Installing and Configuring the BACnet®/IP Router

Ordering number: 4950 0471 (ARCNET), 4950 0472 (Ethernet)

This document describes the installation and configuration of the BACnet/IP Router. The router enables you to connect two BACnet local area networks (LANs) to create a BACnet inter-network. The LANs may be either BACnet/IP Ethernet or BACnet ARCNET®.

Before you begin

Before wiring or configuring the router, get the TCP/IP information from the network administrator for the site. Figure 1 on page 2 shows a sample letter of request. Ensure that the TCP/IP information includes: IP address, subnet mask, default gateway, and user datagram protocol (UDP) port.

In addition to the TCP/IP information, you may also need the following information to help with the network system setup:

- Capability of enabling and disabling a BACnet broadcast messaging device (BBMD)
- IP addresses of remote BBMDs, routers, and gateways in the TCP/IP networks
- BACnet network numbers for each of the direct LAN interfaces
- Information about the LAN to which the router will be connected, such as other devices connected to it: BACnet routers, BBMDs, TCP/IP routers, gateways, switches, and hubs

Note:
Since the router holds configuration information indefinitely, you can configure the router before travelling to the site.

For more information about BACnet/IP network installations, see engineering bulletin *Tracer Summit® BACnet/IP Network Installations* (BAS-PRB004-EN).

When you have the TCP/IP information, refer to the topics that follow. The topics provide router specifications and wiring information. They also provide information and procedures for connecting, configuring, and troubleshooting the router.

Router specifications

Table 1 shows the specifications for the Router.

Table 1: Router specifications

Electrical requirements	100 Vac at 50–60 Hz (240 Vac at 50–60 Hz) 45 W
Operating temperature	32–158° F (0–70° C)
Dimensions	3 in. × 7.5 in. × 13 in. (8 cm × 19 cm × 35 cm)
Weight	54 oz (1.5 kg)
Mounting	Screw slots for wall mounting Optional rack mount ears

Wire the router

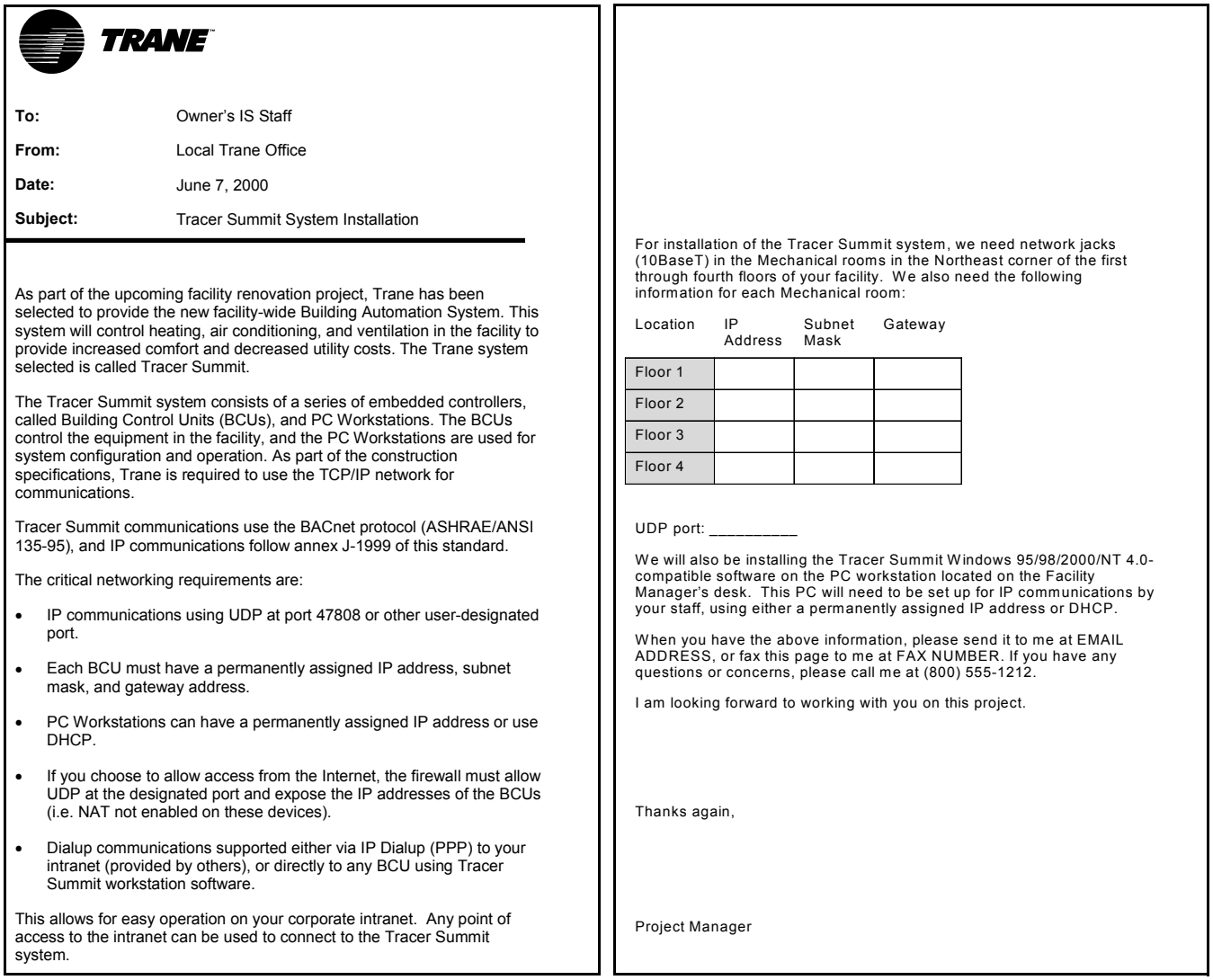
When wiring the router and the hub to the Ethernet LAN, use any combination of straight (patch) cables and crossover category (CAT) 5 cables. Using CAT 5 cables enables you to connect other devices, such as a BMTW building control unit (BCU) to the LAN. Use straight cables when there is a hub; use crossover cables when there is no hub.
Figure 2 on page 3 shows a router connected to a typical LAN topology.

