![Anemostat AIR DISTRIBUTION logo]

Application Note–AN0404A

Revision B

Planning BACnet networks

About this application note

This application note describes the principles behind planning a BACnet installation. It is intended for control system designers and programmers who are experienced with the principles of building automation or HVAC controls but have yet to design a BACnet installation. Subjects covered in this document are:

- ◆ Creating a simple network with the MS/TP protocol.
- ◆ Assigning MAC addresses, device instance numbers and network numbers.
- ◆ Using routers to create internetworks on LANs, WANs and the internet.
- ◆ Avoiding network loops and broadcast storms.
- ◆ Integrating BACnet with the KMC Controls KMD series of products.
- ◆ The principles of MS/TP network wiring.

Related reference materials

The examples in this application note cover only system level details and do not cover detailed information about the individual pieces of KMC equipment in the examples. Refer to the individual installation guides supplied with the equipment for exact details about each piece of equipment.

- ◆ Installation and operation guide for each advanced application controller
- ◆ BAC–5050 FullBAC Router
- ◆ KMD–5567 Suppressor Module
- ◆ KMD–5575 Network Repeater Isolator

Required software

KMC BACnet controllers and the BAC–5050 router require the following software for configuration and programming.

- ◆ *Router Configuration Tool* to configure the BAC–5050.
- ◆ *BACstage* to configure and program KMC BACnet controllers.
- ◆ *Hardware Configuration Manager* to configure KMC Tier 1 controllers with a BACnet option.
- ◆ *WinControl XL Plus* to program a KMC Tier 1 controller with a BACnet option.
- ◆ *TotalControl* (optional) as a high level, multi-protocol user interface.

Equipment from other manufacturers

In addition to the KMC documentation and software, if equipment from another manufacturer is planned for installation, you will need the installation manuals and recommend software for that equipment.

Simple network

A simple network requires only two or more controllers, an operator workstation and network wiring. The example MS/TP (master slave/token passing) network in Illustration 1 connects an operator workstation, four variable air volume controllers, and a controller with eight inputs and eight outputs. Each of the devices, including the workstation, was configured with the following parameters before they were connected to the network.

◆ Each device is assigned a MAC address.
◆ Each device is assigned a device instance number.
◆ All devices are configured to communicate at the same baud rate.

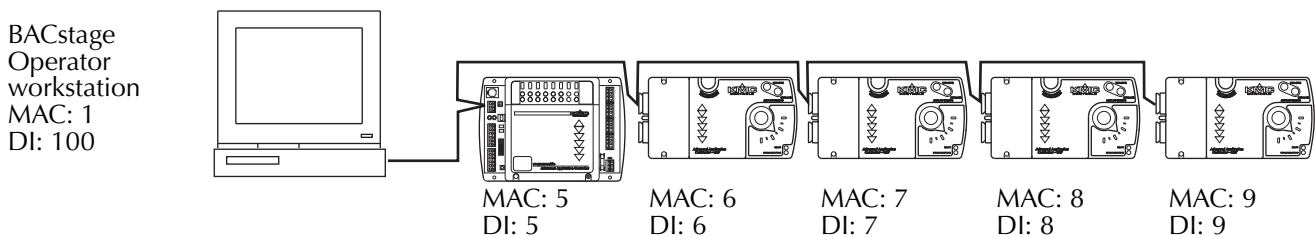BACstage
Operator
workstation
MAC: 1
DI: 100

MAC: 5   MAC: 6   MAC: 7   MAC: 8   MAC: 9
DI: 5   DI: 6   DI: 7   DI: 8   DI: 9

Illustration 1 Example MS/TP network

Key terms!

Network A collection of devices that directly communicate over a shared medium or protocol without crossing a BACnet router.

MAC address The MAC (Media Address Control) address uniquely identifies a device on its MS/TP network.

◆ The MAC address must be unique across the network.
◆ Valid MS/TP MAC addresses are 0-127 for master devices and 0-254 for slave devices.
◆ The practical limit for the number of devices on a single MS/TP network is about 60. The actual number of controllers will depend upon the volume of network traffic between controllers.

Device instance A number that uniquely identifies a device on an internetwork.

◆ The device instance number must be unique across the internetwork. (Internetworks are discussed in *Creating an internetwork* on page 2-10.)
◆ Valid instance number's range from 0 to 4,194,303.
◆ The device instance number is assigned by the BACnet system designer. For KMC BACnet controllers it is set in the controller during configuration with BACstage.
◆ It is by reference to the device instance number that data is exchanged between BACnet devices.

In this simple network, *BACstage* is connected through either a serial or USB port to the MS/TP network. Its default device instance is 100 and the MAC address is 1.

Detail

MS/TP network principles and wiring are discussed in the section *MS/TP networking practices* on page 2-24.

Adopting a numbering system

Good network planning requires a well thought out numbering scheme for device instance and MAC numbers.

MS/TP MAC numbers

MAC address numbers are assigned to all active devices on an MS/TP network.

◆ If a router is present, use MAC 0 for the router's MS/TP address. See *Creating an internetwork* on page 2-10 for details on using routers.

◆ Reserve MAC addresses 1-4 for service tools such as BACstage on a technicians laptop. This will result in a small, but acceptable, performance loss when controllers on the network look for MAC addresses that may not be present.

◆ Begin numbering controllers at MAC address 5 and number consecutively until each controller is assigned a MAC address.

Device instance numbers

Small and medium systems For simple installations, such as the network in Illustration 1, the device instance number is the same as the MAC address. For more complex systems, the device instance number is created by combining the network number (See *Creating an internetwork* on page 2-10 for details on network numbers) with the MS/TP MAC address.

Larger systems More sophisticated numbering schemes may also be used that describes the location of each piece of equipment on a campus. For this type of number system, the device instance is composed of a building number, floor number and the MAC address.

◆ The format of BBFFMMM assumes one MS/TP network per floor.

◆ BB—the first two digits indicate building number (01-41).

◆ FF—the second two digits indicate floor number (01-94).

◆ MMM—the last three digits indicate the MAC address.

Network numbers

Number BACnet networks sequentially. Network numbers, routers and internetworks are covered in detail in a following section. The default BAC–5050 network numbers are:

◆ Networks 1-4 for MS/TP ports 1-4

◆ Network 5 for the 8802-3 port

◆ Networks 6-9 for IP ports 1-4.

Creating an internetwork

For systems that require more than 127 master devices or systems that are distributed through large buildings or connect several buildings together, a single MS/TP network is not practical and may not be possible. To overcome MS/TP network limitations, expand the system by joining two or more networks with a router. Routers may also be required when connecting to other manufacturers equipment or to TotalControl or other high-end operator workstations.

New term!

Internetwork Two or more networks connected by one or more routers. Each of the networks is identified with a network number.

The internetwork in Illustration 2 is composed of three separate networks joined by a BAC–5050 router.

◆ Network 1 connects all of the devices on the top MS/TP network to the router.
◆ Network 2 connects all of the devices on the bottom MS/TP network to the router.
◆ Network 5 connects the operator workstations with BACnet 8802-3 over the LAN.
◆ The router was enabled to use BACnet 8802-3 with *Router Configuration Tools*.
◆ The MAC addresses for the router on BACnet 8802-3 Network 5 and BACstage use the Ethernet MAC address assigned by the manufacturer.

