SIEMENS

Climatix™
BACnet communication modules POL904.00/XXX
POL908.00/XXX

Documentation on basics

Contents

1 About this document

1.1 Revision history

Version	Date	Changes	Section	Pages
	27.05.2009	First edition		
	22.03.2010	BACnet objects for standard AHU removed (are now to be found in document CB1Y3963en)	9.2 and 9.3	68-78

1.2 Before you start

Validity

This document applies to the following products:

Name	Type (ASN)	Short name
BACnet/IP communication module	POL908.00/STD	BACnet/IP module
BACnet MS/TP communication module	POL904.00/STD	BACnet MS/TP module

Product versions

Description and functional scope of the products are based on the Climatix Valid Version Set 8.0 or higher.

Target audience

This document is intended for the following audience:
- BACnet system integrators
- Measuring and control engineering staff of OEM customers
- Sales and commissioning staff of OEM customers
- Siemens employees in sales and support

Use

This document intends to help the target audience to:
- Create offers for BACnet integration of Climatix controllers, types POL63x (AHU applications) and POL68x (chiller applications).
- Engineer and commission ventilation and air conditioning plants equipped with these device combinations.

Prerequisites

The above target audience:
- Has general professional knowledge on planning and commissioning HVAC technology measuring and control solutions.
- Has basic knowledge of BACnet.

1.3 Reference documents

Further information

The following documents contain additional information on the products described in this manual:

Document	Order no.
Data sheet "Communication module BACnet/IP"	CB1Q3933en
Data sheet "Communication module BACnet MS/TP"	CB1Q3932en
"PICS" basic documentation	CB1P3939en

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1.4 Document conventions

Symbols used

Below is an overview of all symbols used in this document denoting risks or important information:

⚠ This symbol draws your attention to special safety notes and warnings. Failing to observe these notes may result in injury and/or serious damages.

🛑 This symbol denotes special information that, when failed to observe, may result in faulty functionality *or loss of data*.

ℹ Notes with this symbol provide important information that requires appropriate attention.

💡 This symbol marks passages containing tips and tricks.

Abbreviations

The following abbreviations are used in text and illustrations:

Abbreviation	Meaning
BACnet	**B**uilding **A**utomation and **C**ontrol **N**etwork
BSP	**B**oard **S**upport **P**ackage (operating system)
Climatix	Controller family with common tools
HVAC	**H**eating, **V**entilating, **A**ir **C**onditioning
MS	**M**anagement **S**tation
SAPRO	Programming tool SAPRO
SCOPE	Commissioning and service tool SCOPE
SELV	**S**afety **E**xtra-**L**ow **V**oltage

1.5 Important information on safety

Field of application

Use BACnet communication modules only for control and monitoring functions in ventilation, air conditioning and refrigeration plants.

Intended use

Trouble-free and safe product operation of the above products presupposes transport, storage, mounting, installation, and commissioning as intended as well as careful operation.

Electrical installation

Fuses, switches, wiring and grounding must comply with local safety regulations for electrical installations.

Wiring

When wiring, strictly separate AC 230 V mains voltage from AC 24 V safety extra-low voltage (SELV) to protect against electrical shock!

Commissioning and maintenance

Only qualified staff trained accordingly may prepare for use, commission, and maintain BACnet communication modules.

Maintenance

Maintenance of BACnet communication modules generally only means regular cleaning. We recommend removing dust and dirt from system components installed in the control panels during standard service.

Faults

Only authorized staff may diagnose and correct faults and recommission the plant. This applies to working within the panel as well (e.g. testing or changing fuses).

Storage and transport

Refer to the environmental conditions specified in the respective data sheets for storage and transport.
If in doubt, contact your supplier.

Disposal

Devices contain electrical and electronic components; do not dispose of them in household garbage.
Observe all local and applicable laws.

1.6 Trademarks and copyrights

Trademarks, legal owners

The table below lists the third-party trademarks used in this document and their legal owners. The use of trademarks is subject to international and domestic provisions of the law.

Trademarks	Legal owner
BACnet	American National Standard (ANSI/ASHRAE 135-1995)

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Document contents

These documents were prepared with great care.
- The contents of all documents are checked at regular intervals.
- All necessary corrections are included in subsequent versions.
- Documents are automatically amended as a consequence of modifications and corrections to the products described.

Please make sure that you are aware of the latest document revision date.

Suggestions

If you find lack of clarity while using this document, or if you have any criticisms or suggestions, please contact the product manager in your nearest branch office. The addresses of the Siemens regional companies are available at www.siemens.com/sbt.

1.8 Document use/ request to the reader

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More information

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2 Overview

2.1 Device range

Modules' task

BACnet communication modules help integrate controller types POL6XX of the Climatix family in networks featuring the BACnet protocol.

Two types

Two device types are available for these network options:
- BACnet/IP
- BACnet MS/TP

Brief description

Below is a description of the two devices and their primary properties:

Illustration	Type (ASN)	Properties
	POL908.XX/XXX	• For integration in **BACnet/IP** networks. • Tooling via Ethernet. • Network parameters can be configured via the Climatix POL6XX controller. • Functionality as BACnet server and BACnet client.
	POL904.XX/XXX	• For integration in **BACnet MS/TP** networks. • Tooling via HMI or SCOPE. • Network parameters can be configured via the Climatix POL6XX controller. • Functionality as BACnet server and BACnet client.

Both communication modules comply with the following standardized profile for BACnet equipment:

B-AAC BACnet Advanced Application Controller

See the following document for "BACnet Interoperability Building Blocks" (BIBBs) and standard object types etc. supported:

CB1P3939en "Protocol Implementation Conformance Statement (PICS)"

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2.2   BACnet/IP module application

Server function

Climatix controllers POL6XX provide all necessary process data from the automation and field levels for monitoring and operation of HVAC plants to the building management station.

Client function

Climatix controllers POL6XX are able to interchange process data via value subscription, e.g. read and pass on the current outside temperature value (°C) of a common sensor.

Example

The figure below shows a simple example for integration of Climatix controllers in a BACnet/IP network:

| ML | Management level | FL | Field level |
| AL | Automation level | FD | Field devices |

Explanations (figure)

The devices and functions in the figure are:

Device	Designation / Functions
POL908	BACnet/IP communication module: – Convert data point values of Climatix controllers to BACnet objects.
POL6XX	Climatix controllers, types 63X and 68X: – Primary function: Measure and control via field devices. – Server function: Controllers send corresponding values upon individual request or change of value COV to clients. – Client function: Controllers subscribe to the desired data point values with a "colleague" (server).
HMI	Operating and parameterization unit HMI-DM, type POL895XX: Set the most important BACnet parameters such as Device-ID and BACnet Device Name. See Section 5.4 "Configure BACnet/IP module". – Operate Climatix controllers.
MS	Management station: – Read and write integrated (mapped) controller data points (BACnet objects).

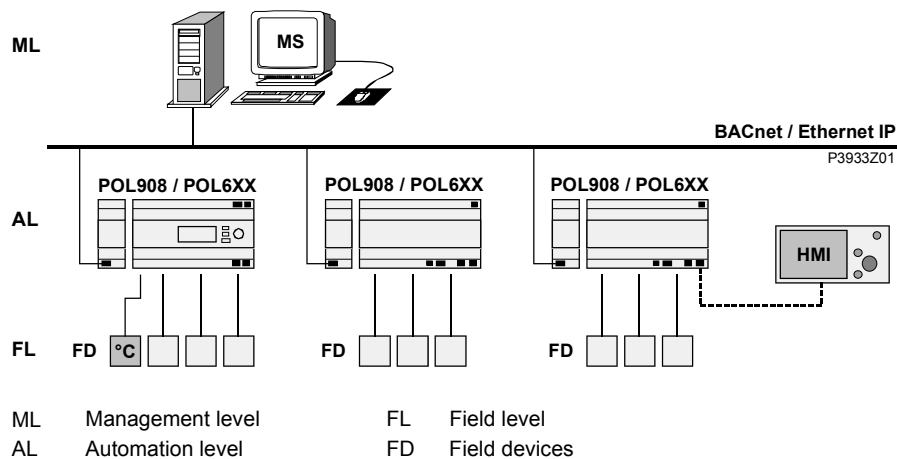# 2.3 BACnet MS/TP module application
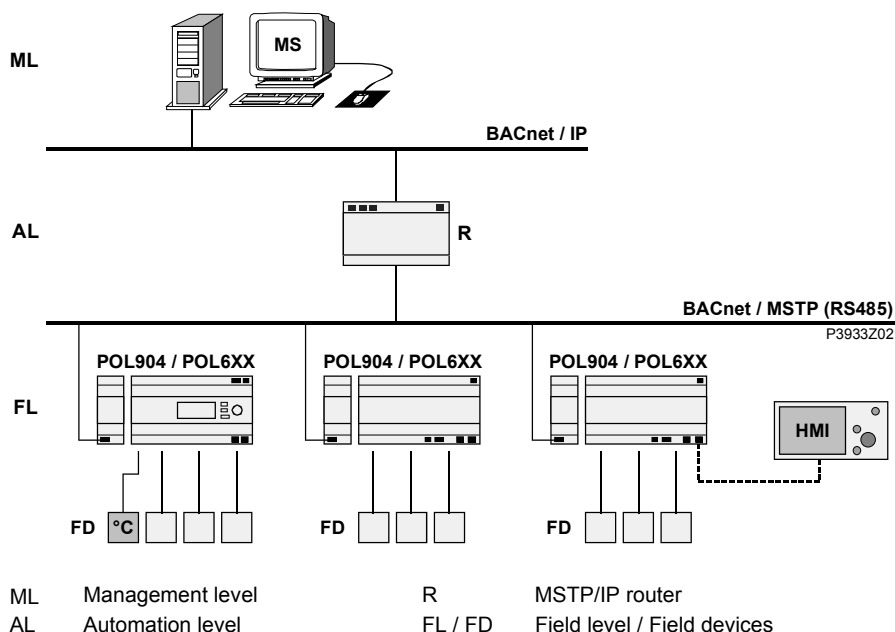
Server function

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Client function

Climatix controllers POL6XX are able to interchange process data via value subscription, e.g. read and pass on the current outside temperature value (°C) of a common sensor.

Example

The figure below shows a simple example for integration of Climatix controllers in a BACnet MS/TP network:

| ML | Management level | R | MSTP/IP router |
| AL | Automation level | FL / FD | Field level / Field devices |

Explanations (figure)

The devices and functions in the figure are:

Device	Designation / Functions
POL904	BACnet MS/TP communication module: – Convert data point values of Climatix controllers to BACnet objects.
POL6XX	Climatix controllers, types 63X and 68X: – Primary function: Measure and control via field devices. – Server function: Controllers send corresponding values upon individual request or change of value COV to clients. – Client function: Controllers subscribe to the desired data point values with a "colleague" (server).
HMI	Operating and parameterization unit HMI-DM, type POL895XX: – Set the most important BACnet parameters such as Device-ID and BACnet Device Name. See Section 5.4 "Configure BACnet/IP module". – Operate Climatix controllers.
R	BACnet MSTP/IP router (e.g. LOYTEC LIP-ME201).
MS	Management station: – Read and write integrated (mapped) controller data points (BACnet objects).

2.4 Principles of BACnet integration

Example: Transmit temperature value

The following figure shows (simplified) how to integrate Climatix controllers POL6XX via BACnet modules in a BACnet/IP bus system. It shows integration of controller N1 **as server**: The value acquired for the outside temperature T_{out} at the controller is to be provided to the management station MS and the neighboring controller N2.
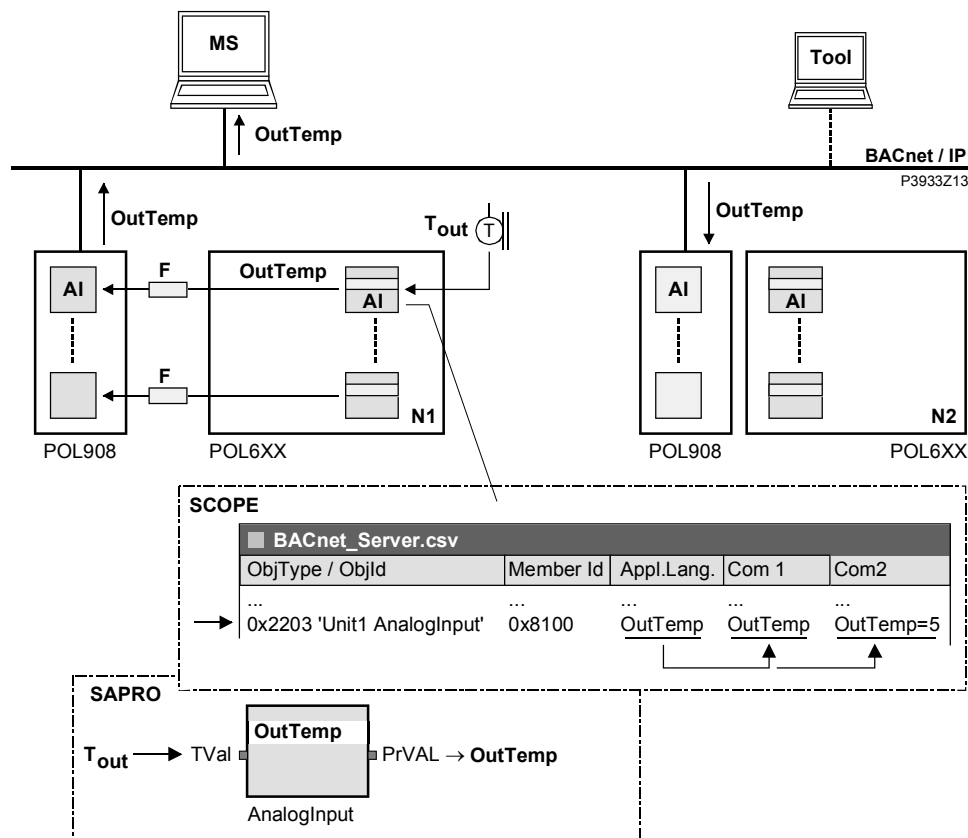
MS	Management station	Tool	Commissioning and service tool SCOPE
AI	Analog input objects	F	Filter, set in SCOPE

Explanations (figure)

The elements and functions in the figure are:

Element	Explanation
SAPRO	SAPRO provides so-called automation objects (aoXY) for controllers to be integrated in BACnet. They correspond to BACnet object types required for controllers as per B-AAC.
SCOPE	BACnet device IDs (names, addresses) must be assigned to the automation objects and filters specified as needed in SCOPE via mapping file "BACnet_Server.csv". Filters help show or hide specific BACnet objects.
POL6XX	After downloading the application, the controller in the BACnet module automatically generates BACnet objects for the automation objects used.
POL908	The communication module contains the BACnet stack: – In server mode, the stack provides the corresponding BACnet data; see Section 4.3 "BACnet server functionality". – In client mode, the stack writes to the connected BACnet server; see Section 5.7 "Configure Climatix as client".

