



ASHRAE STANDARD

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

Approved by the ASHRAE Standards Committee on June 20, 2009; by the ASHRAE Board of Directors on June 24, 2009; and by the American National Standards Institute on June 25, 2009.

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**American Society of Heating, Refrigerating
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1791 Tullie Circle NE, Atlanta, GA 30329
www.ashrae.org

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[This foreword and the “rationale” on the following page are not part of this standard. They are merely informative and do not contain requirements necessary for conformance to the standard.]

FOREWORD

Addendum 135*o* 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*o*-1. Accommodate remote operator access and NAT in Annex J BACnet/IP, p. 2.

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 ~~strike through~~. Where entirely new subclauses are added, plain type is used throughout.

SSPC 135 wishes to express its appreciation to Howard Coleman, John Hartman, Dean Matsen, Bryan Meyers and Andreas Schlumberger for the help they provided in developing this addendum.

135-2008o-1. Accommodate remote operator access and NAT in Annex J BACnet/IP.

Rationale

Two common uses cases for Annex J BACnet/IP are not sufficiently well accommodated by Annex J: Network Address Translation (NAT) and operator access across the Internet to multiple remote subnets. Some small changes have been implemented to accommodate these cases.

Addendum 135-2008o-1

[Add new acronym to Clause 3.3, pp. 5-7, in alphabetic order.]

...
NAT Network Address Translation – RFC 2663
...

[Change ANNEX A, p. 495.]

Networking Options:

- Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
- Annex H, BACnet Tunneling Router over IP
- BACnet/IP Broadcast Management Device (BBMD)
 - Does the BBMD support registrations by Foreign Devices? Yes No
 - Does the BBMD support network address translation? Yes No

[Change Clause J.2.5, p. 619.]

J.2.5 Forwarded-NPDU: Purpose

This BVLL message is used in broadcast messages from a BBMD as well as in messages forwarded to registered foreign devices. It contains the source address of the original ~~node~~ node, *or if NAT is being used, the address with which the original node is accessed* as well as the original BACnet NPDU.

[Change Clause J.4.3, p. 621.]

J.4.3 BBMD Concept

Each IP subnet that is part of a B/IP network comprised of two or more subnets shall have ~~one, and only one, BBMD.~~ *at least one BBMD.* Each BBMD shall possess a table called a Broadcast Distribution Table ~~(BDT) which shall be the same in every BBMD in a given B/IP network.~~ *(BDT). If there are two or more BBMDs on a single subnet, their BDTs shall not contain any common entries in order to avoid a broadcast forwarding loop. The BDT determines which remote IP subnets receive forwarded BACnet broadcasts. To reduce BACnet broadcast traffic, it is possible to configure the BDT to forward broadcasts only to IP subnets where they are required.* If the BBMD has also been designated to register foreign devices as described below, it shall also possess a Foreign Device Table (FDT).

[Change Clause J.4.3.2, p. 622.]

J.4.3.2 Broadcast Distribution Table Format

The BDT consists of one entry for ~~each BBMD within a B/IP network.~~ *the address of the BBMD for the local IP subnet and an entry for the BBMD on each remote IP subnet to which broadcasts are to be forwarded.* Each entry consists of the 6-octet B/IP address ~~of the BBMD serving the IP subnet with which the BBMD is accessed~~ and a 4-octet broadcast distribution mask. *If the IP router to the subnet performs network address translation (NAT), then the BDT entry shall contain the global IP address of the IP router. The operation of BBMDs in the presence of NAT is described in J.7.2.* If messages are to be distributed on the remote IP subnet using directed broadcasts, the broadcast distribution mask shall be identical to the subnet mask associated with the subnet, i.e., all 1's in the network portion of the 4-octet IP address field and

all 0's in the host portion. If messages are to be distributed on the remote IP subnet by sending the message directly to the remote BBMD, the broadcast distribution mask shall be all 1's. *The broadcast distribution masks referring to the same IP subnet shall be identical in each BDT.* The use of the broadcast distribution mask is described in J.4.5.

[Change **Clause J.4.5** p. 622.]

J.4.5 BBMD Operation - Broadcast Distribution

...