BACstage
DI: 100

Network 5

Network 1

MAC: 9
DI: 19

MAC: 8
DI: 18

MAC: 7
DI: 17

MAC: 6
DI:16

MAC: 5
DI:15

BACnet 8802-3
Network: 5

Network 2

MAC: 9
DI:29

MAC: 8
DI:28

MAC: 7
DI:27

MAC: 6
DI:26

MAC: 5
DI:25

MS/TP 1
Network: 1
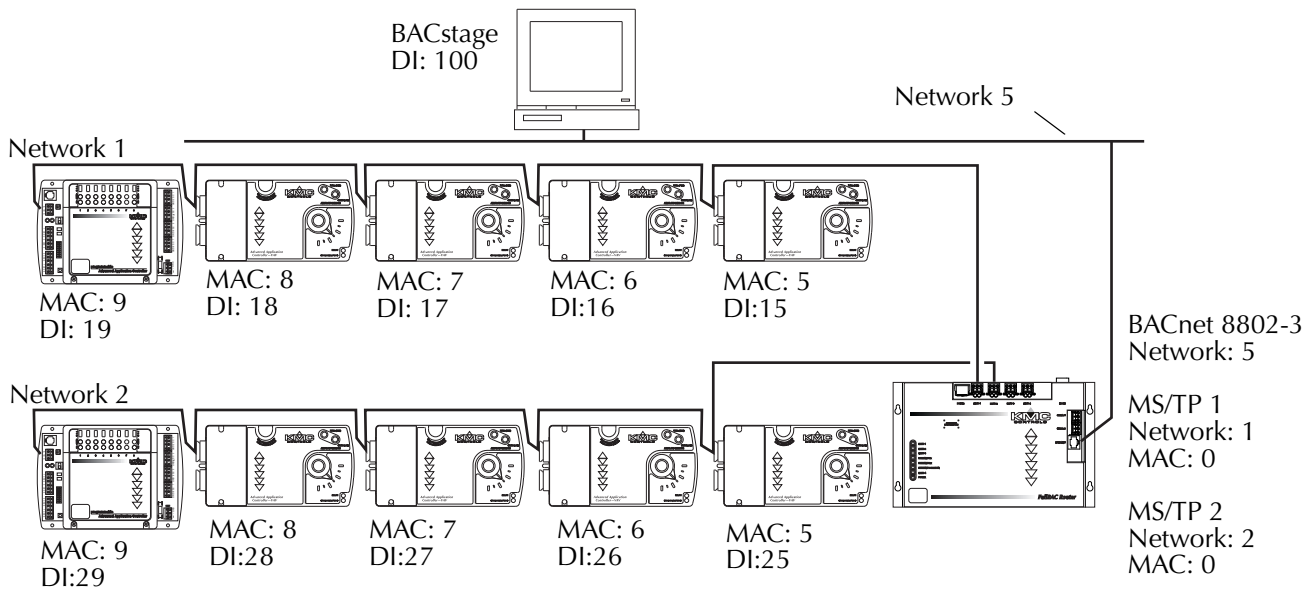MAC: 0

MS/TP 2
Network: 2
MAC: 0

Illustration 2 Internetwork composed of two MS/TP networks

In Illustration 2, the MS/TP MAC address numbers are duplicated between Network 1 and Network 2. The two devices on Network 5, the router and BACstage running on the computer, use the MAC addresses assigned to them by the manufacturer. This is the same MAC address used also by the Ethernet LAN. The BAC–5050 router does not contain objects and therefore does not require a device instance number.

Key terms!

Router A BACnet router is a device that connects two or more BACnet networks. The BACnet networks may be any of the following protocols:

- MS/TP
- BACnet IP
- BACnet 8802-3
- Point-to-point
- ARCNET
- Lonworks

The KMC Controls BAC–5050 routes MS/TP, BACnet IP, BACnet 8802-3 and point-to-point traffic.

Network numbers uniquely identify a network across the entire internetwork.

- They are assigned by the system designer and are configured into the router before the router is placed on the network. For the BAC–5050 router, use *Router Configuration Tools* to assign network numbers.
- All devices on the same network use the same network number.
- Valid network numbers range from 1 to 65,534.
- Network numbers are assigned only in routers.
- BACnet routers identify devices and route traffic to them by using the combination of the network number and MAC address.

Larger internetworks   For systems that require multiple routers, for example one for each floor or wing of a building, the usual connection method is to use the buildings existing Ethernet LAN. The Ethernet LAN then becomes the backbone of the BACnet internetwork. The 8802-3 port in all of the routers are assigned to the same BACnet network number.
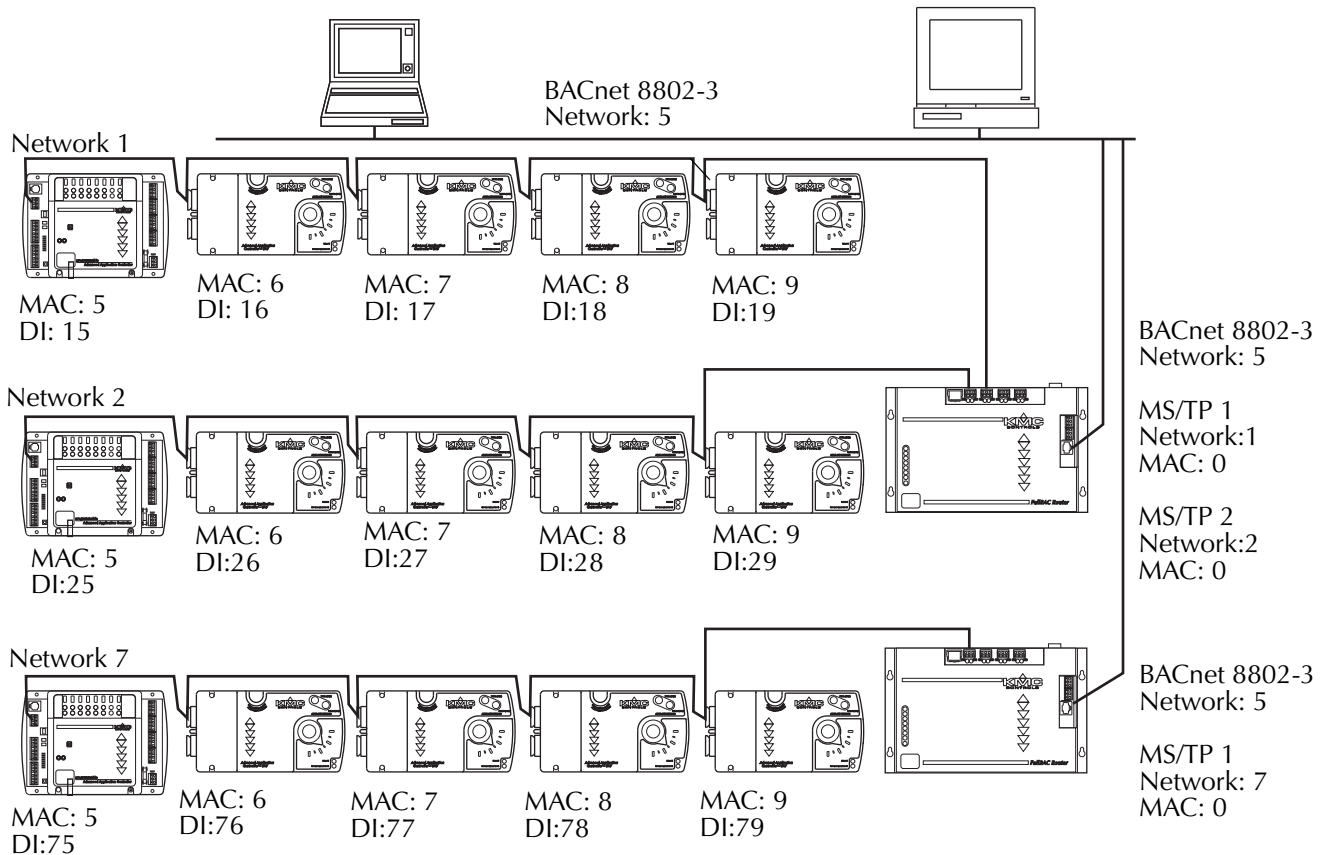

