BACnet Integration Guide
for i-Vu® XT or TruVu™ controllers

⚠️ Verify that you have the most current version of this document from **www.hvacpartners.com**, the **Carrier Partner Community** website, or your local Carrier office.

Important changes are listed in **Document revision history** at the end of this document.

Contents

Overview

You can integrate BACnet devices into a i-Vu® or Field Assistant system using the i-Vu® XT / TruVu™ controller. The Carrier controller serves as a master device.

Carrier	
Read/write capability	Can read from and write to the third-party equipment
Third party	
Supported equipment	Any device that supports the BACnet MS/TP protocol
Supported media	IP, Ethernet, ARCNET, MS/TP (9600, 19200, 38400, 57600, 76800, 115200)

NOTE Every media type is not supported on every controller. See the Carrier controller's <Technical Instructions>.

Before-you-begin checklist

You need the following items, information, and skills for the integration process:

☐ The Carrier controller's *Installation and Start-up Guide*

☐ The third party device's:

- BACnet network number and MAC address or the Device Instance
- Points list, including BACnet Object ID's (object type plus object instance)

☐ The BACnet network's baud rate, data bits, parity, and stop bits
NOTE You can set the baud rate manually or by enabling autobaud.

☐ Verification that all communication settings have been set on the third party device

☐ Experience creating control programs in Snap

☐ Experience installing, wiring, setting up, and downloading custom control programs to the i-Vu® XT or TruVu™ controller

☐ The latest version of *Wireshark* (*http://www.wireshark.org*) downloaded and installed. Use this network analysis tool for troubleshooting.

1 Connect the third-party device to the Carrier controller

The i-Vu® XT or TruVu™ controller can reference a third-party BACnet point on any network type if a BACnet route to the point exists.

You can wire a third-party BACnet device to the i-Vu® XT or TruVu™ controller's **Gig-E**, **Eth0**, or **Eth1** ports, **Port S1**, or **Port S2**.

NOTES

- A non-routing controller supports BACnet devices only on the **Gig-E, Eth0,** or **Eth1** ports and **Port S1**.
- Communication may be affected by the network bandwidth as well as the frequency and number of points communicating.

Scenario 1:
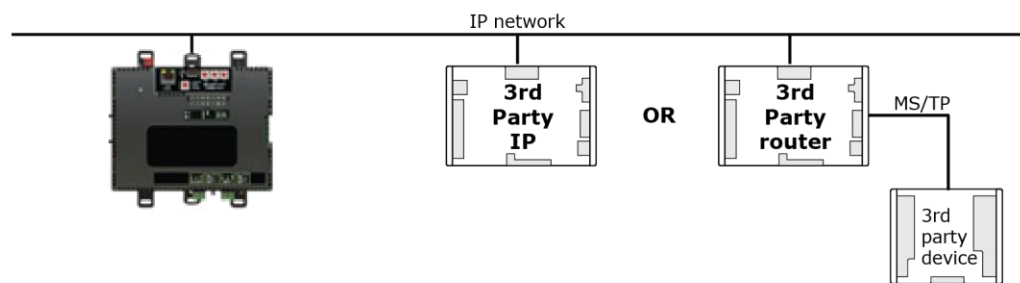
Scenario 2:

Wiring specifications

For...	Use...	Maximum Length
BACnet/IP Ethernet	Cat5e or higher Ethernet cable	328 feet (100 meters)
MS/TP* ARCNET*	22 AWG, low-capacitance, twisted, stranded, shielded copper wire *	2000 feet (610 meters)

* For details see the *Open Controller Network Wiring Guide*.
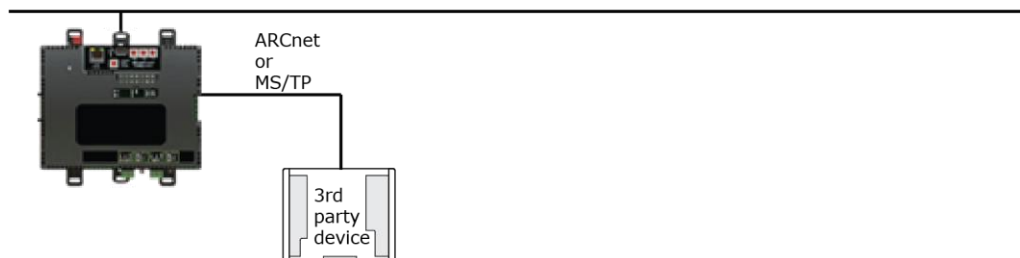
⚠ **WARNING** Do not apply line voltage (mains voltage) to the controller's ports and terminals.

To connect to a BACnet/IP device

To integrate a third-party BACnet/IP device, or any device it routes to, as shown in Scenario 1:

- Make sure an IP route to the point exists.

- Connect an Ethernet cable to the i-Vu® XT or TruVu™ controller's **Gig-E**, **Eth0**, **Eth1** Ethernet port.

- If your controller has a rotary switch, set **Port S1**'s rotary switch to 0 if the port is not being used for any network.

NOTE You must either have the Carrier IP device on the same IP subnet as the third-party device, or you must have BACnet Broadcast Management Devices (BBMD's) configured to communicate to the IP subnet where the third-party device lives. Do not configure more than one BBMD per subnet as this may cause circular routes. To avoid this problem:

- i-Vu® Pro - Let SiteBuilder automatically configure your BBMD tables. (SiteBuilder defines only one controller per IP subnet as a BBMD.)

- Use the BBMD Configuration Tool to make sure that a controller's BBMD table does not contain the IP addresses of other controllers on the same IP subnet.
  See *Appendix B* (page 26).

To wire to a BACnet/ARCNET network

1 Turn **off** the i-Vu® XT or TruVu™ controller's power.

2 Check the communications wiring for shorts and grounds.

3 Connect the communications wiring to **Port S1**'s screw terminals labeled **Net +**, **Net -**, and **Shield**.

NOTE Use the same polarity throughout the network segment.

4 If the controller has a **Port S1 Configuration** rotary switch, set it to 2.

5 If the i-Vu® XT or TruVu™ controller is at either end of a network segment, set the port's **End of Net?** switch to **Yes**..

NOTE The controller's **End of Net** switch applies network termination and bias. See the *Open Controller Network Wiring Guide.*

6 Turn on the controller's power.

7 To verify communication with the network, get a Module Status report in the i-Vu® or Field Assistant interface for a controller on the ARCNET network.

NOTE This step requires that you have discovered and uploaded the controller in the i-Vu® application.

To wire to a BACnet MS/TP network

The following instructions are for i-Vu® XT or TruVu™ controllers that accommodate an MS/TP network wired to either **Port S1** or **Port S2**. On the non-routing controllers, an MS/TP network can be wired only to **Port S1**.

1 Turn **off** the i-Vu® XT or TruVu™ controller's power.

2 Check the communications wiring for shorts and grounds.

3 Connect the communications wiring to the **Port S1** or **Port S2** screw terminals labeled **Net +**, **Net -**, and **Shield**.

NOTE Use the same polarity throughout the network segment.

4 If you are using **Port S1**, and the controller has a **Port S1 Configuration** rotary switch, set it to 1.

NOTE If **Port S1** is not being used for any network, set this rotary switch to 0.

5 If the i-Vu® XT or TruVu™ controller is at either end of a network segment, set the port's **End of Net?** switch to **Yes**.

NOTE The controller's **End of Net** switch applies network termination and bias. See the *Open Controller Network Wiring Guide.*

6 Turn on the controller's power.

7 To verify communication with the network, get a Module Status report in the i-Vu® or Field Assistant interface for a controller on the MS/TP network.

NOTE This step requires that you have discovered and uploaded the controller in the i-Vu® application.

2 Discover BACnet networks, devices, and objects

The i-Vu® or Field Assistant **BACnet Discovery** feature locates all accessible BACnet networks, BACnet devices, and BACnet objects (including devices in your i-Vu® Plus or Pro or Field Assistant system) on a BACnet network.

NOTE BACnet Discovery is not available in the i-Vu® Standard application.

To use **BACnet Discovery**:

1   Select the **System** 🖳 in the navigation tree and then the **Devices** page > **Advanced** tab.

2   Click the **BACnet Discovery Start** button to discover BACnet networks for the sites. An item called **Discovered Networks** appears in the tree.

3   To discover BACnet networks, select **Discovered Networks**, then click **Go**. A list of all BACnet networks appears in the navigation tree. After all networks are found, close the status dialog box.

