-To-Network,
   DNET = DNET2
3. TRANSMIT
   DESTINATION = BROADCAST,
   SOURCE = TD,
   I-Am-Router-To-Network,
   Network Numbers = DNET2

4. MAKE (IUT transmit a ReadProperty request to the D2A device on the remote network)
5. RECEIVE
   DA = TD,
   SA = IUT,
   DNET = DNET2,
   DADR= D2A,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = O1 (any BACnet standard object in D2A),
   'Property Identifier' = P1 (any required property of the specified object)
6. TRANSMIT
   DA = IUT,
   SA = TD,
   SNET = DNET2,
   SADR = D2A,
   BACnet-ComplexACK-PDU,
   'Service ACK Choice' = ReadProperty-ACK,
   'Object Identifier' = O1,
   'Property Identifier' = P1,
   'Property Value' = (any valid value)

10.Y.4 Router Binding via Broadcast

Dependencies: ReadProperty Service Initiation Tests, 8.15, ReadProperty Service Execution Tests, 9.15

BACnet Reference Clause: 6.5.3

Purpose: To verify that the IUT can initiate requests to a remote network when the IUT uses an initial broadcast to discover the MAC address of the router to that remote network.

Test Concept: The IUT broadcasts a request to a device on the remote network and notes the MAC address of the intervening router in the reply. If the IUT does not support router binding via broadcast, then this test shall be omitted. If the IUT cannot initiate a ReadProperty request, then another confirmed service can be substituted.

Test Steps:
1. MAKE (IUT transmit a ReadProperty request to the D2A device on the remote network)
2. RECEIVE
   DA = BROADCAST,
   SA = IUT,
   DNET = DNET2,
   DADR= D2A,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = O1 (any BACnet standard object in D2A),
   'Property Identifier' = P1 (any required property of the specified object)
3. TRANSMIT
   DA = IUT,
   SA = TD,
   SNET = DNET2,
   SADR = D2A,
   BACnet-ComplexACK-PDU,
   'Service ACK Choice' = ReadProperty-ACK,
   'Object Identifier' = O1,
   'Property Identifier' = P1,

'Property Value' = (any valid value)

4. MAKE (IUT transmit a ReadProperty request to the D2A device on the remote network)
5. RECEIVE
   DA = TD,
   SA = IUT,
   DNET = DNET2,
   DADR= D2A,
   Hop Count = 255,
   BACnet-Confirmed-Request-PDU,
   'Service Choice' = ReadProperty-Request,
   'Object Identifier' = O1 (any BACnet standard object in D2A),
   'Property Identifier' = P1 (any required property of the specified object)
6. TRANSMIT
   DA = IUT,
   SA = TD,
   SNET = DNET2,
   SADR = D2A,
   BACnet-ComplexACK-PDU,
   'Service ACK Choice' = ReadProperty-ACK,
   'Object Identifier' = O1,
   'Property Identifier' = P1,
   'Property Value' = (any valid value)

135.1-2009*g*-11 Remove Time Delay in TO-FAULT Tests

Rationale
The BACnet Test Standard ANSI/ASHRAE 135.1-2009 defines a number of tests for TO-FAULT event transitions. In all these tests, Time_Delay is respected when transitioning to a FAULT event state, but in BACnet Standard 135-2008, where transitions to FAULT are independent of Time_Delay, these transitions take place immediately when the conditions are met.

[Change **Clause 7.3.1.10 Event_Enable Tests**, Modify Test Step 11, p. 39]

…
11. IF (the event-triggering object can be placed into a fault condition) THEN {
MAKE (the event-triggering object change to a fault condition)
~~WAIT (Time_Delay)~~
BEFORE **Notification Fail Time**
…

[Change **Clause 7.3.2.21.1 Priority Tests**, Remove Test Steps 13 and 17, Renumber following steps, p. 74]

…
11. IF (the event-triggering object can be placed into a fault condition) THEN {
12. MAKE (the event-triggering object change to a fault condition)
~~13. WAIT (Time_Delay)~~
~~14.~~*13.* BEFORE **Notification Fail Time**
RECEIVE ConfirmedEventNotification-Request,
'Process Identifier' = (any valid process ID),
'Initiating Device Identifier' = IUT,
'Event Object Identifier' = (the event-generating object configured for this test),
'Time Stamp' = (any valid time stamp),
'Notification Class' = (the class corresponding to the object being tested),
'Priority' = (the value configured to correspond to a TO-FAULT transition),
'Event Type' = (any valid event type),
'Notify Type' = EVENT | ALARM,
'AckRequired' = TRUE | FALSE,
'From State' = NORMAL,
'To State' = FAULT,
'Event Values' = (values appropriate to the event type)
~~15.~~*14.* VERIFY Event_State = FAULT
~~16.~~*15.* MAKE (the event-triggering object change to a normal condition)
~~17. WAIT (Time_Delay)~~
~~18.~~*16.* BEFORE **Notification Fail Time**
RECEIVE ConfirmedEventNotification-Request,
…

[Renumber original steps 14 to 19 to become steps 13 to 17]

[Change **Clause 7.3.2.21.3.4 Transitions Test**, Modify Test Step 11, p. 80]

…
11. IF (the event-triggering object can be placed into a fault condition) THEN {
MAKE (the event-triggering object change to a fault condition)

~~WAIT (Time_Delay)~~
BEFORE **Notification Fail Time**
IF (the Transitions bit corresponding to the TO-FAULT transition is TRUE) THEN
…

[Change **Clause 8.4.2 CHANGE_OF_STATE Test**, Remove Test Step 18, Renumber following steps, p. 119]

…
16. IF (the object being tested is a multi-state object that supports intrinsic reporting) THEN
17. IF (Present_Value is writable) THEN
WRITE Present_Value = (a value x: x = one of the Fault_Values)
ELSE
MAKE (Present_Value have a value x: x = one of the Fault_Values)
~~18. WAIT (Time_Delay)~~
~~19.~~*18.* BEFORE **Notification Fail Time**
RECEIVE ConfirmedEventNotification-Request,

…

~~25.~~*24.* IF (Present_Value is writable) THEN
WRITE Present_Value = (a value x: x corresponds to a NORMAL state)
ELSE
MAKE (Present_Value have a value x: x corresponds to a NORMAL state)
~~26. WAIT (Time_Delay)~~
~~27.~~*25.* BEFORE **Notification Fail Time**
RECEIVE ConfirmedEventNotification-Request,

…

[Renumber original steps 19 to 31 to become steps 18 to 29]

[Change **Clause 8.4.8.14 TO-FAULT Transition Tests**, Remove Test Step 3, Renumber following steps, p. 148]

…
2. MAKE (Present_Value have a value x such that x corresponds to a FAULT state)
~~3. WAIT Time_Delay~~
~~4.~~*3.* BEFORE **Notification Fail Time**
~~5.~~*4.* RECEIVE ConfirmedEventNotification-Request,
…
~~10.~~*9.* MAKE (Present_Value have a value x such that x corresponds to a NORMAL state)
~~11. WAIT Time_Delay~~
~~12.~~*10.* BEFORE **Notification Fail Time**
…

[Renumber original steps 4 to 17 to become steps 3 to 15]

135.1-2009*g*-12 Make Additions to the TCSL Language.

Rationale
The TCSL as described by 135.1 can be improved to make the tests more readable through the addition and modification of some of the statements.

[Change **Clause 6.1.1**, p 24]

6.1.1 Common Symbols and Characters
The following definitions are used to represent common symbols and characters.

<binary digit> ::= '0' | '1'
<decimal digit> ::= '0' | '1' | '2' | '3' | '4' | '5' | '6' | '7' | '8' | '9'
<hex digit> ::= <decimal digit> | 'A' | 'B' | 'C' | 'D' | 'E' | 'F'
<single quote> ::= (the single quote character)
<double quote> ::= (the double quote character)
<*conditional*> ::= *'='* | *'<'* | *'>'* | *'<='* | *'>='* | *'~='* | *'<>'*

The conditional '~=' is approximately equal to. The definition of approximate is dependant on the context of its use.

[Change **Clause 6.2**, p 25]

6.2 TCSL Statements
Statements in TCSL fall into two categories, those that control the flow and order of tests and those that tell the TD to send data, receive data, or both.

<statement> ::= <simple statement> | <compound statement>
<compound statement> ::= '{' <statement>… '}'

A <compound statement> can be used anywhere a <simple statement> can be used.

<simple statement> ::= <if statement> | <repeat statement> | <error statement>
~~| <say statement>~~ | <check statement> | <make statement>
| <transmit statement> | <receive statement>
| <write statement> | <verify statement> | <before statement>
| <*read statement*>

[Change **Clause 6.2.10**, p 29]

6.2.10 VERIFY Statement

<verify statement> ::= VERIFY [<object identifier> ','] <property identifier> ~~'='~~<*conditional*>
<property value> [',' ARRAY INDEX '=' <array index>]

The verify *that the* procedure consists of the following steps:

1. WAIT **Internal Processing Fail Time**
2. TRANSMIT ReadProperty-Request,
   'Object Identifier' = <object identifier>,
   'Property Identifier' = <property identifier>,
   'Property Array Index' = <array index>
3. RECEIVE BACnet-ComplexACK-PDU,
   'Object Identifier' = <object identifier>,

'Property Identifier' = <property identifier>,
'Property Array Index' = <array index>,
'Property Value' = *(any valid value x, where x <conditional>* <property value> *is TRUE*
subject to the resolution constraints of *Clause* 4.4.2*)*

Example: WRITE (Analog Output, 1), Present_Value = 6.5, PRIORITY = 8
VERIFY (Analog Output, 1), Present_Value = 6.5

[Insert new **Clause 6.2.13**, p 29]

6.2.13 READ Statement

<read statement> ::= READ <variable> '=' [<object identifier> ','] <property identifier>
[',' ARRAY INDEX '=' <array index>]

The read procedure consists of the following steps:

1. WAIT **Internal Processing Fail Time**
2. TRANSMIT ReadProperty-Request,
'Object Identifier' = <object identifier>,
'Property Identifier' = <property identifier>,
'Property Array Index' = <array index>
3. RECEIVE BACnet-ComplexACK-PDU,
'Object Identifier' = <object identifier>,
'Property Identifier' = <property identifier>,
'Property Array Index' = <array index>,
'Property Value' = (any valid value, <variable>)

Example: READ X = Priority_Array, ARRAY_INDEX=10

[Insert new **Clause 6.5**, p 30]

6.5 TD Requirements

The tests defined in this test standard describe specific conversations between the TD and the IUT. While these test conversations take place, the IUT may initiate other conversations related to or unrelated to the current test. Unless otherwise noted in the test, for conversations initiated by the IUT that are not reflected in the test steps of the test, the TD shall generate a correct response consistent with the device capabilities and state that the TD is emulating.

135.1-2009*g*-13 Changes to Acknowledge Alarm Initiation Tests

Rationale
The existing tests in Standard 135.1 need clarification.

[Change **Clause 8.1**, 106]

8.1 AcknowledgeAlarm Service Initiation Tests

Dependencies: None.

