Beyond Measure
User Manual and Reference Guide

March 15, 2014

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Introduction

Contrary to how most other applications work, Beyond Measure (hence forth abbreviated 'BM'), does not come prepackaged in a way that it work out-of-the-box. Instead, it lets you, the user, set things up the way you want, and it allows you to purchase only those parts that you want to utilize.

Application overview

BM consists of two main parts:

- The kernel and its modules
- The configuration tool

The Kernel

The kernel runs in the background as a Windows service and is normally not visible to the user. It is responsible for starting the desired modules (modules are parts of the application that provides specific functionality) based on the configuration read from the configuration file.

The Configuration Tool

BM is configured using a tool know simply as “BM Tool” which is the only means to prepare a configuration for use by the kernel. Using this tool, you specify which module(s) to load when the kernel starts, and how they are configured and how they should operate with each other and external systems, if applicable.

The Modules

As stated above, a module is a part of the application that provides certain functionality. Some modules are totally stand-alone, meaning that they have no external dependencies, while others require other modules to be present to provide the full functionality. For example, the DB Storage module (provides a common way for other modules to store data in a database) will perform no work without being asked to do so by another module. A module such as the Rule Engine (which executes a schema containing user defined rules) can be run totally stand-alone without any external dependencies (depending on the rule set, of course). More information on modules is available in the Modules section.

Installation

Before you can start using BM, you must first install it onto the computer you wish to run it. Start by downloading the latest version from the download page, then start the installer and follow the instructions. Take care to select the upgrade-option if you are performing an upgrade of a licensed system, otherwise the installer will overwrite your license key with a trial key. Before installing however, you should make sure that the prerequisites are met.

Prerequisites

BM runs on any 32 or 64bit platform with Microsoft .NET Framework 4 installed (Windows XP SP3, Windows Vista SP1 or later, Windows 7, Windows Server 2003 SP2, Windows Server 2008 (not Server Core Role), Windows Server 2008 R2 (not Server Core Role)).

Depending on your functional requirements, you will likely have to install one ore more of the following items:

- Maxim's 1-Wire driver for 1-Wire support. (Be sure to select the correct 32 or 64bit version)
- ODBC driver for database connectivity.
    - Microsoft SQL Server
        - SQL Server 2005 (section *Microsoft SQL Server Native Client,* select the x86 or x64 package)
        - SQL Server 2008 (*Microsoft SQL Server 2008 Native Client,* select x86 or x64 package)
        - SQL Server 2012 (Microsoft® SQL Server® 2012 Native Client, select x86 or x64 package)
    - MySQL
    - SQLite (this driver is included in the application and does not need separate installation.

    Of course, you will also have a functional database server, should you choose other than SQLite.

Selecting a database

As a user new to these things, it might be tempting to opt for the SQLite database as it does not require a separate server installation, but be aware that most users of BM actually uses Microsoft SQL Server or MySQL since they allow for easier access from other applications and also comes with more mature configuration and administration tools.

Service Configuration

During installation the kernel is installed as a Windows service (unless you choose not to) and will run under the local system account. Normally this gives the application sufficient access right to perform its work, but be aware that network access is limited; network shares etc. are not accessible.

To configure the service to run as another user (to allow network share access etc.), follow these

steps:

- Open the Services Management Console (Winkey+R, enter “services.msc” and hit Enter.
- Find the Beyond Measure service in the list.
- Right-click on and select Properties.
- Open the Log On tab
- Select the This account option and enter the account name and password.
- Press Apply. Please note that the changes does not take effect until the the service is restarted (done via the General tab).

Completing the Installation

BM comes with a default, empty, configuration so you may opt to configure the application before starting the service (Winkey+R, enter services.msc, hit Enter then find the service entry and start it) or, you may start the application in desktop mode by using the shortcut on your start-menu. See section Starting the Application for more details.

Using a Trial License

The trial license that comes with the license key allows you to load up to four modules, and a run time of a certain number of hours since the last reboot of of the computer. Note that each module has its separate time counter, thus each module will stop operations at different times within the preset time. Once a module considers the trial license to be expired, you have to reboot the computer before operations can continue.

Installing a purchased license file

When you receive a license file after completing a purchase, simply copy it to the installation folder and (re)start the service. The application will look for available license files, and select the one with the latest creation date. Should this search for some reason select the wrong license, such as the trial license (you can determine this by enabling debug log messages) simply delete the license files that you do not want it to use.

Starting the Application

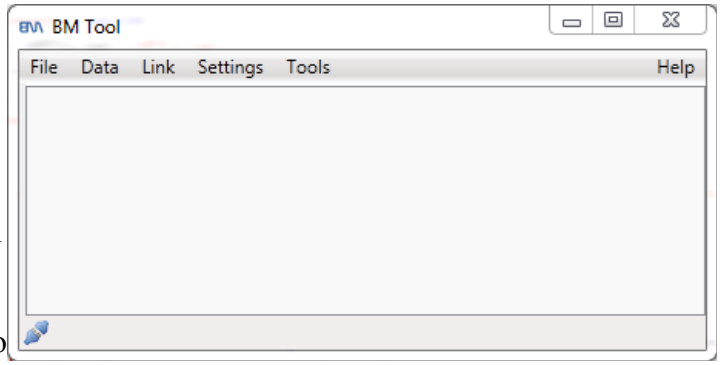
As noted above, the kernel can run in two modes:

- Desktop Mode
- Service Mode

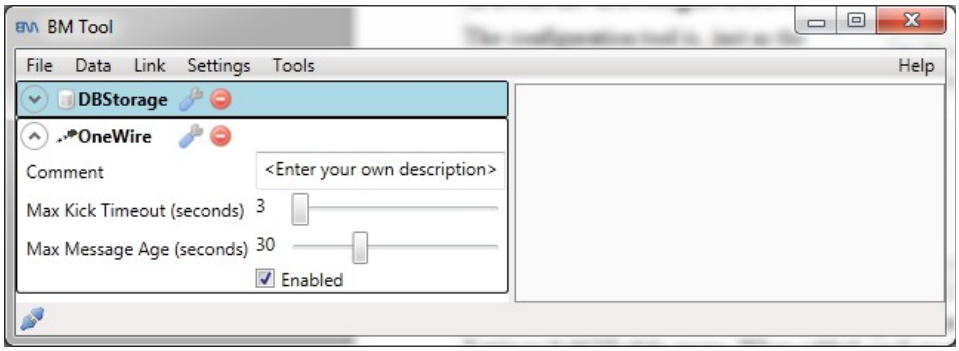
Running in desktop mode has the advantage that you can see the generated log information directly from within the console window that appears. Regardless of which way you choose, whenever the configuration file is changed, the kernel will reload it and restart all modules so they can refresh their settings. Please note that you cannot run the service and in desktop mode at the same time – only the first instance will be operational.

General Configuration

The configuration tool is, just as the modules, divided into different parts, each with its specific purpose. When first started, it looks like the image to the right. The configuration file read by the kernel/modules is named “BeyondMeasure.scb” and always resides in the applications data-folder (this folder can be accessed through the menu File/Open data directory). In all likelihood, you want to open this file before continuing (File/Open menu).



As a new user, you'll want to start by adding the modules you want use, do this through the Settings/Add Module menu. When added, each module instance is displayed on the left side of the window.



Note that you can expand each item to access the settings that modules support. To configure the specific instance, click the tool-icon.

A module can be added multiple times. Reasons for adding multiple instances of the same module type may be that you want to store data in to multiple databases or run two 1-Wire networks in parallel. Some modules makes sense to run in multiple instances while other do not. Care should be taken not to to configure to modules to perform the same work as that usually leads to undesired side effects.

The Supervisor

The supervisor is a part of the kernel that monitors all enabled modules and when they are deemed to be non-functional for whatever reason, will attempt to restart the module in question. Each module reports (aka. 'kicks') to the supervisor with a regular interval, and if it does not it is considered to be non-functional. The most common reason for a module to be considered non-functional is when a module performs a long running operation, such as a database query that results in a large data set. If you know this to happen, you may increase the kick-time for that module. However, the default of three minutes is sufficient in nearly all cases so do not change this without reason. The supervisor also has some configuration options you can change in the Settings/Preferences/Supervisor tab.

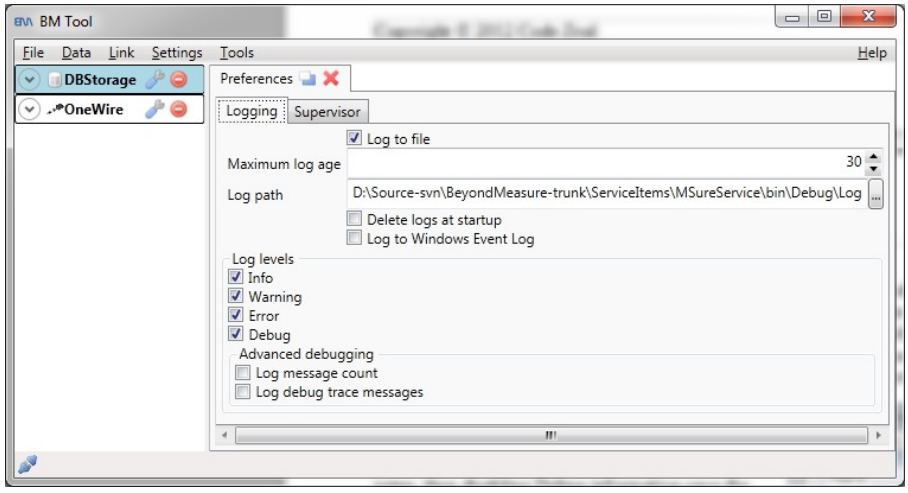
Logging

Regardless of run mode (desktop or service), the application will produce log files in the Logs-folder beneath the installation folder. The log files are named after the current date, their respective module name and instance number, or, in the case of the kernel, simply Kernel-<date>.log. These files are UTF-8 encoded files, and as such you are recommended to use an editor capable of reading

UF8 encoding (most modern editors do). The application outputs a lot of information to the log files by default (all four log levels are enabled: Info, Warning, Error & Debug) and the log files are the first place you should look if you run into problem. It is recommended to let all levels be enabled during initial setup, then disabling Debug information once the system is taken into production use.

You access the Log settings through Settings/Preferences/Logging.

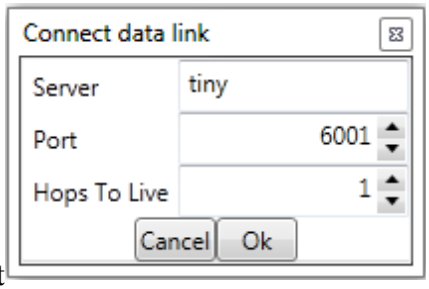
You can select which debug levels you want to log, and whether you want to log them to file and/or Windows Event Log). You can also change how and when log files should be deleted (Windows Event Log clean-up is configured using Windows' own tool).



