BACnet

History

Benefits

Future

About Me

- Professional Engineer (Electronics)
- Major Designs
  - The 7300 series of power meters for Schneider Electric
  - A solar-powered wireless crosswalk
  - The MACH-Pro line of advanced building controllers for Reliable Controls Corporation
- Represent Reliable Controls Corporation at the SSPC 135 (BACnet) Standard meetings.

What I'm going to talk about…

- History of BACnet
  - Background including some definitions
  - Why BACnet happened
  - Some dates
  - Its growth
- Benefits of BACnet
  - How the Standard is of benefit
  - For the Manufacturer, Consultant, and Customer
- Wireless
- Network Security
- The Future of BACnet
  - Alarming
  - Web services
  - Objects and Properties
  - Communications

Background

A Few Definitions

- BACnet
  - Building Automation and Control Networking protocol
  - Standardized communications between different building automation systems
  - Defines a series of objects, services and communication methods that can be used to control and manage building systems
  - Designed to grow and improve over time
  - Designed to support proprietary extensions
  - BACnet defines generic profiles (B-OWS, B-BC, B-AAC, etc)
  - BACnet does not define a chiller profile but does provides the tools to control it

A Few More

- 135
  - Is the ASHRAE BACnet Standard
- 135.1
  - Is the testing methods for 135
  - Called "Methods of Test for Conformance to the BACnet Standard"

BACnet Interest Groups

- BACnet International (BI) (was BIG-NA)
  - Industry Association that facilitates and promotes the use of BACnet
- BACnet Interest Groups
  - BIG-EU (Europe)
    - Most Active
    - Promotes use of BACnet standard ISO 16484-5 (135-2001)
    - Over 80 members
  - BIG-AA (AustralAsia), BIG-CN (China), BIG-FI (Finland), BIG-ME (Middle East), BIG-PL (Poland), BIG-RU (Russia), BIG-SE (Sweden)

BTL

- BTL (BACnet Testing Laboratories)
  - Created by BI to support compliance and interoperability testing
  - Consists of the BTL Manager and BTL-WG
  - Publish Implementation Guidelines
  - Organize Plugfest
  - Approve testing labs (SoftDEL, WSPLabs)
  - Awards the BTL Listing mark
- BTL-WG
  - BACnet Testing Laboratories – Working Group
  - Provides oversight and guidance to BTL
  - Responsible for the technical aspects BI's testing and listing activities (135.1)

History Lesson

Why?

- In the 1980s
  - Microprocessor based DDC systems began to appear
  - Networking was becoming prevalent in building automation systems
  - Large HVAC equipment manufacturers started building there own controllers
  - Controller manufacturers had to either:
    - Create a complete solution
    - Partner with complimentary manufacturers
    - Create a gateway between systems
  - Integration became complex and custom
  - Customers and consulting engineers demanded choices
  - The concept of the "Intelligent Building" came about with the idea of distributed control for HVAC, Lighting, Security, Fire
- Manufacturers, consulting engineers, integrators, and customers all wanted and needed a solution

BACnet: A Brief History

1987

- ASHRAE committee formed to develop a standard protocol for the building automation industry (SPC 135P)
- Initial Charter of BACnet was targeted to address the needs of all building systems not just HVAC

1991

- First public draft (507 comments from 6 countries)

1994

- Second public draft (228 comments from 12 countries)

1995

- Third public draft (6 comments)
- ASHRAE 135-1995 approved (ANSI)

BACnet: A Brief History

- ASHRAE 135 updated in 2001, 2004, 2008, and 2010

- In 2003, International Standard ISO 16484-5 approved (Based on ASHRAE 135-2001)

- AHSRAE 135.1-2003 approved (testing standard)

- AHSRAE 135.1 updated in 2007 and 2009

1995 Communications

BACnet Layers

Application Layer	BACnet Application Layer			
Network Layer	BACnet Network Layer			
Data Link Layer	ISO 8802-2 (IEEE 8802.3) Type 1		MS/TP	PTP	LonTalk
Physical Layer	ISO 8802-3 (IEEE 8802.3)	ARCNET	EIA-485	EIA-232	

