All About BACnet Broadcast Management Devices (BBMD)

Application Guide 200731A

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Modern local area networks are fast, robust, and secure, making them an ideal infrastructure to support a BACnet internetwork. A BACnet internetwork is composed of two or more BACnet networks, each of which includes only devices of the same BACnet network protocol. As needed, BACnet routers convert the various protocols to join all networks into one BACnet internetwork. However, if the BACnet internetwork crosses the subnetwork boundaries of the Local Area Network (LAN), some BACnet traffic will be blocked, preventing device discovery and data sharing. This bulletin presents the use of BACnet Broadcast Management Devices (BBMD) as a solution to crossing subnetwork boundaries.

A simple internetwork

In Illustration1: Simple internetwork, the TotalControl workstation is configured as an IP device and the controllers are connected to an MS/TP network. The MS/TP network is connected also to a BACnet router. The BACnet router is enabled for both BACnet IP and MS/TP, which joins the two networks into a BACnet internetwork. When the Workstation broadcasts a “Who Is” or “I AM” message on the IP network, the router passes the broadcast messages to the MS/TP network. The MS/TP controllers can then respond as needed or send their own broadcast messages. This simple internetwork can freely share data because no subnetworks are involved that can block BACnet broadcast messages.

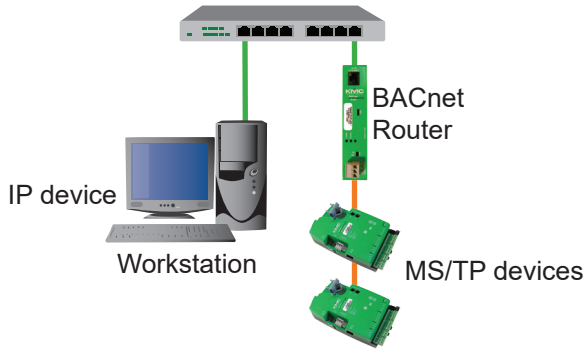


Illustration 1: Simple internetwork

BBMDs and IP subnetworks

In many installations, the BACnet IP protocol is used to integrate the various BACnet networks because it interfaces easily with the LAN. However, because broadcasting can pose a threat to network security, most IT managers block broadcast messages between IP subnetworks. To overcome blocked broadcasts, one BACnet solution places a BACnet Broadcast Management Device (BBMD) on every subnetwork that must carry BACnet traffic. A BBMD may be part of a dedicated BACnet router, such as a KMC Controls BAC-5051E, embedded in a BACnet device, or a software service running on a computer.

BBMDs monitor network traffic for BACnet broadcast messages. When they receive a broadcast message, they repackage it and then forward it to other BBMDs as a normal network message. The receiving BBMDs then unpackage the message and broadcast the original message on the local subnetworks. BBMDs know the location of other BBMDs because of an internal table that is part of every BBMD. This table, known as the Broadcast Distribution Table, or BDT, contains the address of every other BBMD on the internetwork. A BDT is added by a technician as part of the installation and configuration of the BBMD.

When configuring BBMDs and network routing, the following rules will help reduce network problems.

- Use a BBMD for permanent devices and workstations. Use Foreign Devices, detailed in Scenario 5: Foreign Device Registration, only for temporary connections.
- Connect only one BBMD with the same port number to a subnetwork.
- The BDT in every BBMD must include all BBMDs on the BACnet internetwork. If a BBMD is added to an internetwork, all BDTs must be updated.
- The BBMD must have a static IP address. The IT department must supply this address.

Planning for BBMDs

System plans are essential for installing, commissioning, and troubleshooting a BACnet internetwork. When planning an internetwork, the BACnet system engineer and the IT department contribute the following information to the system plans.

- BACnet network and port numbers are part of a BACnet router configuration and are assigned by the system engineer.
- Device instance numbers are part of a BACnet device are also assigned by the system engineer.
- IP addresses, gateways, and subnetworks are part of IP router configuration and are assigned and managed by the IT department.

While there are many possibilities for using BBMDs, the following scenarios focus on common BACnet solutions.

Scenario 1: Simple networks

The network in Illustration 1 consists of two subnetworks, each with a BACnet router that includes a BBMD. In addition, a workstation is connected to subnetwork 192.168.1.0 as a BACnet IP device. By using the BBMDs that are embedded in the BACnet routers, the BACnet devices on both IT subnetworks are joined with a single BACnet network, in this scenario Network 1 using UDP Port 47808.

