

The Siemens logo is displayed in a teal, sans-serif font. It is positioned in the upper right quadrant of the slide, set against a background of a stylized globe with white grid lines on a light gray surface.

SIEMENS



BACnet in Focus

Understanding BACnet and the Protocol
Implementation Conformance Statement

ASHRAE Montreal

May, 2011

BACnet in Focus

Review BACnet Objects, Properties, Services, and Transport

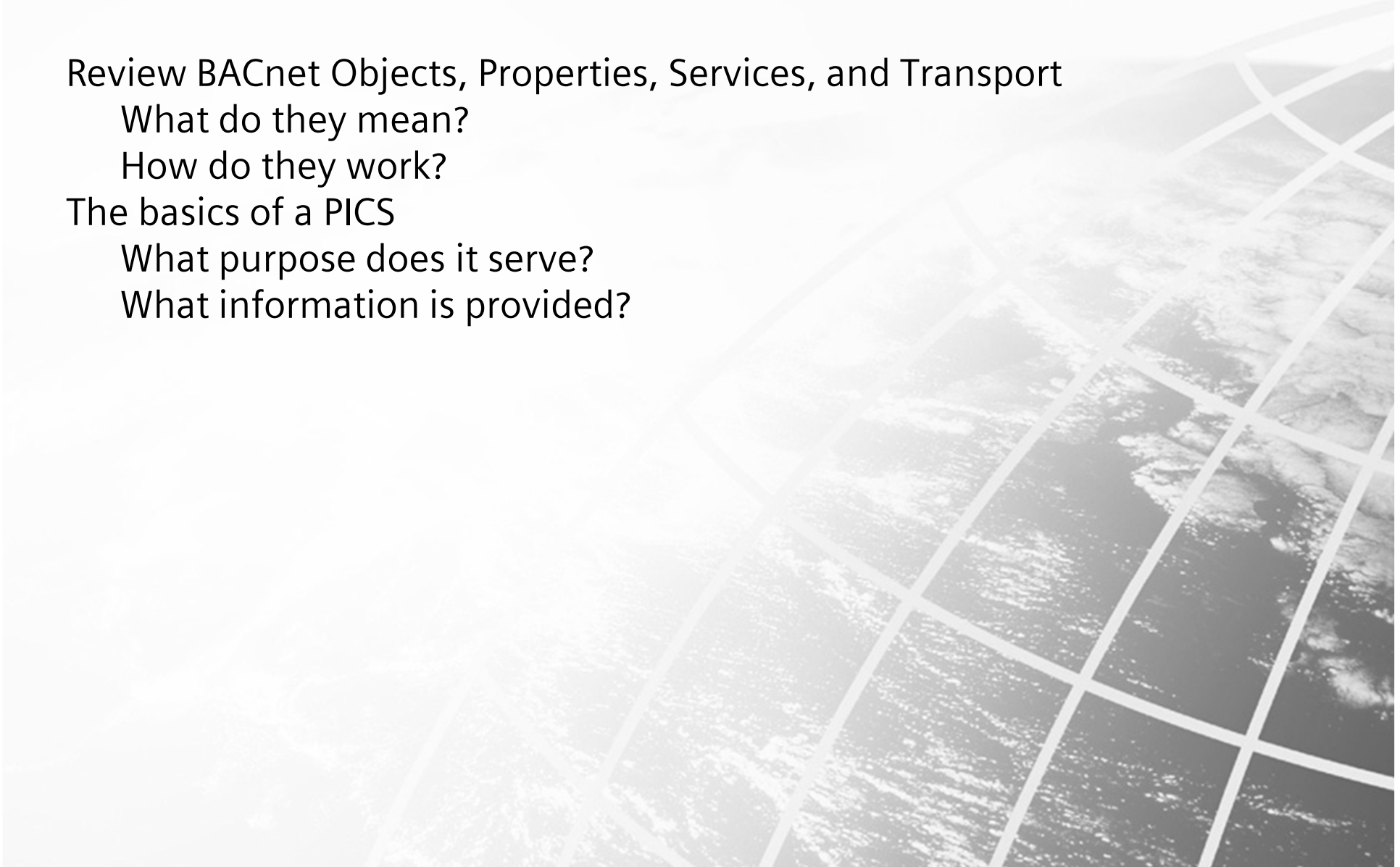
What do they mean?

How do they work?

The basics of a PICS

What purpose does it serve?

What information is provided?



BACnet in Focus

PICS for specific device profiles

- BACnet Operator Workstation (B-OWS)

- BACnet Building Controller (B-BC)

- BACnet Advanced Application Controller (B-AAC)

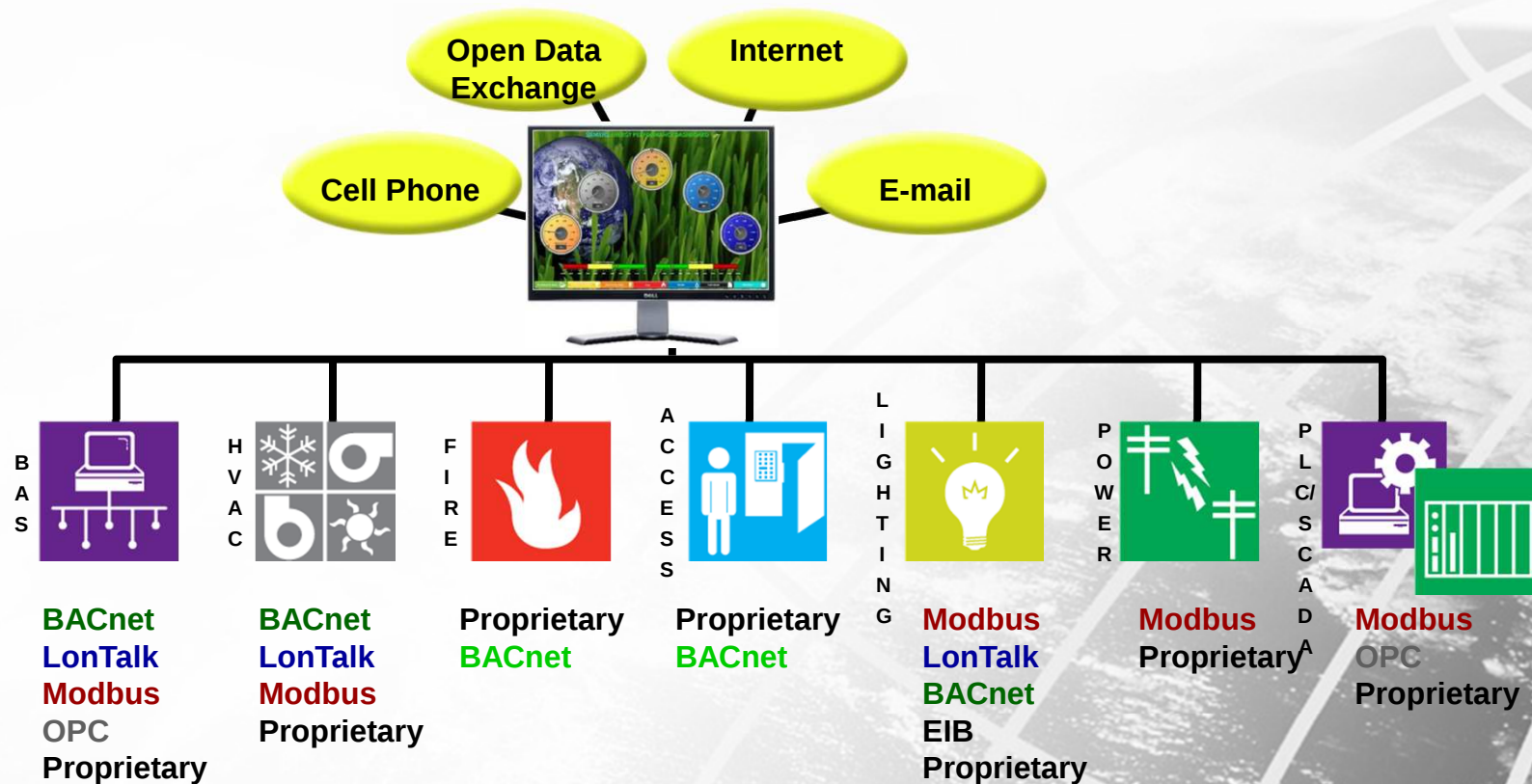
- BACnet Application Specific Controller (B-ASC)