3 BACnet/IP module

3.1 Mechanical design

Design

The figure shows the BACnet/IP module. It is connected to the Climatix controller via the internal communication extension bus. This is done via plug connection on the left side of the controller.
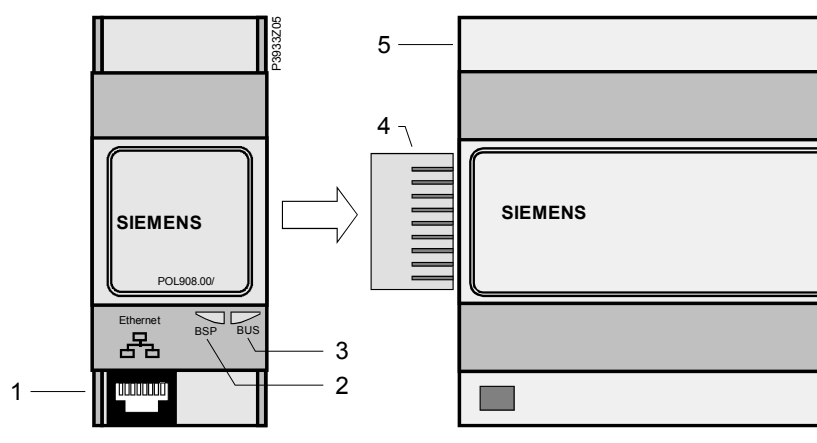
Elements and connections

The elements and connections in the figure are:

Pos.	Element / Connection
1	Ethernet interface 10/100 Mbit (IEEE 802.3U), RJ45 plug, 8-pin.
2	Status display "BSP" (Board Support Package).
3	Status display "BUS" (bus connections / bus traffic o.k.).
4	Plug connection "Communication extension bus".
5	Climatix controller POL6XX.

Status displays

The status displays "BSP" and "BUS" are bi-color LEDs in red and green. A viewer will see yellow when both LEDs are lit simultaneously.

"BSP" LED

This LED informs on the status of the "Board Support Package" (BSP). Color and flashing frequency of the LED:

Color	Flashing frequency	Meaning / Mode
Red / yellow	1 s "on" / 1 s "off"	Upgrade mode.
Green	Steady "on"	BSP operating and communication with controller working.
Yellow	Steady "on"	BSP operating, but no communication with controller.
Red	Flashing at 2Hz	BSP error (software error).
Red	Steady "on"	Hardware fault.

"BUS" LED

This LED shows the status of external communication with the bus, not to the controller. Color and flashing frequency of the LED:

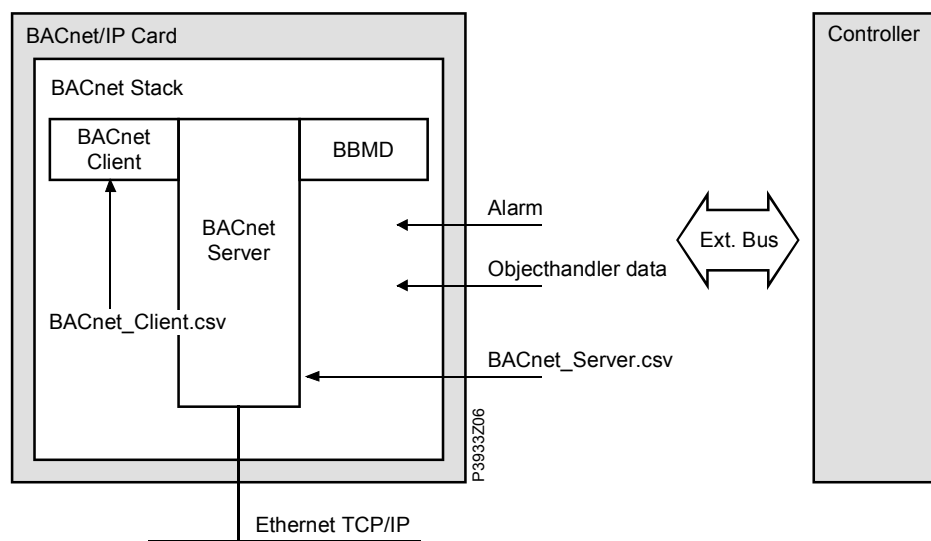| Color	Flashing frequency	Meaning / Mode
Green	Steady "on"	Communication active.
Red	Steady "on"	Communication interrupted.
Yellow	Steady "on"	Initializing – no communication yet via IP.

ℹ️ Power supply is outside the allowed range if both LEDs are dark.

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BACnet/IP module

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3.2 Functional design

Block diagram

The diagram shows the functional elements of the BACnet/IP module:

Description of elements

The elements and functions are:

Element	Description / Function
BACnet stack	Stack for BACnet communication and protocol services.
BACnet client	Client function, see Section 2.2, BACnet/IP module application.
BACnet_Client.csv	Mapping file for client functionality.
BBMD	BACnet Broadcast Management Device, see Section 4.1 "Networks and addressing".
Ext. Bus	Bus to extend communication between module and controller.
Alarm	Alarms from Climatix controllers.
Object handler data	Complete file information from the Climatix controller.
BACnet_Server.csv	Mapping file for server functionality.
BACnet server	Server function, see Section 2.2, BACnet/IP module application.
Ethernet TCP/IP	Transport medium for communication between BACnet devices.

4 Engineering BACnet/IP

4.1 Networks and addressing

BACnet internetworks

A BACnet internetwork consists of two or more BACnet networks. They may be BACnet/IP networks or implemented with other BACnet datalink protocols (e.g. BACnet MS/TP).
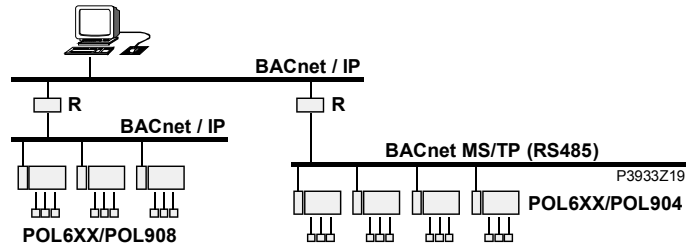
BACnet/IP networks

A BACnet/IP network consists of one or more IP subnets (IP domains) assigned the **same** BACnet network number.
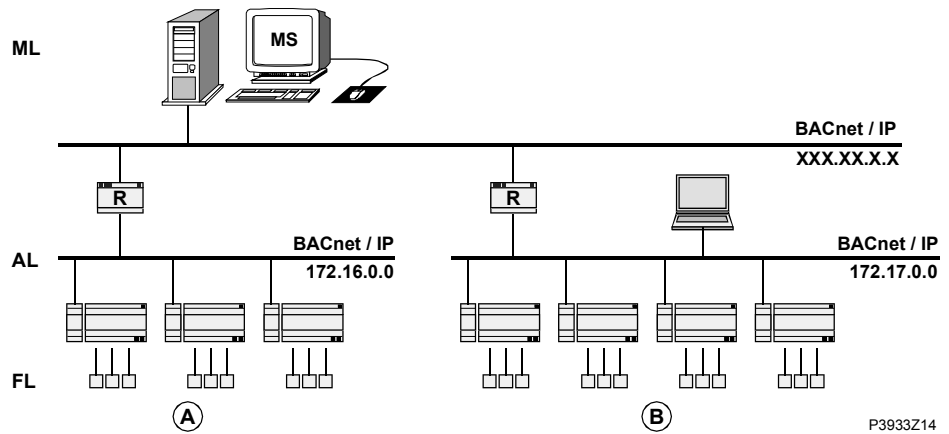
ML	Management level	R	Router
AL	Automation level	FL	Field level

Learning objectives of this section

This section discusses BACnet/IP networks, and necessary measures for several subnets in particular. The individual topics are:

- Broadcasts and BBMDs (BACnet Broadcast Management Devices).
- Broadcast Distribution Table (BDT).
- Foreign Devices (FDs).

Networks and addressing, *continued*

Broadcasts and BBMDs

BACnet often uses broadcasts for communication. In contrast to unicasts, they are intended for all network members.

This must be considered when engineering IP subnets. BACnet uses the "BACnet Broadcast Management Device" (BBMD) as explained below.

One IP subnet

Broadcast messages from a device (e.g. 172.16.255.255:0xBAC0) in BACnet/IP networks consisting of only **one** IP subnet are sent to all other subnet members as IP broadcasts without requiring an additional measure.

Example:

172.16.0.0   P3933Z09
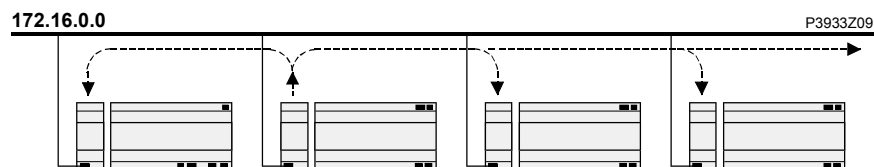
Several IP subnets: BBMDs required

If a BACnet/IP networks comprises several subnets, additional mechanisms are necessary to distribute broadcasts. Because routers used to connect subnets do not allow for broadcasts.

BACnet thus offers the "BACnet Broadcast Management Device" (BBMD) as a solution. This is not a separate product but rather an additional function of BACnet devices.

BBMDs transmit broadcasts to all other BBMDs on the BACnet network, thus distributing broadcasts across the corresponding subnets.

Example:
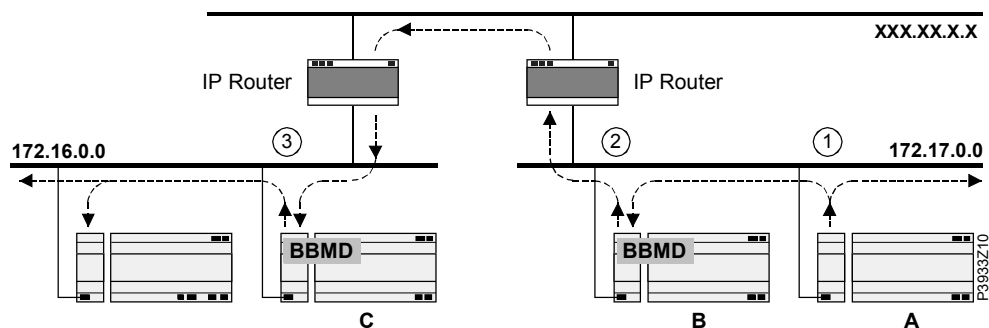
Functioning

Broadcasting works as follows:

Step	Procedure
1	Device "A" on subnet 172.17.0.0 sends a broadcast.
2	BBMD "B" receives the broadcast and forwards it to BBMD "C" via the IP routers.
3	BBMD "C" distributes the broadcast in subnet 172.16.0.0.

Broadcast Distribution Table (BDT)

All BBMDs in a BACnet network must be configured using by means of a "Broadcast Distribution Table" (BDT). The BDT table must be the same for all BBMDs. A BDT contains the following entries:
– IP address
– UDP port
– Broadcast Distribution Mask (BDM)

Two procedures for broadcasts

There are two procedures to distribute broadcasts:
- If BDM 255.255.255.255 is set, the broadcast is sent to the corresponding BBMD as a unicast. The BBMD stores it to the local subnet. This procedure is referred to as "**two**-hop forwarding". This is standard.
- "**One**-hop forwarding" can be used if IP routers are configured to distribute broadcasts to remote subnets. The BBMDs send broadcasts directly to the various IP subnets. In this process, the subnet address is determined based on the broadcast distribution mask.

Sample entries

Sample entries for both procedures:

IP address	UDP port	BDM	Procedure
172.16.0.1	0xBAC0	255.255.255.255	**Two**-hop forwarding via BBMD → 172.16.0.1:0xBAC0
172.16.0.1	0xBAC0	255.255.0.0	**One**-hop forwarding direct to IP subnet → 172.16.255.255:0xBAC0

BDT properties

The BDT is configured as static table during commissioning. It is not updated dynamically.
The maximum size of the table depends on the product used (or its BBMD). This information is available in the respective data sheet under PICS.

BBMD rules

Apply the following rules when using "BACnet Broadcast Management Devices" (BBMDs):
- No BBMD is needed if a BACnet/IP network consists of only one IP subnet. An existing BBMD does not cause any problems, however.
- A BBMD must be defined for each subnet if a BACnet network comprises more than one IP subnet.
- BBMDs are grouped by BACnet/IP networks. Communication between BBMDs of different BACnet networks is **not** possible!
- Normally, "two-hop distribution" is used because it works with all IP routers without needing additional configuration.

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Networks and addressing, *continued*

Foreign Devices

BBMDs presuppose that all IP segments of the BACnet network are available at all times. The corresponding IP segments always transmit full BACnet broadcasts. This is true even if only one BACnet device is located on the IP segment, temporary or always.

