WEBfactory®

WEBfactory 2010

BACnet WhitePaper

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This whitepaper is a product of the company WEBfactory GmbH.

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1. Introduction

This whitepaper is intended for all the users of WEBfactory 2010 software and is designed to facilitate the understanding of WEBfactory 2010's approach on BACnet.

The document will present a WEBfactory BACnet toolkit overview as well as a guide through the processes of installing, configuring and using the WEBfactory BACnet toolkit.

For a correct understanding of the following information, WEBfactory 2010 software and additional modules must be installed on the operating machine.

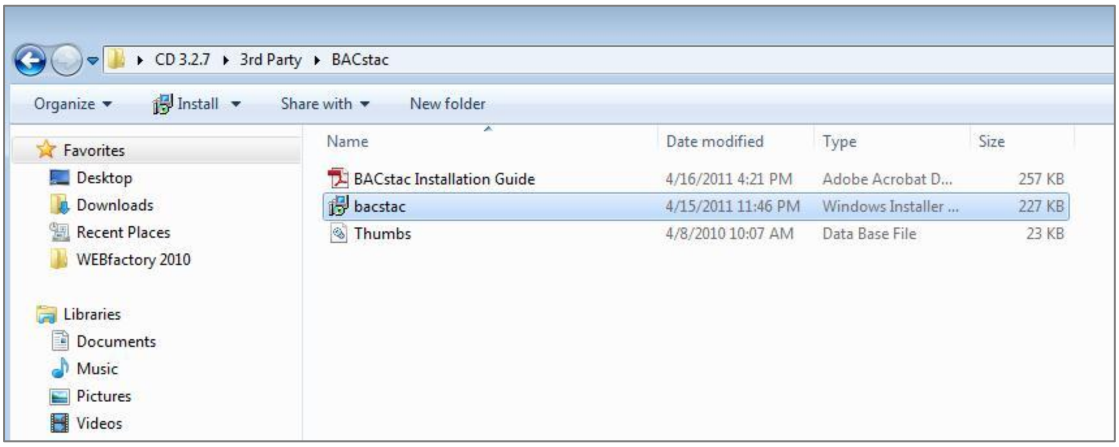
For more information about installing WEBfactory 2010, system requirements, licensing and release notes, please visit the WEBfactory Knowledge Base at:

http://webfactory-support.de/assets/documentation/Default.htm .

2. BACnet Setup

2.1. BACstac Installation

The BACstac installer can be found in the 3rd Party folder of the WEBfactory 2010 installation kit.



Name	Date modified	Type	Size
BACstac Installation Guide	4/16/2011 4:21 PM	Adobe Acrobat D...	257 KB
bacstac	4/15/2011 11:46 PM	Windows Installer ...	227 KB
Thumbs	4/8/2010 10:07 AM	Data Base File	23 KB

BACstac setup

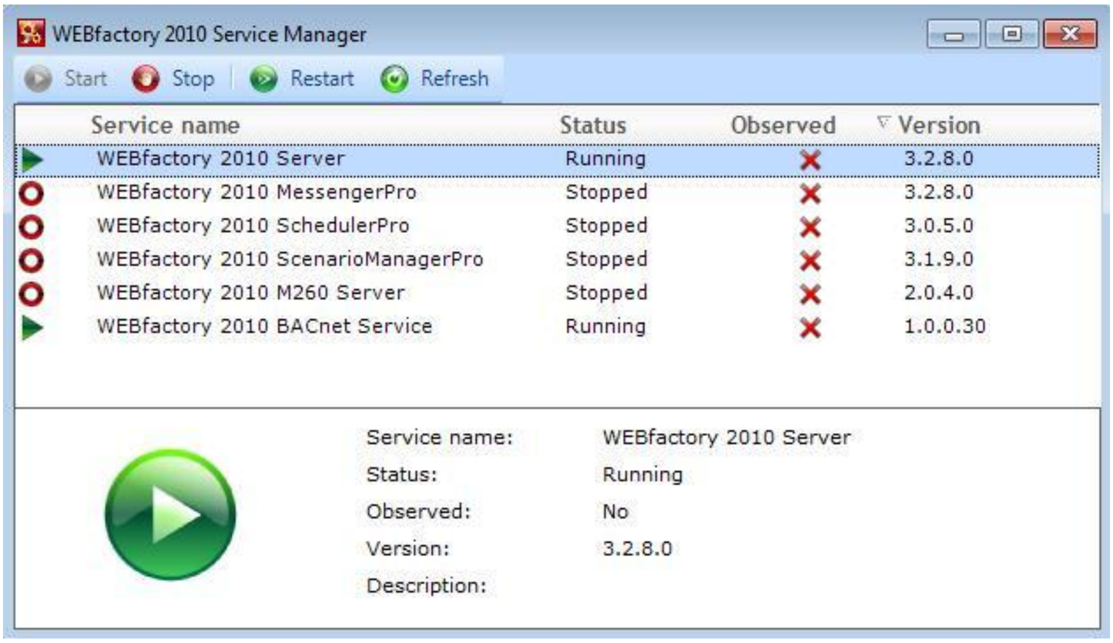
The BACstac provides you with the ability to create client and server application programs which use BACnet protocol for communication.

Run the BACstac installer before proceeding.

2.2. Starting BACnet Service

The BACnet Service needs to be started before proceeding with further setup or work.

WEBfactory Service Manager lists the WEBfactory services including the WEBfactory 2010 BACnet Service.



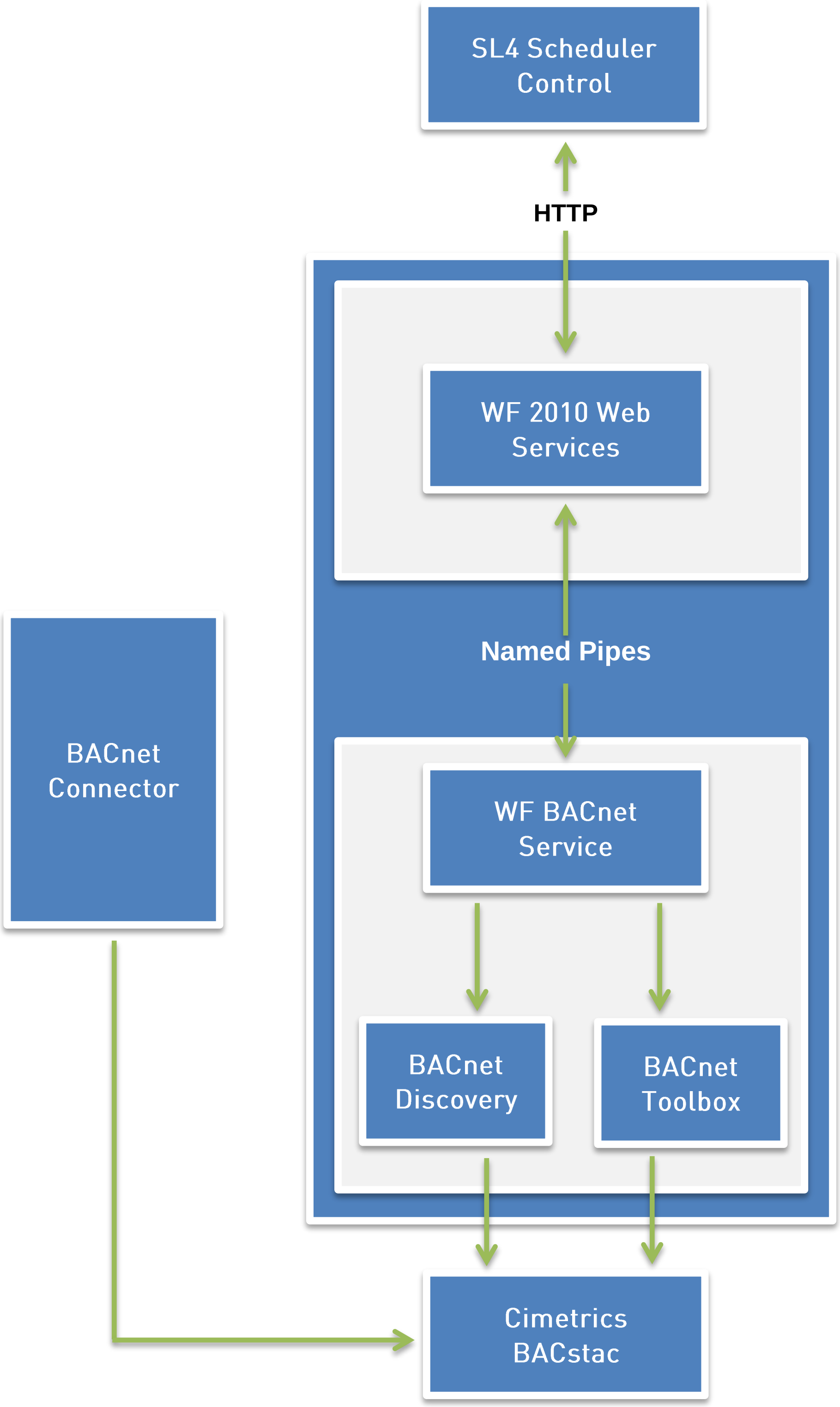
	Service name	Status	Observed	Version
▶	WEBfactory 2010 Server	Running	✗	3.2.8.0
○	WEBfactory 2010 MessengerPro	Stopped	✗	3.2.8.0
○	WEBfactory 2010 SchedulerPro	Stopped	✗	3.0.5.0
○	WEBfactory 2010 ScenarioManagerPro	Stopped	✗	3.1.9.0
○	WEBfactory 2010 M260 Server	Stopped	✗	2.0.4.0
▶	WEBfactory 2010 BACnet Service	Running	✗	1.0.0.30

Service name:	WEBfactory 2010 Server
Status:	Running
Observed:	No
Version:	3.2.8.0
Description:	

WEBfactory 2010 Service Manager

WEBfactory 2010 Service Manager is located in WEBfactory 2010\Tools\Service Manager. Make sure that the WEBfactory 2010 BACnet Service is started,

3. BACnet Overview



BACnet diagram

3.1. WF2010WebService

- This is the standard WEBfactory web service interface. Its role is to provide a standardized API that can be used for communicating with lower level components in an easier manner. Basically this is the component that is used by the scheduler control for all its functionality. The methods exposed by this API cover the following functionalities:
    - Discovering BACnet devices
    - Reading device object properties
    - Writing device object properties
- The WF2010WebService component resides on the server side and is hosted in IIS.

3.2. WFBacNetService

- This is a windows service that offers lower level BACnet functionality. It basically acts as a wrapper on top of several COM components and is used by the WF2010WebService component for executing low level commands.
- The windows service offers on one side functionality for executing BACnet commands (read/write operations). The read/write functionality offered by this service is in the form of a low level XML–based API that covers actions such as writing the value of a property or of a set of properties and querying the value of a property.
- The other functionality exposed by the service is discovering BACnet devices. The windows service acts as a caching system for minimizing the time required for discovering devices. When started, it will try to discover all BACnet devices in the network, along with their objects and the object names. When the WF2010WebServices query the available devices, they will always get a cached list. The discovery and caching is affected by two parameters (configurable from WEBfactory Studio):
    - SearchDeviceMinimumTime – the minimum time that the discovery will wait for a new device to send an “I AM” response before the discovery is ended. The default value here is 6000ms, but depending on the speed of the devices and network conditions, this value can be increased to allow for more time for the devices to send an answer.

  - DeviceScanInterval – this is the time interval between two subsequent discoveries. After the service runs its first discovery process and places the devices in the cache, it will wait for a period of time equal to the value of this setting and then it will start another discovery process. This flow is repeated after each discovery is completed. The default value is 10 minutes. When configuring the network, this value can be decreased to a smaller value. When the network is configured and the chances that the topology changes are smaller, the value can be increased in order to decrease network traffic.
- In order to prevent stale data, the service also schedules a new discovery as soon as a write operation is performed.
- A secondary role for the Windows Service is to provide the correct apartment and threading context for the BACnet Toolbox and BACnet Discovery COM components and a stable lifetime for the device cache.

3.3. BACnetToolbox

BACnetToolbox executes any command built into it. It is assumed that range of supported data types and operations would be extended over time.

BACnetToolbox exposes single method which takes as input xml string containing command specification and outputs, in addition to the return code, xml string containing result of the operation plus optional data. Current range of supported operations involves reading and writing complex property data, in addition to inserting and deleting list elements.

3.4. BACnetDiscovery

BACnetDiscovery detects devices on network using “WhoIs”/”IAm” broadcast messages. Discovery process always involves listing of devices, with optional information about device objects and optional information about object properties. Discovery process is complete when no previously known device is detected for the specified timespan.

3.5. Cimetrics BACstac

BACnet communication layer from Cimetrics, current version is 6.2.

3.6. BACnet connector operation

3.6.1. Device, object, property

The BACnet Device is used in 2 different contexts: as piece of electronic equipment and as part of BACnet networking model.

Each device has several objects; each object is of certain type (like analog input or binary output) and because certain type of object can be present multiple times in a device, each object has got its instance number. This instance number must be unique for given object type inside the device.

There is one special object type - device object. Each device has exactly one object of type device object. Though a device object must exist only once inside device, it still has an instance number.

The instance number of the device object becomes instance number of the whole device. On a BACnet network, each device must have unique instance number, which is the instance number of its single instance object.

