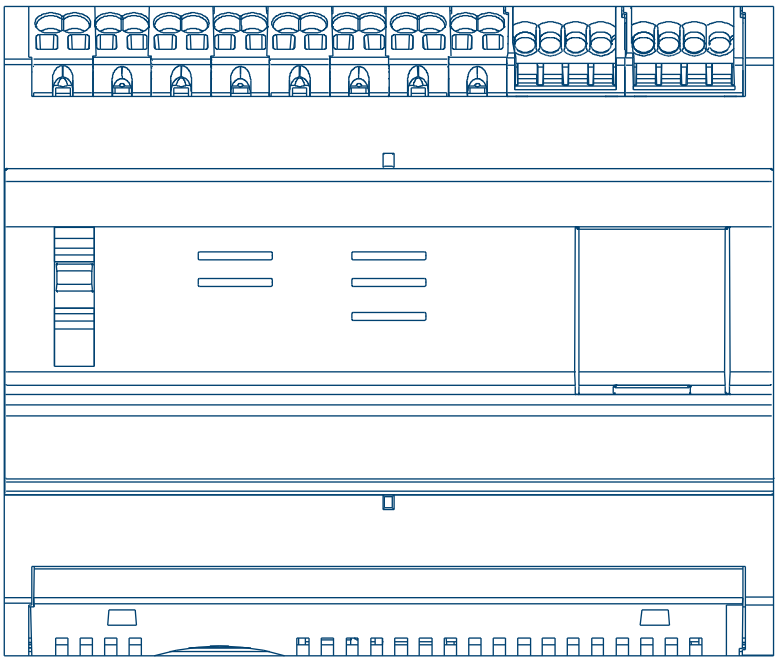
configuration guide

agardio. manager BACnet Server



agardio.manager BACnet Server
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01 Introduction

01.01 **Purpose and scope** 05
01.02 **Conventions, definitions (glossary), acronyms, abbreviations** 05
01.03 **References** 05
01.04 **Certification** 05

02 Activation and Basic Configuration

02.01 **Activation of the BACnet Server in Agardio manager** 06
02.02 **Configuration of the BACnet Server in Agardio manager** 06
02.03 **Server settings** 07
02.04 **Communication Settings** 08
02.04.01 Discovering state 08
02.04.02 Foreign device 08
02.04.03 Time synchronization 09
02.04.04 Maximum configuration 09
02.04.05 Technical message format 09
02.05 **Notification of server restart** 10
02.06 **BACnet peer referenced** 11

03 Configuration of the BACnet objects

03.01 **Measurement services** 12
03.01.01 Create a single object 13
03.01.02 Out Of Service status 14
03.01.03 Create multiple object 15
03.01.04 Update an object 15
03.01.05 Delete an object 15
03.02 **IO inputs / outputs** 15
03.02.01 Add an output object 16
03.02.02 Out Of Service status 17
03.02.03 Update an output object 18
03.02.04 Delete an output object 18
03.03 **Calendars** 18
03.03.01 Create a calendar object 18
03.03.02 Update a calendar object 20
03.03.03 Delete a calendar object 20
03.04 **Schedule** 20
03.04.01 Create a schedule object 21
03.04.02 Out Of Service status 24
03.04.03 Update a schedule object 24
03.04.04 Delete a schedule object 24

03.05 Notification list 25
03.05.01 Creation of notification list 25
03.05.02 Recipient Configuration 26
03.05.03 Update notification list 26
03.05.04 Delete notification list 26
03.06 Event 27
03.06.01 Creation of event object 27
03.06.02 Update event object 28
03.06.03 Delete event object 28

04 Maintenance of BACnet server

05 Use case examples

05.01 Reduction of integration time with automatic detection of Agardio manager 30
05.02 Reduction of integration time by using BACnet time synchronization 31
05.03 Avoiding communication problems when using IP routers 32
05.04 Optimize the communication operation between Agardio manager and the BMS 33
05.05 Schedule a dedicated process 35

01 Introduction

01.01 Purpose and scope

This document is a guide for Agardio manager BACnet server. It describes the functionalities delivered by the device according to the BACnet/IP protocol and the services delivered to BACnet clients.
A pre-requirement for complete understanding of this documentation is a minimum knowledge about BACnet protocol and the protocol high level features.

01.02 Conventions, definitions (glossary), acronyms, abbreviations

Abbreviation	Signification
AON	All or Nothing (relay)
APDU	Application Protocol Data Unit
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
B-AAC	BACnet Advanced Application Controller
BBMD	BACnet/IP Broadcast Management Device
BDT	Broadcast Distribution Table
BTL	BACnet Testing Laboratories
COV	Change of Value
FDR	Foreign Device Registration
HVAC	Heating Ventilation Air Conditioning
IP	Internet Protocol
MSTP	Master Slave Token Passing
UDP	User Datagram Protocol
UTC	Universal Time Coordinated

01.03 References

	Reference	Title
[Ref-1]	http://www.bacnet.org/Tutorial/HMN-Overview/sld001.htm	BACnet official introduction
[Ref-2]	http://www.bacnet.org/Tutorial/BACnetIP/index.html	BACnet/IP introduction
[Ref-3]	ISO 16484-5	BACnet standard
[Ref-4]	https://www.bacnetlabs.org/resource/resmgr/Files/BTL_Implementation_Guideline.pdf	BTL implementation Guide, containing BTL specific requirements.
[Ref-5]	ttps://www.bacnetinternational.net/catalog/manu/hager%20electro%20sas/pics_1.7.1.pdf	Agardio PICs

01.04 Certification

Agardio manager is certified for B-AAC profile according to the standard version 1 revision 14.
List of supported service is available in PICS document (Ref-5)

02 Activation and Basic Configuration

02.01 Activation of the BACnet Server in Agardio manager

Agardio manager is a server able to communicate on several protocols, such as BACnet, that are not all activated by default. For the activation of the non-standard protocols such as BACnet server a special Login **Integrator** is required.
The user connects to the HMI with the special login called **Integrator**. By default the password is **Integrator**.
On the **Preferences** application, the **System** page presents BACnet server activation status.
After activating the server and saving change, the user can see a new page: **Preferences** | **Servers** | **BACnet Server**.
By setting this status, the protocol becomes visible but not running yet. More configuration is required (like Ethernet interface, UDP port and so on) before to have a runnable configuration.

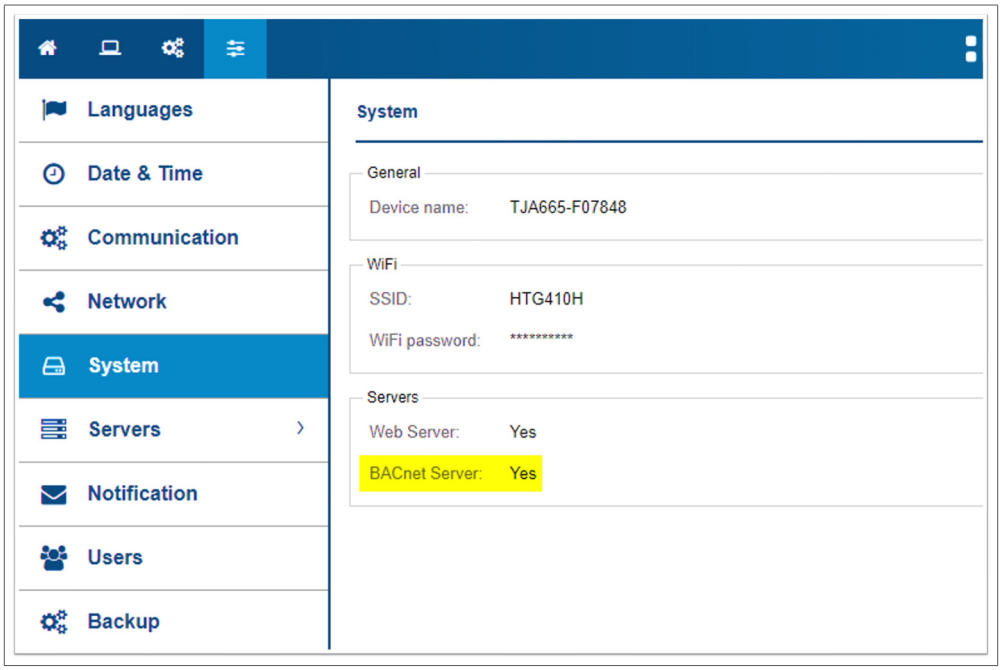

Fig. 1: Activate BACnet in the system configuration

02.02 Configuration of the BACnet Server in Agardio manager

On the page **Preferences** | **Servers** | **BACnet Server**, every administrator is able to begin the BACnet server configuration by setting the **Activated** field to **Yes**. Then the BACnet configuration shall be completed.
After registering these changes by clicking **Save** button, the server starts automatically.
Be careful: when the Agardio manager is started in Setup Mode, the BACnet is never available.
BACnet server is started only when Agardio manager is started in normal mode.

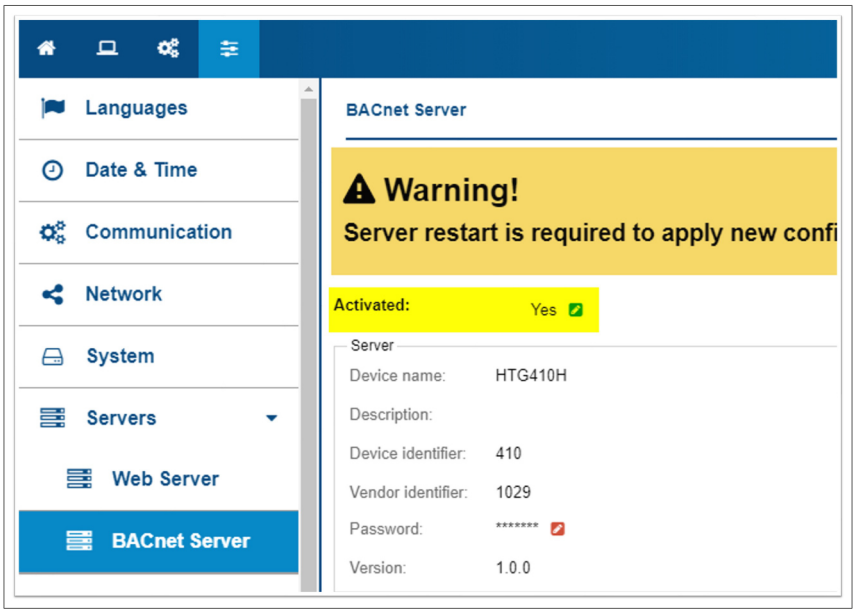

Fig. 2: Overview BACnet Server Settings

The server configuration is divided into:

– Server settings
– Communication settings
– Restart notification
– Peer list

Each of these sections will be described in following section.
The modification of any server parameter is not immediately applied because these changes can have major impact on server behaviour and capabilities.
BACnet protocol is Object Oriented where Agardio manager server is the **Device** object, and measurements are **Analog** objects. Schedule, calendar and other BACnet entities are so much object types.
It results that the configuration will be done through several types of object.

02.03 Server settings

The first section of the BACnet server configuration is the descriptive properties of the BACnet **Device** object. The name and the description are plaintext field and have no impact on BACnet server behaviour.

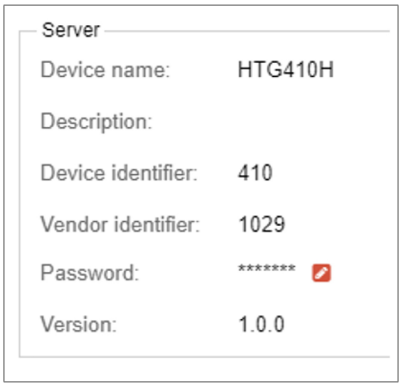

Fig. 3: Server Settings

The Device identifier is an integer value between 1 and 4194303 (0x3F FF FF). The device identifier **must be unique** in a BACnet network otherwise the discovering method is not fully compliant.

By default, the value is initialized to 410 but it is recommended to change it during the device installation.

A password is required to configure the BACnet server following the rules:
– Only alpha-decimal characters
– Password length between 8 and 20 characters

This password is used to access to any protected services (Device communication control and Reinitialize device).

Two additional fields are displayed but not editable:
– Vendor identifier is a static value assigned by ASHRAE for Hager Group devices.
– Version is the BACnet implementation label. This information is referenced in the certification delivered by BTL.

02.04 Communication Settings

The next section of the configuration is the Communication settings.

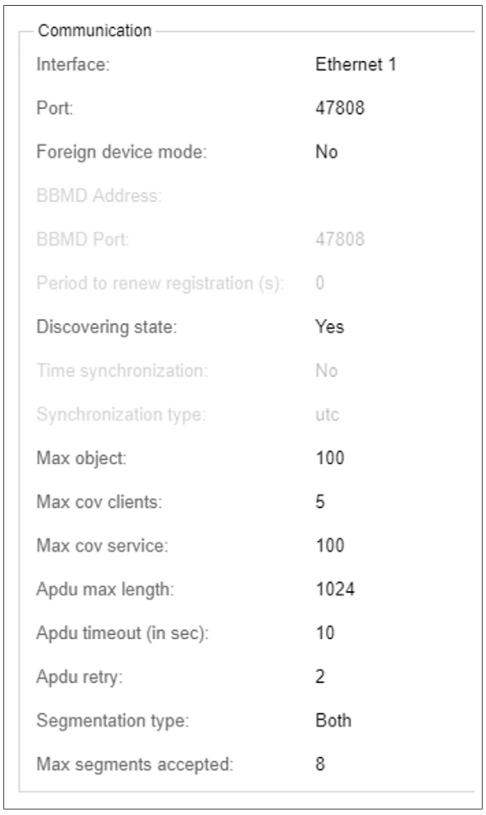

Fig. 4: Communication settings

With these settings, the complete communication ability of the server is configured.
The user shall select the Ethernet interface and UDP port on which the server is bound. By default, the port is configured with the generic value 47808 (decimal value for 0xBAC0).