To solve this problem, BACnet defines the "Foreign Device" (FD). This is not a product similar to the BBMD, but rather a supplementary function of a device such as e.g. of a PC for commissioning and operation.

Example:
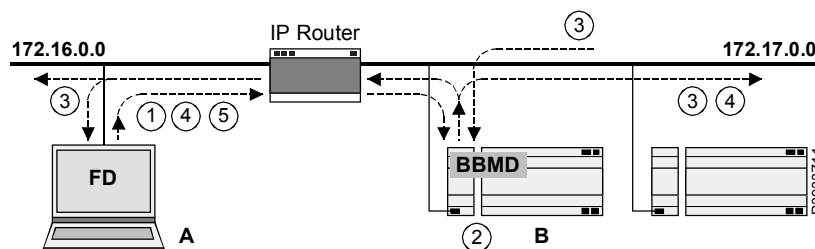
Functioning

Defining the foreign device and broadcasting works as follows:

Step	Procedure
1	Foreign Device "A" logs in to BBMD "B" for receiving broadcasts. The login is accepted without special login mechanisms. Login must be repeated at specific intervals. *Note:* The foreign device must be predefined in the BACnet module settings.
2	The BBMD enters the foreign device in its Foreign Device Table (FDT). The maximum size of the table depends on the product used. This information is available in the respective data sheet under PICS.
3	If the local BBMD receives a broadcast, the broadcast is sent to all BBMDs as per "Broadcast Distribution Table" (BDT) as well as to all foreign devices as per FDT.
4	The FD cannot send broadcasts. It sends its messages to all members to the BBMD. The BBMD then sends a broadcast to the local subnet. *Note:* The FD can always send unicasts directly to the desired member.
5	The foreign device logs off the BBMD and is removed from the FDT. If logoff does not work, the BBMD automatically deletes the entry after a timeout (if logon was not renewed).

Unique ID for the foreign device!

Login as BBMD generates an IP address and UDP port entry. A foreign device can use any port number.

Login makes the foreign device a temporary member of the BACnet network. For this reason, all rules of the associated internetwork must be complied with. Device ID and Device Name of the foreign device in particular must be unique within the internetwork.

4.2 BACnet/IP limits

DHCP rules

🛑

Automatic assignment of DHCP may have an undesired effect on the system. Remember the following:

Item	Rules
BBMDs	DHCP may **never** be used together with "BACnet Broadcast Management Devices" (BBMDs), as the IP addresses of the "Broadcast Distribution Table" (BDT) are configured as static addresses and cannot change during operation.
Alarm recipient	In BACnet, alarm recipients are entered with their "Device Object Identifier" or their BACnet address. The IP address is part of the BACnet address and may not be changed for the alarm recipient. For this reason, option "Device Object Identifier" must always be used.
Access rights	If access rights are assigned based on IP address (e.g. for firewalls), the address must be static.
IP version	The BACnet standard currently supports only IP Version 4, i.e. only IP devices with 32 bit address that can be operated as BACnet/IP device. The BACnet protocol does not work with 128-bit addresses of IPv6.

Limits for objects and COVs

Limits for objects and COV subscriptions:

Item	Number
Objects in device, total	max. 500
BACnet objects, portion of total number	max. 300
Simultaneous COV subscriptions	max. 50
COVs on BACnet	max. 5 per sec

4.3   BACnet server functionality

Supported standard

The BACnet/IP module supports BACnet standard B-AAC (BACnet Advanced Application Controller).

Object types supported

The BACnet/IP module supports the following BACnet standard object types:

Climatix object	BACnet object	Comment
Clock	Device	
aoDeviceGroup	Device	
aoDiagnostic	Device	
aoAnalogInput	AnalogInput	
aoAnalogOutput	AnalogOutput	
aoAnalogValue	AnalogValue	No Alarm
aoSetpointValue	AnalogValue	No Alarm
aoDisplayValue	AnalogValue	No Alarm
aoSetpointValueLimit	AnalogValue	No Alarm
aoBinaryInput	BinaryInput	
aoBinaryOutput	BinaryOutput	
aoBinaryValue	BinaryValue	
aoMultistateInput	MultiStateInput	
aoMultistateOutput	MultiStateOutput	
aoMultistateValue	MultiStateValue	
aoSetpointMultistate	MultiStateValue	No Alarm
aoDisplayMultistate	MultiStateValue	No Alarm
aoSchedule	Schedule	No Alarm
aoScheduleWord	Schedule	No Alarm
aoCalendar	Calendar	No Alarm
MessageClass	NotificationClass	

ℹ In the future, this device may support other objects such as "LoopController" or "Trend".
For information on the current status, see:
CB1P3939en "Protocol Implementation Conformance Statement (PICS)"

Different alarm handling

Alarms of a BACnet client are handled differently from those of Climatix:
– In BACnet, each objects in alarm is acknowledged and reset as well as transitioned from "ToNormal", "ToOffNormal", and "ToFault".
– Climatix objects do not support this transition, but rather only transitions to "ToNormal". This is done via general acknowledgement for each object, not for each individual object in alarm.

ℹ The behavior described above means that acknowledgement and reset in BACnet does not impact pending/unhandled alarms in Climatix.
Acknowledgement in BACnet is only information that the alarm has been identified.
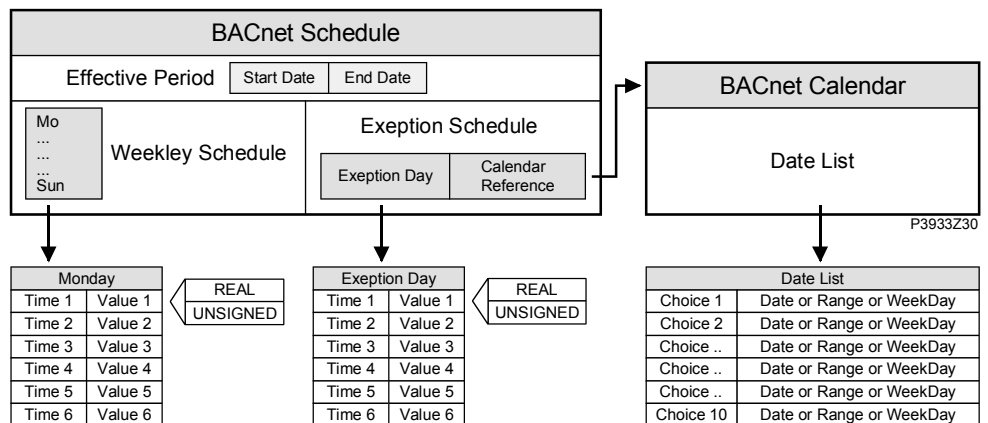
Workaround

The following workaround is needed to reset a BACnet alarm:
An additional BACnet object "MultiStateValue" named "Reset" is used for general acknowledgement in Climatix.

BACnet server functionality, *continued*

Schedule and Calendar

The figure shows the Climatix schedule concept for BACnet:

P3933Z30

Explanations (figure)

The elements and functions in the figure are:

Element	Function
BACnet Schedule	BACnet object "Schedule" defines a weekday and exception day program as well as an actual time period during which the schedule is active.
Weekly Schedule	Each day – from Monday to Sunday – allows for six different entries "Time/Value". Value REAL(FLOAT), DIGITAL, or UNSIGNED (multistate) depends on the Climatix object connected to the program.
Exception Schedule	The exception day program consist of a list of exception days. Climatix only offers one exception day. It refers to the BACnet Calendar object. The exception day is defined like any day of the weekly schedule. The BACnet calendar then determines when the exception day is active. It takes priority over the weekly schedule.
BACnet Calendar	The BACnet "Calendar" object is a list with "Date" **or** "Range" **or** "WeekNDay" (weekday) entries. The exception day of a related schedule is active when the entry is selected via the BACnet calendar.
Date	*Date* defines a start date. The present value is active for this date. – *Example 1:* *,07/04/25 (April 25, 2007). – *Example 2:* Sun,*/04/25 (each 25th of April, provided it is a Sunday).
Range	Date range defining start and end date. The present value is active for this range. Entry format: Same as for *Date*.
WeekDay	This entry allows for selecting a special day as exception day. Entry format: Week of month (number), day (name), month. – *Example 1:* 02/Mo/Mar (second Monday in March, every year). – *Example 2:* */Tu/* (every Tuesday).

4.4   FAQ on TCP/IP

TCPI/UDP ports

Port number	Type	Used for …
21		FTP
23	UDP	Telnet/Ping
80		Web
135	TCP	DCOM
139		NetBIOS
502	TCP	Modbus
4242	TCP	Scope, RemoteOPC TCP/IP
11211	UDP	DeviceCOM
21211	TCP	DeviceCOM
42058		RemoteOPC RAS
47808	UDP	BAC0
47809	UDP	BAC1
47823	UDP	BACF

IP address

The IP address is assigned either dynamically via the DHCP server or set manually via HMI as follows:

Step	Action
1	Set parameter DHCP to **Fixed**.
2	Change **IP address**.
3	Confirm by setting **Apply** to **Yes**.
4	Restart controller.

MAC address and WINS name

The MAC address is the topmost number of the sticker on the communication module POL908. It always follows the same form: "00 A0 03 FF XX XX XX", where XX XX XX is a continuous number.
Example: 00 A0 03 FF 2C 9D
The WINS name is generated from the prefix POL908_ and XX XX XX (i.e. the last six digits of the MAC address).
Example: POL908_2C9D
You can also find the WINS name in the configuration settings in the HMI.

Web server

Use the WINS address or IP address to successfully connect to the web server.
Example: *"http://POL908_XX XX XX" or "http://192.168.0.10"*
The web server uses TCP port 80 for communication.

Default password:

User name: ADMIN
Password: SBTAdmin!

FTP server

Use the same address as for the web server, but replace
"**http://**" by "**ftp://ADMIN@**" to successfully connect to the FTP server.
Example: "ftp://ADMIN@POL908_FF2C40"
The following setting must be selected in the Internet Explorer:
Tools > **Internet Options** > **Use Passive FTP** (for compatibility with firewalls and DSL modem).

Password

User name: ADMIN
Password: SBTAdmin!

**Network:
Disconnected**

Ping the communication module using the WINS or IP address to test communications:

Step	Action
1	Select **Start** > **Run** on the Windows start bar: → The "Run" dialog box opens.
2	Enter **CMD** and click **OK**: → The "CMD.exe" DOS window opens.
3	Enter **C:\>ping POL908_XX XX XX** and press **Enter**: → The ping result is displayed.

You are dealing with a network or IP settings error if pinging does not work.

Problems with security scan

The SNMP service (Simple Network Management Protocol) may present a problem during a security scan by the network administrator.
You can disable the SNMP service.

Blank page

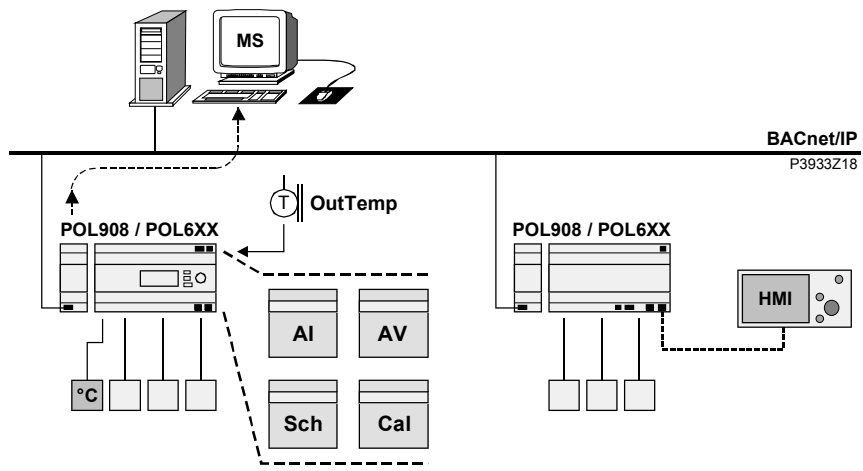# 5 Integration in BACnet/IP

5.1 Overview

Example

Section 2.4 "Principles of BACnet integration" describes the principle for integrating Climatix controllers as **server**. The following section shows how to integrate the controllers in real life.

The following four automation objects are to be integrated as an example:

- AnalogInput
- AnalogValue
- Calendar
- Schedule

The integrated automation objects are provided as BACnet objects on the management station.

| AI | AnaloInput (OutTemp) | Sch | Schedule |
| AV | AnalogValue | Cal | Calendar |

Jobs

Integration includes the following jobs:

Procedure	Job	Section
1	Create SAPRO application	5.2
2	Mapping (objects, alarms)	5.3
3	Configure BACnet/IP module	5.4
4	Export EDE files	5.5
5	Configure DESIGO INSIGHT	5.6

The following pages describe the individual jobs.

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5.2 Create SAPRO application

Insert automation objects

Insert and connect the required automation objects in the SAPRO application for the above example:

Step	Action
1	Insert automation objects: AnalogInput, AnalogValue, Schedule und Calendar
2	Connect.
3	Set parameters.
4	Generate file "MBRTCode.bin".
5	Load file in the controller.

Explanations (figure)

The elements and functions are:

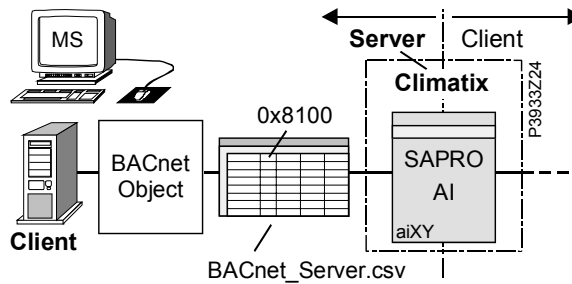| Element	Description / Function
AnalogInput	Reads an analog process value (here OutTemp) from a physical input.
AnalogValue	Calculated internal process value.
Calendar	List of entries for exception schedule.
Schedule	Schedule comprising weekly and exception schedules.