Note:
If you are using coax cable, prior to wiring the router, verify that each LAN cable is terminated with the appropriate resistor. Ethernet RG58 coax cable needs a 50 ohm resistor. ARCNET RG62 coax cable needs a 93 ohm resistor.

To wire the configuration shown in Figure 2 on page 3:

1. Using straight CAT 5 cables, connect the workstation to the Ethernet LAN and the Ethernet LAN to the hub.

Figure 1: Sample Planning Memo



TRANE

To: Owner's IS Staff

From: Local Trane Office

Date: June 7, 2000

Subject: Tracer Summit System Installation

As part of the upcoming facility renovation project, Trane has been selected to provide the new facility-wide Building Automation System. This system will control heating, air conditioning, and ventilation in the facility to provide increased comfort and decreased utility costs. The Trane system selected is called Tracer Summit.

The Tracer Summit system consists of a series of embedded controllers, called Building Control Units (BCUs), and PC Workstations. The BCUs control the equipment in the facility, and the PC Workstations are used for system configuration and operation. As part of the construction specifications, Trane is required to use the TCP/IP network for communications.

Tracer Summit communications use the BACnet protocol (ASHRAE/ANSI 135-95), and IP communications follow annex J-1999 of this standard.

The critical networking requirements are:

- IP communications using UDP at port 47808 or other user-designated port.
- Each BCU must have a permanently assigned IP address, subnet mask, and gateway address.
- PC Workstations can have a permanently assigned IP address or use DHCP.
- If you choose to allow access from the Internet, the firewall must allow UDP at the designated port and expose the IP addresses of the BCUs (i.e. NAT not enabled on these devices).
- Dialup communications supported either via IP Dialup (PPP) to your intranet (provided by others), or directly to any BCU using Tracer Summit workstation software.

This allows for easy operation on your corporate intranet. Any point of access to the intranet can be used to connect to the Tracer Summit system.