Each object in a device has several properties. A property is of certain type (like present-value or status-flags). Each object type/property type combination determines what data type the property will contain. These data types might be simple like floating point values or very complex ones.

BACnet connector’s goal is to facilitate the retrieving of values from the properties and setting values for the properties.

3.6.2.Retrieving the values of the properties

There are two basic ways how to retrieve values of the properties

- Reading value of the properties - sending request to the device asking for a property value and receiving answer from device containing that value;
- Setting device to send a value of the property whenever property value changes.

3.6.2.1. Property value reading

This process must be executed periodically, with period of “PollPeriod” parameter inside “Device” section inside XML configuration. There are two types of reading requests: requesting value of single property or requesting value of multiple properties.

If reading request type asking value of several properties should be used than “RPM” parameter inside “Device” section should be 1, in opposite case that parameter should be 0.

There are some properties that typically do not change their value. If it is the case than “ReadRepeat” parameter inside “Property” section should be 0, otherwise that parameter should be 1.

3.6.2.2. Setting device to send value of properties in case of change

There are 2 types of BACnet protocol services that facilitate sending property values whenever value changes: object COV and property COV (COV-P).

Object COV makes device send **c**hanges **o**f **v**alue of most important properties for given object type. **C**hanges **o**f **v**alues of some of the remaining **p**roperties can be sent via COV-P service.

Connector starts COV/COV-P by making order for COV/COV-P operation to the device. Than processing of value sent by device during normal operation follows. Such order for COV/COV-P operation is not generally valid forever: after some period of time COV/COV-P expires and connector must reissue order for COV to the device. Such new order is issued before existing order for COV/COV-P expires.

If object COV should be used than “COV” parameter in “Object” section should be 1, otherwise it should be 0.

If property COV should be used that “COV” parameter in “Property” section should be 1, otherwise it should be 0.

Both COV and COV-P device generated messages with new property values could be of a type that requires (or not) confirmation from the connector - hence confirmed or not confirmed COV. Confirmed COV is more immune to loss of packets. If confirmed COV/COV-P is used, the “COVConfirmed” parameter in “Object” section should be 1, otherwise it should be 0.

When a COV/COV-P operation is ordered from the device, some devices immediately send current value of relevant properties at the moment the order was made. However, other devices don’t send property value until later when it changes. If device does not send property value in the time when COV/COV-P was ordered, this value must be read - though just once. In the configuration file, parameter ” COV1Read” inside “Device” section should be 1 if such reading of property value is necessary, otherwise it should be 0.

“COVPeriod” parameter inside “Device” section specifies period in milliseconds after which COV/COV-P operation order would be considered to be expired by the device. The connector will use this time period information to renew COV/COV-P orders before expiry could occur.

3.6.3.Setting value of the properties

The connector always uses single property write service to set new value of the property in the device.

Some of the properties are commendable. Commendable properties make use of priority of writing operation to resolve conflict when multiple BACnet clients write values into the very same property. Implicit priority used for writing is BACSTAC_PRI_MANUAL_OPERATOR. This value can be overridden by the ”WritePriorityLevel“ parameter in “Device” section.

Resetting value of commendable property is accomplished when VT_EMPY variant value is being requested by the connector client to be written to the property.

3.6.4.Device disconnect, reconnect

Device (re)discovery process is invoked by connector using “WhoIs” broadcast on network with network number specified by parameter “Network” in “Devices” section. If -1 is used for network number than global broadcast is used, in case of 0 local broadcast is used. In case of value of “Network” parameter other than 0 or -1, remote broadcast is utilized.

At the connector startup device, (re)discovery process happens immediate, afterwards it is repeated with period specified by “WhoIsPeriod” parameter in “Devices” section.

This (re)discovery process than waits for period specified in “WhoIsReplyWait” for “IAm” broadcast from connected devices.

Both “WhoIsPeriod” and “WhoIsReplyWait” parameters are in milliseconds.

Any device listed in connector configuration that did not respond with “IAm” message is consider to be disconnected for the time being

At the beginning or when device is reconnected list of objects is retrieved from device and existence of each object in the configuration is verified.

Polling for property values in one device is independent of polling for property values of any other device. Offline device will not cause delays in communication with other devices

3.6.5.Supported objects and properties

Following objects and properties are supported

OBJ_ACCUMULATOR

```
        PROP_PRESENT_VALUE
        PROP_MAX_PRES_VALUE
        PROP_VALUE_BEFORE_CHANGE
        PROP_VALUE_SET
        PROP_PULSE_RATE
        PROP_HIGH_LIMIT
        PROP_LOW_LIMIT
        PROP_LIMIT_MONITORING_INTERVAL
        PROP_NOTIFICATION_CLASS
        PROP_TIME_DELAY
        PROP_OUT_OF_SERVICE
```

OBJ_ANALOG_INPUT

```
        PROP_PRESENT_VALUE            (COV)
        PROP_MIN_PRES_VALUE
        PROP_MAX_PRES_VALUE
        PROP_RESOLUTION
        PROP_COV_INCREMENT
        PROP_HIGH_LIMIT
        PROP_LOW_LIMIT
        PROP_DEADBAND
        PROP_UPDATE_INTERVAL
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_ANALOG_OUTPUT

```
        PROP_PRESENT_VALUE            (COV)
        PROP_MIN_PRES_VALUE
        PROP_MAX_PRES_VALUE
        PROP_RESOLUTION
        PROP_RELINQUISH_DEFAULT
        PROP_COV_INCREMENT
        PROP_HIGH_LIMIT
        PROP_LOW_LIMIT
        PROP_DEADBAND
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_ANALOG_VALUE

```
        PROP_PRESENT_VALUE            (COV)
        PROP_RELINQUISH_DEFAULT
        PROP_COV_INCREMENT
        PROP_HIGH_LIMIT
        PROP_LOW_LIMIT
        PROP_DEADBAND
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_AVERAGING

```
        PROP_MINIMUM_VALUE
        PROP_AVERAGE_VALUE
        PROP_VARIANCE_VALUE
        PROP_MAXIMUM_VALUE
        PROP_ATTEMPTED_SAMPLES
        PROP_VALID_SAMPLES
        PROP_WINDOW_INTERVAL
        PROP_WINDOW_SAMPLES
```

OBJ_BINARY_INPUT

```
        PROP_CHANGE_OF_STATE_COUNT
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
        PROP_PRESENT_VALUE            (COV)
        PROP_ALARM_VALUE
        PROP_ELAPSED_ACTIVE_TIME
```

OBJ_BINARY_OUTPUT

```
PROP_CHANGE_OF_STATE_COUNT
PROP_TIME_DELAY
PROP_NOTIFICATION_CLASS
PROP_OUT_OF_SERVICE
PROP_PRESENT_VALUE              (COV)
PROP_RELINQUISH_DEFAULT
PROP_FEEDBACK_VALUE
PROP_ELAPSED_ACTIVE_TIME
PROP_MINIMUM_OFF_TIME
PROP_MINIMUM_ON_TIME
```

OBJ_BINARY_VALUE

```
PROP_TIME_DELAY
PROP_NOTIFICATION_CLASS
PROP_OUT_OF_SERVICE
PROP_PRESENT_VALUE              (COV)
PROP_RELINQUISH_DEFAULT
PROP_ALARM_VALUE
PROP_CHANGE_OF_STATE_COUNT
PROP_ELAPSED_ACTIVE_TIME
PROP_MINIMUM_OFF_TIME
PROP_MINIMUM_ON_TIME
```

OBJ_CALENDAR

```
PROP_PRESENT_VALUE
```

OBJ_COMMAND

```
PROP_PRESENT_VALUE
PROP_IN_PROCESS
PROP_ALL_WRITES_SUCCESSFUL
```

OBJ_DEVICE

```
PROP_PROT_VERSION
PROP_PROTOCOL_REVISION
PROP_MAX_APDU_LENGTH_ACCEPTED
PROP_MAX_SEGMENTS_ACCEPTED
PROP_APDU_SEGMENT_TIMEOUT
PROP_APDU_TIMEOUT
PROP_NUMBER_OF_APDU_RETRIES
PROP_MAX_INFO_FRAMES
PROP_DATABASE_REVISION
PROP_DAYLIGHT_SAVINGS_STATUS
```

OBJ_EVENT_ENROLLMENT

```
PROP_NOTIFICATION_CLASS
```

OBJ_FILE

```
PROP_FILE_SIZE
PROP_RECORD_COUNT
PROP_ARCHIVE
PROP_READ_ONLY
```

OBJ_LIFE_SAFETY_POINT

```
        PROP_DIRECT_READING
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_LIFE_SAFETY_ZONE

```
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
        PROP_MAINTENANCE_REQUIRED
```

OBJ_LOOP

```
        PROP_PRESENT_VALUE                    (COV)
        PROP_CONTROLLED_VAR_VALUE     (COV)
        PROP_SETPOINT                         (COV)
        PROP_PROPORTIONAL_CONST
        PROP_INTEGRAL_CONSTANT
        PROP_DERIVATIVE_CONSTANT
        PROP_BIAS
        PROP_MAXIMUM_OUTPUT
        PROP_MINIMUM_OUTPUT
        PROP_COV_INCREMENT
        PROP_ERROR_LIMIT
        PROP_UPDATE_INTERVAL
        PROP_PRIORITY_FOR_WRITING
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_MULTISTATE_INPUT

```
        PROP_PRESENT_VALUE            (COV)
        PROP_NUMBER_OF_STATES
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_MULTISTATE_OUTPUT

```
        PROP_PRESENT_VALUE            (COV)
        PROP_NUMBER_OF_STATES
        PROP_RELINQUISH_DEFAULT
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_FEEDBACK_VALUE
        PROP_OUT_OF_SERVICE
```

OBJ_MULTISTATE_VALUE

```
        PROP_PRESENT_VALUE            (COV)
        PROP_NUMBER_OF_STATES
        PROP_RELINQUISH_DEFAULT
        PROP_TIME_DELAY
        PROP_NOTIFICATION_CLASS
        PROP_OUT_OF_SERVICE
```

OBJ_NOTIFICATION_CLASS

```
        PROP_NOTIFICATION_CLASS
```

OBJ_PROGRAM

```
        PROP_OUT_OF_SERVICE
```

OBJ_PULSE_CONVERTER

```
        PROP_PRESENT_VALUE
        PROP_SCALE_FACTOR
        PROP_ADJUST_VALUE
        PROP_COV_INCREMENT
        PROP_HIGH_LIMIT
        PROP_LOW_LIMIT
        PROP_DEADBAND
        PROP_COUNT
        PROP_COUNT_BEFORE_CHANGE
        PROP_COV_PERIOD
        PROP_NOTIFICATION_CLASS
        PROP_TIME_DELAY
        PROP_OUT_OF_SERVICE
```

OBJ_SCHEDULE

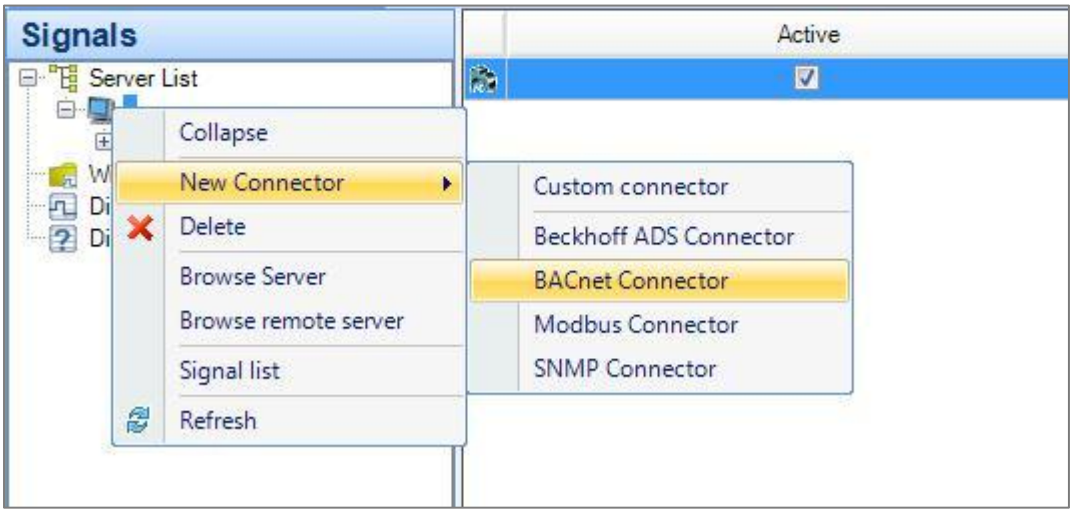
```
        PROP_OUT_OF_SERVICE
```

OBJ_TRENDLOG

```
        PROP_LOG_INTERVAL
        PROP_COV_RESUBSCRIBE_INTERVAL
        PROP_NOTIFICATION_CLASS
        PROP_LOG_ENABLE
        PROP_STOP_WHEN_FULL
        PROP_BUFFER_SIZE
        PROP_RECORD_COUNT
        PROP_TOTAL_RECORD_COUNT
        PROP_NOTIFICATION_THRESHOLD
        PROP_RECORDS_SINCE_NOTIFY
        PROP_LAST_NOTIFY_RECORD
```

4. Adding a BACnet Connector to WEBfactory Studio

In WEBfactory Studio, right-click on the server under the Server List (Signals tab).



