

## Peer to Peer BACnet Configuration

This article explains how to configure SLATE BACnet communication in order to pass data between SLATE systems. When using BACnet, it is important to remember that safety functions can not be performed over BACnet (or any other communication protocol) in SLATE; however, information about safety parameters such as Limit thresholds can be.

For those applications where there are multiple SLATE systems at work and information needs to be shared between them, such as lead/lag boiler configurations or those requiring similar sensors (i.e. outdoor temperature sensors), BACnet is an easy way to get data moving between systems.

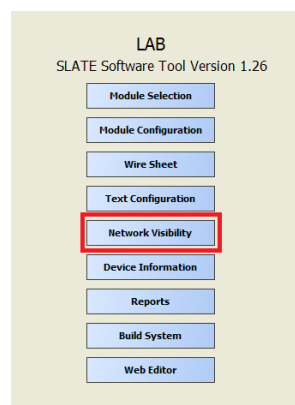
To begin, we need to consider the wire sheet and whether the data point is an input to the wire sheet from another SLATE device or is an output to be read by another SLATE device:

- Wire sheet inputs require BACnet binding registers be used (instead of a Network Setpoint block or Network Input block). These are special registers in the SLATE Base Module which facilitate peer to peer communication with other SLATE devices. Each SLATE device can receive up to 20 BACnet messages when communicating to other SLATE devices.
- Wire sheet outputs require no special handling. The same Network Output block can be used on the wire sheet to send information out to a display as well as over BACnet to another SLATE device if needed. Additionally any module register value (not only the Network registers) can be shared with other SLATE devices on a network. To do this, registers to be shared over com must be visible to the network.

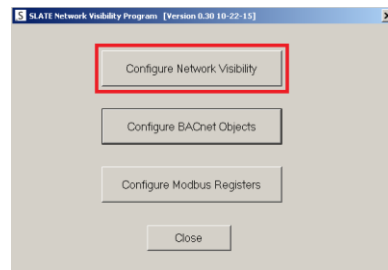
To make modules visible to the network:

NOTE: NetworkInput, NetworkSetpoint, and NetworkOutput registers are set to “visible” by default while all other registers are set to “hidden”.

- Open the station.
- Connect to the station with username/password.
- Select the SLATE device to work on.
- Click the “Network Visibility” button.



- Click the “Configure Network Visibility” button.



- Locate the register(s) whose data needs to be shared over the network.

SLATE Network Visibility Program - BACnet Configuration [Version 0.30 10-22-15]

SLATESamples.LAB SLATE Network Visibility

	Resource	Description	Hidden	ReadOnly	Password	Range Minimum	Range Maximum
7	m1r2	Operation state	Hidden			1	18
8	m1r3	Fault reason code	Hidden			0	65535
9	m1r4	Fault source	Hidden			1	5
10	m1r5	Reset fault command	Hidden			1	2
11	m1r6	Alert display level	Hidden			0	255
12	m1r7	Install date	Hidden			0	20
13	m1r8	Service disable	Hidden			1	2
14	m1r9	OS number	Hidden			0	20
15	m1r10	Serial number	Hidden			0	20
16	m1r11	Build code	Hidden			0	4294967295
17	m1r12	Module identifier	Hidden			0	20
18	m1r13	Module type	Hidden			0	10
19	m1r14	Module version	Hidden			0	65535
20	m1r15	Module revision	Hidden			0	65535
21	m1r16	Module short name	Hidden			0	10
22	m1r17	Module name	Hidden			0	60
23	m1r18	LED control	Hidden			0	65535
24	m1r19	Keypress event	Hidden			1	2
25	m1r20	Verification needed	Hidden			0	65535
26	m1r21	Comm diagnostics data 1	Hidden			0	4294967295

☒ Protect Mode ☐ Multiple Select Mode

Save Close Hide All Hidden by Default Unhide All

- To make the register(s) visible over the network, first uncheck the Protect Mode box then select the register(s) to be made visible then select the blank view in the “Hidden” column. Click the “Save” button when finished.