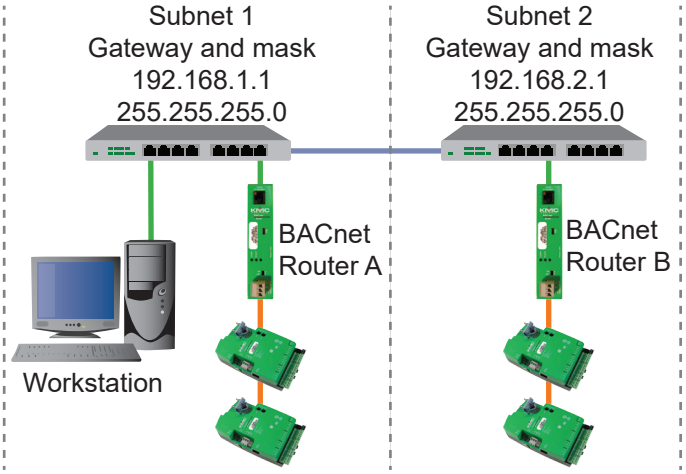


Illustration 2: Internetwork with two subnetworks

Without the BBMDs, a BACnet broadcast message sent from the workstation is blocked by the IP router at 192.168.1.0 and cannot reach the devices connected to Router B. However, the BBMD in Router A forwards the broadcast message to the BBMD in Router B. The message is then rebroadcast to the devices on subnetwork 192.168.2.0. When devices on 192.168.2.0 respond with their own broadcast messages, the process is reversed.

Router configuration for two subnetworks

TotalControl or workstation	Router A	Router B
IP: As assigned by DNS or static	IP: 192.168.1.10	IP: 192.168.2.10
Device Instance: 10	Device Instance: 1	Device Instance: 2
IP: Enabled	IP Port 1	IP Port 1
Net: 1	Enabled, BBMD	Enabled, BBMD
Port: 47808	Net: 1	Net: 1
	Port: 47808	Port: 47808
	Table (BDT)*	Table
	192.168.1.10 (self)	192.168.1.10
	192.168.2.10	192.168.2.10 (self)
	* In Table, all Subnet Mask entries are 255.255.255.255.	

Scenario 2: Adding subnetworks

Scenario 2 is similar to Scenario 1, but includes a third IT subnetwork. Adding a subnetwork to the internetwork requires adding another BBMD. Note that each BDT now includes three addresses, one for each BBMD.

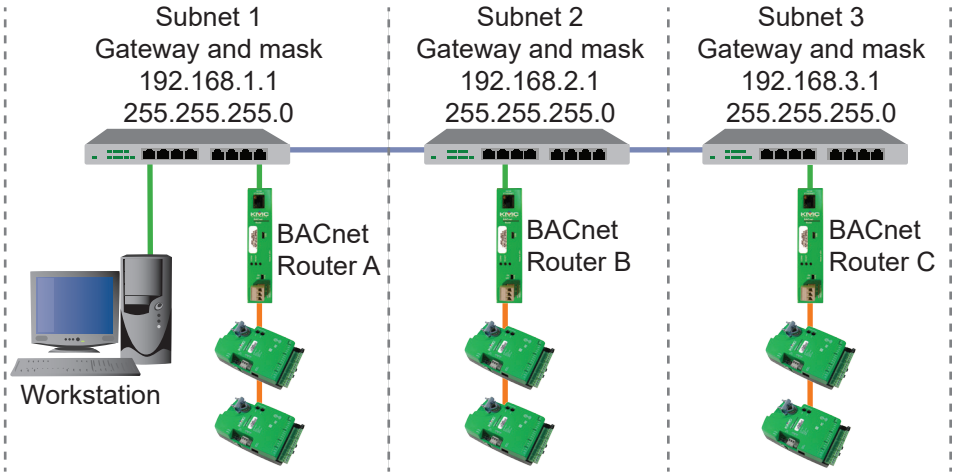


Illustration 3: Internetwork with three subnetworks

Router configuration for three subnetworks

Workstation	Router A	Router B	Router C
IP: As assigned by DNS or static	IP: 192.168.1.10	IP: 192.168.2.10	IP: 192.168.3.10
Device Instance: 10	Device Instance: 1	Device Instance: 2	Device Instance: 3
IP: Enabled	IP Port 1	IP Port 1	IP Port 1
Net: 1	Enabled, BBMD	Enabled, BBMD	Enabled, BBMD
Port: 47808	Net: 1	Net: 1	Net: 1
	Port: 47808	Port: 47808	Port: 47808
	Table (BDT)*	Table (BDT)*	Table (BDT)*
	192.168.1.10 (self)	192.168.1.10	192.168.1.10
	192.168.2.10	192.168.2.10 (self)	192.168.2.10
	192.168.3.10	192.168.3.10	192.168.3.10 (self)
	* In Table, all Subnet Mask entries are 255.255.255.255.		