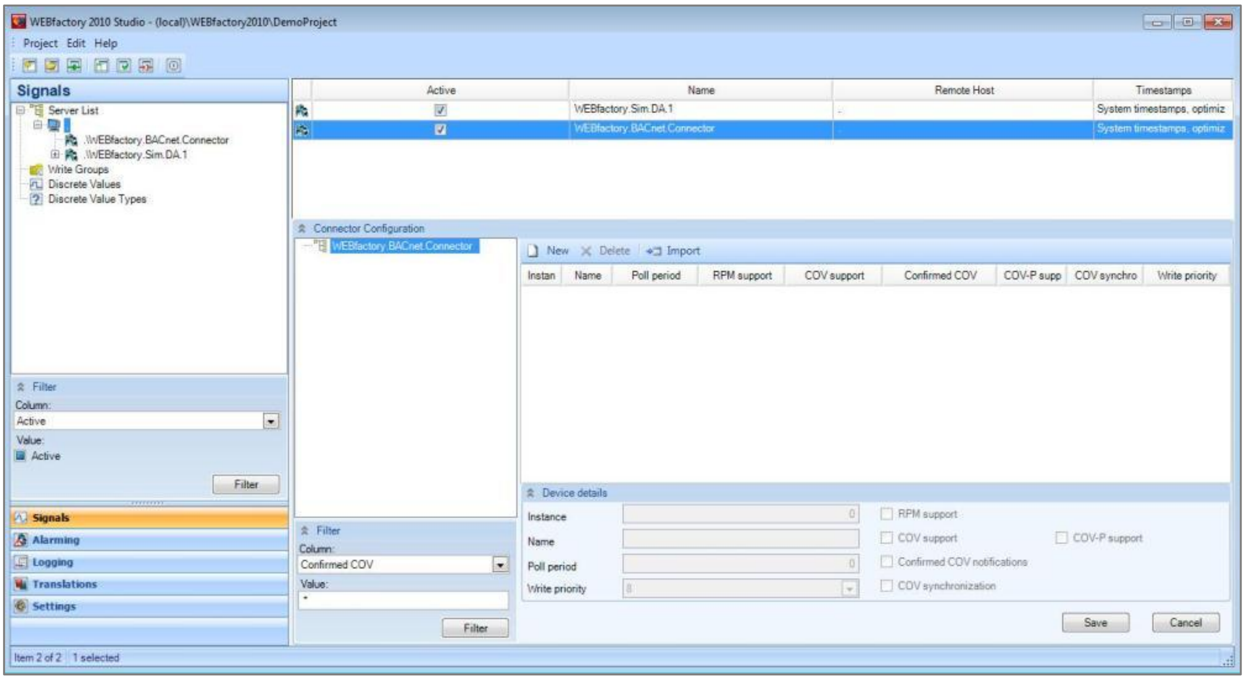
Adding a BACnet connector to the Studio

Select New Connector > BACnet Connector.

The BACnet Connector will appear under the selected server.

5. BACnet Connector parameterization in WEBfactory Studio

WEBfactory Studio offers the possibility of custom configuration for the BACnet Connector. To access the configuration panel, select the server and select the desired BACnet connector. The Connector Configuration panel will appear on screen.



Active	Name	Remote Host	Timestamps
☑	WEBfactory.Sim.DA.1	-	System timestamps, optimiz
☑	WEBfactory.BACnet.Connector	-	System timestamps, optimiz

Filter
Column: Active
Value: Active

Instan	Name	Poll period	RPM support	COV support	Confirmed COV	COV-P supp	COV synchro	Write priority

Instance: 0
Name:
Poll period: 0
Write priority: 8

☐ RPM support
☐ COV support ☐ COV-P support
☐ Confirmed COV notifications
☐ COV synchronization

Filter
Column: Confirmed COV
Value: *

The BACnet Connector inside WEBfactory Studio

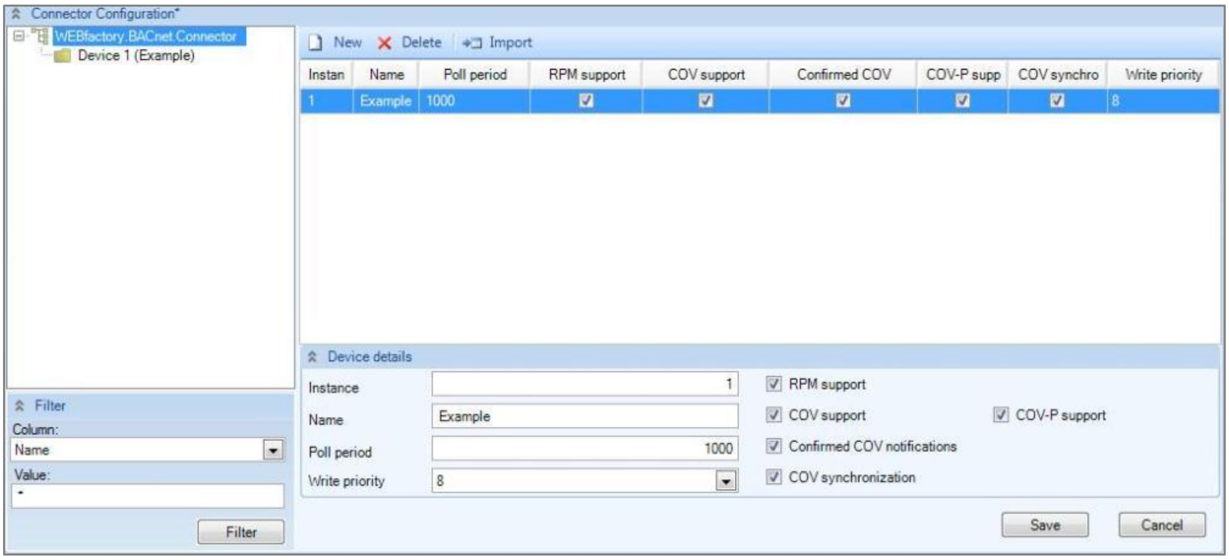
The configuration panel is an overview of the connector and the devices attached. It allows the parameterization of the devices by using an attributes grid panel.

The left side of the panel consists in a tree structure of the connector and its devices and a filtering option dialog. The root of the tree structure is always the connector, and it contains all the devices and their imported objects.

The right side of the configuration panel contains a menu bar, the attributes grid and the device details panel.

- If the root of the tree (left) is selected, the grid panel will display the imported devices;
- If a device is selected in the tree, the grid panel will display the list of imported objects for that device;

- If an object is selected in the tree structure, the grid panel will list the imported properties for the selected object.



Instan	Name	Poll period	RPM support	COV support	Confirmed COV	COV-P supp	COV synchro	Write priority
1	Example	1000	☑	☑	☑	☑	☑	8

Instance: 1
Name: Example
Poll period: 1000
Write priority: 8

☑ RPM support
☑ COV support
☑ COV-P support
☑ Confirmed COV notifications
☑ COV synchronization

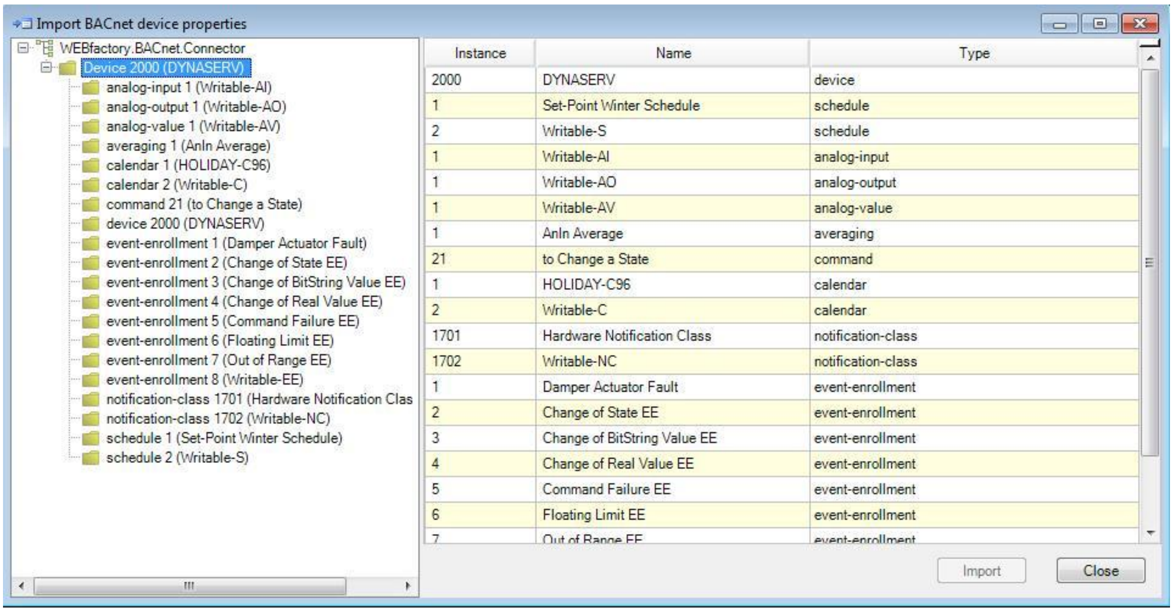
Column: Name
Value: *

BACnet Connector Configuration

The BACnet Connector Configuration allows two methods of adding devices to a connector:

- create a new connector by pressing the New button on the connector configuration menu bar, while the root of the tree is selected.
  - If the New button is pressed while having a device selected in the tree structure, a new object will be created (by default an accumulator object);
  - If the New button is pressed while an object is selected in the tree structure, a property selection dialog will pop up.
- importing devices by clicking on the Import button on the connector configuration menu bar

Importing a BACnet device will open the import properties window. Here the user will be able to select the connected BACnet devices and import the desired ones.



- WEBfactory.BACnet.Connector
  - Device 2000 (DYNASERV)
    - analog-input 1 (Writable-AI)
    - analog-output 1 (Writable-AO)
    - analog-value 1 (Writable-AV)
    - averaging 1 (AnIn Average)
    - calendar 1 (HOLIDAY-C96)
    - calendar 2 (Writable-C)
    - command 21 (to Change a State)
    - device 2000 (DYNASERV)
    - event-enrollment 1 (Damper Actuator Fault)
    - event-enrollment 2 (Change of State EE)
    - event-enrollment 3 (Change of BitString Value EE)
    - event-enrollment 4 (Change of Real Value EE)
    - event-enrollment 5 (Command Failure EE)
    - event-enrollment 6 (Floating Limit EE)
    - event-enrollment 7 (Out of Range EE)
    - event-enrollment 8 (Writable-EE)
    - notification-class 1701 (Hardware Notification Clas
    - notification-class 1702 (Writable-NC)
    - schedule 1 (Set-Point Winter Schedule)
    - schedule 2 (Writable-S)

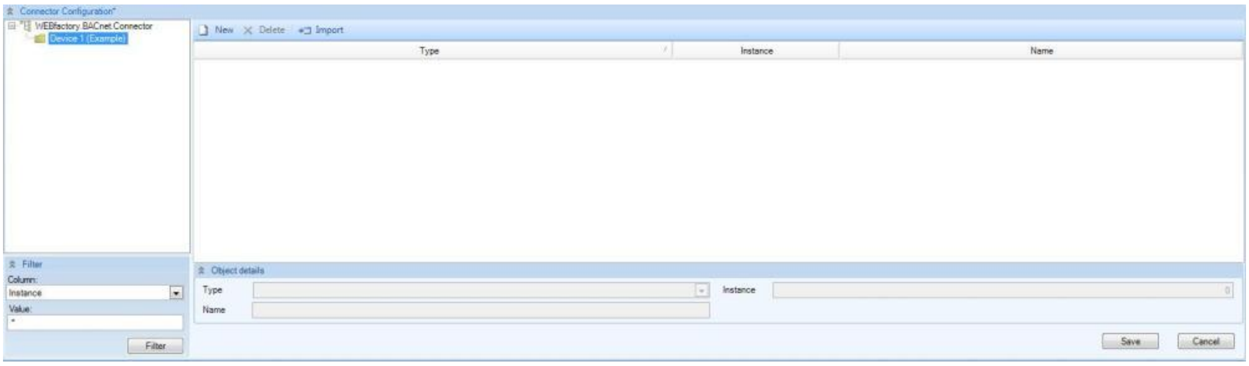
Instance	Name	Type
2000	DYNASERV	device
1	Set-Point Winter Schedule	schedule
2	Writable-S	schedule
1	Writable-AI	analog-input
1	Writable-AO	analog-output
1	Writable-AV	analog-value
1	AnIn Average	averaging
21	to Change a State	command
1	HOLIDAY-C96	calendar
2	Writable-C	calendar
1701	Hardware Notification Class	notification-class
1702	Writable-NC	notification-class
1	Damper Actuator Fault	event-enrollment
2	Change of State EE	event-enrollment
3	Change of BitString Value EE	event-enrollment
4	Change of Real Value EE	event-enrollment
5	Command Failure EE	event-enrollment
6	Floating Limit EE	event-enrollment
7	Out of Range EE	event-enrollment

Import BACnet device properties

When a device is added, it appears in the property grid. The same properties also appear in the Device details panel. The devices properties can be customized as necessary:

- Instance - Any device must have an unique instance number
- Name - Any device must have a name - the name doesn't have to be unique
- Poll period - The period of time between interrogations
- RPM support - Read Property Multiple is supported. Several property values can be read in a RPM query.
- COV support - Change Of Value notifications are supported. The device sends property value changes on its own.
- Confirmed COV - Confirmed change of values notifications are supported. Confirmed COV is more immune to loss of packets.
- COV-P support – Change of value for a property
- COV synchronization - Change of Values synchronization is supported
- Write priority - Sets the level of priority for a commendable property. Write operation to an object property has a priority attribute: in this way a device resolves the conflict when several BACnet clients write different value to a property.