   💡 **TIP** Run a commstat manual command to determine which device routes to each network. The **BACnet Bind Show Network** section of the Commstat window shows the IP address of the router to each network.

4   To discover BACnet devices on a network, select a network in the navigation tree, then click **Go**. After all devices are found, close the status dialog box. Click ▶ beside an item to expand the list of devices.

5   To discover BACnet objects on a device, select the device on the navigation tree, then click **Go**. After all objects are found, close the status dialog box. A list of all BACnet objects in this device appears on the navigation tree.

   💡 **TIP** Make sure you are discovering objects in the correct device. It may take some time to discover objects in devices with more than 100 objects.

6   Optional: Do the following to export the BACnet information so that it can be used in the Snap application:

   a)   On the navigation tree, select a discovered network with devices or a single device.

   b)   Click **Export**.

   c)   Name and save the .discovery file in any folder.

NOTES

- Some third-party BACnet devices may not be discovered because they do not support the BACnet methods required for auto discovery.

- If the discovery process returns ambiguous information, such as multiple points with similar names, contact the third-party manufacturer's representative for clarification.

- Device configuration or network load can prevent the i-Vu® or Field Assistant interface from showing all BACnet devices. If you do not see a BACnet device that you expect to see, check the system's BBMD configurations. If the configurations are correct, try the discovery process again.

- If a third-party device is not discoverable, you must get the device's address and point list information from the third-party vendor. See To format a BACnet address.

- Troubleshooting BBMD's. See *Appendix B - Setting up BBMDs* (page 26) or the *BBMD Utility User Guide*.

3 Create a control program in Snap

Use Network I/O microblocks and Display microblocks to read from or write to BACnet objects in a third-party BACnet device.

Use Network I/O microblocks if any of the following is true:

- An Carrier control program must read from or write to third-party BACnet points for automatic control.
- You want to trend values from a third-party device that does not support BACnet trends.
- You want to display third-party values that require unit conversion or other math processing.

Use Network I/O microblocks if any of the following is true:

- A Carrier control program must read from or write to third-party BACnet points for automatic control.
- You want to trend values from a third-party device that does not support BACnet trends.
- You want to display third-party values that require unit conversion or other math processing.

TIP Verify the third-party manufacturer's addressing pattern by establishing communication with a few points whose values you can physically manipulate before you spend time addressing the remaining integration points.

???NOTE You can use the Check All and Uncheck All buttons to the far right.

To create a control program

1 Go to **Start** > **All Programs** > **I-Vu Tools x.x** > **Snap**.

2 Select the appropriate Network Input and Output or Display microblocks to use to gather data from third-party device.

3 Use a unique name and save the .equipment file to any folder.

4 In Snap, select **Edit** > **Third Party BACnet Addresses**.

5 Browse to the .discovery file that you saved from the i-Vu® or Field Assistant BACnet Discovery tool.

6 Click on one of the Network Input and Output or Display microblocks.

   NOTE Check **Only show objects that match selected microblock** to display only the applicable third party points.

7 Select one of the points from **Third Party Addresses**.

8 Click **Set Address** to place the third party address into the selected microblock.

9 Save the file.

To create a control program for multiple identical third-party devices

If you are integrating to multiple identical third-party devices, the i-Vu® or Field Assistant application can help you address the Network I/O microblocks.

1   Replicate the first device's control program for each of the other third-party devices.

2   Do one of the following:
  - If Network I/O microblocks were addressed in the Snap application, go to step 3.
  - If the Network I/O microblocks do not have addresses, enter the addresses in the i-Vu® or Field Assistant interface for one instance of the equipment. Do this on the equipment's **Properties** page > **Network Points** tab. Then use Global Copy to copy the addresses to all other instances of the equipment.

3   Go to the **Properties** page > **Network Points** tab for another instance of the equipment.

4   Click **Search/Replace** at the top of the **Address** column.

5   Replace the device identification in the addresses with the identification for the third-party device the control program will communicate with.

To edit a microblock address

You can edit a microblock address in the following places:
  - In the Snap Property Editor
  - In the i-Vu® or Field Assistant interface on the microblock's **Properties** page > **Details** tab
  - In the i-Vu® or Field Assistant interface on the control program's **Properties** page > **Network Points** tab

To format a BACnet address

The BACnet standard allows multiple formats for creating a valid address in each microblock that you use to read from or write to a third-party BACnet point. Some are shown below.

⚠️ **CAUTION** When integrating third-party devices into your system, most communication problems are caused by incorrect data or typing errors in the microblock's Address field.

bacnet://device/object/property@priority
           ❶   ❷   ❸   ❹

NOTE Numeric values in a BACnet address can be entered using decimal or hexadecimal notation. Type `0x` before a hexadecimal value.

① **Device** - Use one of the following: **EXAMPLES**

Device instance number   `bacnet://2010/…`

BACnet device name   `bacnet://MyDevice/…`

Network number: MAC address   `bacnet://1234:35/…`
(of third-party device)   `bacnet://1234:0x23/…`

The word "this" if a network point requests a value from   `bacnet://this/…`
another control program in the same Carrier controller. Avoids
network traffic. Requires v2.05 or later controller driver.

A single * (wildcard) that sends out a request on the network `bacnet://*/…`
for all devices that contain the Object specified in the address.
(See **Object** below.) The microblock subscribes to the nearest
responder.

NOTES

- You can use an * in the address of Network Input
  microblock.
- An address with an * is restricted to the present_value
  property (the default when you do not specify a property).

② **Object** - Use one of the following: **EXAMPLES**

Object type: Instance number   `bacnet://…/ai:2`
(See NOTES below)

BACnet object name   `bacnet://…/MyObject`

NOTES

- For object type, you may type the abbreviation (not case sensitive), the full name, or the object type
  number. Some standard BACnet object type numbers are listed below. See the BACnet standard for a
  complete list. For proprietary BACnet objects, see the object's manufacturer.

Use…	Or…	Or…
ai	analog-input	0
ao	analog-output	1
av	analog-value	2
bi	binary-input	3
bo	binary-output	4
bv	binary-value	5
dev	device	8
msi	multistate-input	13
mso	multistate-output	14
msv	multistate-value	19

- Every object in a controller has a unique instance number, regardless of its control program.

③ Property (optional) If you want to read or write a property other than present_value, type one of the following:

EXAMPLES

BACnet property identifier   `bacnet://…/…/cov_increment`

BACnet property identifier #   `bacnet://…/…/22`

Property identifier (with index)   `bacnet://…/…/priority-array(12)`

Property identifier # (with index)   `bacnet://…/…/87(12)`

NOTE Some standard BACnet properties are listed below. See the BACnet standard for a complete list. For proprietary BACnet objects, see the object's manufacturer.

Property identifier	Identifier #
change_of_state_count	15
cov_increment	22
derivative_constant	26
event_state	36
high_limit	45
integral_constant	49
low_limit	59
max_pres_value	65
min_pres_value	69
out-of-service	81
present_value	85
proportional_constant	93
reliability	103
relinquish_default	104
setpoint	108
system_status	112
trigger	205
units	117
vendor_identifier	120

④ Priority (optional) If you want to write at a priority other than 16, type @ followed by a priority number.

EXAMPLE

Number (1–16)   `bacnet://…/…/…@9`

NOTE Priority levels 1 and 2 are reserved for manual and automatic life safety commands. For more information on reserved priority levels see the BACnet standard.

Examples of BACnet addresses:

`bacnet://MyDevice/ai:2`

`bacnet://1234:0x23/analog-input:2/priority-array(12)@8`

`bacnet://2499:0x00E0C90047CA/bi:3`

`bacnet://2436:192.168.47.36:47806/0:2`

To set up network inputs

Polling or BACnet COV

If a network input or totalizer microblock's **Address** field references a BACnet object property, the microblock reads the property's value using one of the following methods.

- Polling—The microblock reads the property at the **Refresh Time** interval using the BACnet ReadProperty or ReadPropertyMultiple service (see "Method 1: Polling" below).

- BACnet COV (Change of Value) subscription—The microblock subscribes with the target BACnet object. An analog target notifies the microblock if the target's value changes by more than the target's BACnet COV_Increment. A binary target notifies the microblock when it changes state (see "Method 2: BACnet COV subscriptions" below).