💡 See the SAPRO online help for detailed information on how to create applications for automation objects.

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5.3 Mapping

Principle

The figure shows the underlying principle for mapping the Climatix function as server:

BACnet_Server.csv

Create a file named "BACnet_Server.csv". This file specifies that the SAPRO automation objects for the client (MS) are visible in BACnet. The objects and alarms to be integrated are mapped to virtual member 0x8100 in the file.

Jobs

Mapping consist of the following tasks:
1. Map objects.
2. Map alarms.
3. Generate and load file "OBH.bin".

1. Map objects

Map objects in SCOPE.
Procedure:

Step	Action
1	Read language support file "ObjLang.csv" from the controller and rename to "BACnet_Server.csv".
2	Delete all objects excepting the BACnet objects to be integrated!
3	Change all member IDs of the BACnet objects to **0x8100**.
4	Two options for this step: • Either assign only the object names in column **COM1**. → The BACnet instance numbers are generated automatically. • Or manually assign fixed object names **and** BACnet instance numbers in column **COM2**.

Example:

P3933O01

Explanations (figure)

The figure shows both options from Step 4:

– Entries in column "COM1" only comprise object names.
  → The BACnet instance numbers are generated automatically.
– For entries in column "COM2", the BACnet instance numbers were fixed (e.g. "=5" in row 1).

Mapping, *continued*

2. Map alarms

Alarm mapping comprises two tasks:
1. Map Message Classes (0…15).
2. Define Notification Classes.

Map Message Classes

Use virtual object "0xF010" to map the Message Classes to BACnet Notification Classes. Procedure:

Step	Action
1	Continue with the file "**BACnet_Server.csv**" created previously.
2	Enter the virtual object and object instances in column **A**. The object instance (Object ID) always is the present MessageClass +1. *Example:* 0xF010 0x0002 = MessageClass1
3	Enter the virtual member in column **B**. The virtual member here is 0x8100 (as always for BACnet). It binds the Message Class to the Notification Class.
4	Enter the Message Classes (0…15) in column **C**.
5	Enter the associated Notification Class IDs in columns **COM1**, **COM2** as well as any further language columns "**Language**…".

Example:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1	Com 2
1	0xF010 0x0001	0x8100	MessageClass0	11	11
2	0xF010 0x0002	0x8100	MessageClass1	21	21
3	0xF010 0x0003	0x8100	MessageClass2	31	31
4	0xF010 0x0004	0x8100	MessageClass3	41	41
5	0xF010 0x0006	0x8100	MessageClass5	12	12

P3933O02

Define Notification Classes

Use virtual object "0xF011" to define the properties for the Notification Classes. Procedure:

Step	Action
1	Continue with file "**BACnet_Server.csv**".
2	Enter the virtual object (0xF011) and object instances (0x0001, 0x0002 etc.) in column **A**. Object instance (Object ID) starts with 1, and there may be max. 16 Notification Classes. *Example:* 0xF011 0x0001 = Notification Class 0
3	Enter the virtual member in column **B**. It is again 0x8100.
4	Enter the Notification Classes in column **C**.
5	Enter the properties for the Notification Classes in columns **COM1**, **COM2** as well as any further language columns "**Language**…". See below for syntax.
6	Save the file.

Mapping, *continued*

Define Notification
Classes, *cont.*

The syntax to define the properties from Step 5 is:
"Instance,Name,PrioToOffNormal,PrioToFault,PrioToNormal,AckOffNormal,AckToFault,AckToNormal"

Element	Meaning
Instance	Instance for Notification Class = Notification Class ID
Name	Notification Class name.
PrioToOffNormal	Priority for transition to "OffNormal".
PrioToFault	Priority for transition to "Fault".
PrioToNormal	Priority for transition to "Normal".
AckToOffNormal	Acknowledgement required for transition to "OffNormal".
AckToFault	Acknowledgement required for transition to "Fault".
AckToNormal	Acknowledgement required for transition to "Normal".

Example:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1	Com 2
1	0xF011 0x0001	0x8100	NotificationClass0	11,NC11 ,1,1,5,0,0,0	11,NC11 ,1,1,5,0,0,0
2	0xF011 0x0002	0x8100	NotificationClass1	21,NC21 ,2,2,5,0,0,0	21,NC21 ,2,2,5,0,0,0
3	0xF011 0x0003	0x8100	NotificationClass2	31,NC31 ,3,3,6,0,0,0	31,NC31 ,3,3,6,0,0,0
4	0xF011 0x0004	0x8100	NotificationClass3	41,NC41 ,6,6,8,0,0,0	41,NC41 ,6,6,8,0,0,0
5	0xF011 0x0006	0x8100	NotificationClass5	12,NC12 ,1,1,5,0,0,0	12,NC12 ,1,1,5,0,0,0
6	0xF011 0x0007	0x8100	NotificationClass6	22,NC22 ,2,2,5,0,0,0	22,NC22 ,2,2,5,0,0,0
7	0xF011 0x0008	0x8100	NotificationClass7	32,NC32 ,3,3,6,0,0,0	32,NC32 ,3,3,6,0,0,0
8	0xF011 0x0009	0x8100	NotificationClass8	42,NC42 ,6,6,8,0,0,0	42,NC42 ,6,6,8,0,0,0
9	0xF011 0x000a	0x8100	NotificationClass9	13,NC13 ,1,1,5,0,0,0	13,NC13 ,1,1,5,0,0,0
10	0xF011 0x000b	0x8100	NotificationClass10	23,NC23 ,2,2,5,0,0,0	23,NC23 ,2,2,5,0,0,0
11	0xF011 0x000c	0x8100	NotificationClass11	33,NC33 ,3,3,6,0,0,0	33,NC33 ,3,3,6,0,0,0
12	0xF011 0x000d	0x8100	NotificationClass12	43,NC43 ,6,6,8,0,0,0	43,NC43 ,6,6,8,0,0,0
13	0xF011 0x000e	0x8100	NotificationClass13	14,NC14 ,1,1,5,0,0,0	14,NC14 ,1,1,5,0,0,0
14	0xF011 0x000f	0x8100	NotificationClass14	24,NC24 ,2,2,5,0,0,0	24,NC24 ,2,2,5,0,0,0
15	0xF011 0x0010	0x8100	NotificationClass15	34,NC34 ,3,3,5,0,0,0	34,NC34 ,3,3,5,0,0,0

P3933O03

**3. Generate and load
file "OBH.bin"**

Complete the job as follows:

Step	Action
1	Generate file "OBH.bin" from file "BACnet_Server.csv".
2	Load file "OBH.bin" in the controller.

5.4 Configure BACnet/IP module

Two possibilities

There are two possibilities to configure the BACnet/IP module:

A. Via operator unit (HMI-DM and integrated HMI).
B. Via the module's web page.

A. Configuration via operator unit

Use the operator unit to enter BACnet basic settings. Individual parameters in "Communication settings":

Parameters	Explanation
BnDevName	BACnet device name.
BACnetDevID	BACnet device ID.
BACnetPort	BACnet port (UDP port), normally 0xBAC0 = 47808
Language	Determines the active "Languages" column in mapping file "BACnet_Server.csv".
WINSName	POL908_XX XX XX
IP	Module IP.
Mask	Module mask.
Gateway	Module gateway.
DHCP	DHCP active/passive.
Recipient Device 1-3	Fix recipient device 1-3
US UnitSystem	Change dimensions.
Unicode	Set the parameter to "active" ("passive" is default) if Unicode characters are used.
UseDefault	Reset to default settings.
SecurityLevel	Set security level for BACnet.
SoftwareVersion	Module version.
CommFailure	Active = Communications error.
State	Current controller status.

ℹ️ The "Communication settings" offer some application and module-specific menu items in addition to BACnet basic settings.

B. Configure on web page

Enter the IP address or WINS name in the browser to open the module's web page. We differentiate between the following tasks:

1. Enter basic settings.
2. Enter BBMD settings (incl. any foreign devices).

1. Enter basic settings

Enter the basic settings via the **BACnet Config** menu:


P3933O04

2. Enter BBMD settings

You must define and parameterize "BACnet Broadcast Management Devices" (BBMDs) if a BACnet/IP network comprises several subnets. This allows for broadcasts via routers to all network members.

Application example without foreign device

The following network with two subnets only contains servers (controllers) and to set connected clients (PCs). All members can communicate with each other if one BBMD is defined per subnet.

P3933Z25
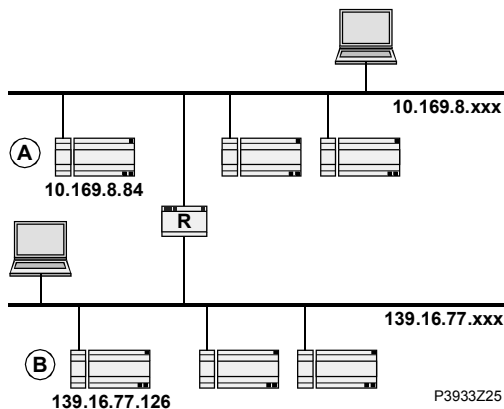
"BBMD Settings" window

The web page for the corresponding controller offers the BBMD Settings window to parameterize BBMDs (here: Controller A):

P3933O05

Settings

The window offers the following options:

Element	Description
Enable BBMD	Select BBMD function for this controller.
Update BBMD	Assume settings and refresh display.
FDT present	Checkbox: Foreign Device Table yes / no Text field: Max. number of entries (possible foreign devices).
Update FDT	Assume settings and refresh display.
Two-Hop Forwarding	Select two-hop forwarding.
Update Two Hops	Assume settings and refresh display.
IP Address	IP address for the partner BBMD on other subnet, e.g. for the above case: – Partner for controller "**A**": **139.16.77.126** – Partner for controller "**B**": **10.169.8.84**
UDP Port	Same as for "IP Address".
Update	Assume settings and refresh display.
New	IP address for BBMD server in an third subnet. *Important:* Enter the setting for all three BACnet servers!

Application example with foreign device

The following topology contains:
- Two BBMDs "A" and "B".
- One foreign device "C" (MS / DESIGO INSIGHT client).

P3933Z26
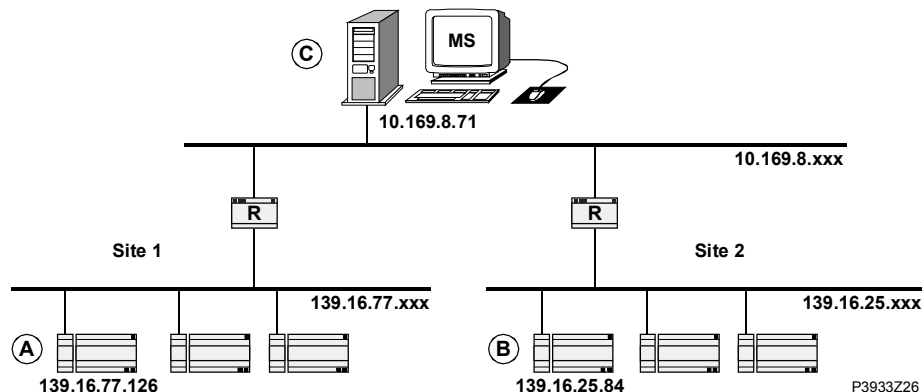
Settings for controller "A"

Enter the settings again via window "BBMD Settings" for the respective controller:

BBMD Settings

enable BBMD	☑	Update BBMD
FDT present (Max Entries)	☑ 1	Update FDT
Two-Hop Forwarding	☑	Update Two Hops

BBMD Table

IP Address	UDP Port	
139.16.25.84	47808 ▾	Update
	47808 ▾	New

P3933O06

Explanations

Differences to the application example without foreign device on the previous page:
- Checkbox **FDT present** is selected.
- Text field **Max. Entries** contains "**1**" (for MS "C").

Settings for controller "B"

Same settings as for controller "A", but with the following difference:
The **IP Address** is **139.16.77.126**

FD settings in INSIGHT client (C)

The following figures show the FD settings required for the DESIGO INSIGHT client 10.169.8.71, for BBMD of Site 1 and Site 2 each:

Site 1

P3933O07

Site 2

P3933O07

Explanation

Enter the IP addresses of the BBMDs, i.e. for controllers "A" or "B".

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5.5 Export EDE files

Procedure

Export files containing information on the BACnet objects are required for integration in a management station (here: DESIGO INSIGHT).
These files can be exported via ftp as follows:

Step	Action
1	Open **ftp** for the module in the browser (Internet Explorer): **ftp://IP address** of the module.
2	Go to **Temp** and copy the two files selected in the screenshot below.
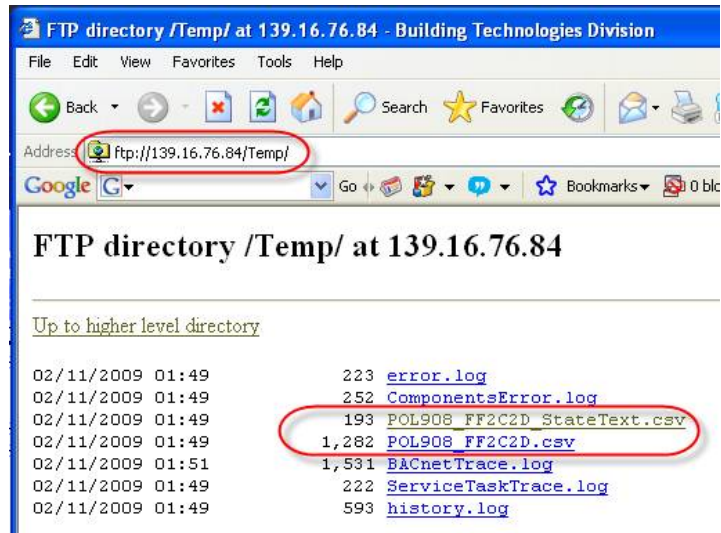
P3933O09

5.6 Configure DESIGO INSIGHT

Create project XML file

Create a project XML file from the EDE files of the controller using the DESIGO tool "DIEPT".