After adding a device to the BACnet Connector, the device will appear in the left tree navigation. Click on it to view its details.



Column: Instance

Value: *

BACnet device

The Device details panel contains a main view and the detail view panel.

When a device is selected, the main view will list the objects defined for the device. When selecting an object from the main view, the details will be listed in the details view.

To add a new object, the user can either create a new one and define it, or import it via the import menu.

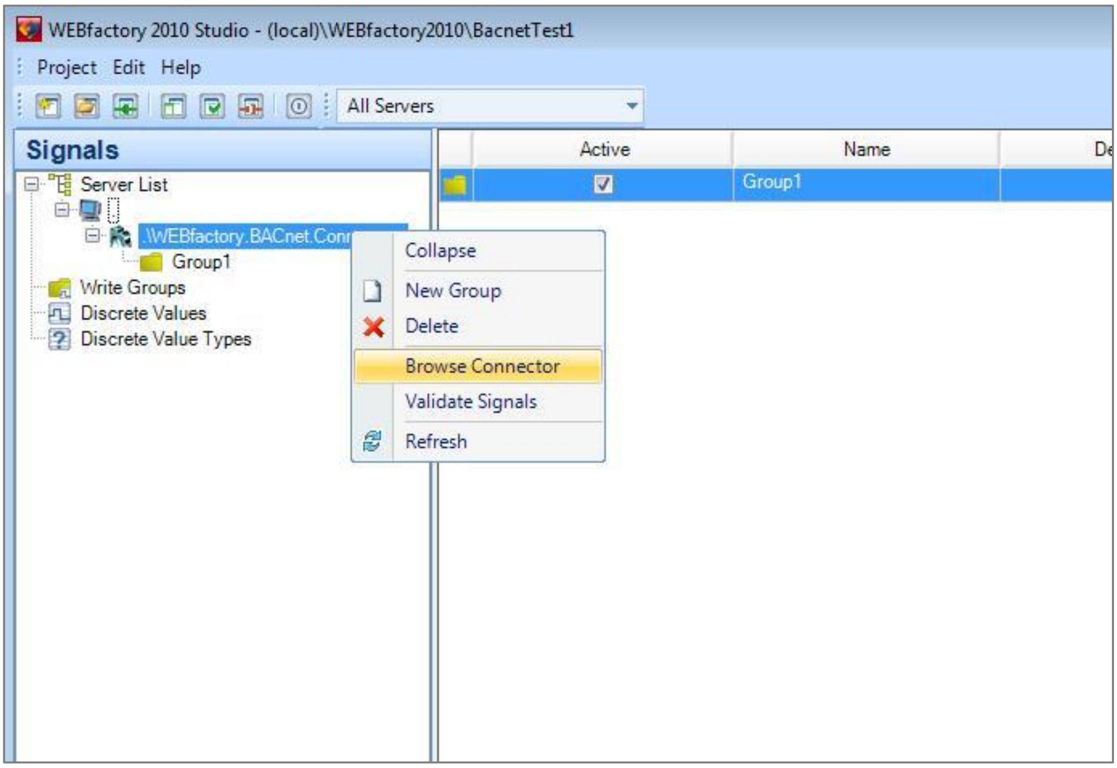
The desired object type can be selected from the Type drop-down menu in the property grid.

Like the BACnet devices, BACnet objects must have an unique instance number. Then name does not have to be unique. The same properties for the BACnet object can be found in the Object details panel.

When an object is selected in the tree structure, on the right panel, the list of properties will be displayed in the main view, and the details of the properties in the details view. New properties can be added for this selected objects (if they are not available already) by clicking the New button.

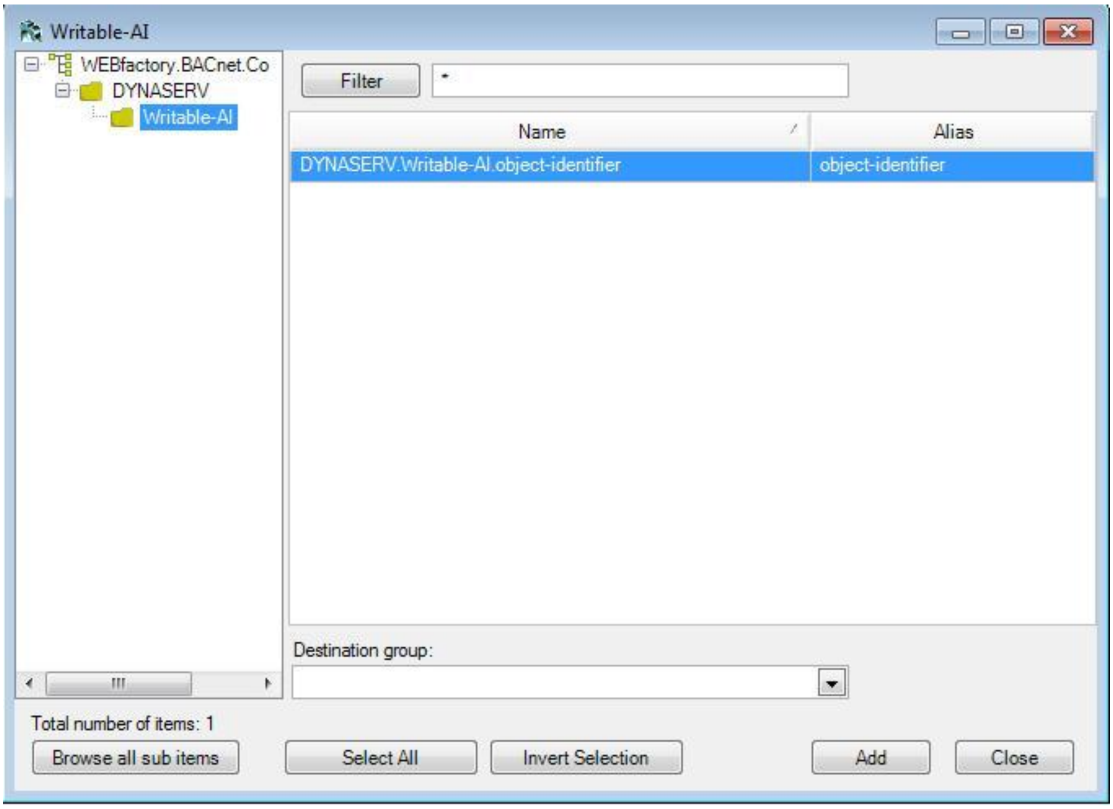
Browsing BACnet Connector

WEBfactory Studio allows the user browse the BACnet connector and select the desired properties to assign signals to them.



Browsing the BACnet connector

The Browse Connector option (available in the contextual menu of the connector entry in the Server List) will open a browser window. The user has the options to browse for properties and select the desired ones.



Filter: *

Name	Alias
DYNASERV.Writable-AI.object-identifier	object-identifier

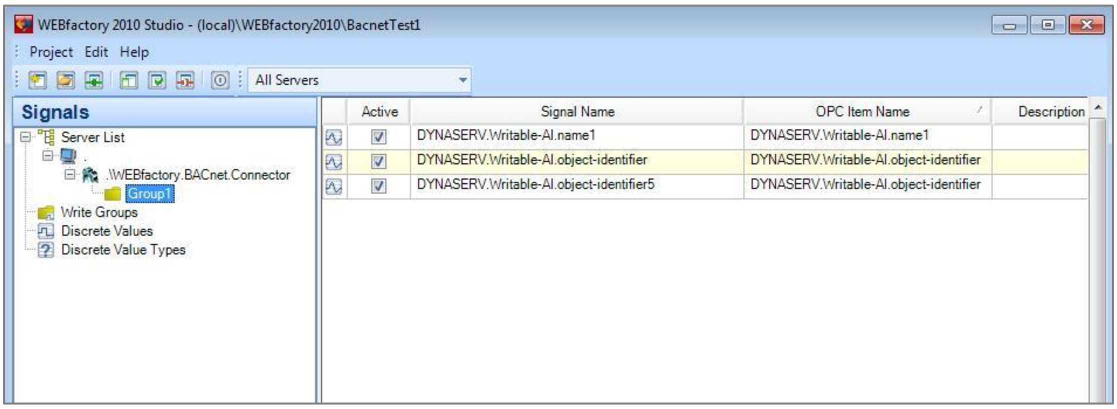
Connector Browser window

One important part of the connector browser is the Filtering option. It allows the user to filter the properties by name. The filtering options uses wildcards for easier input:

- *X will filter the names that end with X
- X* will filter the names beginning with X
- *X* will filter the names that have X anywhere in the name.

To add the selected properties to the Studio, the properties need to be assigned to a Destination group. This destination group can be created inside the connector browser window by typing the desired name of the new group in the Destination group text field.

The new created group will be listed under the BACnet connector entry in the Server List. Inside the group, the imported properties will have signals assigned automatically. This way the BACnet object can be monitored.

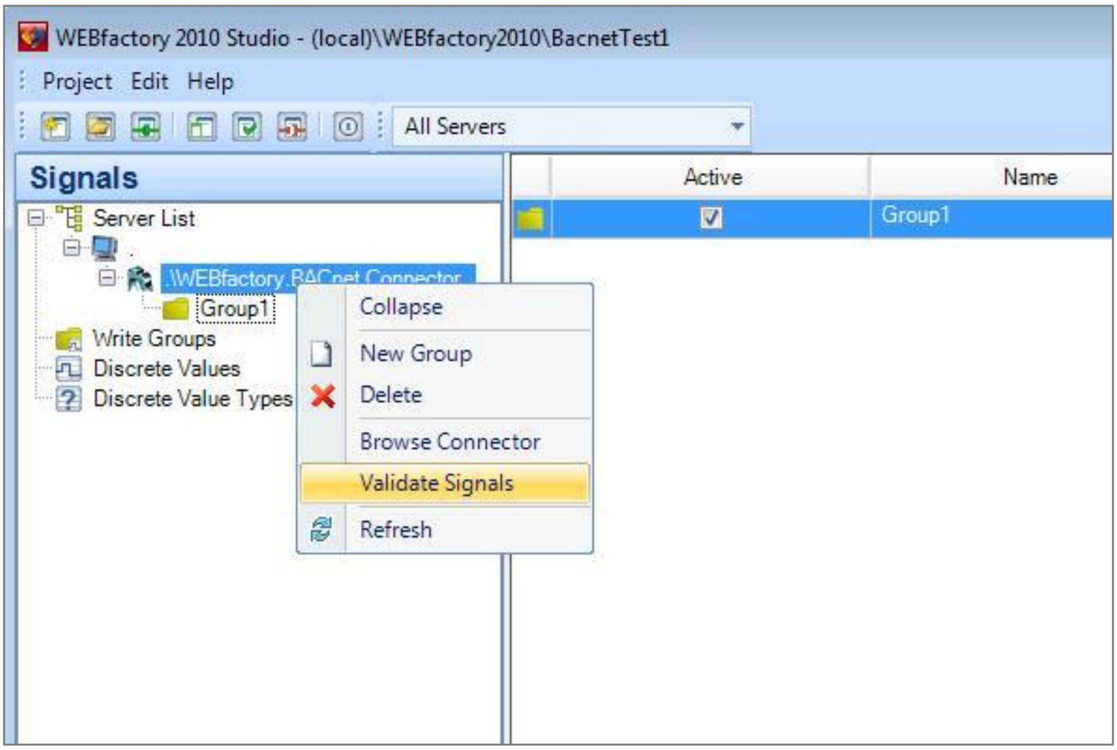


	Active	Signal Name	OPC Item Name	Description
	☑	DYNASERV.Writable-AI.name1	DYNASERV.Writable-AI.name1	
	☑	DYNASERV.Writable-AI.object-identifier	DYNASERV.Writable-AI.object-identifier	
	☑	DYNASERV.Writable-AI.object-identifier5	DYNASERV.Writable-AI.object-identifier	

Destination group view

Validate Signals

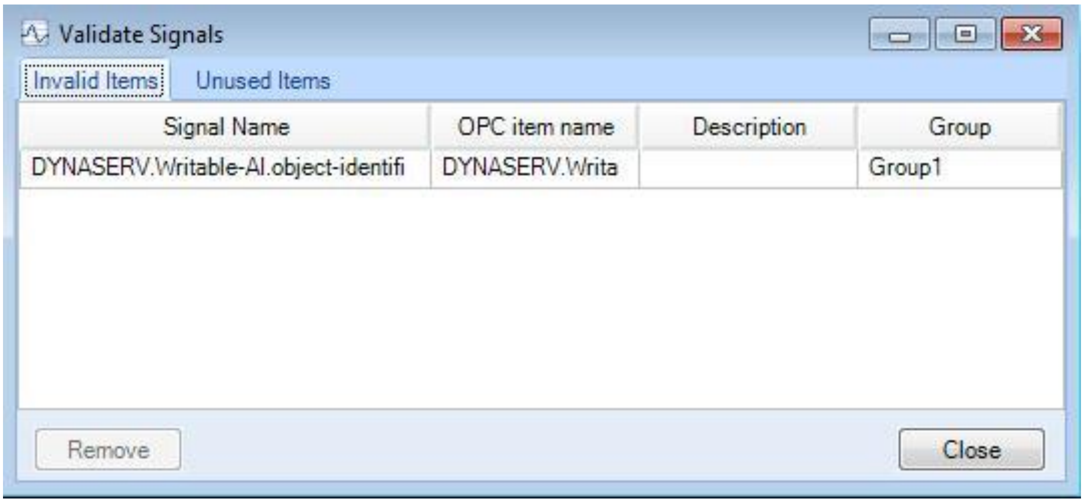
The contextual menu of the BACnet connector allows the user to Validate Signals.



