Using FieldServers in BACnet applications

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Presentation Highlights

The BACnet Standard
- BACnet organizations
- Protocol hierarchy of functionality
- PICS
- BACnet Addressing

BACnet Variations

BACnet Applications
- Routers vs Gateways
- FieldServer application of BACnet properties
- BACnet ports
- Priority Arrays
- Binary Text
- BBMD
- Read Property Multiple (RPM)
- Using COV's with FieldServer

Question and Answer Session

The BACnet Standard

Organizations related to BACnet

- The BACnet standard is maintained by ASHRAE (ASHRAE/ANSI 135-2004)
- ASHRAE SSPC135 consists of 7 working groups that focus on separate aspects of BACnet for maintenance and improvement.
- BMA (Bacnet Manufaturers Association) is a user group that focuses on the application side of BACnet (Interoperability, testing, training, promotion, etc)
- BTL (Bacnet Testing Laboratories) was founded by BMA to provide an Agency testing standard for vendors to comply to.
- BIG-NA (Bacnet Interest Group of North America) consists of users, integrators, contractors etc, and has many partner organizations worldwide.

The BACnet Standard

BACnet building blocks

- The BACnet protocol contains the following Layers of information:
  - Properties
  - Objects
  - Devices
  - Services
  - BIBBs (Bacnet Interoperability Building Blocks)

- Objects have Properties, and are contained within Devices.
- To communicate, these devices need Services that manage the communication transactions.
- Different device types demand different groups of services. BIBBS define the classes of services and the level of support these services need in each of the device types.

The BACnet Standard

BACnet BIBBs - Example

Supported BIBBs

Product	Supported BIBBs	BIBB Name	Tested
Excel Energy Manager(XEM)	DS-RP-B	Data Sharing-ReadProperty-B	✓
	DS-RPM-B	Data Sharing-ReadPropertyMultiple-B	✓
	DS-WP-B	Data Sharing-WriteProperty-B	✓
	DS-WPM-B	Data Sharing-WritePropertyMultiple-B	✓
	DM-DDB-B	Device Management-Dynamic-Device-Binding-B	✓
	DM-DOB-B	Device Management-Dynamic-Object-Binding-B	✓

The BACnet Standard

What you need to know about PICS:

- PICS stands for Protocol Implementation Conformance Statement
- Vendors are required to produce a PICS so that users know what BIBBs, Services, Objects and Properties they are getting.
- PICS is designed to assist the user in determining whether the Vendor's level of BACnet support will suffice for the application.
- Be sure to read a Vendor's PICS before purchasing the product.

The BACnet Standard

BACnet Addressing:

- Bacnet points (Objects) have addresses that consist of an Object Type (Data Type) and Object Instance.
- There are 25 types of Objects, but different device types only need to support a subset of these objects depending on functionality required.
- Each Object type can have over 4 million instances of objects in a Device.
- The combination of Object Type and Object Instance defines a unique object in a Device, and is referred to as the Object ID. Two different devices can possess the same Object ID (eg: Two different devices can both have the point Analog Input 1, but because they are on different devices they are unique)
- Object ID's are usually transparent at host level.

BACnet Variations

- Variations exist due to a difference in connection medium:
  - BACnet PTP – RS-232 Point to Point connection
  - BACnet MSTP – RS-485 Token Passing connection
  - BACnet ARCnet – ARCnet Connection
  - BACnet Ethernet – Ethernet connection, MAC address based
  - BACnet I/P – Ethernet connection, IP address based.

- All variations use the same application protocol, but differ at the transport level due to demands set by the medium.

BACnet Variations

BACnet ARCnet:

- Legacy Protocol. Needs cards for communication. Seldom used.
- Cards are becoming hard to find, and expensive.
- Hard to fault find. No “sniffer” tools available.
- Best aproach is to replace ARCnet with BACnet/IP in most applications.

BACnet Variations

BACnet PTP:

- RS-232 Protocol. Seldom used.
- Few vendors support it, but it is a stable protocol.
- RS-232 sniffer tools can be used for debugging problem applications.

BACnet Variations

BACnet MSTP:

- RS-485 Token Passing Protocol. Commonly used.
- Watch out for dual addressing: Some vendors address by MAC address, others by device ID. FieldServer can support either.
- MSTP supports multiple masters on a network by sharing a token between masters.
- TIP: Set Master MAC addresses low so that the Max Master parameter can be low, allowing minimum overhead.

BACnet Variations

BACnet Ethernet:

- Ethernet Protocol. MAC address based.
- All devices communicating with each other using BACnet Ethernet MUST be on the same subnet.
- Due to the Address base difference, BACnet Ethernet and BACnet I/P are distinctly different protocols.
- Myth: BACnet Ethernet devices do not need an IP address.

BACnet Variations

BACnet I/P:

- Ethernet Protocol. IP address based.
- BACnet I/P allows for devices on different subnets to communicate with one another, but BBMD is required.
- BACnet I/P is also known as Annex J BACnet.