Method 1: Polling

Benefits	• Allows rapid detection of a dead device or of network problems
	• Does not require additional memory
Drawbacks	• Generates unnecessary network traffic if a value does not change frequently
	• Misses value changes that occur between pollings
	• Can overwhelm the target's controller if many microblocks request the same property value (such as outside air temperature). The BACnet object must send the value to each microblock that polls for that data.
To set up	Set the microblock's **Refresh Time** to 30 seconds or less.

NOTE The microblock will not poll at a **Refresh Time** interval smaller than 1 second.

BACnet ReadProperty and ReadPropertyMultiple services

See the BACnet specification for details on the ReadProperty and ReadPropertyMultiple services.

ReadPropertyMultiple occurs if:

- two or more microblocks in a controller read more than one target in the same remote controller,
- the **Refresh Time** in two or more microblocks expires at the same time, and
- the remote controller supports the service.

Method 2: BACnet COV subscriptions

Benefits	• Can decrease network traffic by preventing unnecessary updates if the target's COV_Increment is set appropriately. See step 2 in "To set up" below.
Drawbacks	• Can generate excessive network traffic if the target's COV_Increment property is too small. See step 2 in "To set up" below.
	• Can delay detection of a dead device or of network problems
To set up	1 Set the microblock's **Refresh Time** to 31 seconds or more.
	2 If the microblock's **Address** field references an analog property, set the target's COV_Increment property to the smallest amount by which the value must change for the target to notify its subscribers. The optimal COV_Increment is large enough to prevent unnecessary updates but small enough to be useful to the control program(s) receiving the updates.

NOTE If COV subscription fails, the microblock reads the value at the **Refresh Time** interval using the BACnet ReadProperty or ReadPropertyMultiple service. See "Method 1: Polling" above.

COV subscription details

When an input (network input or totalizer microblock) subscribes with a BACnet target (object property), the input sets a 21-minute subscription Lifetime in the target. The target responds with a COV notification that includes the target's value and time remaining from the original subscription Lifetime (TimeRemaining). The input resubscribes with the target every 10 minutes to keep the target's BACnet subscription service active. i-Vu® or Field Assistant shows the time remaining until the input's next subscription in the **Next Refresh** field on the input's i-Vu® or Field Assistant **Properties** page.

The target also sends a COV notification that includes the target's value and subscription Lifetime TimeRemaining when the target's value changes by more than the target's COV_Increment.

If the Carrier target has one subscriber, the target sends COV notifications directly to that subscriber. If the Carrier target has more than one subscriber, it broadcasts its COV notifications to optimize network traffic. A third-party subscriber can participate in this broadcast scheme by subscribing for Unconfirmed COV notifications with a Process ID of 0. Otherwise, the Carrier target maintains and responds to the third-party subscription separately with its own Lifetime timer.

The Carrier input compares the TimeRemaining value in each COV notification broadcast the target sends to its (Next Subscription time + 11) to determine whether another input has subscribed since it did. If another input has subscribed more recently, the input adds 10 minutes to its **Next Refresh** time. This allows the COV Subscription request from the last subscribing input to keep the subscription service active for all subscribers to the same data.

EXAMPLE

Elapsed time (minutes)	Action	Target Lifetime TimeRemaining (minutes)	Input 1 Next Subscription (minutes)	Input 2 Next Subscription (minutes)
0	Input 1 subscribes to target	21 (Input 1)	10	
0	Target broadcasts COV notification because Input 1 subscribed	21	$21 \le 10 + 11$, so keep current value of 10	
2	Input 2 subscribes to target	21 (Input 2)	10 - 2 = 8	10
0	Target broadcasts COV notification because Input 2 subscribed	21	$21 > 8 + 11$, so add 10 to current value of 8 8 + 10 = 18	$21 \le 10 + 11$, so keep current value of 10
3		21 - 3 = 18	18 - 3 = 15	10 - 3 = 7
0	Target broadcasts COV notification because value changed	18	$18 \le 15 + 11$ so keep current value of 15	$18 \le 7 + 11$ so keep current value of 7
7		18 - 7 = 11	15 - 7 = 8	7 - 7 = 0 resubscribe
0	Input 2 resubscribes	21 (Input 2)	8	10
0	Target broadcasts COV notification because Input 2 subscribed	21	$21 > 8 + 11$, so add 10 to current value 8 + 10 = 18	$21 \le 10 + 11$, so keep current value of 10

Input 2 keeps the subscription service active at the target with a minimum of network traffic.

NOTE If an input receives COV notification with a target TimeRemaining < 11, which could happen if the last subscribing input loses communication with the target, the input resubscribes immediately.

COV notification rate

COV notifications from a BACnet object property are controlled by that property's BACnet COV_Increment. When the absolute value of the difference between the property's Present_Value and the value sent in the last COV notification is greater than the COV_Increment, the object broadcasts a COV notification. For Carrier controllers, the rate of notifications is further limited by two internal processes.

1   The control program's execution rate determines how often the check against COV_Increment is performed.

2   The controller's pending COV Notification task has built-in delays to prevent COV notifications from consuming the controller's CPU processing time.

The built-in delays are as follows:

If more than 15 COV notifications are pending delivery, the controller inserts a 50 millisecond delay after each set of 15 notifications. Once the entire list of pending notifications is serviced, the controller inserts another 50 millisecond delay. This results in a maximum COV notification rate of 300 COV notifications per second per Carrier controller.

To speed detection of a dead device

If a BACnet object's device loses network communication, a network input reading the object's value does not detect the failure until:

- The network input's next subscription (up to 10 minutes) if using BACnet COV subscription, or

- The **Refresh Time** expires, if polling

You can use a small **Refresh Time** to poll more often, but this can generate unnecessary network traffic under normal conditions.

To use the benefits of BACnet COV subscription, but overcome the potential delay in detection of a dead device, send a constantly changing value from the BACnet object's control program to a network input using BACnet COV subscription. If the value stops changing, the network input's control program generates an alarm.

EXAMPLE

The logic in the BACnet object's control program that sends the value. The BACnet Analog Value microblock has a COV Increment of 0.5.
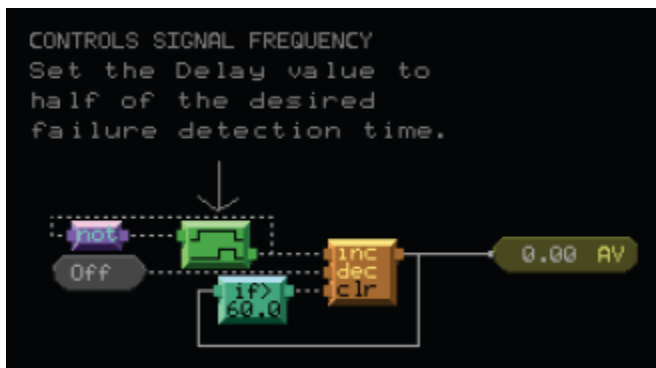
The logic in the network input's control program that receives the changing value. The SIGNAL analog network input's **Address** field contains the address of the BACnet Analog Value microblock sending the changing signal, and the network input's **Refresh Time** is 31 seconds.

4 Configure Display microblocks

To allow an operator to change a third-party object's property from the i-Vu® or Field Assistant interface through a Display microblock, the desired property must be present and be editable (not marked "Read only") in the third-party object.

In the Snap Property Editor of a microblock, select **Present** (if the optional property exists in the third-party device), **Editable**, and **Write to field** checkboxes. See COV increment in the example below.

The Display microblocks in the table below require special configuration.

Binary Output Binary Value	If you want the text of a BACnet Modeled Binary Output or BACnet Modeled Binary Value on a graphic to display the inactive and active text instead of 0 and 1, select the **Present** checkboxes.
	NOTE If the third-party device does not support this feature, your graphic will display 0 or 1 even if you select the **Present** checkboxes.
Schedule	If you want the i-Vu® or Field Assistant schedule to write to a third-party BACnet-schedule object through a BACnet modeled schedule object, do the following:
	1 In the Snap application, select the **Schedule Category** of the i-Vu® or Field Assistant schedule that will write to the third-party object.
	2 In the **Property Editor**, select the **Present**, **Editable**, and **Write to field** checkboxes for **Weekly Schedule** and **Exception Schedule**.
	NOTES
	• Only Carrier-manufactured devices support Carrier Dated Weekly schedules.
	• If you get an error in the i-Vu® or Field Assistant interface, clear the **Array Resize Write Index** and **Array Resize Write Past End** checkboxes.