02.04.01 Discovering state

The **Discovering State** status manages the discovering integration. If this capability is not activated, the device can't be discovered through BACnet services. The server doesn't reply to WhoIs and WhoHas requests and intiate any IAm broadcast request.

02.04.02 Foreign device

Foreign device is an advance feature of BACnet/IP infrastructure that must be deeply understood before

to go further. If user has no knowledge about this topic, it probably means that it is not required for his BACnet/IP installation.
The Foreign device mode is an important feature for Agardio manager when it is isolated on a network. Indeed, common network router natively blocks any broadcast as BACnet can produce for WhoIs service for example. If broadcast are blocked, such a device cannot be discovered (and discover any other device). See following figure for a network configuration concerned by Foreign device mode.

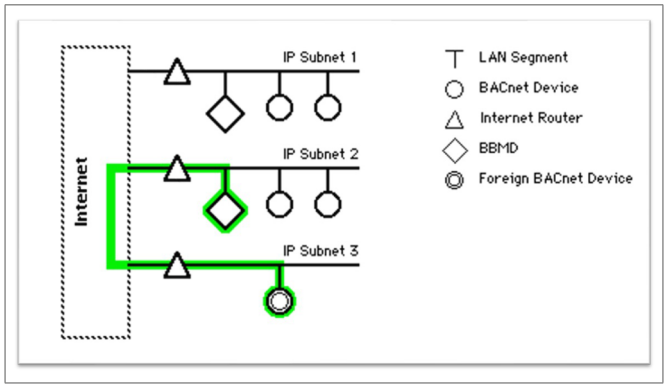

Fig. 5: Foreign device registration

A Foreign device must register it-self to a BBMD device to be able to receive and send broadcast request. The BBMD device IP address and port must be configured in Foreign device configuration.
The period of BBMD registration renew shall be configured in seconds. The default value for this period is 0 that means the registration is limitless. But all BBMD device doesn't accept 0 value and it is not recommended by BACnet standard. A more acceptable value is one hour, i.e. 3600.

02.04.03 Time synchronization

BACnet server is able to synchronize its date and time from a client request. To enable this feature, the administrator selects **BACnet** value in Preferences | Date&Time page.
After this time synchronization method is saved, the BACnet server configuration proposes two new available fields. One to activate the time synchronization, and the second to select the synchronization types.

Two types are supported:
– Utc: the BACnet client must send a UTC timestamp regardless on time zone configuration.
– Local: the BACnet client provides a timestamp in local format. Be careful about different time zone configuration between client and server can induce a wrong synchronization.

02.04.04 Maximum configuration

The capabilities of the device are limited in order to save the process resources (CPU, RAM memory, …) and IT network availability.

These limitations can be adjusted using three fields:
– The maximum number of objects means the number of measurement or event available throw BACnet server.
– The maximum number of different clients for COV subscription.
– The maximum number of COV subscription. This limitation doesn't depend on the number of clients.

02.04.05 Technical message format

These configurations are reserved to client having technical skills about IP infrastructure.

A BACnet message can be split in several APDU depending on the IT infrastructure and the message length. An APDU is a set of data sent unitary between devices.
However, the number of APDU by message can be limited to avoid blocking server availability.
The maximum size of any APDU can be managed regarding the network infrastructure. Indeed, short APDU can induce an overload of the network.
A very long BACnet message will be cut in a list of APDU and sent one by one to the client.

This slicing is named segmentation and three types are supported by Agardio manager:
– **None**, the segmented messages are rejected and any message longer than the max APDU length value is not sent.
– **Transmit**, the segmented messages are rejected but a long message is sent as segmented APDU.
– **Both**, the segmented messages are accepted and generated by server.

Because of the BACnet protocol is using UDP protocol, the receiver is in charge to acknowledge the received message. When no acknowledgement is received, the server can retry to send the same message. This capability is configured using APDU retry field.

02.05 Notification of server restart

When a BACnet server restarts an IAm notification is sent in broadcast on the local network. In addition to this notification, a specific message is sent to specified device.
By default, this notification is sent in broadcast on the local network but administrator can configure any remote device. These devices can be located out of the local network for example.

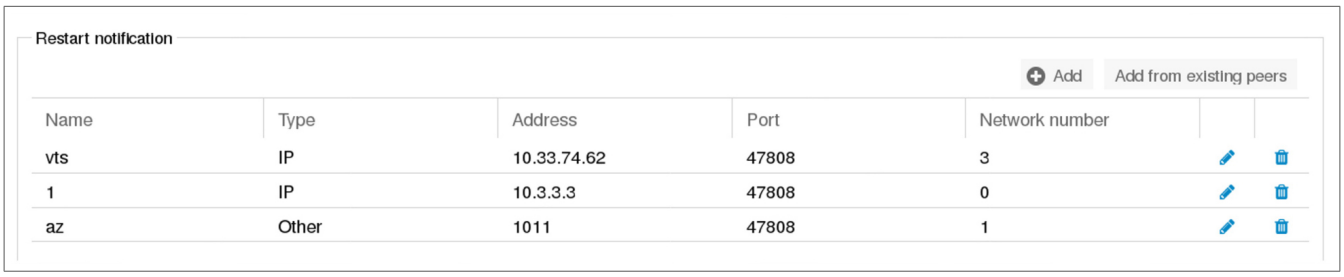

Fig. 6: Management of notifications for server restart

In this section, an administrator can manage the list of recipients notified when server restarts.

A recipient can be added:
– manually by setting a name and a network address set
– from the list of devices detected on network

For maintenance purpose the name must be unique.

A network address set is composed by:
– A type, IP or Other. The second type is used to send a message to a MSTP device through a BBMD device.
– An address compliant with the selected type. MSTP address are composed by hexa-decimal char with even length lower than 10.
– A network number, 0 means the local network. When the Other type is selected, 0 cannot be set in Network number because Agardio manager supports only an local network IP.

02.06 BACnet peer referenced

For easing configuration, Agardio manager is able to discover other BACnet devices available on the network. All BACnet devices found during discovery are displayed into a list. This list helps the user during recipient configuration by setting the address and port of the device automatically.

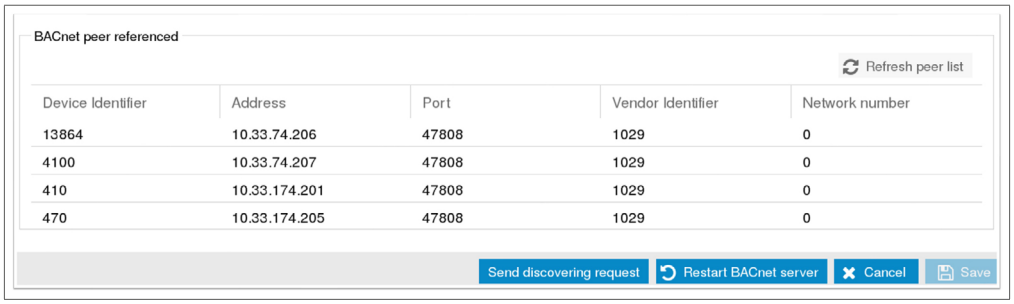

Fig. 7: Peer management

The discovering process can be managed by sending a broadcast request to discover other peers available on local network. This operation is done using the **Send discovering request** button at the bottom of the page.

03 Configuration of the BACnet objects

BACnet device manages internal object and exchange these properties. A single service like V1 voltage is an Analog object providing a list of property: PresentValu, Reliability, and so on.

Agardio manager server supports 9 types of BACnet object:
– **AnalogInput**
– **AnalogValue**
– **BinaryInput**
– **BinaryValue**
– **AnalogOutput**
– **BinaryOutput**
– **Calendar**
– **Schedule**
– **NotificationClass**
– **EventEnrollment**

These objects need to be declared in Agardio HMI to expose measurements or internal capability like schedule. The configurator user creates the objects from Configuration | BACnet. This page is structured by tabs gathering object by type.
Any operation performed about object, creation/update/deletion, are immediately considered by server and existing object are updated. The BACnet server doesn't need to be restarted to activate modifications about object.
Each object of the BACnet server has a name and this name is unique among objects of a single device.

03.01 Measurement services

In order to expose measurement to other BACnet devices, the measurement service has to be exposed as a single BACnet object. For example, a V1 voltage is exposed as an **AnalogValue**.

In fact, measurements can be exposed following 3 BACnet objects:
– **AnalogInput**, for LOCALIO analogue measurements, for example a pulse counter connected directed on the Agardio manager.
– **AnalogValue**, for any service provided by fieldbus devices.
– **BinaryInput**, for LOCALIO binary measurements, for example a relay connected directly on the Agardio manager.
– **BinaryValue**, for any boolean service provided by fieldbus devices.

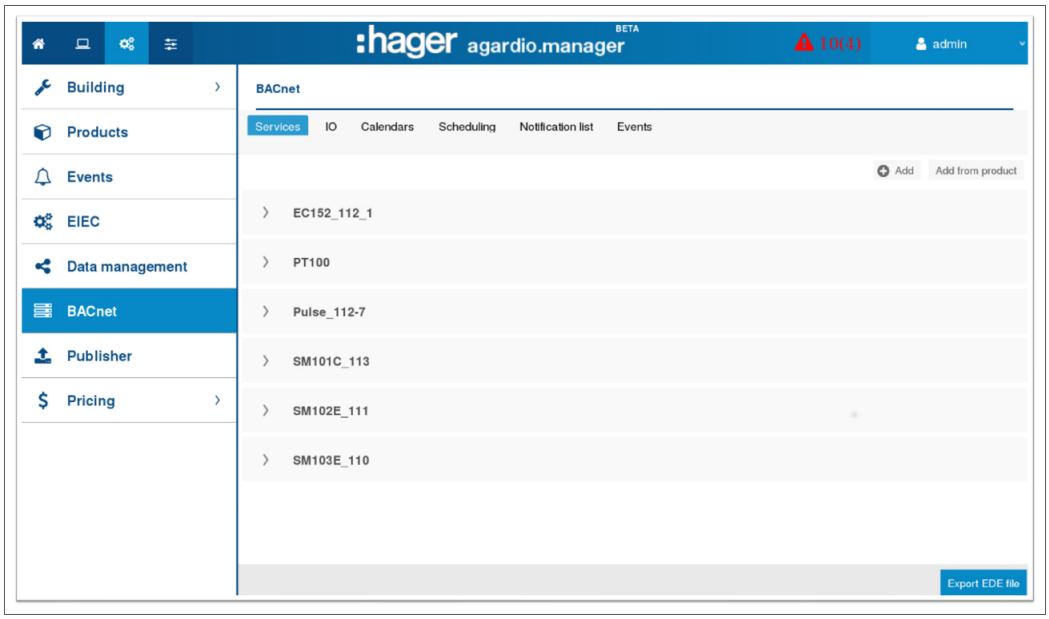

Fig. 8: Overview Services

A configurator user has two ways to create a BACnet object:
– Add a single object by selecting a service of a device.
– Add several objects from a selected device.

In both of these options, the BACnet object type is automatically defined from type of the service and communication method of the device.

03.01.01 Create a single object

By clicking on the button **Add**, the user is asked to select a device and an associated measurement. Keep in mind, the object name must be unique otherwise the creation is rejected.

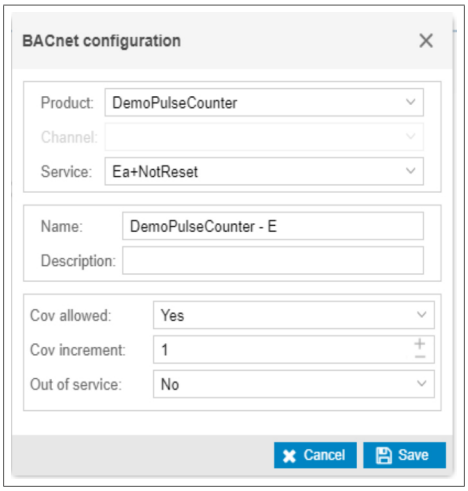

Fig. 9: Service configuration

Then the user is able to update other parameters of the object:

Name	The name of the BACnet object.
Description	Optional ASCII text helping the user to identified the measurement.
COV allowed	The capability for BACnet client to subscribe to the change of value on this object.
COV Increment	The differential value which generate a COV notification.
Out of Service	This value is not available for Binary object because every change is notified.
Polarity	See following section
	Only available for binary objects, the polarity of the input. I.e. with a reverse polarity, the value **true** is converted to **inactive** in BACnet object value.

Tab. 01: Parameters of the object

03.01.02 Out Of Service status

The **Out Of Service** status changes the BACnet object behaviour for BACnet communication test.