BACnet Reference Clause: 13.5.

~~Purpose: To verify that the IUT can initiate an AcknowledgeAlarm service request.~~
Purpose: To verify that the IUT is capable of acknowledging alarms and events that are reported to the IUT via the ConfirmedEventNotification and UnconfirmedEventNotfication services.

Configuration: For this test, the tester shall choose 1 object, O1, in the TD, which is configured to send event notifications to the IUT. The tester places O1 into an alarm state such that the transition requires an acknowledgment.

Test Steps:

1. TRANSMIT ConfirmedEventNotification-Request | UnconfirmedEventNotification-Request,
   'Subscriber Process Identifier' = ~~(any value selected by the TD),~~*(a value acceptable to the IUT configured in the Notification Class object for the IUT),*
   'Initiating Device Identifier' = ~~(any value selected by the TD),~~ *TD,*
   'Event Object Identifier' = ~~(any value selected by the TD),~~ *O1,*
   'Time Stamp' = ~~(any value selected by the TD),~~ *(any valid value, T1),*
   'Notification Class' = ~~(any value selected by the TD),~~ *(the value configured in O1),*
   'Priority' = (any value selected by the TD),
   'Event Type' = (any value selected by the TD),
   'Notify Type' = ALARM | *EVENT*,
   'AckRequired' = TRUE,
   'From State' = ~~NORMAL~~*(any valid value),*
   'To State' = ~~(any offnormal state appropriate to the event type),~~*(any valid value, S_1)*
   'Event Values' = (any event values appropriate to the event type)

2. IF (the ConfirmedEventNotification choice was selected) THEN
   RECEIVE BACnet-SimpleACK-PDU
3. MAKE (~~the IUT initiate an AcknowledgeAlarm service request with parameters appropriate to the event notification~~ *the IUT acknowledge O1*)
4. RECEIVE AcknowledgeAlarm-Request,
   'Acknowledging Process Identifier' = (any process identifier),
   'Event Object Identifier' = (~~the 'Event Object Identifier' from the notification~~*O1*),
   '*Event State Acknowledged*' = S_1,
   'Time Stamp' = (~~the 'Time Stamp' from the notification~~*T1*),
   'Acknowledgement Source' = (~~any CharacterString~~*any valid value*),
   'Time of Acknowledgement' = (~~the current time as determined by the IUT~~*any valid value*)
5. TRANSMIT BACnet-SimpleACK-PDU

135.1-2009*g*-14 Add New Tests for Reading and Presenting Properties

Rationale
Tests are needed for B-OWS functionality.

[Insert new **Clause 8.18.3**, p 165]

8.18.3 Reading and Presenting Properties

Purpose: This test case verifies that the IUT is capable of reading and presenting properties. It is a generic test used to test data presentation requirements.

Configuration: For this test, the tester shall choose a property, P1, from an object, O1. The TD shall be configured to not support the execution of ReadPropertyMultiple or the initiation of COV notifications.

Test Steps:

1. MAKE (the IUT read P1)
2. RECEIVE ReadProperty-Request,
   'Object Identifier' = O1,
   'Property Identifier' = P1
3. TRANSMIT BACnet-ComplexACK-PDU,
   'Object Identifier' = O1,
   'Property Identifier' = P1,
   'Property Value' = (any valid value for P1)
4. CHECK (that the IUT presents a value that is consistent with the value received in step 3)

Notes to Tester: The value presented by the IUT may differ from the value transmitted on the wire due to rounding, truncation, formatting, language conversion, etc.

Notes to Tester: If the property being read and displayed is an array, the IUT may include an Array Index parameter in the ReadProperty-Request in step 2 and the TD will include it in the response in step 4.

Notes to Tester: If the IUT has not already determined that the TD does not support execution of ReadPropertyMultiple, SubscribeCOV, and SubscribeCOVProperty, the IUT may initiate any of these services. If this occurs, the IUT shall pass the test only if it automatically falls back to using ReadProperty upon receipt of the correct BACnetReject-PDU(s) from the TD, indicating that other service(s) is not supported.

[Insert new **Clause 8.22.**4, p 169]

8.22.4 Accepting Input and Modifying Properties

Purpose: This test case verifies that the IUT is capable of accepting user input and using it to modify properties. It is a generic test used to test data-input requirements.

Configuration: For this test, the tester shall choose a property, P1, from an object, O1. The TD shall be configured to not support execution of WritePropertyMultiple.

Test Steps:

1. MAKE (the IUT accept a new value for P1 from the user)
2. RECEIVE WriteProperty-Request,
   'Object Identifier' = O1,
   'Property Identifier' = P1

'Property Value' = (the value provided to the IUT for P1)

3. TRANSMIT BACnet-SimpleACK-PDU

Notes to Tester: The value accepted by the IUT may differ from the value transmitted on the wire due to rounding, truncation, formatting, language conversion, etc.

Notes to Tester: If the property being modified is an array element, the IUT may include an Array Index parameter in the WriteProperty-Request in step 2.

Notes to Tester: If the IUT has not already determined that the TD does not support execution of WritePropertyMultiple, the IUT may initiate a WritePropertyMultiple. If this occurs, the IUT shall pass the test only if it automatically falls back to using WriteProperty upon receipt of the correct BACnetReject-PDU from the TD, indicating that WritePropertyMultiple is not supported.

[Insert new **Clause 8.22.5**, p 169]

8.22.5 Accepting Input and Commanding/Relinquishing Properties

Purpose: This test case verifies that the IUT is capable of accepting user input and using it to modify a commandable property at a specific priority. It also tests that the IUT is capable of relinquishing at that same priority.

Configuration: For this test, the tester shall choose a commandable property, P1, from an object, O1. The TD shall be configured to not support execution of WritePropertyMultiple. PR1 is the specific priority that will be tested.

Test Steps:

1. MAKE (the IUT accept a new value for P1 from the user, to be commanded at priority PR1)
2. RECEIVE WriteProperty-Request,
   'Object Identifier' = O1,
   'Property Identifier' = P1,
   'Priority' = PR1,
   'Property Value' = (the value provided to the IUT for P1)
3. TRANSMIT BACnet-SimpleACK-PDU
4. MAKE (the IUT relinquish P1 at priority PR1)
5. RECEIVE WriteProperty-Request,
   'Object Identifier' = O1,
   'Property Identifier' = P1,
   'Priority' = PR1,
   'Property Value' = NULL
6. TRANSMIT BACnet-SimpleACK-PDU

Notes to Tester: The value accepted by the IUT may differ from the value transmitted on the wire due to rounding, truncation, formatting, language conversion, etc.

Notes to Tester: If the IUT has not already determined that the TD does not support execution of WritePropertyMultiple, the IUT may initiate a WritePropertyMultiple. If this occurs, the IUT shall pass the test only if it automatically falls back to using WriteProperty upon receipt of the correct BACnetReject-PDU from the TD, indicating that WritePropertyMultiple is not supported.

135.1-2009*g*-15 Add New Event Notification Tests.

Rationale
Tests are needed for B-OWS functionality.

[Insert new **Clause 9.4.5**, p. 206]

9.4.5 ConfirmedEventNotification Simple Presentation

Purpose: This test case verifies that the IUT is capable of minimally displaying ConfirmedEventNotifications.

Configuration: For this test, the tester shall choose one event-generating object, O1.

Test Steps:

1. TRANSMIT ConfirmedEventNotification-Request,
   'Process Identifier' = (a valid process identifier specified by the IUT vendor),
   'Initiating Device Identifier' = TD,
   'Event Object Identifier' = O1,
   'Time Stamp' = (current time in any format),
   'Notification Class' = (any valid notification class),
   'Priority' = (any valid priority),
   'Event Type' = (any standard event type),
   'Message Text' = (any character string),
   'Notify Type' = ALARM | EVENT,
   'AckRequired' = TRUE | FALSE,
   'From State' = (state S1, any valid state for this event type),
   'To State' = (state S2, any valid state for this event type that can follow S1),
   'Event Values' = (any values appropriate to the event type)
2. RECEIVE BACnet-SimpleACK-PDU
3. CHECK (that the IUT indicates the notification to the operator and that the indication includes identification of the event generating object or the monitored object, the event timestamp, and the event Message Text)
4. CHECK (that all information indicated to the user is consistent with the information provided in step 1)

Passing Result: The IUT shall truncate the message text if it is longer than the maximum length displayable by the IUT. The IUT is allowed to include characters in the displayed text that indicate the message has been truncated, even if the truncated message is then shorter than 32 characters. The IUT shall not truncate Message Text that is less than or equal to 32 characters in length.

[Insert new **Clause 9.4.6**, p 207]

9.4.6 ConfirmedEventNotification Full Presentation

Purpose: This test case verifies that the IUT is capable of displaying ConfirmedEventNotifications.

Configuration: For this test, the tester shall choose one event generating object, O1.

Test Steps:

1. TRANSMIT ConfirmedEventNotification-Request,
   'Process Identifier' = (a valid process identifier specified by the IUT vendor),
   'Initiating Device Identifier' = TD,
   'Event Object Identifier' = O1,
   'Time Stamp' = (current time in any format),
   'Notification Class' = (any valid notification class),

'Priority' = (any valid priority),
'Event Type' = (any standard event type),
'Message Text' = (any character string),
'Notify Type' = ALARM | EVENT,
'AckRequired' = TRUE | FALSE,
'From State' = (state S1, any valid state for this event type),
'To State' = (state S2, any valid state for this event type that can follow S2),
'Event Values' = (any values appropriate to the event type)

2. RECEIVE BACnet-SimpleACK-PDU
3. CHECK (that the IUT indicates the notification to the operator and that the indication includes identification of the event generating object or the monitored object, the event timestamp, the event Message Text, Notification Class, Priority, Notify Type, Ack Required, To State and Event Values)
4. CHECK (that all information indicated to the user is consistent with the information provided in step 1)

Passing Result: The IUT shall truncate the message text if it is longer than the maximum length displayable by the IUT. The IUT is allowed to include characters in the displayed text that indicate the message has been truncated, even if the truncated message is then shorter than 255 characters. The IUT shall not truncate Message Text that is less than or equal to 255 characters in length.

[Insert new **Clause 9.5.1**, p 206]

9.5.1 UnconfirmedEventNotification Simple Presentation

This test is identical to the one in Clause 9.4.5 ConfirmedEventNotification Simple Presentation, except that an UnconfirmedEventNotification is sent in step 1 and that no BACnet-SimpleACK-PDU is returned by the IUT in step 2.

[Insert new **Clause 9.5.2**, p 206]

9.5.2 UnconfirmedEventNotification Full Presentation

This test is identical to the one in Clause 9.4.6 ConfirmedEventNotification Simple Presentation, except that an UnconfirmedEventNotification is sent in step 1 and that no BACnet-SimpleACK-PDU is returned by the IUT in step 2.

135.1-2009*g*-16 Update Trending Tests for Revision 3

Rationale
A number of tests for Trending functionality need to be updated to reflect changes made in BACnet protocol revision 3 (Addendum 135-2001b) and to correct errors.