- BACnet Smart Actuator (B-SA)

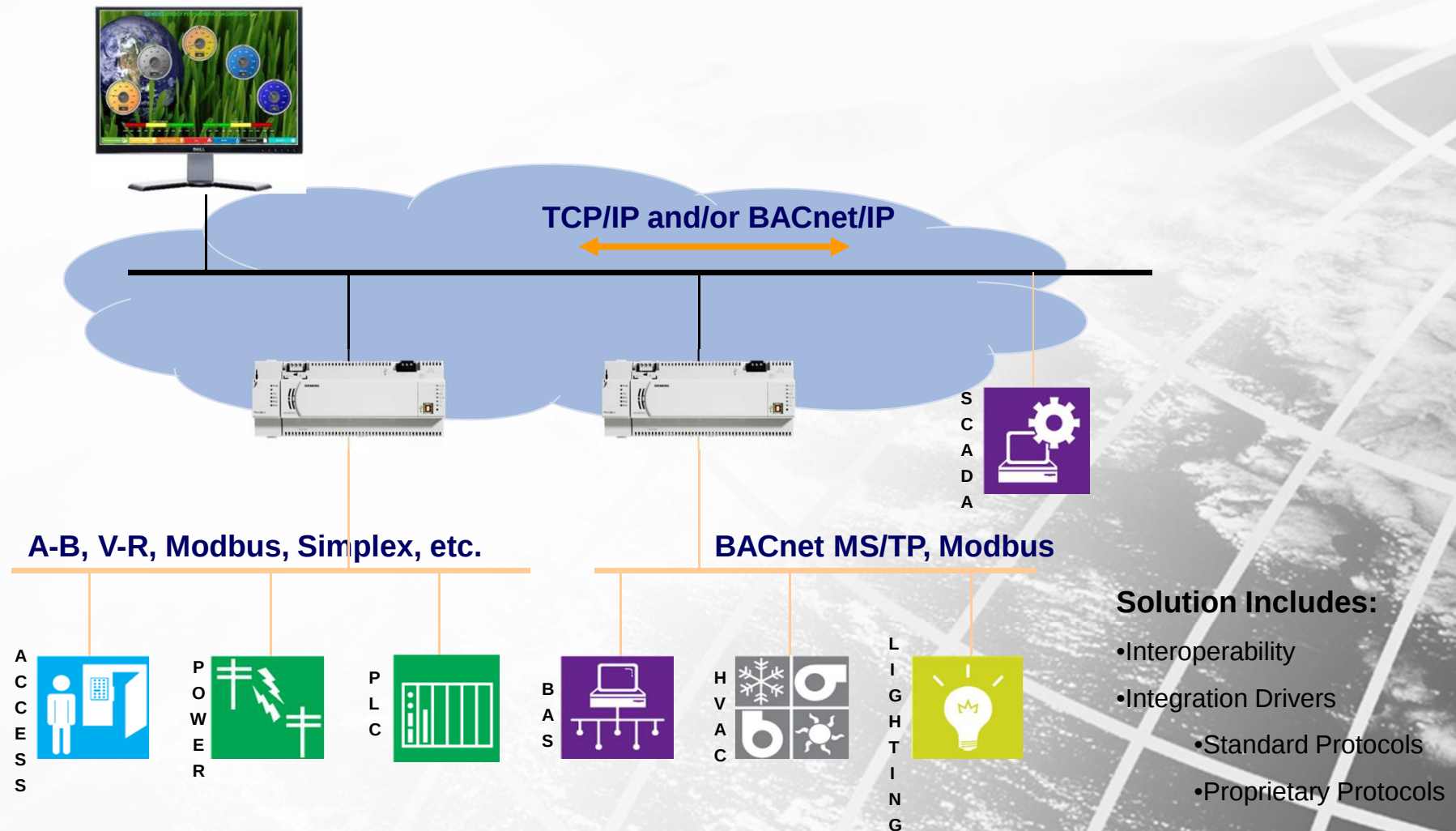
Fun Quiz!!!

BACnet Interoperability Challenges and Troubleshooting

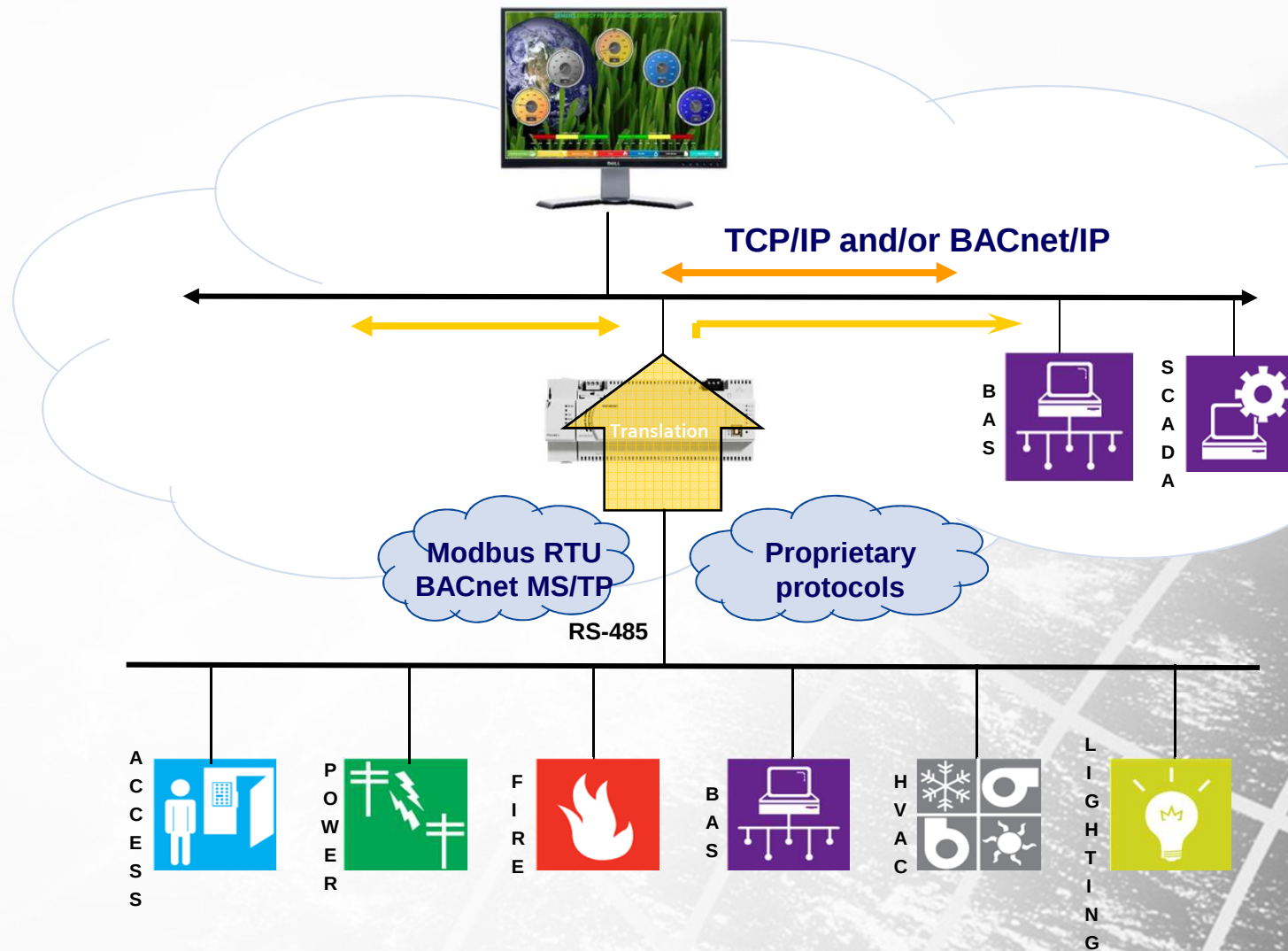
Protocols within building subsystems...



