ASHRAE STANDARD

BACnet®—A Data Communication Protocol for Building Automation and Control Networks

Approved American National Standard

ANSI

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ASHRAE Standing Standard Project Committee 135
Cognizant TC: TC 1.4, Control Theory and Application
SPLS Liaison: Douglas T. Reindl

SPECIAL NOTE

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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*r* to ANSI/ASHRAE Standard 135-2008 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.

135-2008*r*-1. Clarify transitions in FLOATING_LIMIT and OUT_OF_RANGE events, p. 2.
135-2008*r*-2. Clarify router action when a network is marked as temporarily unreachable, p. 6.
135-2008*r*-3. Clarify the destination MAC used when replying to a broadcast DER frame, p. 7.
135-2008*r*-4. Clarify the handling of write priorities greater than 16, p. 8.
135-2008*r*-5. Clarify LogDatum presentation, p. 10.

In the following document, language to be added to existing clauses of ANSI/ASHRAE 135-2008 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.

SSPC 135 wishes to acknowledge the following people for their help they provided in developing this addendum: James Butler, Howard Coleman, Phillipe Goetz, John Hartman and René Kälin.

135-2008*r*-1. Clarify transitions in FLOATING_LIMIT and OUT_OF_RANGE events.

Rationale
Interpretation IC 135-2004-8 (approved by SSPC 135 on June 25, 2005) states "An object that reports FLOATING_LIMIT or OUT_OF_RANGE events shall not generate TO-OFFNORMAL transitions from an OFFNORMAL (LOW_LIMIT or HIGH_LIMIT) state." This clarification needs to be embodied in the language in the standard.

Addendum 135-2008*r*-1

[Change **12.2.19.1**, p. 142]

12.2.19.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must exceed the High_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the HighLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *property, and*
(d) *the Event_State must not be equal to LOW_LIMIT.*

The Analog Input object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from LOW_LIMIT to HIGH_LIMIT, the object shall first transition to the NORMAL state.

[Change **12.2.20.1**, p. 143]

12.2.20.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must fall below the Low_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the LowLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *property, and*
(d) *the Event_State must not be equal to HIGH_LIMIT.*
.
The Analog Input object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from HIGH_LIMIT to LOW_LIMIT, the object shall first transition to the NORMAL state.

[Change **12.3.20.1**, pp. 147]

12.3.20.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must exceed the High_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the HighLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *property, and*
(d) *the Event_State must not be equal to LOW_LIMIT.*

The Analog Output object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from LOW_LIMIT to HIGH_LIMIT, the object shall first transition to the NORMAL state.

[Change **12.3.21.1**, p. 148]

12.3.21.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must fall below the Low_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the LowLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *, property, and*
(d) the Event_State must not be equal to HIGH_LIMIT.

The Analog Output object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from HIGH_LIMIT to LOW_LIMIT, the object shall first transition to the NORMAL state.

[Change **12.4.26.1**, p. 152]

12.4.16.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must exceed the High_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the HighLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *, property, and*
(d) the Event_State must not be equal to LOW_LIMIT.

.

The Analog Value object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from LOW_LIMIT to HIGH_LIMIT, the object shall first transition to the NORMAL state.

[Change **12.4.17.1**, pp. 152-153]

12.4.17.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must fall below the Low_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the LowLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *, property, and*
(d) the Event_State must not be equal to HIGH_LIMIT.

The Analog Value object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from HIGH_LIMIT to LOW_LIMIT, the object shall first transition to the NORMAL state.

[Change **12.17.32**, p. 214]

12.17.32 Error_Limit

This property, of type REAL, shall convey the absolute magnitude that the difference between the Setpoint and Controlled_Variable_Value (the Error) must exceed before a TO-OFFNORMAL event is generated. This property is required if intrinsic reporting is supported by this object.

The Loop object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from LOW_LIMIT to HIGH_LIMIT, or HIGH_LIMIT to LOW_LIMIT, the object shall first transition to the NORMAL state.