SLATE Network Visibility Program - BACnet Configuration [Version 0.30 10-22-15]

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	Resource	Description	Hidden	ReadOnly	Password	Range Minimum	Range Maximum
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14	m1r9	OS number	Hidden			0	20
15	m1r10	Serial number	Hidden			0	20
16	m1r11	Build code	Hidden			0	4294967295
17	m1r12	Module identifier	Hidden			0	20
18	m1r13	Module type	Hidden			0	10
19	m1r14	Module version	Hidden			0	65535
20	m1r15	Module revision	Hidden			0	65535
21	m1r16	Module short name	Hidden			0	10
22	m1r17	Module name				0	60
23	m1r18	LED control	Hidden			0	65535
24	m1r19	Keypress event	Hidden			1	2
25	m1r20	Verification needed	Hidden			0	65535
26	m1r21	Comm diagnostics data 1	Hidden			0	4294967295

☐ Protect Mode ☐ Multiple Select Mode

Save Close Hide All Hidden by Default Unhide All

Once all of the key registers are visible to the network, the next step is to enable the BACnet network on the SLATE Base modules. If connected to a display or a computer on the same subnet as the SLATE devices, follow the procedure below to enable the BACnet network:

- Open the Generic pages on the SLATE device to be configured. Click on “Module Pages” then the “BASE” module.

< SLATE		Module Pages
Module Pages	MODULE INFORMATION View/Edit information about any Module.	DIGITAL View/Control Digital I/O Modules
Register Tools	BASE View/Edit Base Module	ANNUNCIATOR View/Edit Annunciator Modules
System Tools		
Logger Tools	BURNER View/Edit Burner Modules	
Language	FUEL AIR View/Edit/Commission Fuel Air Modules	
Help	LIMIT View/Edit Limit Modules	
	ANALOG View/Edit Analog I/O Modules	

- Click on the “Communication Setup” button.

< Generic

SLATE Base - Status

None

<b>Base State</b> Running <b>Base Fault</b> No event <b>FBE Fault</b> No event <b>Kit ID:</b> Test_Lead_Lag_4 <b>Date/Time:</b> 2016-12-08 5:35 pm <b>Day Seconds:</b> 63350 Thursday <b>System Up Time:</b> Up 1 day 21:27:40	<div> <div>Application Status</div> <div>General Setup</div> <div>Communication Setup</div> </div> <div>( FBE / Wire sheet )</div> <div> L1 Voltage 163.2 psk  System Current Draw 0.4  0 = 24V 1 = 120/240  Battery status High (None, Reversed, Low, Medium, High)  Boost convertor voltage 0.6  Boost output voltage 165.1  CPU temperature 30.7  Snubber temperature 36.3 </div>
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- Click the “BACnet” tab.

< Base Status

SLATE Base - Communications

None

<b>Ethernet</b> Source Static IP address Address 192.168.92.10 Subnet Mask 255.255.255.0 Router Address 192.168.92.1 DNS Address 192.168.92.1 MAC Address 0.0.0.0.0.0 <b>RS-485</b> Protocol None Baud Rate 38400 Parity None	<div> <div>Communication Setup</div> <div>BACnet Configuration Status Configuration OK</div> </div> <div> Modbus BACnet Router and Foreign Device </div> <div> RS-485 Slave Address 1  Modbus/TCP Configuration None  Modbus/TCP Port 502 </div>
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The required fields to fill out are Device Object Instance, Ethernet Configuration, and MAC Address, depending on the protocol needed/used. If using BACnet over Ethernet, fill out the Device Object Instance field (NOTE: each SLATE device must have a unique instance number) and the Ethernet Configuration which in this application of SLATE devices communicating to other SLATE devices on the same network, will be either “Plain BACnet/IP” or “BACnet/Ethernet”. All configured SLATE devices on the network must use the same Ethernet configuration.