Event Notification	You can use a BACnet Modeled Event Enrollment microblock to view the status of a third-party BACnet Event Object. If you want the third-party device to deliver its alarms to the i-Vu® or Field Assistant Alarms View tab, you must configure the third-party device to send alarms to the i-Vu® or Field Assistant Server application. You can add i-Vu® or Field Assistant Server to the Recipient List for each alarm or set up a BACnet Modeled Notification Class microblock to add i-Vu® or Field Assistant Server to the Recipient List for every alarm generated by the third-party device.

NOTE A third-party device may not retain alarm recipient information through a power loss or download.

1   In the BACnet Modeled Event Enrollment microblock, select the **Standard** Template for the best results on your i-Vu® or Field Assistant Alarms View tab.

2   In the Event Enrollment or Notification Class microblock, select the **Editable** and **Write to field** checkboxes for **Recipient List**.

	Present	Editable	Read from Field	Write to Field
Recipient List		☑	☑	☑

3   On the i-Vu® or Field Assistant **Properties** page **Details** tab for a device's BACnet Modeled Notification Class microblock or an event's BACnet Modeled Event Enrollment microblock, click **Add**.

4   Define the recipient. See field descriptions below.

5   Generate an alarm at the third-party device to verify that you see the alarm delivered to your i-Vu® or Field Assistant Alarms View tab.

Field	Notes
Recipient Type	Select **Device**.
Time section	Select the days and define the hours that the third-party device should send alarms to i-Vu® or Field Assistant Server.
Device Object Identifier	Enter your i-Vu® or Field Assistant system's BACnet Alarm Recipient instance number.
Process Identifier	Type 1.
Issue Confirmed Notification	Select this checkbox.

Trend	If the third-party trend does not display correctly, change the **Trend Conformance Level** to **Default**.

5 Download the driver and control programs

If you need an updated drv_fwex driver or the latest SAL library, go to *Carrier Control Systems Support Sites http://www.hvacpartners.com/, https://accounts.ivusystems.com/* and save it to your computer.

To change the driver

1 On the i-Vu® or Field Assistant navigation tree, right-click the controller that you wish to update and select **Driver Properties**.

2 Go to **Driver** > **Properties** > **Update** tab.

3 Do one of the following:

If the driver is...	
In the **Driver Version** drop-down list	a. Select the driver. b. Click **Accept**.

Not in the **Driver Version** drop-down list	Click **Update** and the driver is updated using the latest Factory SAL.
	or
	    a) Click **Add**.
	    b) Browse to select the driver.
	    c) c. Click **Open**.
	    d) d. Click **Continue**.
	    e) e. Click **Close**.
	    f) f. Click **Close** again.

4 Click the **Download All Content** button.

5 Click **OK.**

6 Click **Accept.**

To update the SAL library in the i-Vu® application

1   In the i-Vu® interface, click **System Menu** , then select **System Options** > **Update**.

NOTE Expand **Current Libraries (.sal)** to see the current SAL libraries and their revision. Compare them to what you downloaded and determine if any of them need updating.

2   Click and browse to the updated .sal file that you have saved on your computer, select the file, and click **Open**.

3   Click **Continue**.

4   When process is complete, the message appears **File added successfully**.

5   Click **Close**.

6   Click **Close** again.

7   Click the **Download All Content** button.

8   Click **OK.**

9   Click **Accept.**

To add a control program

1   Select the router in the navigation tree and go to the **Devices** > **Manage** tab.

2   If you are adding a new control program, click the **Add Control Program** button . A dialog window appears.

3   Enter a name for your control program in **Display Name** and select your controller in the **Controller** drop-down list.

4   Do one of the following:

If the control program is...	
In the **Control Program** drop-down list	Select the control program.
Not in the **Control Program** drop-down list	a. Click **Add New**.
	b. Browse to select the control program.
	c. Click **Open**.
	d. Click **Continue**.
	e. Click **Close**.

5   Click **Continue**. When message appears **File added successfully**, click **Close**.

6   Click **Close** again.

7   Right-click on the controller in the list and select **Check Status** from the list. The status of the controller should say **File Mismatch**.

8   Click the **Download All Content** button.

6 Verify the network points are operating correctly

1   On the i-Vu® or Field Assistant navigation tree, select the Carrier controller.

2   Select the **Properties** page > **Network Points** tab.

If...	Then...
You see the point value you expect with no errors in the **Error** column	You have successfully established communication with the third-party device.
All points show question marks instead of values	The i-Vu® or Field Assistant application is not communicating with the i-Vu® XT or TruVu™ controller. Troubleshoot communications. See the Carrier *controller's Installation and Start-up Guide*.
The point name is red	Look in the **Error** column for one of the following error codes and descriptions. • **1 - Communications Disabled for this Microblock** Enable the integration point's **Communications Enabled** field on the i-Vu® or Field Assistant **Network Points** tab. • **3 - Address Error - Unknown Protocol Specified** Verify that **Address** in the integration point is correct.
A value is incorrect	Verify that: • The **Address** in the integration point is correct. • The retrieved value is scaled properly, if necessary. For example, scaled from Celsius to Fahrenheit. Refer to the third-party manufacturer's documentation for scaling information.

If the above solutions do not resolve the problem, gather the following information for Technical Support:

• A diagnostic capture. See next topic.

• A screenshot of the **Driver Properties** - right-click on the third-party controller in the navigation tree, select **Driver Properties** > **Properties** page > **BACnet MS/TP** > **Properties** page

• A screenshot of the controller's **Properties** page > **Network Points** tab, showing addresses and errors

Network Diagnostics - Packet Capture

This page allows you to capture network communication on a port and then download the capture file for troubleshooting. Choose one of the following capture options:

- **Start/Stop** - Define the start and stop criteria, and then click **Start** and **Accept** to begin the capture. When the capture stops, the capture file is generated.
  NOTE If a Start/Stop capture is running on any other port, the **Get capture file** button will be disabled until all Start/Stop captures have completed.

  - **Start capture:** - When you check **At (mm/dd/yyyy hh:mm AM/PM)**, enter the time and date, and click **Start**, the packet capture begins at the date and time you specified.

    NOTE The hours field is validated from 0 to 12, and minute field is validated from 0 to 59.

  - **Continuous** - Click **Start** and **Accept** to begin the capture. Click **Save** to momentarily stop the capture and create the capture file. The capture will automatically resume. Click on the **Start/Stop** option to end the **Continuous** capture.

  - If the port is set up for MS/TP, select an option in the **Capture** section.

To download the capture file

Capture files are Wireshark files that are added to the Device Log Archive .tgz file. Do the following to view the files.

1 If you do not have Wireshark installed on your computer, download the latest version from the *Wireshark website* (*http://www.wireshark.org*).

2 Run the install program, accepting all defaults. Include WinPcap in the installation.

3 On the i-Vu® or Field Assistant **Packet Capture** page, click **Get capture file** to download the .tgz file. The message appears "Retrieving the file, this may take a little while". Click **OK**.

NOTE If the size of the .tgz is large, there could be a considerable delay (for example, over 2 minutes) after you click **Get capture file** until your browser begins the download.

4 Open the .tgz file. The files are in the **captures** folder.
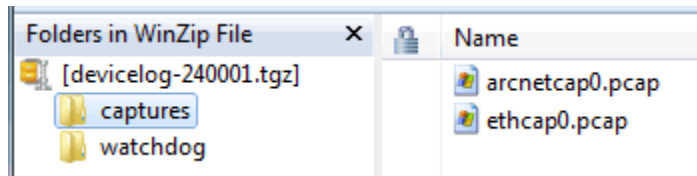
Capture file names are based on the ports.
NOTES

- If you have an MSTP capture file for both Port S1 and Port S2, the file names will be:
  mstpcap0 for Port S1
  mstpcap1 for Port S2
- Clicking **Get capture file** generates the port's .pcap file. If the port has a .pcap file from a previous capture, that file will be overwritten.

5 Extract the .pcap file from the .tgz file.

6 Open the .pcap file in Wireshark.

<div style="border:1px solid blue;background:#cdd9ec;">

Appendix A - Configuring the driver parameters by using the Service Port

</div>

You can set many driver parameters locally from the controller by using the **Service Port's** web-based controller setup interface. You can set operational parameters, such as port and communications' protocol settings, without the need to connect the i-Vu® or Field Assistant application to the i-Vu® XT or TruVu™ controller. Any parameters set locally through this interface take effect immediately. To connect to the controller setup pages, some i-Vu® XT or TruVu™ controllers have an Ethernet Service Port and some have a USB Service Port.