[Change **Clause 7.3.2.24.1**, p. 95]
[Reason for Change: In the previous version of the test, Log_Enable was being set to TRUE too late such that step 10 could pass incorrectly.]

7.3.2.24.1 Log_Enable Test

Dependencies: ReadProperty Service Execution Tests, 9.18; WriteProperty Service Execution Tests, 9.22.

BACnet Reference Clause: 12.25.5.

Purpose: To verify that the Log_Enable property enables and disables the logging of data by the Trend Log object.

Test Concept: The Trend Log is configured to acquire data by each means (polling and COV subscription) available to the implementation. Log_Enable is enabled and the collection of one or more records in the Log_Buffer is confirmed. Log_Enable is then disabled and non-collection of records is confirmed.

The COV increment used is either the Client_COV_Increment property of the Trend Log or the COV_Increment property of the monitored object, depending on the configuration of the Trend Log object being tested.

Configuration Requirements: Start_Time, if present, shall be configured with a date and time preceding the beginning of the test. Stop_Time, if ~~present shall~~ *present, shall* be configured with a time that will occur after the completion of the test. Stop_When_Full, if configurable, shall be set to FALSE.

Test Steps:

~~1. WRITE Log_Enable = FALSE~~
~~2. WRITE Record_Count = 0~~
~~3. WAIT **Internal Processing Fail Time**~~
~~4 TRANSMIT ReadProperty-Request,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~5 RECEIVE ReadProperty-ACK,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~'Property Value' = (any valid value, X)~~
~~6. WRITE Log_Enable = TRUE~~
~~7. WAIT **Internal Processing Fail Time**~~
~~8. IF (COV subscription in use) THEN~~
~~MAKE (monitored value change more than Client_COV_Increment)~~
~~ELSE~~
~~WAIT (Log_Interval)~~
~~9. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)~~
~~10. VERIFY Total_Record_Count > (value X returned in step 5)~~
~~11. WRITE Log_Enable = FALSE~~
~~12. WAIT **Internal Processing Fail Time**~~
~~13. TRANSMIT ReadProperty-Request,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~14. RECEIVE ReadProperty-ACK,~~

~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~'Property Value' = (any valid value, X)~~
~~15. IF (COV subscription in use) THEN~~
~~MAKE (monitored value change more than Client_COV_Increment)~~
~~ELSE~~
~~WAIT (Log_Interval)~~
~~16. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)~~
~~17. VERIFY Total_Record_Count = (value X returned in step 14)~~

1. READ I = Log_Interval
2. WRITE Log_Enable = FALSE
3. WRITE Record_Count = 0
*4. WAIT **Internal Processing Fail Time***
5. WRITE Log_Enable = TRUE
6. READ X = Total_Record_Count
7. IF (I = 0) THEN
MAKE (monitored value change more thanthe COV increment)
ELSE
WAIT (I)
*8. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)*
9. VERIFY Total_Record_Count > X
10. WRITE Log_Enable = FALSE
11. READ Y = Total_Record_Count
12. IF (I = 0) THEN
MAKE (monitored value change more than the COV increment)
ELSE
WAIT (I)
*13. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)*
14. VERIFY Total_Record_Count = Y

[Change **Clause 7.3.2.24.3**, p. 96]
[Reason for Change: In the previous version of the test, Log_Enable was being set to TRUE too late such that step 10 could pass incorrectly. The test is also made clearer through the use of the new READ statement.]

7.3.2.24.3 Stop_Time Test

Dependencies: ReadProperty Service Execution Tests, 9.18; WriteProperty Service Execution Tests, 9.22.

BACnet Reference Clause: 12.25.7.

Purpose: To verify that logging is disabled at the time specified by Stop_Time.

Test Concept: The Trend Log is configured to acquire data by each means (polling and COV subscription) available to the implementation. The test is begun at some time prior to the time specified in Start_Time and collection of records is confirmed. Non-collection of records after the time specified by Stop_Time is then confirmed.

Configuration Requirements: Stop_Time shall be configured with a date and time such that steps 1 through 9 will be concluded before that time. Start_Time, if present, shall be configured with *a* date and time preceding the initiation of the test. Stop_When_Full, if configurable, shall be set to FALSE.

Test Steps:

1. WRITE Log_Enable = FALSE

2. WAIT **Internal Processing Fail Time**
3. WRITE Record_Count = 0
4. WRITE Log_Enable = TRUE
[the following test steps have been renumbered appropriately]
~~4. TRANSMIT ReadProperty-Request,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~5. RECEIVE ReadProperty-ACK,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~'Property Value' = (any valid value, X)~~
~~6. WRITE Log_Enable = TRUE~~
5. READ X = Record_Count
6. WAIT **Internal Processing Fail Time**
7. IF (COV subscription in use) THEN
MAKE (monitored value change more than Client_COV_Increment)
ELSE
WAIT (Log_Interval)
8. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)
9. VERIFY Total_Record_Count > ~~(value X returned in step 5)~~*X*
10. WHILE (IUT clock is earlier than Stop_Time) DO {}
11. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)
~~13. TRANSMIT ReadProperty-Request,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~14. RECEIVE ReadProperty-ACK,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~'Property Value' = (any valid value, X)~~
12. READ X = Total_Record_Count
13. IF (COV subscription in use) THEN
MAKE (monitored value change more than Client_COV_Increment)
ELSE
WAIT (Log_Interval)
14. WAIT (**Notification Fail Time** + **Internal Processing Fail Time**)
15. VERIFY Total_Record_Count = ~~(value X returned in step 14)~~*X*

[Change **Clause 7.3.2.24.5**, p. 98]

7.3.2.24.5 COV_Resubscription_Interval Test

Dependencies: Confirmed Notifications Subscription, 8.10.1~~; Unconfirmed Notifications Subscription, 8.10.2~~.

BACnet Reference Clause: 12.25.10.

Purpose: To verify that a Trend Log acquiring data via COV notification reissues its subscription at the interval set by COV_Resubscription_Interval.

Test Concept: The Trend Log is configured to acquire data from the TD by COV notification. The TD verifies the resubscription interval.

(a) Configuration Requirements: Start_Time, if present, shall be configured with a date and time preceding the beginning of the test. Stop_Time, if present, shall be configured with the latest possible date and time, in order that it occur after the end of the test. Stop_When_Full, if configurable, shall be set to FALSE. Log_Enable shall be set to TRUE. Non-zero values shall be chosen for COV_Resubscription_Interval in accordance with the range and resolution specified by the manufacturer for this property.

Test Steps:

~~1. IF (the IUT uses SubscribeCOV) THEN~~
~~RECEIVE SubscribeCOV-Request,~~
~~'Subscriber Process Identifier' = (any value),~~
~~'Monitored Object Identifier' = (the object to be monitored),~~
~~'Issue Confirmed Notifications' = (TRUE or FALSE),~~
~~'Lifetime' = (2 * COV_Resubscription_Interval)~~
~~ELSE~~
~~RECEIVE SubscribeCOVProperty-Request,~~
~~'Subscriber Process Identifier' = (any value),~~
~~'Monitored Object Identifier' = (the object to be monitored),~~
~~'Issue Confirmed Notifications' = (TRUE | FALSE),~~
~~'Lifetime' = (2 * COV_Resubscription_Interval),~~
~~'Monitored Property Identifier' = (the property to be monitored),~~
~~'COV Increment' = (Client_COV_Increment optional)~~
~~2. IF ('Issue Confirmed Notification' = TRUE) THEN~~
~~TRANSMIT ConfirmedCOVNotification-Request,~~
~~'Subscriber Process Identifier' = (corresponding value in step 1),~~
~~'Initiating Object Identifier' = (Device object identifier of the TD),~~
~~'Monitored Object Identifier' = (corresponding value in step 1),~~
~~'Issue Confirmed Notifications' = (corresponding value in step 1),~~
~~'Time Remaining' = (2 * COV_Resubscription_Interval),~~
~~'List of Values' = (appropriate BACnetPropertyValue(s))~~
~~ELSE~~
~~TRANSMIT UnconfirmedCOVNotification,~~
~~'Subscriber Process identifier' = (corresponding value in step 1),~~
~~'Initiating Object Identifier' = (Device object identifier of the TD),~~
~~'Monitored Object Identifier' = (corresponding value in step 1),~~
~~'Issue Confirmed Notifications' = (corresponding value in step 1),~~
~~'Time Remaining' = (2 * COV_Resubscription_Interval),~~
~~'List of Values' = (appropriate BACnetPropertyValue(s))~~
~~3. WAIT (COV_Resubscription_Interval - **Notification Fail Time**)~~
~~4. BEFORE (2 * **Notification Fail Time**)~~
~~IF (the IUT uses SubscribeCOV)~~
~~RECEIVE SubscribeCOV-Request,~~
~~'Subscriber Process Identifier' = (corresponding value in step 1),~~
~~'Monitored Object Identifier' = (corresponding value in step 1),~~
~~'Issue Confirmed Notifications' = (corresponding value in step 1),~~
~~'Lifetime' = (corresponding value in step 1)~~
~~ELSE~~
~~RECEIVE SubscribeCOVProperty-Request,~~
~~'Subscriber Process Identifier' = (corresponding value in step 1),~~
~~'Monitored Object Identifier' = (corresponding value in step 1),~~
~~'Issue Confirmed Notifications' = (corresponding value in step 1),~~
~~'Lifetime' = (corresponding value in step 1),~~
~~'Monitored Property Identifier' = (corresponding value in step 1),~~
~~'COV Increment' = (corresponding value in step 1)~~

1. IF (the IUT uses SubscribeCOV) THEN
RECEIVE SubscribeCOV-Request,
'Subscriber Process Identifier' = (any value),
'Monitored Object Identifier' = (the object to be monitored),
'Issue Confirmed Notifications' = (TRUE),
'Lifetime' = (any value >= COV_Resubscription_Interval)