**< Base Status SLATE Base - Communications** None

<b>Ethernet</b> Source: Static IP address ▾ Address: 192.168.92.10 Subnet Mask: 255.255.255.0 Router Address: 192.168.92.1 DNS Address: 192.168.92.1 MAC Address: 0.0.0.0.0.0		<b>BACnet Configuration Status</b> Configuration OK	
<b>Communication Setup</b> Modbus: BACnet Router and Foreign Device			
Device Name: <input type="text"/> Device Object Instance: 1		BACnet Binding: <input type="text"/>	
DCC/RD Password: <input type="text"/>		<b>MS/TP (RS-485)</b> MAC Address: 1 Max Info Frames: 1 Max Master: 127	
<b>RS-485</b> Protocol: None ▾ Baud Rate: 38400 ▾ Parity: None ▾		<b>Ethernet</b> Ethernet Configuration: Plain BACnet/IP ▾ IP Port: 47808	

If networking over RS-485, select “BACnet MS/TP” in the lower left hand section of the page. Assign a distinct MAC address to each SLATE device in the network. All configured SLATE devices on the network must use the same Ethernet configuration.

**< Base Status SLATE Base - Communications** None

<b>Ethernet</b> Source: Static IP address ▾ Address: 192.168.92.10 Subnet Mask: 255.255.255.0 Router Address: 192.168.92.1 DNS Address: 192.168.92.1 MAC Address: 0.0.0.0.0.0		<b>BACnet Configuration Status</b> Configuration OK	
<b>Communication Setup</b> Modbus: BACnet Router and Foreign Device			
Device Name: <input type="text"/> Device Object Instance: 1		BACnet Binding: <input type="text"/>	
DCC/RD Password: <input type="text"/>		<b>MS/TP (RS-485)</b> MAC Address: 1 Max Info Frames: 1 Max Master: 127	
<b>RS-485</b> Protocol: BACnet MS/TP ▾ Baud Rate: 38400 ▾ Parity: None ▾		<b>Ethernet</b> Ethernet Configuration: None ▾ IP Port: 47808	

Setting up BACnet communication over Plain BACnet/IP or BACnet/Ethernet from the SLATE Base menu:

- On the SLATE Base module, click the “Menu” button.
- Using the up/down arrows, move to “Base setup” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “Network” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “Ethernet” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “BACnet” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “Configuration” and click the “OK” button on the SLATE Base module.
- Using the up/down, left/right arrows, select the connectivity protocol and move to OK on the screen and click the “OK” button on the SLATE Base module.

Setting up BACnet communication over RS-485 from the SLATE Base menu:

- On the SLATE Base module, click the “Menu” button.
- Using the up/down arrows, move to “Base setup” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “Network” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “RS-485” and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “Configuration” and click the “OK” button on the SLATE Base module.
- Using the left/right arrows, move to “MS/TP” then using the up/down arrows move to “YES” to confirm selection and click the “OK” button on the SLATE Base module.
- Using the up/down arrows, move to “MS/TP address” and click the “OK” button on the SLATE Base module.
- Using the up/down, left/right arrows select a unique MS/TP address number for the SLATE device then move to “YES” to confirm selection and click the “OK” button.

The SLATE Base is now configured to communicate over BACnet using the selected protocol.

NOTE: Make sure the other SLATE Base modules are set up using the same protocol.