Upon receipt of a BVLL Forwarded-NPDU message, a BBMD shall process it according to whether it was received from a peer BBMD as the result of a directed broadcast or a unicast transmission. A BBMD may ascertain the method by which Forwarded-NPDU messages will arrive by inspecting the broadcast distribution mask field in its own BDT entry since ~~all BDTs are required to be identical.~~ *masks referring to the same subnet are required to be identical in all BBMDs.* If the message arrived via directed broadcast, it was also received by the other devices on the BBMD's subnet. In this case the BBMD merely retransmits the message directly to each foreign device currently in the BBMD's FDT. If the message arrived via a unicast transmission, it has not yet been received by the other devices on the BBMD's subnet. In this case, the message is sent to the devices on the BBMD's subnet using the B/IP broadcast address as well as to each foreign device currently in the BBMD's FDT. A BBMD on a subnet with no other BACnet devices (*such as a NAT-supporting BBMD, see J.7.2*) may omit the broadcast using the B/IP broadcast address. The method by which a BBMD determines whether or not other BACnet devices are present is a local matter.

...

[Insert new **Clause J.7.X**, p. 627, and renumber subsequent clauses.]

J.7.X BBMD Operation with Network Address Translation

Network Address Translation (NAT) is in widespread use by IP routers and firewalls to connect private subnets to the global Internet. Using NAT, multiple hosts on a subnet can access the Internet using a single public IP address. BBMD operation supporting NAT routers is optional for BBMD devices. A single BACnet device may contain several B/IP network ports, each with its own internal BBMD.

For those B/IP networks that communicate through a NAT router, there are several additional considerations:

- a) For any single B/IP network, only one device on the local side of the NAT router may be accessible from the global side. All other devices on the local side of that NAT router need to be on different BACnet networks so that they can be uniquely addressed using the BACnet network layer. The globally accessible device will contain a BACnet router to those networks. The globally accessible device may be either a BBMD or a foreign device.
- b) The NAT router at each subnet location should be configured to port forward B/IP messages to the BBMD. Port forwarding causes all messages directed to the specified port to be forwarded to a specific local address.
- c) To enable messages to traverse the Internet, the destination IP address and UDP port in all Forwarded-NPDU messages shall be the global IP address and UDP port of the destination subnet. This is facilitated by entering the global B/IP address of each BBMD in the BDT.
- d) Except when propagating a received Forwarded-NPDU message, the "B/IP Address of Originating Device" field in Forwarded-NPDU messages is the global IP address and port of the NAT Router through which the BBMD communicates. This is required so that responding devices on the remote subnet may communicate with the originating device. Received Forwarded-NPDU messages are propagated as-is to foreign devices and to the local IP subnet as defined in J.4.5
- e) A foreign device behind a NAT router should register often with a BBMD to maintain a return path through the NAT router back to the foreign device. The maximum allowed time between registrations is dependent on the NAT router, and may be 30 seconds or less.
- f) Two-hop distribution shall be used in B/IP networks that contain NAT routers, since one-hop distribution is not possible through NAT routers.

A B/IP internetwork containing NAT Routers can be configured several ways. See Figures J-X1 and J-X2 for example configurations.