BACnet applications

Routers vs Gateways:

- BACnet Routers connect BACnet networks of dissimilar medium together (e.g: BACnet MSTP to BACnet I/P)
- Gateways connect networks of dissimilar protocols together (e.g: Modbus RTU to BACnet I/P)
- The FieldServer is a Gateway.
- BACnet Routers cannot function as gateways. However, the FieldServer Gateway can be used in applications where a BACnet router is required.

BACnet applications

Standard BACnet Properties used in the FieldServer:

- These map descriptor keywords are used invariably in FieldServer BACnet applications
  - Map_Descriptor_Name – Used to specify a name for the Object_ID
  - Data_Type – Used to specify Object_Type
  - Object_ID – Used to specify the Object_Instance
  - Units (Server Side) – Used to specify a unit for the Object_ID
  - Relinquish_Default (Server Side) – Used to specify the relinquished default of a setpoint
  - Property (Client Side) – Invariably set to Present_Value to request the present value of the remote Object_ID.

//==========								
//								
// Server Side Map Descriptors								
//								
Map_Descriptors								
Map_Descriptor_Name	Data_Array_Name	Data_Array_Offset	Function	Node_Name	Data_Type	Object_ID	Units	Relinquish_Default
Space_Temp_SP	DA_AO_01	0	Server	FS_11	AO	12	Deg_f	72

BACnet applications

BBMD (BACnet Broadcast Management Device):

- BACnet as a protocol struggles with operation across network subnets. This is due to the prolific use of broadcasting in the protocol.
- BACnet solves the problem by assigning a BBMD in every subnet. Each BBMD listens for broadcasts, and distributes them to other BBMD's using direct messaging. The other BBMD's then re-broadcast the broadcast messages.
- The FieldServer is capable of being a BBMD as long as it is not fulfilling a BACnet Client role. A file called bdt.ini needs to be loaded into the FieldServer for this application. Bdt.ini stores the IP addresses of all the BBMD's on the network, including the FieldServer's IP address. All BBMD's will use the same bdt.ini file.

//==========		
//		
// Server Side Connections		
//		
Connections		
Adapter	Protocol	Connection_Type
N1	Bacnet_IP	BBMD

BACnet applications

BACnet Communications Port:

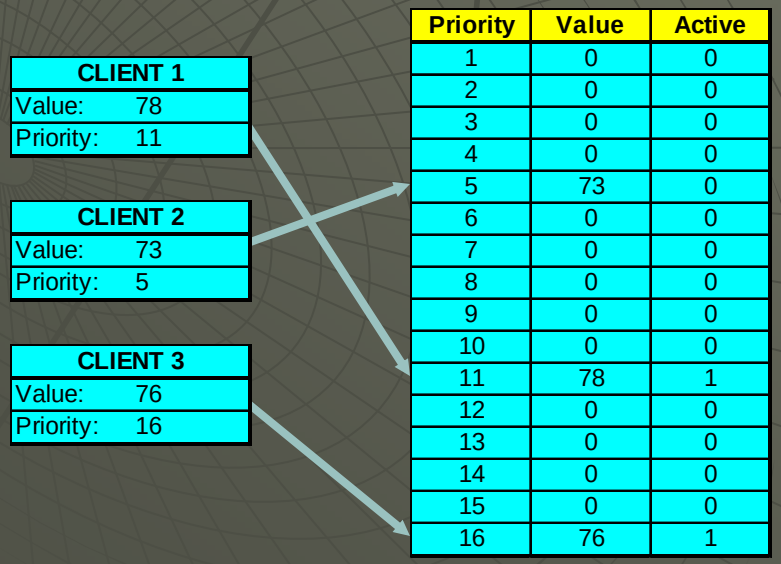
- The default communications port for BACnet is 47808
- The Port number can be changed in the Connection parameters by adding the IP_Port Keyword.

//==========		
//		
// Server Side Connections		
//		
Connections		
Adapter	Protocol	IP_Port
N1	Bacnet_IP	47809

BACnet applications

Priority Arrays:

- For each Output variable, the FieldServer maintains a priority Array of 16 priority levels. The value written from each Client is stored in this array at the priority level specified by the Client
- The FieldServer also maintains a set of flags that indicate which priority levels are active