NOTE: Make sure all SLATE modules required to communicate with each other over Ethernet are set up on the same subnet. The IP address is configured using the SLATE Base menu:

Menu: Base Setup/Network/Ethernet

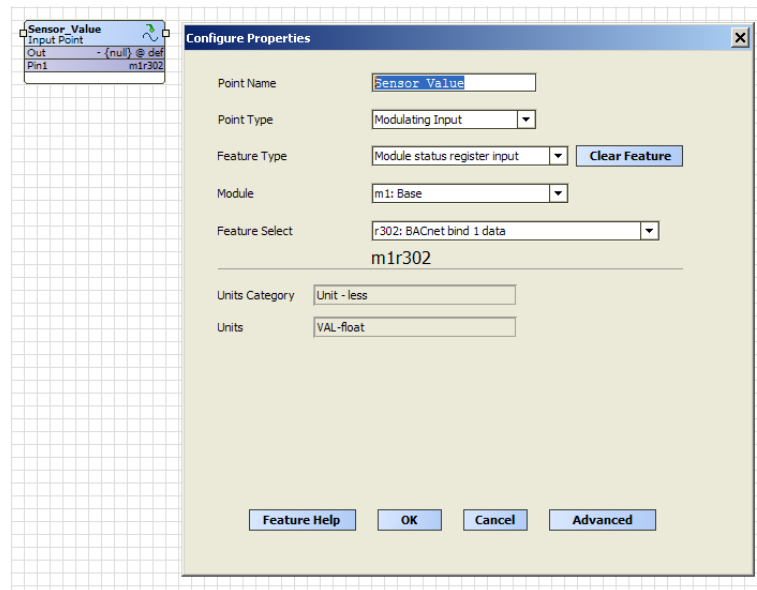
Scroll to “IP addr” and set up the subnet making sure no two SLATE devices have the same IP address, i.e. terminate in the same 3 digits. (i.e. SLATE device 1 IP address: 192.168.92.10; SLATE device 2 IP address: 192.168.92.20).

## Wire Sheet

Data coming into a wire sheet from another SLATE module must come into a BACnet binding register. Twenty such registers exist for each SLATE device. These registers are intended to facilitate SLATE systems communicating to each other in a peer to peer fashion. They can also be considered as “hooks” for planned data from other yet un-configured SLATE devices, needed by the wire sheet. These “hooks” will then be configured to point to the source of the data that is required for that input on the wire sheet.

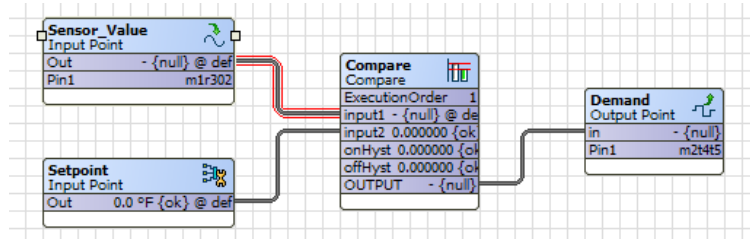
The following example shows how a BACnet binding register is used to collect data from a sensor that is physically wired to another SLATE device. This sensor value is used to create a temperature controller which will close a relay when the sensor value drops below that of the setpoint.

- Select a Modulating Input block from the Physical Points category in the palette. (registers are accessed from the Physical Points input/output folder)
- Name the block (“Sensor\_Value” is used in this example)
- Select the Feature Type from the drop down menu. The BACnet binding registers are found in the “Module status register input” group starting with register 302. Information about the BACnet message quality as well as the actual register value is found in this register grouping.
- BACnet binding registers are located in the Base module. Select “Base” for the Module category.
- In this example, the first BACnet binding register will be used. Select “r302: BACnet bind 1 data”. Click the “OK” when finished.



- Next, select the Network Set Point block from the Software Points category in the palette. This block will be used to enter the control setpoint. Name and configure as needed for degrees F or degrees C and enter a default value as desired. In this example, this block is named “Setpoint” and the default value is left at 0F.

- Next, select a Compare block from the Analog category in the palette, configure as needed and link to the “Sensor\_Value” and “Setpoint” blocks.
- Next, select a Binary Output block from the Physical Points category in the palette. This will be the relay which reacts when the sensor value drops below that of the setpoint. Name the block. In this example the relay is named “Demand”.