DB import in DESIGO INSIGHT

Import the created XML file via DB-Import in DESIGO INSIGHT.
The data is then available in the DESIGO INSIGHT project.

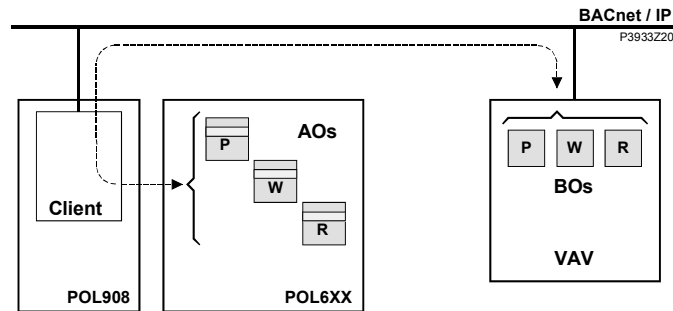For details, see:
DESIGO INSIGHT
Excel project tool DIEPT
CM11063en

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5.7 Configure Climatix as client

Example

The diagram of principles shows an example for an application of the Climatix controller as BACnet client. The three BACnet objects "Pressure", "Temperature setpoint", and "Release" for the VAV device are mapped to the related automation objects of the controller to provide for control.

AOs	SAPRO automation objects	P	Pressure
Bos	BACnet objects	W	Temperature setpoint
VAV	VAV device	R	Release

Integrate setpoint W

The following example shows how to integrate temperature setpoint W in the VAV device.

Prerequisite

For integration, the BACnet device ID of the server (here: VAV device) and the object information must be known. This information is listed e.g. in the device list of the system integrator. The client requires the information to know where to look for the BACnet objects to be integrated.
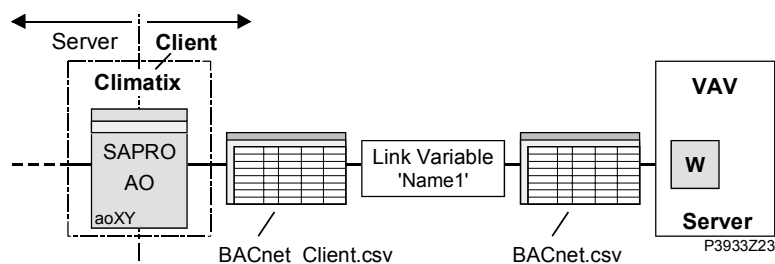
In our example, temperature setpoint W, i.e. BACnet object "AnalogInput" is to be read:

– BACnet Device ID = 50
– BACnet Object Instance = 3
– BACnet Object = AnalogInput

Mapping principle

The figure shows mapping from the Climatix controller's point of view:

– As a server to the MS to the left; see Section 5.3.
– As a VAV device **client** to the right; here: for automation object AO to read setpoint W.

Explanations (figure)

The above elements for mapping are:

Element	Explanation
BACnet_Client.csv	The file connects each SAPRO automation object required for client function to a link variable.
Link variable	Variable to be defined by you. Connects "BACnet_Client.csv" to "BACnet.csv".
BACnet.csv	The file connects the associated BACnet objects (values) of the server to the corresponding link variable.

Configure as Climatix client, *continued*

Jobs

Mapping consist of the following tasks:
1. Create file "BACnet_Client.csv".
2. Create file "BACnet.csv".
3. Download files.

1. Create file "BACnet_Client.csv"

Configure the first file (client → link variable). Procedure:

Step	Action
1	Read language support file "ObjLang.csv" from the controller and rename to "**BACnet_Client.csv**".
2	Delete all except the client objects to be integrated (e.g. "P", "W", "R").
3	Change the member IDs to **0x8115**.
4	Configure connection client → link variable as per the syntax below. *Explanation:* "Temp" (CName) in our example is the link variable.
5	Save the file.

(STOP) The name of the defined link variable must be unique !

Sample row for mapping temperature setpoint W:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1
37	0x2200 'Unit1\AnalogValue'	0x8115	AnalogValue	<0x3043,-1,1,0,,Temp,R>

P3933O10

Syntax for "Language" column

The syntax for the entries in "Language" column **Com1** is:

[COV1,[COV2]]<MemberID,StateID,[Gain],[Offset],[subst],CName,R|W >

Element	Meaning
COV1, COV2	Optional members for COV increment. If no default value is set, a value of 0.1 is used. This COV value is only valid if there is no COV subscription. In this case, the COV value from BACnet is used.
MemberID	The MemberID whose value is written to or read from. If just a bit is needed, addressing "MemberID.Bitposition" (e.g. 5.1).is used. In this case, the member value is converted to an ULONG and calculated from bit no. 1. Afterwards, value is written back to its native format.
StateID	The status Member. If set to -1 it is disabled
Gain	Gain factor (default = 1.0)
Offset	Offset (default = 0.0).
	OBHvalue = Receivedvalue * Gain + Offset
subst	Substitution table which allows a remapping of the present value. E.g. 1=2; 3=4; 7=0.
CName	Unique identifier of the client connection
R/W	Only one of the following flags R,W,C,U R = Input Value W = Output Value H=Default: = Input value with received heartbeat. Use this default value if there are missing received heartbeats or in case of a communication error.

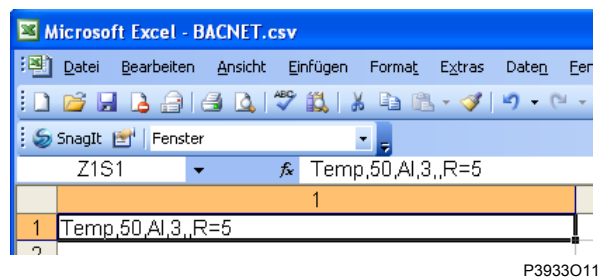# Configure as Climatix client, *continued*

2. Create file "BACnet.csv"

Configure the second file (server → link variable). Procedure:

Step	Action
1	Start file "**BACnet.csv**" in Excel.
2	Configure in column 1 as per the syntax below.
3	Save the file to binder **Online** of the SCOPE project.

(STOP) At present, only PropertyID "Present Value" (member "PrVal") is supported.

Sample row for mapping temperature setpoint W:

P3933O11

Explanation of the row

Variable "Temp" with priority 5 is to be read at the VAV device with Device ID "50" at "AI" No. "3".

Entry syntax

The syntax for the entries in file "BACnet.csv" is:

CName,DevID,ObjTyp,ObjInst,[PropertyID],R|W|C|U=time,[1..16], [Gain],[Offset],[subst]

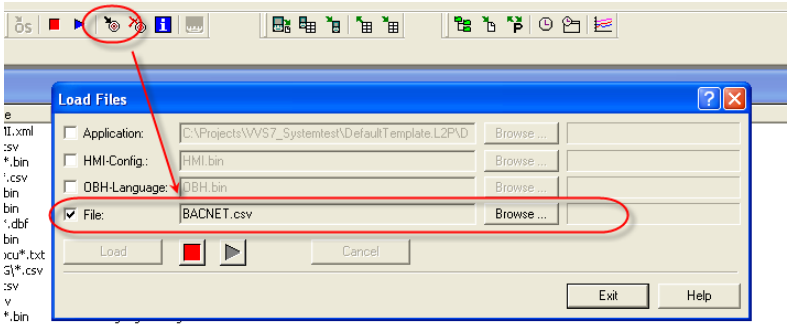| Element	Meaning
CName	Unique identifier of the client connection (e.g. "Temp")
DevID	BACnet DeviceID of the remote device (e.g. "50")
ObjType	BACnet ObjectType of the remote object: AI,AO,AV,BI,BO,BV,MI,MO,MV (e.g. "AI")
ObjInst	BACnet ObjectInstance of the remote object (e.g. "3")
PropertyID	BACnet PropertyID, in the first version only PresentValue is supported (85)
R/W/C/U	Only one of the following flags R,W,C,U (here "R") – W = Time: Write the present value of a remote object on ValueChange with heartbeat time. (Default = 60, 0 is set to default). – R = Time: Read the present value of a remote object within the defined polling time. (Default = 60, 0 is set to default). – C = Time: Use a confirmed COV subscription for updating from the remote object. Time = Resubscriptiontime (Default = 300, 0 is set to default). – U = Time: Use an unconfirmed COV subscription for updating from the remote object. Time = Resubscriptiontime (Default = 300, 0 is set to default).
1..16	Priority for writing or H=DefaultValue (here "5")
Gain	Gain factor (default = 1.0) used only for analog values.
Offset	Offset (default = 0.0) `OBHvalue = Receivedvalue * Gain + Offset`
subst	Substitution table that allows a remapping of the present value. OBHVal1=Val1; OBHVal2=Val2….. OBHVal2=Val2;DefaultObh;Default E.g. 1=2; 3=4; 7=0;8;8

(STOP) Values set for "Gain", "Offset" or "subst" overwrite the values of 0x8115 defined in file "BACnet_Client.csv".

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Configure as Climatix client, *continued*

3. Download files

Download files using SCOPE via USB or Ethernet port to the controller. Procedure:

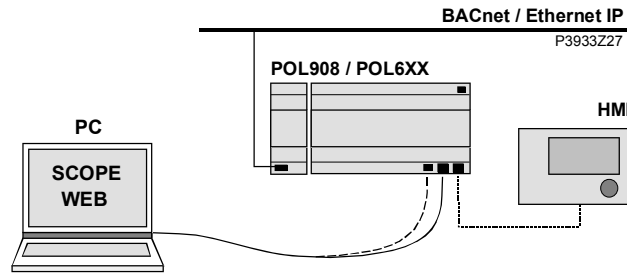| Step	Action
1	Download **BACnet_Client.csv** (as for OBH.bin).
2	Download **BACnet.csv** via **Load Files**, see below: *Notes:* – The file name **must** be "BACnet.csv". – This file cannot be downloaded any other way, e.g. via SD card.
3	Client setup is done. After startup, the controller automatically provides the required data to the communication module.

5.8　Commission BACnet/IP module

Active devices

The Climatix controller and the communication module are involved in this action:

BACnet / Ethernet IP

P3933Z27

POL908 / POL6XX

HMI

PC

SCOPE WEB

Tools

Tools used:
– Operator unit (HMI).
– PC with SCOPE and web browser.

Commission the controller

Prerequisite: The SAPRO application (MBRCode.bin) is fully commissioned.
Proceed as follows for BACnet:

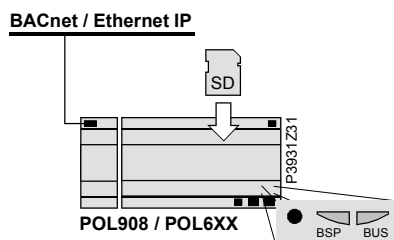| Step	Action

1	Download the mapping files created previously to the controller:
	 • Controller is **server**:
	   "OBH.bin" (generated from "BACnet_Server.csv"), see Section 5.3.
	 • Controller is **client**:
	   "BACnet_Client.csv", see Section 5.7.

Commission the BACnet/IP module

Proceed as follows to connect the BACnet/IP module to the bus and configure it:

Step	Action
1	Controller **OFF**.
2	Connect BACnet/IP module to the controller via plug connection.
3	Connect the BACnet/IP bus cable to the module.
4	Controller **ON**: → The module starts / initialization begins. → As soon as the two LEDs "BSP" and "BUS" are steady green, communication with the controller and bus (BACnet) is active.
5	Enter the BACnet settings via HMI or SCOPE and web browser; see Section 5.4.
6	If the controller is **client**: Download file "BACnet.csv"; see Section 5.7.

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5.9 Upgrade BSP via SD card

Devices involved

The Climatix POL6XX controller and the BACnet/IP module POL908 are involved in this action:

Prerequisite

To upgrade the BSP for the BACnet/IP modul the following items are needed:

- SD card
- BSP file

Upgrade procedure

To upgrade the BSP proceed as follows:

Step	Action
1	Format an SD Card with FAT file system (not FAT-32).
2	Copy the BSP file to the SD Card and rename it to **POL8195.hex**.
3	Switch **OFF** the power supply of the controller.
4	Insert the SD card into the controller.
5	Press the small button near by the BSP LED (e.g. with a paper clip).
6	Switch **ON** the power supply: – If the BSP red LED is switched off the controller is in BSP upgrade mode. – If the BSP LED flashes between Red and Green the controller files will be updated
7	Wait until the BSP LED is yellow or switched off.
8	Carry out a further restart: Switch the power supply **OFF** / **ON**.

5.10 Troubleshooting

BACnet does not work

Check the following if BACnet does not work:
- Does the BACnet server run in the Process Manager (web)?
  File "BACnetserver.exe" must be visible. Otherwise, start the BACnet server on the BACnet page.
- Do the EDE files exist?
  EDE = "Engineering Data Exchange" is the format recommended by the BACnet Interest Group Europe to exchange data between BACnet server and BACnet client.
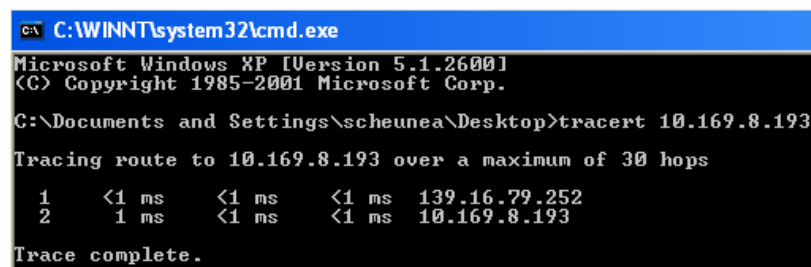
Does the BACstac service run?

Check if the BACstac service is running if you are using BACnet Explorer by "Cimetrics".