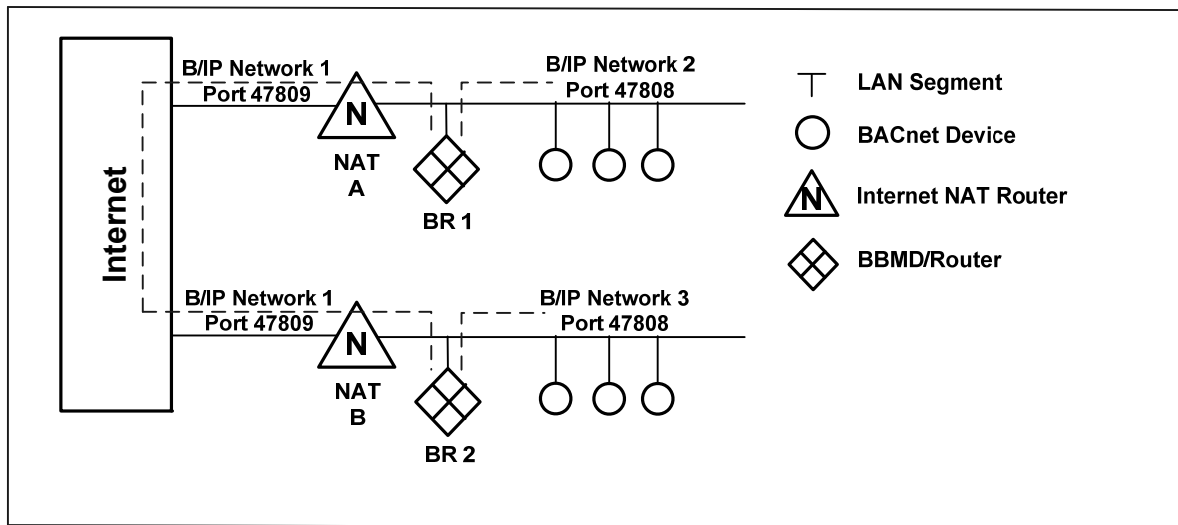


Figure J-X1. This figure represents a B/IP internetwork that uses the Internet to connect two remote sites. The NAT devices translate global Internet IP/Port addresses into private addresses. Different networks behind NAT devices may use the same IP/Port address range as demonstrated here. Both B/IP network 2 and B/IP network 3 use locally-assigned IP addresses from the subnet 192.168.1.* and UDP port 47808.

NAT A Configuration

Internet IP 201.1.1.1
 Forward 201.1.1.1:47809 → 192.168.1.10:47809

NAT B Configuration

Internet IP 237.2.2.2
 Forward 237.2.2.2:47809 → 192.168.1.10:47809

BR1 - BBMD/Router Configuration

Global IP Address 201.1.1.1:47809 (global B/IP address of NAT A)
 B/IP Address Net 1 192.168.1.10:47809
 BDT Net 1 201.1.1.1:47809 (global B/IP address of NAT A, self),
 237.2.2.2:47809 (global B/IP address of NAT B)
 B/IP Address Net 2 192.168.1.10:47808
 BDT Net 2 192.168.1.10:47808 (self)

BR2 - BBMD/Router Configuration

Global IP Address 237.2.2.2:47809 (global B/IP address of NAT B)
 B/IP Address Net 1 192.168.1.10:47809
 BDT Net 1 237.2.2.2:47809 (global B/IP address of NAT B, self),
 201.1.1.1:47809 (global B/IP address of NAT A)
 B/IP Address Net 3 192.168.1.10:47808
 BDT Net 3 192.168.1.10:47808 (self)

The broadcast distribution masks in the above BDT configurations are 255.255.255.255 indicating two-hop broadcast distribution.