Network 1

BACnet 8802-3
Network: 5

MAC: 5
DI: 15

MAC: 6
DI: 16

MAC: 7
DI: 17

MAC: 8
DI:18

MAC: 9
DI:19

BACnet 8802-3
Network: 5

MS/TP 1
Network:1
MAC: 0

Network 2

MS/TP 2
Network:2
MAC: 0

MAC: 5
DI:25

MAC: 6
DI:26

MAC: 7
DI:27

MAC: 8
DI:28

MAC: 9
DI:29

Network 7

BACnet 8802-3
Network: 5

MS/TP 1
Network: 7
MAC: 0

MAC: 5
DI:75

MAC: 6
DI:76

MAC: 7
DI:77

MAC: 8
DI:78

MAC: 9
DI:79

Illustration 3 Two routers on an internetwork

As with the one-router internetwork in Illustration 2, the MAC addresses on each of the MS/TP networks are exact duplicates. The device instance numbers are unique and continue using the numbering scheme with the network number as the first digit. Both routers in Illustration 3 were configured with the BACnet 8802-3 protocol enabled and assigned to network 5. For simple networks such as Illustration 3, all routers and the workstations must be on the same Ethernet broadcast domain.

Using the existing LAN

The internetwork shown in Illustration 4 is a simple diagram of an internetwork for a large building. Each of the BAC–5050 routers are connected to a network hub for the floor on which the equipment is located. The hubs are connected by a backbone which may be any type of Ethernet media.

Some important things to consider about this example:

- ◆ Each of the twelve MS/TP networks require unique network numbers.
- ◆ The BACnet network connected over the building's Ethernet requires an additional network number.
- ◆ Each BAC–5050 router requires a unique IP address that is supplied by the network administrator.
- ◆ Unless a tunnel network is created, the BAC–5050 routers and hubs must be on the same Ethernet subnet and use the same subnet mask. Tunnel networks are discussed in *Crossing the Internet and IP subnetworks* on page 2-17.
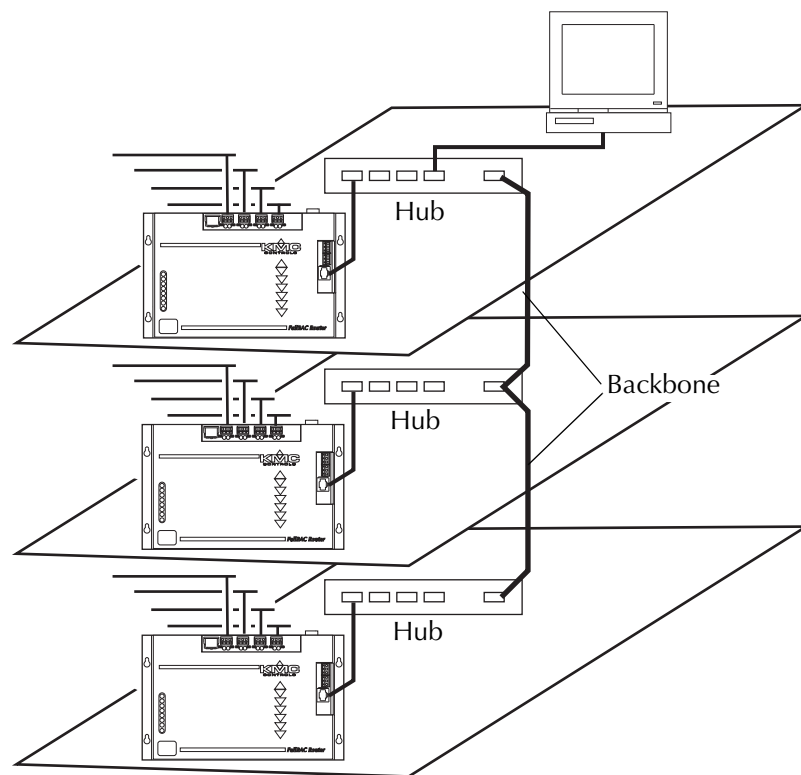

Illustration 4 A multi-floor internetwork

The LAN backbone and hubs are usually supplied, configured and maintained by the IT department. The system administrator will supply IP addresses and subnet masks for the BAC-5050 routers.

Mixing BACnet IP and 8802-3

Some installations, such as the expansion of an existing network, will require using both BACnet IP and BACnet 8802-3 protocols. BACnet 8802-3 is also the only protocol available in the KMD–5210-001 and KMD–5270-001 (See *Integrating BACnet with KMC digital networks* on page 2-23.) To use both protocols on the same internetwork, enable one router for both BACnet 8802-3 and BACnet IP. In Illustration 5, Network 5, the BACnet 8802-3 network, and Network 6, the BACnet IP network, are considered separate BACnet networks even though they connect to the same physical media, in this example the building's LAN.
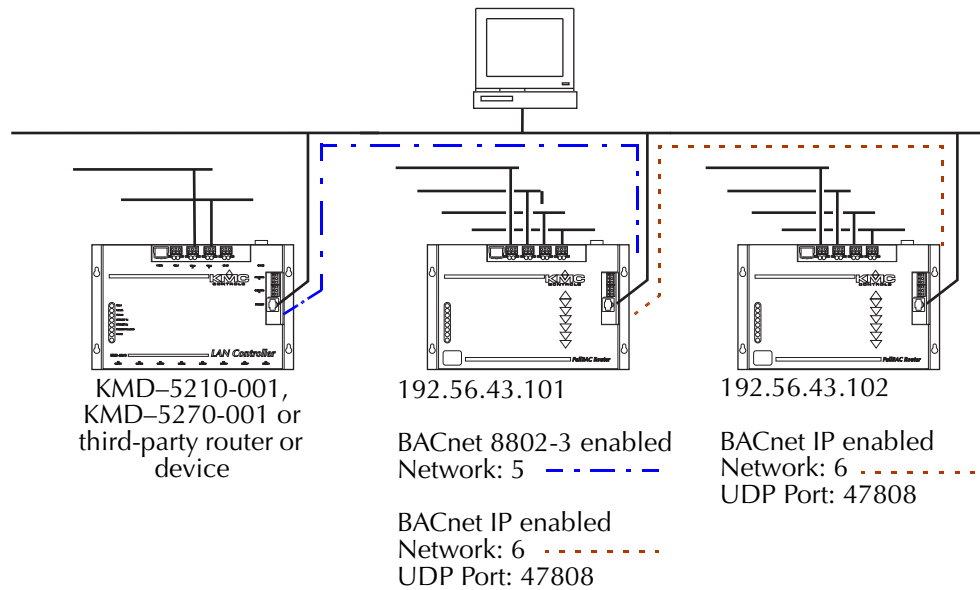