ELSE
RECEIVE SubscribeCOVProperty-Request,
'Subscriber Process Identifier' = (any value),
'Monitored Object Identifier' = (the object to be monitored),
'Issue Confirmed Notifications' = (TRUE),
'Lifetime' = (any value >= COV_Resubscription_Interval),
'Monitored Property Identifier' = (the property to be monitored),
'COV Increment' = (Client_COV_Increment -- optional)
2. TRANSMIT BACnet-SimpleACK-PDU
3. TRANSMIT ConfirmedCOVNotification-Request,
'Subscriber Process Identifier' = (corresponding value in step 1),
'Initiating Device Identifier' = (Device object identifier of the TD),
'Monitored Object Identifier' = (corresponding value in step 1),
'Issue Confirmed Notifications' = (corresponding value in step 1),
'Time Remaining' = (any value <= the Lifetime from step 1),
'List of Values' = (appropriate BACnetPropertyValue(s))
4. RECEIVE BACnet-SimpleACK-PDU
5. BEFORE (the lesser of COV_Resubscription_Interval + ***Re-subscription Interval Tolerance*** *and LifeTime from step 1)*
IF (the IUT uses SubscribeCOV)
RECEIVE SubscribeCOV-Request,
'Subscriber Process Identifier' = (corresponding value in step 1),
'Monitored Object Identifier' = (corresponding value in step 1),
'Issue Confirmed Notifications' = (TRUE),
'Lifetime' = (any value >= COV_Resubscription_Interval)
ELSE
RECEIVE SubscribeCOVProperty-Request,
'Subscriber Process Identifier' = (corresponding value in step 1),
'Monitored Object Identifier' = (corresponding value in step 1),
'Issue Confirmed Notifications' = (TRUE),
'Lifetime' = (any value >= COV_Resubscription_Interval),
'Monitored Property Identifier' = (corresponding value in step 1),
'COV Increment' = (corresponding value in step 1)
6. TRANSMIT BACnet-SimpleACK-PDU
7. TRANSMIT ConfirmedCOVNotification-Request,
'Subscriber Process Identifier' = (corresponding value in step 1),
'Initiating Device Identifier' = (Device object identifier of the TD),
'Monitored Object Identifier' = (corresponding value in step 1),
'Issue Confirmed Notifications' = (corresponding value in step 1),
'Time Remaining' = (any value <= the Lifetime from step 5),
'List of Values' = (appropriate BACnetPropertyValue(s))
8. RECEIVE BACnet-SimpleACK-PDU
9. WAIT (COV_Resubscription_Interval - ***Re-subscription Interval Tolerance****)*
*10. BEFORE (2 *** ***Re-subscription Interval Tolerance****)*
IF (the IUT uses SubscribeCOV)
RECEIVE SubscribeCOV-Request,
'Subscriber Process Identifier' = (corresponding value in step 1),
'Monitored Object Identifier' = (corresponding value in step 1),
'Issue Confirmed Notifications' = (TRUE),
'Lifetime' = (corresponding value in step 1)
ELSE
RECEIVE SubscribeCOVProperty-Request,
'Subscriber Process Identifier' = (corresponding value in step 1),
'Monitored Object Identifier' = (corresponding value in step 1),
'Issue Confirmed Notifications' = (TRUE),
'Lifetime' = (corresponding value in step 1),

'Monitored Property Identifier' = (corresponding value in step 1),
'COV Increment' = (corresponding value in step 1)

11. TRANSMIT BACnet-SimpleACK-PDU

Passing Result: Where the Lifetime parameter of a SubscribeCOV request is less than COV_Resubscription_Interval + Re-subscription Interval Tolerance, the IUT shall send the subsequent SubscribeCOV request within Lifetime seconds even though this is a smaller time window than defined by the test. If the IUT does not meet this stricter time window, then the IUT shall fail the test.

[Change **Clause 7.3.2.24.9**, p. 101]
[Reason for Change: It is not clear whether or not log records should be added to a Trend Log when Record_Count is set to 0 and the Trend Log is disabled. As such, the test steps were re-worked to ignore this issue.]

7.3.2.24.9 Total_Record_Count Test

Dependencies: ReadProperty Service Execution Tests, 9.18; WriteProperty Service Execution Tests, 9.22.

BACnet Reference Clause: 12.25.16.

Purpose: To verify that the Total_Record_Count property increments for each record added to the Log_Buffer, even after Buffer_Size records have been added. (Note: it is not reasonable to test for the requirement of BACnet Clause 12.23.16 that the value wrap from 2^{32}-1 to 0; even if a record was collected every 100^{th} of a second it could take more than 497 days to complete the test.)

Test Concept: The Trend Log is configured to acquire data by whatever means. Record_Count is set to zero and Total_Record_Count is read. Collection of data proceeds until Record_Count changes, collection is halted and Total_Record_Count is checked that it has incremented by Record_Count. If, for whatever reason, the IUT cannot be configured such that the TD is able to halt collection before Buffer_Size records are collected this test shall not be performed.

Configuration Requirements: Start_Time, if present, shall be configured with a date and time preceding the beginning of the test. Stop_Time, if present, shall be configured with the latest possible date and time in order that it occur after the end of the test. Log_Enable shall be set to FALSE.

Test Steps:

1. WRITE Record_Count = 0
2. WAIT **Internal Processing Fail Time**
~~3. TRANSMIT ReadProperty-Request,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count~~
~~4. RECEIVE ReadProperty-ACK,~~
~~'Object Identifier' = (the object being tested),~~
~~'Property Identifier' = Total_Record_Count,~~
~~'Property Value' = (any valid value, X)~~
3. READ X = Total_Record_Count
4. READ Y = Record_Count
5. WRITE Log_Enable = TRUE
6. WHILE (Record_Count = ~~0~~*Y + 1*) DO { }
7. WRITE Log_Enable = FALSE
8. WAIT **Internal Processing Fail Time**
9. ~~IF (Record_Count = Buffer_Size) THEN~~
~~ERROR "Buffer full; cannot verify Total_Record_Count value."~~
~~ELSE {~~
~~IF (Total_Record_Count != Record_Count + (value X returned in step 4)) THEN~~
IF (Total_Record_Count - X != Record_Count - Y) THEN

ERROR "Total_Record_Count has incorrect value."

}

[Change **Clause 9.21**, p. 263]

9.21 ReadRange Service Execution Tests

This clause defines the tests necessary to demonstrate support for executing ReadRange service requests.

Dependencies: None.

BACnet Reference Clause: 15.8.

Configuration Requirements: The IUT shall be configured with a Trend Log object that contains a set of known trend data. The TD must have exact knowledge of the trend data in order to evaluate the results of the tests. The value of the Log_Enable property shall be FALSE so that the Log_Buffer does not change during the tests.

The following sample buffer is used as explanation for the tests in this section.

Sample Log_Buffer, (Trend Log, Instance 1)

Arbitrary Record Designation	***Position (index)***	***Implied Sequence #***	***Timestamp (Date excluded for clarity)***	***LogDatum***
a	*1*	*16*	*13:01:00.00*	*Log-status, buffer-purged*
b	*2*	*17*	*13:02:00.00*	*log-status, log-disabled = FALSE*
c	*3*	*18*	*13:05:00.00*	*real-value = 5.0*
d	*4*	*19*	*13:10:00.00*	*real-value = 10.0*
e	*5*	*20*	*13:15:00.00*	*real-value = 15.0*
f	*6*	*21*	*13:16:00.00*	*log-status, log-disabled = TRUE*
g	*7*	*22*	*13:21:00.00*	*log-status, log-disabled = FALSE*
h	*8*	*23*	*13:25:00.00*	*real-value = 25.0*
i	*9*	*24*	*13:30:00.00*	*real-value = 30.0*
j	*10*	*25*	*13:35:00.00*	*real-value = 35.0*
k	*11*	*26*	*13:36:00.00*	*log-status, log-disabled = TRUE*

[Change **Clause 9.21.1.2**, p. 264]

9.21.1.2 Reading Items by Position with Positive Count

Purpose: To verify that the IUT correctly responds to a ReadRange service request to return items specified by indicating a position and the number of items after that position to return.

Test Concept: A ReadRange request is transmitted by the TD requesting a range of items known to be in the Log_Buffer. This range is specified using the 'By Position' option and a positive value for 'Count'. The 'Reference Index' and 'Count' are selected so that the results can be conveyed in a single acknowledgment.

Test Steps:

1. TRANSMIT ReadRange-Request,
   'Object Identifier' = (the Trend Log object configured for this test),

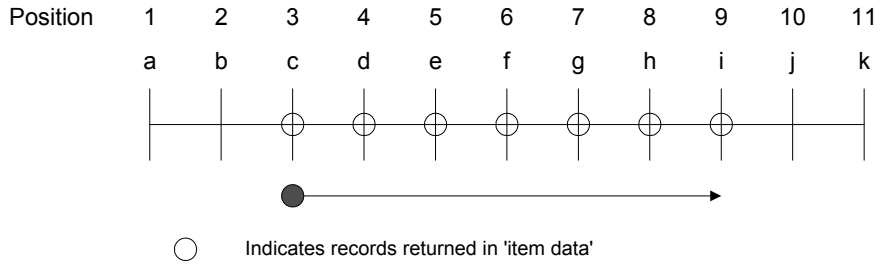
'Property Identifier' = Log_Buffer,
'Reference Index' = (any value x: 1 ≤ x ≤ *Record_Count* ~~(the number of trend records in the buffer - the 'Count' used below)~~),
'Count' = (any value *y: 0 < y ≤ Record_Count – x + 1)* ~~x: 0 < x ≤ the number of trend records remaining beyond "Reference Index')~~

2. RECEIVE Read-Range-ACK,
'Object Identifier' = (the Trend Log object configured for this test),
'Property Identifier' = Log_Buffer,
'Result Flags' = {?~~TRUE~~, ?~~TRUE~~, FALSE},
'Item Count' = *y* ~~(the same value used in the 'Count' parameter in step 1),~~
'Item Data' = (all of the specified trend records *in order of increasing position. The items specified include the item at the index specified by x, plus (y-1) items following.*)

Test Example (using the sample buffer at beginning of section):

1. TRANSMIT ReadRange-Request,
'Object Identifier' = (Trend Log, Instance 1),
'Property Identifier' = Log_Buffer,
'Reference Index' = 3,
'Count' = 7

2. RECEIVE ReadRange-ACK,
'Object Identifier' = (Trend Log, Instance 1),
'Property Identifier' = Log_Buffer,
'Result Flags' = {FALSE, FALSE, FALSE},
'Item Count' = 7,
'Item Data' = Records < c, d, e, f, g, h, i > in that order.



[Change **Clause 9.21.1.3**, p. 264]

9.21.1.3 Reading Items by Position with Negative Count

Purpose: To verify that the IUT correctly responds to a ReadRange service request to return items specified by indicating a position and the number of items before that position to return.

Test Concept: A ReadRange request is transmitted by the TD requesting a range of items known to be in the Log_Buffer. This range is specified using the 'By Position' option and a negative value for 'Count'. The 'Reference Index' and 'Count' are selected so that the results can be conveyed in a single acknowledgement.

Test Steps:

1. TRANSMIT ReadRange-Request,
'Object Identifier' = (the Trend Log object configured for this test),
'Property Identifier' = Log_Buffer,
'Reference Index' = (any value x: *1 ≤ x ≤ Record_Count* ~~2 < x < the number of trend records in the buffer~~),

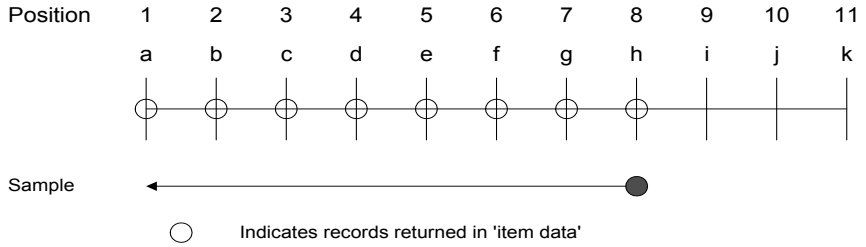
'Count' = (any value *y: y < 0 AND |y| ≤ x* ~~x: x < 0 AND |x| < the 'Reference Index'~~)

2. RECEIVE *ReadRange-ACK* ~~Read-Range-ACK~~,
'Object Identifier' = (the Trend Log object configured for this test),
'Property Identifier' = Log_Buffer,
'Result Flags' = {*?*~~TRUE~~, *?*~~TRUE~~, FALSE},
'Item Count' = |*y*| ~~(the same value used in the 'Count' parameter in step 1)~~,
'Item Data' = (all of the specified trend records *in order of increasing position. The items specified include the item at the index specified by x, plus |y|-1 items preceding.)*

Test Example (using the sample buffer at beginning of section):

1. TRANSMIT ReadRange-Request,
'Object Identifier' = (Trend Log, Instance 1),
'Property Identifier' = Log_Buffer,
'Reference Index' = 8,
'Count' = -8

2. RECEIVE ReadRange-ACK,
'Object Identifier' = (Trend Log, Instance 1),
'Property Identifier' = Log_Buffer,
'Result Flags' = {TRUE, FALSE, FALSE},
'Item Count' = 8
'Item Data' = Records < a, b, c, d, e, f, g, h > in that order.