System Architecture – Integration



System Integration



What is BACnet?

Protocol Stack

A protocol is a set of rules defining the format of data transmission between two or more devices.

The protocol defines:

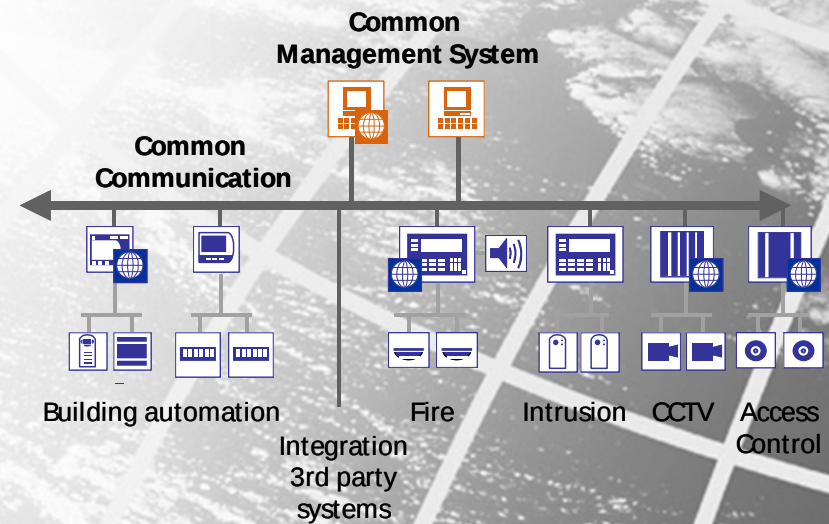
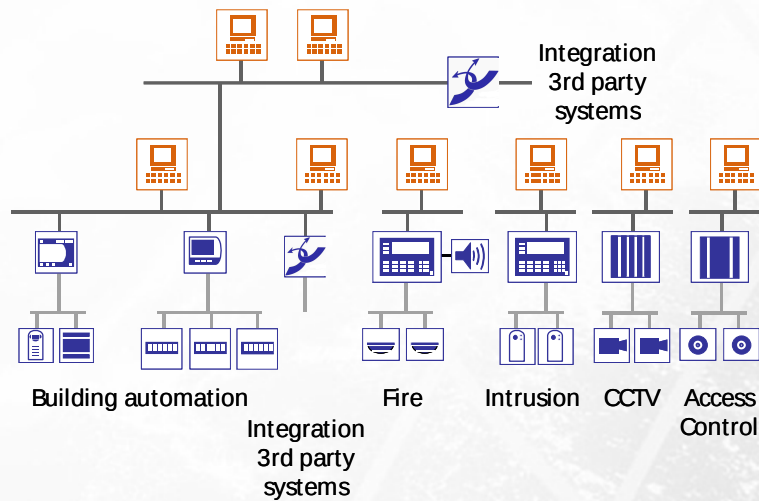
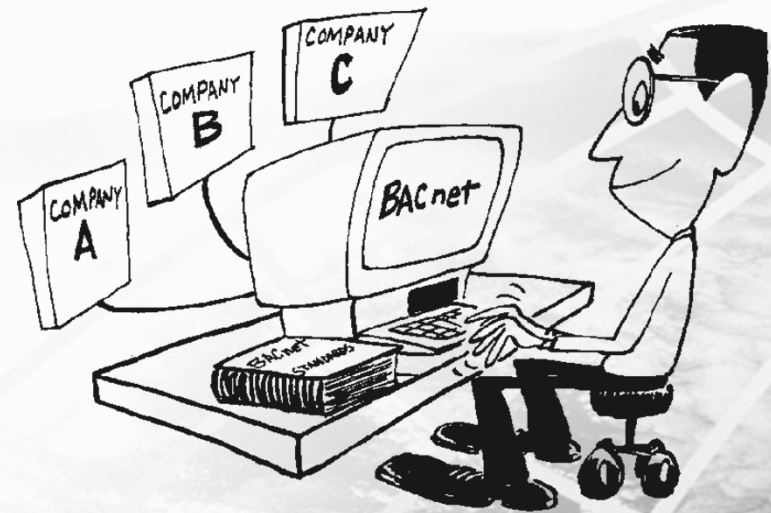
- Data format and composition
- Addressing
- Error checking
- Data compression
- Send/receive message notification

For communications to work effectively between two or more devices, the rules covering the required functionality must be interpreted and implemented exactly the same way



The OSI Model explains the basics

Objective: Single Building Automation Interface



BACnet – What is it?

Developed within ASHRAE

ASHRAE guidelines guarantee open membership to both end-user and producer

Worldwide standard adopted by ANSI, ISO and CEN

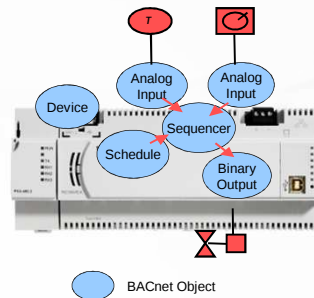
Organizational support includes SSPC-135 ASHRAE Committee, BACnet Testing Laboratories (BTL), and BACnet International

Freely distributed with no licenses, and hardware independent
Used worldwide by hundreds of vendors



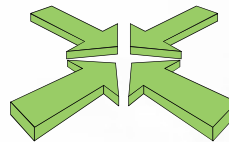
Main Elements of BACnet

Objects



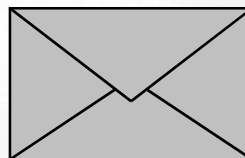
Represent data
and functionality

Services



Issue commands
and exchange data

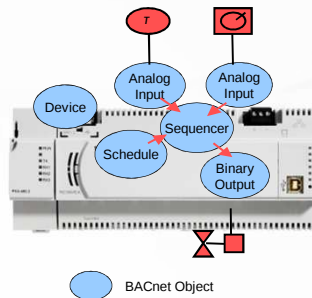
Transport



Transport and
distribute data

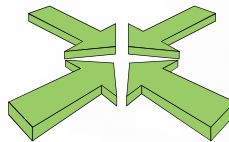
BACnet Objects

Objects



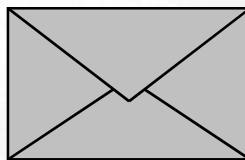
**Represent data
and functionality**

Services



**Issue commands
and exchange data**

Transport



**Transport and
distribute data**

BACnet Objects

Each BACnet device contains a set of "**BACnet objects**"