KMD–5210-001,
KMD–5270-001 or
third-party router or
device

192.56.43.101

BACnet 8802-3 enabled
Network: 5 — · — · —

BACnet IP enabled
Network: 6 · · · · · · ·
UDP Port: 47808

192.56.43.102

BACnet IP enabled
Network: 6 · · · · · · ·
UDP Port: 47808

Illustration 5 BACnet IP and 8802-3 on the same LAN

New term!

Port An interface on a computer, either physical or logical, to which you can connect a device. Examples of physical ports are connections for disk drives, display screens, keyboards, networks, etc. Ports may also be a logical connection on networks. For example, UDP port 80 is used for HTTP traffic.

In addition to the IP address for each router, the routers with BACnet IP enabled also require a UDP port number for each enabled BACnet IP network. Typical UDP port numbers are 47,808 to 47,817 (0xBAC0 to 0xBAC9 in hexadecimal). It is with a UDP port number that the router directs BACnet IP traffic to each of the four available BACnet IP networks on each BAC–5050.

Avoiding loops

Loops create the most serious problem on an internetwork. They occur when more than one network path exists between any two devices. For example, in the internetwork shown in Illustration 6, both routers are configured with both BACnet 8802-3 and BACnet IP enabled for the same network. Network messages (shown with dashed lines) travel between the two routers over two different network paths. The first time one of the routers broadcasts a message to the network, it will start a broadcast storm of repeated messages.

In this example, the broadcast storm begins when Router A sends a broadcast message to the internetwork on the BACnet 8802-3 network. Router B receives the message and repeats it on all networks *except* the one on which it received the message. The message goes out not only on the MS/TP ports, it is also rebroadcast on the BACnet IP port for Router B. Router A then sees the message on its BACnet IP port and repeats it on all ports including the BACnet 8802-3 port where the message originated. This continues until the router becomes overloaded. Beginning with firmware release 1.4, the BAC–5050 router will detect and disable networks that create loops. Routers from other manufacturers may not detect a loop and could still create a problem.

! Caution

Do not configure a network with a loop. A loop will result in a broadcast storm of repeated messages that will bring down a network. A loop forms when a path is created from a router out to one or more routers and then back to the original router without using a network number twice. Any type of network can form part of the loop.
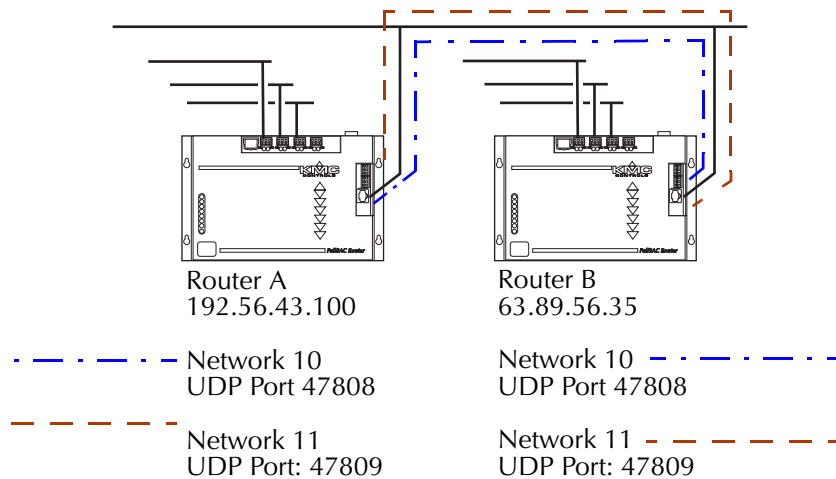

Router A
192.56.43.100

Router B
63.89.56.35

Network 10
UDP Port 47808

Network 10
UDP Port 47808

Network 11
UDP Port: 47809

Network 11
UDP Port: 47809

Illustration 6 A loop on the internetwork

A loop will start also when two routers are connected with the Ethernet LAN and MS/TP. If both routers are enable for MS/TP and either BACnet 8802-3 or BACnet IP, a storm will start.
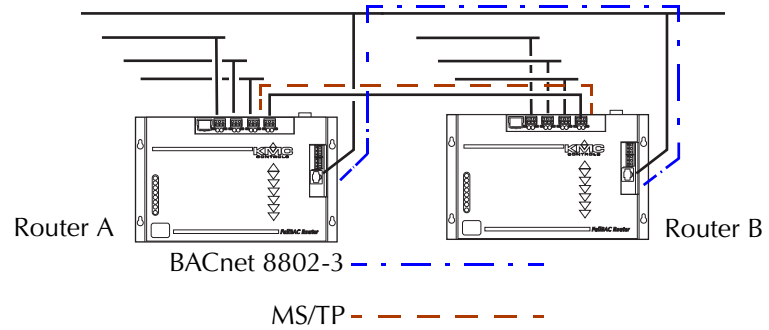
Router A

Router B

BACnet 8802-3 — · — · — · —

MS/TP — — — — —

Illustration 7 An MS/TP loop

Crossing the Internet and IP subnetworks

BACnet systems often consist of several remote networks that are joined together to form a single BACnet internetwork. Because internet access is widely available, it is a preferred method to join these remote networks. There are some limitations when an internetwork crosses IP subnetworks.

Special handling is required because the BACnet protocol uses broadcasting as a means to quickly send a message to several devices at one time. However, to minimize the impact on network traffic, most system administrators will block broadcast messages from crossing IP routers but will allow broadcasting within the subnetwork. This prevents key BACnet services such as "Who Is" and time synchronization broadcasts from reaching all parts of a BACnet internetwork.

To work around this limitation two methods are available using KMC products.

  ◆ Crossing IP subnets with tunnel routing.
  ◆ Crossing IP subnets with a BBMD described on page 19.

Crossing IP subnets with tunnel routing

One method of extending BACnet internetworks across IP subnetworks is to use a pair of BACnet PAD routers to form a tunnel network. A pair of PAD routers pass BACnet messages between each other that are blocked by a network router.

New term!

PAD router A BACnet IP PAD is a special type of router that connects two or more BACnet networks that are separated by at least one IP-only router. The PAD router monitors network traffic for BACnet messages addressed to the other

subnet and repackages the message that can pass through IP routers, in effect forming a *tunnel* between the two network. A companion PAD router unpacks and retransmits the message on the remote BACnet network.

◆ The tunnel network is created only to connect BACnet networks that are connected to two different IP subnetworks.

◆ Each PAD router must know the IP address and UDP port number of its companion.

