Adding Cube I/O Modules to BACnet Spyder Controllers



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Honeywell Spyder VAV and unitary controllers are available with either a LON or BACnet interface. These controllers typically have 21 physical points but this point count can be expanded on the BACnet versions by adding BACnet Cube I/O modules instead of adding another Spyder. Cube I/O modules are low-cost, low-density DIN-rail modules with a variety of I/O point configurations. Installation can be accomplished using a Honeywell WEBstation-AX (Niagara workstation) with an installed Honeywell Spyder Tool for configuration and commissioning. Connecting the WEBstation to the Spyder is facilitated with a Contemporary Controls' BACnet MS/TP to BACnet/IP router. Once the Spyder is commissioned, the BACnet router can be disconnected.

With the standard-size Spyder models there are three which are BACnet MS/TP compliant. The PUB6438S is a unitary controller while both the PVB6436S and PVB6438S are VAV controllers. The PVB6436S has a resident damper actuator while the PVB6438NS requires an external actuator. In this example we are using a PVB6436S. All models can be expanded with the use of BACnet Cube I/O Modules.

For I/O expansion, we will use a BMT-DIO4/2 Cube I/O Module with four binary contract closure inputs and two relay outputs. The four input points can be used for additional Spyder inputs and the two output points can be used by the Spyder for additional outputs.



Cube I/O BMT-DIO4/2 BACnet MS/TP Mixed Module



Honeywell Spyder

Wiring

Figure 1 provides detail on connecting the various devices for this demonstration. A portable BASrouter is shown but a DIN-rail BASrouter will work as well. With the portable BASrouter, power from the router is derived from a USB port on a workstation or laptop computer. With the DIN-rail BASrouter, a 24VAC connection can be shared with the Spyder and Cube I/O from an adequately powered 24V control transformer. Make sure that COM (GND) connection integrity is observed as shown in figure 1.

Wire the BACnet connections as shown observing proper polarity of the MS/TP connection. For this bench test we will float the shield and ignore the need for a 120 ohm termination resistor. Both the Cube I/O and Spyder utilize nonisolated EIA-485 transceivers while the BASrouters do not.

Therefore connect system common (SC) on the BASremote to a COM point. You can wire in switches for the Cube I/O or you can just use jumper wires. The two Cube I/O outputs have two LEDs which turn on when the output is true. This is what we will observe. Leave the two hand-off-auto switches in the middle position.

We need a workstation or laptop with Honeywell's WEBstation-AX software installed along with Honeywell's Spyder Tool. Ethernet on the computer can attach directly to the BASrouter or via an Ethernet switch.

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Figure 1 - Demonstration Wiring

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Configuration

Configuration is necessary for all the components.

Cube I/O

The default baud rate is 9600 baud for the Cube I/O. Change the baud rate to 38,400 through the use of the two hexadecimal rotary switches X1 and X10. Refer to documentation on the BMT-DIO4/2 which can be found on the Contemporary Controls' website. First set X10 to "E" and then turn X1 to "C" which is the setting for 38,400. Next return X10 to "F". After one second you should see the red and green lights alternatively blinking. Next set the network address which in our case is 06. Set X10 to "0" and X1 to "6" and you are finished. There is a jumper below the faceplate. You can leave it in its default position of GND.

The Cube I/O module is set for BACnet device instance 421000+MAC address. Since the MS/ TP MAC address we assigned is 06, the resulting BACnet device instance is 421006.

BASrouter

The BASrouter and the workstation (or laptop computer) must be on the same subnet. Make sure this is the case when assigning IP addresses to the workstation and BASrouter. Using the web browser on the workstation access the BASrouter home page. In our example the BASrouter is set for 10.0.0.237. If you can reach the BASrouter you are on the same subnet. Study the configuration in figure 2 at the right.

Device instances must be unique so assign a unique device instance. We need unique BACnet/IP and MS/TP network assignments. Usually the default "1" is good enough for the BACnet/IP. For the MS/TP network we assigned the value "2345." Set the baud rate to 38400 if it is not already selected. Make sure you save you changes. Your BASrouter is now configured.