BACnet objects represent information

Device Object - Device Characteristics

Analog Input Object - Measuring

Analog Output Object - Setting

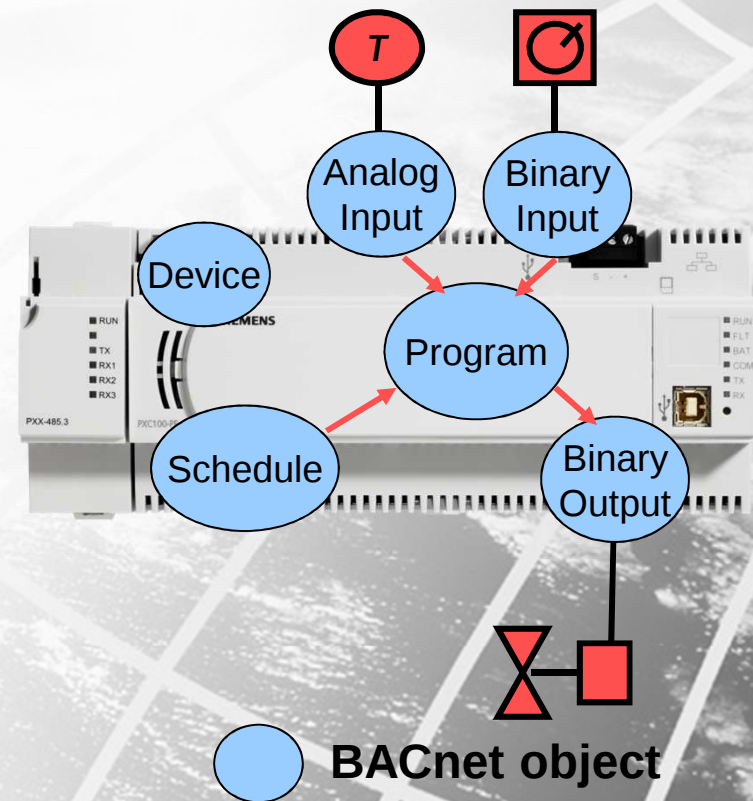
Binary Input Object - Detection

Binary Output Object - Switching

Program Object - Control Logic

Schedule Object - Schedule Dates

Calendar Object - Agenda and Values



BACnet Objects

BACnet objects represent information

Averaging Object - Statistics Functions

Loop Object - Control Loop

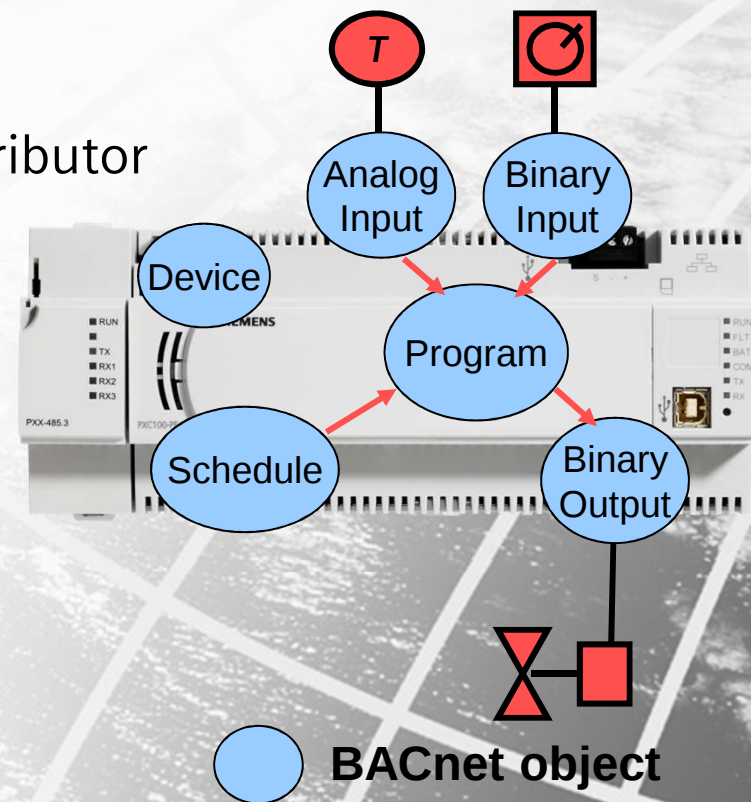
Life Safety Object - Life Safety

Notification Class Object - Message Distributor

Trend Log Object - Trend Recording

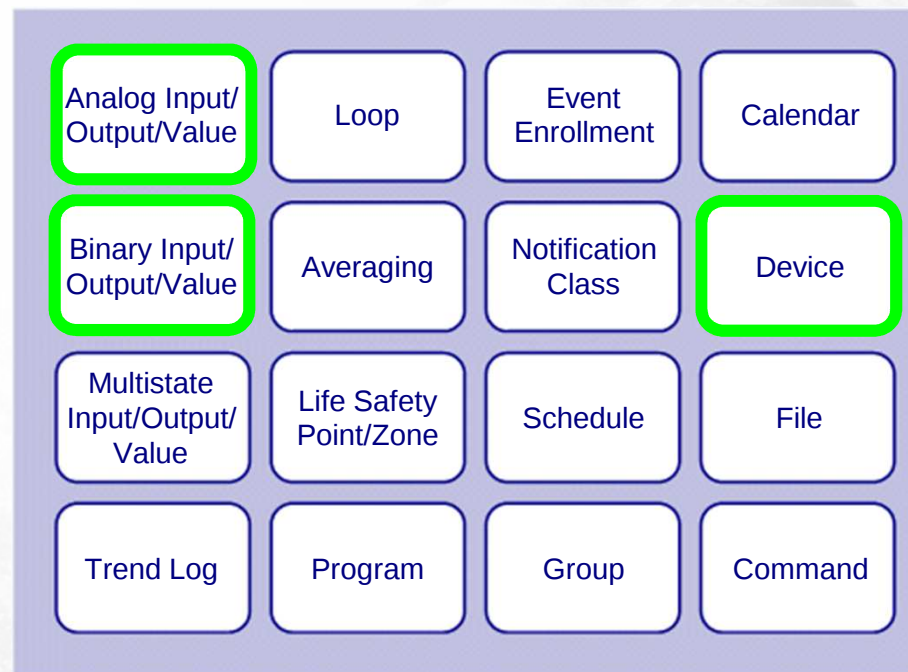
File Object - File

Others...