2001 Communications

BACnet Layers

Application Layer	BACnet Application Layer					
Network Layer	BACnet Network Layer					
Data Link Layer	ISO 8802-2 (IEEE 8802.3) Type 1		MS/TP	PTP	LonTalk	BVLL
Physical Layer	ISO 8802-3 (IEEE 8802.3)	ARCNET	EIA-485	EIA-232		UDP/IP

2010 Communications

BACnet Layers

Application Layer	BACnet Application Layer						
Network Layer	BACnet Network Layer						
Data Link Layer	ISO 8802-2 (IEEE 8802.3) Type 1		MS/TP	PTP	LonTalk	BVLL	**BZLL**
Physical Layer	ISO 8802-3 (IEEE 8802.3)	ARCNET	EIA-485	EIA-232		UDP/IP	**ZigBee**

Objects in 1995

- Analog Inputs, Outputs, Values
- Binary Inputs, Outputs, Values
- Multi-State Inputs, Outputs
- Calendar
- Command
- Device
- Event Enrolment
- Group
- Notification Class
- Program
- Schedule

16 Objects

Objects in 2001

21 Objects

- Analog Inputs, Outputs, Values
- Binary Inputs, Outputs, Values
- Multi-State Inputs, Outputs
- Calendar
- Command
- Device
- Event Enrolment
- Group
- Notification Class
- Program
- Schedule

- Trend Log
- Averaging
- Multi-State Value
- Life Safety Objects
- File

Objects in 2004

- Analog Inputs, Outputs, Values
- Binary Inputs, Outputs, Values
- Multi-State Inputs, Outputs
- Calendar
- Command
- Device
- Event Enrolment
- Group
- Notification Class
- Program
- Schedule
- Trend Log
- Averaging
- Multi-State Value
- Life Safety Objects
- File

23 Objects

- Accumulator

- Pulse Converter

Objects in 2008

28 Objects

- Analog Inputs, Outputs, Values
- Binary Inputs, Outputs, Values
- Multi-State Inputs, Outputs
- Calendar
- Command
- Device
- Event Enrolment
- Group
- Notification Class
- Program
- Schedule
- Trend Log
- Averaging
- Multi-State Value
- Life Safety Objects
- File
- Accumulator
- Pulse Converter

- Trend Log Multiple
- Structured View
- Access Door
- Event Log
- Load Control

Objects in 2010

48 Objects

- Analog Inputs, Outputs, Values
- Binary Inputs, Outputs, Values
- Multi-State Inputs, Outputs
- Calendar
- Command
- Device
- Event Enrolment
- Group
- Notification Class
- Program
- Schedule
- Trend Log
- Averaging
- Multi-State Value
- Life Safety Objects
- File
- Accumulator
- Pulse Converter
- Trend Log Multiple
- Structured View
- Access Door
- Event Log
- Load Control

- Network Security

- Global Group

- Access Objects (6)

- Primitive Objects (12)

Benefits

Standard
Proprietary Extentions
Testing
Manufacturer
Products
Consultants
Customers

BACnet Benefits - Standard

- OPEN Protocol (no royalties)
  - Purchase the complete standard for $100
  - Download a royalty-free stack from Sourceforge
- OPEN Protocol (multi-vendor)
  - Anybody with a little time, a $3 processor and a $0.50 EIA-485 transceiver can produce a BACnet product
- BACnet not limited by current technology - the object and services are independent of the underlying network
- Networking Technologies can be added (Zigbee)
- Standard is growing

BACnet Benefits – Proprietary Extensions

- Proprietary properties within objects
  - Feedback Object property in a Binary Output
  - Adding a Name to a Special Event in a Schedule
- Proprietary objects
  - Diagnostic Object
  - Communications Object
- Private Transfer service
  - Allows any data to be transferred from one device to another including another protocol