For installation of the Tracer Summit system, we need network jacks (10BaseT) in the Mechanical rooms in the Northeast corner of the first through fourth floors of your facility. We also need the following information for each Mechanical room:

Location	IP Address	Subnet Mask	Gateway
Floor 1			
Floor 2			
Floor 3			
Floor 4			

UDP port: _____

We will also be installing the Tracer Summit Windows 95/98/2000/NT 4.0-compatible software on the PC workstation located on the Facility Manager's desk. This PC will need to be set up for IP communications by your staff, using either a permanently assigned IP address or DHCP.

When you have the above information, please send it to me at EMAIL ADDRESS, or fax this page to me at FAX NUMBER. If you have any questions or concerns, please call me at (800) 555-1212.

I am looking forward to working with you on this project.

Thanks again,

Project Manager

Note:
If the router has two Ethernet cards, the ports are labeled with the interface number for each card (refer to factory configuration document).

2. Using a straight CAT 5 cable, connect the hub to the bottom RJ-45 port on the router (Figure 3 on page 3).
3. Using a crossover CAT 5 cable, connect the 10Base2 Ethernet port to the BMTS BCU Ethernet port.

   Note:
   The router cannot start without the onboard Ethernet connected.

4. Connect the supplied ac power cable to both the router and an ac power source.

   Note:
   There is no power switch. When the router is connected to both an IP Ethernet LAN and a power source, the router turns on.

▲ IMPORTANT

Do not plug an active ARCNET cable into the onboard Ethernet port. Electrical incompatibilities between the two network types may cause the Ethernet port to be permanently damaged.

Note:
If an ARCNET cable is disconnected during router operation, the router buffers the packets that are destined for the ARCNET network as long as possible. When all buffers are full, the router automatically reboots.

Figure 2: Sample router network

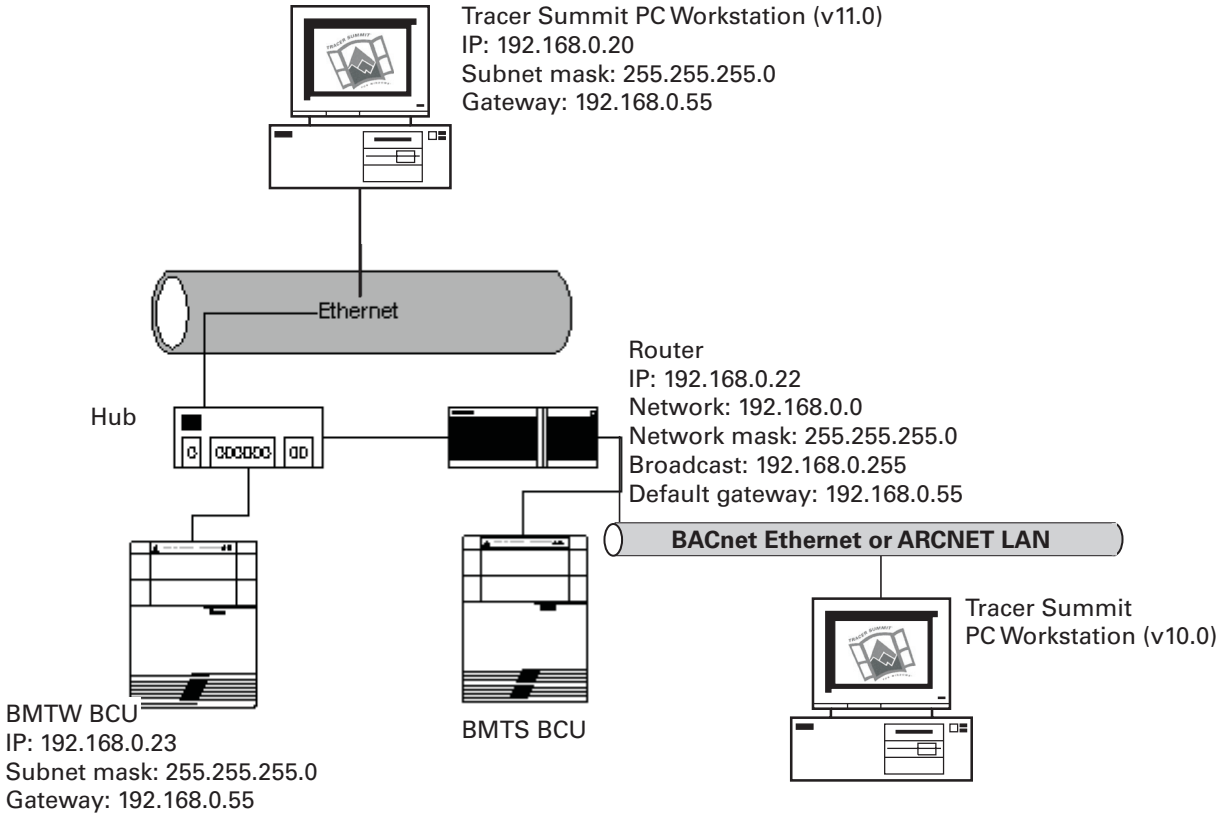
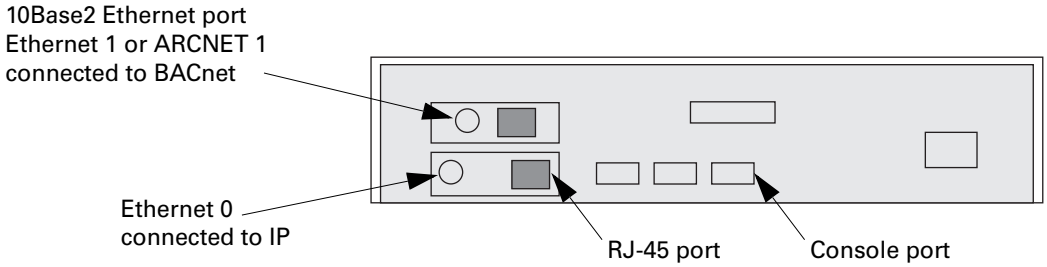