Objects

Collection of information within a device
25+ standard BACnet object types

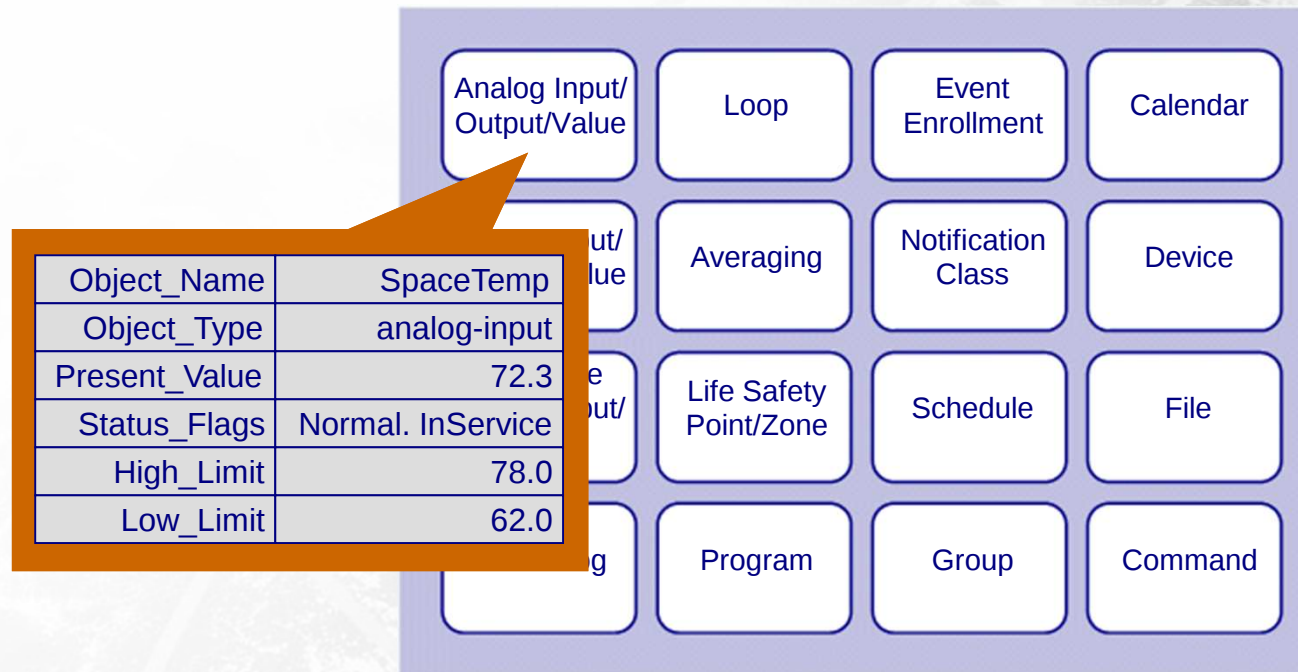


Properties

Convey information about a BACnet Object

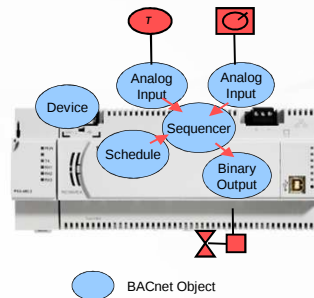
BACnet devices share data by accessing property values via read, write, or other services

Properties can be required or optional, standard or proprietary, read-only or read/write



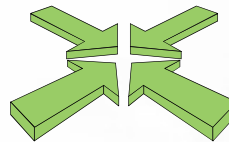
BACnet Services

Objects



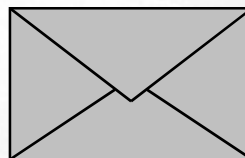
Represent data
and functionality

Services



Issue commands
and exchange data

Transport



Transport and
distribute data

BACnet Services – Client / Server

A BACnet Client is the user of data (A)

Requests information in BACnet server device

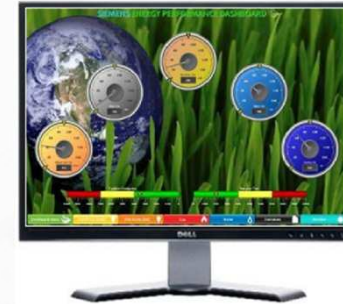
Requests a change in BACnet server device

A BACnet Server is the provider of data (B)

Provides information to BACnet client device

Responds to change requests from

BACnet client device



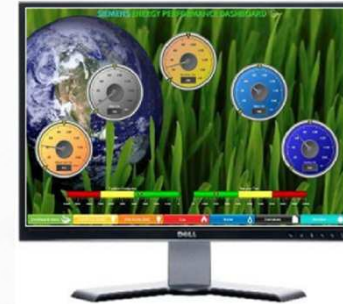
BACnet Services – Client / Server

Object Access

- Read/Write Property/Properties
- COV Subscription and Reporting
- Add/Remove Object
- Add/Remove List Element

Alarm & Event

- Alarm Notification and Acknowledgment
- Alarm Logs



**Client / Server
relationship**



BACnet Services – Client / Server

Device Management

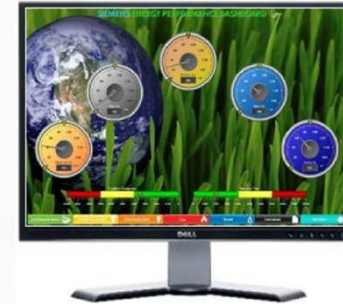
- Device Online/Offline
- Time Synchronization
- Device and Object Discovery

File Transfer

- File Discovery
- Database Upload and Download

Virtual Terminal

- User Interface Session



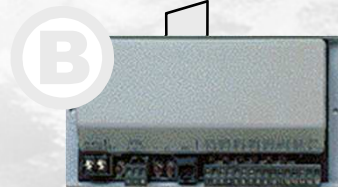
**Client / Server
relationship**



Services – ReadProperty Service



**ReadProperty(msg#186
objectid=AnalogInput 11
propertyid=Present_Value)**



**ReadPropertyAck(msg#186
objectid=AnalogInput 11
propertyid=Present_Value
value=68.0)**

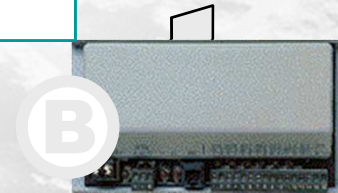
or

**Error(msg#186
class=object
code=NoSuchObject)**

Services – WriteProperty Service



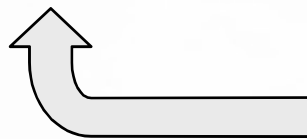
**WriteProperty(msg#187
objectid=BinaryOutput 17
propertyid=Present_Value
value=1)**



**SimpleAck(msg#187
service=WriteProperty)**

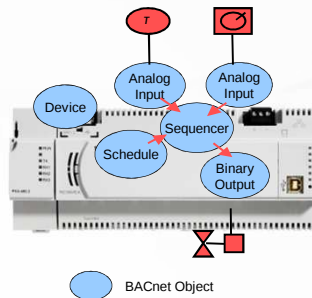
or

**Error(msg#187
class=object
code=NoSuchObject)**



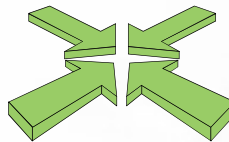
BACnet Transport

Objects



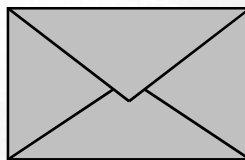
Represent data
and functionality

Services



Issue commands
and exchange data

Transport



Transport and
distribute data

BACnet Transport

Physical Network Types

ISO 8802-3, 10BASE5
ISO 8802-3, 10BASE2
ISO 8802-3, 10BASET
ISO 8802-3, Fiber

BACnet/IP, (Annex J)

5 ARCNET, coax star
2 ARCNET, coax bus
ARCNET, twisted pair star
ARCNET, twisted pair bus
ARCNET, fiber star

BACnet over
Ethernet

- MS/TP master, baud rate(s): _____
- MS/TP slave, baud rate(s): _____
- Point-To-Point, RS 232, baud rate(s): _____
- Point-To-Point, modem, baud rate(s): _____
- LonTalk, medium: _____

BACnet/IP
over Ethernet

PICS

PICS (Protocol Implementation Conformance Statement)

Manufacturer and device information

Physical media and lower protocol layers

Application services and their role

BIBBs (BACnet Interoperability Building Blocks) supported

Initiate (A) or Execute (B)