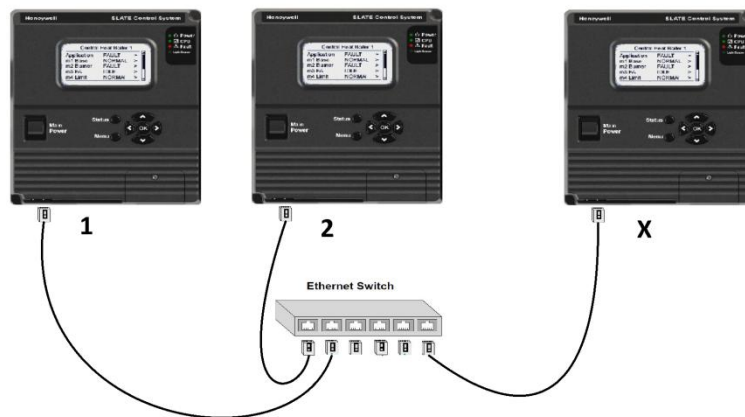


This brief wire sheet example shows primarily how to set up the BACnet register which is key when multiple SLATE devices are communicating with each other. The place holder for the sensor information is now embedded in the wire sheet.

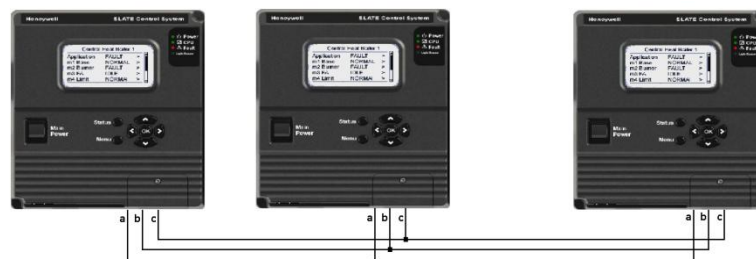
It is assumed that another wire sheet belonging to the other SLATE device is set up to read the physical signal from the temperature sensor.

It is also assumed the desired networking is complete (either network cables through a switch or RS-485 connected between SLATE devices).

#### Plain BACnet/IP or BACnet/Ethernet



#### MS/TP (RS-485)



Continuing with the example, let's assume that SLATE device 2 has the sensor value and SLATE device 1 needs the value to control the demand (see wire sheet above).

We also assume the wire sheets of each SLATE device has been completed and a kit has been created and loaded into each SLATE device.

The last step in completing the communication connection between SLATE devices 1 and 2 is to configure the BACnet binding using the Generic page via an HMI. This step configures the BACnet binding registers to retrieve their data from the correct SLATE device, specify proper data type and retrieve the proper Object ID (which maps to the register within the SLATE device which has the required data).

Continuing on from the Module/Base Generic pages, click the "BACnet Binding" button.

< Base Status SLATE Base - Communications None

**Ethernet**

Source: Static IP address

Address: 192.168.92.10

Subnet Mask: 255.255.255.0

Router Address: 192.168.92.1

DNS Address: 192.168.92.1

MAC Address: 0.0.0.0.0.0

**RS-485**

Protocol: None

Baud Rate: 38400

Parity: None

**Communication Setup**

Modbus BACnet Router and Foreign Device

Device Name: [ ]

Device Object Instance: 1

DCC/RD Password: [ ]

**BACnet Configuration Status**

Configuration OK

**BACnet Binding**

**MS/TP (RS-485)**

MAC Address: 1

Max Info Frames: 1

Max Master: 127

**Ethernet**

Ethernet Configuration: Plain BACnet/II

IP Port: 47808

The BACnet Binding page is where BACnet binding registers used in the wire sheet are directed in order to receive the information required.

< Communications SLATE Base - BACnet Binding None

**Register Select:** Bind Register 1

**Live status:**

BACnet bind 1 data = 114.000

BACnet bind 1 status = Access - Normal

**Setup:** Device=2|AV-115

The binding registers can be used to pull (read) data from any BACnet device, such as another SLATE control. Each register has an associated setup register and a status register with a code that identifies a status message. Status messages include reporting of any syntax errors in the setup register.