	Active	Name
	☑	Group1

Signal validation

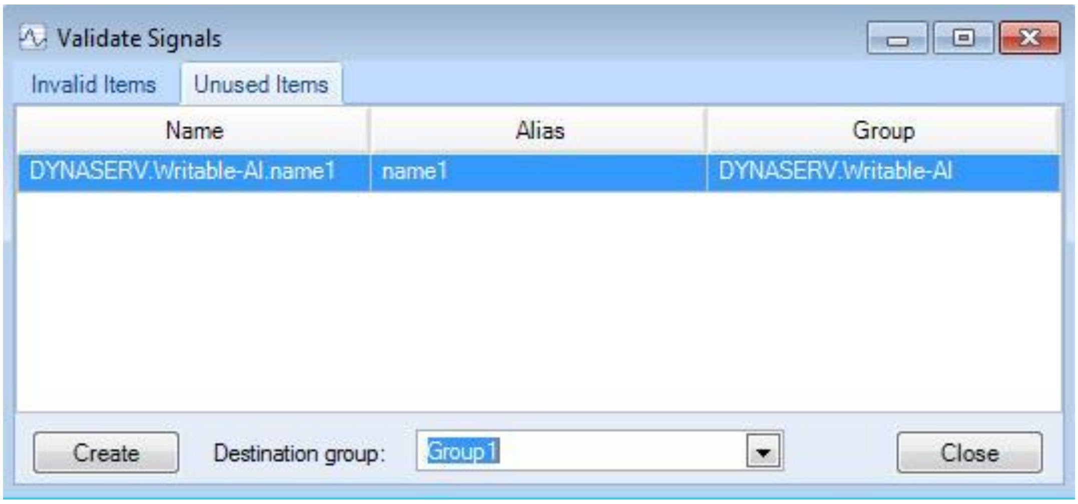
The Signal Validation window displays a list of used invalid items and a list of unused items. The invalid items can be removed from the Studio, and the unused items can be set to be used.



Signal Name	OPC item name	Description	Group
DYNASERV.Writable-AI.object-identifi	DYNASERV.Writa		Group1

Invalid items panel

To make an unused item to be used, the item must be selected from the Unused Items and assigned to a Destination group.

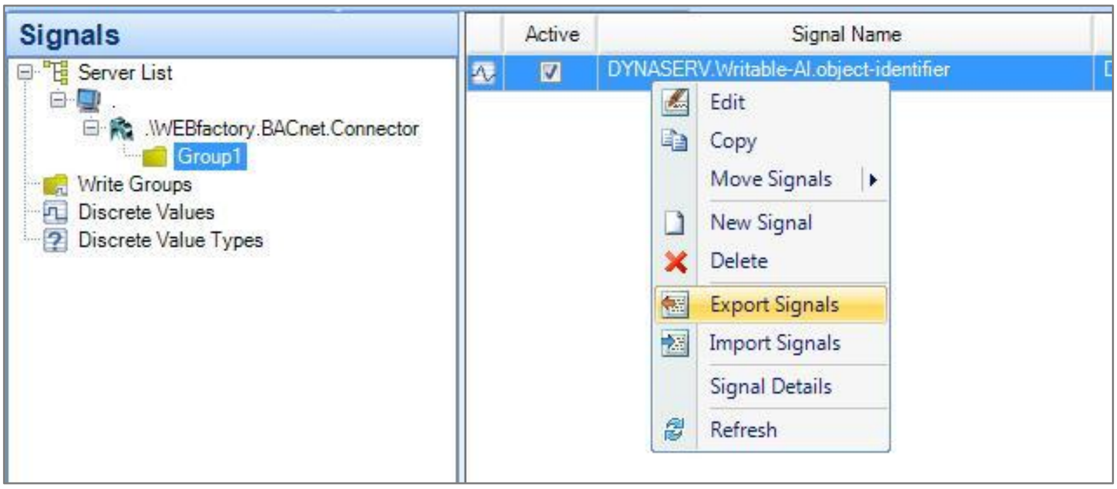


Name	Alias	Group
DYNASERV.Writable-AI.name1	name1	DYNASERV.Writable-AI

Destination group: Group1

Unused Items panel

The signals created for the BACnet object properties can be exported and imported by selecting the appropriate options in the contextual menu.



Importing and exporting signals from the BACnet destination group

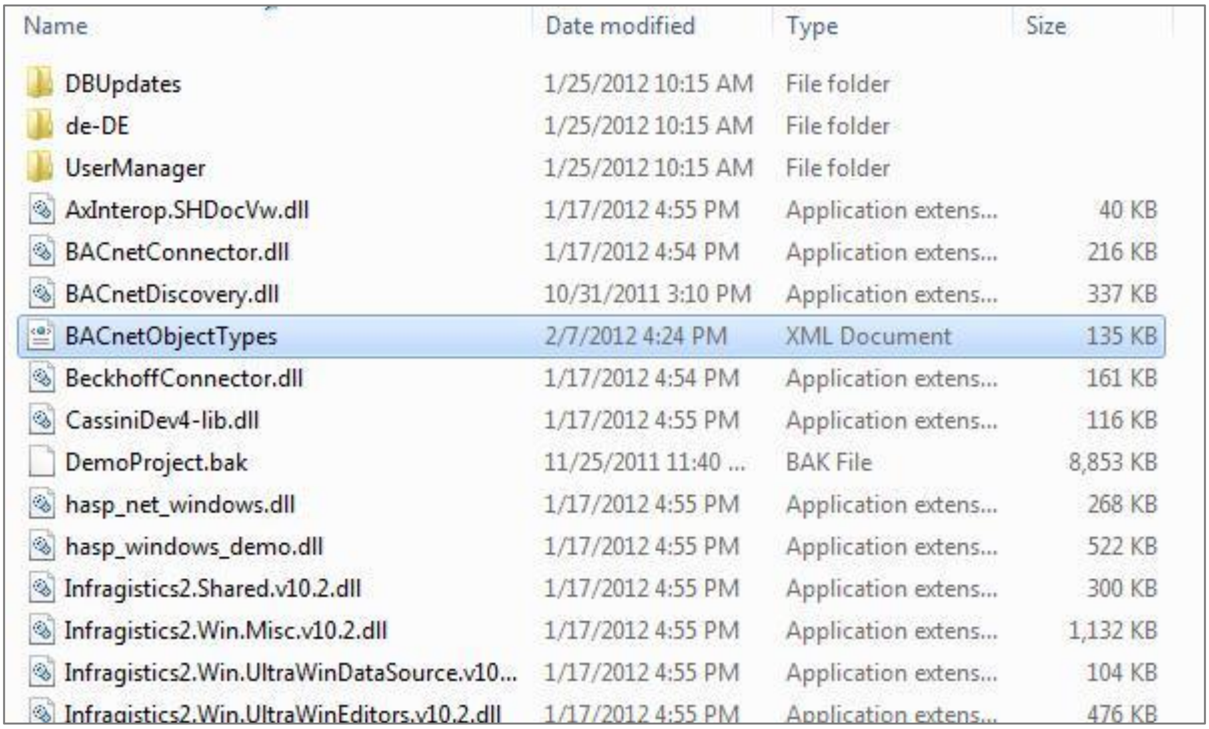
The format used for importing/exporting is xml.

6. Filtering BACnet objects when importing a BACnet configuration in WEBfactory Studio

WEBfactory Studio only imports object types that have the value of "Required" as 1.

In order to import only the desired BACnet object types, the BACnetObjectTypes.xml file must be edited, and all the desired BACnet object types must have the value of Required set to 1. The objects that will have the value of Required set to 0 will not be imported.

Navigate to the WEBfactory 2010 installation folder > Studio.

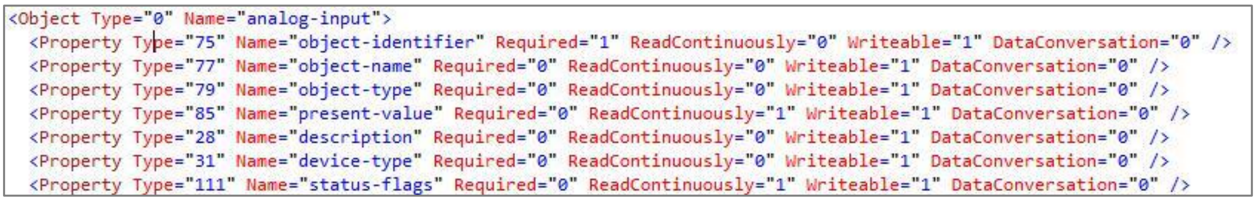


Name	Date modified	Type	Size
DBUpdates	1/25/2012 10:15 AM	File folder	
de-DE	1/25/2012 10:15 AM	File folder	
UserManager	1/25/2012 10:15 AM	File folder	
AxInterop.SHDocVw.dll	1/17/2012 4:55 PM	Application extens...	40 KB
BACnetConnector.dll	1/17/2012 4:54 PM	Application extens...	216 KB
BACnetDiscovery.dll	10/31/2011 3:10 PM	Application extens...	337 KB
BACnetObjectTypes	2/7/2012 4:24 PM	XML Document	135 KB
BeckhoffConnector.dll	1/17/2012 4:54 PM	Application extens...	161 KB
CassiniDev4-lib.dll	1/17/2012 4:55 PM	Application extens...	116 KB
DemoProject.bak	11/25/2011 11:40 ...	BAK File	8,853 KB
hasp_net_windows.dll	1/17/2012 4:55 PM	Application extens...	268 KB
hasp_windows_demo.dll	1/17/2012 4:55 PM	Application extens...	522 KB
Infragistics2.Shared.v10.2.dll	1/17/2012 4:55 PM	Application extens...	300 KB
Infragistics2.Win.Misc.v10.2.dll	1/17/2012 4:55 PM	Application extens...	1,132 KB
Infragistics2.Win.UltraWinDataSource.v10...	1/17/2012 4:55 PM	Application extens...	104 KB
Infragistics2.Win.UltraWinEditors.v10.2.dll	1/17/2012 4:55 PM	Application extens...	476 KB

The BACnetObjectTypes.xml is located in the Studio folder inside the WEBfactory installation folder

Open the BACnetObjectTypes.xml in an editor and search the string Required.

TIP: Use the Find and Replace functionality of the editor for easier replacement.



```
<Object Type="0" Name="analog-input">
  <Property Type="75" Name="object-identifier" Required="1" ReadContinuously="0" Writeable="1" DataConversation="0" />
  <Property Type="77" Name="object-name" Required="0" ReadContinuously="0" Writeable="1" DataConversation="0" />
  <Property Type="79" Name="object-type" Required="0" ReadContinuously="0" Writeable="1" DataConversation="0" />
  <Property Type="85" Name="present-value" Required="0" ReadContinuously="1" Writeable="1" DataConversation="0" />
  <Property Type="28" Name="description" Required="0" ReadContinuously="0" Writeable="1" DataConversation="0" />
  <Property Type="31" Name="device-type" Required="0" ReadContinuously="0" Writeable="1" DataConversation="0" />
  <Property Type="111" Name="status-flags" Required="0" ReadContinuously="1" Writeable="1" DataConversation="0" />
```

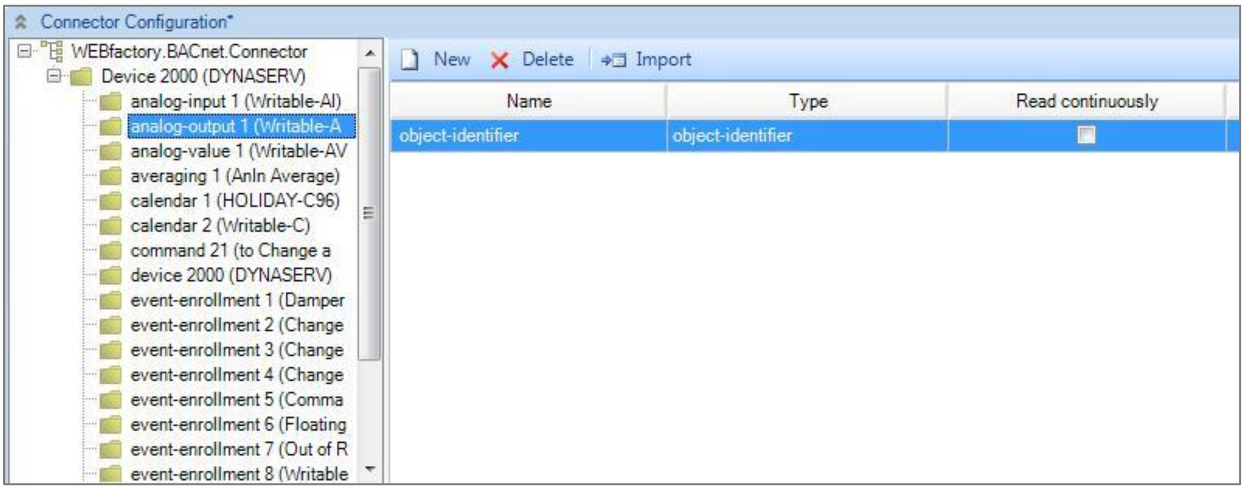
Replacing the value of Require with 1 for the desired object types

Like in the picture above, replace the value of Require with 1 for the desired object types. The object types not desired for importing should have the value of Required set to 0.