Device Name	BASRT-B006aaf
Device Instance	245237
Device Location	location
Ethernet Network	0
BACnet/IP UDP Port	BAC0
BACnet/IP Network 1	1
IP Address	10.0.237
IP Subnet	24
IP Gateway	10.0.0.1
MS/TP MAC	0
MS/TP Network	2345
	407
Max Masters	127
Max Info Eramoo	100
wax into ritames	100
MS/TP Baudrate	38400 ▼
MS/TP Tolerance	 Strict Lenient
	Saure Channes
	Save Changes



WEBstation

Any Spyder configuration, other then MAC address which is assigned by DIP switches, will occur through the WEBstation. The Spyder autobauds so it will Link up with the BASrouter once it sees network traffic.

Next we need to start the WEBstation-AX program which should have already been installed on the workstation or laptop being used.

- WEDSTATION-AX	
File Edit Search Bookmarks Tools	Window Help
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about.html	C Html Viev
Image: Station (Jason) Image: Station (Jason) Image: Station (Jason)	

🕆 Authentication 🛛 🔀						
Authentication						
Realm						
Name CCSI						
Scheme HTTP-Basic						
Credentials Username costmuest						
Password ••••••						
Remember these credentials						
OK Cancel						

If the Navigation pane is not visible, go to Side Bar just below Bookmarks and bring it down. Expand the tree under My Host and doubleclick on Platform and enter your credentials for this workstation.

Platform	
Name	Description
Application Director	Control applications and access console output
ortificate Management	Manage X.509 Certificates and Host Exemptions.
DDNS Configuration	Configure the way DDNS operates.
A Lexicon Installer	Install lexicons to support additional languages
License Manager	Manage licenses and certificates
Platform Administration	Update the platform daemon's port or credentials, or set its date and time
🗍 Software Manager	Install software to the remote host
CP/IP Configuration	Manage the host's TCP/IP settings
🚨 User Manager	Manage the local OS users and groups
Remote File System	The remote host's file system

After successfully logging into Platform you will see a listing of Platform programs. Click on Application Director at the top which will show a list of pre-generated stations.

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Cor	nected to localhos	t				
Na	ime	Туре	Status	Details	Auto-Start	Restart on Failure
=	demo	station	Idle	fox=n/a,foxs=n/a,http=n/a,https=n/a	false	true
	demoAppliance	station	Idle	fox=n/a,foxs=n/a,http=n/a,https=n/a	false	true
	Jason	station	Idle	fox=n/a,foxs=n/a,http=n/a,https=n/a	false	false

This application note assumes that a station has previously been created and only needs to be started or possibly restarted. If this is not the case, consult your WEBstation-AX documentation on creating a station. In our case we created a station called Jason that needs to be started. Highlight the station details and click on Start on the right side of the screen. Once the station is started you should notice a confirmation message in the main window.

	🕆 Authentication 🛛 🛛	
	Authentication Logon required for access	
In the navigation pane on the left side click on Station (Jason) and enter the credentials that were created for this station.	Realm Name local: fox: Scheme Fox (digest) Credentials Username Edmin Password enember Remember these credentials OK Cancel	► Nav ► Nav ► My Network ► ► My Host : GUEST01 (Jason) ► My File System ► My My Modules ► Platform ► Station (Jason) ► Config
Once you log into the tree under Station (Ja Expand the tree: Sta as shown in the figur	e station you can expand the naviga ason). ation > Config > Drivers > BacnetNet e to the right.	tion twork
Next we need to discover our B devices. Go to BacnetNetwork Bacnet Device Manager.	SACnet Config BACnet Config Bacnetvetwork Config Bacnet Config Bacnet	Spyder Batch Operations



Once it is brought up click on Discover.

ቹ Configure Device Disc	covery 🔀
O Device Discovery Config	
🔲 🔘 Device Low Limit	0
🗆 🔘 Device High Limit	4194302
🗆 😑 Networks	Send Global? Select All Clear All 1 3 65 1011 1012 1100 1155 1432 1534 2000 2345
🔲 🔘 Wait Response Time	10 s
	OK Cancel

You will have a choice of networks to discover. We are only interested in network 2345 which is the MS/TP network we selected with the BASrouter. Therefore we cleared all other networks. Once this network is selected click OK.