◆ Addressable BACnet devices are not allowed on a tunnel network.

◆ A single tunnel network can connect only two BACnet networks.

◆ Tunnel routing is useful for small internetworks that require crossing only a few IP subnetworks.

IP router   IP router

LAN, WAN or Internet

Router A   Router B

192.56.43.100   63.89.56.35

Network: 10   Network: 11
UDP Port: 47808   UDP port: 47808

PAD network: 20   UDP PAD network: 20
UDP Port: 47809   Port: 47817
PAD enabled   PAD enabled
Remote address: 63.89.56.35   Remote address: 192.56.43.100
Remote port: 47817   Remote port: 47809

Illustration 8 PAD router tunnel network

The two routers in Illustration 8 form a tunnel router configuration. Router A routes traffic from Network 10 and its local MS/TP networks onto Network 20, the tunnel network. On the other side of the internet, Router B routes traffic from Network 11 and its enabled MS/TP networks onto Network 20. Each router is configured not only with its own IP address and UDP port but also with the IP address and UDP port of its companion PAD router.

In Illustration 9, Network 20, the original tunnel network from Illustration 8, is still in place. A third tunnel router, Router C, is added to the network to form a second tunnel network. In this example, Router A routes traffic between its BACnet IP network, network 10 (not shown for clarity), and tunnel networks 20 and 21.
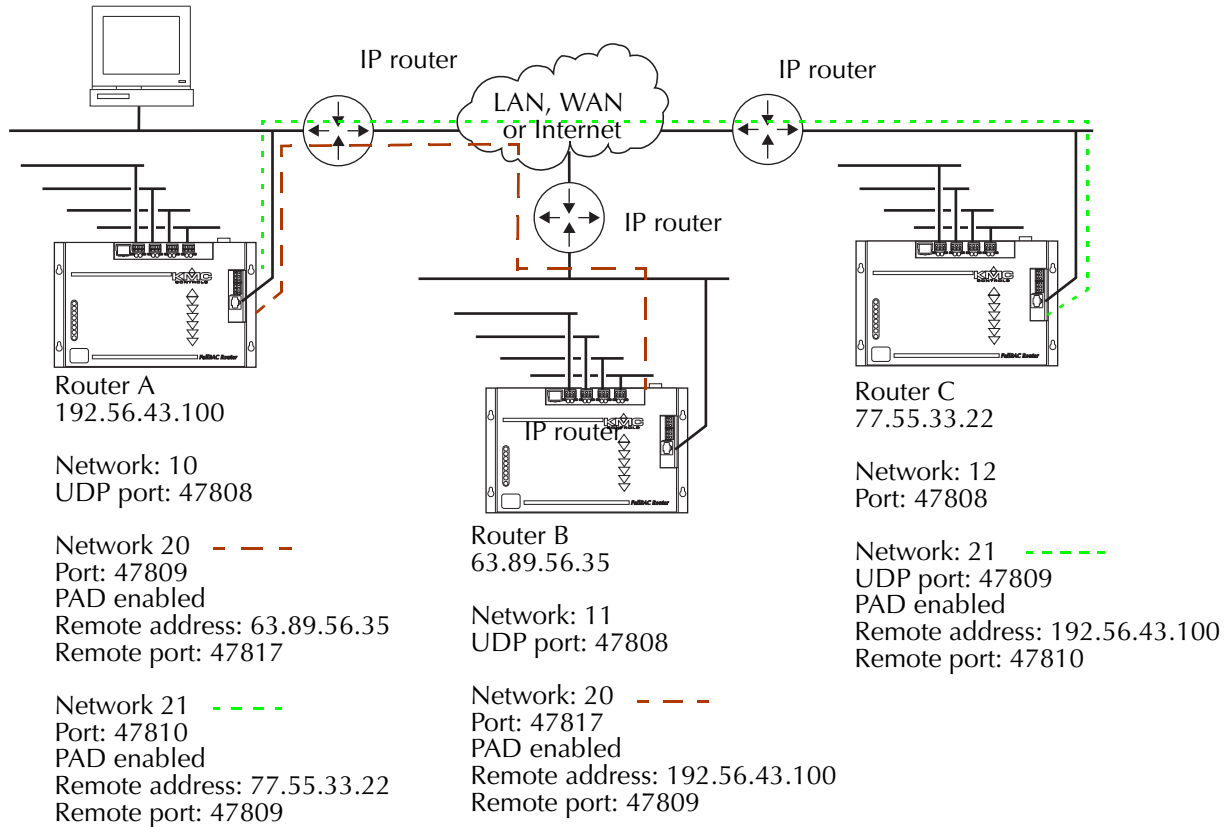

Router A
192.56.43.100

Network: 10
UDP port: 47808

Network 20   – — –
Port: 47809
PAD enabled
Remote address: 63.89.56.35
Remote port: 47817

Network 21   – – – –
Port: 47810
PAD enabled
Remote address: 77.55.33.22
Remote port: 47809

Router B
63.89.56.35

Network: 11
UDP port: 47808

Network: 20   – — –
Port: 47817
PAD enabled
Remote address: 192.56.43.100
Remote port: 47809

Router C
77.55.33.22

Network: 12
Port: 47808

Network: 21   – – – –
UDP port: 47809
PAD enabled
Remote address: 192.56.43.100
Remote port: 47810

Illustration 9 Two tunnel networks

Crossing IP subnets with a BBMD
An alternative to tunnel routing for crossing IP subnetworks is to install one or more BACnet Broadcast Management Devices (BBMD) on the internetwork.
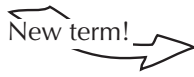
BBMD A BACnet broadcast-management device (BBMD) is a special type of routing device that is used in BACnet/IP networks to distribute broadcast messages across multiple IP subnets. A BBMD may be a dedicated device or software that runs on computer.

192.56.43.101
Port: 47808
Network: 10

BBMD

LAN, WAN or Internet

IP router   IP router

Router A
192.56.43.100

Network: 10
UDP port: 47808

Router B
63.89.56.35

Network: 10
UDP port: 47809
Foreign device enabled
Remote address: 192.56.43.101
Remote port: 47808
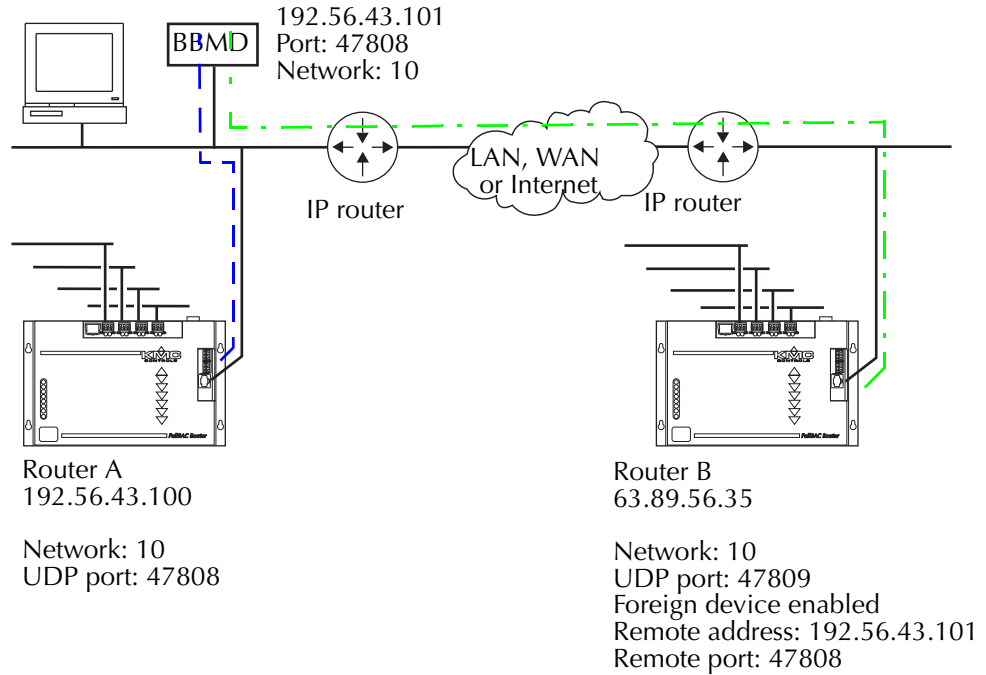
Illustration 10 BBMD and foreign devices