Advanced debugging

The two options, “Log message count” and “Log debug trace messages” should be used with care as they can potentially cause a huge amount of data being written to the log files and Windows Event log. The latter of them should only be enabled if searching for the cause of a problem in the application.

Data Link

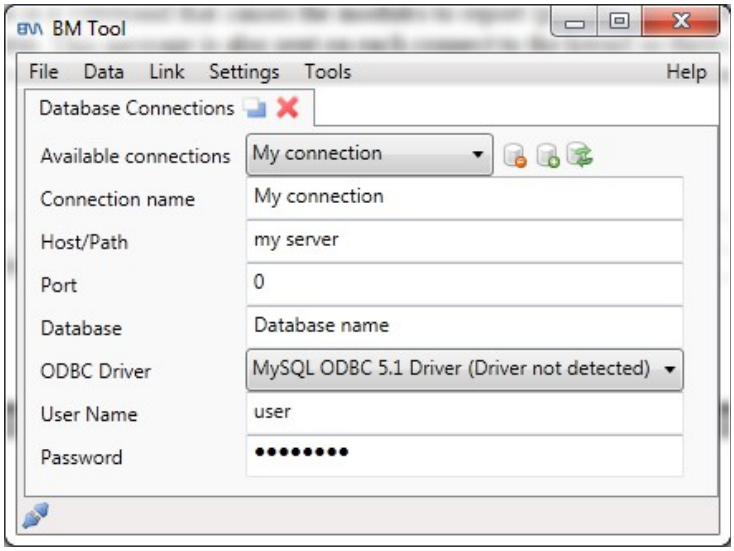


Depending on your use case (such as running a schema with live data), you may want to connect the configuration tool to a kernel running at either the local or a remote computer. To do this you must first enable the Network Binder module in the kernel and configure it to act as a server. Then, open menu Link/Data link/Connect. You will be presented with the Link Settings window in which you must enter the IP address or DNS name of the computer running the kernel. Unless you have changed the port used by the Network Binder module, leave it at its default of 6001. Once satisfied with the server address, press enter and the tool will attempt to connect to the kernel through the Network Binder module. The data link indicator will reflect the link status in the lower left corner of the window. For information about the Hops To Live-setting, see Module: Network Binder.

There are two additional menu items under the Data Link menu; “Block all outgoing non-user commands” and “Request Update”. The former can be used to prevent a schema running in the configuration tool to interfere with a live system by preventing any command messages being sent to the kernel. The latter one is a command that causes the modules to report (possibly re-read from end devices) its current status. This message is also sent on each connect to the kernel so there is no need to manually issue the command without good reason as it may cause an unwanted load on the system.

Database Connections

Connections to databases are configured centrally using the Database Connections window (Data/Database Connections).



Each connection requires a set of parameters:

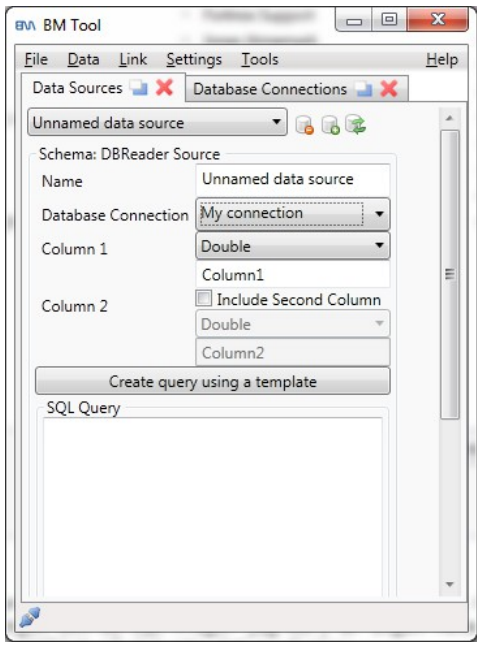
- Connection name
- Host/Path (in the case of SQLite databases, you must enter the path to where the file should reside on the local computer)
- Port (not used for SQLite)
- ODBC Driver (if the driver cannot be located, it is indicated in the drop down box)
- User name
- Password
- Database name (in the case of SQLite databases, you must enter the name of the database file (so the full path to the database becomes the path entered in the Host-filed + the database name))

You can click the icon beside drop down box to test the current connection. The application will attempt to create the database if it does not already exist. Of course, the creation of the database will only work if the specified user account has sufficient access rights in the database.

These connections can later be used from various modules.

Data Sources

Data Sources (menu Data/Data Sources) are used to define how to retrieve data from external sources, such as a database, for use in for graph generation. Each data source requires a database connection from where the data should be read and information on how the data should be parsed. There are a number of templates for different 1-Wire sensors, but you may also write your own custom SQL queries.



Currently, there are two types of data sources:

- Graph Sources – these are for use in Data Series in graph generation.
- Schema Sources – these are for use in schema components.

Modules

A module (also known as a “plug-in” or “add-on”) can be seen as a separate application, but one that runs within the same application context as other modules. This separation into function-specific parts makes it easier to build a system that can be expanded based on the user's need without adding parts that are not used from the start.

Module Communication

All modules are capable of talking to each other through a common messaging interface; this enables great possibilities in terms of integration. To the average user these messages are of no immediate concern, but for those that delve into the User Module Engine, these messages are of great importance. The kernel handles all message distribution automatically so there is no need to manually configure it; as long as the module is loaded, it can receive and send messages to/from other modules.

Messaging Overflow

All messages takes a certain amount of time to process. For example, a command to read a 1-Wire device takes approximately one second to execute, depending on the network complexity. If you request it to be read every half second the receiving module, in this case the 1-Wire module, will start accumulating a number of unprocessed commands, essentially delaying the execution of the commands. To prevent the system from being flooded, all modules drop messages that are too old (by default 30 seconds or older) and logs a warning in the module log.

If any of your modules logs such a message, it means that it cannot keep up with the number of incoming messages and you need to revise your system configuration to lighten the load.

For each separate module, you can set a maximum message age. Although you can set it as high as a full minute, doing so is not recommended unless you know that a module occasionally is busy for such a long time.

Module: 1-Wire

The 1-Wire module adds the ability to read and control Maxim's 1-Wire devices. For those that are not yet familiar with these, Maxim provides a technical but good introduction here. In less technical terms, a 1-Wire device can be seen as a component with a very specific functionality that is controlled by a master, in this case the 1-Wire module of BM.

Supported 1-Wire Adapters

BM supports those adapters that are supported by Maxim's 1-Wire drivers, except for parallel port adapters.

- Serial: DS9097U
- DIY/Homebrew adapters (various schematics can be found on the Internet)
- USB: DS9490R

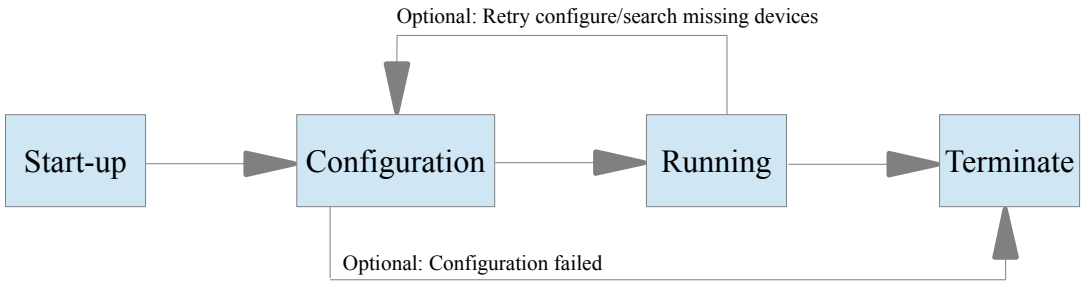
Supported 1-Wire Devices

- 0x05 – DS2405

- 0x10 – DS18S20
- 0x12 – DS2406 (one and two channel versions), DS2407
- 0x1D – DS2423
- 0x1F – DS2409 (when acting as a 1-Wire network switch)
- 0x20 – DS2450
- 0x22 – DS1822
- 0x26 – DS2438 (also as humidity devices when paired with humidity sensors HIH4000/4021)
- 0x28 – DS18B20
- 0x29 – DS2408
- 0x30 – DS2760/61/62
- 0x3A – DS2413
- 0xEF – Hobbyboards 4 Channel Hub
- LCD devices: There are currently two supported LCD devices; Swart and Hobby-board. Since neither of these devices have an official family code, they must be manually converted from their actual device types from within the configuration, and their type and LCD-size provided by the user.

Operation and Configuration

There are four states in which the module operates, and they are linked as shown in the following figure.



During the Start-up state, the 1-Wire network is scanned for present devices, including devices behind 1-wire network hubs. This search has been verified to a depth of two cascaded hubs, but should work at deeper depths too. When the search is complete, the module enters the Configuration state in which it configures all devices according to the settings defined by the user. Such settings are device specific and includes settings like alarm levels and value resolution. When all devices have been configured, the Running state is entered in which the devices are read according to the defined schedule and commands from external sources are processed.

Operational Settings

1-Wire networks are mostly stable, but it does happen that a device temporarily is unavailable for various reasons, especially on larger networks with long wires. There are two options to handle such situations.

- *Automatically search for missing devices every 15 minutes.*
    - With this option enabled, the module will enter a search-mode every 15 minutes when a device is unavailable during start-up.
- *Instead of terminating when device configuration fails, retry every 15 minutes.*
    - With this option enabled, the module will resume normal operation even when the configuration stage fails for a device during start-up.

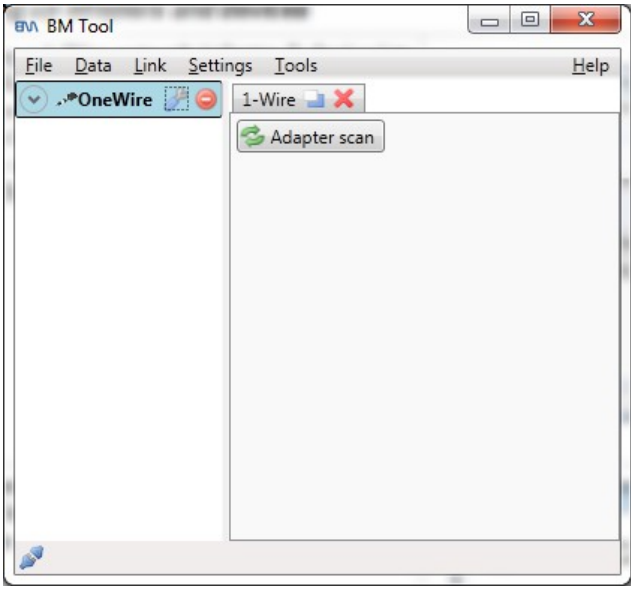
Command Priority

Commands that are received from external sources, such as a component in a schematic, have priority over the normal read schedule and as long as there are commands to process, the normal read schedule is put on hold. In practical terms, this means that if too many commands are sent to the module it will not be able to perform its normal procedure. A command does however not abort a scheduled read already on progress when the command is received.