Application objects (analog/binary input, analog/binary output,
schedule, calendar, trend log)

Character sets supported



BIBBS

BIBBs (BACnet Interoperability Building Blocks)

Functions and application services supported

Data Sharing (DS)

Alarm and Event Management (AE)

Scheduling (SCHED)

Trending (T)

Device and network management (DM or NM)

Role in functionality and services supported

Initiate or client side functionality (A)

Execute or server side functionality (B)



Device Profiles

Device profiles, a BACnet standard classification of BACnet devices

To meet a device profile, a device must support a minimum set of BIBBs

Device profiles exist for 6 device classifications

- Operator Workstations (B-OWS)

- Building Controllers (B-BC)

- Advanced Application Controllers (B-AAC)

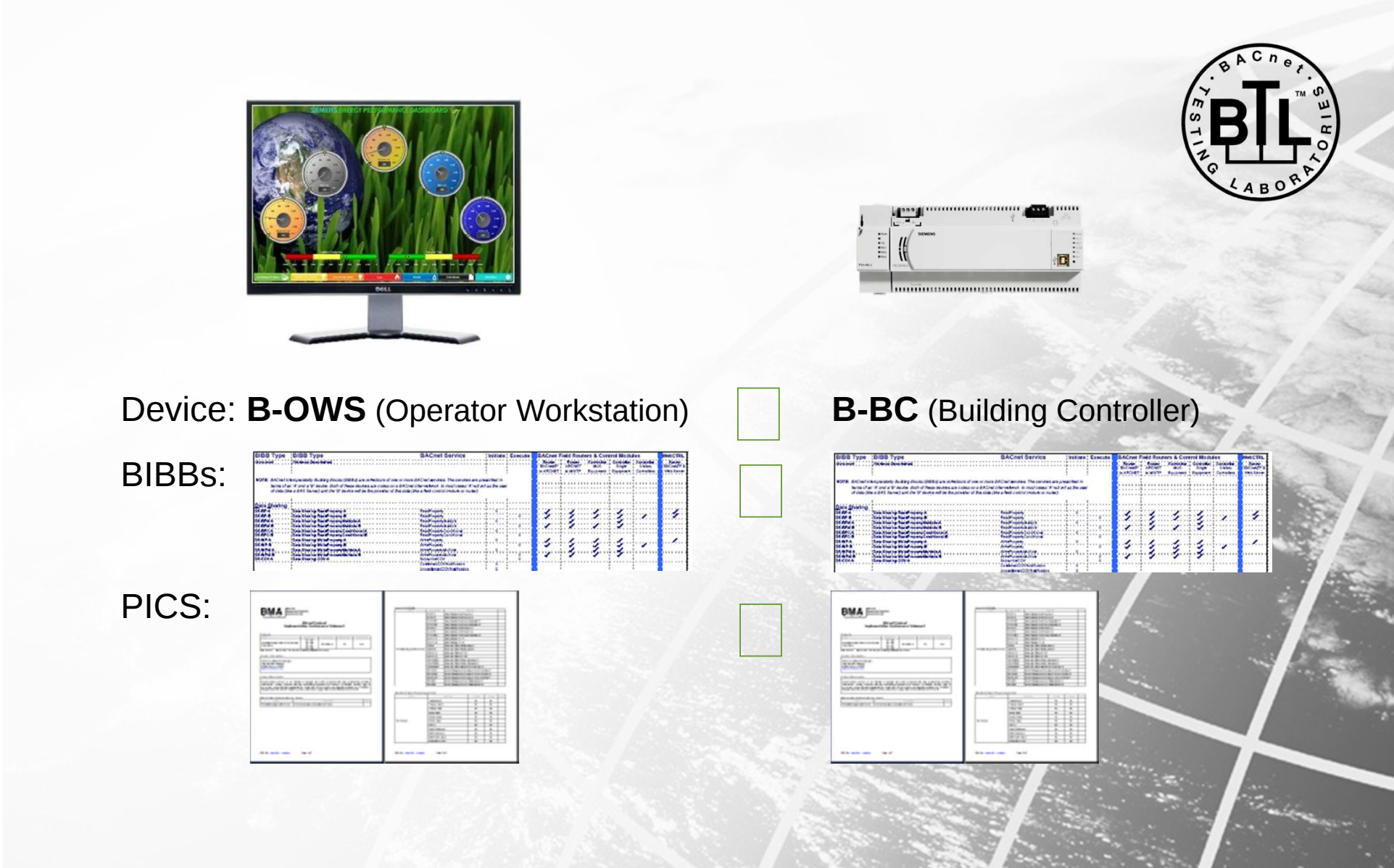
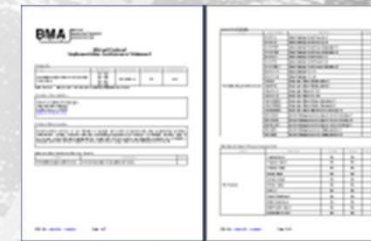
- Application Specific Controllers (B-ASC)

- Smart Actuators (B-SA)

- Smart Sensors (B-SS)



PICS, BIBBS, and Device Profiles

[illegible][illegible]

B-OWS (BACnet Operator Workstation) Profile

Data Sharing

DS-RP-A,B
DS-RPM-A
DS-WP-A
DS-WPM-A

Alarm & Event Mgmt

AE-N-A
AE-ACK-A
AE-INFO-A
AE-ESUM-A

Scheduling

SCHED-A

Trending

T-VMT-A
T-ATR-A

Device & Network Mgmt

DM-DDB-A,B
DM-DOB-A,B
DM-DCC-A
DM-TS-A
DM-UTC-A
DM-RD-A
DM-BR-A
NM-CE-A

B-BC (BACnet Building Controller) Profile

Data Sharing

DS-RP-A,B
DS-RPM-A,B
DS-WP-A,B
DS-WPM-B
DS-COVU-A,B

Alarm & Event Mgmt

AE-N-I-B
AE-ACK-B
AE-INFO-B
AE-ESUM-B

Scheduling

SCHED-E-B

Trending

T-VMT-I-B
T-ATR-B

Device & Network Mgmt

DM-DDB-A,B
DM-DOB-A,B
DM-DCC-B
DM-TS-B or DM-UTC-B
DM-RD-B
DM-BR-B
NM-CE-A

PICS: BACnet Operator Workstation (B-OWS)

BACnet Protocol Implementation Conformance Statement

Products

Product	Model Number	Protocol Revision	Software Version	Firmware Version
Somebody's Operator Workstation	SAMPLE B-OWS	135-2004	X.XX	X.XX

Date Tested: Not Tested

Vendor Information

Somebody's Controls
9999 99th Street
Somewhere in NA
www.somebody.com

Product Description

Somebody's Operator Workstation (SAMPLE B-OWS) is a full-featured BACnet workstation which provides a full featured operator interface for BACnet devices and products. Features include Internet access to BACnet devices and objects, dynamic graphics with viewing and commanding capability, and complete scheduling and trending application support.

BACnet Standardized Device Profile

Product	Device Profile	Tested
SAMPLE B-OWS	BACnet Operator Workstation (B-OWS)	

PICS: BACnet Building Controller (B-BC)



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BACnet Testing Labs Product Listing

This product has been tested at the BACnet Testing Labs and found to comply with all the necessary interoperability requirements in place on the published test date. This listing represents the tested capability of the Listed Product. For information on additional functionality that was not covered in the test process, refer to the Manufacturer's PICS statement on the BMA website.