BACnet Benefits - Testing

- BTL logo means products are tested at an independent lab
- Two certified labs exist (SoftDEL, WSPLabs)
- At the BACnet Interop (Plugfest), Engineers get together and test there products against the competition
- Protocol Implementation Conformance Statement (PICS)
  - A statement of the capabilities of the device
  - Is it a building controller or a workstation
  - What objects does it support (Trending, scheduling, etc)
  - What objects are creatable, deletable
  - What properties are writable
  - What proprietary objects and properties exist and there capabilities
  - Networking capabilities

BACnet Benefits - Manufacturer

- Speciality manufacturers (drives, RTUs, sensors) can invest in one protocol
- Controls manufacturers can support less protocols and improve products in other ways
- Allows one manufacturer to enter the domain of another
- The smaller manufacturers can compete with the big players
- BACnet allows proprietary enhancements to add value and feature differentiation
- No fees, no licenses, no royalties

BACnet Benefits - Products

- 505 vendor IDs
- 57 different companies have BTL tested products including:
  - ABB, Alerton, Automated Logic, Carrier, Delta Controls, Distech Controls, Hitachi Appliances, Honeywell, ITT, Johnson Controls, KMC, Lennox, Mitsubishi, Reliable Controls, Samsung, Schneider, Siemens, Trane, Tridium

BACnet Benefits – Consulting Engineers and Integrators

- Can focus on the feature set not the protocol
- More options to offer customers (Demand/Response, energy management, etc)
- More options for integration with other systems
- Much easier to offer add-ons and improvements to meet changing customer needs

BACnet Benefits - Customer

- A manufacturer can no longer under bid a job and then expect to jack up prices on the expansion work
- A manufacturer can provide that special solution that the customer needs
- Single workstation control
- Customers can choose a workstation from one manufacturer, building controller from another and VAV boxes from yet another
- Extendable into lighting, fire, access, and security

Fun Stuff

Wireless

Security

Wireless

- BACnet/IP
  - The specification does not specify an Ethernet connection for BACnet/IP so Wi-Fi and any other network that supports IP packets can support BACnet/IP

- BACnet/Zigbee
  - This is a datalink/physical layer specification just like MS/TP / EIA-485
  - It is not at the sensor level