Scenario 3: Connecting networks with the Internet

Using the Internet to form a Wide Area Network (WAN) usually involves crossing Network Address Translation and Port Address Translation (NAT/PAT) routers. To cross NAT/PAT routers, add a second BBMD to one subnetwork on each side of the NAT/PAT router. Configure one BBMD with an IP address for the LAN and configure the additional BBMD with a public IP address to connect through the Internet. In Illustration 4, the second IP ports in Routers B and C are as enabled as BBMDs, with Network 2 and UDP Port 47809 configured for the public part of the BACnet internetwork.

Connecting across a NAT/PAT router follows the same rules as internal BBMDs plus the following items.

- Static, public IP addresses are required for the BBMDs. These addresses, in addition to the local static IP addresses, are provided by the IT department.
- The network port for the BBMD connecting to the Internet, in this scenario UDP Port 47809, must be opened in the IT firewall.
- Do not mix public and private IP addresses in the same BBMD.
- For devices with internal IP addresses, do not use the public network (Network 2 in this scenario).

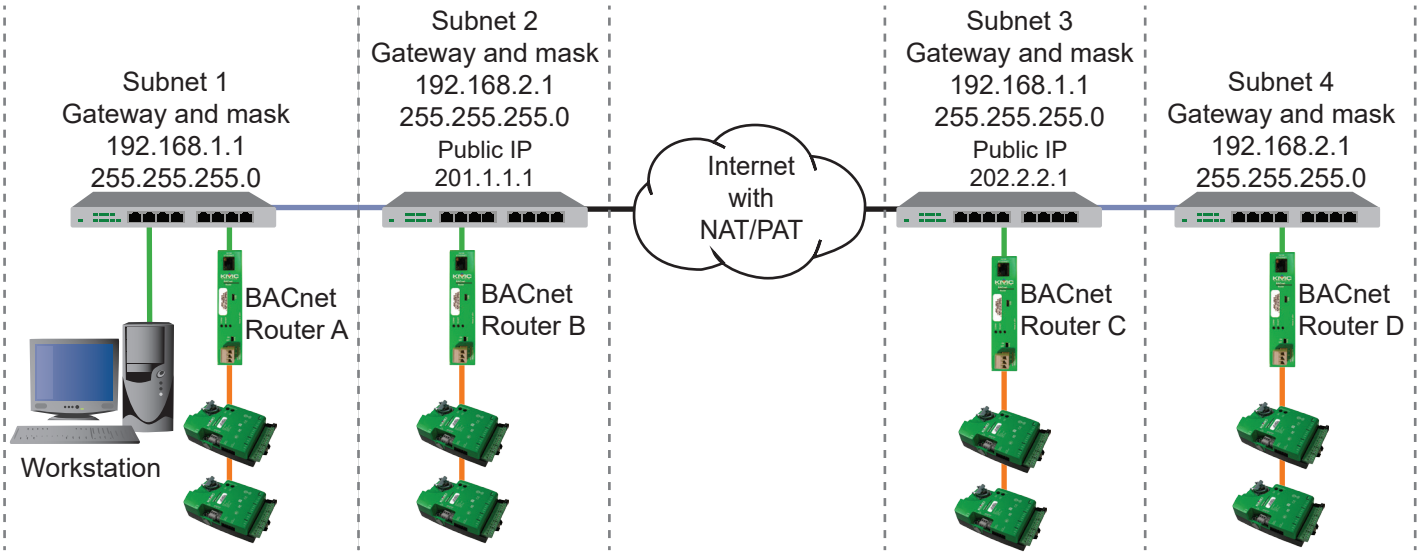


Illustration 4: Connecting across the Internet

Router configuration for NAT/PAT

Router A	Router B	Router C	Router D
Local IP: 192.168.1.10	Local IP: 192.168.2.10	Local IP: 192.168.1.10	IP: 192.168.2.10
Gateway: 192.168.1.1	Gateway: 192.168.2.1	Gateway: 192.168.3.1	Gateway: 192.168.4.1
Mask: 255.255.255.0	Mask: 255.255.255.0	Mask: 255.255.255.0	Mask: 255.255.255.0
Device Instance: 1	Device Instance: 2	Device Instance: 3	Device Instance: 4
IP Port 1	IP Port 1	IP Port 1	IP Port 1
Enabled, BBMD	Enabled, BBMD	Enabled, BBMD	Enabled, BBMD
Net: 1	Net: 1	Net: 1	Net: 1
Port: 47808	Port: 47808	Port: 47808	Port: 47808
Table (BDT)*	Table (BDT)*	Table (BDT)*	Table (BDT)*
192.168.1.10 (self)	192.168.1.10	192.168.1.10 (self)	192.168.1.10
192.168.2.10	192.168.2.10 (self)	192.168.2.10	192.168.2.10 (Self)
	IP Port 2*	IP Port 2*	
	Enabled, BBMD	Enabled, BBMD	
	Net: 2	Net: 2	
	Port: 47809	Port: 47809	
	Public IP: 201.1.1.1	Public IP: 202.2.2.2	
	Table (BDT)*	Table (BDT)*	
	201.1.1.1(self)	201.1.1.1	
	202.2.2.1	202.2.2.1 (self)	

* In Table, all Subnet Mask entries are 255.255.255.255.

Scenario 4: Virtual Private Networks (VPN)

A Virtual Private Network (VPN) is an alternative to joining BACnet networks with the Internet. Instead of using BBMDs with public/private addresses, a VPN creates a virtual, point-to-point connection that requires authentication. VPNs are available as either a software or hardware solution and may include encryption. The best solution will depend on the size of the building automation system and close coordination with the IT department.

Consider the following items when planning for a VPN.

- The BACnet principles for joining networks together with a VPN are similar to joining networks on the same LAN as described in Scenarios 1 and 2.
- The subnetworks on both sides of the VPN must be unique.
- The VPN is configured with the public/private address and port assignments. Configuring a VPN is beyond the scope of this topic.