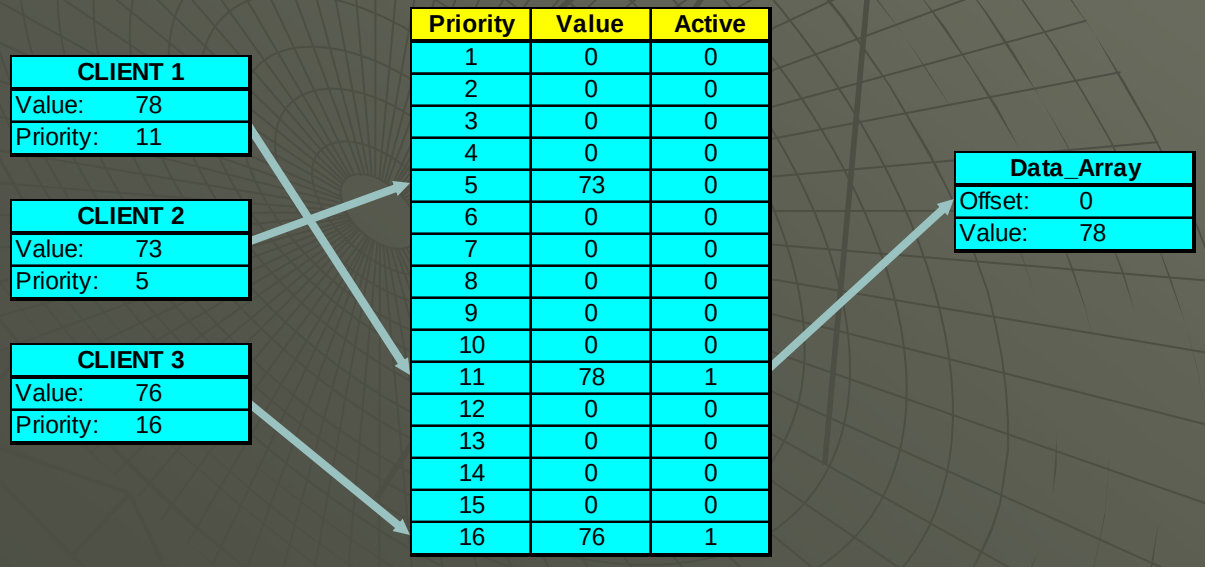


Priority	Value	Active
1	0	0
2	0	0
3	0	0
4	0	0
5	73	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	78	1
12	0	0
13	0	0
14	0	0
15	0	0
16	76	1

BACnet applications

Priority Arrays:

- The FieldServer also copies the value stored in the highest active priority level to the current value for the Output (which is the Data_Array offset associated with the related server map descriptor)
- If no Priorities are active, then the Relinquish default value is stored as the current value.



BACnet applications

Priority Arrays:

- The contents of the Priority Array can be assigned to a Data Array for visualization

//==========											
//											
// Server Side Map Descriptors											
//											
Map_Descriptors											
Map_Descriptor_Name	Data_Array_Nam	Data_Array_Offs	Function	Node_Name	Data_Type	Object_ID	Relinquish_Default	DA_Pri_Array	DA_Pri_Array_Offset	DA_Pri_In_Use	DA_Pri_In_Use_Offset
SMD_AI_01	DA_AI_01	0	Server	FS_11	AO	1	20	P_Values	0	P_State	0

BACnet applications

Active/Inactive text:

- For objects that support these properties, it is possible to specify Active and Inactive texts for binary states in a Server Side Map Descriptor.

//								
// Server Side Map Descriptors								
//								
Map_Descriptors								
Map_Descriptor_Name	Data_Array_Nam	Data_Array_Offs	Function	Node_Name	Data_Type	Object_ID	Active_Text	Inactive_Text
Back_Door_Alarm	DA_DI_01	0	Server	FS_11	DI	1	Alarm	Normal

BACnet applications

Read Property Multiple (RPM):

- The FieldServer initiates the RPM function when you specify a Length of > 1 in the map descriptor.
- Note that when using RPM on the server side of the FieldServer, the FieldServer needs to “Auto-Name” the variables. This is done by appending the Map_Descriptor_Name with [x], where x is a running number for each variable (starting at 0).

// Server Side Map Descriptors							
//							
Map_Descriptors							
Map_Descriptor_Name	Data_Array_Nam	Data_Array_Offs	Function	Node_Name	Data_Type	Object_ID	Length
DI_Values	DA_DI_01	5	Server	FS_11	DI	1	4

OBJECT NAME	OBJECT_ID	Data_Array_Offset
DI_Values[0]	DI1	5
DI_Values[1]	DI2	6
DI_Values[2]	DI3	7
DI_Values[3]	DI4	8

BACnet applications

New to FieldServer: Change of Value (COV):

- As a server, FieldServer can accept COV subscriptions for AI,DI,AO,DO objects.
- Both Confirmed and Unconfirmed subscriptions are supported.
- Currently available for BACnet IP. Will be available on other BACnet drivers soon.
- No special configuration required in FieldServer server map descriptor.

Resources

1) www.fieldserver.com
   - FieldServer Configuration manual
   - FieldServer Troubleshooting manual
   - BACnet PICS
   - BACnet combined Data Fact Sheet
   - BACnet driver manuals

2) www.bacnet.org
   - Official ASHRAE SSPC 135 website

3) www.bacnetassociation.org
   - BMA website
   - Includes BTL and BTL product listings

4) www.ethereal.com
   - Ethernet packet capture utility

Questions?

Email Mac at:

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THANK YOU!

.....for taking the time to attend this presentation.