BACnet/Zigbee Network
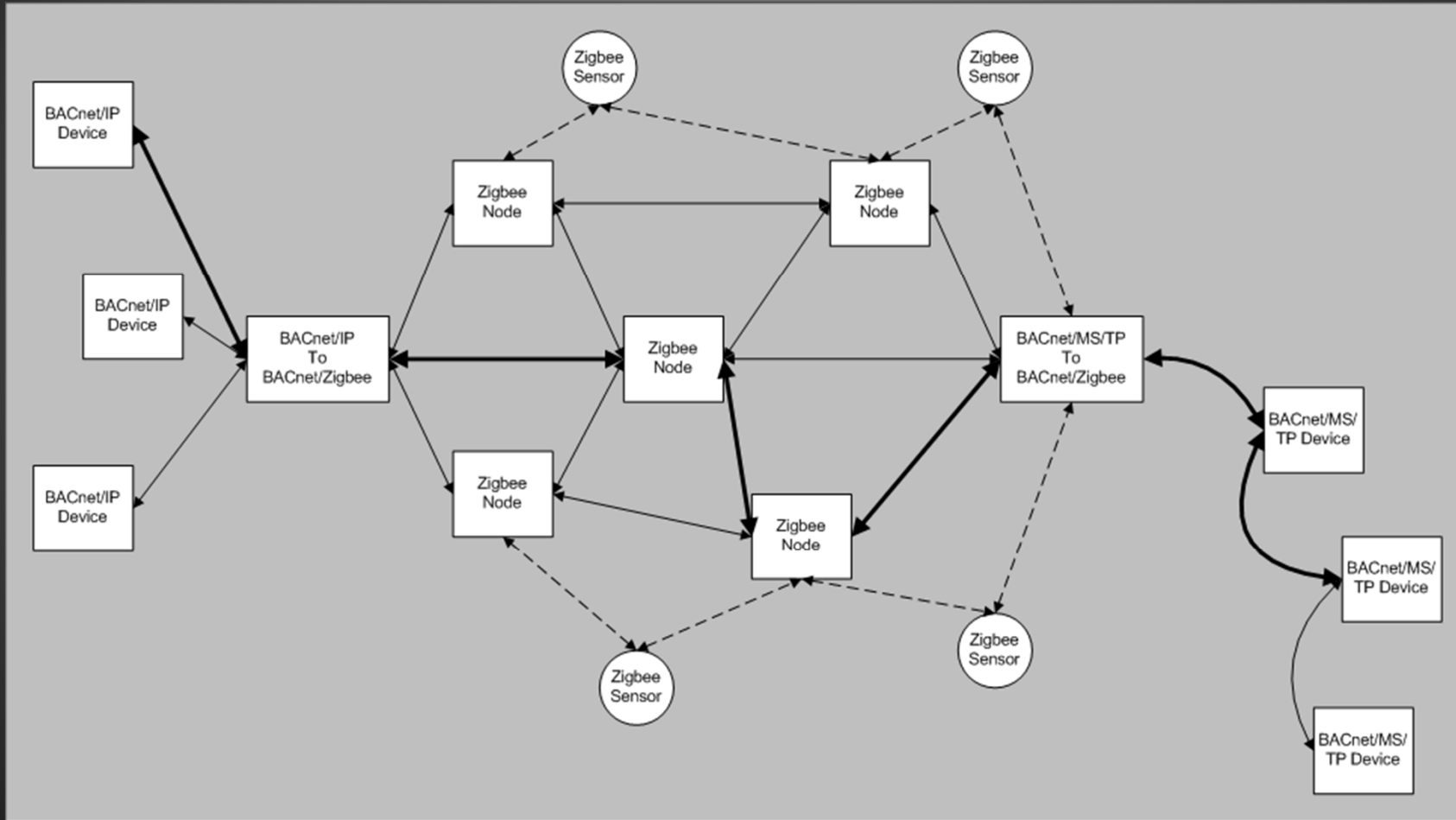
Wireless Sensors

- Zigbee
  - Mesh network
  - 2.4 GHz (global band)
  - Working on a battery-less solution
- EnOcean
  - 315MHz or 868MHz (not available in some countries)
  - Battery-less energy harvesting solutions

Network Security

- Is BACnet specific network security needed?
- Operator Workstation level (not part of standard)
  - User levels
  - Password protection
  - Audit Trail
- IP level
  - Is there external network access?
  - Can Firewalls, VPN, and other standard IP security measures do the job?
- MS/TP level
  - Is the building secure?

BACnet Network Security

- BACnet Security architecture provides device and user authentication and data hiding

- Can be implemented on BACnet/IP and BACnet/MS/TP devices

- BACnet networks are divided into trusted (physical or protocol level) and non-trusted