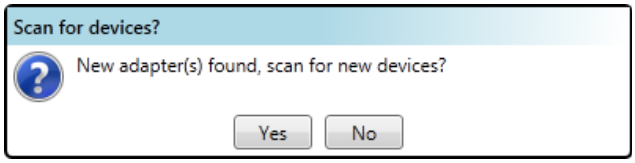
Setting up adapters and devices

Adding a 1-Wire network (adapter & devices) to a configuration is done through the use of the auto-search function. Simply press the button labeled “Adapter scan”. When you do, the application will search all available ports (Serial and USB) for available adapters.

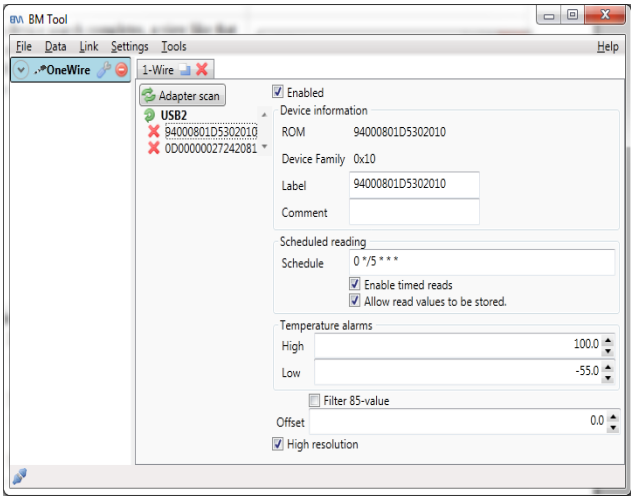
If a serial adapter is found, the application will ask if it is of a DIY/Homebrew type in order to handle it correctly



When the adapter search is complete, a question asking if a search for adapters should be performed is shown. Select Yes to search for all connected devices on the found adapters.



When device search completes, a view like that to the right is shown with all devices listed on the left side and the properties for the selected device on the right side.



Each device type has its own set of properties, and there are a few common properties for all devices:

- Enabled – if unchecked, the device will not be considered for any operation.
- Device information
  - Label – specifies the name to use throughout the application when identifying the device. Also used as database table name.
  - Comment – allows for storing an arbitrary text along with the device, such as its location.
- Scheduled reading
  - Schedule – specifies the read interval for the device. This setting uses the Cron format.
  - Enabled timed reads – if unchecked, the device will never be read according to the schedule, only on direct request from an external source.
  - Allow read values to be stored – if checked, a properly configured DB Storage module will store the read values from this device. This only applies to scheduled reads, devices read in other fashions do not result in values being stored.
  - Distribute at tags – if checked, all read values for the device will be distributed as Tags whenever a new value is read.

Adapters and multiple module instances

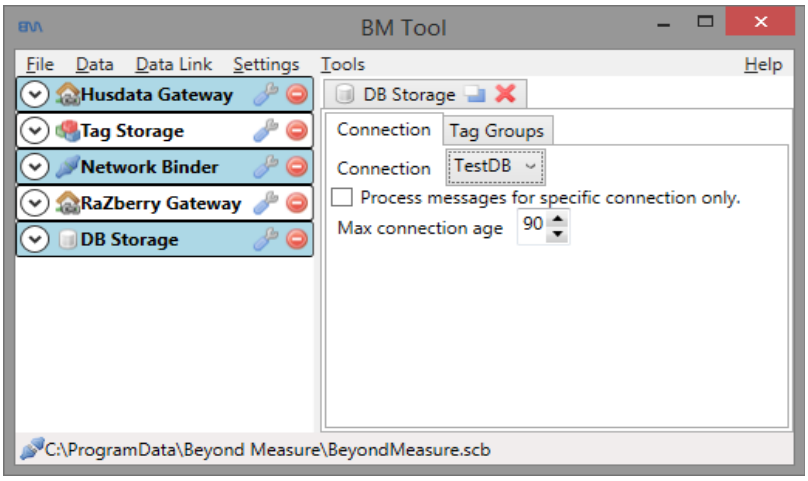
An adapter can only be used by one module instance at a time, so if you add two or more instances of this module, you must disable all adapters except those you intend to use in the current module instance. When the adapter is disabled, the devices on that adapter are hidden in the network tree.

Module: Database Storage

This module has only one purpose; to store data gathered/published by other modules in a database. It requires only a configured database connection to be operational. Once activated, the module will translate messages sent from other modules into tables and columns in the database. Only one database connection can be selected, but you may add additional instances of the module to store the data into multiple databases.

It can operation in two modes:

- Processing all general storage requests from other modules
- Processing only those requests that specify a specific database connection.



The latter mode is used together with a DB Writer component configured with a specific database connection. The reason for the second mode is to allow for configurations where the DB Writer component decides where a value should be written and not the Database Storage module.

The second mode has one limitation that it is important to be aware of; it does not function between different instances of BM linked together with a Network Binder module, even if the database connections are configured with the same name. Also see “Storing tags” below for additional ways of storing values from a schematic and/or modules.

Regardless of operational mode, all connections used by the module are kept alive for the configured time. By setting this to a time slightly longer than the shortest interval between two write requests it is possible to keep the number of reconnects to the database server to a minimum, thereby improving performance.

Storing tags

As your system grows and you come to see the possibilities, you will find that the default functionality for storing values are not meeting your demands. For example, most modules can publish values on a per-device/unit basis for direct storage, but what if you want to combine multiple values into from different sources? This is where the Tag Groups tab comes into play.

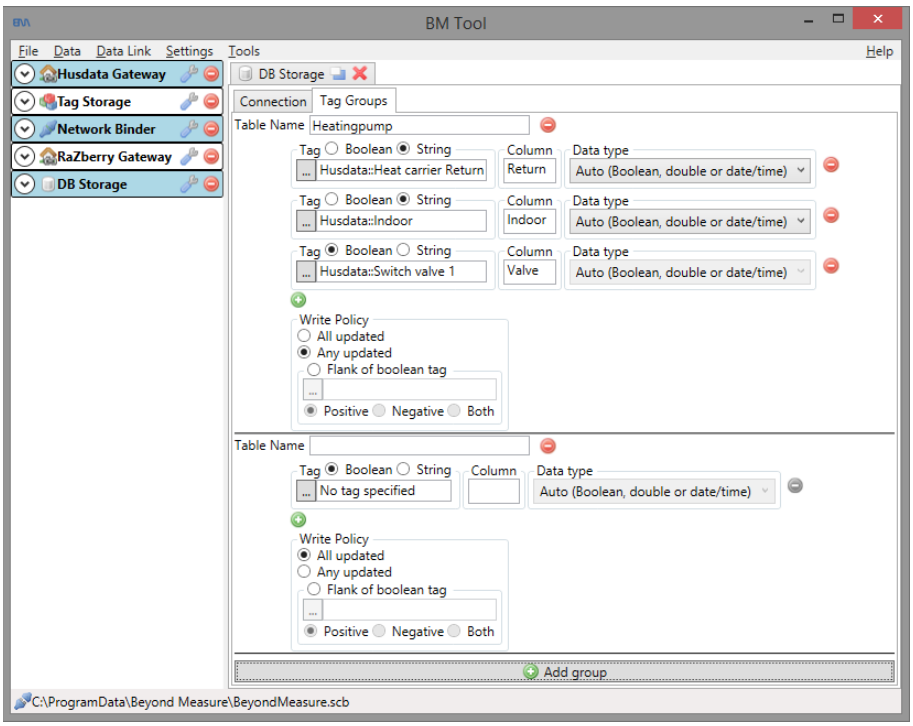
By adding one or more groups, you can define a set of tags that shall be stored in a single table, as specified in the group. For each tag, you can specify the column name and data type it should be interpreted as but in most cases you can leave it as “Auto” unless you know the value to be outside the limits of what can be parsed as a boolean, double or date/time type. If a boolean tag is selected, the type selection becomes unavailable.

There are a few rules that determine when a group is written to the database:

- All tags within the group must have been updated at least once.
- The write policy must be fulfilled

- All updated – when selected, nothing is written until all tags within the group are updated with a value since the last time the group was written. This means that some values may be updated multiple times between each write while others are only updated once.
- Any updated – when selected, the group is written any time a value is updated. Note that an update with the same values as the previous update also counts as an update – there is not filtering.
- Flank of boolean tag – when selected, the value of the selected boolean tag in conjunction with the selected flank (positive [false to true], negative [true to false] or both) [any change] determines when the group should be written. This can be used to either send a "write command" from a schematic or to initiate a write based on a tag published by another module.

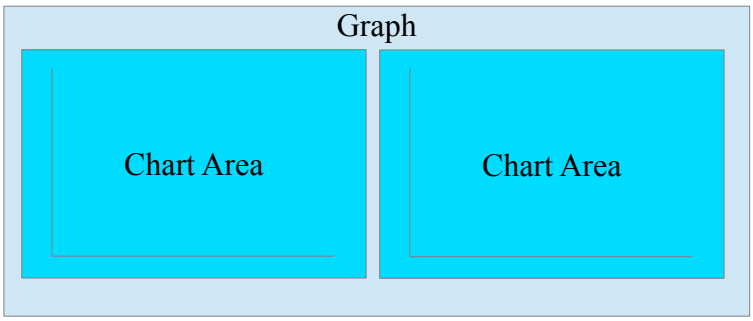
- The tag being parsed is not a refresh broadcast, i.e. the tag is not sent as a refresh from the Tag Storage module in response to a refresh command. In other words, only tags that has actually been updated are taken into consideration.



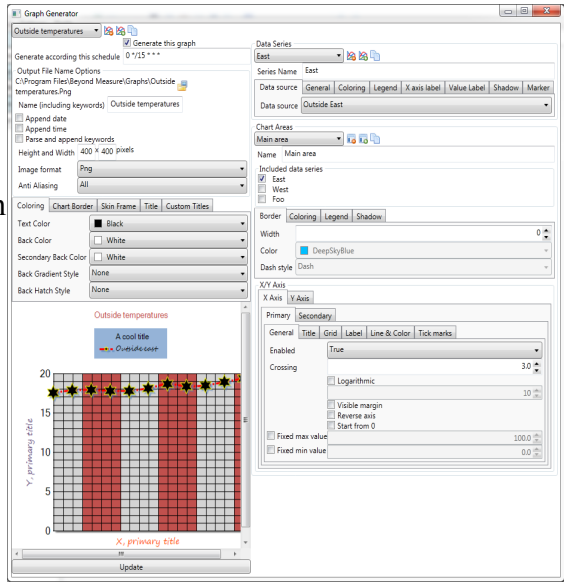
Module: Graph Generator

This module is for generating static graphs according to a user defined schedule. Almost any data series can be plotted; as long as the data is retrievable as described in Data Sources it should work.