BBMDs required?

BBMD must be used if BACnet client and BACnet server are located in different subnets.
Use command "tracert" to check this.

Example (result):

Tracert shows all stations used to forward the signal to another segment.

Device Name and ID unique?

Make sure both Device Name and die Device ID are unique within the BACnet network.
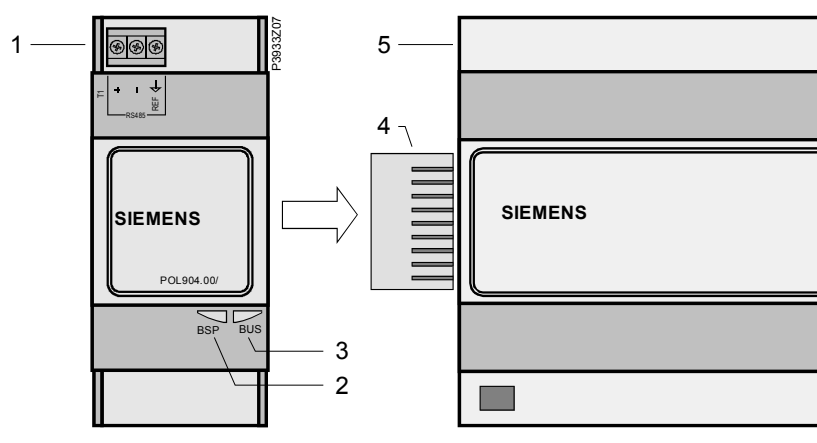
Note BACnet multistate objects

BACnet multistate objects do not use value "0". They always start at "1".

6 BACnet MS/TP module

6.1 Mechanical design

Design

The figure shows the BACnet MS/TP module. It is connected to the Climatix controller via the internal communication extension bus. This is done via plug connection on the left side of the controller.

Elements and connections

The elements and connections in the figure are:

Pos.	Element / Connection
1	Interface RS485, plug-in terminals with screw/terminal connections.
2	Status display "BSP" (Board Support Package).
3	Status display "BUS" (bus connections / bus traffic o.k.).
4	Plug connection "Communication extension bus".
5	Climatix controller POL6XX.

Status displays

The status displays "BSP" and "BUS" are bi-color LEDs in red and green. A viewer will see yellow when both LEDs are lit simultaneously.

"BSP" LED

This LED informs on the status of the "Board Support Package" (BSP). Color and flashing frequency of the LED:

Color	Flashing frequency	Meaning / Mode
Red / yellow	1 s "on" / 1 s "off"	Upgrade mode.
Green	Steady "on"	BSP operating and communication with controller working.
Yellow	Steady "on"	BSP operating, but no communication with controller.
Red	Flashing at 2Hz	BSP error (software error).
Red	Steady "on"	Hardware fault.

"BUS" LED

This LED shows the status of external communication with the bus, not to the controller. Color and flashing frequency of the LED:

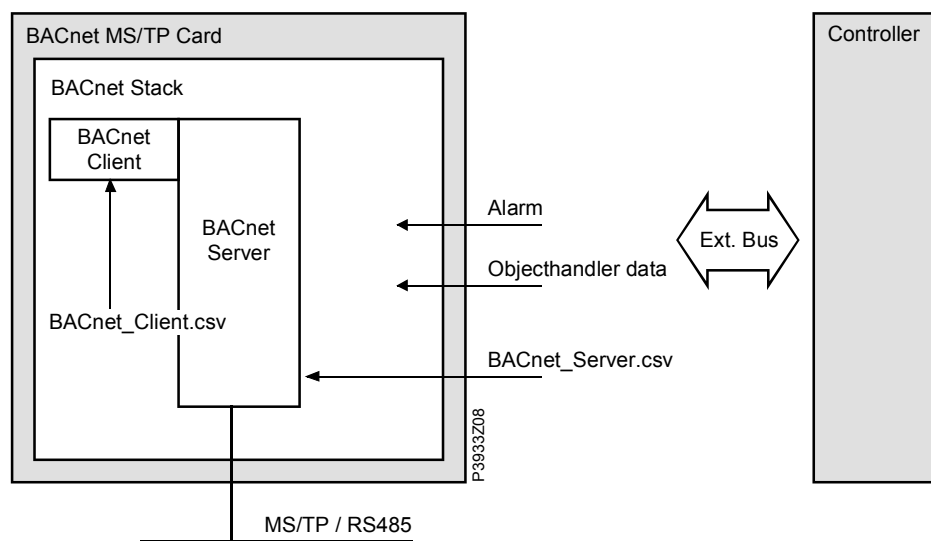| Color	Flashing frequency	Meaning / Mode
Green	Steady "on"	Communication active.
Red	Steady "on"	Communication interrupted.
Yellow	Steady "on"	Initializing – no communication yet via IP.

Power supply is outside the allowed range if both LEDs are dark.

6.2 Functional design

Block diagram

The diagram shows the functional elements of the BACnet MS/TP module:

Description of elements

The elements and functions are:

| Element	Description / Function
BACnet stack	Stack for BACnet communication and protocol services.
BACnet client	Client function, see Section 2.3, BACnet MS/TP module application.
BACnet_Client.csv	Mapping file for client functionality.
Ext. Bus	Bus to extend communication between module and controller.
Alarm	Alarms from Climatix controllers.
Object handler data	Complete file information from the Climatix controller.
BACnet_Server.csv	Mapping file for server functionality.
BACnet server	Server function, see Section 2.3, BACnet MS/TP module application.
MS/TP / RS485	Data protocol/Transport medium for communication between BACnet devices.

7 Engineer BACnet MS/TP

7.1 Topologies

RS485 and BACnet

BACnet MS/TP uses the physical layer of interface RS485, which is low cost and simple. However, observe a few important points to guarantee full functionality. Select the right topology to begin with.

Best: Individual line

The best topology is a single line (line topology), with the bus cable connected directly to the individual devices.
This type of connection has the least problems.
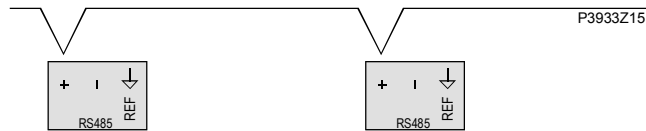
Note: Only one line + (TX) is shown for the example.

**Impairment due to intermediate terminals**

Connecting network devices via intermediate terminals can result in reflections and harmonics of electrical signals. Long, not twisted intermediate lines obviously increase the risk of interference.
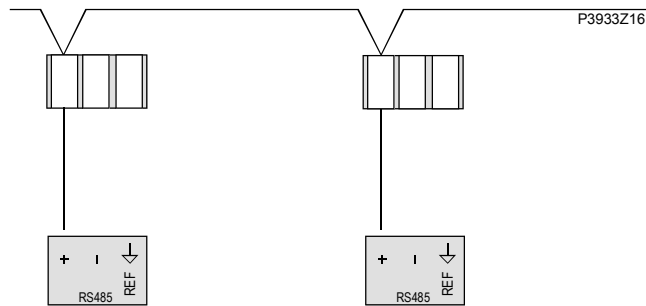
Note: Only one line + (TX) is shown for the example.

Error-prone: Star

Avoid star topologies because errors/problems are hard to located and remove.
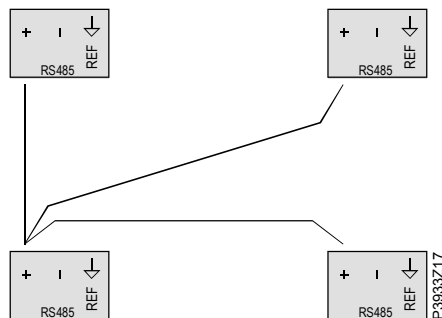
Note: Only one line + (TX) is shown for the example.

7.2 RS485, cable installation

Task of the third wire

Handle the RS485 bus in practice as 3-wire network even though RS485 as per EIA 485 only specifies a two-wire line for differential signals. Reason:
Devices with RS485 interface have third connection named "Common", "Ground" or "REF" (e.g. in Climatix).
This connection is not used to connect to ground, but rather for a common reference signal. Voltage on lines Tx/Rx (or +/-) are measured relative to the voltage level on the reference signal.

Risks due to missing third wire

You risk the following if you do not use a third wire:
- Destroyed RS485 inputs.
- Unstable work.
- New installation.

The risks are greater:
- The higher the number of feeds to supply devices.
- The greater the physical separation.
- If fewer well grounded devices and feeds are used.

Screening not required

You do not need screens. The twisted cable for Tx and Rx suppresses interference more effectively than a screen.

Screening as third wire?

You can use the third wire as screen for emergencies. It is better, however, to use a wire of the second wire pair of a CAT5 cable; see "Cable selection" below.

Connect third wire first

Always connect the third wire first if
- You connect a device to be switched on or
- Connect your laptop to an operating network.

Alternately:
Select optically separated devices to nearly always protect the transmitter/receiver of RS485.

Observe cabling

Observe the following when running the bus cable:
- Do not wind the bus cable around other cables or electric/magnetic sources (e.g. around a motor cable).
- Do not run the bus cable next to DC load switches (e.g. relay). These are the main sources of interferences.
- Frequency-controlled actuators are also source of high interference.
- Protect bus cable against undesired moving (e.g. due to vibrations).

Impedance is important when selecting the cable

Each cable has its own impedance. Some cables are designed for impedance independent of length. Use this kind of cable. Nominal impedance is a start for selection:
- A cable is well suited if a number e.g. 100 Ohm is indicated.
- The cable is not suited if impedance is indicated by meter/foot, as determination of the value for terminating resistances requires measurements and calculations.

Thus, select a cable with the lowest possible capacity.

Cat5 cables?

Yes, these cables are good. Use a pair for Tx/Rx and a wire of the other pair for the reference signal (ground).
We recommend the following cables:

Manufacture / Type	Specifications
Belden 3106A Bild02	Multi-Conductor - EIA Industrial RS-485 PLTC/CM 22 AWG stranded (7×30) tinned copper conductors, Datalene® insulation, twisted pairs, overall Beldfoil® shield (100% coverage) plus a tinned copper braid (90% coverage), drain wire, UV resistant PVC jacket.
Belden 3107A Bild03	Multi-Conductor - EIA Industrial RS-485 PLTC/CM 22 AWG stranded (7×30) tinned copper conductors, Datalene® insulation, twisted pairs, overall Beldfoil® shield (100% coverage) plus a tinned copper braid (90% coverage), drain wire, UV resistant PVC jacket.

More than 32 devices on one RS485 trunk?

Yes, a repeater makes this possible.
However, in reality a repeater is not always necessary because:

Although the RS485 standard is based on just 32 devices, most RS485 chips need less than the specified unit load since initial development. Today, some devices on the market require only half or a quarter of the load units.
Read the associated data sheets and count the required load to determine how many devices you can install. This data is located in "UL" ("Unit Load").

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Cable length and baud rates

RS485 does not specify max cable length. It depends largely on transmission rates:

The greater the transmission rate, the shorter the possible cable length.

Rule of thumb for AWG cable:

Cable length [m] x data rate [bps] < $10^{8.}$

The following guide values result:

Baud rate	Cable length [m]
9,600	10,400
19,200	5,200
38,400	2,600
76,800	1,300
115,200	870

Additionally, note the following:

The higher the baud rate, the more important the cable installation quality. Issues such as twisted pair cable unfolded at each resistor gain importance.

Advice

Use 38,400 baud rather than 76,800 for extended networks with many devices, and optimize using the following measures:
- Use COVs.
- Use separate networks.
- Set max masters to lower number.

7.3 Bandwidth used

Basic question

How many devices can be installed on a specific RS485 trunk considering bandwidth?

Number of useful data is small

The following numbers illustrate how little bandwidth is used for data transfer:

Amount ca.	Purpose
10 %	APDU
25 %	Master polling
65 %	Token passing

APDUs (Application Protocol Data Units) are messages of the application layer, polling and responding to property values, thus transporting useful data.
The remainder is needed to maintain the network by polling new devices (master polling) and passing the token.
Unfortunately, there is no PC to determine the number of devices that can be installed in an individual network. The following information may help introduce bandwidth considerations in engineering.

Number of BACnet slaves?

Token passing and polling new devices on the MS/TP trunk require most bandwidth.
A BACnet slave can be read/written, but never receives the token. As a result, it cannot trigger messages. The more slaves, the fewer token passes. A device typically cannot be set to slave mode. Most providers implement their devices as masters (i.e. token passing devices).

Number of monitored objects per device?

The more is read and the higher the frequency, the more bandwidth is required.
Assumptions:
– Ca 30 bytes to query one property.
– Ca 40 bytes for the reply.
– A token is 8 bytes, identical to master polling.
– 50% of the bandwidth is needed for overhead (token, master polling).
Divide the baud rate by 10 to calculate the bytes per second.
If 30 + 40 = 70 bytes represent the best and 100 bytes the worst case [*)], multiply by the number of objects and properties to be polled regularly.

Example

The above consideration result in the typical values:

Item	Value
Baud	38'400
Bytes per second (bps; baud value divided by 10).	3'840
Amount needed for overhead (token, master polling).	50%
Bytes per second for useful data (a).	1'920
Typical value for poll and reply for **one** property (b).	70
Number of properties polled per second (=a/b).	27,428
Typical number of properties polled per object (e.g. pres value, status_flags, reliability, out of service).	4
Number of objects per second.	6,857

The example assumes that the device does not support "Multiple Service" (see below).

**"Max Master"
Function and values**

Every few cycles, each (master) or token-passing device on the network must check for new devices. "Max Master" determines the highest possible address to be searched for. Each poll comprises of sending a message and waiting for a reply, or a timeout (if no new device is present). Timeouts cost time. The higher the value for "Max Master", the greater the number of potential devices to be polled. 127 is default for "Max Master".

ℹ️ You must adjust the value in each device if you use "Max Master" to adjust the usable bandwidth.