The Future

Alarming
Web Services
Objects
Properties
Communications

Alarming

- Addendum 2008af
- Public review completed March 21, 2011
- General cleanup of the language in the standard
- Addition of Fault Algorithms
- Addition of configurable message texts
- Addition of the Alert Enrollment Object
  – Allows a device to indicate events that do not need to be acknowledged
- Addition of the Notification Forwarder Object
  – Allows simpler devices to participate in sophisticated alarm distribution scenarios
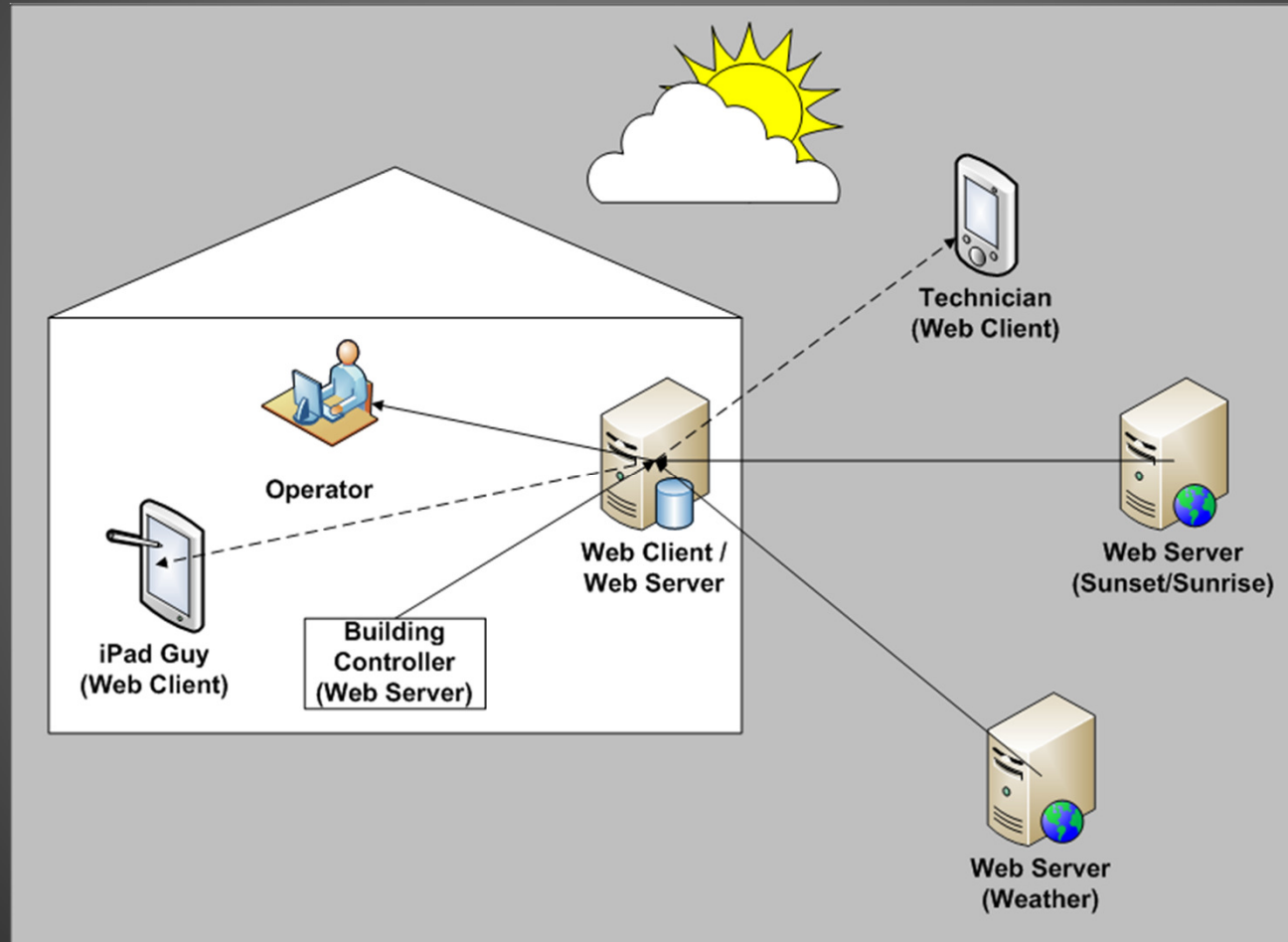- Working on Phase 2