The setup register contains keyword=value pairs that are separated by the vertical bar character. Spaces are allowed, but optional.

Example setup strings to identify the device, object instance, and property that is read:

Device = 12 | AO-123

Device = 12 | AO-123 | propid = present-value (Same as above)

Device = 12 | objtype = 1 | instance = 123 | propid = 85 (Same as above using numeric objtype: 1 is AO, 85 is present value)

Device = 48 | BO-456 | propid=present-value [ 3 ] (Indexed item: use square brackets.)

Device omitted means this device. objtype omitted means the device object. objtype may be AO, AI, AV, BO, BI, BV, MI, MO, MV with a dash and an instance number, or the keyword objtype and a BACnet numeric code. If the numeric code is used then the instance keyword is required. propid if omitted means present-value. propid may use a BACnet property name or number. May be indexed.



In the example in this document, SLATE device 1 is looking for temperature data from SLATE device 2. The BACnet binding register used on the wire sheet for SLATE device 1 was the first of the 20 (r302: BACnet bind 1 data). This is the location (wire sheet block) the temperature information will enter the wire sheet.

**< Communications SLATE Base - BACnet Binding** None

**Register Select:** Bind Register 1

**Live status:**

BACnet bind 1 data = 114.000 Data read from device

BACnet bind 1 status = Access - Normal Status code 1

**Setup:** Device=2|AV-115

The binding registers can be used to pull (read) data from any BACnet device, such as another SLATE control. Each register has an associated setup register and a status register with a code that identifies a status message. Status messages include reporting of any syntax errors in the setup register.

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Device = 48 | BO-456 | propid=present-value [ 3 ] (Indexed item: use square brackets.)

Device omitted means this device. objtype omitted means the device object. objtype may be AO, AI, AV, BO, BI, BV, MI, MO, MV with a dash and an instance number, or the keyword objtype= and a BACnet numeric code. If the numeric code is used then the instance keyword is required. propid if omitted means present-value. propid may use a BACnet property name or number. May be indexed.

Next, the SLATE device 1 is directed to the other SLATE device on the network that has the information needed. In this case, SLATE device 2 has the temperature data needed by SLATE device 1. Additionally, the data type is needed as well as the Object ID in SLATE device 2 which contains the temperature value. This information is written in a specific format in the Setup field.

**< Communications SLATE Base - BACnet Binding** None

**Register Select:** Bind Register 1

**Live status:**

BACnet bind 1 data = 114.000 Data read from device

BACnet bind 1 status = Access - Normal Status code 1

**Setup:** Device=2|AV-115

The binding registers can be used to pull (read) data from any BACnet device, such as another SLATE control. Each register has an associated setup register and a status register with a code that identifies a status message. Status messages include reporting of any syntax errors in the setup register.

The setup register contains keyword=value pairs that are separated by the vertical bar character. Spaces are allowed, but optional.

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Device = 12 | objtype = 1 | instance = 123 | propid = 85 (Same as above using numeric objtype: 1 is AO, 85 is present value)

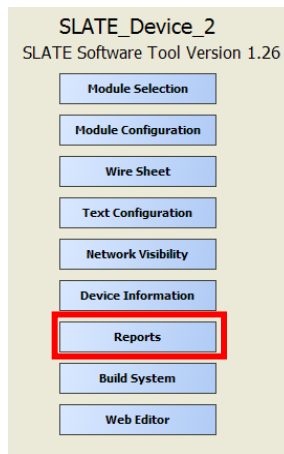
Device = 48 | BO-456 | propid=present-value [ 3 ] (Indexed item: use square brackets.)

Device omitted means this device. objtype omitted means the device object. objtype may be AO, AI, AV, BO, BI, BV, MI, MO, MV with a dash and an instance number, or the keyword objtype= and a BACnet numeric code. If the numeric code is used then the instance keyword is required. propid if omitted means present-value. propid may use a BACnet property name or number. May be indexed.