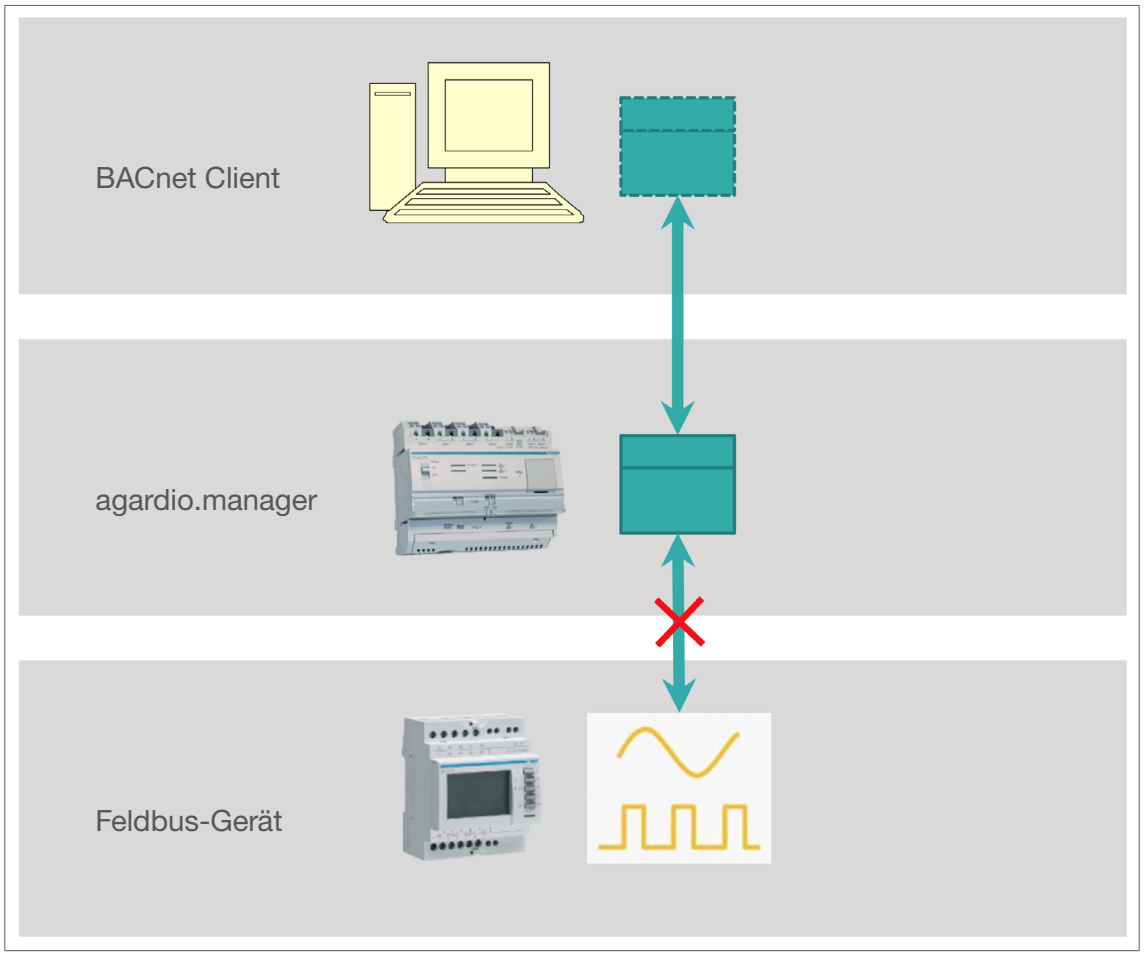

Fig. 10: Illustration out of service

Activating the **Out Of Service** status disconnects the BACnet object from real measurement. If the measurement value change, it is not visible through the BACnet object. Moreover, the object's value and reliability properties become writable.

03.01.03 Create multiple object

By clicking on **Add from Product** button, the user is asked to select a device and the list of all service available is displayed.

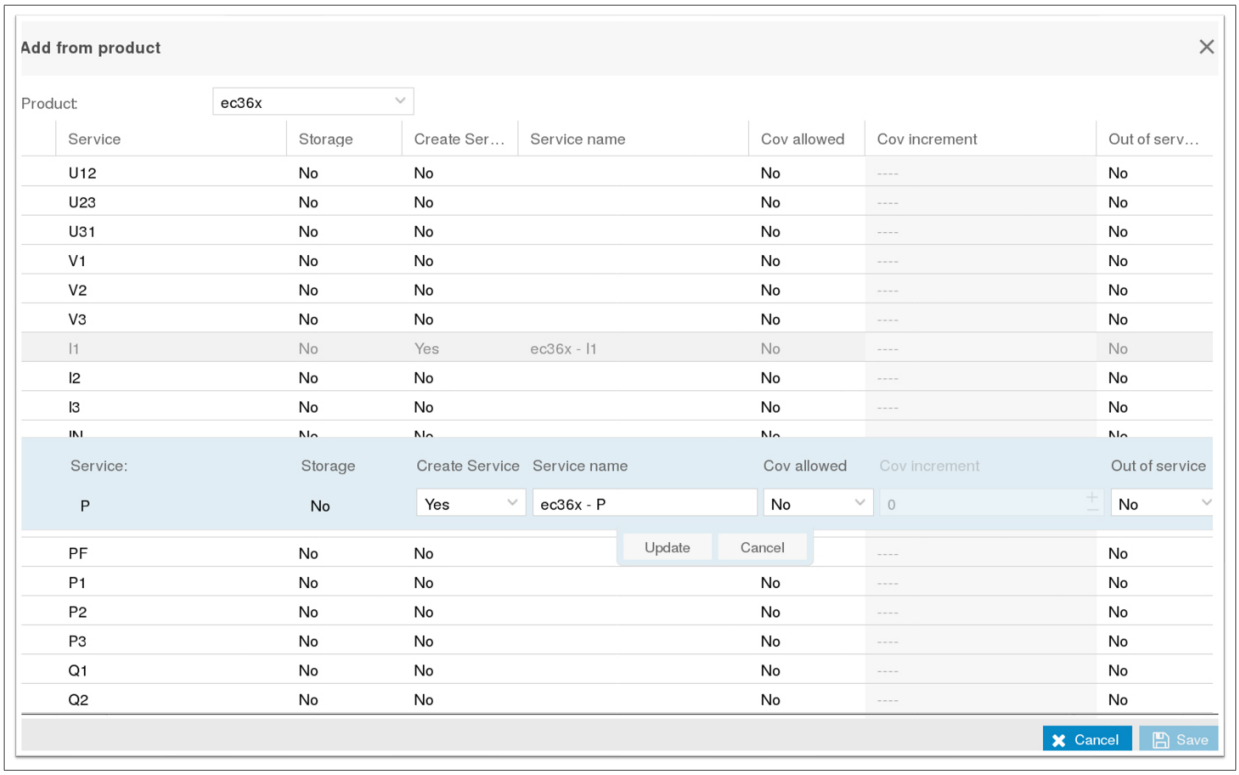

Fig. 11: Services of a device

The list contains all available measurement from the device. It is possible to create only one object per measurement. Once measurement is exposed, then the line in measurement list is greyed.
Clicking on the line opens an editor to configure measurement quickly. All BACnet objects are created on a single time.

03.01.04 Update an object

When an object must be updated, only the measurement associated to this object cannot be updated.

03.01.05 Delete an object

An object can be deleted at any moment except if it is used by any other object. For example, by an Event Enrolment object.

03.02 IO inputs / outputs

The configurator user is able to add output object. Currently two output are available:
– 0-10 V output as an **AnalogOutput**
– AON relay as a **BinaryOutput**

These outputs are physically connected on Agardio manager device.

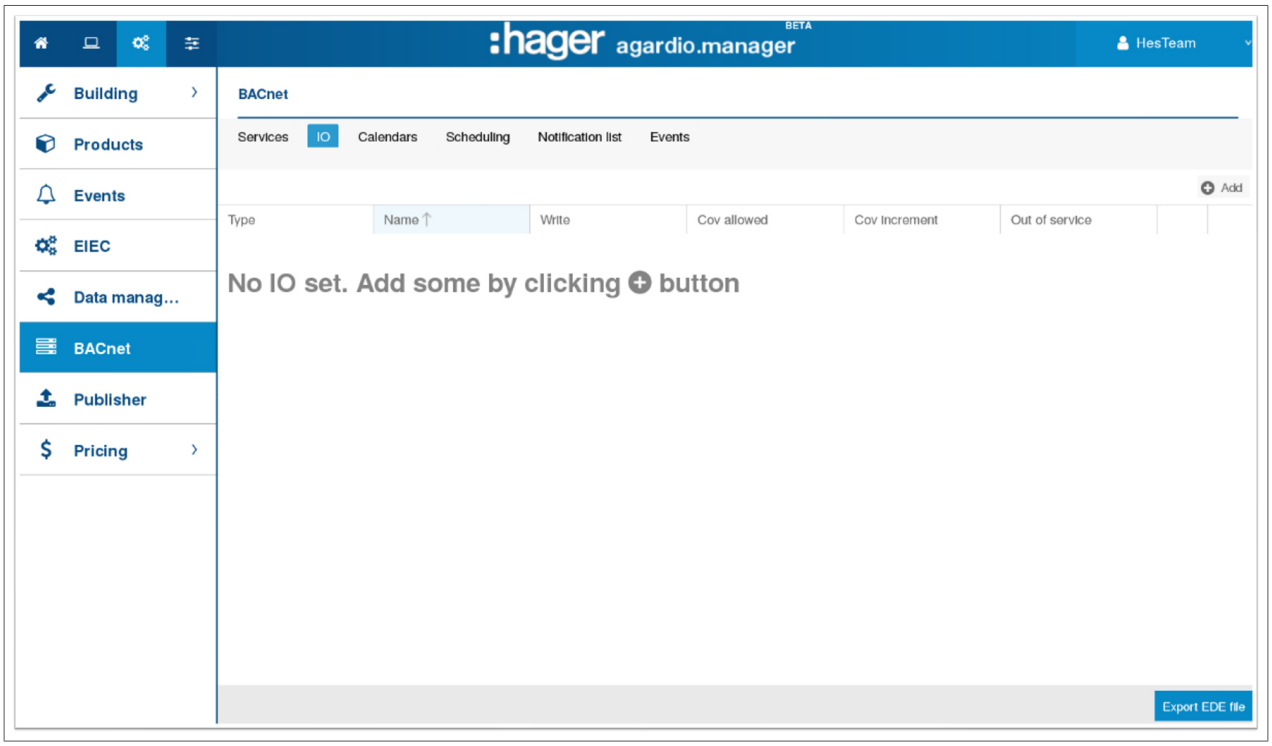

Fig. 12: IO Overview

03.02.01 Add an output object

The adding is the same procedure like in the service section (2.1), only the editable parameters change.

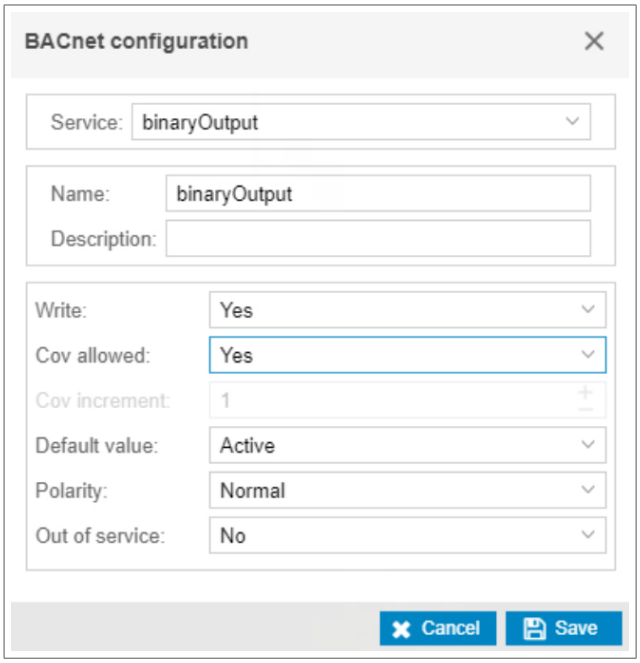

Fig. 13: Binary Output

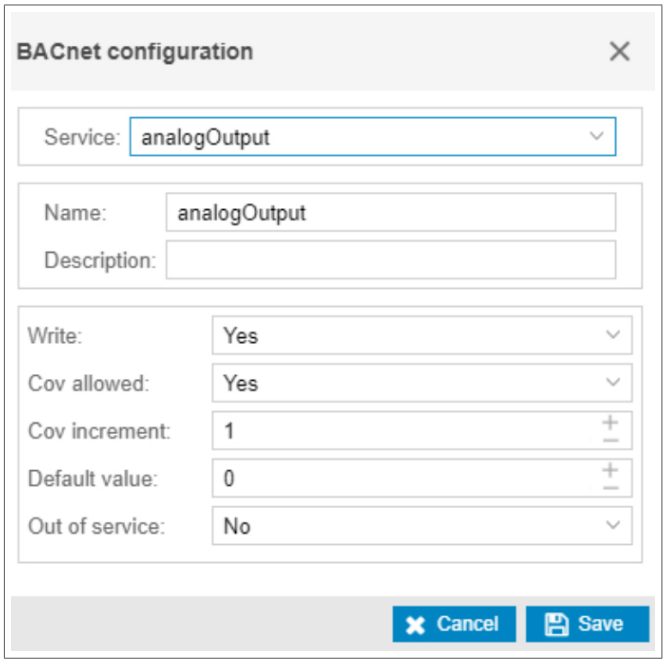

Fig. 14: Analog Output

Name	The name of the output BACnet object.
Description	Here you can describe the function of the service
Write	Enable of this capability allows any BACnet client to change the output value through the BACnet Network
COV allowed	The capability for BACnet client to subscribe to the change of value on this object.
COV Increment	The difference of value between two COV notification. This value is not available for Binary object because every change is notified.
Default value	The value written on output during server initialization if write capability is enabled. Empty value for **0**.
Polarity	Only available for binary services, the polarity of the input. I.e. with a reverse polarity, the value **true** is converted to **inactive** in BACnet object value.
Out of Service	Defines the validity of the value provided by BACnet object. When this flag is activated, the value becomes writable but it has no impact on physical device.