Each graph image is structured as illustrated below. The graph in turn is contained within the actual file that is written to disc. The user interface for the graph module follows the same structure as the graph image – remember this and you will have an easier time finding the settings you need.



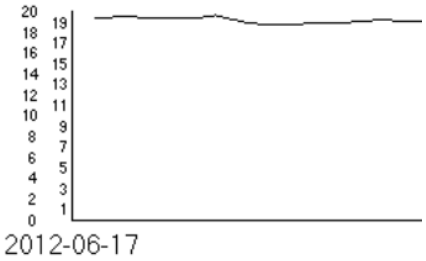
General requirements and rules for creating a graph



- Data Series are what is plotted in the respective Chart Areas. A Data Series can be reused multiple times within the same graph.
- A Chart Area requires at least one Data Series.
- A Data Series requires a Data Source, see section Data Sources, from which it will retrieve the data that should be plotted.

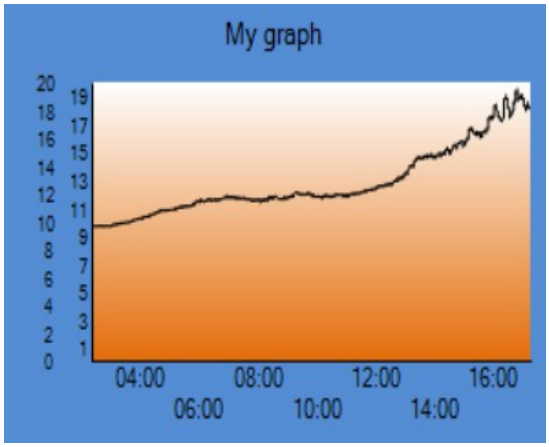
Creating Your First Graph

1. First, make sure that you have a functional Data Source, for example one that retrieves time stamp and temperatures from a table in a database.
2. Add a new graph by clicking on the icon with the +-symbol.
3. Give the graph a name, this also specifies the name of the output file. Note that you can use 'keywords' to insert the current time etc (see the tool tip for a list).
4. Under “Data Series”, select the data source to read values from. You probably want to change the default name of the data series.
5. Under “Chart Areas”, check the data series to include.
6. Now press the button “Update” in the lower left corner (you might have to scroll down). A very basic graph is now shown, much like the image to the right.



Lets make the graph a bit more eye-pleasing.

8. Select the following file option:
    1. Anti Aliasing: All
9. Coloring
    1. Back Color: Cornflower Blue (R:100, G:149, B:247, A:255)
10. Title
    1. Title: Enter a title for your graph.
11. Chart Areas
    1. Coloring: A gradient of your liking and then two different colors for “Color” and “Secondary Color”
12. Chart Areas / X/Y Axis
    1. Under tab “Label” enter “HH:mm” (without quotation marks) into the format string box.
    2. Enter “1” in the Interval box and select Hour in the Interval Type box.
13. Press the Update button in the graph render window and you should have something like this image, depending on what your data and color options were.



Hint: You can duplicate graphs, this can for example be used to try different settings without changing the original graph configuration.

Data Series

Data Series (abbreviated 'DS' below) are what is plotted in a chart area. They have many options, most of which are described by their name alone. However, there are some things that need further explanation.

Chart Type	Specifies how the DS is plotted; as a line, area etc. If you have multiple DS in the same Chart Area, not all combinations are possible. For example, bar and columns cannot be used in the same Chart Area and when using Stacked types each series must have the same number of data points.
X-Axis/Indexed	When checked, the data points are indexed along the X-axis instead of being placed by its actual value. If enabled, and two or more series are enabled, both must have the same number of data points.
Gradient	If a Gradient is enabled, it takes precedence of any other color for the same area. Cannot be used together with Hatching.

Hatch	The hatch color is taken from the color for the same area. Cannot be used together with Gradient.

Keywords in Legend Texts

Each data series has the property “Legend Text” where you may enter a text that will be displayed in the legend for each chart area. By using certain keywords, you can extract values and calculate certain mathematical expressions. The allowed keywords are:

#TOTAL	Total of all Y values in the series.
#AVG	Average of all Y values in the series.
#MIN	Minimum data point of all Y values in the series.
#MAX	Maximum data point of all Y values in the series.
#FIRST	First data point of all Y values in the series.
#LAST	Last data point of all Y values in the series.

All keywords allows the usage of format strings. Format strings are appended to the keyword and always begins and ends with an opening and closing brace: #KEYWORD{#.##}

There are several format strings available, you can read the full specification here and here, but for most use cases a combination of the #, 0 and .-character will be sufficient.

Examples

#AVG{#.##}	Round the average value to two decimals
#LAST{00.00}	Display the value using at least two digits
#FIRST{#}	Round the value, no decimals

Look here for more examples.

Custom Titles

Under tab Chart Appearance/Custom Titles, you can add your own title boxes and place them where you want on the graph.

Keywords and macros in custom titles

The custom titles supports several keywords and macros that results in auto-replacement with actual values.

Keywords

{DATE}	Returns the current local date.

{TIME}	Returns the current local time.
{UTCDATE}	Returns the current UTC date
{UTCTIME}	Returns the current UTC time.
{yy}	Year, two digits
{yyyy}	Year, four digits
{MM}	Month, two digits
{dd}	Day, two digits
{hh}	Hour, 12h format
{HH}	Hour, 24h format
{mm}	Minute, two digits
{ss}	Seconds, two digits
{PATH}	Returns the path, excluding the file name to where the graph is stored.
{FULLPATH}	Returns the path, including the file name to where the graph is stored.
{NAME}	Returns the name of the graph, as specified in the graph configuration.
{HEIGHT}	Returns the configured height of the graph.
{WIDTH}	Returns the configured width of the graph.

Macros

%MEAN('source')	Returns the mean value of the Y-values for the given data source.
%MEDIAN('source')	Returns the median value of the Y-values for the given data source.
%LASTVALUE('source')	Returns the last value of the Y-values for the given data source.
%MAX('source')	Returns the maximum value of the Y-values for the given data source.
%MIN('source')	Returns the minimum value of the Y-values for the given data source.

Example:

%MEAN('outside, west')

results in the mean value of the data source which has its Name-element set to “outside, west”

Note:

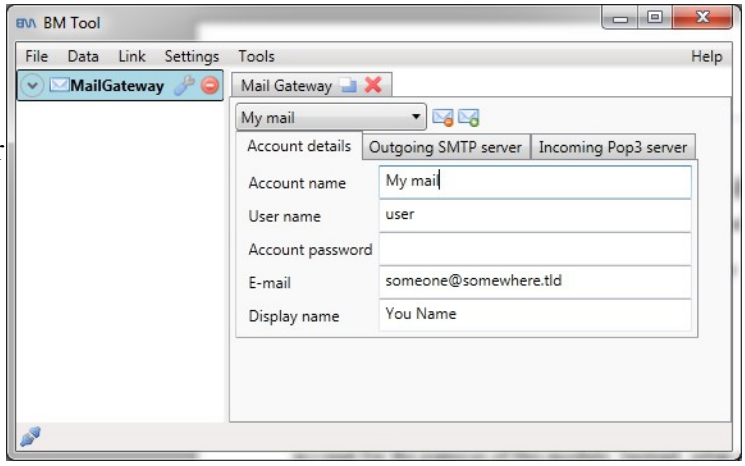
Values returned by these macros are always retrieved from the Y-axis of the data source.

The single quotation marks must be included in the configuration, thus is %MACRO('source') valid syntax, %MACRO(source) is invalid.

Hint: By inserting “\n”, you can force a line break in the text.

Module: Mail Gateway

Please note: To utilize this module, you also need the Rule Engine or the User Module Engine.



E-mail is great thing and with today's smart phones and tablets it can be used in many ways, such as for notification and/or controlling units connected to your system. The purpose of this module is to act as a gateway to one or more e-mail accounts, allowing e-mail to be both sent and received from within BM.

A Word of Caution

We recommended against using your regular e-mail account for the purpose of this module. Instead, setup a separate account dedicated for use with this module.

Configuration

Authentication

All serious e-mail providers requires the e-mail client to authenticate before being allowed to send e-mails in order to prevent their systems from being used by anonymous spammers. This module supports two modes of authentication:

- Normal authentication using user name and password.
- Pre-authentication using POP3. When enabled, the module will first log in to the POP3 server using the provided account details before attempting to send an e-mail using SMTP.

Although the module allows both to be be activated at the same time, one should be sufficient. Ask your ISP which one that applies to you.

Port Numbers

The standard SMTP port number is 25, but most ISP/e-mail providers blocks this port and tend to to configure their SMTP servers to use another port, often 2525, instead.

The standard port for POP3 is 110. When using a secure POP3 connection (by checking the appropriate check box) the port should usually be changed to 995, but this may vary so check with your ISP/e-mail provider.

Retrieving Mail

As each mail is received from the server, it is transformed into a format that can be distributed internally between modules. Note that attachments are not supported at this time.

You may configure each separate account to for manual (instead triggered though a rule schema) or automatic, periodic, retrieval of e-mails in 1 minute intervals. Entering a 0 will disable the automatic retrieval. To filter which messages that shall be retrieved and parsed, you may enter a

filter string that must be present anywhere in the subject of the e-mail (case insensitive comparison).

Note: If you choose not to delete the email after retrieval, the same messages will be read over and over until you manually delete them.

Configuration Example

Google Mail

Google provides all the required information to configure BM to work with GMail on this page but in short, the following settings have been seen to work:

Outgoing:

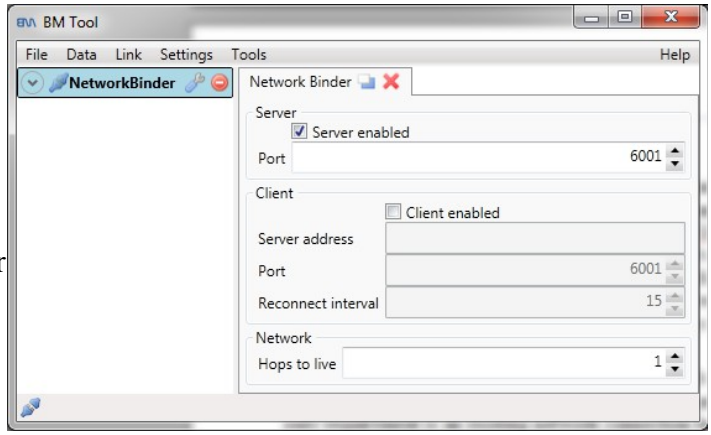
- SMTP Server: smtp.gmail.com
- Port: 587
- Pre-authenticate using POP3: No
- Login using credentials: Yes
- Enable SSL: Yes

Incoming:

- POP3 Server: pop.gmail.com
- Port: 995
- Enable SSL: Yes

Module: Network Binder

Sometimes, it is desired to connect two or more instances of BM to build a larger system out of smaller parts. For example, lets say you have a low-power computer (connected via WiFi) running in your garage for monitoring of temperatures and light control and a media server in your main building running a second instance for additional monitoring and control. Connecting the two instances would enable you to use devices from either instance in a schema as if they were part of the same system.