⚠ **WARNING** After setting parameters locally through the Service Port interface and then connecting the controller to the i-Vu® or Field Assistant application, proceed carefully, as follows:

In the i-Vu® or Field Assistant application, you must **upload** the parameters that you set locally BEFORE you **download** memory or parameters. Downloading, without uploading first, overwrites all the settings you made through the **Service Port**. Uploading first preserves those parameters.

> **NOTE** There are a few parameters that can **only** be set through the Service Port, such as the controller's IP address, and these are not overwritten by a memory or parameter download from the i-Vu® or Field Assistant application.

To connect to the Service Port:

1 Make sure your computer is set to get its IPv4 address automatically via DHCP.

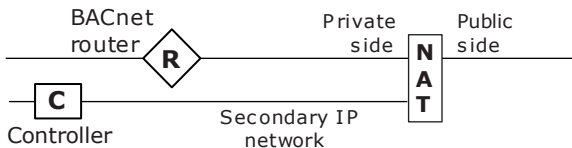**2** Connect an Ethernet cable from a computer to the controller as shown below.
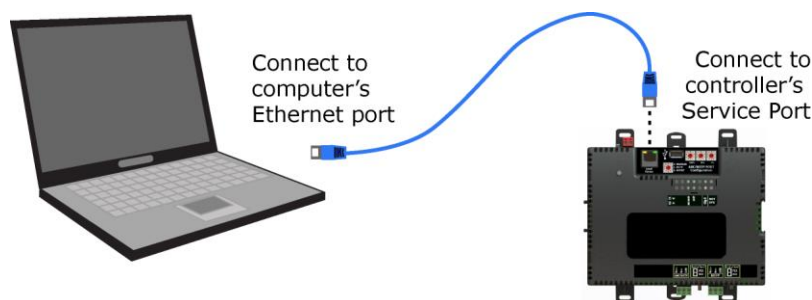
3 Turn off the computer's Wi-Fi if it is on.

4 If your computer uses a static IP address, use the following settings:

- ○ Address: 169.254.1.x, where x is 2 to 7
- ○ Subnet Mask: 255.255.255.248
- ○ Default Gateway: 169.254.1.1

5   If it uses a DHCP address, leave the address as it is.

6 Open a web browser on the computer.

7 Navigate to http://local.access or http://169.254.1.1 to see the Service Port controller setup pages.

> ⚠ **CAUTION** Do not connect the **Service Port** to the same network that the Gig-E port is connected to. The **Service Port** is intended for single computer access only and has a fixed IP address that is not compatible with a building network.

The BACnet tab for all routing controllers

IP Port	
BACnet Network Number	**Disable Routing**—Select if the IP port is not used. **Autogenerated**—The BACnet/IP network number is automatically set to 00. **Assigned**—Lets you enter a specific number.
BACnet UDP Port	The port that the i-Vu® or Field Assistant application will use for BACnet communication.
Enable NAT Routing	**For future use.** Check if the i-Vu® XT or TruVu™ controller is behind a NAT router (firewall).
Global NAT IP Address	**For future use.** Public IP address of the NAT router.
Global NAT BACnet UDP Port	**For future use.** Port number assigned to the NAT router's public interface.
BACnet Secondary IP Net Number	If the i-Vu® XT or TruVu™ controller has two BACnet/IP networks communicating on the Gig-E port, enter the second IP network number in this field. If the i-Vu® XT or TruVu™ controller is behind a NAT router and there is a second network with BACnet/IP devices behind the NAT router, enter the second network number in this field to logically connect the i-Vu® XT or TruVu™ controller to the devices on the second network.
BACnet Secondary UDP Port	If the i-Vu® XT or TruVu™ controller has two BACnet/IP networks communicating on the Gig-E port, enter the port number that the i-Vu® or Field Assistant application will use for BACnet communication. This port must be different than the **BACnet UDP Port**.
Ethernet Port	
MAC Address	A factory assigned Ethernet MAC Address for the **Gig-E** port.
BACnet Network Number	Specify a number for the BACnet/Ethernet network or set to 0 if the port is not used.
Port S1	
End of Network	Indicates status of the controller's End of Net? switch.
Active Protocol	Indicates status of the controller's Port S1 rotary switch. 0=Disabled 1=MS/TP 2=ARCNET 3=Modbus
MAC Address	When using ARCNET, the default is 254, and MSTP is 0. These addresses are hard coded and you cannot change them.
MSTP Autobaud	Select **Yes** to enable this slave device to automatically receive its baud rate from a master on the network that has the fixed baud rate.

|	
MSTP Baud Rate	If you have not enabled autobaud, set this to a baud rate that all other devices on the MS/TP network are set to. Default is 76800.
MSTP Max Master	To increase MS/TP performance, enter the highest address used on the MS/TP network for a master controller. This number must be less than or equal to 127.
MSTP Max Info Frames	This is the maximum number of information messages a controller may transmit before it must pass the token to the next controller. Valid values are 1 to 255. 💡 **TIP** Set **Max Info Frames** to a number in the range 20 to 100 so that the router does not become a bottleneck for traffic being routed from a high-speed network to the slower MS/TP network.
BACnet Network Number	Select: **Disable Routing** if Port S1 is not used. **Autogenerated** to have the network number for Port S1 automatically set to a number equal to ((IP network number + rotary switch address) x 10). **Assigned** to enter a specific number.
Port S2	
End of Network	Indicates status of the controller's End of Net? switch.
Active Protocol	Shows one of the following: • **Modbus** if enabled on the **Modbus** tab • **BACnet/MSTP** if you enter a **BACnet Network Number** below for an MS/TP network • **Disabled** if neither of the above have been done
MSTP Address	The controller's unique address on the MS/TP network. Default is 0.
MSTP Autobaud	Select **Yes** to enable this slave device to automatically receive its baud rate from a master on the network that has the fixed baud rate.
MSTP Baud Rate	If yoiu have not enabled autobaud, set this to a baud rate that all other devices on the MS/TP network are set to.
MSTP Max Master	To increase MS/TP performance, enter the highest address used on the MS/TP network for a master controller. This number must be less than or equal to 127.
MSTP Max Info Frames	This is the maximum number of information messages a controller may transmit before it must pass the token to the next controller. Valid values are 1 to 255. 💡 **TIP** You can set Max Info Frames so that the router does not become a bottleneck for traffic being routed from a high speed network to the slower MS/TP network.
BACnet Network Number	Select: **Disable Routing** if Port S2 is not used. **Autogenerated** to have the network number for Port S2 automatically set to a number equal to ((IP network number + rotary switch address) x 10) + 3. **Assigned** to enter a specific number.
Home Network	This is typically the network that is communicating with the building automation system's application. This sets the BACnet Address of the Device object.

The BACnet tab for non-routing controllers

NOTE The i-Vu® XT or TruVu™ can be configured for only one BACnet communication type.

On the **BACnet** tab, you can:

- Choose to run **BACnet Over IP** or **BACnet Over Ethernet** on the **Gig-E Port**.
  If you choose **BACnet Over IP**, you can edit the **BACnet UDP Port**.
  NOTE The **Port S1 Configuration** rotary switch must be set to 0, 3, or 4 for these options to be editable.

- The **Port S1 Configuration** rotary switch must be set to 1 for MSTP or 2 for ARCNET.

- Enable or disable **MSTP Autobaud** on Port S1. This device will receive its baud rate from the master device with the fixed baud rate.

- Set **MS/TP Baud Rate** to a baud rate that all other devices on the MS/TP network are set to.

Appendix B - Setting up BBMDs

To minimize network communications, IP routers do not pass on broadcasts that they receive. If your system has controllers on different IP subnets separated by an IP router, you must set up a BACnet router on each IP subnet as a BACnet Broadcast Management Device (BBMD). A BBMD passes BACnet/IP broadcasts across the IP router to other BBMDs.
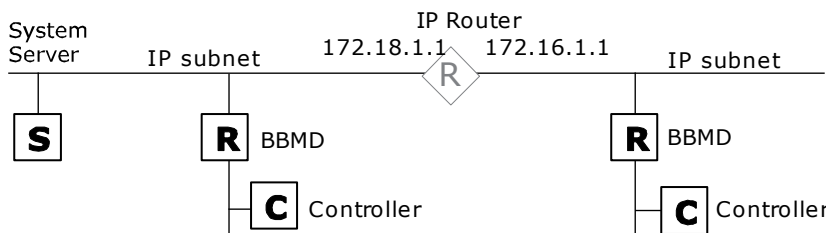
NOTES

- The i-Vu® Standard or Plus application - If the i-Vu® web server is on a separate subnet than the rest of the routers, the internal router must be assigned an IP address and configured as a BBMD.