Notification Forwarder Object
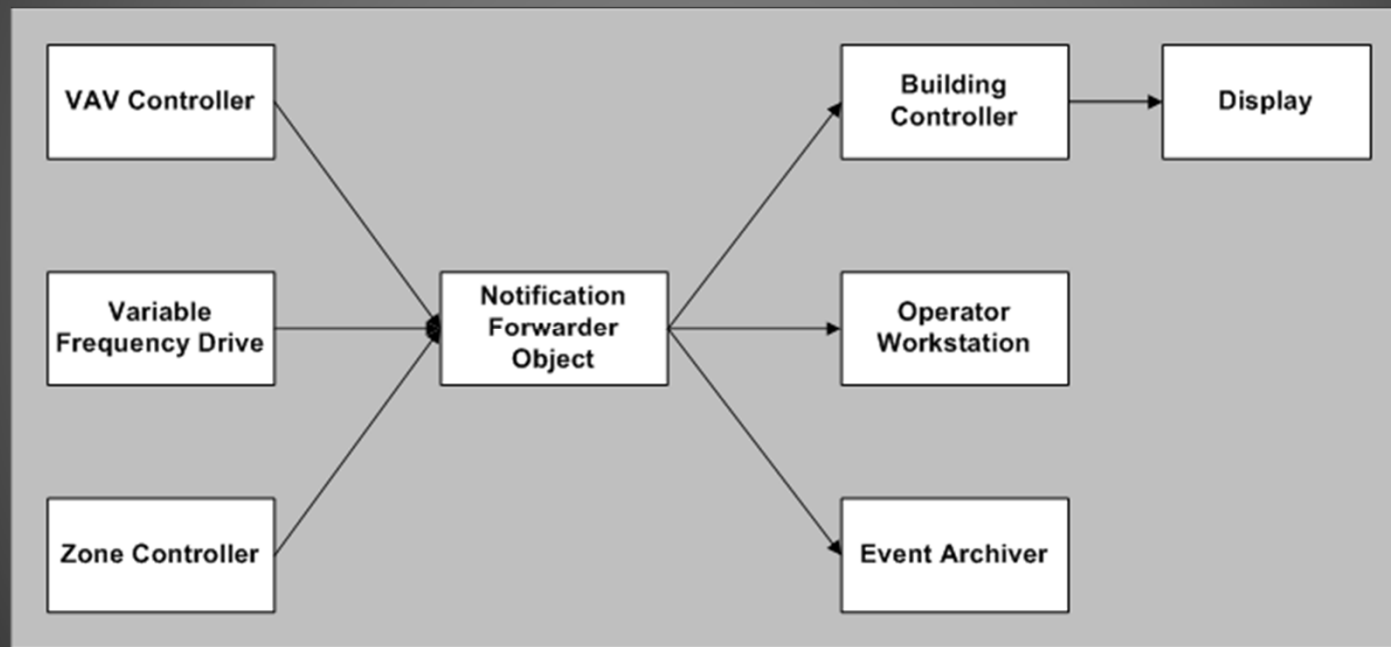
Web Services

- A Web service is a method of communication between two electronic devices over a network
- Annex N defines a data model of how Web services can be used within BACnet (1 way to do it)
- There is a proposal to create a fully interoperable way to use Web services within BACnet

Web Service Example

Potential Objects

- Network Port Object
  - Interoperable method to manage communications ports
- Lighting
  - Lighting Output Object
    - Public review complete
    - Still issues to resolve
  - Channel Object
    - Is an object that takes a single write request and forwards it to multiple devices and objects
    - Can be used to control banks of lights

Potential Properties

- Interface Value
  - The actual value of the output (HOA)
- Serial Number
  - Standard definition of a device serial number
- Runtime Totalizer Properties
  - Standard definition of the total time a device has been ON and how many changes of state

Potential Communications

- IT-WG (BACnet/IT)
  - TCP/IP
    - "The" Internet protocol
    - TCP/IP is reliable and point-to-point while UDP/IP is quick and allows broadcast
    - DHCP (no more static IPs)
  - Internet Security is the most used and updated, get security for "free"
  - How to deal with broadcasts?
  - Many other issues to resolve
- Support for IPv6
  - In public review
  - Using IPv6 Multicast instead of IPv4 broadcast

IPv6

BACnet Layers

							VMAC
Application Layer	BACnet Application Layer						
Network Layer	BACnet Network Layer						
Data Link Layer	ISO 8802-2 (IEEE 8802.3) Type 1		MS/TP	PTP	LonTalk	BVLL	BZLL	**VMAC**
							BVLL
Physical Layer	ISO 8802-3 (IEEE 8802.3)	ARCNET	EIA-485	EIA-232		UDP/IP	ZigBee	**IPv6**

So…

- Any questions?