12.23.22.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must exceed the High_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the HighLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable property~~.~~, *property, and*
(d) *the Event_State must not be equal to LOW_LIMIT.*

The Pulse Converter object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from LOW_LIMIT to HIGH_LIMIT, the object shall first transition to the NORMAL state.

12.23.23.1 Conditions for Generating a TO-OFFNORMAL Event

A TO-OFFNORMAL event is generated under these conditions:

(a) the Present_Value must fall below the Low_Limit for a minimum period of time, specified in the Time_Delay property, and
(b) the LowLimitEnable flag must be set in the Limit_Enable property, and
(c) the TO-OFFNORMAL flag must be set in the Event_Enable ~~property.~~ *, property, and*
(d) *the Event_State must not be equal to HIGH_LIMIT.*

The Pulse Converter object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from HIGH_LIMIT to LOW_LIMIT, the object shall first transition to the NORMAL state.

Table 13-2. Standard Objects That May Support Intrinsic Reporting

Object Type	Criteria	Event Type
…	….	…
Loop	~~If the absolute difference between Setpoint and Controlled_Variable_Value exceeds Error_Limit for longer than Time_Delay AND the new transition is enabled in Event_Enable~~ *If Controlled_Variable_Value is above (Setpoint + Error_Limit) for longer than Time_Delay AND the TO-OFFNORMAL flag is set in Event_Enable AND Event_State is NORMAL,* *OR* *If Controlled_Variable_Value is below (Setpoint - Error_Limit) for longer than Time_Delay AND the TO-OFFNORMAL flag is set in Event_Enable AND Event_State is NORMAL,* *OR* *If Controlled_Variable_Value is below ((Setpoint + Error_Limit) – Deadband) for longer than Time_Delay AND the TO-NORMAL flag is set in Event_Enable AND Event_State is HIGH_LIMIT,* *OR* *If Controlled_Variable_Value is above ((Setpoint - Error_Limit) + Deadband) for longer than*	FLOATING_LIMIT

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	Time_Delay AND the TO-NORMAL flag is set in Event_Enable AND Event_State is LOW_LIMIT	
Analog Input, Analog Output, Analog Value, Pulse Converter	~~If Present_Value exceeds range between High_Limit and Low_Limit for longer than Time_Delay AND the new transition is enabled in Event_Enable and Limit_Enable,~~ ~~OR~~ ~~Present_Value returns within the High_Limit - Deadband to Low_Limit + Deadband range for longer than Time_Delay AND the new transition is enabled in Event_Enable and Limit_Enable~~ *If Present_Value is above High_Limit for longer than Time_Delay AND the HighLimitEnable flag is set in Limit_Enable AND the TO-OFFNORMAL flag is set in Event_Enable AND Event_State is NORMAL,* *OR* *If Present_Value is below Low_Limit for longer than Time_Delay AND the LowLimitEnable flag is set in Limit_Enable AND the TO-OFFNORMAL flag is set in Event_Enable AND Event_State is NORMAL,* *OR* *If Present_Value is below High_Limit - Deadband for longer than Time_Delay AND the TO-NORMAL flag is set in Event_Enable AND the HighLimitEnable flag is set in Limit_Enable AND Event_State is HIGH_LIMIT,* *OR* *If Present_Value is above Low_Limit + Deadband for longer than Time_Delay AND the TO-NORMAL flag is set in Event_Enable AND the LowLimitEnable flag is set in Limit_Enable AND Event_State is LOW_LIMIT*	OUT_OF_RANGE
…	…	…

[Change Clause **13.3.6,** p. 301]

….

An OUT_OF_RANGE occurs if the referenced property leaves a range of values defined by the High_Limit and Low_Limit parameters and remains there for Time_Delay seconds. If the transition is to a value above the High_Limit or below the Low_Limit, the Event Enrollment object generates a TO-OFFNORMAL transition. The event notification shall show an 'Event Type' of OUT_OF_RANGE.