This is where the Network Binder comes into play. It enables you to connect a number of instances together into a larger system, the only requirement is an existing network connection between the physical locations; be it WiFi, hardwired, GPRS/3G or other media.

It provides to operational parts:

- Server - other instances of the Network Binder can connect to it.
- Client - the Network Binder connects to a remote server instance.

Hint: This module provides a great benefit when designing schematics in Sanity to be run in the Rule Engine module, as Sanity can connect and receive live data from the server giving you live feedback directly in the editor.

Message Distribution

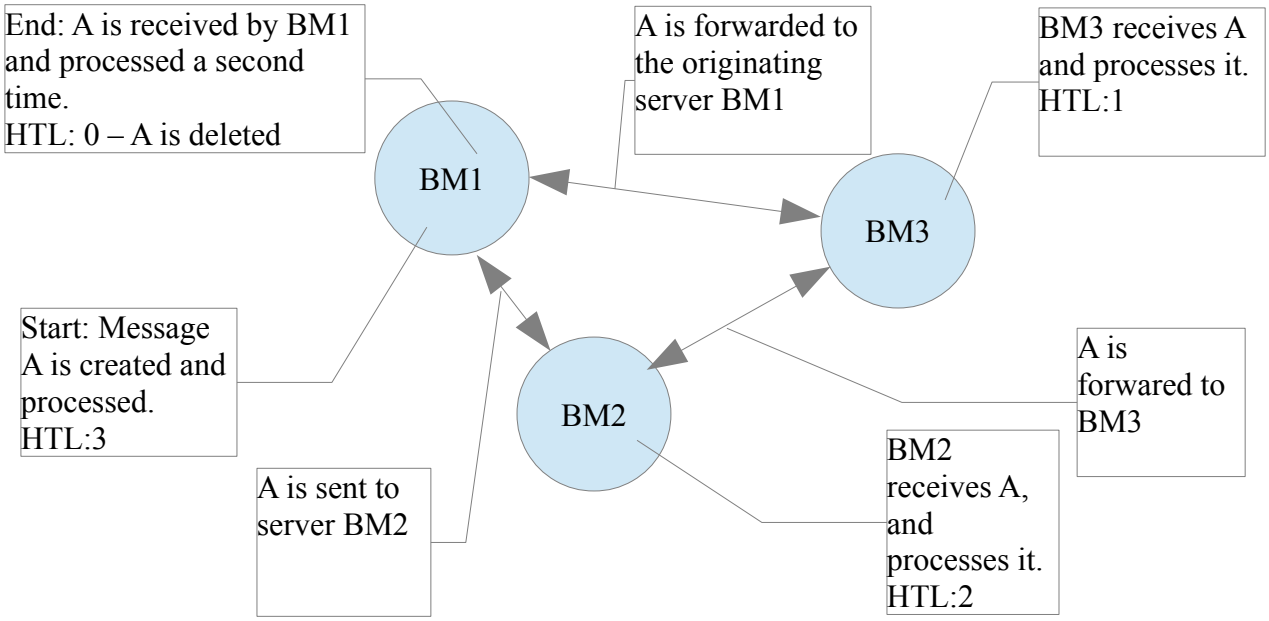
All messages are distributed to all connected clients/servers, as well as internally in the local BM instance with two restrictions:

- Hops To Live (HTL). A 'Hop' is the transference of a message between client/server A and B (illustrated as an arrow below). Each time a message hops from one to the other, the messages' HTL-counter in decreased by one and when it reaches zero, the message will not be distributed further.
- A message is never sent back the way it came to prevent rouge messages in the system.

A problem: Message Loops

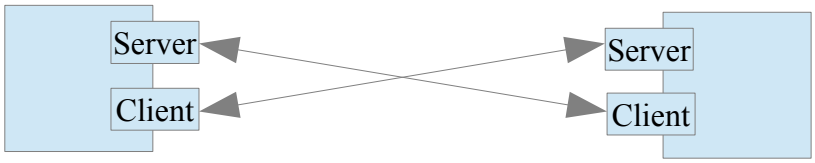
Despite the above two distribution restrictions, you can still end up with messages doing loops within your system if you configure your Network Binder instances to form a circle connection, as illustrated below. The problem is in that the server BM1 processes message A a second time.

This image does not show the full problem though, as the message A is actually distributed from BM1 to both BM2 and BM3, which means that before the message is deleted, it is processed twice by BM2 and BM3, and as many as three times by BM1 before the message is deleted from all

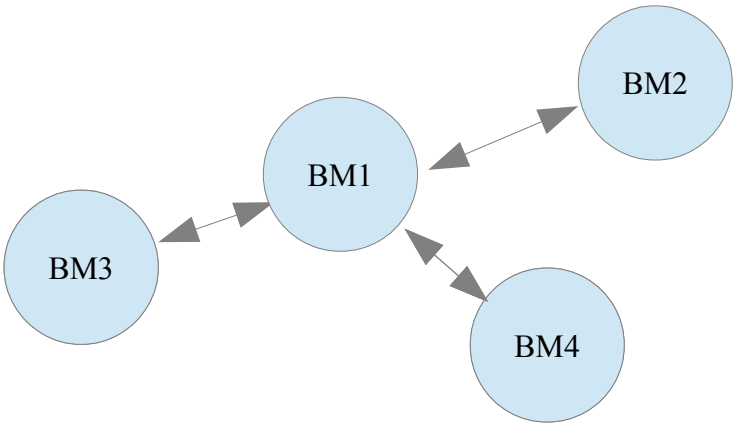


systems.

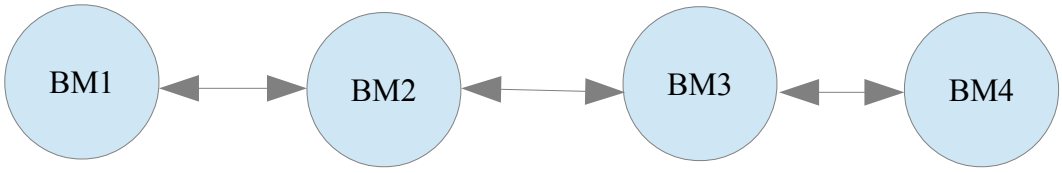
Even with only two instances, it is possible to get this problem if you cross-connect two instances of this module:



To prevent this situation from happening, the default setting for HTL is 1, thus eliminating the problem in most installations as a message is never forwarded when received from another system. Should you need to connect more than two systems, you can either connect them in a star network, or in series. Depending on which one you choose, the HTL-setting must be updated for each system.



Star network. BM2, 3 & 4 requires HTL: 2, BM requires HTL:1



Series network. BM1 & 4 requires HTL: 3, BM2 & 3 requires HTL:2

Connecting With BM Tool

To which Network Binder instance should BM Tool connect, and what HTL setting should be used in the above two scenarios?

Remember that the transfer to the tool adds one Hop. This gives the following answers:

- Star network: Connect to BM1 and set HTL in Sanity to 2.
- Series network: Connect to either BM2 or BM3. Set HTL in Sanity to 3.

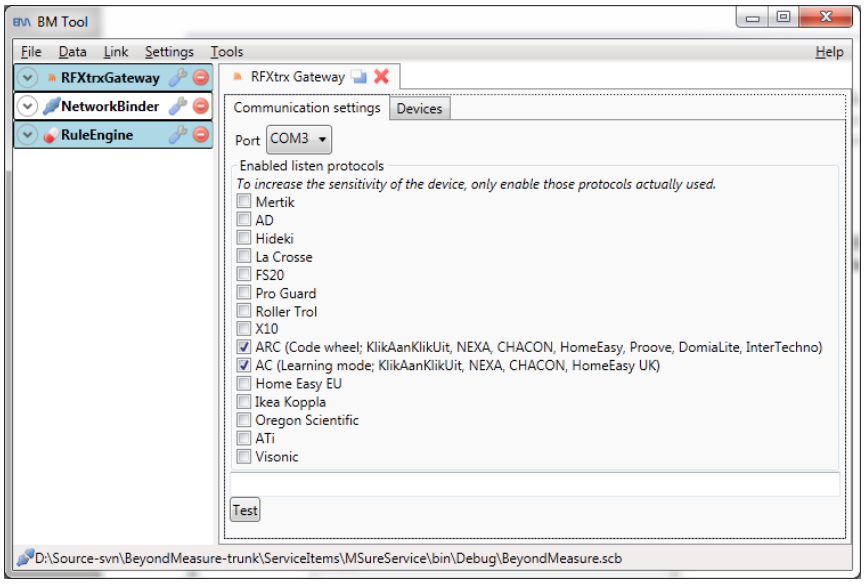
Module: RFXtrx Gateway

This module adds support for RFXCOM's USB RFXtrx433 transceiver. With it, you can both control (through the Rule Engine module) and gather data from devices that are compatible with the device, such as NEXA's lightning devices and also temperature/humidity sensors for various weather stations. Controlling certain projector screens are also possible.

Configuration

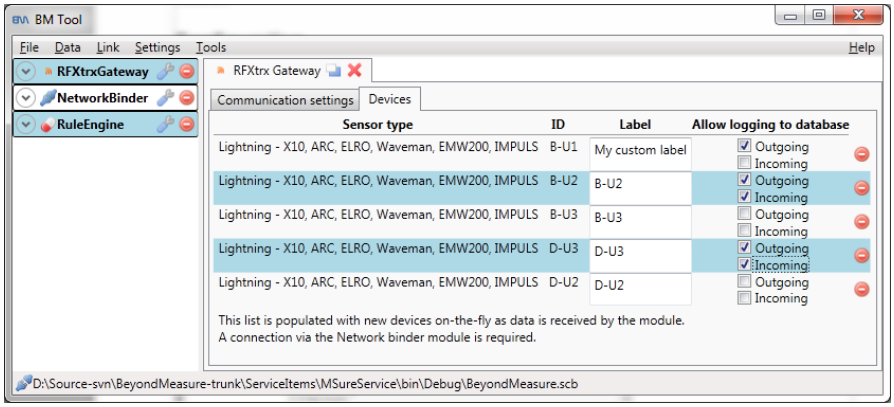
When plugged into your computer, the RFXtrx device will show up as a serial port through which BM will communicate with the device. Simply select the port where the device is located and save the configuration to enable the module. The device supports a long range of devices, using many different communication protocols. Each protocol to be used (for receiving) must be enabled before the device will listen for devices using the respective protocol. The rule is that only those protocols actually being used should be enabled; this will increase the sensitivity of the device. Some protocols cannot be used together, please refer to the RFXtrx Users Guide for more information.

The test button lets you test the communication with the device, observe the output in the text box above the button. If communication is established, a window will show the last received data packet until you close it. Note that you cannot use this test function while the module is active as the port will be busy.