iscovered ievice Name Device DMT\$2dDIO4\$272_06 device VAV device VAV device Natabase Iame Exts Device ID Status	e ID ::421006 ::9999	Netwik 2345 2345 ((((((((MAC Ad 6 29 Add Jame 1 3 VAV [5 Name 7 Type Device Netwk MAC A	ddr Vendor BTR Ne Honeyv Type BACnetSpyde BACnetSpyde	tcom GmbH well Pevice I r device:9 VI BB det 2 2	Model BMT-DIO4/ Spyder D Netwik 999 2345 WCnetSpyde voice 345	Objects 2 11 74 74 MAC Addr 29 r ▼ y 9 [0 - 653	Enabled true 9999 5355]	Use Cov false	Max Cov Sub max	scriptions		
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ame Exts Device ID Status	Netwk		29 Add lame 1 VAV E Name Type Device Netwk MAC A	Honeyv Type BACnetSpyde e ID < Addr	Vell Device I of device:9 VI BI de 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Spyder D Netwk 1999 2345 W ACnetSpyde 245	74 MAC Addr 29 <u>r</u> 9 [0 - 653	Enabled true	Use Cov false	Max Cov Sub max	scriptions		
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atabase ame Exts Device ID Status	Netwk		Name VAV Name Type Netwk MAC A	Type BACnetSpyde e ID < Addr	Device I r device:9	D Netwk 1999 2345 W CnetSpyde 2010e 345	MAC Addr 29 r V 9 0 - 655	Enabled true 9999 535]	Use Cov false	Max Cov Sub max	scriptions	5	
atabase ame Exts Device ID Status	Netwk		 VAV Name Type Device Netwk MAC A 	e ID Addr	r device:9	W CnetSpyde 345	r ▼ [0 - 65:	999 535]	false	max	scripuons		
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atabase ame Exts Device ID Status	Netwk		Name Type Device Netwk	e ID < Addr	V# B# de 2	NV CnetSpyde Wice 345	r 🔽 9 [0 - 655	999					
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atabase ame Exts Device ID Status	Netwk	I) Netwk	< Addr	2	345	[0 - 65	535]					
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ame Exts Device ID Status	Netwk	I)	MAC A	4aar	125	29							
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			🕘 Enable	ed) true 🔻							
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Two BACnet devices are discovered. Double-click the VAV entry which will bring up its device details. This is our Spyder controller. You can change the name of the Spyder during this step. Notice that the default Device ID is 9999 and the MAC address is 29. Click OK and it will be added to the Database pane.

Now double-click on the other device which is the Cube I/O. The WEBstation may think it is a Spyder device so change the Type to Bacnet Device to avoid confusion. Retain all discovered data and click OK and it will be added to the Database pane.

		Device ID Net devices 22006 234 second 2000 1024 Type s24272_06 Bacnet D BHT¥ 24 Bacnet device 2345 6 © true © true criptions nex	wk MAC Addr 5 6 20 20 20 20 20 20 20 20 20 20 20 20 20	Vendor N [STR Netcon on-MeH] 0 [Str Netcon	todel Obje MT-DIO4/2 11 Vddr Enabled 1 true 1	Jse Cov Ma: Jue max	Succe × Cov Subscriptions ×	es » 3	On dat unc	ce your t abase th der Bacn	wo device ey will ap etNetwork	es al pea k.	re in the r in the tree
J.	Database				_						2 ob	jects	
	Name	Exts		Device ID	Status	Netwk	MAC Addr	Vendor	Model	Firmware Rev	App SW Version	9	
	BMT\$2dDI04\$2f2	06 6 4		device:9999	(OK) 06 {ok}	2345	6	noneywell	spyder	1.00 (DUIIO 9a)	1.00 (build 19a)		
				,	(and		-						

If the Palette is not being displayed on the left side bring it down by again going to Side Bar under the word Bookmark. Under Palette is the Open Palette icon. Click this to open up all the Palette options. Select HoneywellSpyderTool. If the Honeywell Spyder Tool cannot be found it will need to be installed in the WEBstation.



Right-click on VAV in the navigation pane and select Engineering Mode in order to reach the wiresheet.

The alternative to Engineering mode is Normal mode but in order to put down logic onto a wiresheet we need engineering mode.

From the SoftwarePoints folder drag and drop four Network Input components onto the wiresheet and rename them CubeInput1, CubeInput2, CubeInput3 and Cubeinput4. From the same folder drag and drop two Network Output components and rename them CubeOutput1 and CubeOutput2. From the Physical point folder drag and drop two physical input points and four physical output points and link them as shown in the nearby figure. You can rename the Spyder physical points as shown for clarity. Our logic is simple. Each Cube I/O input point drives a corresponding Spyder output point while two Spyder input points individually drive two Cube I/O output points.



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Next we need to configure our network variables beginning with the Network Inputs. Right-click each of the objects and select Configure Properties. Change the Point Category to Unit-less and the Sub Category to VAL-ubyte and the then click Advanced.