Tab. 02: Parameters of a BACnet output object

03.02.02 Out Of Service status

The **Out Of Service** status changes the BACnet object behaviour for BACnet communication test.

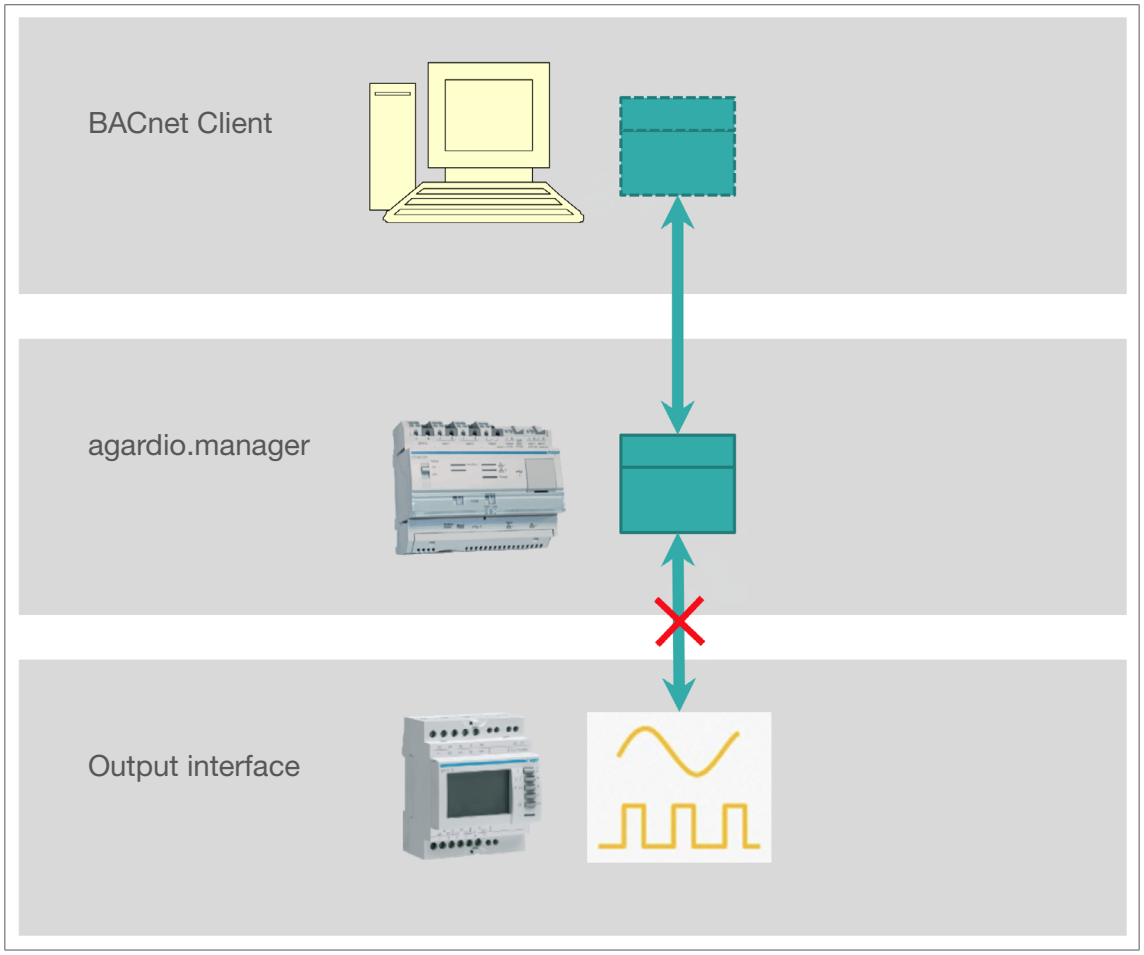

Fig. 15: Status out of service for IO inputs/ outputs

Activating the **Out Of Service** status disconnects the BACnet object from real output interface. The value written by BACnet client are registered by BACnet object but it is not applied on physical output.

03.02.03 Update an output object

When an object must be updated, only the service associated to this object cannot be updated.

03.02.04 Delete an output object

An output object can be deleted at any moment except if it is used by any other object.
For example, by a Schedule object.

03.03 Calendars

The calendar object is available to configure advanced exception of schedule object.
For example, the calendar object can be used to defined rules about vacation or weekend.

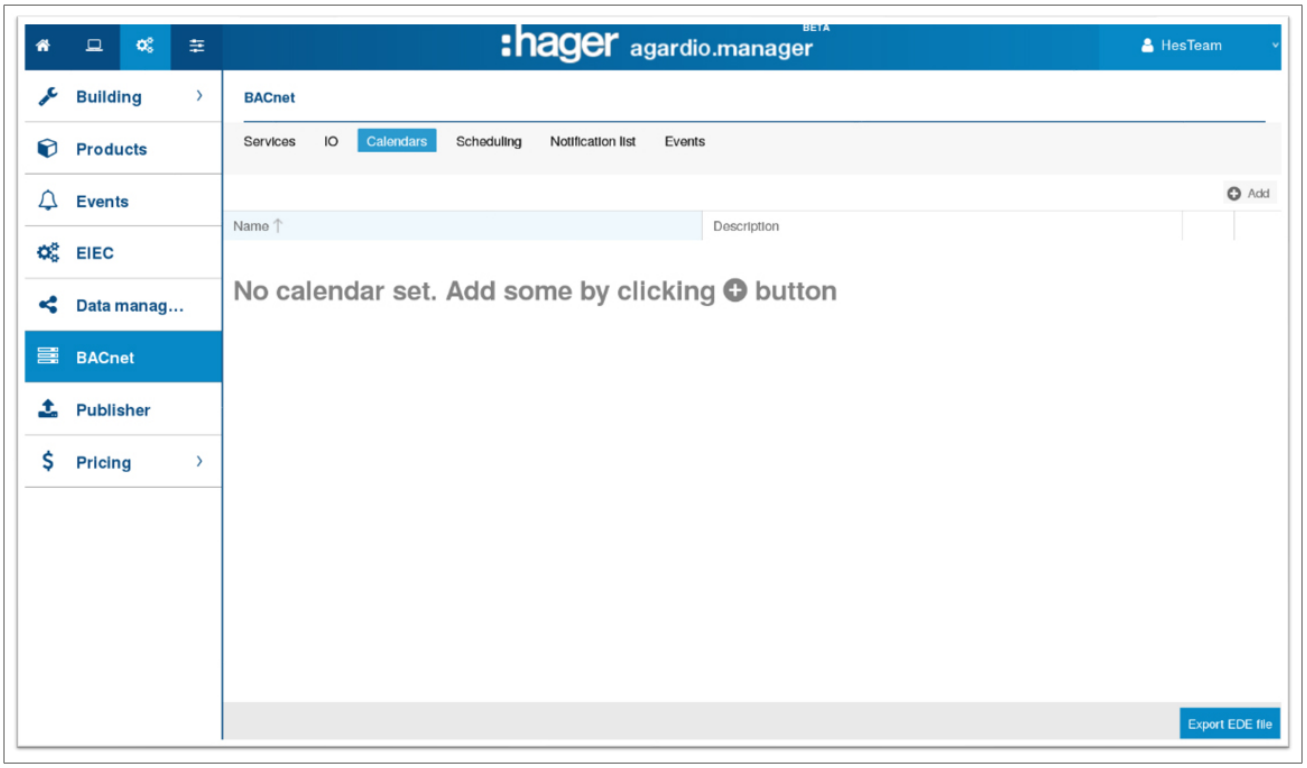

Fig. 16: Calendar Overview

03.03.01 Create a calendar object

By clicking on **Add** button, the user can create a calendar object. This object has a name, a description and a list of periods.

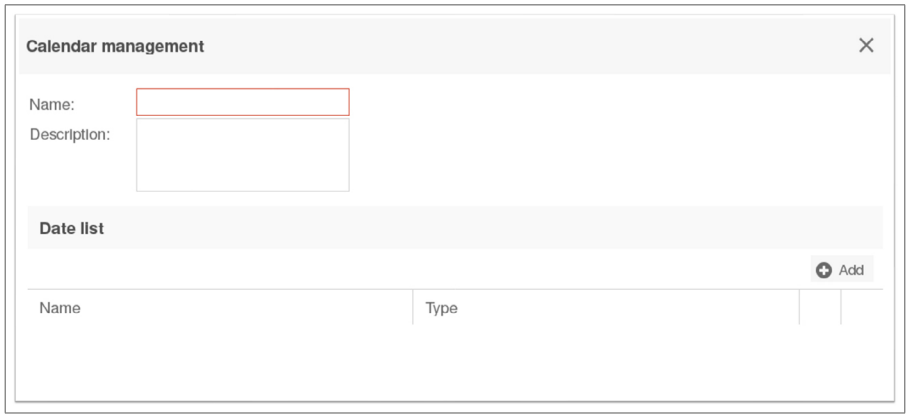

Fig. 17: View on calender object

To add a period, the user should click on **Add** button. A period is defined by a name, a period type and a set of parameters depending on the type selected.

Date type

With this type of period, the user must select a date during which the calendar is applicable.
For more flexibility, the period can take some pattern like any or even or odd item from a set of value.

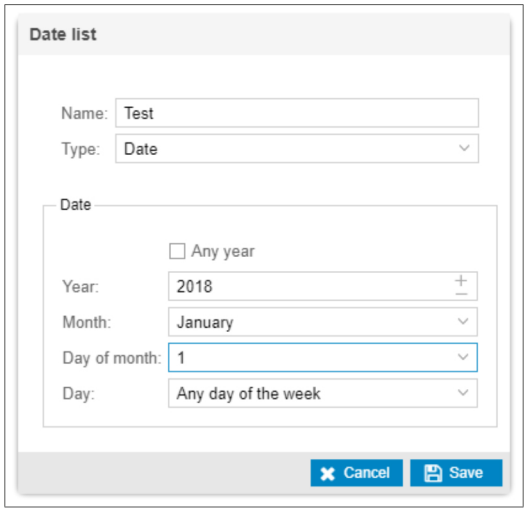

Fig. 18: Period of type **Date**

Date range type

With the type Date range, the user must select a start date and an end date. The calendar is applicable during every day between these two dates.

Each can be set to **Any** that means the limit is not defined:
– Start date to any means: every day until the end
– End date to any means: every day after the start

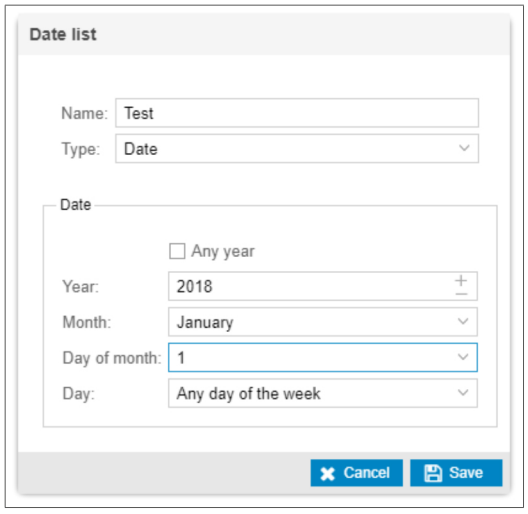

Fig. 19: Period of type **Date range**

Weeks and Days type

The type Weeks and days defined the more flexible date structure. The user must select a month a week and a day.
When he set a fully defined date, the calendar is applicable every date at this date.
Otherwise it is possible to select similar pattern than in date type period.

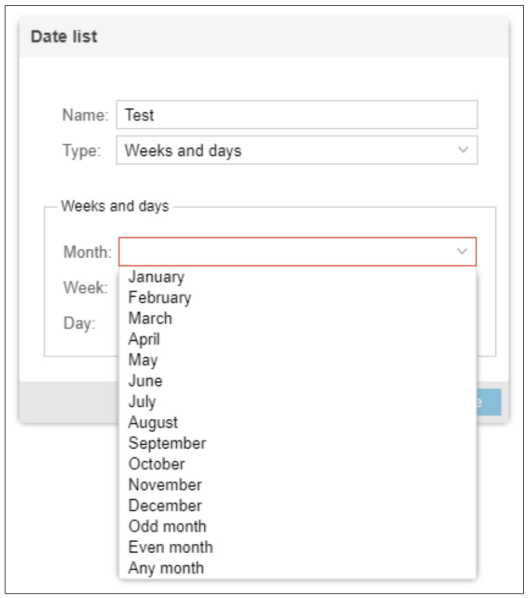

Fig. 20: Period of type **Weeks and days**

03.03.02 Update a calendar object

All field of this type of object can be edited.