[Change **Clause 9.21.1.4**, p. 264]

9.21.1.4 Reading Items by Time

Purpose: To verify that the IUT correctly responds to a ReadRange service request to return items specified by indicating a time and the number of items after that time to return.

Test Concept: A ReadRange request is transmitted by the TD requesting a range of items known to be in the Log_Buffer. This range is specified using the 'By Time' option and a positive value for 'Count'. The 'Reference ~~Index~~ *Time*' and 'Count' are selected so that the results can be conveyed in a single acknowledgement.

Test Steps:

1. TRANSMIT ReadRange-Request,
'Object Identifier' = (the Trend Log object configured for this test),
'Property Identifier' = Log_Buffer,
'Reference Time' = *(any value x: x is older (of earlier time) than the time of an entry in the buffer which has a sequence number of S, and x is newer than or equal to the time of any preceding entry),* ~~(any value older than (earlier time) the last time in the buffer),~~

'Count' = *(any value y: 0 < y ≤ Total_Record_Count – S + 1)*~~(any value > 0)~~

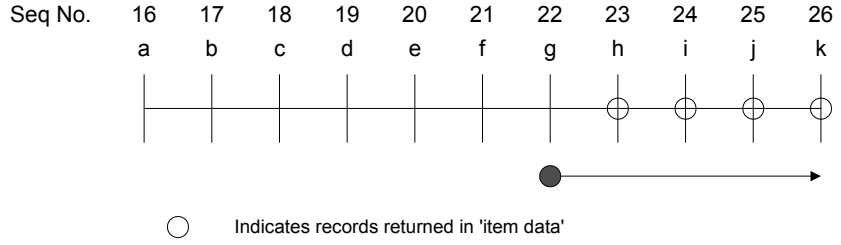
2. RECEIVE *ReadRange-ACK*~~Read-Range-ACK~~,
   'Object Identifier' = (the Trend Log object configured for this test),
   'Property Identifier' = Log_Buffer,
   'Result Flags' = {*?*~~TRUE~~, *?*~~TRUE~~, FALSE},
   'Item Count' = *y*~~(the same value used in the 'Count' parameter in step 1)~~,
   'Item Data' = (all of the specified trend records *in order of increasing sequence number. The items specified include the first item with a timestamp newer than x, plus (y-1) items following.*)
   'First Sequence Number' = *S*

~~Notes to Tester: The first item returned shall be the entry in the Log_Buffer with a timestamp newer (later time) than the time specified by the 'Reference Time' parameter.~~

Test Example (using sample buffer at beginning of section):

1. TRANSMIT ReadRange-Request,
   'Object Identifier' = *(Trend Log, Instance 1),*
   'Property Identifier' = *Log_Buffer,*
   'Reference Time' = *13:21:00.00*
   'Count' = *4*

2. RECEIVE ReadRange-ACK,
   'Object Identifier' = *(Trend Log, Instance 1),*
   'Property Identifier' = *Log_Buffer,*
   'Result Flags' = *{FALSE, TRUE, FALSE},*
   'Item Count' = *4,*
   'Item Data' = *Records < h, i, j, k > in that order.*
   'First Sequence Number' = *23*



135.1-2009*g*-17 Add New Tests for Revision 4 Schedules.

Rationale
These tests have been added because no tests exist for revision 4 functionality schedules in 135.1.

[Add new **Clause 7.3.2.23.X** and its subclauses, p. 94]

7.3.2.23.X Schedule Object Protocol_Revision 4 Tests

The Schedule object was revised in Addendum a to ANSI/ASHRAE 135-2001, which increased Protocol_Revision to 4. Although the basic structure of the Schedule object changed little, its operations are sufficiently different that the existing tests for the original Schedule object need revision in some cases and complete replacement in others, and new tests for some additional changes were needed. This clause presents specific tests to be run for Schedule objects in devices that claim Protocol_Revision 4 or higher.

The Schedule object has no properties required to be writable or otherwise configurable. The following tests are designed to be performed on such a Schedule object. However, if the Schedule object is in any way configurable, then it shall be configured to accommodate as many of the following tests as is possible for the implementation. If it is impossible to configure the IUT in the manner required for a particular test, then that test shall be omitted. If the IUT supports Schedule objects that can write outside the device this shall be demonstrated in one of the Schedule tests.

Tests of the Schedule object center upon observing the write operations scheduled to occur at specific dates and times, verified by reading the Schedule object's Present_Value property. For the test to be performed in a reasonable amount of time it is necessary to be able to alter settings of the device's clock and calendar.

For each test, a date and (as required) time ("Date") for the test is determined beforehand. The tables in the Configuration Requirements section of each test give the criteria for the Date/Time value, designated D1, D2, and so on, to be used in the tests. Date/Time values meeting these criteria may be chosen from existing schedules, or a schedule may be developed by the manufacturer to meet these criteria.

Associated with each Date/Time value, Dn, and defining the time of a schedule write operation is a value Vn, which is the value associated with the time member of Dn in the BACnetTimeValue pair. Vn may take on any primitive datatype.

7.3.2.23.X.1 Revision 4 Effective_Period Test

Purpose: To verify that Effective_Period controls the range of dates during which the Schedule object is active.

Test Concept: Two Date values are chosen by the TD based on the criteria in Table 7-X1 such that one is outside of the Effective_Period and the other corresponds to a known scheduled state inside the Effective_Period. The IUT's local date and time are changed between these dates and a property referenced by the List_Of_Object_Property_References property is monitored to verify that write operations occur only within the Effective_Period.

Configuration Requirements: The IUT shall be configured with a schedule object such that the time periods defined in Table 7-X1 have uniquely scheduled values. The local date and time shall be set such that the Present_Value property has a value other than V_1. The List_Of_Object_Property_References property shall contain at least one reference either to a property within the IUT alterable by the Schedule object or a writable property in another device (in either case: the "referenced property"); if the List_Of_Object_Property_References property cannot be thus configured, then this test shall be skipped.

Table 7-X1. Criteria for Effective_Period Test Dates and Values

Date:	**Criteria:**	**Value:**
D_1	1. Date occurs during Effective_Period, and 2. Date appears either in Weekly_Schedule or Exception_Schedule.	V_1
D_2	1. Date does not occur during Effective_Period, and 2. Date appears either in Weekly_Schedule or Exception_Schedule.	V_2 different from V_1.

Test Steps:

1. VERIFY "referenced property" = (any value other than V_1)
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   | MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY "referenced property" = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   | MAKE (the local date and time = D_2)
6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY "referenced property" = V_1

7.3.2.22.X.2 Revision 4 Weekly_Schedule Property Test

Purpose: To verify that Weekly_Schedule contains distinguishable schedules for each day of the week and that a day's entire schedule can be executed.

Test Concept: The IUT's local date and time are changed sequentially to represent each day of the week as shown in Table 7-X2. The Present_Value property is monitored to verify that write operations occur for each separately scheduled day.

Configuration Requirements: The IUT shall be configured with a schedule object containing a weekly schedule with seven distinguishable daily schedules meeting the requirements of Table 7-X2. The local date and time shall be set such that the Present_Value property has a value other than V_1. If no schedule exists that meets these requirements and none can be configured, then this test shall be omitted. An "active period" is defined as a period of time when the Exception_Schedule determines the value appearing in Present_Value.

Table 7-X2. Criteria for Weekly_Schedule Test Dates and Values

Date:	**Criteria:**	**Value:**
D_1	1. Date occurs during Effective_Period, 2. Date occurs on a Monday, and 3. Date does not occur during an active period in Exception_Schedule.	V_1
D_2	1. Date occurs during Effective_Period, 2. Date occurs on a Tuesday, and 3. Date does not occur during an active period in Exception_Schedule.	V_2 is different from V_1.
D_3	1. Date occurs during Effective_Period, 2. Date occurs on a Wednesday, and 3. Date does not occur during an active period in Exception_Schedule.	V_3 is different from V_2.
D_4	1. Date occurs during Effective_Period, 2. Date occurs on a Thursday, and 3. Date does not occur during an active period Exception_Schedule.	V_4 is different from V_3.
D_5	1. Date occurs during Effective_Period, 2. Date occurs on a Friday, and 3. Date does not occur during an active period in Exception_Schedule.	V_5 is different from V_4.
D_6	1. Date occurs during Effective_Period, 2. Date occurs on a Saturday, and 3. Date does not occur during an active period in Exception_Schedule.	V_6 is different from V_5.
D_7	1. Date occurs during Effective_Period, 2. Date occurs on a Sunday, and 3. Date does not occur during an active period in Exception_Schedule.	V_7 is different from V_6.

Test Steps:

1. VERIFY Present_Value = (any value other than V_1)
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   | MAKE (the local date and time = D_1)
3. WAIT Schedule Evaluation Fail Time
4. VERIFY Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   | MAKE (the local date and time = D_2)
6. WAIT Schedule Evaluation Fail Time
7. VERIFY Present_Value = V_2
8. (TRANSMIT TimeSynchronization-Request, 'Time' = D_3)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_3)
   | MAKE (the local date and time = D_3)
9. WAIT Schedule Evaluation Fail Time
10. VERIFY Present_Value = V_3
11. (TRANSMIT TimeSynchronization-Request, 'Time' = D_4)
    | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_4)
    | MAKE (the local date and time = D_4)
12. WAIT Schedule Evaluation Fail Time
13. VERIFY Present_Value = V_4
14. (TRANSMIT TimeSynchronization-Request, 'Time' = D_5)
    | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_5)
    | MAKE (the local date and time = D_5)
15. WAIT Schedule Evaluation Fail Time
16. VERIFY Present_Value = V_5
17. (TRANSMIT TimeSynchronization-Request, 'Time' = D_6)
    | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_6)
    | MAKE (the local date and time = D_6)
18. WAIT Schedule Evaluation Fail Time

19. VERIFY Present_Value = V_6
20. (TRANSMIT TimeSynchronization-Request, 'Time' = D_7)
    | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_7)
    | MAKE (the local date and time = D_7)
21. WAIT Schedule Evaluation Fail Time
22. VERIFY Present_Value = V_7
23. REPEAT X = (the time portion of the BACnetTimeValue entries for one of the daily schedules in Table 7-X2) DO {
    (TRANSMIT TimeSynchronization-Request, 'Time' = X)
    | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = X)
    | MAKE (the local date and time = X)
    WAIT Schedule Evaluation Fail Time
    VERIFY Present_Value = (the scheduled value corresponding to time X)
    }

7.3.2.23.X.3 Revision 4 Exception_Schedule Property Tests

If the IUT cannot be made to meet the configuration requirements of one or more of the tests in this clause, then that test shall be omitted. The inability to make such a configuration may be due to an absent or immutable Exception_Schedule property to limited numbers of available BACnetSpecialEvent records in the Exception_Schedule or to the unavailability of Calendar objects.