On the second screen change the Proposed Type to BV. Notice that the Object Name has been assigned for you as has the Object Instance. Change Update Interval to 1 and Update Rate to 2. Click OK on both screens and do the same procedure for all four Network Inputs. Unique object instances will automatically be assigned for you.

Configure Properties	
Point Name	DubeOutput1
Point Type	Network Output 💌
Point Category	Unit - less
Sub Category	VAL-ubyte
Help Advanced	OK Cancel

Advanced (Network Outp	out) 🔀
Object Composition	
Object Name	7 CubeOutputl
Field Name P1	resentValue
Object Type B:	inary Value
Object Instance)4
Update Interval 0	sec (min=0 sec max=15 sec)
Proposed Type	AV 🚸 BV
GPU	
GPU 🔇	True 🔷 False
Send Heart Beat 6	0 sec (min=0 sec max=3600 sec)
Help	OK Cancel

Next configure the two Network Outputs in a similar
fashion although the screens are different. On the first
screen again select Unit-less and VAL-ubyte and then
click Advanced.

Proposed Type

Update Interval

Fail Detect

Update Rate

Help

On the second screen change Proposed Type to BV while leaving all other settings unchanged. Click OK on both screens. Follow the same procedure for the other output.

You can check the configuration for the Spyder physical inputs and outputs. Just make sure the proper pins are assigned. You can accept the default values.



🔷 AV 🛛 🐟 BV

Fail Detect Enabled 🚸 True 🛛 🖒 False

1 sec (min=0 sec max=15 sec)

2 sec (min=0 sec max=3600 sec)

OK Cancel



The logic you just created along with the configurations are not in the Spyder. If you look at the Spyder icon (VAV) in the navigation pane you will notice a red down arrow on top of the icon meaning you must download the changes to the wiresheet by right clicking on the VAV icon and selecting Spyder Download. After any changes, you need to download the Spyder once you are finished to effect the changes.

You will be asked to make a choice of a full download or an incremental download assuming you are appending an existing program. Since this is our first download select Full Download. Once download is completed the top of the VAV icon will turn green. When in doubt do a full download.

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🗄 🕋 Niaga	Actions
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🗄 🚰 🔽	Sync From Field Device to Wiresheet
ė. 🔜 Bi	Sync From DB Device to Wiresheet

🕌 Spyder Download 🛛 🚺					
Spyder Download Pa	arameters				
🗆 🔘 Recursive	🔘 true 🔻				
🗆 🔘 Full Download	🔵 true 🔻				
ОК	Cancel				



You are not finished. Next you need to again right-click VAV and then Actions and then click Generate Network Objects. You will not receive a confirmation of this action. Once this is completed we can do data sharing.

Go to BacnetNetwork > Views > Spyder Bacnet Link Manager.



Click Add to get you to the Add Bindings window. You will notice a screen with some default values. For Source and Target columns you will see VAV displayed as the device which is our Spyder controller. On the Source side you will notice one of the network variables – in this case one of the network outputs we created. On the other side we see one of our network inputs we created. What this means is that the Spyder binds its network outputs as sources to third-party BACnet output targets and that third-party BACnet input sources bind to Spyder network input targets.

We will do inputs first. Under the Source section use the Device Name drop-down to find the Cube I/O. Use the Object Type drop-down to select binary input because the Cube I/O has four binary inputs with object identifiers from 1 to 4. Enter Object ID 1 and you will notice that the Object Name will change accordingly. Under the Target section use the Object Name drop-down to find AV_CubeInput1. Click OK and you will notice your first binding appearing as a New Link.

You need to keep adding links for the remaining three inputs assigning unique Object IDs that match the Cube I/O points. This process requires you to know the object IDs for the points being bound to Spyder network variables.

			-		
Device Name VAV		•	Device Name	VAV	•
Object Name AV_Cu	beOutput1	-	Object Name	AV_CubeInput3	ŀ
Property			Property		
presentValue			presentValue	t.	

Source Details		1	Target Details -		
Device Name	BMT\$24242dDIO4\$24242f2_0 -		Device Name	VAV	•
Object Name (Optional)	BI_obj1		Object Name	AV_CubeInput1	•
Object Type	Binary Input 💌		Property		
Object Id	1		presentvalue		
Property	presentValue				

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When doing the output side the device roles change. VAV will be the Source and the Cube I/O the target. There are only two physical outputs to the Cube I/O which are identified as BACnet object type Binary Output with Object identifiers 1 and 2. On the Spyder side you have AV_CubeOutput1 and AV_CubeOutput2. Enter the corresponding bindings. There is one other decision to make and that is the Priority property. It defaults to 12 but change it to 11. A value of 1 represents the highest priority while a value of 16 is the lowest.