- The i-Vu® Pro application - If the i-Vu® Pro server is on a separate subnet than the rest of the routers, you must register it as a foreign device.

To set up BBMDs, use the appropriate method in the table below.

If your i-Vu® or Field Assistant system has...	Use this method
500 or less IP subnets with: • No third-party BACnet routers • Authority from your customer to manage all Carrier and third-party BBMDs on the network • Third-party BACnet routers that support BBMD writes from the network	• The i-Vu® Standard or Plus application - Set up BBMDs through the i-Vu® interface, or using the BBMD Configuration Tool. • The i-Vu® Pro application - Let SiteBuilder automatically configure your BBMDs.
Any of the following: • More than 500 IP subnets • Third-party BBMDs that you do not have authority to manage • Third-party BBMDs that use a non-standard port for BACnet communications	Set up custom BBMDs in the i-Vu® or Field Assistant interface or in the BBMD Configuration Tool.

There are multiple ways for configuring BBMD's in an i-Vu system

1   In thei-Vu® or Field Assistant navigation tree, select the Carrier router that will be the BBMD.

2   To check if that router has an existing BBMD table, click [icon], select **Manual Command**, and type **bbmd read**.

   NOTE If you want to read the BBMD table for a different router, select it and perform a Manual Command bbmd read x.x.x.x where x.x.x.x is the IP address of the controller you are on.

3   Click **OK**.

4   Make a list of the IP addresses for every router that will function as a BBMD in your system.

⚠ **CAUTION** Multiple BBMDs on an IP subnet disrupt BACnet communications. Define only one BBMD on either side of each IP router in your system.
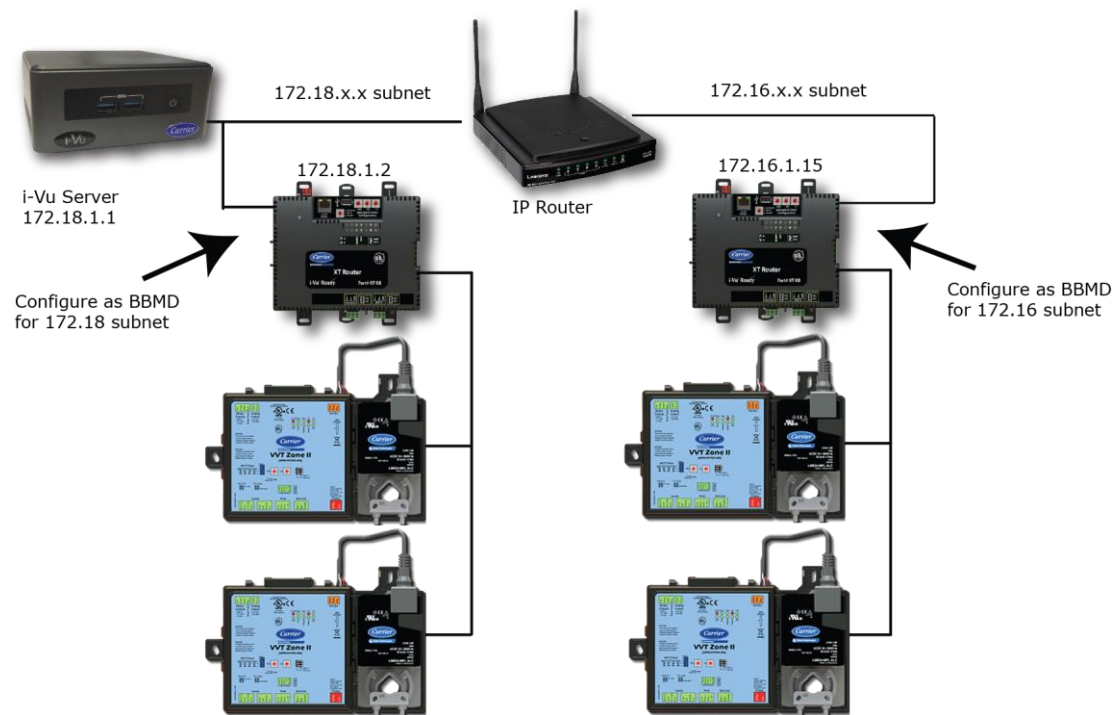
To set up BBMDs in SiteBuilder

As you add each Carrier BACnet router to an IP network on the **Network** tree, check **Automatically Configure My BBMDs** on the **Address** tab. SiteBuilder automatically selects a router in each IP subnet as the BBMD and sets up BBMD tables appropriately.

To see which BACnet routers SiteBuilder assigned as BBMDs, select **View** > **Display** > **BBMD**. BBMDs show **B=assigned** on the **Network** tree.

To override SiteBuilder's BBMD selection, right-click a different BACnet router on the same IP subnet, then select **Force to BBMD**.

NOTE If you are managing 3rd party BBMDs, you must add every 3rd party device that could be a BBMD as a 3rd party device router in SiteBuilder.

To create and download a BBMD table

1 Make a list of the IP addresses for every controller that will function as a BBMD in your system.

⚠ **CAUTION** Multiple BBMDs on an IP subnet disrupt BACnet communications. Define only one BBMD on either side of each IP router in your system.

2 In Notepad, type the list putting each IP address on a separate line. (i-Vu® XT or TruVu™ routers support up to 500.)

NOTE If you must communicate with a third-party router that does not use the BACnet/IP port 47808 (0xbac0), you must include the hexadecimal port number in the IP address. For example,
`172.168.23.67:0xe78a`
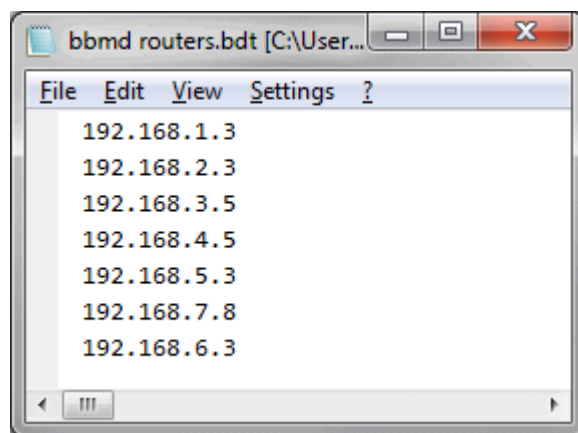
3 Save the file to your folder of choice or the **webroot**\<system_name> folder. Use a .bdt, .bbmd, or .text extension instead of .txt.

4 On the i-Vu® or Field Assistant navigation tree, select one of the Carrier controllers that will function as a BBMD.

5 To check if the controller has an existing BBMD table, click ⬛ and select **Manual Command**.

6 In the manual command field, type: `bbmd read x.x.x.x`
where x.x.x.x is the IP address of the controller you are on.

7 Click **OK**.

8 If the **Broadcast Distribution Table** contains IP addresses that are not in your file, add them to your file.

9 Click ⬛ and select **Manual Command**.

10 In the manual command field, type: `bbmd write filename.ext x.x.x.x`
where `filename.ext` is the .bdt, .bbmd, or .text file in the **webroot**<system_name> folder
and `x.x.x.x` is the IP address of the controller you are on.

11 If the **Broadcast Distribution Table** contains IP addresses that are not in your file, verify that they are valid BBMD's and, if so, add them to your file.

12 Click **OK**.

13 Issue another bbmd read command to verify that the file was written correctly.

```
http://localhost/_common/lvl5/

 local:192.168.1.3
  local:192.168.2.3
  local:192.168.3.5
  local:192.168.4.5
  local:192.168.5.3
  local:192.168.6.3
  local:192.168.7.5
```
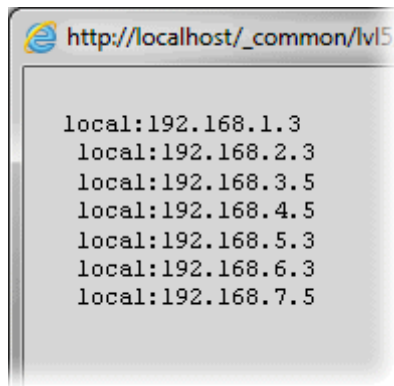
To set up BBMDs using the BBMD Configuration Tool

If your system has multiple routers that reside on different IP subnets, you must set up one router on each IP subnet as a BACnet/IP Broadcast Management Device (BBMD).