**Read/Write property
"Multiple Services"**

The network's performance increases if a block of properties must be read rather than one single property.
How do you know if the devices used support "Read/Write property "Multiple Services" or if each property must be read individually with a separate message? You can find this information for each device:
- Either in the BIB statement
- Or in the Device object.

Look for property "BACnetServicesSupported" in the Device object. Check the array if the following two items are supported:
– Item 14 "Read Property Multiple"
– Item 16 "Write Property Multiple"
However, many devices do not show this information for the Device object.

Use BACnet COV

COV is change of value. When a device supports COV, another device or application can subscribe to notification in the event of object property changes. As a result, the data client does not need to constantly query data, but rather can wait passively until it receives COV notification.
This drastically reduces network traffic.

**Select devices with
short token usage**

BACnet allots up to 15 ms to a device to use the token. As most messages on an MS/TP network are token passes, a device that uses the token within 5 ms needs less bandwidth than one using it for 15 ms.
Unfortunately, this is the weakness of some devices and manufacturers often bank on implementation by other manufacturers.
Remember this: The higher the token usage of a device, the more bandwidth is needed although no action really is taking place!

7.4 Limits for Climatix devices

Introduction

Below is a list of limits and recommendations for Climatix devices on a MS/TP network helping you to be on the safe side.

Maximum number of devices

Max number of devices in dependence of baud rate:

Baud rate	Number of devices
76800	64
38400	32
19200 and lower	Not recommended

Limits for objects and COVs

Limits for objects and COV subscriptions:

Item	Number
Objects in device, total	max. 500
BACnet objects, portion of total number	max. 300
Simultaneous COV subscriptions	max. 50
COVs on BACnet	max. 5 per sec

MaxMaster and MaxInfoFrames

Parameter settings:

Parameters	Setting
MaxMaster	Number of MS/TP devices (device address) + 1
MaxInfoFrames	1, unless device generates high-priority events (alarm, COV, client functionality).

BACnet/IP per MS/TP

Recommended router settings to integrate BACnet MS/TP in BACnet/IP:

Parameters	Setting
MaxMaster	Number of MS/TP devices (device address) + 1
MaxInfoFrames	10 or higher.

Router

Siemens tested the following device:
Cimetrics B6000
BACnet/IP to MS/TP router

Blank page

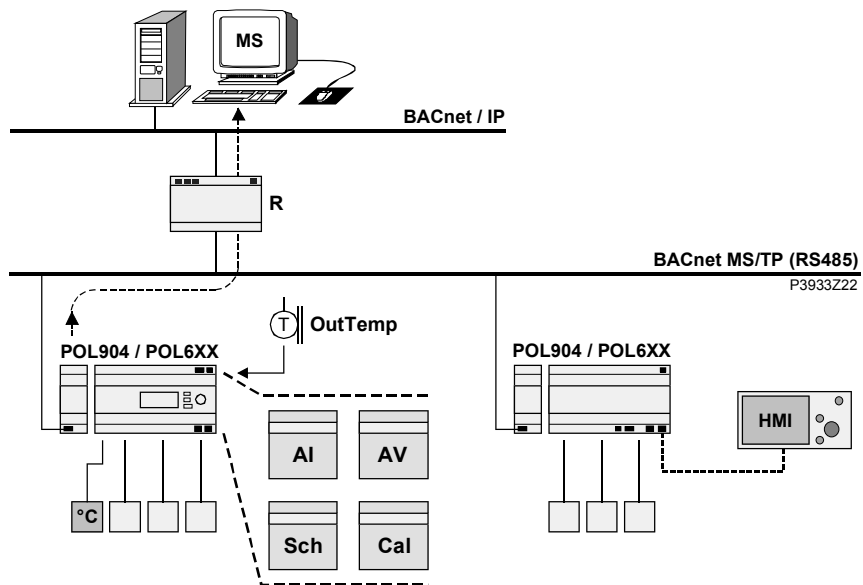# 8 Integration in BACnet MS/TP

8.1 Overview

Example

Section 2.4 describes the principle for integrating Climatix controllers as **server**.
The following section shows how to integrate the controllers in real life.
The following four automation objects are to be integrated as an example:

- AnalogInput
- AnalogValue
- Calendar
- Schedule

The integrated automation objects are provided as BACnet objects on the management station.

AI	AnaloInput (OutTemp)	Sch	Schedule
AV	AnalogValue	Cal	Calendar

Procedure

Integration includes the following jobs:

Procedure	Job	Section
1	Create SAPRO application	8.2
2	Mapping (objects, alarms)	8.3
3	Configure BACnet MS/TP module.	8.4

The following pages describe the individual jobs.

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8.2   Create SAPRO application

Insert automation objects

Insert and connect the required automation objects in the SAPRO application for the above example:

Step	Action
1	Insert automation objects: AnalogInput, AnalogValue, Schedule und Calendar
2	Connect.
3	Set parameters.
4	Generate file "MBRTCode.bin".
5	Load file in the controller.

Explanations (figure)

The elements and functions are:

Element	Description / Function
AnalogInput	Reads an analog process value (here OutTemp) from a physical input.
AnalogValue	Calculated internal process value.
Calendar	List of entries for exception schedule.
Schedule	Schedule comprising weekly and exception schedules.

💡 See the SAPRO online help for detailed information on how to create applications for automation objects.

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8.3 Mapping

Principle

The figure shows the underlying principle for mapping the Climatix function as server:

BACnet_Server.csv

Create a file named "BACnet_Server.csv". This file specifies that the SAPRO automation objects for the client (MS) are visible in BACnet. The objects and alarms to be integrated are mapped to virtual member 0x8100 in the file.

Jobs

Mapping consist of the following tasks:
1. Map objects
2. Map alarms
3. Generate and load file "OBH.bin".

1. Map objects

Map objects in SCOPE.
Procedure:

Step	Action
1	Read language support file "ObjLang.csv" from the controller and rename to "BACnet_Server.csv".
2	Delete all objects excepting the BACnet objects to be integrated!
3	Change all member IDs of the BACnet objects to **0x8100**.
4	Two options for this step: • Either assign only the object names in column **COM1**. → The BACnet instance numbers are generated automatically. • Or manually assign fixed object names **and** BACnet instance numbers in column **COM2**.

Example:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1	Com 2
1	0x2203 'Unit1\OutTemp'	0x8100	OutTemp	AnalogInput	AnalogInput=5
2	0x2200 'Unit1\AnalogValue'	0x8100	AnalogValue	AnalogValue	AnalogValue=1
3	0x2209 'Unit1\Calendar'	0x8100	Calendar	Calendar	Calendar=2

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Explanations (figure)

The figure shows both options from Step 4:
– Entries in column "COM1" only comprise object names.
  → The BACnet instance numbers are generated automatically.
– For entries in column "COM2", the BACnet instance numbers were fixed (e.g. "=5" in row 1).

2. Map alarms	Alarm mapping comprises two tasks: 1. Map Message Classes (0…15). 2. Define Notification Classes

Map Message Classes	Use virtual object "0xF010" to map the Message Classes to BACnet Notification Classes. Procedure:

Step	Action
1	Continue with the file "**BACnet_Server.csv**" created previously.
2	Enter the virtual object and object instances in column **A**. The object instance (Object ID) always is the present MessageClass +1. *Example:* 0xF010 0x0002 = MessageClass1
3	Enter the virtual member in column **B**. The virtual member here is 0x8100 (as always for BACnet). It binds the Message Class to the Notification Class.
4	Enter the Message Classes (0…15) in column **C**.
5	Enter the associated Notification Class IDs in columns **COM1**, **COM2** as well as any further language columns "**Language**…".

Example:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1	Com 2
1	0xF010 0x0001	0x8100	MessageClass0	11	11
2	0xF010 0x0002	0x8100	MessageClass1	21	21
3	0xF010 0x0003	0x8100	MessageClass2	31	31
4	0xF010 0x0004	0x8100	MessageClass3	41	41
5	0xF010 0x0006	0x8100	MessageClass5	12	12

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Define Notification Classes	Use virtual object "0xF011" to define the properties for the Notification Classes. Procedure:

Step	Action
1	Continue with file "**BACnet_Server.csv**".
2	Enter the virtual object (0xF011) and object instances (0x0001, 0x0002 etc.) in column **A**. Object instance (Object ID) starts with 1, and there may be max. 16 Notification Classes. *Example:* 0xF011 0x0001 = Notification Class 0
3	Enter the virtual member in column **B**. It is again 0x8100.
4	Enter the Notification Classes in column **C**.
5	Enter the properties for the Notification Classes in columns **COM1**, **COM2** as well as any further language columns "**Language**…". See below for syntax.
6	Save the file.

Mapping, *continued*

Define Notification Classes, *cont.*

The syntax to define the properties from Step 5 is:
"Instance,Name,PrioToOffNormal,PrioToFault,PrioToNormal,AckOffNormal,AckToFault,AckToNormal"

Element	Meaning
Instance	Instance for Notification Class = Notification Class ID
Name	Notification Class name.
PrioToOffNormal	Priority for transition to "OffNormal".
PrioToFault	Priority for transition to "Fault".
PrioToNormal	Priority for transition to "Normal".
AckToOffNormal	Acknowledgement required for transition to "OffNormal".
AckToFault	Acknowledgement required for transition to "Fault".
AckToNormal	Acknowledgement required for transition to "Normal".

Example:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1	Com 2
1	0xF011 0x0001	0x8100	NotificationClass0	11,NC11 ,1,1,5,0,0,0	11,NC11 ,1,1,5,0,0,0
2	0xF011 0x0002	0x8100	NotificationClass1	21,NC21 ,2,2,5,0,0,0	21,NC21 ,2,2,5,0,0,0
3	0xF011 0x0003	0x8100	NotificationClass2	31,NC31 ,3,3,6,0,0,0	31,NC31 ,3,3,6,0,0,0
4	0xF011 0x0004	0x8100	NotificationClass3	41,NC41 ,6,6,8,0,0,0	41,NC41 ,6,6,8,0,0,0
5	0xF011 0x0006	0x8100	NotificationClass5	12,NC12 ,1,1,5,0,0,0	12,NC12 ,1,1,5,0,0,0
6	0xF011 0x0007	0x8100	NotificationClass6	22,NC22 ,2,2,5,0,0,0	22,NC22 ,2,2,5,0,0,0
7	0xF011 0x0008	0x8100	NotificationClass7	32,NC32 ,3,3,6,0,0,0	32,NC32 ,3,3,6,0,0,0
8	0xF011 0x0009	0x8100	NotificationClass8	42,NC42 ,6,6,8,0,0,0	42,NC42 ,6,6,8,0,0,0
9	0xF011 0x000a	0x8100	NotificationClass9	13,NC13 ,1,1,5,0,0,0	13,NC13 ,1,1,5,0,0,0
10	0xF011 0x000b	0x8100	NotificationClass10	23,NC23 ,2,2,5,0,0,0	23,NC23 ,2,2,5,0,0,0
11	0xF011 0x000c	0x8100	NotificationClass11	33,NC33 ,3,3,6,0,0,0	33,NC33 ,3,3,6,0,0,0
12	0xF011 0x000d	0x8100	NotificationClass12	43,NC43 ,6,6,8,0,0,0	43,NC43 ,6,6,8,0,0,0
13	0xF011 0x000e	0x8100	NotificationClass13	14,NC14 ,1,1,5,0,0,0	14,NC14 ,1,1,5,0,0,0
14	0xF011 0x000f	0x8100	NotificationClass14	24,NC24 ,2,2,5,0,0,0	24,NC24 ,2,2,5,0,0,0
15	0xF011 0x0010	0x8100	NotificationClass15	34,NC34 ,3,3,5,0,0,0	34,NC34 ,3,3,5,0,0,0

P3933O03

3. Generate and load file "OBH.bin"

Complete the job as follows:

Step	Action
1	Generate file "OBH.bin" from file "BACnet_Server.csv".
2	Load file "OBH.bin" in the controller.

8.4 Configure BACnet MS/TP module

Tool/site

Configure the BACnet/IP module as follows:
- Via operator unit (HMI-DM and integrated HMI).

See "Communication settings" for individual parameters.

Configuration table

Individual parameters and their functions:

Parameters	Meaning
BnDevName	BACnet device name.
BACnetDevID	BACnet device ID.
Language	Determines the active "Languages" column in mapping file "BACnet_Server.csv".
MSTP-Addr	MSTP address.
MSTP-TermResistor	MSTP terminating resistance.
MSTP-Baud	Baud rate.
MSTP MaxMaster	Max number of master MS/TP devices in MS/TP network.
MSTP MxInfoFram	Max number of simultaneous polls/replies.
Recipient Device 1-3	Fixed recipient device 1-3.
US UnitSystem	Change dimensions.
Unicode	Set the parameter to "active" ("passive" is default) if Unicode characters are used.
UseDefault	Reset to default settings.
SecurityLevel	Set security level for BACnet.
SoftwareVersion	Module version.
CommFailure	Active = Communications error.
State	Current controller status.

ℹ️ The "Communication settings" offer some application and module-specific menu items in addition to BACnet basic settings.

8.5   Configure Climatix as client

Example

The diagram of principles shows an example for an application of the Climatix controller as BACnet client. The three BACnet objects "Pressure", "Temperature setpoint", and "Release" for the VAV device are mapped to the related automation objects of the controller to provide for control.

AOs	SAPRO automation objects	P	Pressure
BOs	BACnet objects	W	Temperature setpoint
VAV	VAV device	R	Release

Integrate setpoint W

The following example shows how to integrate temperature setpoint W in the VAV device.

Prerequisite

For integration, the BACnet device ID of the server (here: VAV device) and the object information must be known. This information is listed e.g. in the device list of the system integrator. The client requires the information to know where to look for the BACnet objects to be integrated.