Listing Information

Vendor		Listing Status
Somebody's Controls 9999 99 th Street Somewhere in NA		Listed Product
Test Requirements	BACnet Protocol Revision	Date Tested
Requirements as of May 2005	135-2001b	May 2005

Product Name	Model Number	Software Version
BACnet BC	XX-XX	Firmware X.X

Product Name	Link to PICS on BMA Website
BACnet BC	http://bacnetassociation.org/BMAProductCatalog.htm

Device Profiles

Profile	Model Numbers
BACnet Building Controller (B-BC)	XX-XX

PICS: BACnet Advance Application Controller (B-AAC)



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Listing Information

Vendor		Listing Status
Somebody's Controls 9999 99 th Street Somewhere in NA		Listed Product
Test Requirements	BACnet Protocol Revision	Date Tested
Requirements as of May 2004	135-2001	May 2004

Product Name	Model Number	Software Version
BACnet Advanced Application Controller	XX.XX	X.X Firmware

Product Name	Link to PICS on BMA Website
BACnet Advanced Application Controller	http://bacnetassociation.org/BMAProductCatalog.htm

Device Profiles

Profile	Model Numbers
BACnet Advanced Application Controller (B-AAC)	XX.XX

PICS: BACnet Application Specific Controller (B-ASC)



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Listing Information

Vendor Somebody's Controls 9999 99 th Street Somewhere in NA		Listing Status Listed Product
Test Requirements Requirements as of August 2005	BACnet Protocol Revision 135-2001b	Date Tested August 2005

Product Name BACnet ASC –VAV Controller	Model Number XX-XX	Software Version Rev. XX
--	-----------------------	-----------------------------

Product Name BACnet ASC -VAV Controller	Link to PICS on BMA Website http://bacnetassociation.org/btl/Listings/htm
--	--

Device Profiles

Profile BACnet Application Specific Controller (B-ASC)	Model Numbers All Devices
---	--

PICS: BACnet Application Specific Controller (B-ASC)



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Listing Information

Vendor		Listing Status
Somebody's Controls 9999 99 th Street Somewhere in NA		Listed Product
Test Requirements	BACnet Protocol Revision	Date Tested
Requirements as of January 2002	135-1995b	January 2005

Product Name	Model Number	Software Version
BACnet ASC	XX-CCC	Release 1

Product Name	Link to PICS on BMA Website
BACnet ASC	http://www.bacnetassociation.org/

Device Profiles

Profile	Model Numbers
BACnet Application Specific Controller (B-ASC)	XX-CCC

PICS: BACnet Smart Actuator (B-SA)



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BACnet Testing Labs Product Listing

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Listing Information

Vendor		Listing Status
Somebody's Controls 9999 99 th Street Somewhere in NA		Listed Product
Test Requirements	BACnet Protocol Revision	Date Tested
Requirements as of January 2002	135-1995	January 2005

Product Name	Model Number	Software Version
BACnet VAV Controller with Flow Sensor & Actuator	XX-AA	X.X
BACnet VAV Controller with Flow Sensor & Actuator	XX-BB	X.X
BACnet VAV Controller with Flow Sensor	XX-CC	X.X

Product Name	Link to PICS on BMA Website
VAV Controller with Flow Sensor & Actuator	http://www.bacnetassociation.org
VAV Controller with Flow Sensor	http://www.bacnetassociation.org

Quiz Question...

A BACnet Operator Workstation (BACnet Client) sends a request to discover device information to a BACnet Building Controller. What BIBBs must be supported?

B-OVS

K.5.1 BIBB - Device Management - Dynamic Device Binding - A (DM-DDB-A)

The A device seeks information about device attributes of other devices and interprets device announcements.

	Initiate	Execute
BACnet Service		
Who-Is	x	
I-Am		x

B-BC

K.5.2 BIBB - Device Management - Dynamic Device Binding - B (DM-DDB-B)

The B device provides information about its device attributes and responds to requests to identify itself.

	Initiate	Execute
BACnet Service		
Who-Is		x
I-Am	x	

Quiz Question...

A BACnet Building Controller (BACnet Client) requests to read temperature set-point in BACnet Application Specific Controller. What BIBBs must be supported?

B-BC

K.1.1 BIBB - Data Sharing-ReadProperty-A (DS-RP-A)

The A device is a user of data from device B.

	Initiate	Execute
BACnet Service		
ReadProperty	x	

B-ASC

K.1.2 BIBB - Data Sharing-ReadProperty-B (DS-RP-B)

The B device is a provider of data to device A.

	Initiate	Execute
BACnet Service		
ReadProperty		x

Quiz Question...

A BACnet Operator Workstation (BACnet Client) requests a write to temperature set-point in a BACnet Application Specific Controller. What BIBBs must be supported?

B-OWS

K.1.7 BIBB - Data Sharing-WriteProperty-A (DS-WP-A)

The A device sets a value in device B.

	Initiate	Execute
BACnet Service		
WriteProperty	x	

B-ASC

K.1.8 BIBB - Data Sharing-WriteProperty-B (DS-WP-B)

The B device allows a value to be changed by device A.

	Initiate	Execute
BACnet Service		
WriteProperty		x

Quiz Question...

A BACnet Building Controller (BACnet Client) requests a COV Subscription for a humidity reading in a BACnet Building Controller. What BIBBs must be supported?

B-BC

K.1.11 BIBB - Data Sharing-COV-A (DS-COV-A)

The B device is a provider of COV data to device A.

	Initiate	Execute
BACnet Service		
SubscribeCOV	x	
ConfirmedCOVNotification		x
UnconfirmedCOVNotification		x

Devices claiming conformance to DS-COV-B shall support a minimum of 5 simultaneous subscriptions.

K.1.12 BIBB - Data Sharing-COV-B (DS-COV-B)

The A device is a user of COV data from device B.

B-BC

	Initiate	Execute
BACnet Service		
SubscribeCOV		x
ConfirmedCOVNotification	x	
UnconfirmedCOVNotification	x	

Top 5 Reasons for Interoperability Headaches

- Timing Timing Timing
 - token pass timing for MS/TP, poll and response (too busy to respond), too many requests in too short of time
- Communication format not quite right
 - packet malformed, packet size not as expected, packet not recognized, character not expected
- Object name conventions
 - point names not within host system guidelines or expectations

Top 5 Reasons for Interoperability Headaches

- Insufficient device network documentation
 - network numbers, device addresses, conflicting addresses, device instance numbers unknown
- Function mismatch
 - required information in unsupported object, or service
 - required write not supported in read only object