In Illustration 10, Router A is configured as a normal BACnet IP router. It is required only for routing traffic to the MS/TP networks or any other BACnet IP network on its IP subnet. The configuration for Router B is similar to PAD routing in the previous section except that the router is configured as a BACnet Foreign Device registered with the BBMD.

The BBMD method of crossing an IP boundary has several advantages over tunnel routing:

◆ When the BBMD is configured, you do not need to know any router IP addresses because the routers will register themselves with the BBMD.

◆ Expanding the internetwork is simpler than with PAD routing. Adding a new network with an additional router requires only that the router registers with the BBMD which is configured only at the new router. PAD routers require configuration at both routers.

◆ Internetwork topology with a BBMD is a simple, single star topology. With PAD routing and only four PAD networks available on a BAC–5050, large internetworks become complicated multiple stars with multiple points of failure.

The TotalControl workstation from KMC Controls includes a BBMD as part of the Cimetrics driver. The BAC–5050 routers in the internetwork are then configured with an IP network configured as a foreign device and the IP address and UDP port number of the BBMD in BACstac driver.
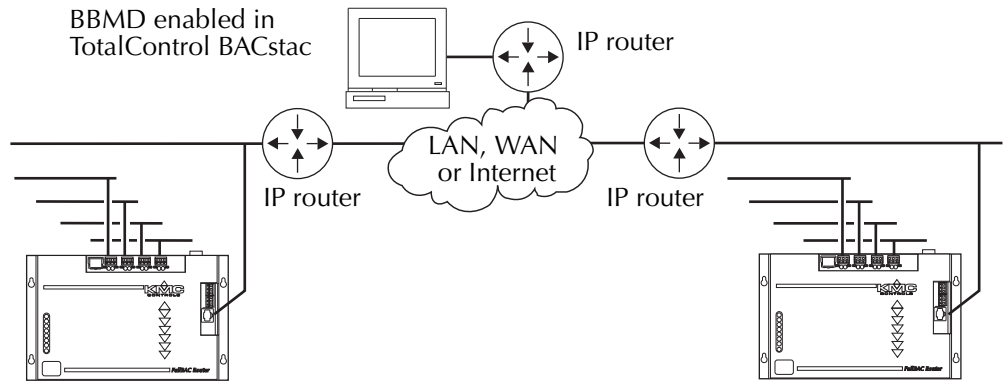

BBMD enabled in
TotalControl BACstac

IP router

IP router   LAN, WAN or Internet   IP router

Illustration 11 TotalControl BBMD with foreign device

Detail

Because of network conflicts, BACstage and TotalControl can operate on the same computer under the following configuration.

◆ Install a second network interface card.
◆ Configure a BAC–5050 with two different networks each with a unique UPD port number. Configure BACstage to use one of the ports; the TotalControl driver will then use the other.

More robust internetworks use a BBMD on each IP subnetwork. All BBMDs are aware of other BBMDs but foreign devices need register only with the BBMD on its own subnetwork. This presents a redundant path for broadcast messages to cross IP boundaries. If one BBMD stops operating, the broadcast message will still be routed by other BBMDs.

Connecting routers with MS/TP

Two routers may be connected by a common MS/TP network. Because connecting the internetwork with MS/TP presents a throughput limitation, use this method only in situations where a limited amount of traffic crosses the MS/TP network.

- ◆ The ports on both routers must be set to use the same baud rate.
- ◆ The MS/TP MAC addresses for the routers on the connecting network must be unique.
- ◆ Controllers may also connect to the MS/TP network. They also must be addressed with unique MAC addresses.
- ◆ Avoid configurations that require high network traffic on the linking MS/TP network.
- ◆ See *MS/TP networking practices* on page 2-24 when connecting two routers with an MS/TP network.
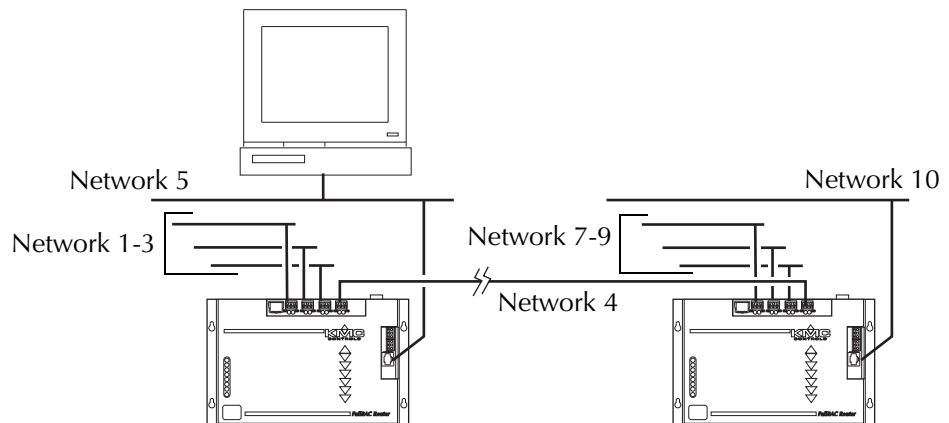
Illustration 12 Two routers connected with MS/TP

Integrating BACnet with KMC digital networks

Three models of KMC Tier 1 controllers include an interface between a KMC digital network and a BACnet internetwork.

- ◆ The KMD–5270–001 Web Lite connects with BACnet 8802-3.
- ◆ The KMD–5210–001 LAN Controller connects with BACnet 8802-3.
- ◆ The KMD–5210–002 LAN Controller connects through MS/TP.

Programming and configuration details are included in the installation and operation guide supplied with each controller. The following details apply to using a Tier 1 controller as an interface to a BACnet internetwork:

- ◆ Inputs, outputs and variables within the Tier 1 controller appear as BACnet device input, output and value objects.
- ◆ A point configured as a KMD digital point will appear as a BACnet binary object. Analog points appear as analog objects.
- ◆ To be visible as an object to BACnet devices, a descriptor must be entered for the point.
- ◆ Use *BAC-SET*, *BAC-GET* and B*AC-RLQ* in Control Basic to read from and write to objects in other BACnet devices.