The Event Enrollment object shall not generate a TO-OFFNORMAL transition from the LOW_LIMIT or HIGH_LIMIT state. When transitioning from LOW_LIMIT to HIGH_LIMIT, or HIGH_LIMIT to LOW_LIMIT, the object shall first transition to the NORMAL state.

An OUT_OF_RANGE clears when the referenced property attains a value greater than the (Low_Limit + Deadband) or a value less than the (High_Limit - Deadband) and remains there for Time_Delay seconds. Note that the limit values may be Boolean TRUE or FALSE as well as analog values. The Event Enrollment object generates a TO-NORMAL transition. The event notification shall show an 'Event Type' of OUT_OF_RANGE. See Figure 13-8.

135-2008*r*-2. Clarify router action when a network is marked as temporarily unreachable.

Rationale
Interpretation IC 135-2004-10 (approved by SSPC 135 on June 25, 2005) states "If a router receives a message that is destined for a particular network that is marked as temporarily unreachable in the routing table, then the router must respond by transmitting a Reject-Message-To-Network message with reject reason 2." This clarification needs to be embodied in the language in the standard.

Addendum 135-2008*r*-2

[Change **Clause 6.6.3.6**, p. 62]

6.6.3.6   Router-Busy-To-Network

If a router wishes to curtail the receipt of messages for specific DNETs or all DNETs, it shall generate a Router-Busy-To-Network message.

If a router temporarily wishes to receive no more traffic for one or more specific DNETs, it shall broadcast a Router-Busy-To-Network message with a list of the 2-octet network numbers corresponding to these DNETs. If the 2-octet network numbers are omitted, it means the router wishes to stop the flow of messages to all the networks it normally serves.

Each router receiving a Router-Busy-To-Network message shall update its routing table to indicate that the specified DNETs are not reachable, set or reset a 30-second timer for this status, and broadcast a Router-Busy-To-Network message out each port other than the one on which it was received so that all routers may learn of the congestion control restriction. *The congestion control indication shall be cleared upon expiration of the 30-second timer. Upon receiving a message whose destination is on one of the temporarily unreachable DNETs, a router shall send a Reject-Message-To-Network message with a reject reason of 2 to the originating node.*

Normally, a Router-Busy-To-Network message should be followed in a short time by a Router-Available-To-Network message indicating that the congestion control restriction has been lifted. ~~In the event that this does not happen within a timeout period of 30 seconds or if a node that has recently joined the network did not receive a previous Router-Busy-To-Network message, it may attempt a transmission to the "busy" router.~~ *In the event that a router receives a message while it is still requiring congestion control and* ~~If~~ the router is able to accept the message, it shall do so and, at its discretion, again broadcast a Router-Busy-To-Network message for the benefit of this node and any others that may not have received the previous transmission. If the router is unable to accept the message, it shall immediately return a Reject-Message-To-Network to the sender. It may then also broadcast another Router-Busy-To-Network message for the reasons cited above.

135-2008*r*-3. Clarify the destination MAC used when replying to a broadcast DER frame.

Rationale
Interpretation IC 135-2004-22 (approved by SSPC 135 on April 25, 2007) states "In Clause 6.5.3 of 135 the 4th method for establishing the address of a router was never intended to be used for replies as the request indicates the router address. When replying to a DER frame from a remote network, if the responding device does not already know a route to the remote network, it shall use the source MAC address from the DER frame as the address through which to route the response frame" (with additional comments). This clarification needs to be embodied in the language in the standard.

Addendum 135-2008*r*-3

[Change **Clause 6.5.3**, p. 57]

….