7.3.2.23.X.3.1 Revision 4 Calendar Reference Test

Purpose: To verify that a date appearing in a referenced Calendar object enables the referencing Schedule object. This test applies to Protocol_Revision 3 and prior, as well as to Protocol_Revision 4 and later schedule objects.

Test Concept: The IUT's local date and time are changed to values that are selected by the TD based on the criteria in Table 7-X3. The value of the Present_Value property is monitored to verify that the scheduled write operations occur.

Configuration Requirements: The IUT shall be configured to contain a Schedule object that references a Calendar object with a non-empty Date_List. The criteria for the dates used are given in Table 7-X3. The local date and time shall be set such that the Present_Value property has a value other than V_1.

Table 7-X3. Criteria for Calendar Reference Dates and Values

Date	Criteria	Value
D_1	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent references Calendar object via calendarReference, 2B. Date appears in that Calendar's Date_List property, 2C. Time is on or after the time of the entry with V1, but before any other entry in the Exception_Schedule, and 2D. BACnetSpecialEvent has a higher eventPriority than any other coincident BACnetSpecialEvent records.	V_1
D_2	1. Date occurs during Effective_Period, 2. Date does not appear in any BACnetSpecialEvent records, and 3. Date occurs on the same date as, but with time following, an entry in a BACnetDailySchedule in the referencing Schedule object.	V_2 different from V_1

Test Steps:

1. VERIFY Present_Value = (any value other than V_1)
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   | MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2)

| (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
| MAKE (the local date and time = D_2)

6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY Present_Value = V_2

7.3.2.23.X.3.2 Revision 4 Calendar Entry Date Test

Purpose: To verify that a specified date appearing in an Exception_Schedule enables the referencing Schedule object.

Test Concept: The IUT's local date and time are changed to values that are selected by the TD based on the criteria in Table 7-X4. The value of the Present_Value property is monitored to verify that the scheduled write operations occur.

Configuration Requirements: The IUT shall be configured to contain a Schedule object, S, with an Exception_Schedule containing a BACnetCalendarEntry with a specific date. The criteria for the dates used in the test are given in Table 7-X4. The local date and time shall be set such that the Present_Value property has a value other than V_1.

Table 7-X4. Criteria for Calendar Entry Date Test Dates and Values

Date	Criteria	Value
D_1	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: Date, 2B. Date matches calendarEntry: Date, 2C. Time is on or after the time of the entry with V1, but before any other entry in the Exception_Schedule, and 2D. BACnetSpecialEvent has a higher eventPriority than any coincident BACnetSpecialEvent records.	V_1
D_2	1. Date occurs during Effective_Period, 2. Date does not appear in any BACnetSpecialEvent records, and 3. Date occurs on the same date as, but with time following, an entry in a BACnetDailySchedule in the referencing Schedule object.	V_2 different from V_1

Test Steps:

1. VERIFY Present_Value = (any value other than V_1)
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY S, Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   MAKE (the local date and time = D_2)
6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY S, Present_Value = V_2

7.3.2.23.X.3.3 Revision 4 Calendar Entry DateRange Test

Purpose: To verify that a date appearing in an Exception_Schedule's date range enables the referencing Schedule object.

Test Concept: The IUT's local date and time are changed to values that are selected by the TD based on the criteria in Table 7-X5. The value of the Present_Value property is monitored to verify that the scheduled write operations occur.

Configuration Requirements: The IUT shall be configured to contain a Schedule object, S, with an Exception_Schedule containing a BACnetCalendarEntry with a date range. The criteria for the dates used in the test are given in Table 7-X5. The local date and time shall be set such that the Present_Value property has a value other than V_1.

Table 7-X5. Criteria for Calendar Entry DateRange Test Dates and Values

Date	Criteria	Value
D_1	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: DateRange, 2B. Date matches BACnetCalendarEntry: DateRange, 2C. Time is on or after the time of the entry with V1, but before any other entry in the Exception_Schedule, 2D. BACnetSpecialEvent has a higher eventPriority than any coincident BACnetSpecialEvent records, and 2E. DateRange shall not include wildcards.	V_1
D_2	1. Date occurs during Effective_Period, 2. Date does not appear in any BACnetSpecialEvent records, 3. Date occurs on the same date as, but with time following, an entry in a BACnetDailySchedule in the referencing Schedule object, and 4. DateRange shall not include wildcards.	V_2 different from V_1

Test Steps:

1. VERIFY (S), Present_Value = any value other than V_1
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY S, Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   MAKE (the local date and time = D_2)
6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY S, Present_Value = V_2

7.3.2.23.X.3.4 Revision 4 Calendar Entry WeekNDay Month Test

Purpose: To verify that a date matching a WeekNDay's Month field, specifying a specific month in an Exception_Schedule, enables the referencing Schedule object.

Test Concept: The IUT's local date and time are changed to values that are selected by the TD based on the criteria in Table 7-X6. The value of the Present_Value property is monitored to verify that the scheduled write operations occur.

Configuration Requirements: The IUT shall be configured to contain a Schedule object, S, with an Exception_Schedule containing a BACnetCalendarEntry with a WeekNDay entry specifying a specific month, from January (1) to December (12). The criteria for the dates used in the test are given in Table 7-X6. The local date and time shall be set such that the Present_Value property has a value other than V_1.

Table 7-X6. Criteria for Calendar Entry WeekNDay Month Test Dates and Values

Date	Criteria	Value
D_1	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: WeekNDay, 2B. calendarEntry: WeekNDay: specifies Month, 2C. Date matches calendarEntry: WeekNDay, 2D. Time is on or after the time of the entry with V1, but before any other entry in the Exception_Schedule, and 2E. BACnetSpecialEvent has a higher eventPriority than any coincident BACnetSpecialEvent records.	V_1
D_2	1. Date occurs during Effective_Period, 2. Date does not appear in any BACnetSpecialEvent records, and 3. Date occurs on the same date as, but with time following, an entry in a BACnetDailySchedule in the referencing Schedule object.	V_2 different from V_1

Test Steps:

1. VERIFY (S), Present_Value = any value other than V_1
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY S, Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   MAKE (the local date and time = D_2)
6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY S, Present_Value = V_2

7.3.2.23.X.3.5 Revision 4 Calendar Entry WeekNDay Week Of Month Test

Purpose: To verify that a date matching a WeekNDay's WeekOfMonth field in an Exception_Schedule enables the referencing Schedule object.

Test Concept: The IUT's local date and time are changed to values that are selected by the TD based on the criteria in Table 7-X7. The value of the Present_Value property is monitored to verify that the scheduled write operations occur.

Configuration Requirements: The IUT shall be configured to contain a Schedule object, S, with an Exception_Schedule containing a BACnetCalendarEntry with a WeekNDay entry specifying a week of the month. The criteria for the dates used in the test are given in Table 7-X7. The local date and time shall be set such that the Present_Value property has a value other than V_1.

Table 7-X7. Criteria for Calendar Entry WeekNDay Week Of Month Test Dates and Values

Date	Criteria	Value
D_1	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: WeekNDay, 2B. calendarEntry: WeekNDay specifies WeekOfMonth, 2C. calendarEntry: WeekNDay: WeekOfMonth is in the range 1..5, 2D. Date matches calendarEntry: WeekNDay, 2E. Time is on or after the time of the entry with V1, but before any other entry in the Exception_Schedule, and 2F BACnetSpecialEvent has a higher eventPriority than any coincident BACnetSpecialEvent records.	V_1
D_2	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: WeekNDay, 2B. calendarEntry: WeekNDay specifies WeekOfMonth, 2C. calendarEntry: WeekNDay: WeekOfMonth is in the range 1..5, and 2D. Date does not match calendarEntry: WeekNDay: WeekOfMonth.	V_2 different from V_1

Test Steps:

1. VERIFY (S), Present_Value = any value other than V_1
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY S, Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   MAKE (the local date and time = D_2)
6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY S, Present_Value = V_2

7.3.2.23.X.3.6 Revision 4 Calendar Entry WeekNDay Last Week Of Month Test

Purpose: To verify that a date matching a WeekNDay's WeekOfMonth field in an Exception_Schedule enables the referencing Schedule object.

Test Concept: The IUT's local date and time are changed to values that are selected by the TD based on the criteria in Table 7-X8. The value of the Present_Value property is monitored to verify that the scheduled write operations occur.

Configuration Requirements: The IUT shall be configured to contain a Schedule object, S, with an Exception_Schedule containing a BACnetCalendarEntry with a WeekNDay entry specifying the last week of the month. The criteria for the dates used in the test are given in Table 7-X8. The local date and time shall be set such that the Present_Value property has a value other than V_1.

Table 7-X8. Criteria for Calendar Entry WeekNDay Last Week Of Month Test Dates and Values

Date	Criteria	Value
D_1	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: WeekNDay, 2B. calendarEntry: WeekNDay specifies WeekOfMonth, 2C. calendarEntry: WeekNDay: WeekOfMonth has the value 6, 2D. Date is in the last week of the month, 2E. WeekNDay:Month matches the specified month, 2F. WeekNDay:dayOfWeek matches the specified day of the week, 2G. Time is on or after the time of the entry with V1, but before any other entry in the Exception_Schedule, and 2H. BACnetSpecialEvent has a higher eventPriority than any coincident BACnetSpecialEvent records.	V_1
D_2	1. Date occurs during Effective_Period, 2A. BACnetSpecialEvent incorporates calendarEntry: WeekNDay, 2B. calendarEntry: WeekNDay specifies WeekOfMonth, 2C. calendarEntry: WeekNDay: WeekOfMonth has the value 6, and 2D. Date is not in the last week of the month.	V_2 different from V_1

Test Steps:

1. VERIFY (S), Present_Value = any value other than V_1
2. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_1)
   MAKE (the local date and time = D_1)
3. WAIT **Schedule Evaluation Fail Time**
4. VERIFY S, Present_Value = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2) |
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time' = D_2)
   MAKE (the local date and time = D_2)
6. WAIT **Schedule Evaluation Fail Time**
7. VERIFY S, Present_Value = V_2

[Delete **Clause 7.3.2.23.3.1**, p. 84, and replace it with the following]

7.3.2.23.3.1 Calendar Reference Test

See Clause 7.3.2.23.X.2.1 Revision 4 Calendar Reference Test.

135.1-2009*g*-18 Add New Test for Event Notification Network Priority.