Use the following programs to configure and program the Tier 1 controller.

- ◆ Use *Hardware Configuration Manager* to assign a KMD panel number, ethernet information and a BACnet device instance, name and description to the Tier 1 controller.
- ◆ The Tier 1 panel number assigned with HCM becomes the MS/TP MAC address in the KMD–5210–002.
- ◆ Use *WinControlXL Plus* to program the Tier 1 controllers.
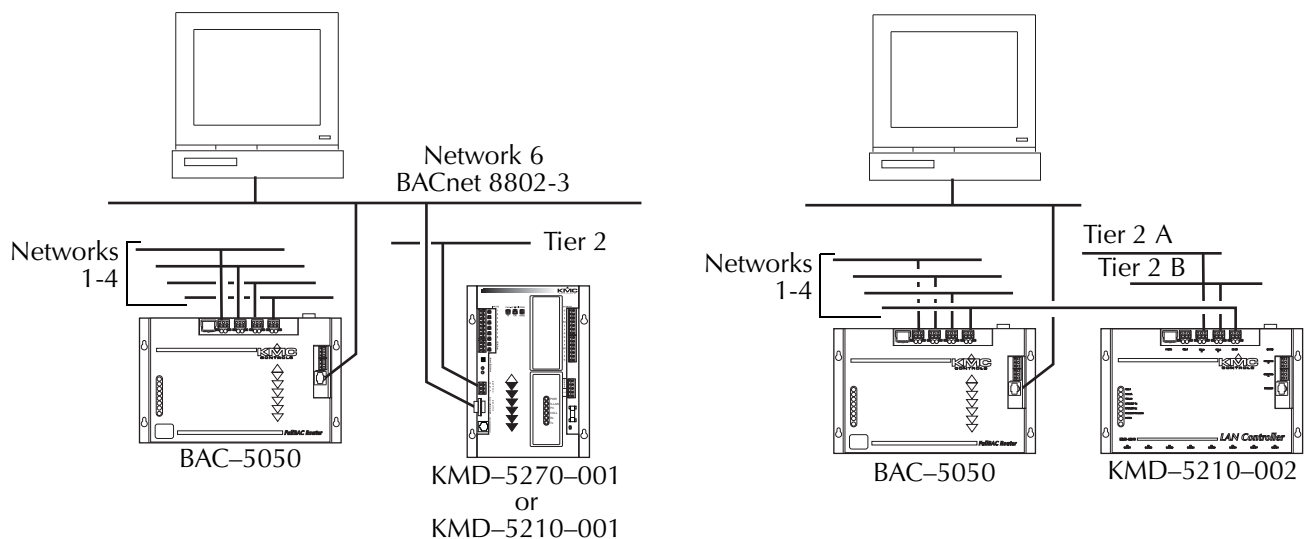
Illustration 13 Connecting to KMD networks

MS/TP networking practices

The MS/TP (master slave/token passing) protocol is unique to BACnet and is implemented using the EIA-485 signaling standard. Up to 128 BACnet master devices or 256 slave devices can connect to a single MS/TP network.

Key terms!

Slave devices cannot initiate requests for data; they can reply only to messages from other devices. They are best suited for simple, low-cost functions.

Master devices can initiate but require more processing and memory capacity than slave devices. The KMC advanced application controllers are MS/TP master devices.

Key terms!

MS/TP network segment An electrically separate section of a network. An MS/TP network segment contains no more than 32 devices of any type. Repeaters connect the segments of an MS/TP network.

Repeater A network device used to regenerate analog or digital signals distorted by transmission loss. An EIA–485 repeater cannot perform intelligent routing. The network may be divided into two or more segments with repeaters.

Connecting controllers

Use proper cable and the following principles when connecting a controller to an MS/TP network:

♦ You may connect up to 128 BACnet master devices or 256 BACnet slave devices to one *MS/TP* network.

♦ Use 18 gauge, twisted pair, shielded cable with capacitance of no more than 50 picofarads per foot for all network wiring. Belden cable model 82760 meets the cable requirements.

♦ Connect the –A terminal in parallel with all other –A or – terminals.

♦ Connect the +B terminal in parallel with all other +B or + terminals.

♦ For shielding techniques, see *Single point shielding* on page 2-25.

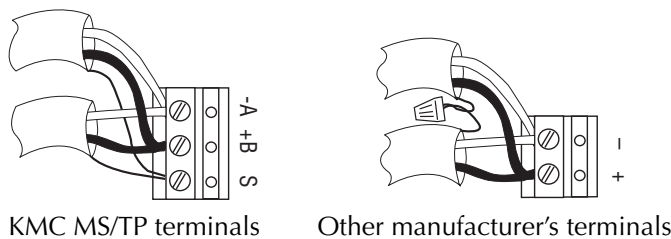KMC MS/TP terminals   Other manufacturer's terminals

Illustration 14 Connecting to a controller

Single point shielding
Connect the shield at only one end of the cable. The router is usually in a location that provides a good equipment ground and is the recommended ground point. However, either end of the cable can be grounded if a good equipment ground is available.

◆ Connect the shields of the cables together at each controller. For KMC BACnet controllers use the *S* terminal.

◆ Connect the shield for each segment to an earth ground at one end only. See

Illustration 15 Shielding detail

🖎 **Note**

If the ground point is at a KMC controller or router with an S terminal, the S terminal can be used a connection point between the cable shield and equipment ground.

Ground at only one
end of the segment
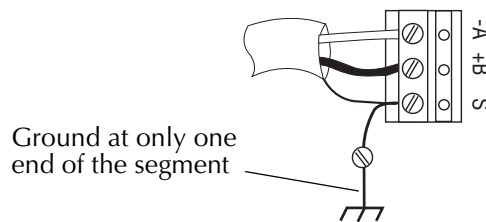
Illustration 16 Shield grounding with KMC controllers

End-of-line termination
Each MS/TP network segment requires end-of-line termination for proper
operation of the network. Proper termination prevents signal degradation and
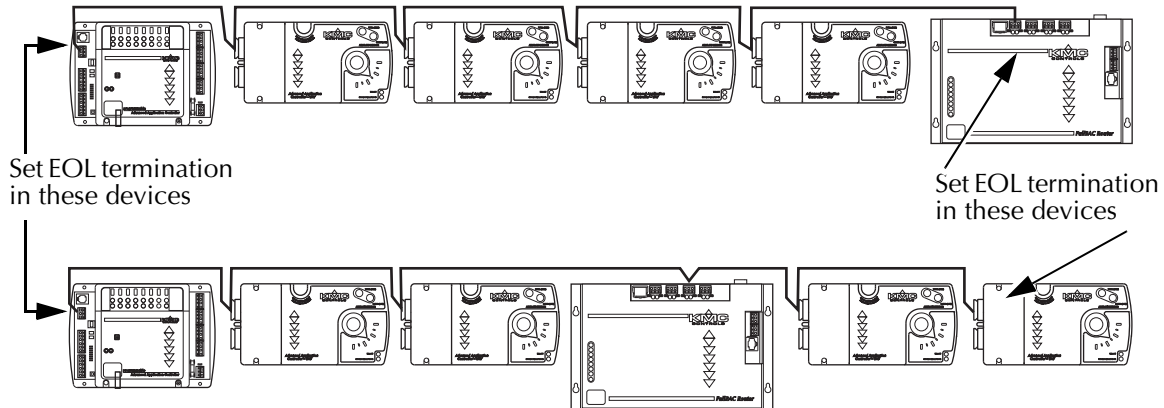EMI interference with other system wiring.