Figure 3: Router ports



Connect PC to router

The router is a single-board computer. It has no keyboard or display. To interface with the router and configure it, connect the router to a PC that has a terminal emulation program such as ProComm™ or HyperTerminal.

Prior to connecting to the router via terminal emulation, ensure that the PC satisfies these requirements:

- Serial port cabled to the router console port (Figure 3) with the provided crossover cable
- Properties set to: 9600 baud, 8 bits, 1 stop bit, and no parity
- ANSI command and character sets installed (VT100 compatible)

To connect to the router via terminal emulation:

1. At the login prompt, type:

   root

2. Press **ENTER**.
3. At the password prompt, type:

   1q2w3e4r

4. Press **ENTER**. The setup menu displays (Figure 4).
5. Go to *Configure router*.

Configure router

After connecting to the router via terminal emulation, you must configure the router. Configuring the router begins at the setup menu. The setup menu enables you to set, change, and save TCP/IP information in a file on the router flash disk.

Note:
If the setup menu is not displayed on the PC screen, use the RCONFIG editing program to access it. At the command line, type RCONFIG, then press **ENTER** until the setup menu displays (Figure 4).

View the PORT TABLE screen and note LANs setup:

1. At the setup menu (Figure 4), use the **TAB** key to move the cursor to Port Table.
2. Press **ENTER**. The PORT TABLE screen displays (Figure 5).

   Note:
   The bottom of the PORT TABLE screen shows the navigation commands. The most commonly used commands are **TAB**, **+**, and **^Q** (**CTRL** key and **Q** key pressed simultaneously). The **^Q** (return) command steps the display back through the program.

3. At the BACnet Network column, verify that each BACnet LAN has a network number from 1 through 65,534 (FFFE hex).

   Note:
   The network number is the same as the BCU network number in the site configuration information.

4. At the NIC and BACnet Protocol columns, verify eth0 is a BACnet/IP LAN, eth1 is an Ethernet LAN, and arc0 is an ARCNET LAN.

   Note:
   The router supports one eth0 connection and either one eth1 or one arc0 connection (Figure 3 on page 3).

5. Use the **^Q** command to return to the setup menu (Figure 4).
6. Go to *Configure eth0 from the NETWORK CONFIGURATION screen* on page 5.