Data logging

The module is capable of distributing both sent and received data for storage in a database through the use of the Database Storage module. Which devices to log data from is determined on the tab “Devices”. The list of devices is populated on-the-fly as data



is received from the module though the Network Binder module, so for this to work, you must be connected to the NB-module.

Specifying a custom label for a device is optional, but recommended as the default label is just a copy of the unit id. Also note that the label will become the name of the table in the database. The two options “Outgoing” and “Incoming” refers to data going out of the device, i.e. being sent, and data going into the device, i.e. being received from an outside source. The actual data being logged depends what is available for the specific device family.

Module: RaZberry Gateway

The RaZberry, an extension to the Raspberry Pi created by Z-Wave.me, allows you to control and react upon events from devices on a Z-Wave network, such as wall plugs, door sensors, motion detectors and temperature/humidity sensors.

Through the RaZberry Gateway, Beyond Measure integrates the information provided by the RaZberry and makes it available for the Rule Engine in the form of Tags and also allows for storage of the retrieved information in a database by the use of the Database Storage module.

Prerequisites

The RaZberry Gateway requires the following:

- A properly setup RaZberry on a Raspberry Pi.
- A network connection between the server BM runs on and the Raspberry Pi.
- To do more than log data from the Z-Wave devices, use of the Rule Engine module is required.

Supported devices

The different Z-Wave devices may support one or more of the many command classes.

Currently, the following command classes are supported.

Command Class	Command Class number (decimal)
Alarm	156
Basic	32
Binary Switch	37
Battery	128
Configuration	112
Meter	50
Sensor Binary	48
Sensor Multilevel	49
Switch Binary	37
Binary sensor	48
Switch Multilevel	38
Wakeup	132

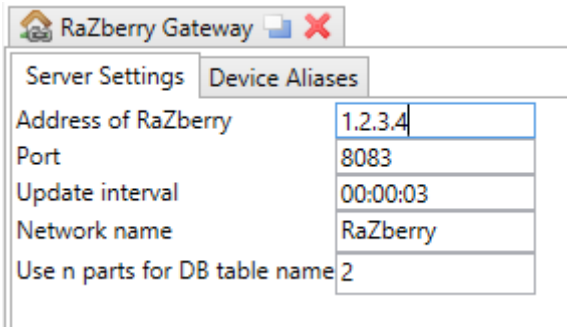
If you are missing support for a Command Class, please let us know through the forum.

Setup

Configuring the RaZberry Gateway is done in a few simple steps.

1. Enter the IP address or DNS name of the RaZberry/Raspberry Pi.

2. Enter the port number the RaZberry service is listening on.
3. Choose an Update Interval. This setting determines how often the RaZberry is asked for updated information since the last update.
4. Enter a network name. This is used to identify this particular network if multiple RaZberry devices are used. See also the RaZberry Gateway components in the Rule Engine.

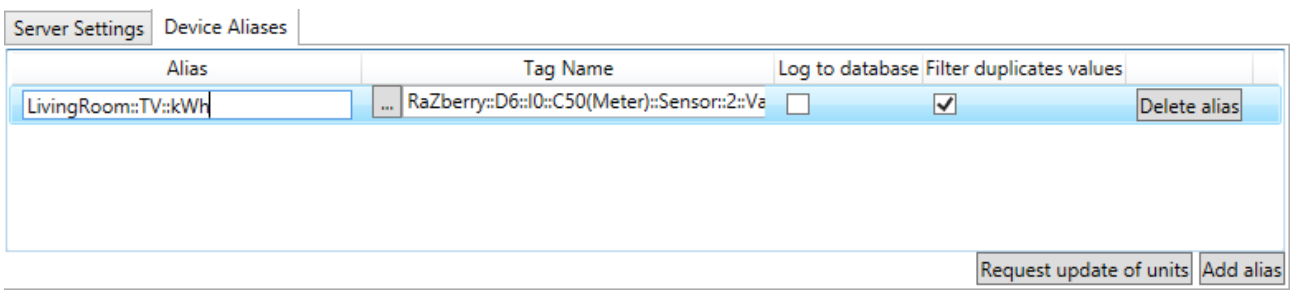


5. Choose how many parts of the alias that are to be used to build a table name when a value is logged to database. See below for more info on this.

Device aliases

When working with the device aliases, you need to be connected to the BM service, otherwise some parts of the interface are disabled.

By deault, values are published as Tags using the name format “network name::deviceno::instance.no::commandClass(Name)::subpart::value”. While these are perfectly fine to use, they are not very readable. Instead, you can create aliases for each value you want to use. You can enter the tag name manually, or selecting one of the available from the menu presented when you click the “...”-button. To determine which Tag that corresponds to which device, please refer to the RaZberry Expert UI. Please note that only Tags beginning with the network name set in the configuration for this module are displayed.



The entered alias will also be used as the table name when the “Log to database” option is selected. Using the setting “Use n parts for DB table name”, a table name is built of the n last namespace parts. In the example above, the name would be “TV_kWh”. In case there is only one part in the alias (i.e. no “::”) or too few, as many parts as are available will be used.

The button “Request update of units” will send a command to all active RaZberry modules, requesting that they perform a full refresh of available devices from the RaZberry.

Note: When an alias is created, the default tag will no longer be updated.

Controlling devices

Devices whose values are published can also be controlled, simply by setting the Tag to the desired value from withing a schematic using the tag components, or through the use of the Tag Storage interface.

Adjusting configuration options for a device through BM.

Please note that adjusting configuration values may result in not-functioning devices, use caution. Configuration values are also reported to BM as tags, therefore you can adjust them (if they are not read-only, see the device's manual) by setting the Tag to a new value.

Example:

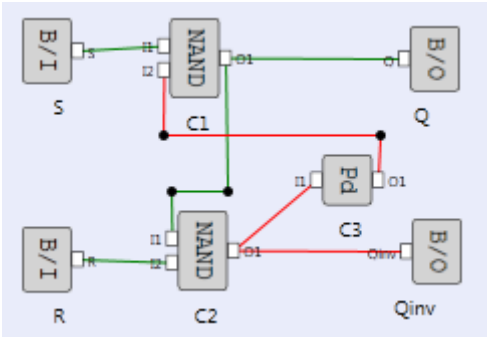
Tag: RaZberry::D13::I0::C112(Configuration)::Parameter::39::Value

Value: 600,2

In this case, the value is “600”, and the size of the value, in bytes, is 2. When adjusting the value you look at what is published by the device and then adjust the first part of the value as the second part should be the same as was published. For example, if e wanted to decrease the value to 500, we would send “500,2”.

Please refer to the manual for your device for information on what each configuration setting is used for and what the valid values are.

Module: Rule Engine



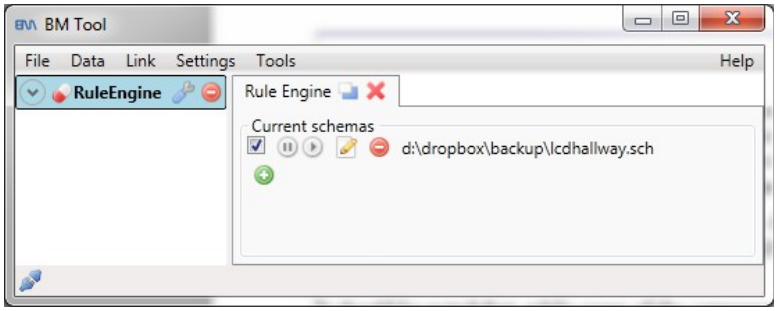
In 1854, George Boole developed what is known as Boolean algebra. Today you take advantage of his work almost without noticing it – any electronic device with a microprocessor (such as a personal computer, smart-phone or calculator) uses Boolean algebra to perform its tasks. Now you actively can take advantage of his work through the use of the Rule Engine module.

This module really embodies what BM stands for - flexibility and the user's own choice. It brings together different worlds, such as 1-Wire, xAP and SMS into a single domain where the user can make them interact in a way he or she wants.

It should be noted that, while some of the components included with this module functions without external dependencies, many requires other modules to be activated and configured.

The Basics

This module do not perform any operations on its own, instead it loads a set of user-built schematics that define the operations to be performed based on input from internal or external sources. Of course, it is entirely possible to write a schematic that is fully self-sustained if the requirements are such. Adding and removing schematics to load is done via the module configuration, as for any other module.

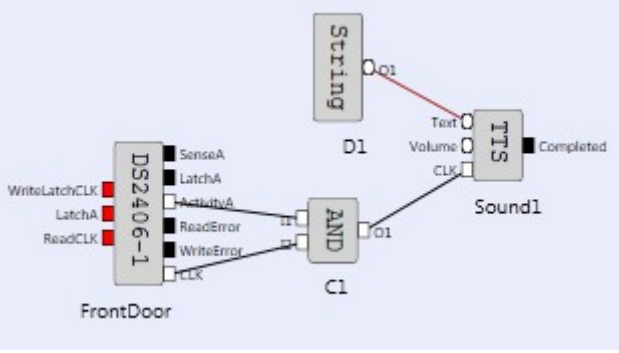


The Play and Pause buttons sends a message to a running instance of the Rule Engine module (via Network Binder) to unload or load the specified schematics. This only works if it is known to the module in the currently running configuration. The Edit button naturally opens the schematics in an editor.

A First Example

Lets say that we have a 1-Wire network switch (DS2406) connected to a push button on the front door, and when someone presses that button we want to have our computer say the phrase “There is someone at the front door”.

A schematic that realizes this functionality can look what is illustrated in this image.



In short, it functions as follows:

1. The 1-Wire module reads the status from the device labeled 'FrontDoor'.
2. The Rule Engine receives the resulting status message and forwards it to the FrontDoor component.
3. If activity was detected on the input of the switch, the output ActivityA will go high and a clock pulse emitted on the CLK output. Together, they the are AND:ed (*C1*) into a clock pulse for the TTS component, *Sound1*, which will send a command to the Sound module to output the phase read from the component's *Text* input; the String component (*D1*) holds the phrase to speak.

Schematics

As seen above, a schematic is a set of components connected via wires to perform a specific function. A schematic is in itself a special type of component – a Composite Component, see chapter Composite Components, but labeled as a 'schematic' since it is the topmost/encompassing component. You use the schematics editor (accessed via menu *Tools/Rule Editor*) to create your schematics.

Custom Components

By saving a Composite Component to the folder <*data-dir*>*ComponentLibrary*, you can make your own components available for reuse from the library. If you want to organize your own components into separate sections in the library, simply create sub folders in the *ComponentLibrary* folder, and they will be shown parallel to the *Custom*-section.

Note: When a custom component has been added or removed from a the library, you must reload the library through the menu *Library/Reload* from the editor's menu.

Component Library

The component library, on the left side of the editor, is where all available components are held. These are added using drag-and-drop into an editor. The components are sorted by their type, such as Logic (AND, OR), Terminals, module-specific etc and can be mixed as you see fit in a schematics.