Set EOL termination
in these devices

Set EOL termination
in these devices

Illustration 17 EOL termination

To terminate an MS/TP network segment at a KMC BACnet controller, use the
end-of-line termination switches (See Illustration 18). Other manufacturer's use
different methods for end-of-line terminations which may be as simple as an
external resistor shown also in Illustration 18.

Typical EOL termination
switch in KMC controllers

120 ohm
1/4 watt
5%

KMC termination

Resistor EOL
termination for
controllers without
internal termination.

Other manufacturers's termination
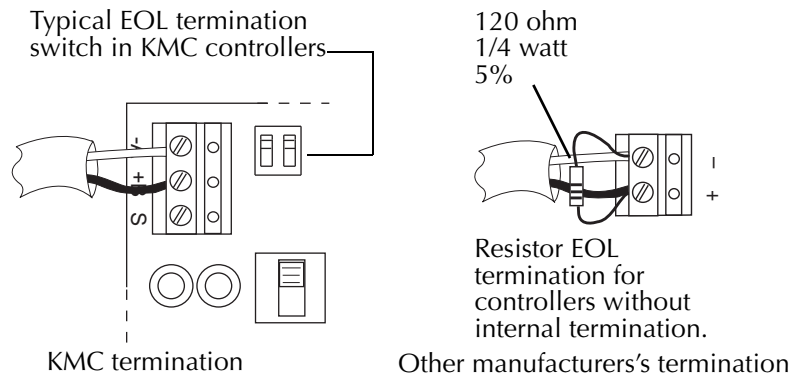
Illustration 18 End-of-line termination methods

BAC–5050 end-of-line termination
Termination jumpers are located on both sides of each MS/TP connector (one each for the -A and +B terminals; see Illustration 19.)

To activate the end-of-line termination, place the jumpers over the pair of termination pins. If termination is not required, position the jumpers so they cover only one termination pin.
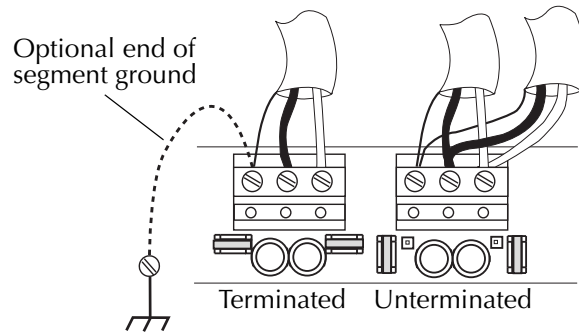

Illustration 19 BAC–5050 End-of-line termination

Splitting MS/TP networks with repeaters

Use repeaters to split the MS/TP network into physical network segments.

◆ Connect no more than 32 devices to any one segment.
◆ Add repeaters as required for additional controllers up to the limit of the MS/TP network.
◆ Total cable length on any segment must be less than 4000 feet (1220 meters)
◆ Ground the shield at only one end of each segment.
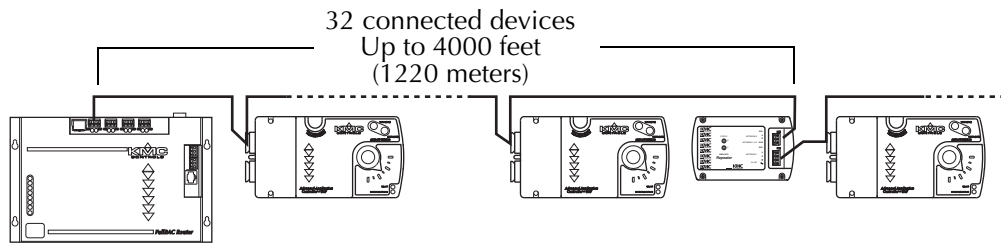◆ Add end-of-line termination to both ends of each segment.

Illustration 20 Typical MS/TP network segment

When the physical layout of building requires a star topology, use repeaters to branch from a main MS/TP trunk. The network in Illustration 21 is an example of a star topology.
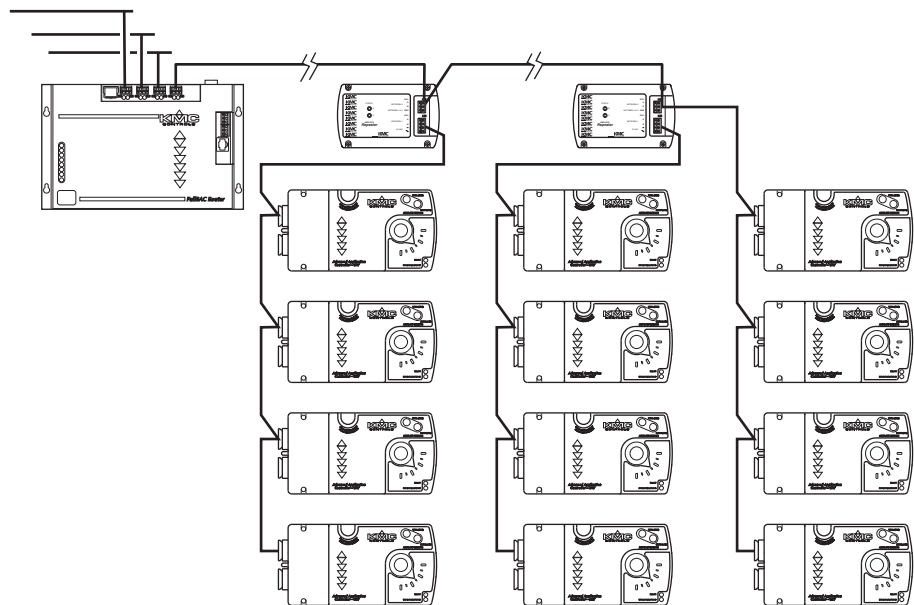

Illustration 21 MS/TP star topology

Building to building issues

If the MS/TP network cable runs between two buildings, place a KMD–5567 surge suppressor in the cable at both buildings. Locate the suppressors as close to the cable exits as possible and use a good earth ground. See the installation and operation guide for the KMD–5567 for wiring details.
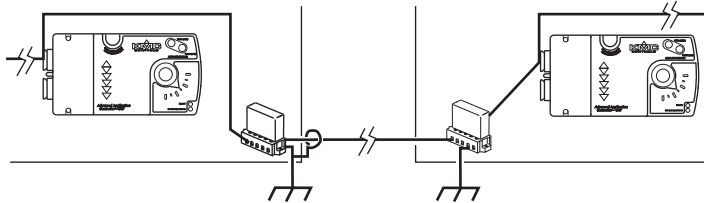

Illustration 22 MS/TP between buildings

Use a KMD–5567 also when an MS/TP network exits a building and terminates at a roof top or air handling unit.