Every subnet with a router must have a BBMD configured in order for broadcasts from routers on that subnet to reach the rest of the routers on the network.

NOTES

- The i-Vu® Standard or Plus application - If the i-Vu® web server is on a separate subnet than the rest of the routers, the internal router must be assigned a routable IP address and configured as a BBMD.

- The i-Vu® Pro application - If the i-Vu® Pro server is on a separate subnet than the rest of the routers, you must register it as a foreign device to a router acting as a BBMD device.

Use the **BBMD Configuration Tool** to:

- Write/read the **Broadcast Distribution Table** (BDT) of each BBMD device

- Allow controllers on one subnet to communicate with controllers on other subnets

- Enable the i-Vu® application to see, upload, or configure controllers on different subnets

To set up BBMDs using the BBMD Configuration Tool

1   Assign an IP address, subnet mask, and default gateway for each Carrier router on the IP network. See Addressing the i-Vu® XT or TruVu™.

2   Acquire the **BBMD Configuration Tool** from the Tech Tools USB drive or from the *Carrier Control Systems Support Site http://www.hvacpartners.com/*, *https://accounts.ivusystems.com/*. This is a stand-alone executable file and no installation is necessary.

3   Create a BBMD table. See above.

     ⚠ **CAUTIONS**

- Define only one BBMD per subnet. Multiple BBMDs on an IP subnet disrupt network communications.

- Unless explicitly modified, the UDP Port for BACnet/IP is 0xBAC0 (47808). Do not change this parameter unless you made a change in the router.

4   Open the **BBMD Configuration Tool**.

5   In the **IP Address** or **Host Name** field, type the IP address of the router that functions as the BBMD (BACnet Broadcast Management Device) for its subnet.

6   To check if the router has an existing BBMD table, click the Broadcast Distribution Table **Read** button.

7   If the **Broadcast Distribution Table** contains IP addresses that are not in your file, verify that they are valid BBMDs and, if so, add them to your file.

     NOTES

- The BDT's in each BBMD should be identical. Repeat this entire process whenever a BBMD is added.

- If needed, disable the checkbox next to **Show Broadcast** to limit the amount of scrolling text that is displayed.

8   Click the Broadcast Distribution Table **Browse** button and select the file that you made in step 4.

9   Verify that the appropriate IP address is still in the **IP Address** or **Host Name** field.

10 Click the Broadcast Distribution Table **Write** button.

11 Click **Read** again to verify that the new file was written to the router. See example below.

NOTE If you have a large BDT, you may have to re-size the **BBMD Configuration Tool** window to see the **Broadcast Distribution Table**.
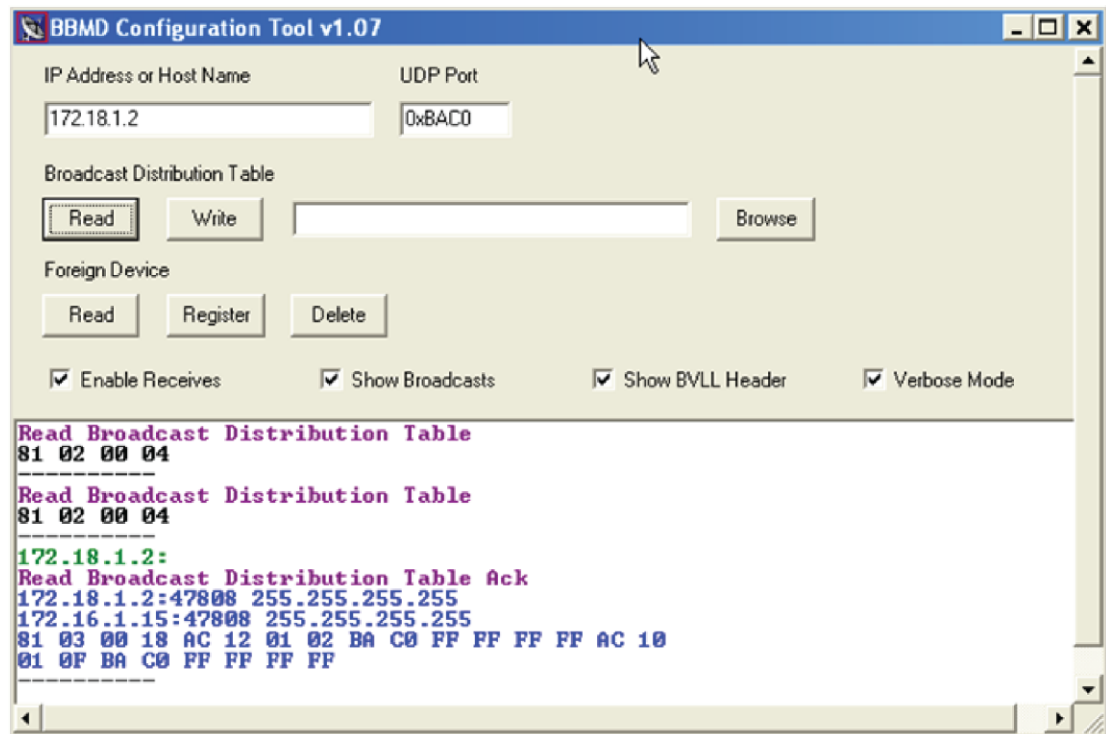
12 Using the next IP address in the file, repeat steps 5 through 10 until every file has been updated.

NOTE To clear the BBMD entries from a router, follow the steps above using an empty (blank) file. A cleared BBMD table contains just the router's IP address without entries in the BBMD table, as shown below.
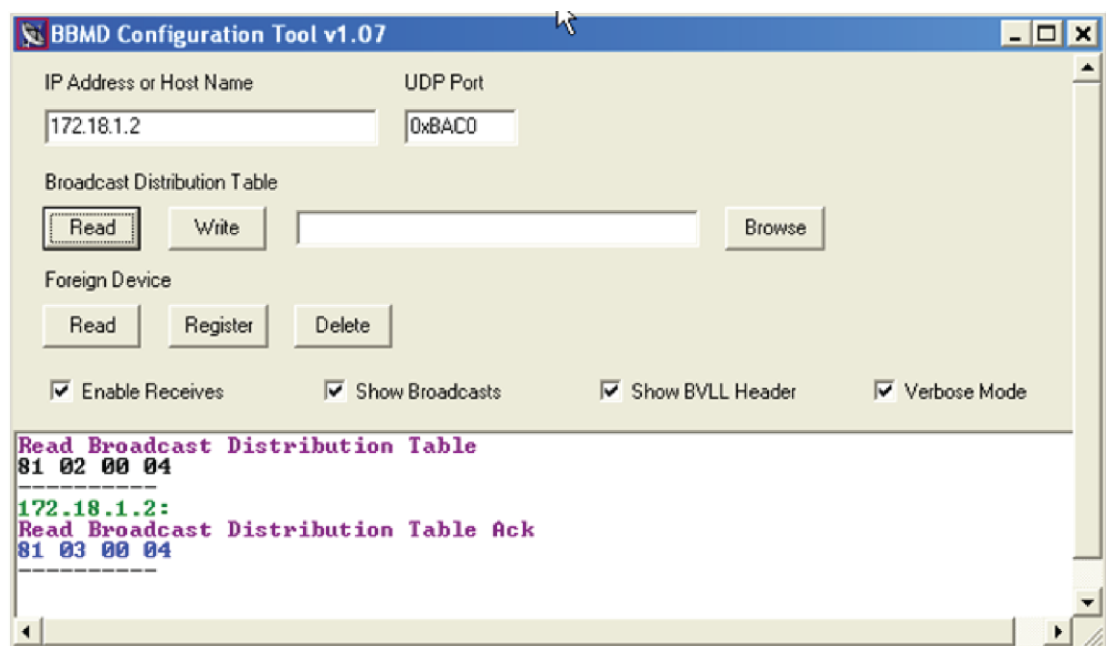
13 Acquire the **BBMD Configuration Tool** from the Tech Tools USB drive or from either of the *Carrier Control Systems Support Sites http://www.hvacpartners.com/, https://accounts.ivusystems.com/*. This is a stand-alone executable file and no installation is necessary.