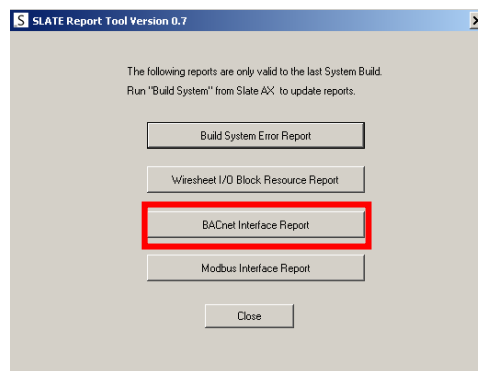
Setup field command format:

- Device=X (X represents the SLATE device with the needed data)
- “|” (this is the key above the Enter key on a N. A. keyboard:  shift +  keys).
- Data type (Analog Value (AV), Analog Output (AO), etc.) followed by a dash.
- BACnet Object ID (the Object ID maps to the register in the target SLATE device which contains the desired data).

Both the Data type and Bacnet Object ID can be found on the same report in Niagara AX. Since the needed data is found in SLATE device 2, we need to open that device to see the BACnet report.



- Click the “BACnet Interface Report” button to access the Object ID and BACnet Type data



- From the report, we can see the Temperature data for SLATE device 2 is mapped to Object ID 115 and the BACnet data type is Analog Value (AV).

	Object ID	Object Name	Resource	BACnet Type	Units	Min Value	Max Value
1	114	m1ControlProgram_Tempsetpoint	m1r1000	Analog Value (AV)	deg F	-3.402823E+038	3.402823E+038
2	115	m1ControlProgram_Temp	m1r1001	Analog Value (AV)	deg F	-3.402823E+038	3.402823E+038
3	116	m1ControlProgram_Proportional	m1r1002	Analog Value (AV)	deg F	-3.402823E+038	3.402823E+038
4	117	m1ControlProgram_Selectorswitch	m1r1003	Analog Value (AV)	deg F	-3.402823E+038	3.402823E+038
5	118	m1ControlProgram_Setpoint	m1r1004	Analog Value (AV)	deg F	-3.402823E+038	3.402823E+038

Returning to the BACnet Binding page, the BACnet bind 1 data and the status of the message can be seen in the Live Status field.

< Communications

SLATE Base - BACnet Binding

None

Register Select: Bind Register 1

Live status:

BACnet bind 1 data = 114.000

Data read from device

BACnet bind 1 status = Access : Normal

Status code 1

Status message

The binding registers can be used to pull (read) data from any BACnet device, such as another SLATE control. Each register has an associated setup register and a status register with a code that identifies a status message. Status messages include reporting of any syntax errors in the setup register.

The setup register contains keyword=value pairs that are separated by the vertical bar character. Spaces are allowed, but optional.

Setup: Device=2|AV-115

Example setup strings to identify the device, object instance, and property that is read:

Device = 12 | AO-123

Device = 12 | AO-123 | propid = present-value (Same as above)

Device = 12 | objtype = 1 | instance = 123 | propid = 85 (Same as above using numeric objtype: 1 is AO, 85 is present value)

Device = 48 | BO-456 | propid=present-value [ 3 ] (Indexed item: use square brackets.)

Device omitted means this device. objtype omitted means the device object. objtype may be AO, AI, AV, BO, BI, BV, MI, MO, MV with a dash and an instance number, or the keyword objtype= and a BACnet numeric code. If the numeric code is used then the instance keyword is required. propid if omitted means present-value. propid may use a BACnet property name or number. May be indexed.

In this example, SLATE Device 1 will receive a temperature value of 114F from SLATE device 2 which enters the wire sheet through the “Sensor\_Value” block.

Data transfer between SLATE devices will continue as long as the network is enabled and the SLATE devices are in working condition. Each SLATE device will process its new data at one second intervals.