03.03.03 Delete a calendar object

A calendar can be deleted at any moment except if it is used by any schedule object.

03.04 Schedule

The Schedule Object is available to manage output object by writing values during a period.

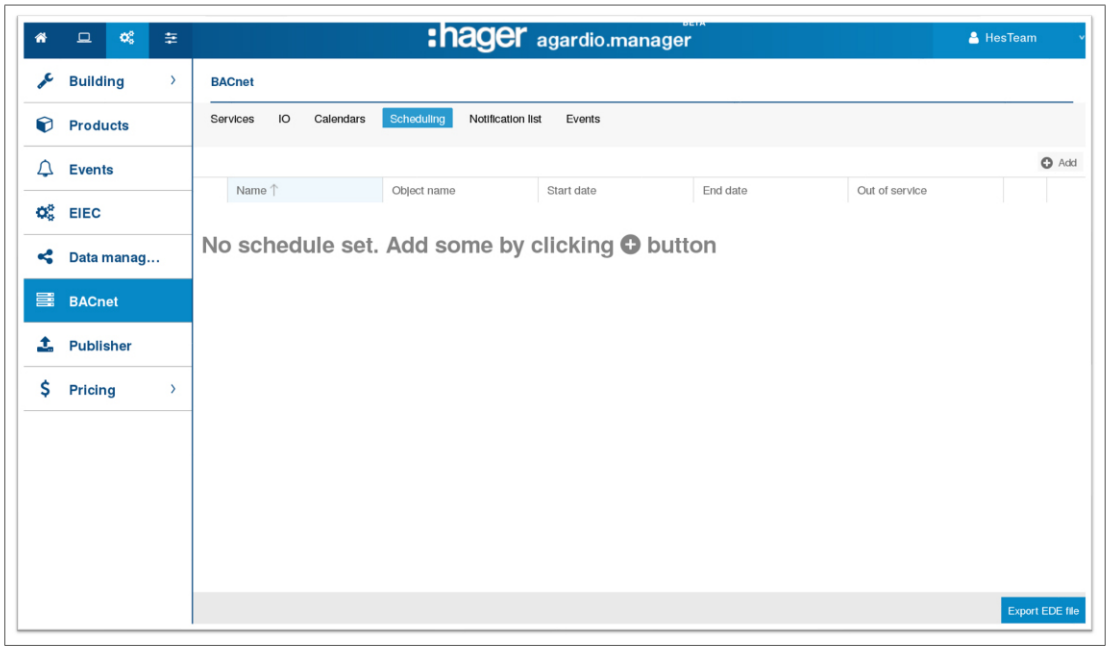

Fig. 21: Schedule overview

Before to be able to create a schedule object, the configurator user must create an output object with write allowed.

03.04.01 Create a schedule object

By clicking on the button **Add**, the user is asked to select a managed object. This object is important because it defines the type of value to configure in schedule, binary or real values.

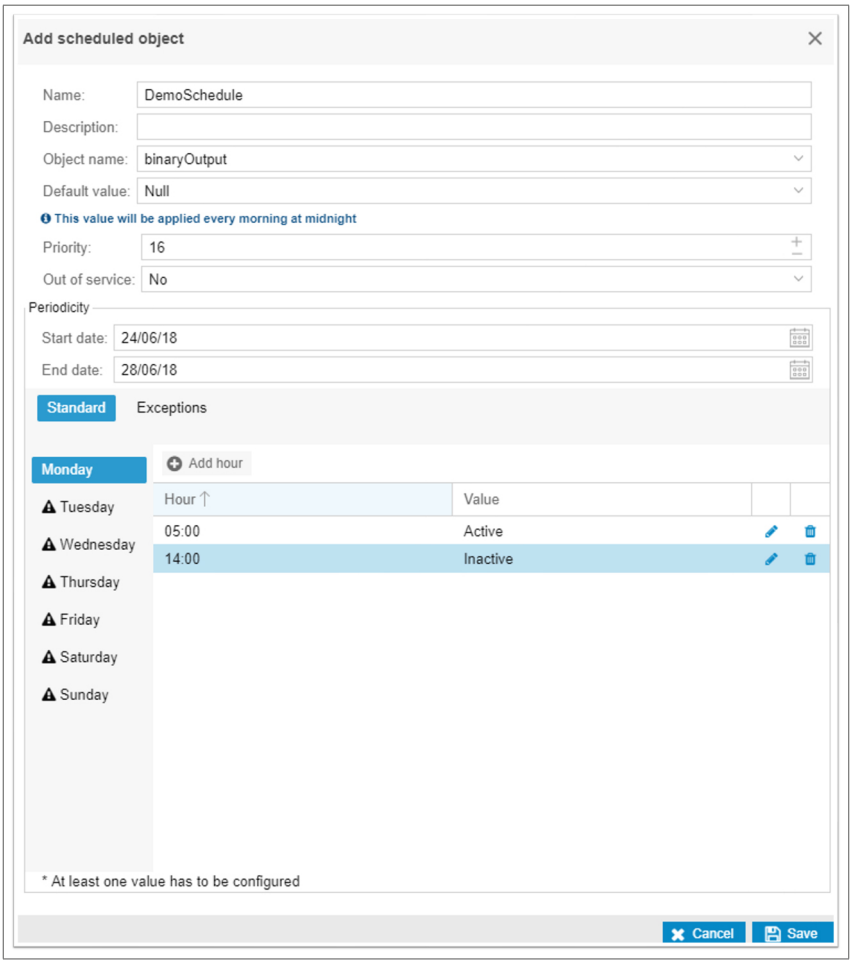

Fig. 22: Overview Object properties

Activated after the selection of reference object, a list of parameters must be completed:

Description	The description of the schedule object
Default Value	The default value of the IO. This value is restored every day at midnight if no rule is configured for this hour.
Priority	The write operation priority.
Out of Service	With this parameter the hardware communication can be blocked. However, the present value is written.

Tab. 03: Parameters of a schedule object

Priority

The priority array is managed by every output object to handle different write operation. The range of values is from 1 (highest priority) to 16 (lowest priority) except 6 that is reserved for internal use. When an operation writes a value, it is applied on output object except if a value is set with higher priority. High priority can be erased by write NULL value.

Default Value
Null

Periodicity
The schedule is applied during every day in the range of date configured in periodicity section.
The applicable rules are defined for each day of week. This week is repeated during all the period of schedule applicability.

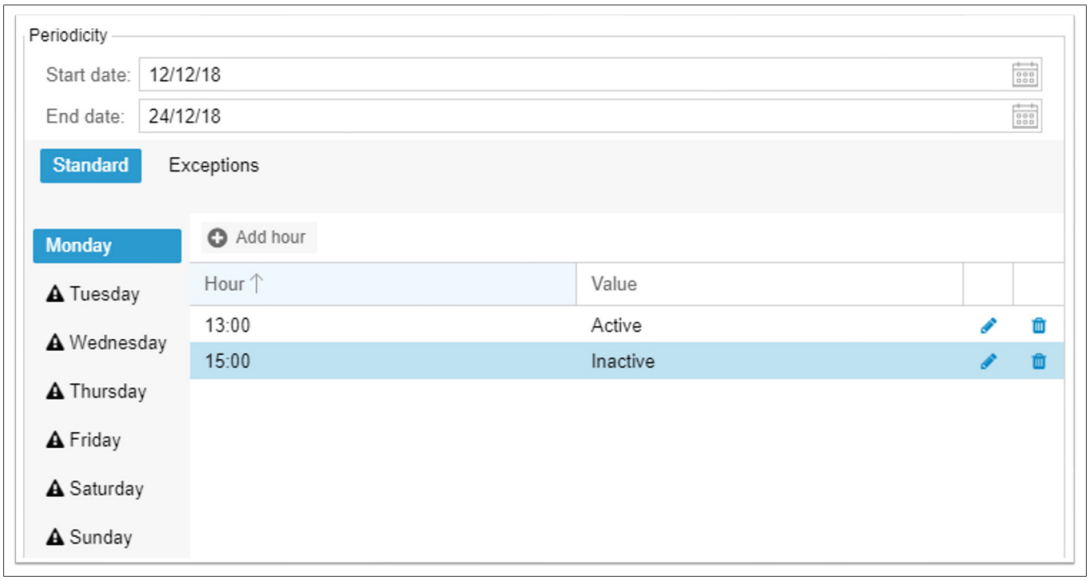

Fig. 23: Periodicity Standard

A rule of day is added by clicking on + **Add hour**, the user is asked to select an hour and a value to apply at this moment.
The hour configured corresponding to a change, that means a user wanting the value 3 to its output between 8am and 2pm must define a rule for 8am and a rule for 2pm to set next value. All intermediate hours are not required.
The NULL value means apply the default value.

Exceptions
To complete the Schedule periodicity, a user can define a list of exception. It is possible to create Exceptions by clicking the + button **Add hour** Button.
Many Exceptions can be created a mechanism of priority exist depending on the list order and the priority of the exception.

Note
This priority is not the same as the priority of the write operation.

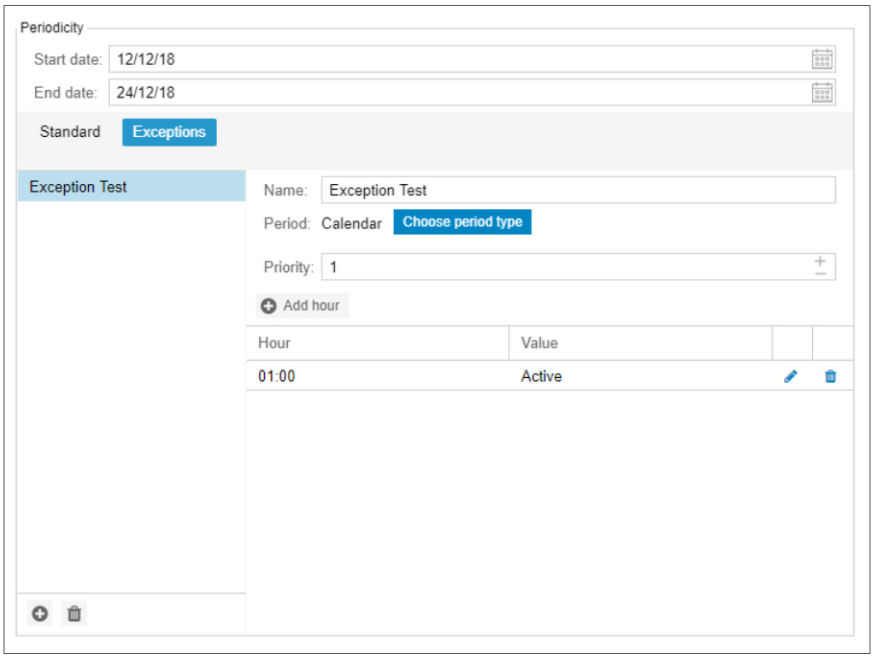

Fig. 24: Periodicity Exceptions

The user must choose a unique name, a validity period, a priority and a list of rules.
In the Period property, the user can choose to use a calendar predefined or define a new period. The available type is the same than in calendar configuration. For maintenance purpose, it is recommended to use calendar object.

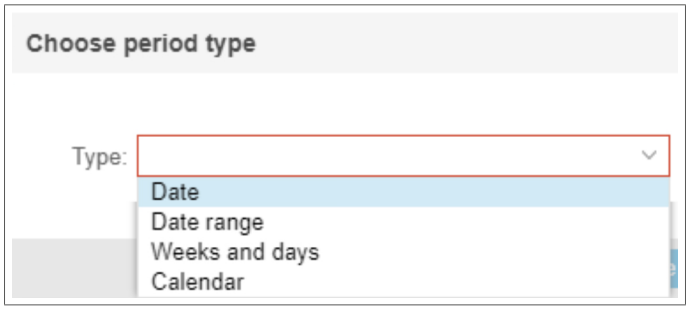

Fig. 25: Available Period types

Exception priority

Each exception has two priorities that defines which one is applied at any moment:
– he relative priority, provided by order in the exception list. First exception is more prority than last
– The absolute priority defined by the parameter priority.

To find which exception must be applied, the Agardio manager find the exception having an applicable period and order by priority. When the rule to apply return NULL value, the next one exception is checked. Do same until a value is found, otherwise standard rules are applied without consideration to exception.

03.04.02 Out Of Service status

The **Out Of Service** status changes the BACnet object behaviour for BACnet communication test.