Save the XML document.

Open WEBfactory Studio and import the BACnet configuration. You will notice that only the selected object types have been imported.

NOTE: The BACnetObjectTypes.xml file will be loaded when the WEBfactory Studio is launched. If the Studio is opened, close it and re-open it. Any change in the BACnetObjectTypes.xml file will require WEBfactory Studio to be restarted.


Connector Configuration*
WEBfactory.BACnet.Connector
Device 2000 (DYNASERV)
analog-input 1 (Writable-AI)
analog-output 1 (Writable-A
analog-value 1 (Writable-AV
averaging 1 (AnIn Average)
calendar 1 (HOLIDAY-C96)
calendar 2 (Writable-C)
command 21 (to Change a
device 2000 (DYNASERV)
event-enrollment 1 (Damper
event-enrollment 2 (Change
event-enrollment 3 (Change
event-enrollment 4 (Change
event-enrollment 5 (Comma
event-enrollment 6 (Floating
event-enrollment 7 (Out of R
event-enrollment 8 (Writable
New
Delete
Import

Name	Type	Read continuously
object-identifier	object-identifier	□

Only the selected object type has been imported

The BACnet objects that have not been selected may be displayed in the navigation tree, but they are not imported. As we have selected for import only the analog-output > object-identifier, only this object type is available after the import.

7. Using BACnet Scheduler in Expression Blend

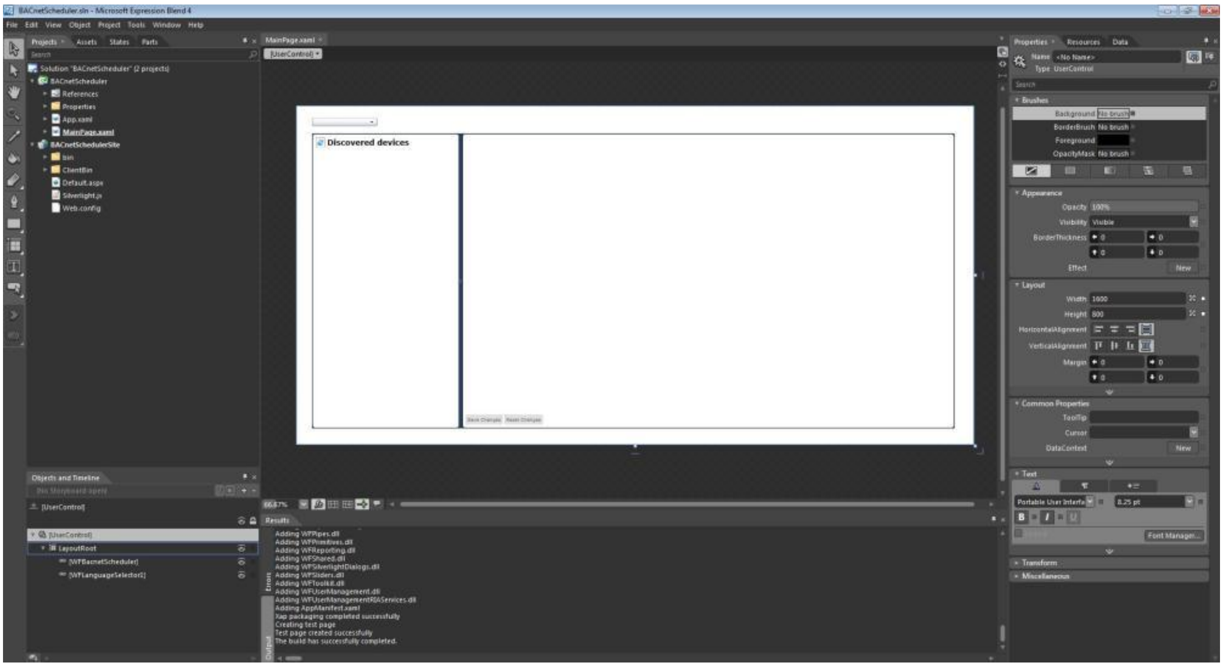
The BACnet Scheduler control handles signal values following a predefined schedule. The main utility of BACnet Scheduler is implementing calendar based schedules and exceptions.

To create a BACnet Scheduler visualization in Expression Blend, create a new WEBfactory Silverlight Application + Website project.

Select the UserControl and expand it to 1600x800.

Add the dll files from the folder WEBfactory 2010/Silverlight 4/Standard as references to this project.

After the references are loaded, drag the WFBacnetScheduler control on the project page. Optional, WFLanguageSelector control can be added, in order to translate de BACnet Scheduler from German to English.



```
Adding WFPipes.dll
Adding WFPrimitives.dll
Adding WFReporting.dll
Adding WFShared.dll
Adding WFSilverlightDialogs.dll
Adding WFSliders.dll
Adding WFToolkit.dll
Adding WFUserManagement.dll
Adding WFUserManagementRIAServices.dll
Adding AppManifest.xaml
Xap packaging completed successfully
Creating test page
Test page created successfully
The build has successfully completed.
```

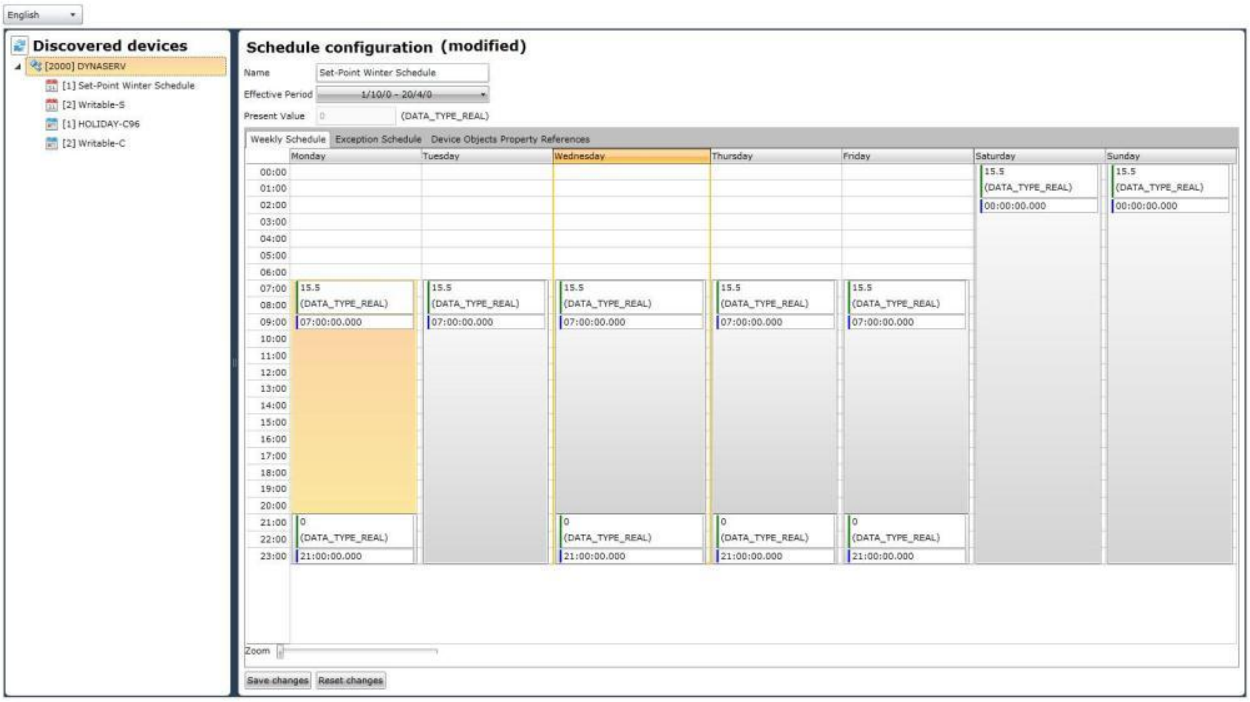
BACnet Scheduler visualization project in Expression Blend

In the Properties panel, under the WEBfactory category there are two properties of the WFBacnetScheduler control:

- SearchDeviceMinimumTime
- SearchDeviceTimeout

The project is ready to be executed, so press F5 to run.

The BACnet scheduler will open in the browser window:



Schedule configuration (modified)

Name: Set-Point Winter Schedule

Effective Period: 1/10/0 - 20/4/0

Present Value: 0 (DATA_TYPE_REAL)

Monday: 15.5 (DATA_TYPE_REAL) 07:00:00.000; 0 (DATA_TYPE_REAL) 21:00:00.000

Tuesday: 15.5 (DATA_TYPE_REAL) 07:00:00.000

Wednesday: 15.5 (DATA_TYPE_REAL) 07:00:00.000; 0 (DATA_TYPE_REAL) 21:00:00.000

Thursday: 15.5 (DATA_TYPE_REAL) 07:00:00.000; 0 (DATA_TYPE_REAL) 21:00:00.000

Friday: 15.5 (DATA_TYPE_REAL) 07:00:00.000; 0 (DATA_TYPE_REAL) 21:00:00.000

Saturday: 15.5 (DATA_TYPE_REAL) 00:00:00.000

Sunday: 15.5 (DATA_TYPE_REAL) 00:00:00.000

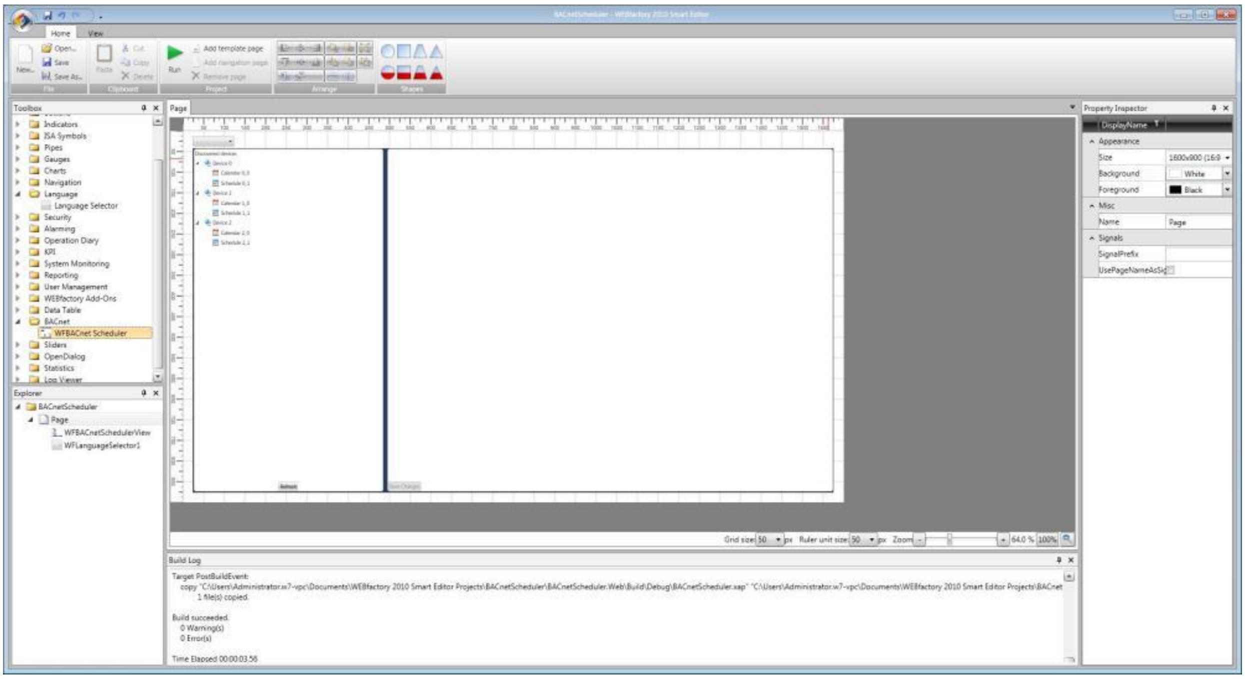
BACnet Scheduler control in web browser

8. Using BACnet Scheduler in Smart Editor

The BACnet Scheduler control handles signal values following a predefined schedule. The main utility of BACnet Scheduler is implementing calendar based schedules and exceptions.

To use the BACnet Scheduler in Smart Editor, create a new project and set the size of the project page to 1600x900. BACnet Scheduler requires more canvas space in order to be easily operated.

From the Toolbox panel, drag the WFBACnet Scheduler control (from the BACnet category) on the page. Also place a Language Selector in order to translate the texts from German to English. German is the default language.