Components

A component can be seen as a box that, given some input, performs a specific operation and outputs the result on its output pin(s) and/or as a message to an external part, such as another module. Some components are self-sustained, i.e. they are not dependent on external parts, while other components requires another component or module to perform some operation before performing its own operation. To rename a component, just double-click on the component name and enter the new name.

Most components have a clock-input, and often a clock output, pin. These pins are used to trigger an operation, or to signal that new data is available on the outputs of the component as a result of the physical device being read.

Component Properties

When open, the *Component Properties*, on the right side of the editor, shows the properties for the

currently selected component. All components have a color, rotation and comment property. Most components have additional properties that can be adjusted to fit the requirements.

Note: If you do not want to use the images in the components, simply delete the corresponding file(s) in the <application data>\ComponentImageLibrary folder.

Input and Outputs

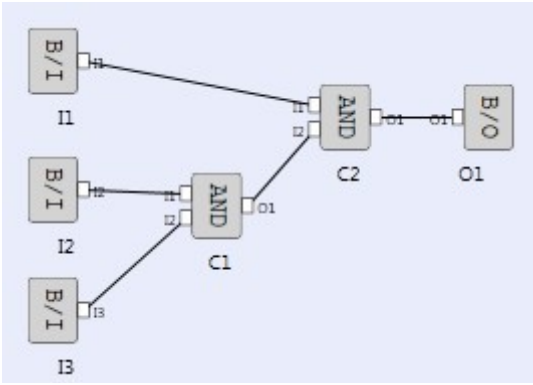
Most components have both inputs and outputs. Inputs are always located on the left side of the component and outputs on the right side. In- and outputs (commonly known as connection points – see Terminals) are used to pass signals between two components, via a wire. There are two kinds of connection points:

1. Boolean – these are used to signal either true (high) or false (low) signals. These connection points are visualized as a square.
2. Data – these are used to pass arbitrary data, such as a string or a temperature value. These connection points are visualized as a circle.

Pull States

All *unconnected* Boolean inputs have a default pull-state (default value) of *false*, as indicated with red coloring. By *pressing and holding shift and right-clicking* on an input, the pull-state is toggled between *true* (colored green) and *false*. When a wire is connected, the pull-state does not have any effect.

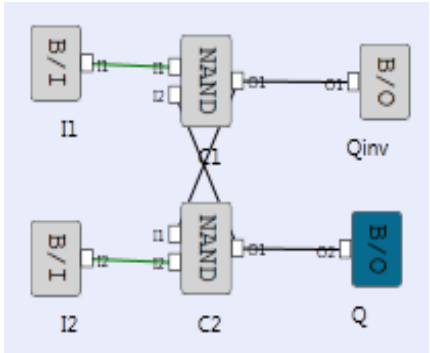
Signal Quality



Depending on how a schematic is built, there are times when the state of the input/outputs are unknown. This is known as a signal having *bad quality*. For example, look at the schematic in the image (a user-built 3-input AND gate). This schematic has three inputs, *I1, I2* and *I3* and one output, *O1*. Since neither of the inputs has a connected wire, they have neither a *true* nor a *false* value, thus the quality is bad. Bad quality is visualized with a black coloring of the connected wires.

When a component has an input with a bad signal quality, the component will in most cases not operate until all inputs has a signal with good quality.

Circular Connections



When designing a schematic, one should take care not to create circular connections. The image illustrates a non-functional $\overline{SR}$-FlipFlop circuit. The reason it is not functional is due to the circular connections between components *C1* and *C2*. As each component is dependent on the others output, neither is able to provide a good signal quality on its output. To solve this issue, a *pull-down* or *pull-up* component can be inserted between C2/O1 and C1/I2.

The *Pull down*-component pulls its output low when it receives a bad quality on its input pin, thus making it possible to connect as desired.

It should be noted that circular connections have a negative impact on performance due to that they cause a recursive evaluation of the state of the components. If such a situation is encountered, the evaluation will be forcefully stopped after a certain number of recursions to prevent infinite loops and subsequent application malfunction.

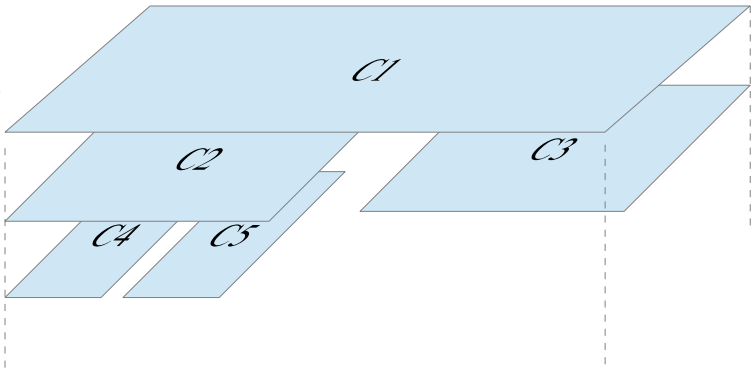
Clock Signals

Many components have a *CLK*-input, where CLK stands for “clock”. These components do not perform their operations based on changes on their other inputs, if any. Instead, they require a clock-pulse (low to high state change) to be provided on their clock input. When such is detected, the component perform its operation.

Some components also has a *CLK*-output. When such is the case, they first update the values on their other outputs, if any, then they provide a clock-pulse on their clock output. By using the clock pulses, it is easier to determine when something will happen in a chain of components.

Hint: Components without a clock input perform their operation directly whenever their input changes state or value.

Composite Components



A composite component is a component like any other component, with the difference that it can contain any number of other components in different layers. For example, the component C1 in the image contains two components, C2 and C3. In turn, C2 consists of C4 and C5. In this example, C1 and C2 must be composite components (they contain other components) but C3, C4 and C5 can be either a composite component or a regular component.

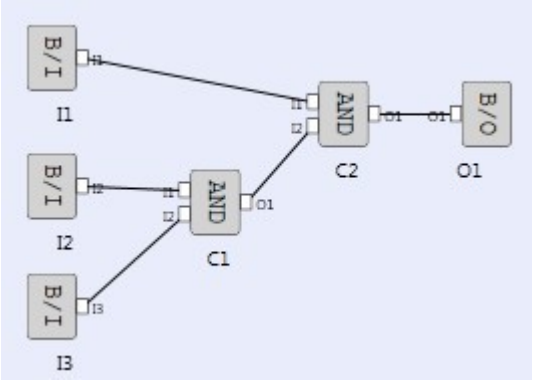
Hint: You can look inside a composite component within the editor by *ALT-clicking* on it. To go back up a level, *ALT-click* on an empty space in the editor.

Terminals

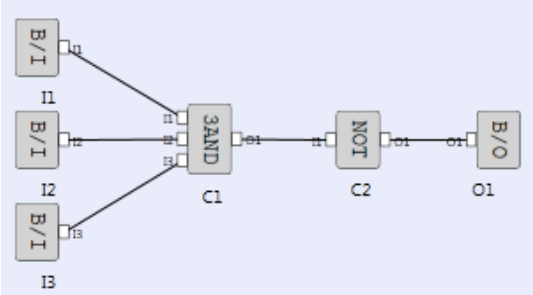
In order to build a reusable component, and to connect different layers inside a composite component, some sort of connection points are needed where wires can be attached. This is where terminals come into play. Just like connection points, there are two types – Boolean and Data terminals, of which there are both inputs and outputs.

You've already seen the terminals in use in the Input and Outputs section, but we will now look at them in more detail by building a simple three-input NAND component.

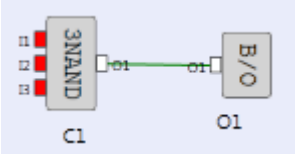
First, we create a schematic with a three-input AND circuit. The Boolean inputs (B/I) will serve as the input connections when using the schematic as a component. Likewise, the Boolean output (B/O) will serve as the output connection.



After saving the component in the *ComponentLibrary* (named 3AND), reload the component library from the menu. and add it to a new schematic and connect three input terminals and a NOT-component and also a final output terminal as illustrated in the image.



Again, save the schematic as a new component in the *ComponentLibrary* (named 3NAND), reload and add a copy of it to a new schematic. You have now built a composite component in two layers. An additional output terminal has been added in the image, just to illustrate that the output of the 3NAND component in fact has a value of *true*.



Hint: By right-clicking on an input terminal, you can set a temporary value it should provide on its output. This way, you can test a schematic directly within the editor.

All terminals have a *Sort Order*-property that is used to determine the order of the resulting pin of the parent composite component. The sort algorithm works like this:

- All Terminals with a sort order larger than 0 are sorted in ascending order and placed first (top) on the resulting composite component. Input and outputs may have the same Sort Order.
- The rest of the components are sorted alphabetically and are placed after the others.

Wire breaks

Wire breaks can be used to route a wire in a more esthetic way around other components, but also to split a wire in two. By pressing Ctrl-Shift while left-clicking on a wire, you add a wire break to it. You can then move the break point to where you wish. Connecting other wires to it is done as normal, but in order to pull a wire *from* it, you must press and hold shift, otherwise you'll move the break point instead. You can easily 'unbend' a wire by pressing Ctrl-Shift while left-clicking on the wire break (this only works if there are exactly two wire connected to it). Removing a wire break will also remove any wires connected to it.

Live View

When BM Tool is connected to the kernel using the Data Link/Network Binder, your schematic is run directly from within the editor as if it was running under the Rule Engine module. This way, you can edit and test the schematic and directly see the results based on actual data.

There are a few important items you need to be aware of:

1. The schematic is run as the current user so access rights etc. may be different than when run under the Rule Engine.
2. If BM Tool is not run on the same computer as the Rule Engine any differences between the two may affect the outcome.
3. If the schematic is active in the Rule Engine at the same time as it is run from within an editor, there is a risk that they may interfere with each other. For example, double sets of commands may be sent to an external system – one from each instance. To avoid this, either unload the schematic in the Rule Engine module, or prevent outgoing messages from leaving Sanity through the *Link/Data Link/Block all outgoing non-user commands* menu.
4. There is no synchronization made between a running instance of a schematics under the Rule Engine and the same schematics opened in an editor – they are completely separate instances.

Oscilloscope

The oscilloscope (accessible via *Tools/Oscilloscope*) can be a great aid in viewing and troubleshooting a schematic. You add (*right-click*) a probe to either input or output connections and whenever the value on that point changes, the oscilloscope will display the new value. A probe is removed by *pressing and holding CTRL and right-clicking* on the input or output.

Boolean data is always presented as either 0 or 1, while a data point will be presented as its actual value, but only if it is convertible to a numeric value. Values that are not convertible can be viewed in the 'Data' tab, where all values are presented in text format, with the most recent value at the top.

Tag Components

A Tag is a user-defined pair of a name and a certain value. Using a tag, you can abstract a physical device into a logical one. For example, if you use a 1-Wire or xAP device to monitor the state of your front door, you can distribute the resulting value as a Tag, thereby removing the need to know how the value is read by the system.