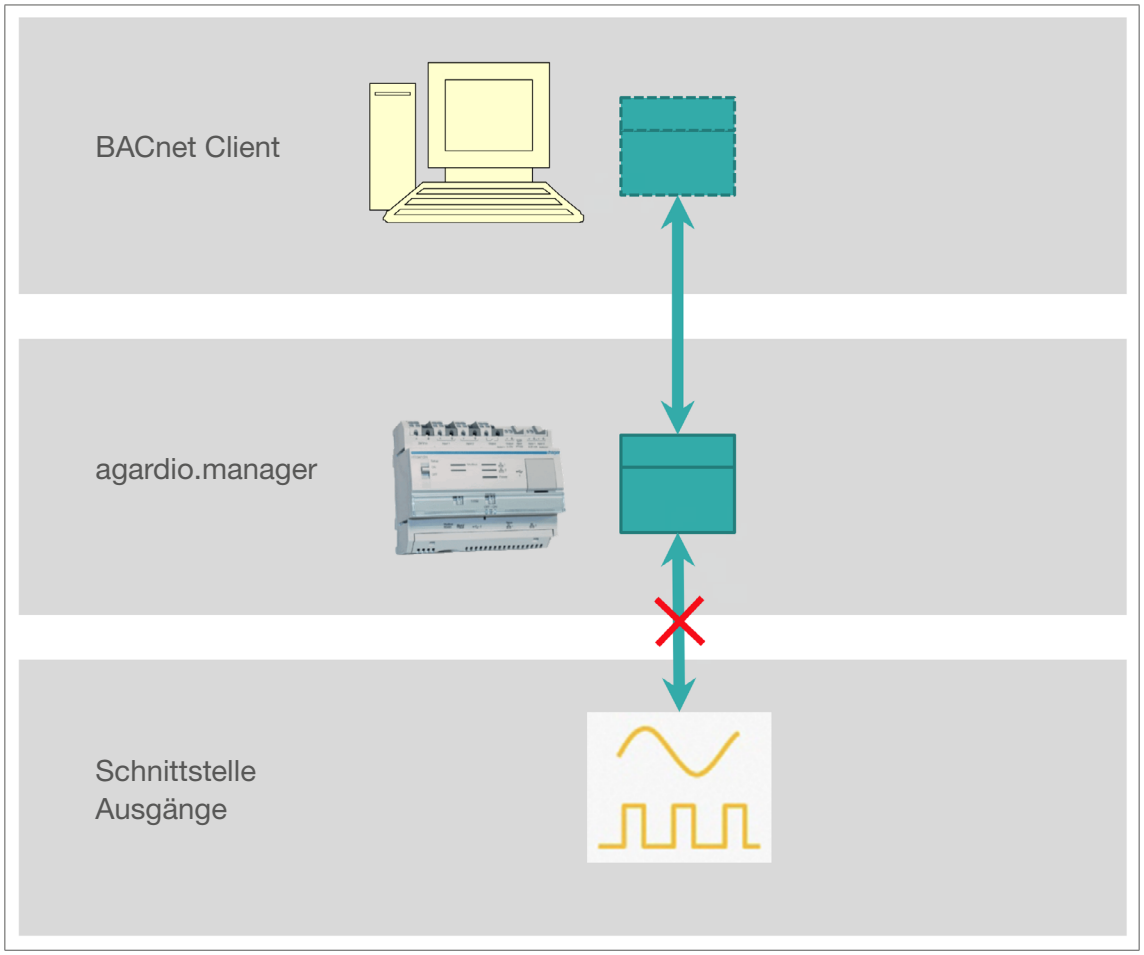

Fig. 26: Out of service status for scheduling

Activating the **Out Of Service** status disconnects the BACnet schedule object from the BACnet output object. So, the schedule value becomes writable.
The value written by BACnet client are registered by schedule object but it is not applied on BACnet output object.

03.04.03 Update a schedule object

All fields of the schedule object can be edited except the output object associated.

03.04.04 Delete a schedule object

A schedule object can be deleted at any moment.

03.05 Notification list

The Notification list is a BACnet Object that is used to configure a list of recipients for event notifications within a BACnet System.

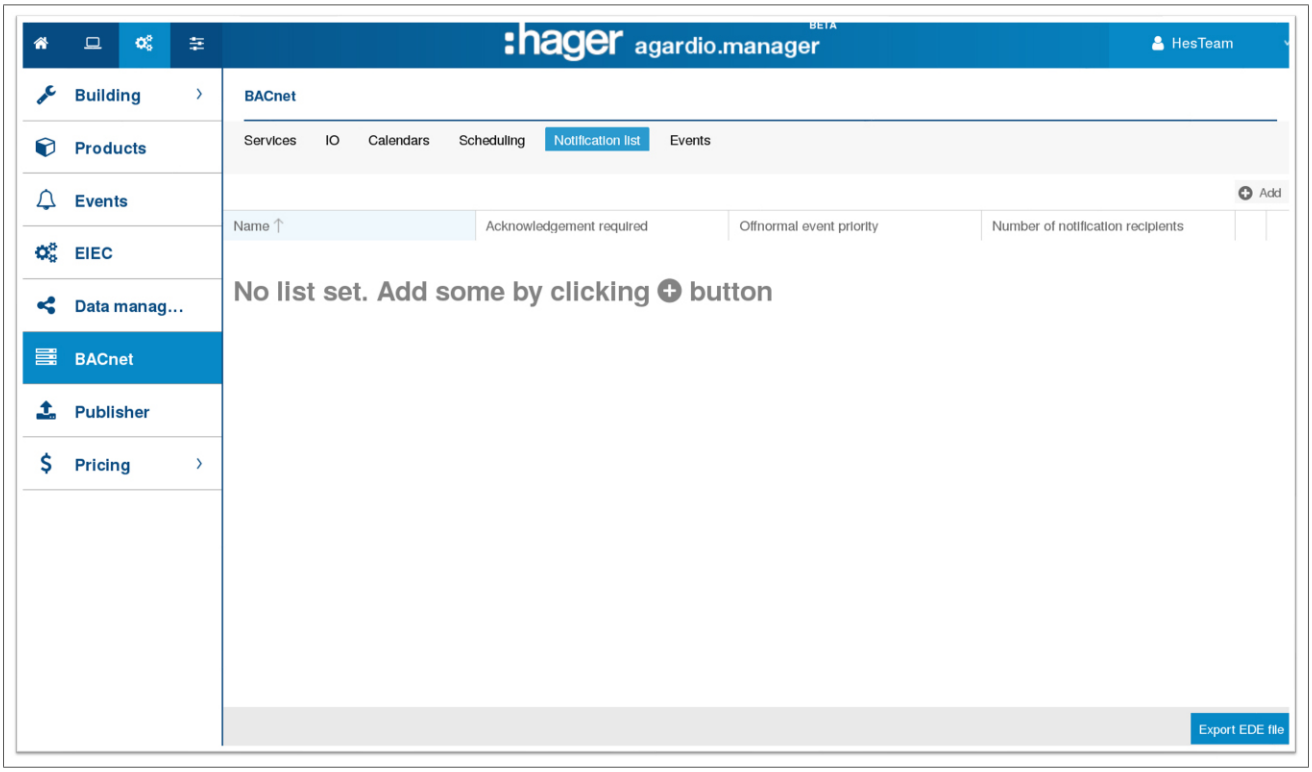

Fig. 27: Notification overview

03.05.01 Creation of notification list

By clicking on the button **Add**, the user is asked to configure a notification list. As for all object a unique name and a description should be set.
The configuration of the acknowledgement defines if the BACnet client must acknowledge the event notification. The normal event never requires an acknowledgement even if this configuration is activated. The priority of the event is sent on the message but has no impact on the behaviour at server point of view.

Fig. 28: Notification List Management

To register a notification list, it is necessary to add at least one recipient. This operation can be done by selecting a registered peer or manually.

03.05.02 Recipient Configuration

A recipient configuration defines:
– how to send the notification
– when sends the notification
– which notification sent

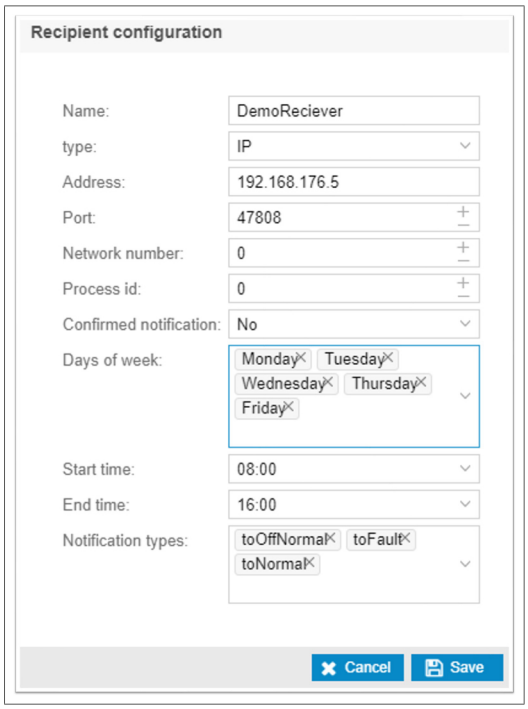

Fig. 29: Recipient configuration

The recipient communication is configured with an IP address, a port and a network number. The process identifier value is an identifier for client purpose.
The configuration of the notification defines the BACnet message send when an event is notified. Regarding this type of message, the BACnet client must acknowledge the reception that assumes the event is well delivered. Otherwise a retry is sent according to the server configuration (see previous chapter).
The period of notification is configured by date and range of hour. The event notification to the recipient only between the configured hour (of selected day). All even occurring out of this range are not notified.

The type of notification can be configured too. The goal is to limit the notification to send:
– **toOffNormal**: when the monitored value raises out of the threshold
– **toNormal**: when the monitored value put down of the threshold
– **toFault**: when the device associated to the monitored value has communication issue.

03.05.03 Update notification list

All field of the notification list and the recipient can be edited at any moment.

03.05.04 Delete notification list

A notification list can be deleted at any moment except if it is used by any Event object.

03.06 Event

The event object is available to expose an internal event through BACnet services.

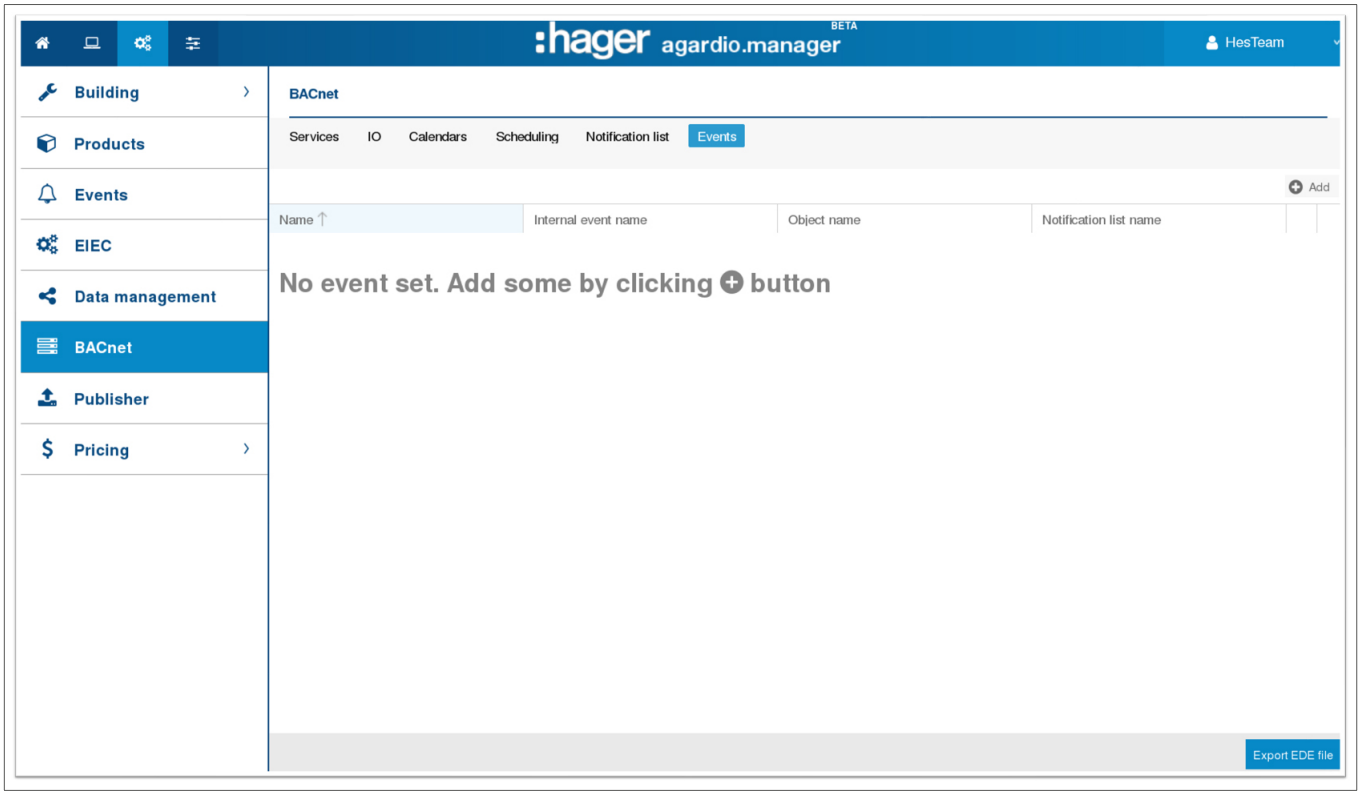

Fig. 30: Event overview

Before to be able to create an event object, the configurator user must create the following items:
– An internal event associated to a device in **Configuration** | **Events**
– A BACnet object associated to the monitored value
– A notification list object

03.06.01 Creation of event object

By clicking on the button **Add** , the user is asked to select an internal event and a notification list.
If any of the required element is not yet available, the popup displays an error message.