DisplayName	
Appearance	
Size	1600x900 (16:9
Background	White
Foreground	Black
Misc	
Name	Page
Signals	
SignalPrefix	
UsePageNameAsSig	□

```
Target PostBuildEvent:
  copy "C:\Users\Administrator.w7-vpc\Documents\WEBfactory 2010 Smart Editor Projects\BACnetScheduler\BACnetScheduler.Web\Build\Debug\BACnetScheduler.xap" "C:\Users\Administrator.w7-vpc\Documents\WEBfactory 2010 Smart Editor Projects\BACnet
        1 file(s) copied.

Build succeeded.
  0 Warning(s)
  0 Error(s)

Time Elapsed 00:00:03.56
```

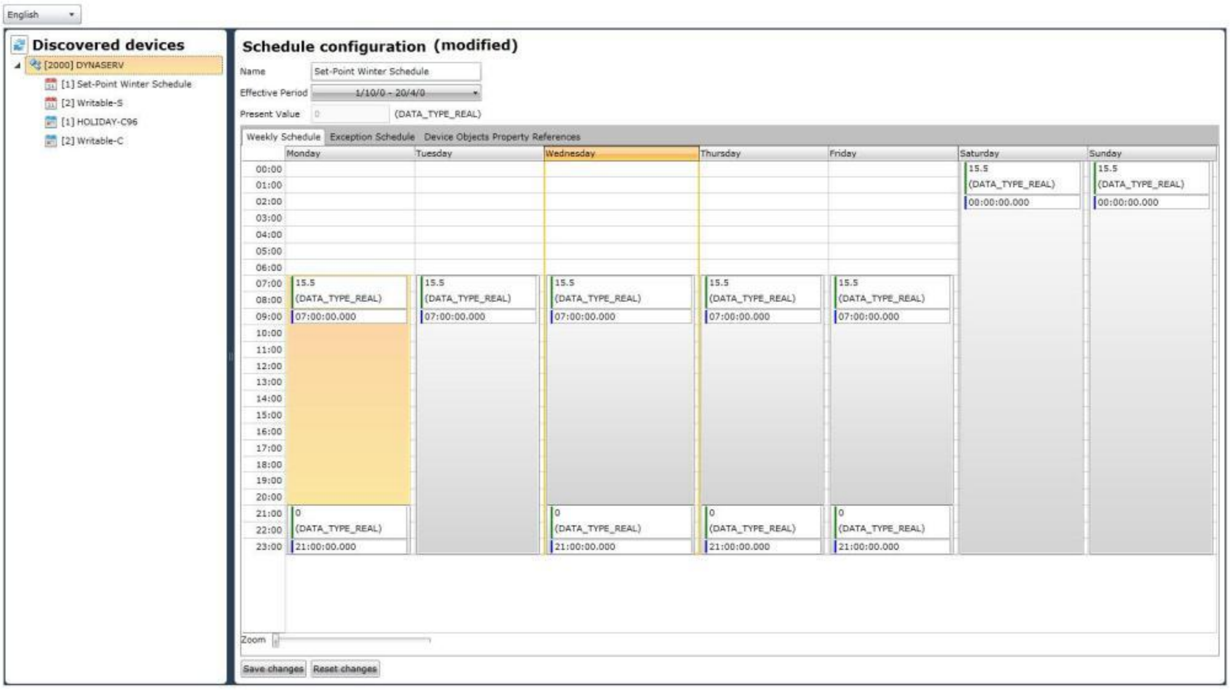
BACnet Scheduler in Smart Editor

In the Property Inspector panel, under the Configuration category there are two properties of the WFBacnetScheduler control:

- SearchDeviceMinimumTime
- SearchDeviceTimeout

The project is ready to be run now. Pres F5 or click on the Run button from the top bar to run the project.

The BACnet scheduler will open in the browser window:



Schedule configuration (modified)

Name: Set-Point Winter Schedule

Effective Period: 1/10/0 - 20/4/0

Present Value: 0 (DATA_TYPE_REAL)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
00:00						15.5 (DATA_TYPE_REAL) 00:00:00.000	15.5 (DATA_TYPE_REAL) 00:00:00.000
07:00	15.5 (DATA_TYPE_REAL) 07:00:00.000	15.5 (DATA_TYPE_REAL) 07:00:00.000	15.5 (DATA_TYPE_REAL) 07:00:00.000	15.5 (DATA_TYPE_REAL) 07:00:00.000	15.5 (DATA_TYPE_REAL) 07:00:00.000		
21:00	0 (DATA_TYPE_REAL) 21:00:00.000		0 (DATA_TYPE_REAL) 21:00:00.000	0 (DATA_TYPE_REAL) 21:00:00.000	0 (DATA_TYPE_REAL) 21:00:00.000		

BACnet Scheduler control in web browser

9. The BACnet Scheduler control at runtime

The BACnet Scheduler control is divided in two panels

- Discovered Devices panel - left side - lists the BACnet devices and all the objects (schedules and calendars)
- Configuration panel - right side - the configuration options for the BACnet objects

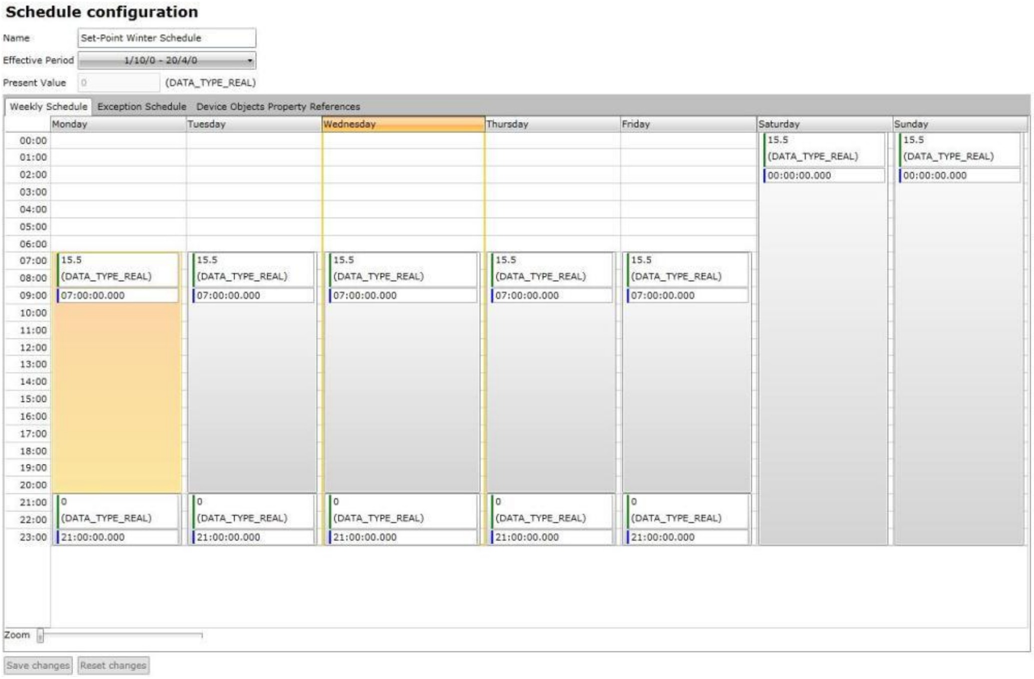
When an object (schedule or calendar) is selected in the left panel, the configuration options are displayed in the configuration panel. The Discovered devices panel features a Refresh button that allows the user to manually reload the devices and objects if any configuration had changed.

9.1. BACnet Scheduler workflow

- A get devices query is executed when the control starts or on any click of the refresh button. The get devices query has a configurable timeout (-1 means wait indefinitely). This will in turn query the devices from the WF2010WebService and subsequently from WFBacNetService. If the cache is populated with devices, or gets populated until the timeout expires, the control will get them. Otherwise, it will get an empty list and a new refresh should be executed. After the first initialization of the cache, the control should always get a list. The get devices query will return the list of devices and the list of scheduler and calendar objects for each device)
- When the user accesses any of the device objects, one or more queries (depending on the object type) are made for reading each of the object properties or property groups.
- When writing values, the scheduler tries to write each property one by one. As noted above, this will trigger a rescheduling of the discovery so that the objects are updated (useful for example when the name of an object is changed).

9.2. Schedule Configuration

The Schedule Configuration allows the user to configure a weekly schedule for an event. The weekly scheduler can be repeated over a period of time. It also allows the user to name the schedule and it displays the current value.



Schedule configuration

Name: Set-Point Winter Schedule

Effective Period: 1/10/0 - 20/4/0

Present Value: 0 (DATA_TYPE_REAL)

BACnet Configuration panel

To name the schedule, input the name in the Name textbox.

To set the period of repetition for a weekly schedule, use the Effective Period drop down menu and enter the Start Date and the End Date.

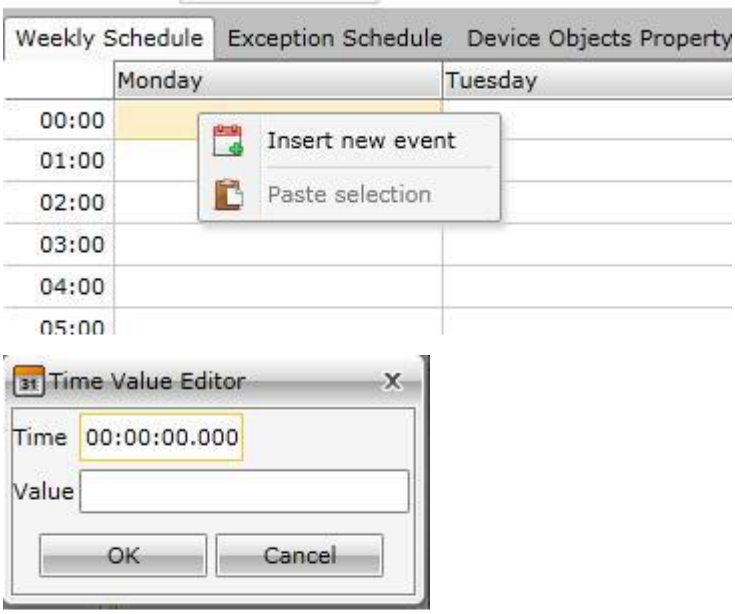
Use the Save changes button from the bottom of the panel to save any modifications, or Reset changes to reset to the default configurations.

Any change in the BACnet Scheduler must be saved in order to be preserved. The Save changes button is located at the bottom of the configuration panel

The main area of the configuration panel is represented by a tabbed grid. The three tabs are:

Weekly Schedule - allows the user to plan a schedule over the week days (the weekly schedule repeats over the Effective Period).

To create a new event, right-click in the grid, on the desired day and hour, and select Insert new event.



Time 00:00:00.000

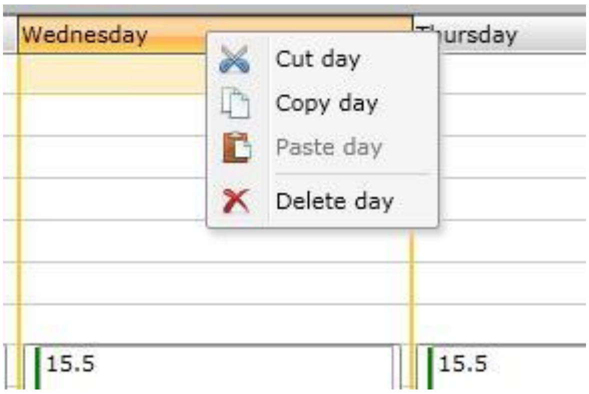
Inserting a new event in the weekly schedule

An event will expand itself from the beginning hour to the end of the day. To stop an event at a specific hour, insert a new event with the value 0.

An event sets the value of a signal on a specific time. Stopping an event means setting the value of the signal to the initial state, before the first event occurred. This can be done only by creating another event and altering the value of the one which is currently executing.

An event can be copied and pasted over an entire week or just on specific days. It also supports cutting, deleting or editing. To access this functions, select an event and right-click on it. The options will be available in the contextual menu.

Not only the events support copy, cut and paste options. The calendar days can be edited the same. Right-click on a day to open the contextual menu.

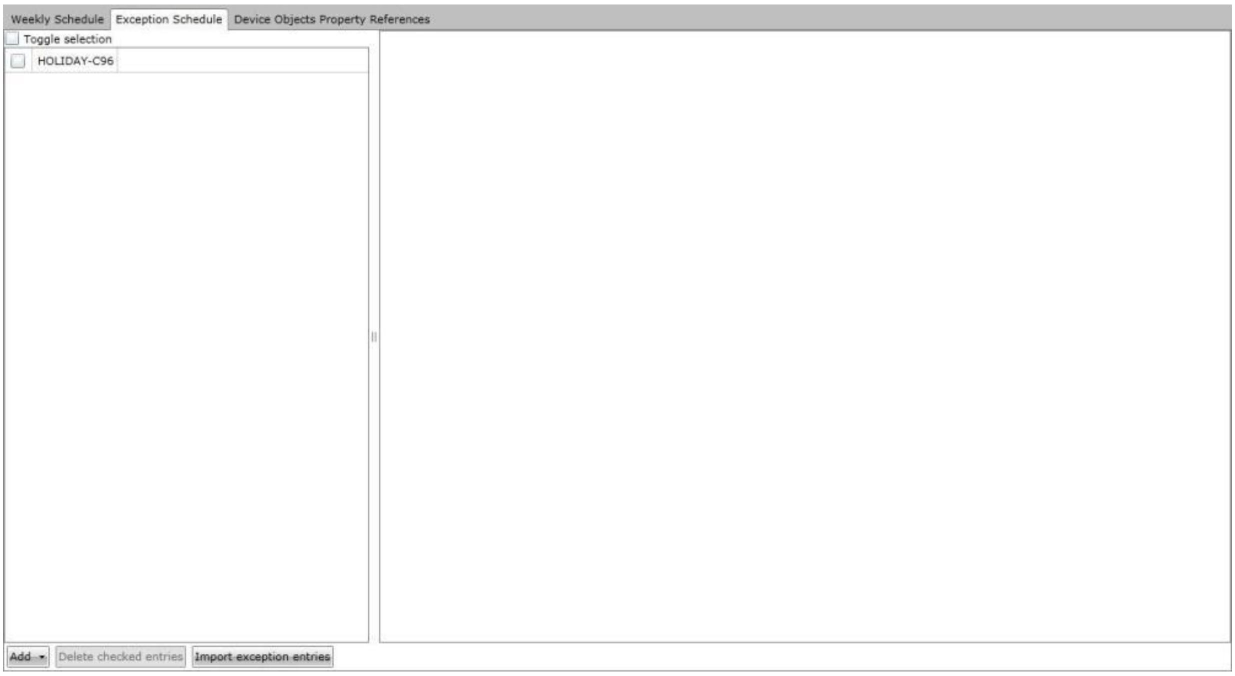


Editing entire days

These options allow the user to duplicate days in the schedule, cut days or even delete days from the schedule.