Rationale
The standard requires that EventNotifications be sent with a specific network priority based on the event priority of the notification. This new test verifies that the IUT does just that.

[Add new **Clause 8.4.X,** p 149]

8.4.X Network Priority Test
Dependencies: ReadProperty Service Execution Tests, 9.18; WriteProperty Service Execution Tests, 9.22.

BACnet Reference Clause: 13.4.1

Purpose: To verify that the correct network priority is used when transmitting EventNotification requests.

Test Concept: The IUT is made to generate a ConfirmedEventNotification with a specific priority. The network priority in the NPCI is checked to ensure that it is correct based on the priority of the event.

Test Configuration: The IUT is configured with an event generating object E1 that refers to Notification Class object N1.

Test Steps:

1. IF (the IUT can generate ConfirmedEventNotifications with an event priority in the range 0..63) THEN
2. MAKE (The IUT initiate a ConfirmedEventNotification-Request with a event priority in the range 0..63)
3. BEFORE **Notification Fail Time**
   RECEIVE ConfirmedEventNotification-Request,
   'Network Priority' = 3
   'Process Identifier' = (any valid process ID),
   'Initiating Device Identifier' = IUT,
   'Event Object Identifier' = (the intrinsic reporting object or the Event Enrollment object being tested),
   'Time Stamp' = (the current local time of the IUT),
   'Notification Class' = (the configured notification class),
   'Priority' = (a value in the range 0..63),
   'Event Type' = (any valid value),
   'Notify Type' = EVENT | ALARM,
   'AckRequired' = TRUE | FALSE,
   'From State' = (any valid value),
   'To State' = (any valid value),
   ' Event Values' = (any valid valid)
4. TRANSMIT BACnet-SimpleACK-PDU
5. IF (the IUT can generate ConfirmedEventNotifications with an event priority in the range 64..127) THEN
6. MAKE (The IUT initiate a ConfirmedEventNotification-Request with an event priority in the range 64..127)
7. BEFORE **Notification Fail Time**
   RECEIVE ConfirmedEventNotification-Request,
   'Network Priority' = 2
   'Process Identifier' = (any valid process ID),
   'Initiating Device Identifier' = IUT,
   'Event Object Identifier' = (the intrinsic reporting object or the Event Enrollment object being tested),
   'Time Stamp' = (the current local time of the IUT),
   'Notification Class' = (the configured notification class),
   'Priority' = (a value in the range 64..127),
   'Event Type' = (any valid value),
   'Notify Type' = EVENT | ALARM,
   'AckRequired' = TRUE | FALSE,

'From State' = (any valid value),
'To State' = (any valid value),
'Event Values' = (any valid valid)

8. TRANSMIT BACnet-SimpleACK-PDU
9. IF (the IUT can generate ConfirmedEventNotifications with an event priority in the range 128..191) THEN
10. MAKE (The IUT initiate a ConfirmedEventNotification-Request with a event priority in the range 128..191)
11. BEFORE **Notification Fail Time**

RECEIVE ConfirmedEventNotification-Request,
'Network Priority' = 1
'Process Identifier' = (any valid process ID),
'Initiating Device Identifier' = IUT,
'Event Object Identifier' = (the intrinsic reporting object or the Event Enrollment object being tested),
'Time Stamp' = (the current local time of the IUT),
'Notification Class' = (the configured notification class),
'Priority' = (a value in the range 128..191),
'Event Type' = (any valid value),
'Notify Type' = EVENT | ALARM,
'AckRequired' = TRUE | FALSE,
'From State' = (any valid value),
'To State' = (any valid value),
' Event Values' = (any valid valid)

12. TRANSMIT BACnet-SimpleACK-PDU
13. IF (the IUT can generate ConfirmedEventNotifications with an event priority in the range 192..255) THEN
14. MAKE (The IUT initiate a ConfirmedEventNotification-Request with a event priority in the range 192..255)
15. BEFORE **Notification Fail Time**

RECEIVE ConfirmedEventNotification-Request,
'Network Priority' = 0
'Process Identifier' = (any valid process ID),
'Initiating Device Identifier' = IUT,
'Event Object Identifier' = (the intrinsic reporting object or the Event Enrollment object being tested),
'Time Stamp' = (the current local time of the IUT),
'Notification Class' = (the configured notification class),
'Priority' = (a value in the range 192..255),
'Event Type' = (any valid value),
'Notify Type' = EVENT | ALARM,
'AckRequired' = TRUE | FALSE,
'From State' = (any valid value),
'To State' = (any valid value),
' Event Values' = (any valid valid)

16. TRANSMIT BACnet-SimpleACK-PDU

135.1-2009*g*-19 Add Device and Network Mapping Tests.

Rationale
Tests for this functionality are not in 135.1.

[Insert new **Clause 13.X1**, p 456]

13.X1 Automatic Network Mapping
Purpose: To verify that an IUT can find all devices connected to the BACnet internetwork and present the list of devices to the user.

Test Configuration: The IUT shall be connected to a network consisting of devices that are distributed on multiple networks. The TD shall monitor the IUT's generation of Who-Is service requests and shall verify that the requests cover the complete range of BACnet device instances and that Who-Is requests are used that contain device instance ranges.

Test Steps:

1. IF (the IUT caches device information) THEN
   MAKE (the IUT's cache clear so that is unaware of the existence of any other devices)
2. MAKE (the IUT initiate the network mapping function while monitoring the network for Who-Is requests initiated by the IUT)
3. CHECK (that the IUT identifies all of the devices on the network to the user)

Passing Result: The IUT sends global broadcast Who-Is requests or directed broadcasts to each network, the complete range of device instances is covered by the Who-Is requests, and the IUT does not solely rely on Who-Is requests with no device instance ranges.

Passing Result: The IUT presents a list of all devices on the network to the user. The list shall not indicate devices as present that do not exist on the internetwork. The IUT is not required to include itself in the list.

[Insert new **Clause 13.X2**, p 456]

13.X2 Automatic Device Mapping
Purpose: To verify that an IUT can find all objects in an arbitrary BACnet device and present the objects to the user.

Configuration: Configure the TD to emulate a device with an arbitrary set of self-consistent BACnet characteristics with a collection of objects in it.

Test Steps:

1. MAKE (the IUT initiate its device mapping function for the TD)
2. CHECK (that the IUT correctly identifies all of the objects in the TD)

135.1-2009*g*-20 Add Device Restart Notification Tests.

Rationale
Tests for this functionality are not currently included in 135.1.

[Insert new **Clause 8.3.X**, p. 118]

8.3.X Device Restart Notifications

Purpose: To verify that the IUT initiates UnconfirmedCOVNotification service requests to each entry in its Restart_Notification_Recipients property when it resets.

Test Concept: The IUT is configured to send restart notifications and is then reset. The TD checks for the restart notifications.

Device restart notifications differ from subscribed COV notifications that use the UnconfirmedCOVNotification service in two respects. First, subscription is made through the Restart_Notification_Recipients property instead of SubscribeCOV. Second, the 'Subscriber Process Identifier' parameter always has a value of zero.

Configuration Requirements: For each Recipient of the Restart_Notification_Recipients property in the IUT which is of the device form, there shall be a device on the network that will answer Who-Is requests so that the IUT can determine addressing information before sending the restart notification.

Test Steps:

1. IF (Restart_Notification_Recipients is writable) THEN
   WRITE(Restart_Notification_Recipients = any non-empty list of Recipients)
   ELSE
   MAKE (Restart_Notification_Recipients contain any non-empty list of Recipients)
2. READ T1 = Local_Time
3. MAKE(the IUT reset)
4. REPEAT X = (each entry in the Restart_Notification_Recipients) DO {
   BEFORE **Notification Fail Time**
   RECEIVE UnconfirmedCOVNotification-Request,

DESTINATION =	X,
'Subscriber Process Identifier' =	0,
'Initiating Device Identifier' =	IUT,
'Monitored Object Identifier' =	(the IUT Device Identifier),
'Time Remaining' =	0,
'List of Values' =	(System_Status=OPERATIONAL, Time_Of_Device_Restart = (T2), Last_Restart_Reason=(any valid restart reason, R))

   }
5. VERIFY Time_Of_Device_Restart = T2
6. CHECK (T1 ~= T2)
7. VERIFY Last_Restart_Reason = R

Note to tester: Not all IUTs can accurately differentiate between the types of restart reasons and thus no requirements are placed on the value returned in step 4. The test shall pass regardless of the order in which the IUT generates the UnconfirmedCOVNotification-Requests in step 4. The value of T2 shall be the same for each notification sent out in step 4.

[Change **Clause 9.3**, p 204]

9.3 UnconfirmedCOVNotification Service Execution Tests

~~BACnet does not define a service procedure for executing the UnconfirmedCOVNotification service and thus no tests are needed.~~

9.3.1 Device Restart Notifications

Purpose: To verify that the IUT executes UnconfirmedCOVNotification service requests that convey restart notifications.

Test Concept: The TD sends a restart notification and the tester verifies that the IUT processes the notification in a vendor-specified manner.

Test Configuration: A valid BACnetDeviceStatus and a valid Last_Restart_Reason pair, DS_1 and LRR_1, shall be selected for which the IUT will take some action.

Device restart notifications differ from subscribed COV notifications that use the UnconfirmedCOVNotification service in two respects. First, subscription is made through the Restart_Notification_Recipients property instead of SubscribeCOV. Second, the 'Subscriber Process Identifier' parameter always has a value of zero.

Test Steps:

1. *TRANSMIT UnconfirmedCOVNotification-Request,*
   'Subscriber Process Identifier' = 0,
   'Initiating Device Identifier' = TD,
   'Monitored Object Identifier' = (the TD Device Identifier),
   'Time Remaining' = 0,
   'List of Values' = (System_Status = DS_1,
   Time_Of_Device_Restart = (any valid time),
   Last_Restart_Reason = LRR_1)
2. *CHECK(that the IUT processes the notification as described by the vendor)*

135.1-2009*g*-21 Add Schedule Written Datatypes Tests.

Rationale
Tests for this functionality are not currently included in 135.1.

[Add new **Clause 7.3.2.23.Y** and its subclauses, p. 94]

7.3.2.23.Y Written Datatypes Tests

The following tests verify that the Schedule properly writes datatypes that it claims to support.

7.3.2.23.Y.1 Internally Written Datatypes Test, non-NULL values

BACnet Reference Clauses: 12.24, 12.24.10

Purpose: This test verifies that the Schedule object within the IUT writes to properties in the same device for the non-NULL datatype being tested.

Test Concept: Two Date/Time, values, D_1 and D_2, are chosen by the TD based on the criteria in Table 7-Y1 such that D_1 is sufficiently different from, and later than, the current time to cause a Schedule evaluation when the time is changed to D_1, and such that setting the time to D_2 (later than D_1) from D_1 will cause a Schedule evaluation that will cause it to write value V_2. These values may be chosen based on the Schedule object's existing configuration, or the Schedule object, S, may be configured with such values.