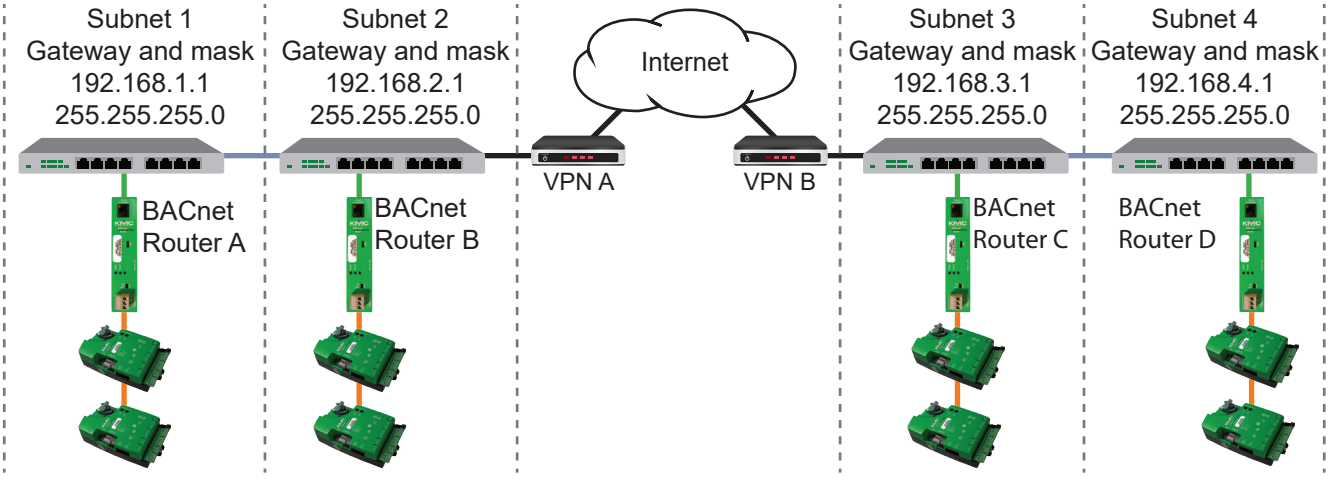


Illustration 5: Joining networks with a VPN

Configuration for joining networks with a VPN

Router A	Router B	Router C	Router D
IP: 192.168.1.10	Local IP: 192.168.2.10	Local IP: 192.168.3.10	IP: 192.168.4.10
Gateway: 192.168.1.1	Gateway: 192.168.2.1	Gateway: 192.168.3.1	Gateway: 192.168.4.1
Mask: 255.255.255.0	Mask: 255.255.255.0	Mask: 255.255.255.0	Mask: 255.255.255.0
Device Instance: 1	Device Instance: 2	Device Instance: 3	Device Instance: 4
IP Port 1	IP Port 1	IP Port 1	IP Port 1
Enabled, BBMD	Enabled, BBMD	Enabled, BBMD	Enabled, BBMD
Network: 1	Network: 1	Network: 1	Network: 1
UDP Port: 47808	UDP Port: 47808	UDP Port: 47808	UDP Port: 47808
Table (BDT)	Table (BDT)*	Table (BDT)*	Table (BDT)*
192.168.1.10 (self)	192.168.1.10	192.168.1.10	192.168.1.10
192.168.2.10	192.168.2.10 (self)	192.168.2.10	192.168.2.10
192.168.3.10	192.168.3.10	192.168.3.10 (self)	192.168.3.10
192.168.4.10	192.168.4.10	192.168.4.10	192.168.4.10 (self)
* In Table (DBT), all Subnet Mask entries are 255.255.255.255.			

Scenario 5: Foreign Device registration to a BBMD

Use Foreign Device registration to temporarily connect devices, such as a technician's BACnet service tool, to a BBMD without adding the device address to the existing BDTs. The Foreign Device needs only the address of one BBMD, the BACnet network number, and the port number assigned to the BBMD.

By configuring a Foreign Device using the following guidelines, it can then join the BACnet internetwork from anywhere on the LAN.

- The BBMD must be enabled to accept Foreign Device registration.