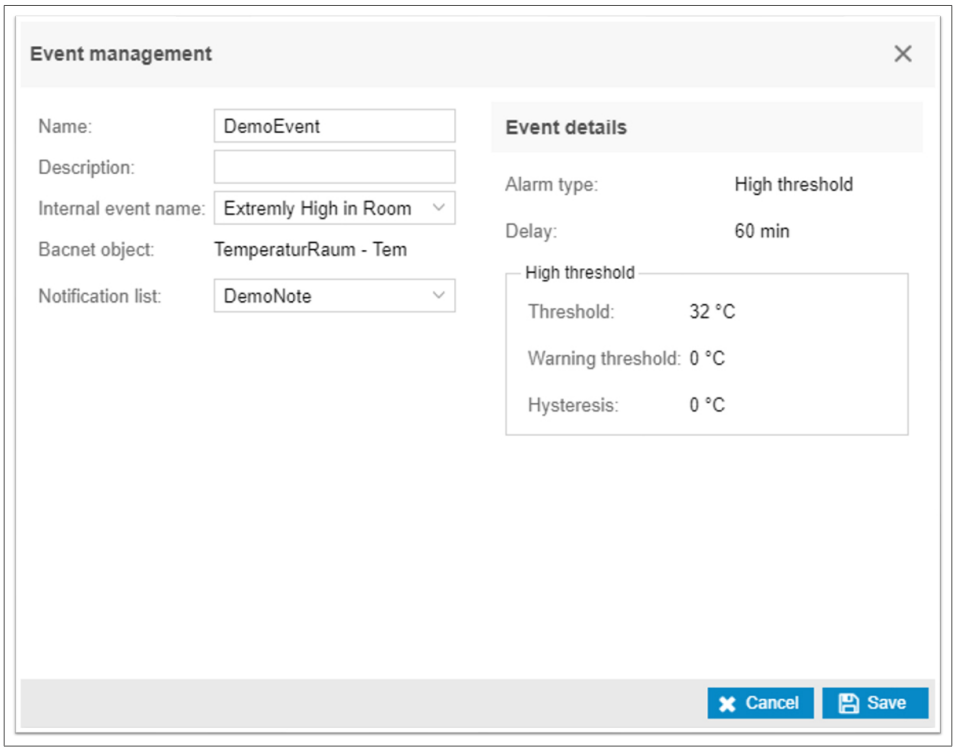

Fig. 31: Event configuration

After selecting the internal event, the details are displayed on the right panel. These values are only available for information, all changes must be made in Configuration | Events page.

03.06.02 Update event object

All field of the event object can be edited except the internal event monitored.

03.06.03 Delete event object

An event object can be deleted at any moment.

04 Maintenance of BACnet server

For maintenance purpose, any administrator has access to a list of all BACnet objects, that are created and the **Out of service** status.
This view is located in Preferences | Analyzer | BACnet.

05 Use case examples

05.01 Reduction of integration time with automatic detection of Agardio manager

Automatic discovery of Agardio manager by the BMS

☑ By default, the **Discovery state** is activated (status = **Yes**)

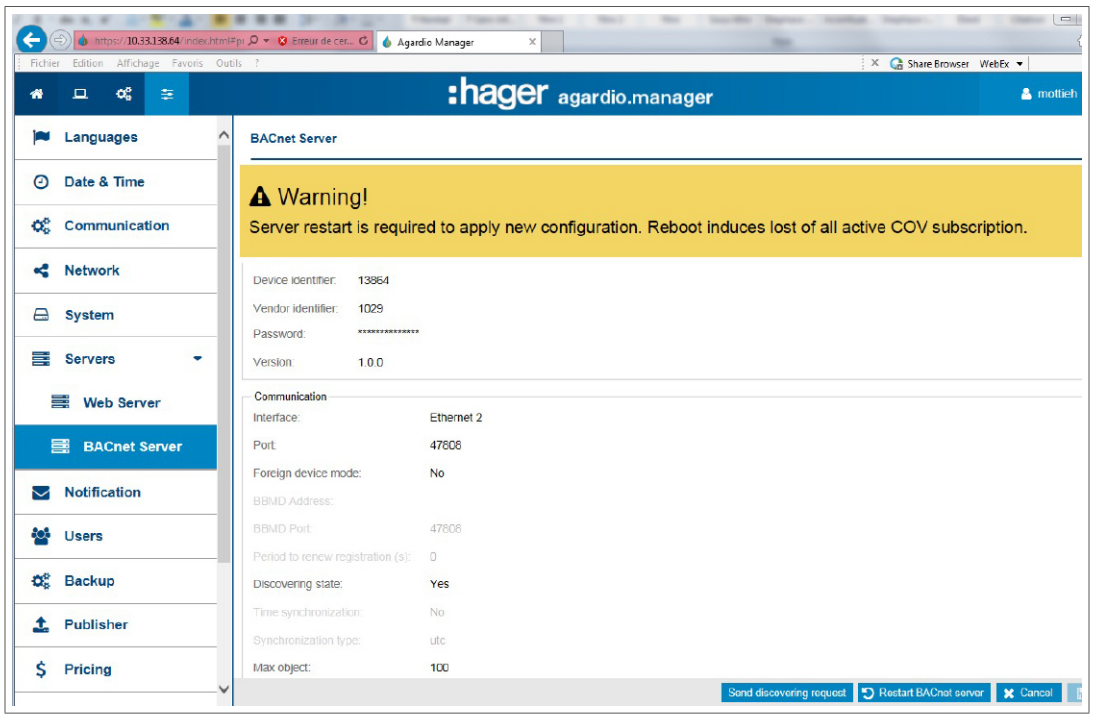

Fig. 32: BACnet settings

- start the **discovery process** from the BACnet client of the BMS, then the BACnet objects of Agardio manager will be automatically discovered

Agardio manager can also discover remote BACnet clients with **Send discovering request**. The list of remote BACnet clients will used afterwards for the event notification list

05.02 Reduction of integration time by using BACnet time synchronization

After activation of the BACnet server, the user should display the hmi view: **Preferences** | **Date & Time**
Then:

❶ select the method: **BACnet** and

❷ the time zone: **UTC+xx:yy**

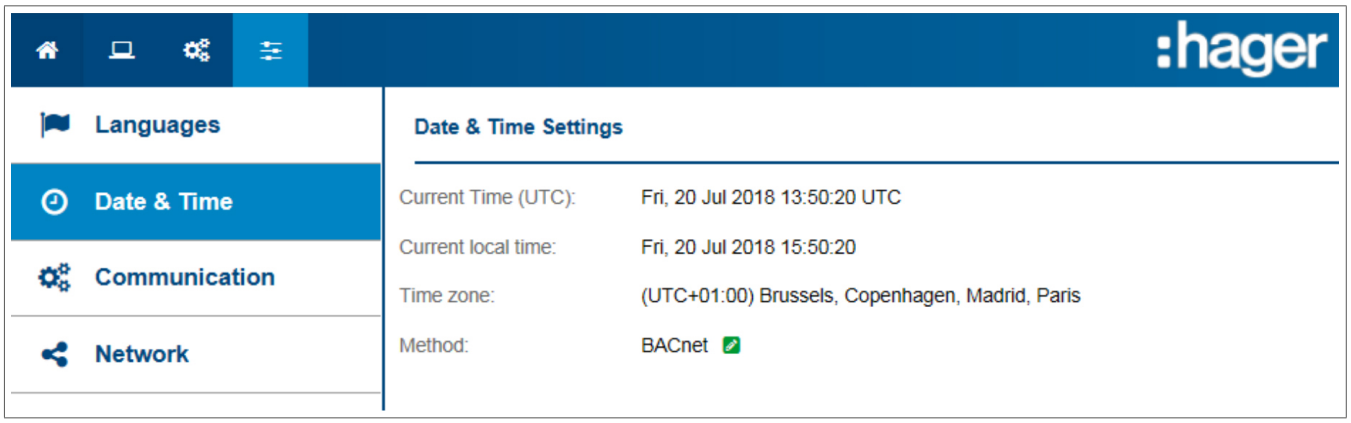

Fig. 33: **Date & Time Settings**

Then:

❸ select **Yes** for **Time synchronization**

❹ choose **UTC** or **Local** for **Synchronization type**

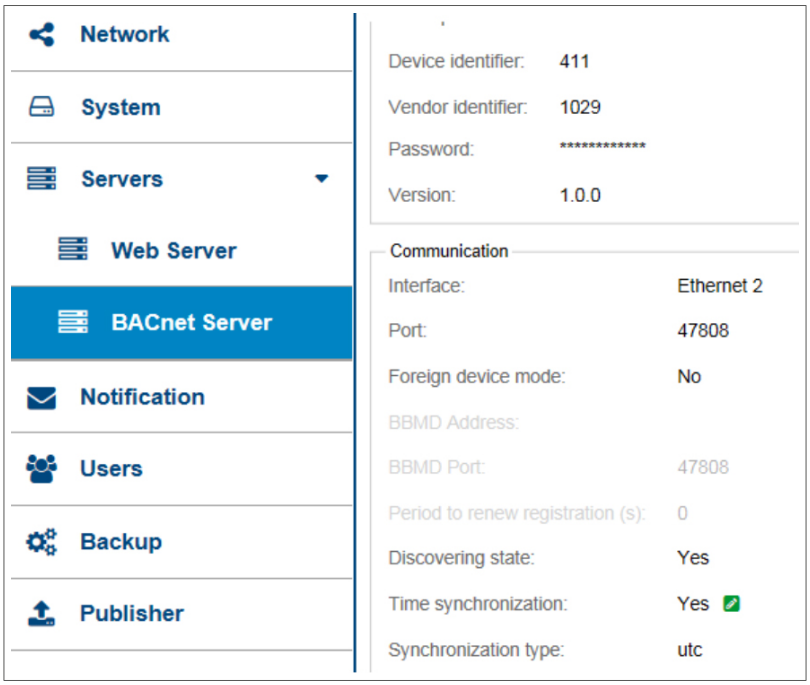

Fig. 34: BACnet communication settings

05.03 Avoiding communication problems when using IP routers

In case of broadcast message (Who-Is, Who-Has) generated on LAN2, the message will be blocked by the router.
Then Agardio manager from LAN1 will never receive the message and in consequence will not reply.

Cause: The different Agardio manager's device are not installed on the same LAN but on 2 LAN's separated by a router.

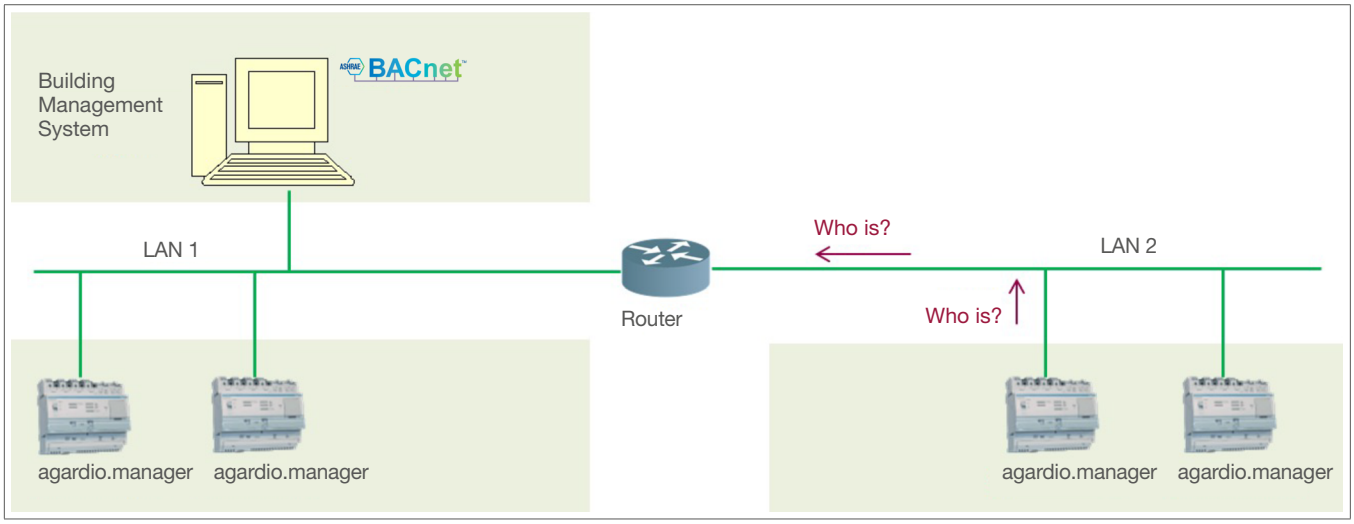

Fig. 35: agardio.manager devices in 2 LANs

Use on on both sub-networks (LAN1 and LAN2) devices with embedded BBMD servers

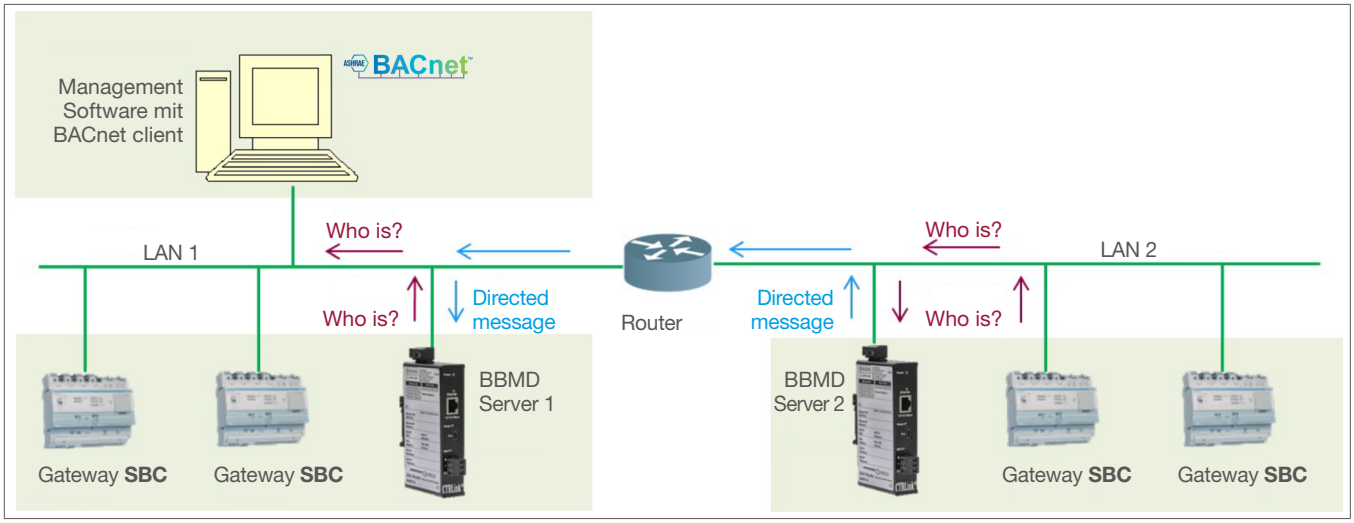

Fig. 36: Solution with BBMD servers

Agardio manager will broadcast a Who-Is message. The Who-Is will be received by the BBMD Server 2 who will forward a directed message to BBMD server 1 who will re-broadcast the Who Is message on the LAN1. Then the gateway from LAN1 will be able to reply with a I-Am.