			-Target Details-	
Device Name	VAV	-	Device Name	BMT\$24242dDIO4\$24242f2_0
Object Name	AV_CubeOutput1	•	Object Name	B0_obj1
Property			Object Type	Binary Output
presentValue			Object Id	1
			Property	priority 12

Once you complete the two other links your link list should look like the nearby image. Verify that this is what you want. If you made a mistake, delete the link and re-enter the data. Once you are finished click Bind.

A successful binding results in the Link Status column for all entries changing from New Link to Bound.

								» 📀
Link Status	Device Status	Source Device	Source Object	Source Property	Target Device	Target Object	Target Property	Poll/Push 🚌
New Link	Downloaded	BMT\$24242dDIO4\$24242f2_06	BI_obj1	presentValue	VAV	AV_CubeInput1	presentValue	Poll
New Link	Downloaded	BMT\$24242dDIO4\$24242f2_06	BV_obj2	presentValue	VAV	AV_CubeInput2	presentValue	Poll
New Link	Downloaded	BMT\$24242dDIO4\$24242f2_06	BI_obj3	presentValue	VAV	AV_CubeInput3	presentValue	Poll
New Link	Downloaded	BMT\$24242dDIO4\$24242f2_06	BI_obj4	presentValue	VAV	AV_CubeInput4	presentValue	Poll
New Link	Downloaded	VAV	AV_CubeOutput1	presentValue	BMT\$24242dDIO4\$24242f2_06	BO_obj1	priority 11	Push
New Link	Downloaded	VAV	AV_CubeOutput2	presentValue	BMT\$24242dDIO4\$24242f2_06	BO_obj2	priority 11	Push

If you go to Bacnet Network > Views > Wire Sheet you will see a graphical view of your bindings.

VAV S** BACnetSpyde Status Status {ok} AV_CubeOutput1_pr AV_CubeInput2_pr AV_CubeInput2_pre AV_CubeInput2_pre AV_CubeInput3_pre AV_CubeInput4_pre	BMT\$242dD Bacnet Device Status {ok} BI_obj1_presentValu BI_obj2_presentValu BI_obj3_presentValu BI_obj4_presentValu BO_obj1_priority12 BO_obj2_priority12
---	--

You can now try out your application program. Switching one of the input points on the Cube I/O will energize the Cube I/O output 2 while switching on all four input points will also energize Cube I/O output 1.

Some Hints

It is possible when doing your testing with the Cube I/O that the priority array for the two output points in the Cube I/O may get set with an unknown priority that is higher (lesser number) than the value 11 used in the application note. The result is that the Cube I/O appears not to set properly by the Spyder because the LEDs do not change state. If the Spyder outputs a value at priority 11, and in the Cube I/O is stored a value at a higher priority level, the output will not change. The simple solution is to power cycle the Cube I/O to clear out any saved priority level and bring it back online. The Spyder will then regain control of the Cube I/O.

When changing wire sheet logic involving network variables or when reconfiguring network variable properties, we found it beneficial to first unbind any network bindings. Binding network variables is the last step in the programming process and we feel that these bindings should be unbound as a first step when contemplating a change to any of the network variable logic. Once changes are made, you can generate your network variables again and then bind them as the final step. We also chose to do full downloads to the Spyder versus incremental downloads. The Spyder solves its wire sheet about once a second. Network variables appear to be treated differently from that of internal I/O points. You will notice an Update Rate for the Network Input variables. We needed to change the default value of 60 seconds down to 2 seconds in order to achieve a reasonable response rate. In our example we are using internal Spyder physical inputs to drive Cube I/O output points via Spyder network output variables while using Cube I/O input points to drive Spyder physical output points via Spyder network input variables. The response times in the two scenarios were different. In the first instance, a change to a Spyder input resulted in a Cube I/O output change in about 2 seconds. In the second instance, a change to the Cube I/O input resulted in a change to the Spyder output in about 4 seconds. Considering the internal cycle time of the Spyder solving its logic and the fact that network commands are occurring over a lower speed MS/TP network, the overall response times seem acceptable.

This application note demonstrates that Cube I/O modules can be successfully deployed as expansion I/O for Spyder controllers.

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