Top 5 Reasons for Interoperability Headaches

- Timing Timing Timing

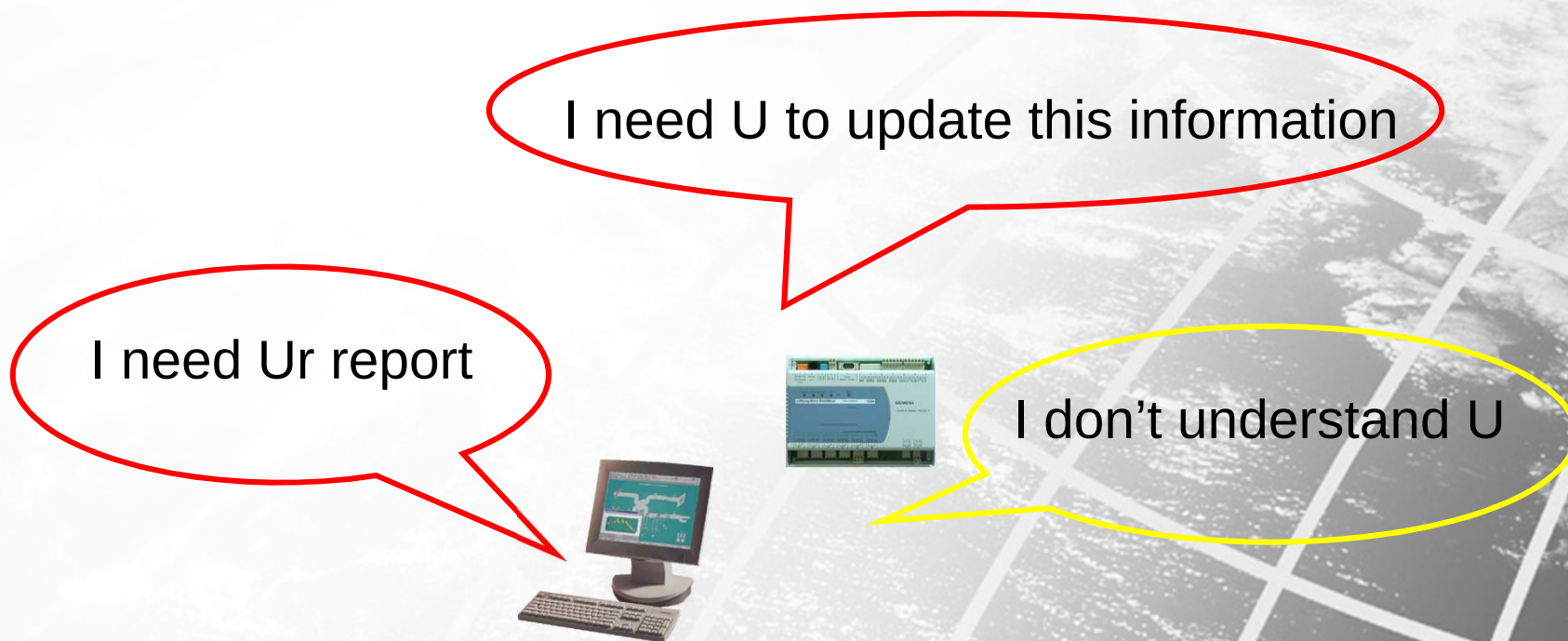
I need an update
What is the status of this request?
I need this change
I need this report right away
When will this be done?
I need this change

Here's your update
Working on it
Working on it
Working on it
I quit!



Top 5 Reasons for Interoperability Headaches

- Communication format not quite right



Top 5 Reasons for Interoperability Headaches

- Object Name Conventions

Object Name: 40 characters

Object Name: setpoint/low

Object Name: stpt

I have room for 32 chars.

I don't understand "/low"

What is stpt?



Top 5 Reasons for Interoperability Headaches

- Insufficient Network Documentation

Why is my network slow?

Too many BBMDs in subnet
BBMD list inaccurate

Why can't I discover this device?

Network number duplication
Device instance duplication



Top 5 Reasons for Interoperability Headaches

- Function Mismatch

Change this value

No, the value is read only

Send an alarm log

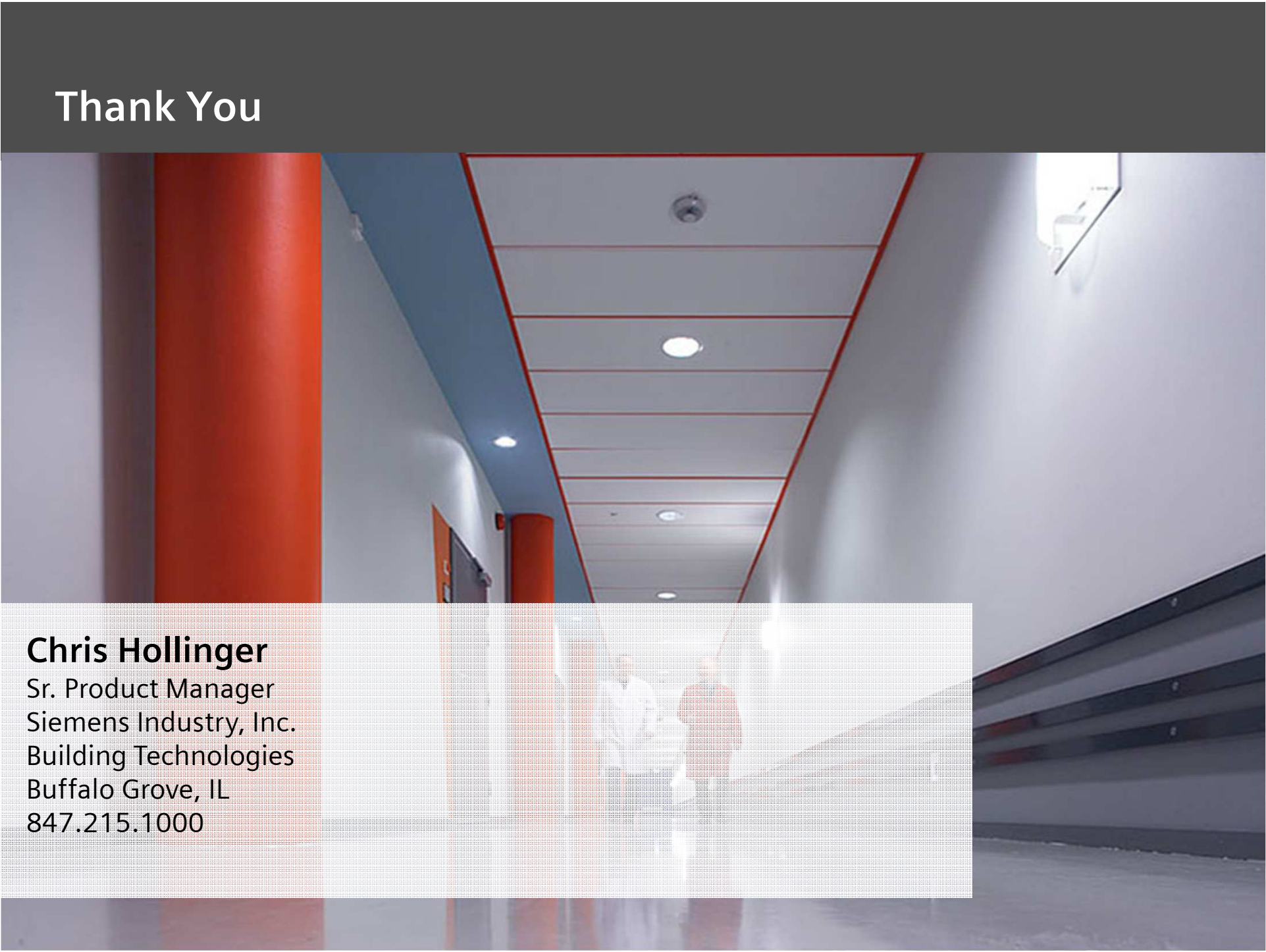
What's an alarm log?



Top 3 Helpful Tools

- ☐ Device logs/file captures/history reports
- ☐ BACnet network browsers
- ☐ Communication wire captures



A photograph of a modern hallway with a white ceiling, red trim, and a large red pillar. The hallway is brightly lit with recessed ceiling lights. The walls are white, and the floor is a light-colored tile. A red pillar is prominent on the left side of the frame. The ceiling has a series of red lines running along it, and there are several recessed lights. The hallway appears to be part of a large building, possibly a school or a corporate office.

Thank You

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