Note that ~~four~~ *five* methods exist for establishing the address of a BACnet router for a particular DNET: 1) the address may be established manually at the time a device is configured, 2) the address may be learned by issuing a Who-Is request and noting the SA associated with the subsequent I-Am message (assuming the device specified in the Who-Is is located on a remote DNET and the I-Am message was handled by a router on the local network), 3) by using the network layer message Who-Is-Router-To-Network, ~~and~~ 4) by using the local broadcast MAC address in the initial transmission to a device on a remote DNET and noting the SA associated with any subsequent responses from the remote ~~device.~~ *device, and 5) by noting the SA associated with any requests received from the remote DNET*. Which method is used shall be a local matter.

The local broadcast MAC address may be used in response messages, although it is discouraged. It is preferable that a device note the SA associated with the original request and reuse that SA in the response. For MS/TP networks, in order for MS/TP master devices to use the local broadcast MAC address in a response, a Reply Postponed MAC frame shall be sent in response to the BACnet Data Expecting Reply frame and the response may then be sent when the MS/TP master device receives the token. MS/TP slave devices are unable to use the local broadcast MAC address for responses because they never receive the token.

135-2008*r*-4. Clarify the handling of write priorities greater than 16.

Rationale
Interpretation request IC135-2004-19 deals with how to handle write requests with a priority parameter greater than 16. This proposed changed codifies the answer.

Addendum 135-2008*r*-4

[Change **Clause 15.9.1.3.1**, p. 358.]

15.9.1.3.1 Error Type

This parameter consists of two component parameters: (1) an 'Error Class' and (2) an 'Error Code'. See Clause 18. The 'Error Class' and 'Error Code' to be returned for specific situations are as follows:

Situation	Error Class	Error Code
….	…	…
The data being written has a datatype not supported by the property.	PROPERTY	DATATYPE_NOT_SUPPORTED
The Priority parameter is not within the defined range of 1..16. This condition may be ignored if the property is not commandable.	*SERVICES*	*PARAMETER_OUT_OF_RANGE*

[Change **15.10.1.3.1,** pp. 359-360.]

15.10.1.3.1 Error Type

This parameter consists of two component parameters: (1) an 'Error Class' and (2) an 'Error Code'. See Clause 18. The 'Error Class' and 'Error Code' to be returned in a 'Result(-)' for specific situations are as follows:

Situation	Error Class	Error Code
….	…	…
The data being written has a datatype not supported by the property.	PROPERTY	DATATYPE_NOT_SUPPORTED
The Priority parameter is not within the defined range of 1..16. This condition may be ignored if the property is not commandable.	*SERVICES*	*PARAMETER_OUT_OF_RANGE*

[Change **15.10.2,** WritePropertyMultiple service procedure, p. 360]

15.10.2 Service Procedure

For each 'Write Access Specification' contained in the 'List of Write Access Specifications', the value of each specified property shall be replaced by the property value provided in the 'Write Access Specification' and a 'Result(+)' primitive shall be issued, indicating that the service request was carried out in its entirety. Interpretation of the conditional Priority parameter shall be as specified in Clause 19.

If, in the process of carrying out the modification of the indicated properties in the order specified in the 'List of Write Access Specifications', a property is encountered that cannot be modified, the responding BACnet-user shall issue a 'Result(-)' response primitive indicating the reason for the failure. The result of this service shall be either that all of the specified properties or only the properties up to, but not including, the property specified in the 'First Failed Write Attempt' parameter were successfully modified.

A BACnet-Reject-PDU shall be issued only if no write operations have been successfully executed, indicating that the service request was rejected in its entirety. If any of the write operations contained in the 'List of Write Access Specifications' have been successfully executed, a Result(-) response indicating the reason for the failure shall be issued as described above.

[Insert new Clause **18.6.X**, p. 394.]

18.6.X   PARAMETER_OUT_OF_RANGE - Generated in response to a confirmed request APDU that conveys a parameter whose value is outside the range defined for this service.

[Change **20.1.8**, p. 414.]

20.1.8 BACnet-Reject-PDU

The BACnet-Reject-PDU is used to reject a received confirmed request PDU that contains syntactical flaws or other protocol errors which would prevent the PDU from being interpreted or the requested service from being provided. Only confirmed request PDUs may be rejected (see *Clause* 18.8).