There is no BBMD server on LAN2

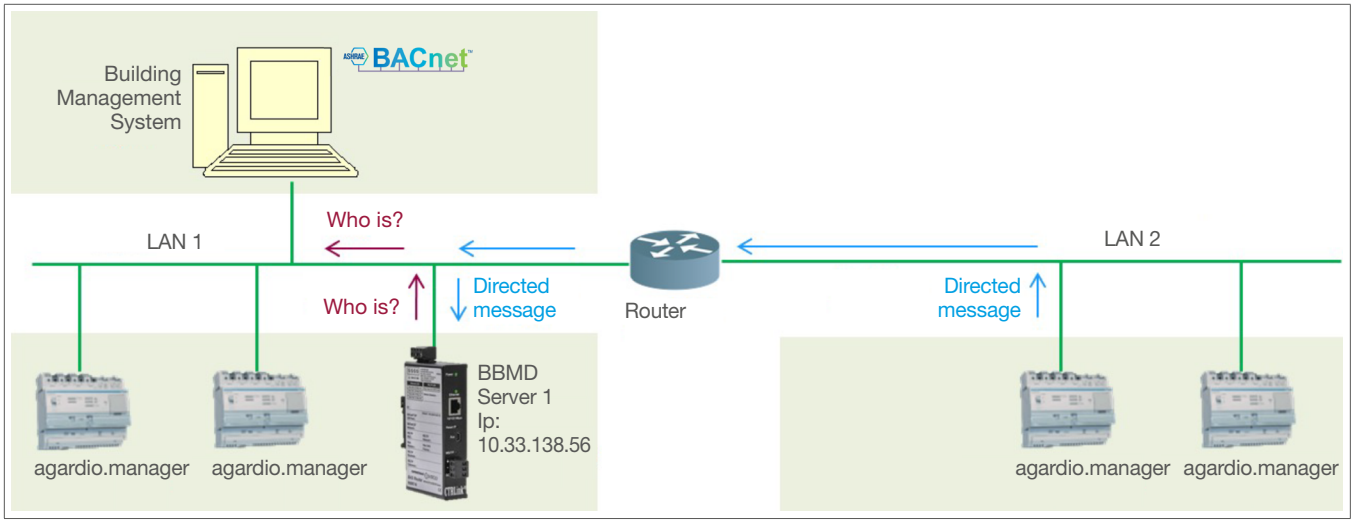

Fig. 37: Without BBMD server in LAN2

Use the Foreign Device Registration mode of Agardio manager

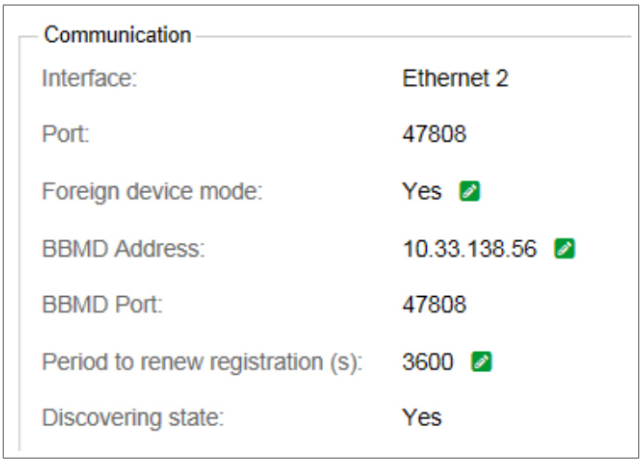

Fig. 38: Communication settings without BBMD server on LAN2

Agardio manager will send directed message to BBMD server 1 using its Ip address 10.33.138.56; then the BBMS server will broadcast a Who-is? message on the LAN1.

05.04 Optimize the communication operation between Agardio manager and the BMS

In case of several Agardio manager and/or other devices with BACnet servers, the usual way to communicate that mean as a passive server waiting for client requests could generate communication problems.
Then to optimize the communication, it is possible to use the COV method to allow the server to notify the client.
For doing that, the BMS as BACnet client must first subscribe (for a definite time) to one or several BACnet objects belonging to Agardio manager.

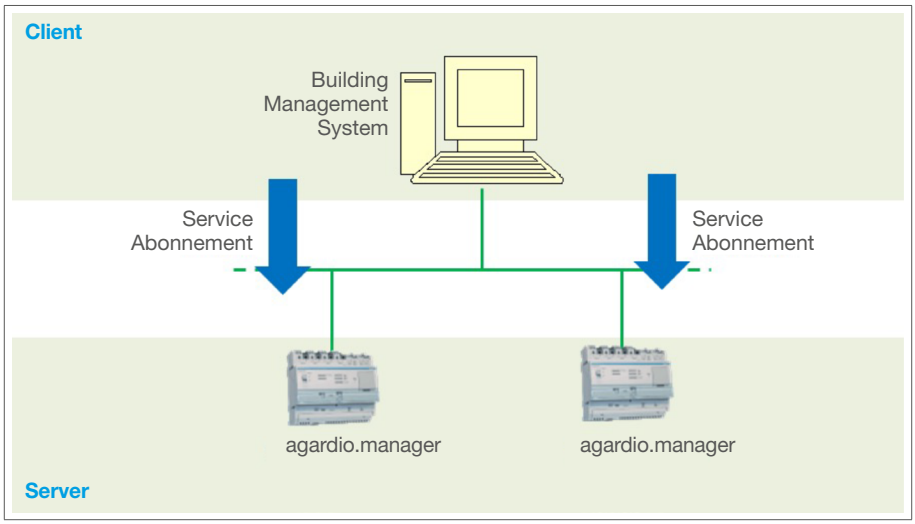

Fig. 39: COV method

- For a service (Ea+ for example), select:
  - **Yes** for Cov allowed
  - A value for Cov increment
  - **No** for out of service

Fig. 40: Choice of service

Then, Agardio manager BACnet servers will automatically notify the BMS for each evolution of the object over the COV increment.

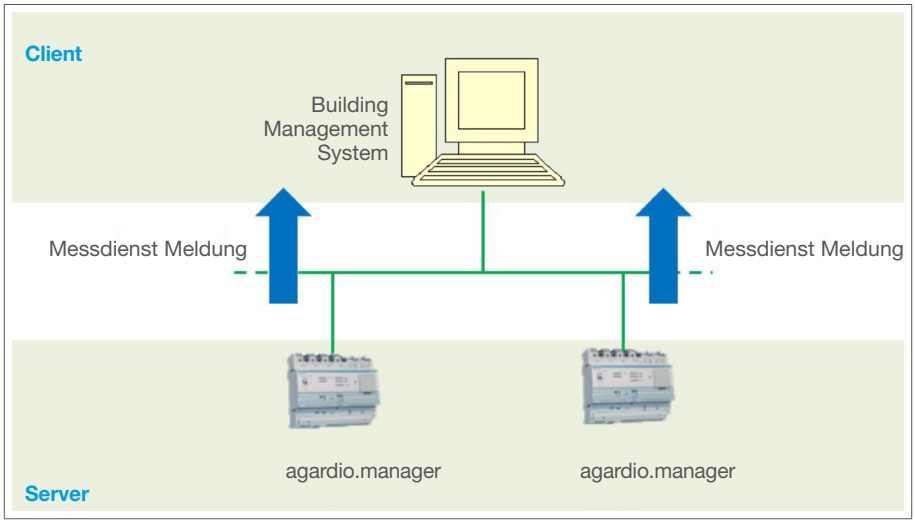

Fig. 41: COV incrementation

If Agardio manager server restarts, the COV subscription of the client has to be renewed.

05.05 Schedule a dedicated process

Non-depending on the BMS, Agardio manager could be used to schedule a process driven by 1 of the 2 possible outputs (relay output or 10 Volts Analog output)
The Analog output could be used to set a heating sub-system as follows:

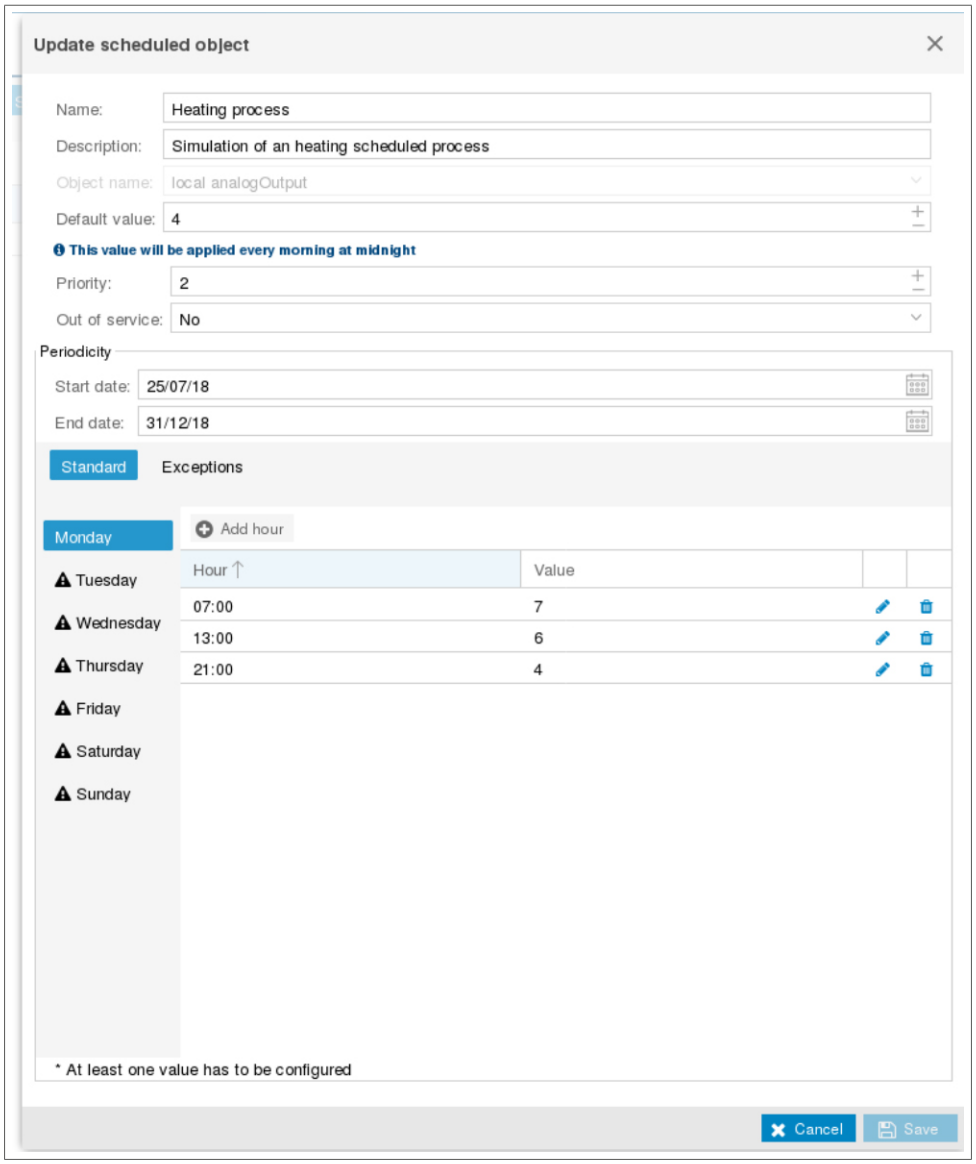

Fig. 42: **Update scheduled objects**

After 00h00; 4 volts (default value) is delivered to the heating sub-system.
After 07h00; 7 volts (pre-set value) is delivered to the heating sub-system.
After 13h00; 6 volts (pre-set value) is delivered to the heating sub-system.
After 21h00; 4 volts (pre-set value) is delivered to the heating sub-system.
After 00h00 of next day; 4 volts (default value) is delivered to the heating sub-system.

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