14 Make a list of the IP addresses for each router that will function as a BBMD in your system.

In the above illustration, the Carrier router, address 172.18.1.2, must be configured as a BBMD for the 172.18 subnet, while the Carrier router, address 172.16.1.15, must be configured as a BBMD for the 172.16 subnet.

⚠ **CAUTIONS**

○ Define only one BBMD per subnet. Multiple BBMDs on an IP subnet disrupt network communications.

○ Unless explicitly modified, the UDP Port for BACnet/IP is 0xBAC0 (47808). Do not change this parameter unless you made a change in the router.

15 In a text editor such as Notepad, create a list of the routers that will be BBMDs. List each IP address on a separate line. (Maximum of 50 IP addresses per file)
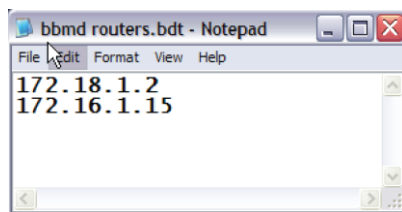
16 Save the file to your folder of choice with a .bdt, .bbmd, or .text extension instead of .txt.

17 Open the **BBMD Configuration Tool**.

18 In the **IP Address** or **Host Name** field, type the IP address of the router that functions as the BBMD (BACnet Broadcast Management Device) for its subnet.

**19** To check if the router has an existing BBMD table, click the **Broadcast Distribution Table Read** button.

20 If the **Broadcast Distribution Table** contains IP addresses that are not in your file, verify that they are valid BBMDs and, if so, add them to your file.

NOTES

○ The BDTs in each BBMD should be identical. Repeat this entire process whenever a BBMD is added.

○ If needed, disable the checkbox next to **Show Broadcast** to limit the amount of scrolling text that is displayed.

21 Click the **Broadcast Distribution Table Browse** button and select the file that you made in step 4.

22 Verify that the appropriate IP address is still in the **IP Address** or **Host Name** field.

**23** Click the **Broadcast Distribution Table Write** button.

24 Click **Read** again to verify that the new file was written to the router. See example below.

NOTE If you have a large BDT, you may have to re-size the **BBMD Configuration Tool** window to see the **Broadcast Distribution Table**.
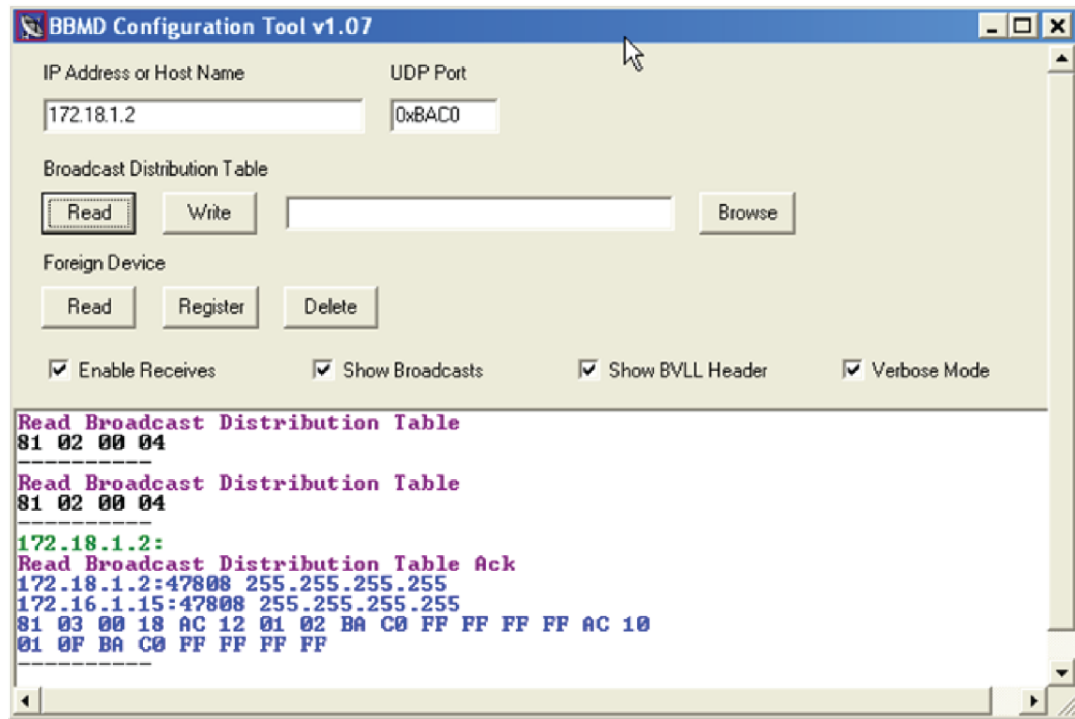
25 Using the next IP address in the file, repeat steps 7 through 14 until every file has been updated.

NOTE To clear the BBMD entries from a router, follow the steps above using an empty (blank) file. A cleared BBMD table contains just the router's IP address without entries in the BBMD table, as shown below.
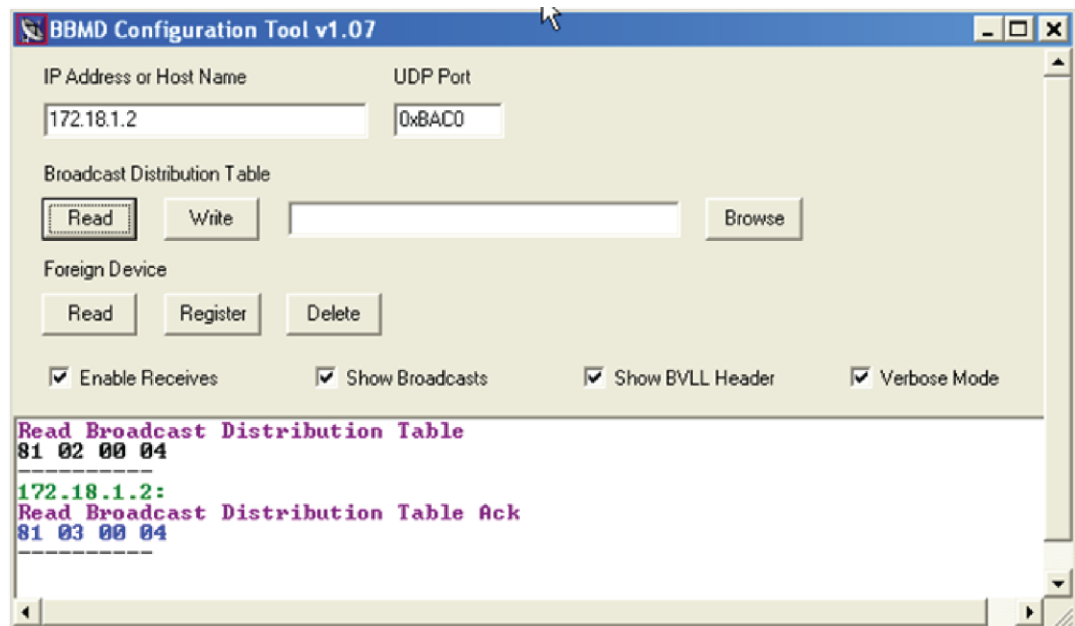
Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
1/31/22	To set up BBMDs using the BBMD Configuration Tool To create and download a BBMD table	Added .bbmd and .text as allowable file extensions, removed .bdt-specific instructions	X-TS-OC-O
	Create a control program in Snap	Added Display microblocks and updated the procedure.	C-TS-JN-O
	Connect the third-party device to the Carrier controller To connect to a BACnet/IP device	Added ports Eth0 and Eth	X-D
	Configure Display Microblocks	New topic	C-TS-JN-O
4/6/20	Overview	Added list of all controllers that can be integrated with a BACnet device	C-PM-KC-O
	Appendix A - Configuring the driver parameters by using the Service Port	Added instructions for the TVMPCXP1628-NR. Added Autobaud.	
	To wire to a BACnet MS/TP network	Changed first paragraph to include comments about the TV-MPCXP1628-NR.	
	Before-you-begin checklist	Added autobaud	
	1 Connect the third-party device to the Carrier controller	Added note regarding TV-MPCXP1628-NR	

* For internal use only