There are error conditions where a valid reject-reason and an equally valid error code exist that can be used to describe the condition. In such cases it is a local matter whether or not a BACnet-Reject-PDU is used to convey the error, with the exception that a BACnet-Reject-PDU shall not be returned if service execution has commenced and the execution has resulted in a standard network visible change in the device's state. For example, a WritePropertyMultiple-Request shall not be rejected if at least one of the write operations has already been applied. In such cases an error code shall be used.

```
BACnet-Reject-PDU ::= SEQUENCE {
    pdu-type        [0] Unsigned (0..15), -- 6 for this PDU type
    reserved        [1] Unsigned (0..15), -- must be set to zero
    original-invokeID [2] Unsigned (0..255),
    reject reason   [3] BACnetRejectReason
-- Context specific tags 0..3 are NOT used in header encoding
    }
```

[Change **Clause 21**, Error production, pp. 446-447]

```
Error ::= SEQUENCE {
    …
    error-code    ENUMERATED {
        …
        optional-functionality-not-supported    (45),
        parameter-out-of-range                  (80),
        password-failure                        (26),
        ...
        -- see not-configured-for-triggered-logging (78),
        -- enumeration values 79 through 82 are reserved for future addenda
        -- enumeration value 79  is reserved for future addenda
        -- see parameter-out-of-range           (80)
        -- enumeration values 81 and 82 are reserved for future addenda
         -- see communication-disabled          (83),
        ...
        }
    -- Enumerated values 0-255 are reserved for definition by ASHRAE. Enumerated values
    -- 256-65535 may be used by others subject to the procedures and constraints described
    -- in Clause 23.
    }
```

135-2008*r*-5. Clarify LogDatum presentation.

Rationale
Interpretation request IC135-2004-17 noted that the language in the Trend Log's Log_Buffer property element LogDatum, "These choices represent data values read from the monitored object and property," was ambiguous in terms of whether the Trend Log was allowed to present data values in different datatypes from those read, such as reading (INTEGER) 2 and presenting it as (REAL) 2.0. This proposed change codifies the answer. For consistency, the same changes are made to the Trend Log Multiple object type introduced by addendum b to 135-2004.

Addendum 135-2008*r*-5

[Change **Clause 12.25.14**, p. 253.]

12.25.14 Log_Buffer

…
The choices available for the LogDatum are listed below:

…	…
boolean-value real-value enum-value unsigned-value signed-value bitstring-value null-value	These choices represent *the* data values *and datatypes* read from the monitored object and property.
…	…
any-value	This choice represents *the* data values *and datatypes* read from the monitored object and property.

[Change **Clause 12.30.19**, p. 286.]

12.30.19 Log_Buffer

...
The choices available for LogData are listed below:

…	….
log-data	The set of logged values. The order of logged values shall correspond to the order of the Log_DeviceObjectProperty array.

	boolean-value real-value enum-value unsigned-value signed-value bitstring-value null-value	These choices represent *the* data values *and datatypes* read from the monitored object and property.
	any-value	This choice represents *the* data values *and datatypes* read from the monitored object and property.
	…	…
…	…	

[Add a new entry to **History of Revisions**, p. 688]

(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

Protocol		Summary of Changes to the Standard
Version	**Revision**	
…	…	…
1	9	**Addendum *r* to ANSI/ASHRAE 135-2008** Approved by the ASHRAE Standards Committee June 20, 2009; by the ASHRAE Board of Directors June 24, 2009; and by the American National Standards Institute June 25, 2009. 1. Clarify transitions in FLOATING_LIMIT and OUT_OF_RANGE events. 2. Clarify router action when a network is marked as temporarily unreachable. 3. Clarify the destination MAC used when replying to a broadcast DER frame. 4. Clarify the handling of write priorities greater than 16. 5. Clarify LogDatum presentation.

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.