Configuration Requirements: The IUT shall be configured with a Schedule object, S, such that the time periods defined in Table 7-Y1 can be configured with uniquely scheduled values. The Schedule object shall be configured with a List_Of_Object_Property_References, including at least one reference to a writable property within the device. If the IUT cannot be configured to these requirements, then this test shall be omitted. Other properties shall be consistent in both datatypes and values in a manner permitting this test to be executed.

Table 7-Y1. Criteria for Test Date and Times

Date and Time:	**Value:**
D_1	V_1
D_2	V_2 different from V_1.

Test Steps:

1. (TRANSMIT TimeSynchronization-Request,'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D1)
   | MAKE (the local date and time = D1)
2. WAIT(**Schedule_Evaluation_Fail_Time)**
3. VERIFY S, Present_Value = V_1
4. REPEAT P = (writable property in List_Of_Property_References)
   VERIFY P = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D1)
   | MAKE (the local date and time = D2)
6. WAIT(**Schedule_Evaluation_Fail_Time)**
7. VERIFY S, Present_Value = V_2
8. REPEAT P = (writable property in List_Of_Property_References)
   VERIFY P = V_2

Note to Tester: In the context of this test definition, writable means that the Schedule object is capable of modifying the property. It does not necessarily indicate that the property is modifiable via BACnet services.

7.3.2.23.Y.2 Internally Written Datatypes Test, NULL Values and Priority_Arrays

Purpose: This test verifies that the Schedule object writes NULLs to priority arrays (via Present_Value) within the same device.

Dependencies: TimeSynchronization Service Execution Tests, 9.30, UTCTimeSynchronization Service Execution Tests, 9.31

BACnet Reference Clauses: 12.24, 12.24.9

Test Concept: Two Date/Time values, D_1 and D_2, are chosen by the TD based on the criteria in Table 7-Y2 such that D_1 is sufficiently different from current time to cause a Schedule evaluation when the time is changed to D_1, and such that setting the time to D_2 from D_1 will cause a Schedule evaluation that will cause it to write value V_2. These values may be chosen based on the Schedule object's existing configuration, or the Schedule object, S, may be configured with such values, and either V_1 or V_2, but not both, has datatype NULL. The values are written to a Present_Value property with the priority designated by the Schedule object's Priority_For_Writing property, X. For devices of protocol revision 4 or higher, the Schedule_Default shall be set to NULL and the schedule shall be configured such that at time D_1 or D_2, but not both, the schedule shall take on the value of Schedule_Default.

Configuration Requirements: The IUT shall be configured with a Schedule object, S, such that the time periods defined in Table 7-Y2 can be configured with uniquely scheduled values. The Schedule object shall be configured with a List_Of_Object_Property_References, including at least one reference within the device to a Present_Value property, P, in an object containing a Priority_Array property, PA. If the IUT cannot be configured to these requirements, then this test shall be omitted.

Table 7-Y2. Criteria for Test Date and Times

Date and Time:	**Value:**
D_1	V_1
D_2	V_2 different from V_1.

Test Steps:

1. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D1)
   | MAKE (the local date and time = D1)
2. WAIT(**Schedule_Evaluation_Fail_Time)**
3. VERIFY S, Present_Value = V_1
4. VERIFY PA[X] = V_1
5. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D2)
   | MAKE (the local date and time = D2)
6. WAIT(**Schedule_Evaluation_Fail_Time)**
7. VERIFY S, Present_Value = V_2
8. VERIFY PA[X] = V_2

7.3.2.23.Y.3 Externally Written Datatypes Test, non-NULL values

Dependencies: TimeSynchronization Service Execution Tests, 9.26, UTCTimeSynchronization Service Execution Tests, 9.31

BACnet Reference Clauses: 12.24, 12.24.10

Purpose: This test verifies that the Schedule object writes to properties in other devices with all datatypes required and claimed for the external write operation. If the IUT supports Schedule objects that have differences in supported datatypes, then this test should be performed on at least one example of each type.

Test Concept: Two Date/Time values, D_1 and D_2, are chosen by the TD based on the criteria in Table 7-Y3 such that D_1 is sufficiently different from, and later than, the current time to cause a Schedule evaluation when the time is changed to D_1, and such that setting the time to D_2 (later than D1) from D_1 will cause a Schedule evaluation that will cause it to write value V_2. These values may be chosen based on the Schedule object's existing configuration, or the Schedule object may be configured with such values.

Configuration Requirements: The TD shall be configured to support the WriteProperty-Request service but not WritePropertyMultiple-Request in the Protocol_Services_Supported property of its Device object. The IUT shall be configured with a Schedule object, S, such that the time periods defined in Table 7-Y3 can be configured with uniquely scheduled values. The Schedule object shall be configured with a List_Of_Object_Property_Reference property, including at least one reference to a property in the TD. Other properties shall be consistent in both datatypes and values in a manner permitting this test to be executed.

Table 7-Y3. Criteria for Test Date and Times

Date and Time:	**Value:**
D_1	V_1
D_2	V_2 different from V_1.

Test Steps:

1. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D1)
   | MAKE (the local date and time = D1)
2. BEFORE **Schedule_Evaluation_Fail_Time**
   REPEAT X = (every reference to the TD in
   List_Of_Object_Property_References) DO {
   RECEIVE WriteProperty-Request,
   'Object Identifier' = (the object identifier of X),
   'Property Identifier' = (the property of X),
   'Property Value' = V_1
   'Priority' = (the value of the Schedule object's Priority_For_Writing property)
   TRANSMIT BACnet-SimpleACK-PDU
   }
3. VERIFY S, Present_Value = V_1
4. (TRANSMIT TimeSynchronization-Request, ' Time' = D_2)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D2)
   | MAKE (the local date and time = D2)
5. BEFORE **Schedule_Evaluation_Fail_Time**
   REPEAT X = (every reference to the TD in
   List_Of_Object_Property_References) DO {
   RECEIVE WriteProperty-Request,
   'Object Identifier' = (the object identifier of X),
   'Property Identifier' = (the property of X),
   'Property Value' = V_2,
   'Priority' = (the value of the Schedule object's Priority_For_Writing property)
   TRANSMIT BACnet-SimpleACK-PDU
   }
6. VERIFY S, Present_Value = V_2

Note to Tester: The Priority parameter for the WriteProperty-Request may be left out if the Schedule is configured with a value of 16 in its Priority_For_Writing property. The test shall pass regardless of the order in which the IUT generates the WriteProperty-Requests in steps 2 and 5.

7.3.2.23.Y.4 Externally Written Datatypes Test, NULL values and Priority_Arrays

Dependencies: TimeSynchronization Services Execution Tests, 9.26; UTCTimeSynchronization Service Execution Tests, 9.31

BACnet Reference Clauses: 12.24, 12.24.9

Purpose: This test verifies that the Schedule object writes NULLs to priority arrays (via Present_Value) in other devices.

Test Concept: Two Date/Time values, D_1 and D_2, are chosen by the TD based on the criteria in Table 7-Y4 such that D_1 is sufficiently different from current time to cause a Schedule evaluation when the time is changed to D_1, and such that setting the time to D_2 from D_1 will cause a Schedule evaluation that will cause it to write value V_2. These values may be chosen based on the Schedule object's existing configuration, or the Schedule object may be configured with such values, and either V_1 or V_2, but not both, has datatype NULL. The values are written to a Present_Value property with the priority designated by the Schedule object's Priority_For_Writing property. For devices of protocol revision 4 or higher, the Schedule_Default shall be set to NULL and the schedule shall be configured such that at time D_1 or D_2, but not both, the schedule shall take on the value of Schedule_Default.

Configuration Requirements: The TD shall be configured to support the WriteProperty-Request service but not WritePropertyMultiple-Request in the Protocol_Services_Supported property of its Device object. The IUT shall be configured with a Schedule object, S, such that the time periods defined in Table 7-Y4 can be configured with uniquely scheduled values. The Schedule object shall be configured with a Priority_For_Writing value other than 16, and with a List_Of_Object_Property_References, including at least one reference to a Present_Value property in an object in the TD containing a Priority_Array property.

Table 7-Y4. Criteria for Test Date and Times

Date and Time:	**Value:**
D_1	V_1
D_2	V_2 different from V_1.

Test Steps:

1. (TRANSMIT TimeSynchronization-Request, 'Time' = D_1)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D_1)
   | MAKE (the local date and time = D_1)
2. BEFORE **Schedule_Evaluation_Fail_Time**
   REPEAT X = (every reference to the TD in List_Of_Object_Property_References) DO {
   RECEIVE WriteProperty-Request,
   'Object Identifier' = (the object identifier of X),
   'Property Identifier' = (the property of X),
   'Property Value' = V_1,
   'Priority' = (the value of the Schedule object's Priority_For_Writing property)
   TRANSMIT BACnet-SimpleACK-PDU
   }
3. VERIFY S, Present_Value = V_1
4. (TRANSMIT TimeSynchronization-Request, 'Time' = D_2)
   | (TRANSMIT UTCTimeSynchronization-Request, 'Time'=D_2)
   | MAKE (the local date and time = D_2)
5. BEFORE **Schedule_Evaluation_Fail_Time**
   REPEAT X = (every reference to the TD in List_Of_Object_Property_References) DO {
   RECEIVE WriteProperty-Request,
   'Object Identifier' = (the object identifier of X),
   'Property Identifier' = (the property of X),
   'Property Value' = V_2,
   'Priority' = (the value of the Schedule object's Priority_For_Writing property)
   TRANSMIT BACnet-SimpleACK-PDU
   }
6. VERIFY S, Present_Value = V_2

Note to Tester: The Priority parameter for the WriteProperty-Request may be left out if the Schedule is configured with a value of 16 in its Priority_For_Writing property. The test shall pass regardless of the order in which the IUT generates the WriteProperty-Requests in steps 2 and 5.

[Add a new entry to **History of Revisions**, p. 489]

(This History of Revisions is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard.)

HISTORY OF REVISIONS

Summary of Changes to the Standard
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Addendum *g* to ANSI/ASHRAE 135.1-2009 Approved by the ASHRAE Standards Committee January 29, 2011; by the ASHRAE Board of Directors February 2, 2011; and by the American National Standards Institute February 3, 2011. 1. Correct Test Step Indention. 2. Remove Recipient Test. 3. Correct Errors in Routing Tests. 4. Change the Ignore Process ID Test. 5. Add Max Info Frames Check. 6. Add Test for Device Identifier Recipients. 7. Add Test for Network Address Recipients. 8. Add Tests for Disable Initiation. 9. Change Tests for Out_Of_Service, Status_Flags, and Reliability. 10. Add Tests for Non-router Network Layer Messages. 11. Remove Time Delay in TO-FAULT Tests. 12. Make Additions to the TCSL Language. 13. Change Acknowledge Alarm Initiation Tests. 14. Add New Tests for Reading and Presenting Properties. 15. Add New Event Notification Tests. 16. Update Trending Tests for Revision 3. 17. Add New Tests for Revision 4 Schedules. 18. Add New Test for Event Notification Network Priority. 19. Add Device and Network Mapping Tests. 20. Add Device Restart Notification Tests. 21. Add Schedule Written Datatypes Tests.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.