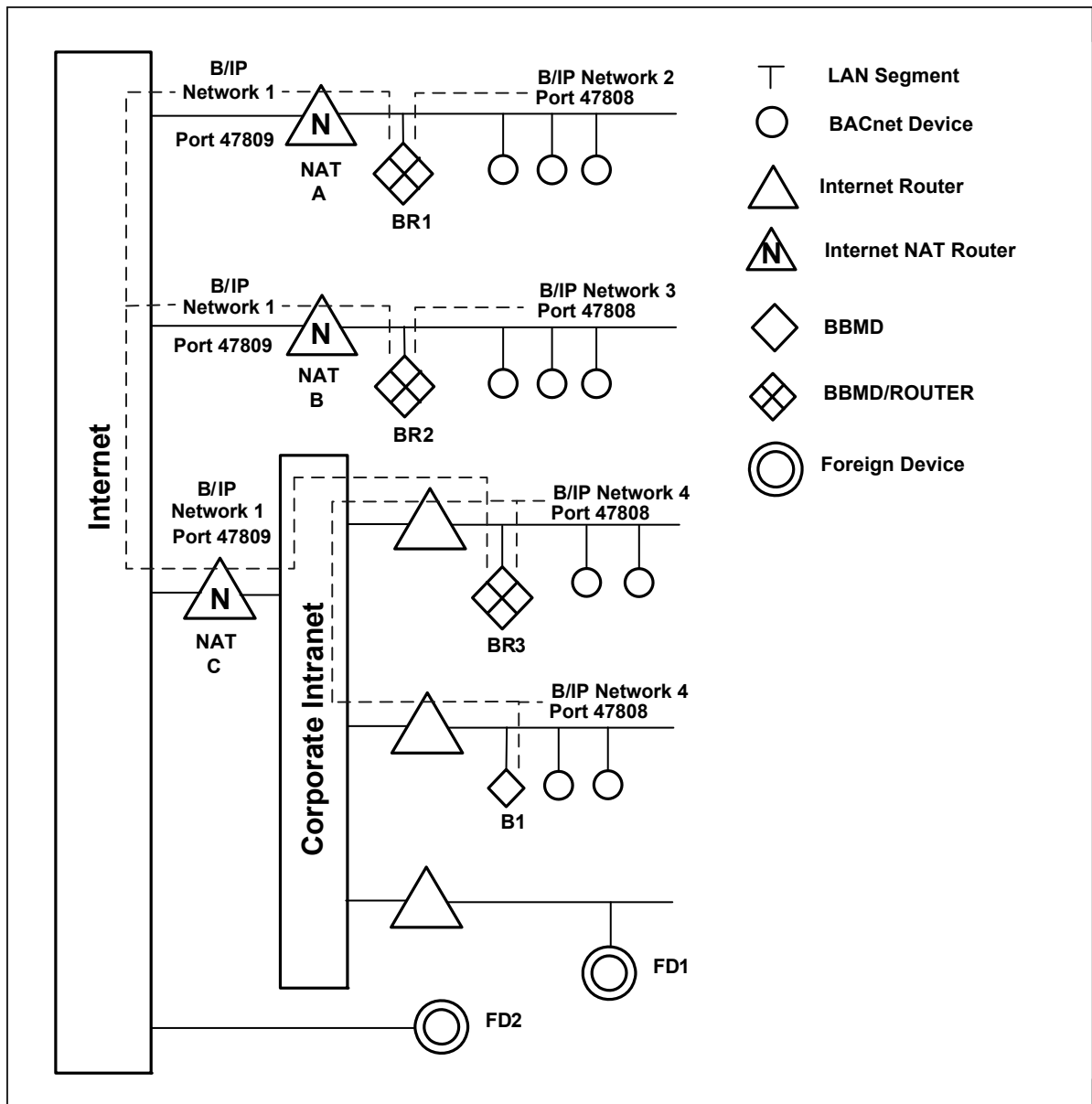


Figure J-X2. This figure represents a potential WAN with multiple remote sites, with BACnet being connected via a corporate intranet. In this configuration, the foreign device FD1 can connect to Network 4 using local addresses and to Networks 2 and 3 using the global IP address of the NAT routers. The foreign device FD2 can only connect to the global IP addresses on the Internet side of the NAT routers.

NAT A Configuration

Internet IP 201.1.1.1
 Forward 201.1.1.1:47809 → 192.168.1.10:47809

NAT B Configuration

Internet IP 237.2.2.2
Forward 237.2.2.2:47809 → 192.168.1.10:47809

NAT C Configuration

Internet IP 203.3.3.3
Forward 203.3.3.3:47809 → 192.168.20.10:47809

BR1 - BBMD/Router Configuration

Global IP Address 201.1.1.1:47809 (global B/IP address of NAT A)
B/IP Address Net 1 192.168.1.10:47809
BDT Net 1 201.1.1.1:47809 (global B/IP address of NAT A, self),
237.2.2.2:47809 (global B/IP address of NAT B),
203.3.3.3:47809 (global B/IP address of NAT C)
B/IP Address Net 2 192.168.1.10:47808
BDT Net 2 192.168.1.10:47808 (self)

BR2 - BBMD/Router Configuration

Global IP Address 237.2.2.2:47809 (global B/IP address of NAT B)
B/IP Address Net 1 192.168.1.10:47809
BDT Net 1 237.2.2.2:47809 (global B/IP address of NAT B, self),
201.1.1.1:47809 (global B/IP of NAT A),
203.3.3.3:47809 (global B/IP of NAT C)
B/IP Address Net 3 192.168.1.10:47808
BDT Net 3 192.168.1.10:47808 (self)

BR3 – BBMD/Router Configuration

Global IP Address 203.3.3.3:47809 (global B/IP address of NAT C)
B/IP Address Net 1 192.168.20.10:47809
BDT Net 1 203.3.3.3:47809 (global B/IP address of NAT C, self),
201.1.1.1:47809 (global B/IP address of NAT A),
237.2.2.2:47809 (global B/IP address of NAT B)
B/IP Address Net 4 192.168.20.10:47808
BDT Net 4 192.168.20.10:47808 (self),
192.168.21.10:47808 (B/IP address of BBMD B1)

B1 – BBMD Configuration

B/IP Address 192.168.21.10:47808
BDT Net 4 192.168.21.10:47808 (self),
192.168.20.10:47808 (B/IP address of BBMD BR3)

The broadcast distribution masks in the above BDT configurations are 255.255.255.255, indicating two-hop broadcast distribution.

[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

<i>Protocol</i>		<i>Summary of Changes to the Standard</i>
<i>Version</i>	<i>Revision</i>	
...
1	9	<p>Addendum o 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.</p> <p>1. Accommodate remote operator access and NAT in Annex J BACnet/IP.</p>

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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.