Figure 4: Setup menu

```
>_Port Table

  Network Configuration

  Router  Configuration

 ENTER, Up, Down, Tab    ^Q - exit
```

Figure 5: Sample PORT TABLE screen

```
                              PORT TABLE
 BAC-  Con-  BACnet   NIC    BACnet      BACnet/IP
 net   nec-  Network         Protocol   Detail  Udp Port
 Port  ted?
   1    on       1  eth0   BACnet/IP    BBMD    47808
   2    on       2  eth1   Ethernet
   3    on       3  arc0s  ARCnet

 TAB,   ^E - select field      +  - hint,   ENTER - detail
 DOWN,  UP - select line      ^Y - delete,  ^Q    - return
```

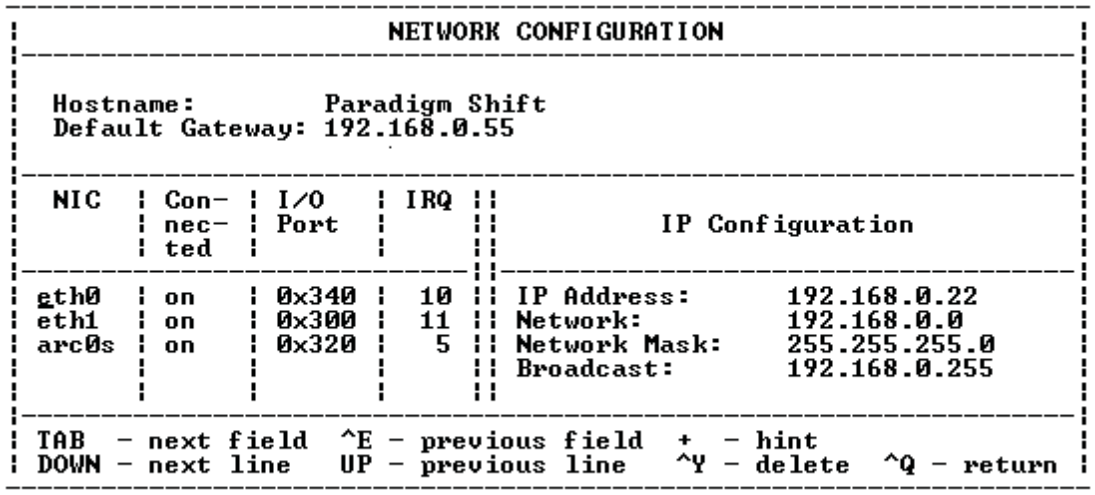
Configure eth0 from the NETWORK CONFIGURATION screen

Configure the Ethernet 0 (eth0) network interface card (NIC) at the NETWORK CONFIGURATION screen:

1. At the setup menu (Figure 4 on page 4), use the **TAB** key to move the cursor to Network Configuration.
2. Press **ENTER**. The NETWORK CONFIGURATION screen displays (Figure 6).

   Note:
   The bottom of the NETWORK CONFIGURATION screen shows the navigation commands. The most commonly used commands are **TAB**, **+**, and **^Q** (**CTRL** key and **Q** key pressed simultaneously). The **^Q** (return) command steps the display back through the program.
3. Use the **TAB** key to move the cursor to eth0.
4. Use the **TAB** key to move the cursor to the IP Address field in the IP Configuration column.
5. Type the IP address that you received from the network administrator.
6. Press the **TAB** key to move the cursor to the Network field in the IP Configuration column.
7. Type the same address that you entered in the IP Address field, but substitute a *0* for the last number.
8. Press the **TAB** key to move the cursor to the Network Mask field in the IP Configuration column.
9. Type the subnet mask address that you received from the network administrator.
10. Press the **TAB** key to move the cursor to the Broadcast field in the IP Configuration column.
11. Type the same address that you entered in the IP Address field, but substitute 255 for the last number.
12. Use the **^Q** command to return to the setup menu (Figure 4 on page 4).
13. Go to *Configure eth1 from the NETWORK CONFIGURATION screen* on page 6.

Figure 6: Sample NETWORK CONFIGURATION screen for eth0



Configure eth1 from the NETWORK CONFIGURATION screen

The configuration of NIC Ethernet 1 (eth1) applies to the router. Normally, eth1 is preconfigured, but if you have to configure it, use the following procedure. At most, you should only have to configure eth1 once. Configure eth1 at the NETWORK CONFIGURATION screen:

1. At the setup menu (Figure 4 on page 4), use the **TAB** key to move the cursor to Network Configuration.
2. Press **ENTER**. The NETWORK CONFIGURATION screen displays (Figure 7).