- The Foreign Device can be configured with the internal IP address of any BBMD that is on the same LAN as the Foreign Device.
- The Time To Live setting automatically disconnects the Foreign Device after inactivity. The length of time is a local policy.
- The Foreign Device can use the IP address assigned by a Domain Name Server (DNS) as it is connected to a sub-network.

Illustration 6 is a typical connection for KMC Connect running on a laptop as a Foreign Device. The subnetwork 192.168.3.0 is not part of the BACnet internetwork and does not have a BBMD or router. However, the BACstac driver for KMC Connect has registered as a Foreign Device and will join the internetwork as if it were connected to one of the subnetworks. Also, the laptop can be connected to either of the two subnetworks without changing settings and still join the BACnet system. The disadvantage to using Foreign Device instead of a BBMD is that if the connection is lost, there is no means to automatically reconnect the Foreign Device.

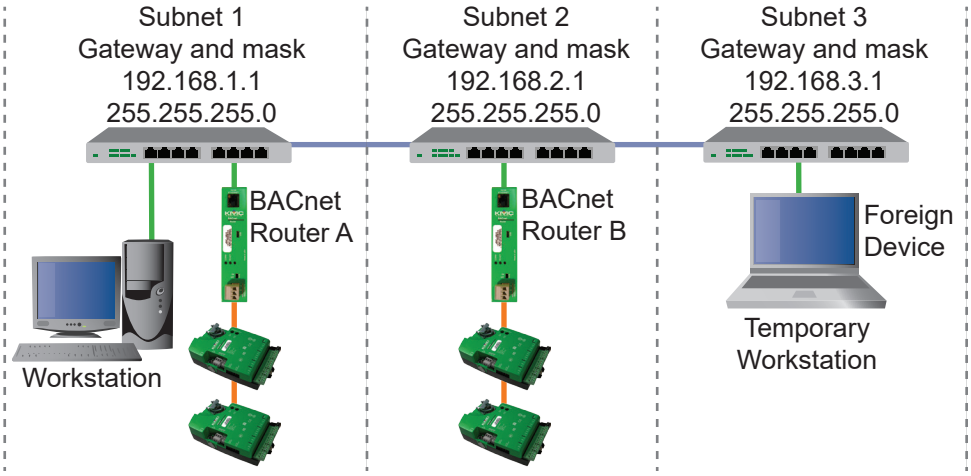


Illustration 6: Foreign Device registration

Router A	Router B	Foreign Device
IP: 192.168.1.10	IP: 192.168.2.10	IP: As assigned by DNS
DI: 1	DI: 2	DI: 20
IP: Port 1	IP Port 1	Foreign Device Enabled
Enabled, BBMD	Enabled, BBMD	BBMD: 192.168.2.10
Net: 1	Net: 1	Net: 1
Port: 47808	Port: 47808	Port: 47808
		Time To Live: 1800
Table (BDT)*	Table (BDT)*	
192.168.1.10 (self)	192.168.1.10	
192.168.2.10	192.168.2.10 (self)	
Accept Foreign Device Service: Enabled		
* In Table, all Subnet Mask entries are 255.255.255.255.		

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