In our example, temperature setpoint W, i.e. BACnet object "AnalogInput" is to be read:

– BACnet Device ID = 50
– BACnet Object Instance = 3
– BACnet Object = AnalogInput

Mapping principle

The figure shows mapping from the Climatix controller's point of view:

– As a server to the MS to the left; see Section 8.3.
– As a VAV device **client** to the right; here: for automation object AO to read setpoint W.

Explanations (figure)

The above elements for mapping are:

Element	Explanation
BACnet_Client.csv	The file connects each SAPRO automation object required for client function to a link variable.
Link variable	Variable to be defined by you. Connects "BACnet_Client.csv" to "BACnet.csv".
BACnet.csv	The file connects the associated BACnet objects (values) of the server to the corresponding link variable.

Jobs

Mapping consist of the following tasks:
1. Create file "BACnet_Client.csv".
2. Create file "BACnet.csv".
3. Download files.

1. Create file "BACnet_Client.csv"

Configure the first file (client → link variable). Procedure:

Step	Action
1	Read language support file "ObjLang.csv" from the controller and rename to "**BACnet_Client.csv**".
2	Delete all except the client objects to be integrated (e.g. "P", "W", "R").
3	Change the member IDs to **0x8115**.
4	Configure connection client → link variable as per the syntax below. *Explanation:* "Temp" (CName) in our example is the link variable.
5	Save the file.

(STOP) The name of the defined link variable must be unique !

Sample row for mapping temperature setpoint W:

	ObjType / ObjId	Member Id	Appl.Lang.	Com 1
37	0x2200 'Unit1\AnalogValue'	0x8115	AnalogValue	<0x3043,-1,1,0,,Temp,R>

P3933O10

Syntax for "Language" column

The syntax for the entries in "Language" colum **Com1** is:

[COV1,[COV2]]<MemberID,StateID,[Gain],[Offset],[subst],CName,R|W >

Element	Meaning
COV1, COV2	Optional members for COV increment. If no default value is set, a value of 0.1 is used. This COV value is only valid if there is no COV subscription. In this case, the COV value from BACnet is used.
MemberID	The MemberID whose value is written to or read from. If just a bit is needed, addressing "MemberID.Bitposition" (e.g. 5.1).is used. In this case, the member value is converted to an ULONG and calculated from bit no. 1. Afterwards, value is written back to its native format.
StateID	The status Member. If set to -1 it is disabled
Gain	Gain factor (default = 1.0)
Offset	Offset (default = 0.0).
	OBHvalue = Receivedvalue * Gain + Offset
subst	Substitution table which allows a remapping of the present value. E.g. 1=2; 3=4; 7=0.
CName	Unique identifier of the client connection
R/W	Only one of the following flags R,W,C,U R = Input Value W = Output Value H=Default: = Input value with received heartbeat. Use this default value if there are missing received heartbeats or in case of a communication error.

2. Create "BACnet.csv"   Configure the second file (server → link variable). Procedure:

Step	Action
1	Start file "**BACnet.csv**" in Excel.
2	Configure in column 1 as per the syntax below.
3	Save the file to binder **Online** of the SCOPE project.

🛑 At present, only PropertyID "Present Value" (member "PrVal") is supported.

Sample row for mapping temperature setpoint W:

P3933O11

Explanation of the row   Variable "Temp" with priority 5 is to be read at the VAV device with Device ID "50" at "AI" No. "3".

Entry syntax   The syntax for the entries in file "BACnet.csv" is:

CName,DevID,ObjTyp,ObjInst,[PropertyID],R|W|C|U=time,[1..16], [Gain],[Offset],[subst]

Element	Meaning
CName	Unique identifier of the client connection (e.g. "Temp").
DevID	BACnet DeviceID of the remote device (e.g. "50").
ObjType	BACnet ObjectType of the remote object: AI,AO,AV,BI,BO,BV,MI,MO,MV (e.g. "AI").
ObjInst	BACnet ObjectInstance of the remote object (e.g. "3").
PropertyID	BACnet PropertyID, in the first version only PresentValue is supported (85).
R/W/C/U	Only one of the following flags R,W,C,U (here "R") – W = Time: Write the present value of a remote object on ValueChange with Heartbeat time. (Default = 60, 0 is set to default) – R = Time: Read the present value of a remote object within the defined polling time. (Default = 60, 0 will be set to default) – C = Time: Use a confirmed COV subscription for updating from the remote object. Time = Resubscriptiontime (Default = 300, 0 is set to default) – U = Time: Use an unconfirmed COV subscription for updating from the remote object. Time = Resubscriptiontime (Default = 300, 0 is set to default)
1..16	Priority for writing or H=DefaultValue (here "5")
Gain	Gain factor (default = 1.0) used only for analog values.
Offset	Offset (default = 0.0) `OBHvalue = Receivedvalue * Gain + Offset`
subst	Substitution table which allows a remapping of the present value. OBHVal1=Val1; OBHVal2=Val2….. OBHVal2=Val2;DefaultObh;Default E.g. 1=2; 3=4; 7=0;8;8

🛑 Values set for "Gain", "Offset" or "subst" overwrite the values of 0x8115 defined in file "BACnet_Client.csv".

Configure as Climatix client, *continued*

3. Download files

Download files using SCOPE via USB or Ethernet port to the controller. Procedure:

| Step	Action
1	Download **BACnet_Client.csv** (as for OBH.bin).
2	Download **BACnet.csv** via **Load Files**, see below: *Notes:* – The file name **must** be "BACnet.csv". – This file cannot be downloaded any other way, e.g. via SD card.
3	Client setup is done. After startup, the controller automatically provides the required data to the communication module.

8.6   Typical router settings

Topology

Typical router settings relate to integration as per the example in Section 8.1 "Overview":
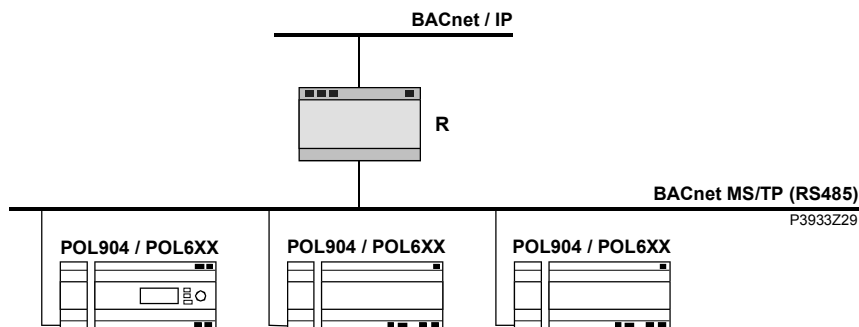
BACnet/IP settings

IP settings comprise the following parameters and values:

Parameter	Value	Description
IP	192.168.16.3	IP address of the router
Network mask	255.255.255.0	Subnet mask
Default gateway	192.168.16.1	IP address of default gateway
UDP port	47808	BACnet/IP UDP port number
DNET	1	Directly connected network number
MAC	00:20:4A:B1:4C:7F	MAC address of the router

MS/TP settings

MS/TP settings comprise the following parameters and values:

Parameter	Value	Description
Baud rate	76'800	Baud rate (bps)
This station (MAC)	1	MAC address of this MS/TP node
Max info frames	1	Maximum number of information frames a node may send before it must pass the token
Max master	127	The highest allowable address for master nodes (not exceed 127)
Reply timeout	255 ms	The minimum time that a node must wait for a station to begin replying to a confirmed request (255 … 300 ms)
Usage timeout	20 ms	The minimum time that a node must wait for a remote node to begin using a token or replying to a poll for a master frame (20 … 100 ms)
DNET	2	Directly connected network number.

8.7 Commission BACnet MS/TP module

Active devices

The Climatix controller and the communication module are involved in this action:
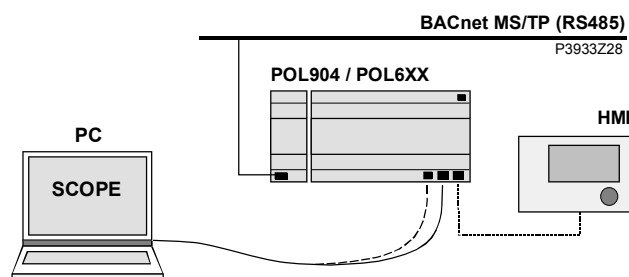
Tools

Tools used:
– Operator unit (HMI).
– PC with SCOPE.

Commission the controller

Prerequisite: The SAPRO application (MBRCode.bin) is fully commissioned.
Proceed as follows for BACnet:

Step	Action
1	Download the mapping files created previously to the controller: • Controller is **server**: "OBH.bin" (generated from "BACnet_Server.csv"), see Section 8.3. • Controller is **client**: "BACnet_Client.csv", see Section 0.

Commission BACnet MS/TP module

Proceed as follows to connect the BACnet/IP module to the bus and configure it:

Step	Action
1	Controller **OFF**.
2	Connect BACnet MS/TP module to the controller via plug connection.
3	Connect the BACnet MS/TP bus cable to the module.
4	Controller **ON**: → The module starts / initialization begins. → As soon as the two LEDs "BSP" and "BUS" are steady green, communication with the controller and bus (BACnet) is active.
5	Enter the BACnet settings via HMI or SCOPE; see Section 8.4, "Configure BACnet MS/TP module".
6	If the controller is **client**: Download file "BACnet.csv"; see Section 0.

8.8 Upgrade BSP via SD card

Devices involved

The Climatix POL6XX controller and the BACnet MSTP module POL904 are involved in this action:

BACnet MS/TP (RS485)

POL904 / POL6XX   P3931Z32   BSP   BUS
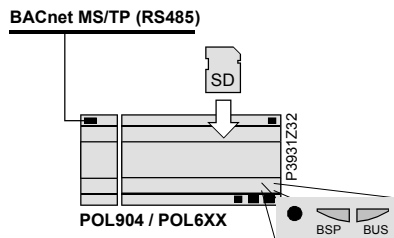
Prerequisite

To upgrade the BSP for the BACnet MSTP modul the following items are needed:

- SD card
- BSP file

Upgrade procedure

To upgrade the BSP proceed as follows:

Step	Action
1	Format an SD Card with FAT file system (not FAT-32).
2	Copy the BSP file to the SD Card and rename it to **POL8194.hex**.
3	Switch **OFF** the power supply of the controller.
4	Insert the SD card into the controller.
5	Press the small button near by the BSP LED (e.g. with a paper clip).
6	Switch **ON** the power supply: – If the BSP red LED is switched off the controller is in BSP upgrade mode. – If the BSP LED flashes between Red and Green the controller files will be updated
7	Wait until the BSP LED is yellow or switched off.
8	Carry out a further restart: Switch the power supply **OFF** / **ON**.

8.9 Network troubleshooting

Introduction

Let's assume you used your entire know-how to set up the network, but performance is unsatisfactory or unacceptable, e.g. loss of data packets, noise and collisions.
In this case, consult an expert to solve the problems. The following sections list a few issues the expert will want to check.

Reflections

You cannot identify the impact of reflection without oscilloscope and associated knowledge. However, their impact can be eliminated easily as follows:
1. Locate the nominal impedance in the cable specifications and buy two resistors with the same value.
2. Install one resistor each at the end of each trunk between Tx and Rx connections.

If no obvious ends exist (because you're using a star topology), we recommend to recable the network and use one line; see Section 7.1 "Topologies".

| i | Some devices have an integrated terminating resistance. It may be active by default. Deactivate it unless the device is the last in the network. Consult the data sheet.

Biasing etc.

This phenomenon has different names: Biasing, Idle State Biasing, Fail Safe Biasing, Anti Aliasing. However, the issue is always the same:

To be able to work with just two wires on RS485 (in contrast to 4-wire full duplex), each device, transmitter and receiver, must be set to idle state to free up the line for use by other devices.

Float lines (free up lines)

Freeing up a line means to float the line. However, the line may not float at any level; for this reason, devices have pull-up/pull-down resistances to make sure the line has the allowed floating voltage.
Comment: The floating state is also referred to as "Tristate".
Loads from other network devices influence floating. For this reason, resistance values may need to be exchanged. This is done in accordance with the number of installed devices as well as their pull-up/pull-down resistance, which can be very tricky because:
If another device is floated in the given range, other devices assume that the device does not float at all. They assume that the device is sending or receiving, thus blocking the line.

Which device is at fault?

The easiest way to answer this question is to reply to the following question: Does the device work properly when alone on the network? If you install the device in a busy network, other devices or this device no longer work properly. Check the device and/or the pull-up/pull-down resistance of other devices.

Installed pull-up/pull-down resistances

Some providers install a number of pull-up/pull-down resistances in their devices, allowing for selection via software or jumper.

9 Appendix

9.1 BACnet object types

Overview

Climatix supports the object types listed below:

Object type	Supported	Can be created dynamically	Can be deleted dynamically
Analog Input	☒	☐	☐
Analog Output	☒	☐	☐
Analog Value	☒	☐	☐
Binary Input	☒	☐	☐
Binary Output	☒	☐	☐
Binary Value	☒	☐	☐
Calendar	☒	☐	☐
Command	☐	☐	☐
Device	☒	☐	☐
Event Enrollment	☐	☐	☐
File	☐	☐	☐
Group	☐	☐	☐
Loop	☐	☐	☐
Multi-State Input	☒	☐	☐
Multi-State Output	☒	☐	☐
Multi-State Value	☒	☐	☐
Notification Class	☒	☐	☐
Program	☐	☐	☐
Schedule	☒	☐	☐
Averaging	☐	☐	☐
Trend Log	☐	☐	☐
Life-Safety-Point	☐	☐	☐
Life-Safety-Zone	☐	☐	☐
Accumulator	☐	☐	☐
Pulse-Converter	☐	☐	☐

Description

See the following basic document for a detailed description of the individual object types:

CB1P3939en_02
"BACnet Protocol Implementation Conformance Statement (PICS)"

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BACnet communication modules
Appendix CB1P3933en
22.03.2010

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