   Note:
   The bottom of the NETWORK CONFIGURATION screen shows the navigation commands. The most commonly used commands are **TAB**, **+**, and **^Q** (**CTRL** key and **Q** key pressed simultaneously). The **^Q** (return) command steps the display back through the program.
3. Use the **TAB** key to move the cursor to eth0.
4. Press the down arrow key to move the cursor to eth1.
5. Use the **TAB** key to move the cursor to the IP Address field in the IP Configuration column.
6. Type the IP address that the manufacturer used to configure the router. Or, use the screen default.
7. Press the **TAB** key to move the cursor to the Network field in the IP Configuration column.
8. Type the same address that you entered in the IP Address field, but substitute a *0* for the last number.
9. Press the **TAB** key to move the cursor to the Network Mask field in the IP Configuration column.
10. Type the address that you received from the network administrator.
11. Press the **TAB** key to move the cursor to the Broadcast field in the IP Configuration column.
12. Type the same address that you entered in the IP Address field, but substitute 255 for the last number.
13. Use the **^Q** command to return to the setup menu (Figure 4 on page 4).
14. Go to *Configure arc0 from the NETWORK CONFIGURATION screen* on page 7.

Figure 7: Sample NETWORK CONFIGURATION screen for eth1

```
                        NETWORK CONFIGURATION

  Hostname:         Paradigm Shift
  Default Gateway: 192.168.0.55

  NIC   | Con- | I/O    | IRQ |
        | nec- | Port   |     |          IP Configuration
        | ted  |        |     |
--------|------|--------|-----|-----------------------------------
 eth0   | on   | 0x340  |  10 | IP Address:      127.0.0.2
 eth1   | on   | 0x300  |  11 | Network:         127.0.0.0
 arc0s  | on   | 0x320  |   5 | Network Mask:    255.255.255.0
        |      |        |     | Broadcast:       127.0.0.255

 TAB  - next field  ^E - previous field  +  - hint
 DOWN - next line   UP - previous line   ^Y - delete  ^Q - return
```

Configure arc0 from the NETWORK CONFIGURATION screen

To configure ARCNET 0 (arc0), repeat the procedure for configuring eth0 with one exception: use the arrow key to move the cursor to arc0 prior to tabbing to the IP Address field in the IP Configuration column.

After you configure arc0, repeat the **^Q** command to return to the setup menu (Figure 4 on page 4) then go to *Configure the default gateway from the NETWORK CONFIGURATION screen*.

Configure the default gateway from the NETWORK CONFIGURATION screen

Configure the default gateway at the NETWORK CONFIGURATION screen:

1. At the setup menu (Figure 4 on page 4), use the **TAB** key to move the cursor to Network Configuration.
2. Press **ENTER**. The NETWORK CONFIGURATION screen displays (Figure 6 on page 5).

   Note:
   The bottom of the NETWORK CONFIGURATION screen shows the navigation commands. The most commonly used commands are **TAB**, **+**, and **^Q** (**CTRL** key and **Q** key pressed simultaneously). The **^Q** (return) command steps the display back through the program.
3. Use the **TAB** key to move the cursor to the Default Gateway field.
4. Type the Default Gateway address that you received from the network administrator.
5. Use the **^Q** command to return to the setup menu (Figure 4 on page 4).
6. Go to *Configure BBMDs*.