The Weekly Schedule tab has a Zoom option at the bottom. This is useful when working with detailed time units.

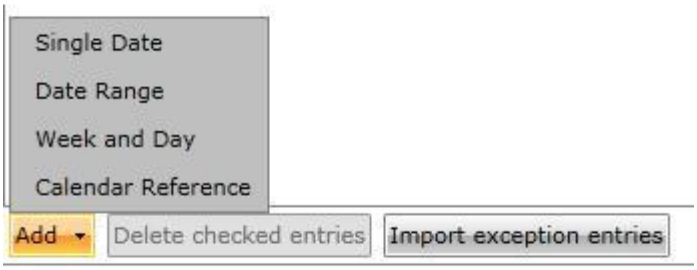
Exception Schedule - allows the user to create exceptions from the Weekly Schedule.



Exception Schedule

The Exception Schedule can be used to create exceptions in the predefined weekly schedule. Using the Add button from the bottom of the panel, the user can add Single Date exceptions, Date Range exceptions, Week and Day exceptions or Calendar References.

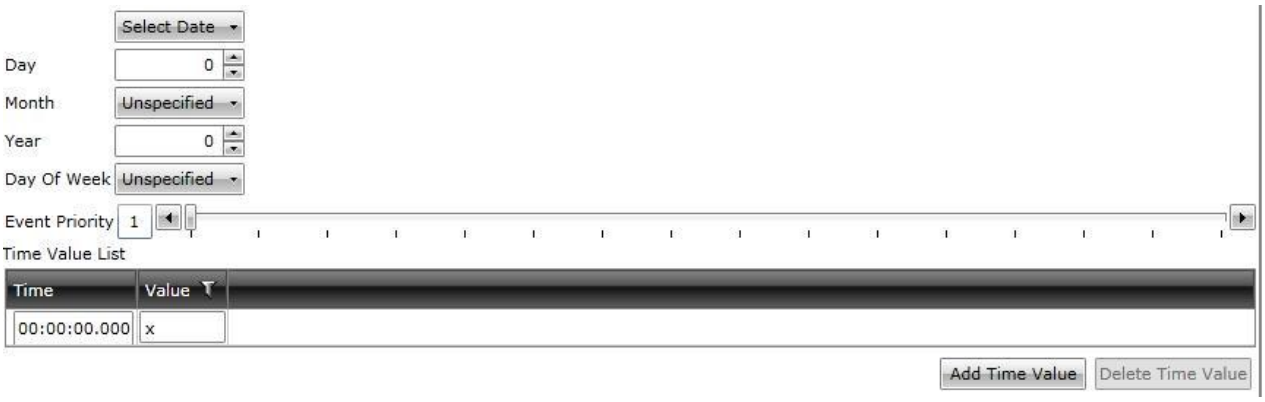
The user can also import exception entries from other calendar applications, using the file format .ics.



Adding and importing exceptions

To delete exceptions, mark the checkbox corresponding with the desired exception and use the Delete checked entries button.

Single Date exceptions - specify a day in which the schedule will be altered, the value of the signal being different for that day.

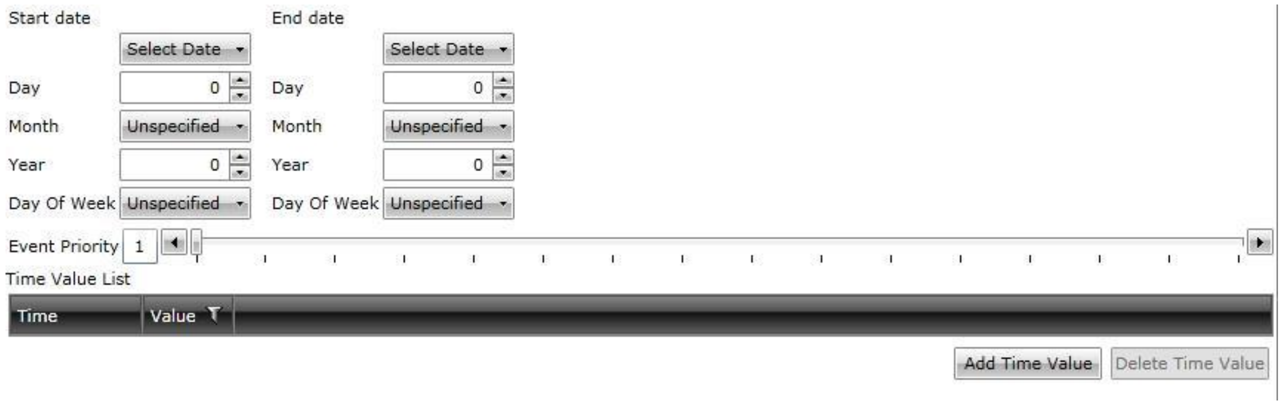


Day 0
Month Unspecified
Year 0
Day Of Week Unspecified
Event Priority 1
Time Value List

Time	Value
00:00:00.000	x

Single Date exception

Date Range exceptions - specify range of time over which the value of the signal will be altered.



Start date	Select Date	End date	Select Date
Day	0	Day	0
Month	Unspecified	Month	Unspecified
Year	0	Year	0
Day Of Week	Unspecified	Day Of Week	Unspecified

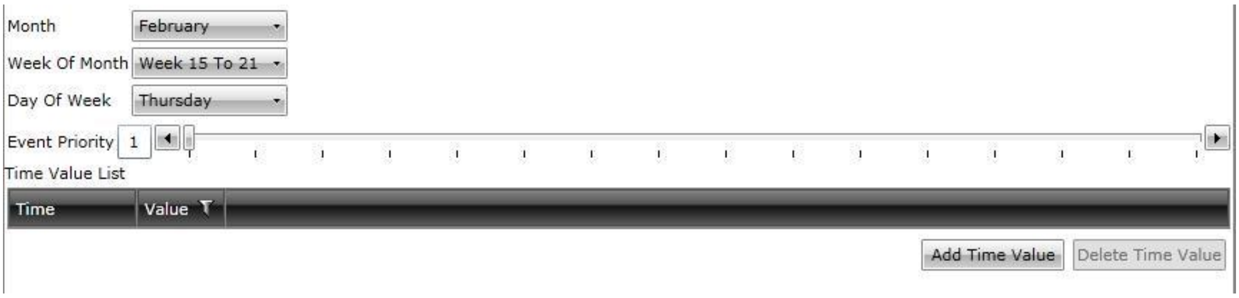
Event Priority 1

Time Value List

Time	Value

Date Range exception

Week and Day - specifies a certain month/week/day when the value of the signal will be altered



Month	February
Week Of Month	Week 15 To 21
Day Of Week	Thursday

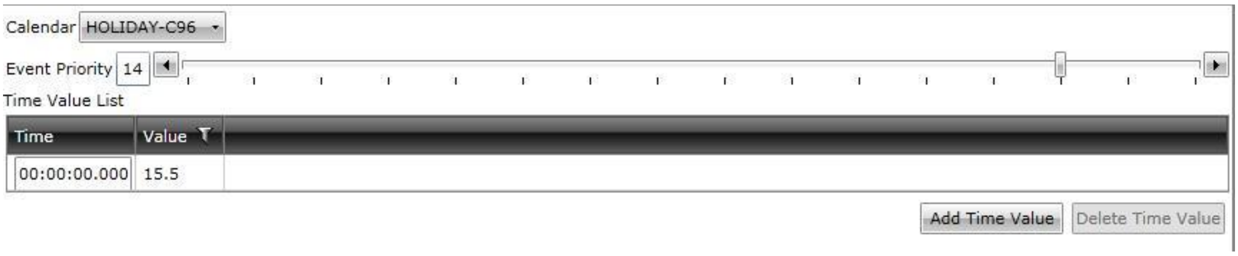
Event Priority 1

Time Value List

Time	Value

Week and Day exception

Calendar Reference exception - specify exception dates imported from an existing calendar object.



Calendar HOLIDAY-C96

Event Priority 14

Time Value List

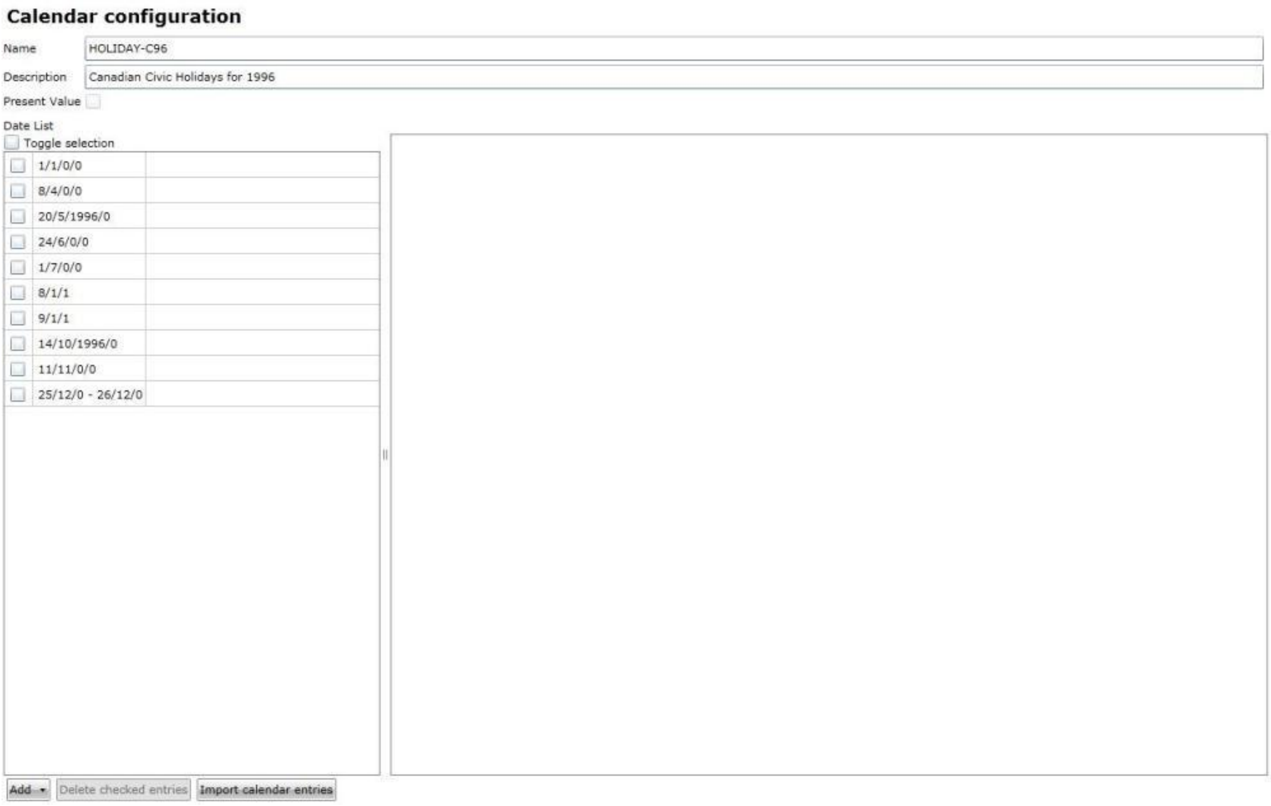
Time	Value
00:00:00.000	15.5

Calendar Reference exception

Device Object Property References - displays a grid of property for the discovered devices.

9.3. Calendar Configuration

The Calendar Configuration view allows the customization of a calendar object. Calendar objects can be used in Exception Schedules under Schedules Configuration.



Calendar configuration

Name: HOLIDAY-C96

Description: Canadian Civic Holidays for 1996

Present Value □

Date List

□ Toggle selection

- □ 1/1/0/0
- □ 8/4/0/0
- □ 20/5/1996/0
- □ 24/6/0/0
- □ 1/7/0/0
- □ 8/1/1
- □ 9/1/1
- □ 14/10/1996/0
- □ 11/11/0/0
- □ 25/12/0 - 26/12/0

Calendar Configuration view

The Calendar Configuration features:

- Name text field - where the calendar can be named
- Description field - where description of the calendar can be entered
- Present Value - displays the present value
- Date List - the list of dates that the calendar holds

By using the Add button from the bottom of the Date List, new entries can be added to the calendar:

- Single Date
- Date Range
- Week and Day

Using these calendar entries, the Scheduler can execute exceptions when programmed to.

The Calendar also features an Import calendar entries button, which allows the user to import .ics calendar files.