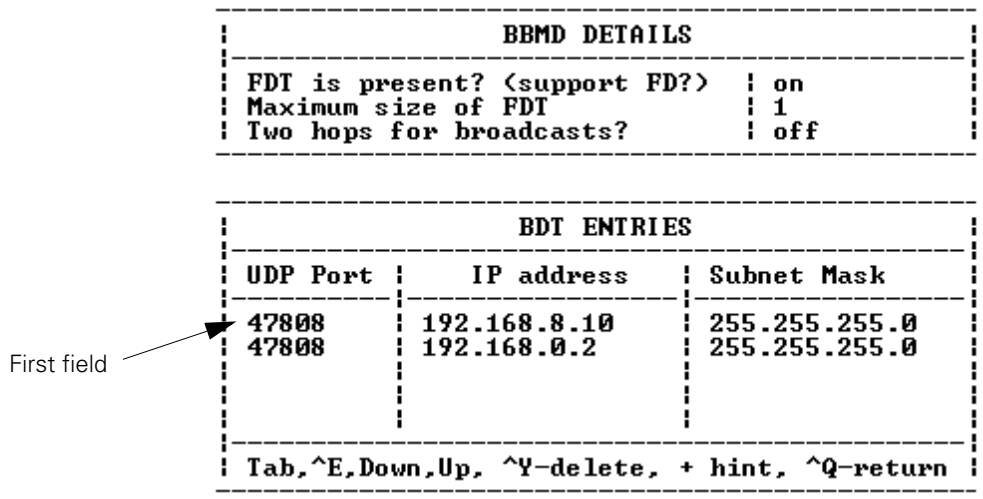
Configure BBMDs

Configure the BBMDs at the broadcast distribution table (BDT). For detailed information about BBMDs and BDTs see engineering bulletin *Tracer Summit® BACnet/IP Network Installations* (BAS-PRB004-EN). To configure the BBMDs:

1. At the setup menu (Figure 4 on page 4), use the **TAB** key to move the cursor to Port Table.
2. Press **ENTER**. The PORT TABLE screen displays (Figure 5 on page 4).
3. Use the **TAB** key to move the cursor to the BACnet/IP Detail column.
4. Press the **+** key to move the cursor to BBMD.
5. Press **ENTER**. The BBMD DETAILS/BDT ENTRIES screen displays (Figure 8).

   Note:
   The bottom of the BBMD DETAILS/BDT ENTRIES screen shows the navigation commands. The most commonly used commands are **TAB**, **+**, and **^Q** (**CTRL** key and **Q** key pressed simultaneously). The **^Q** (return) command steps the display back through the program.

Figure 8: Sample BBMD DETAILS and BDT ENTRIES screen



6. At the BBMD DETAILS portion of the screen, use the **TAB** key, if necessary, to move the cursor to FDT is present? <support FD?>.
7. Press **SHIFT +** and when the menu appears, use the down arrow key to select **on**.
8. Press the **TAB** key to move the cursor to Maximum size of FDT.
9. Type the number of FDs (routers) that are on the network.
10. Use the **TAB** key to move the cursor to the UDP Port column on the BDT ENTRIES portion of the screen. The cursor is at the first field.
11. Type the UDP port number that you received from the network administrator.
12. Press the **TAB** key to move the cursor to the IP address column.
13. Type the address that you received from the network administrator.
14. Press the **TAB** key to move the cursor to the Subnet Mask column.
15. Type the address that you received from the network administrator.

    Note:
    All other fields remain in their default state.
16. Repeat steps 10 through 15 for each BBMD on the network with one exception: at the UDP Port column, use the down arrow key to access the next available field.
17. When all BBMDs are configured, use the **^Q** command to return to the setup menu (Figure 4 on page 4).
18. Go to *Exit the editor and reboot*.

Exit the editor and reboot

When all of the parameters are set, save changes, exit the editor, and reboot the router.

1. Repeat the **^Q** command until a message appears asking if you want to save and write to the disk.
2. Select Y (yes).
3. When asked if you want to reboot, select Y (yes). The router reboots.

   Note:
   When the write operation completes, the screen returns to the command prompt.
4. Disconnect from the terminal emulator and close the screen.

Troubleshooting

After the router is installed and configured, verify proper operation. To verify proper operation, test communications from a network PC to the router:

1. At the DOS prompt on a network PC, type *ping* followed by the IP address for eth0:

   ping <IP address for eth0>

   Note:
   Type the IP address, but not the carets (<>).
2. Press **ENTER**.
3. When the operation completes and the results are returned, note the number of packets sent, the number of packets received, and the elapsed time for the operation.
4. If the operation fails, configure the router again.
5. If the ping completes, but the Tracer Summit PC Workstation does not communicate, check the workstation setup. For more information, see engineering bulletin *Tracer Summit® BACnet / IP Network Installations* (BAS-PRB004-EN).

Contact information

Trane BAS is the contact for technical support for the router.