Tags can also be used to create your own named "signals" for communication inside a single, or between multiple schematics.

Note that tags of different types do not interact with each other. So you can have multiple tags named "A" as long as they are of different types. Having multiple *output* tags of the same type with the same name is strongly discouraged as it usually creates unwanted side effects. Having multiple *inputs* of the same type and same name is however not an issue.

Available Components

Category	Component name	Description/Notes

1-Wire	These components represents a physical device on a 1-Wire network, and requires its physical device to exist to function. Each component is named by its official name. To pair the schematics component with the physical device, rename the component in the schematic to match the label or ROM code of the device in your configuration. All 1-Wire components have a pin named ReadCLK used to request a read of the device. One example usage is to control the read schedule via a schema instead of from the 1-Wire module's schedule configuration. All 1-Wire switches have a WriteLatchCLK input to trigger a write-command to the latches.	
	DS1822	
	DS18B20	
	DS18S20	
	DS2405	
	DS2406-1	Single channel version of DS2406
	DS2406-2	Dual channel version of DS2406
	DS2408	
	DS2413	
	DS2423	
	DS2438	
	DS2438 Humidity	When you configureyour DS2438 as a humidity device, you can use this component to use the humidity values in a schematic.
	DS2450	
	DS2760/61/62	
	LCDHobbyboards	
	LCDSwart	Due to a limitation in the firmware of the device, it does not support reading latch states on the outputs and thus does not support the synchronization procedure used with with other switch-devices.
Data	Compare	Compares the input values according to the specified operation. If both values can be converted to a number then numerical comparison is used, otherwise culture invariant string comparison used used.
	Counter	Increases/decreases a counter in the direction and step specified for each clock pulse. Emits a clock pulse after each change.
	Data select	Selects between two input values based on the Select-value. Low, selects value at input D1.
	Hysteresis	This component applies a hysteresis on a (numerical) input value. The reference value is read from the 'Reference' input, the hysteresis value from the 'Hysteresis' input and the value to apply hysteresis to from the 'Value' input. Example: With a reference value of 5 and hysteresis of 3, the output pin (and clock) will change on the values 2 and 8.

Math	Performs mathematical operations.
Shift	Shift register. Data is taken from input I1, to output O1, then O2 on each clock pulse. Enable determines if the component is active. Reset clears the outputs. Can be chained to create shift registers holding more values.
String	Holds a single string as input to other components.
Strlen	Outputs the number of characters of the input string.
Text Format	Formats up to four strings/values into a single string at its output. • The component has four inputs, D0 through D3. These are known as argument 0, 1, 2 and 3 in the format string. • The input "TryNumeric" is used to tell the component if it should try to treat the input values as numerals instead of plain strings. This option needs to be enabled to use numerical formats. • The Pad-inputs allows padding the result up to a fixed length (PadLeft/Right) using a specified character (PadChar) There are numerous format option available; please refer to Microsoft's MSDN documentation for all details: • Standard Date and Time Format Strings • Custom Date and Time Format Strings • Standard Numeric Format Strings • Custom Numeric Format Strings Specifying a specific culture format is not supported, the invariant culture is always used, which basically corresponds to English formatting. Examples: • First argument, one decimal: {0:0} • Third argument, two decimals: {2:00}
Transform	Transforms the input value according to the specified transformation and decimal properties.
Value	Hold a single numerical value as input to other components.
Value View	A kind of mini-oscilloscope, allowing an easy view of data within a schematic. Whatever data value is available on the input, it is printed inside the component. If the entire value cannot be fit into the component, just hover with the mouse over the component and the tool tip will display the entire value.

	XML Parser	Used to retrieve a value from a specific path/tag and/or attribute within a well-formed XML data block.
		
		• Inputs
		  ◦ XML- XML data to read
		  ◦ CLK – triggers the parsing
		• Outputs
		  ◦ Value – contains the value retrieved from the found element. In those cases where the path results in an an element with sub elements, the full XML structure from the current element is made available for further processing in an other XML Parser.
		  ◦ Attribute - contains the value retrieved from attribute from the found element.
		  ◦ CLK – pulses when a new block of data has been parsed.
		• Properties
		  ◦ Path – the path (including the root element) to the desired element.
		  ◦ Instance count – used to select one of the many instances of the desired element (sorted by document order)
		  ◦ Attribute – the name of the attribute on the found element to retrieve.

Network	Ping	Sends an ICMP Ping to the specified server. The output reflects the result, with the round-trip value in milliseconds.
External	External	The External component is differs from all other components in that it can load external code, like a plug-in. Once loaded, that code can interact like with the schematic like any other component. See below for details.
Sound	Clear Sound	Clears the current and all enqueued sounds for the module which the Target Module Instance Name property matches.
	Sound File	Plays the specified file on the module which the Target Module Instance Name property matches. If provided, the file provided on the input takes precedence over the one specified in the properties.
	TTS	Speaks the specified text on the module which the Target Module Instance Name property matches. If provided, the file provided on the input takes precedence over the one specified in the properties.

Time	Date Compare	Provided with start and end dates, in the form of month and day, its *Within*-pin indicates whether or not the current date is withing the provided two dates. The *CLK* output pulses on every change of the *Within*-pin. The *UTC* input pin tells the component to use local or UTC times. If the provided month and day specifies an invalid date, such as 29:th of February 2011 (2011 is not a leap year), the component will silently reduce the day and month in 1-day decrements until the date is valid. E.g. 29:th of February 2011 becomes the 28:th 2011. If the end date is less than the start date (e.g. end = 1/1 and start = 1/12) then the end date is considered to be during the following year.
	Delay	Delays the input signal with a configurable delay, including a configurable random element. Whenever a positive flank on the input clock is detected, a time interval is calculated and a countdown is started. When the countdown reaches zero, the signal on the input is read and output on the output signal pin and a clock pulse is generated on the output clock. If a new clock signal is received during the countdown, a new interval is calculated and the countdown is begun a new unless “Reset only if in-value changed” is checked, in which case the countdown continues. The time interval is the product of the number of intervals and the interval length +/- a percentage of the calculated interval, as specified in the configuration of the component. For example, a 50% randomness and an absolute time interval of 1 minute results in actual intervals ranging from 30 seconds to 1 minute and 30 seconds.
	Sun	Signals when the sun is up or down based on provided longitude, latitude, UTC offset and Zenith.
	Time	Provides either UTC or local time on its outputs.
	Time Compare	Provided start and end times, its *Within*-pin indicates whether or not the current time is within the provided time range. The *CLK* output pulses on every change of the *Within*-pin. The *UTC* input pin tells the component to use local or UTC times. If the end time is less than the start time (e.g. end = 01:00:00 and start = 22:00:00) then the end time is considered to be on the following day. If a valid time is provided on the input pin *Time*, this time is used as the base for calculations, otherwise the component defaults to the system time.

Time Delay	Adds or subtracts a random time interval from the date/time provided on the *BaseTime* input, whenever a clock signal is received in the input clock. The resulting date/time is provided on the *Time* output.

Time Line

Allows the user to specify multiple events that sets a boolean and/or data value on the components outputs based on the following criteria:

- Time of day
- Week day
- Up to five optional inputs.

Time Line automatically uses the system time. A user defined time can be supplied on the Time input pin.

The value specified in the Data value field of the configuration will be output on D1 for the active event.

Binary outputs B1-B5 can be individually set to hi/low for each event.

At least two events must be defined for the component to work.

The specified events are evaluated in time-ascending order and only the last event found matching the criteria is allowed to set the outputs. If no matching event is found, a backwards search is made, one minute at a time, until at total of 24h has been subtracted from the current time or a match is found.

If checked, the check boxes I1-I5 specifies that the corresponding input(s) must be high for the event to be evaluated at all. This allows for easy enabling and disabling of events based on other data sources.

Fallback value
These check boxes and data value are are used as the output value during the following specific event:

- An event is active (time an input states fulfilled)
- One or more inputs changes so that the input states no longer are fulfilled.

During set up, you will need to sort the items if you change the times of the events to get correct evaluation.

A typical usage case for this component is to turn on or off a device (light, fan etc.) through the RFXtrx Gateway at specific times.

Clock outputs

The CLK-output pulses whenever one of the outputs changes states. The EventCLK pulses whenever the active event changes.

Database	DBReader	Using a special type of data source (see Data Sources), this component reads the first row in the resulting data set and outputs the values onto the O1 and O2 pins (if enabled in the source), and then pulses the CLK out pin. If the operation succeeds, the *Result* pin will be high during the clock pulse, otherwise low. Note that due to the possibly memory- and time-consuming nature of the database read operation, once a read request has been triggered by a positive flank on the CLK input, no further read operations will be initiated until the first one has completed.
	DBWriter	This component is used to write a value to a database table. It requires a Database Storage module, with a matching configuration. There are two operational modes: • By selecting the "Specific database connection", you can specify a specific database connection to use when the value should be stored. • By not selecting a database connection, any DB Storage module (not configured for the above mode) that receives the write request will process the message. The expected columns in the table are: • index (64 bit integer, auto incrementing) • Timestamp (DateTime) • One column as specified in the component properties. If the database and/or table doesn't already exist, it will be created by the DB storage module (assuming sufficient access rights). The Result pin will indicate the result of the write request: • As reported by the DB Storage module when an attempt to write the provided data has been made • As a result of the preparation of the request (value conversions etc.), in which case only failures can be reflected. (success can only be reported by the DB Module, see (1)) The out clock is pulsed every time the Result pin can be read. Please note that, depending on your configuration (such as multiple active DB Storage modules) you may get multiple pulses with different result indications for each write request.
File I/O	File Monitor	Can monitor a file, or files, including sub directories, for changes and output the path and file name when a change is detected.

File Reader

Using regular expressions it can read a file one line at a time and output up to four groups of data extracted from that line. Learning to use regular expressions isn't something that is done in a few minutes, but there are some resources available on the web. Once such is "The 30 minute Regex tutorial" by Jim Hollenhorst. Although a bit dated, it is still very much a valid source of information. The tool used in the article, Expresso, is at the time of writing free to use and register. It is this tool, that I, the author of BM, recommend. Expressions created in Expresso can be used directly in BM.

- The component keeps a track file on disk that allows it to continue where it left off last.
- As the reader keeps track of the last read position by using a tracker file paired with the file to be read, you should not use multiple readers for the same file as doing so will cause the readers to access the same tracker file and thus overwriting each others read positions.
- When it goes high, the *CLK* input triggers a new read cycle of the file specified with the *Path* and *Filename* inputs.
- If high during the clock pulse, the Reset input will reset the read position to the beginning of the file. If this pin is held constantly high, the file will be read from the beginning on each clock pulse.
- The "Require new line character" property specifies if the line must end in a new line before being parsed.

Example

The regular expression, without quotes,

"(?<g1>.{1,})\:(?<g2>.{1,})\:(?<g3>.{1,})\:(?<g4>.{1,})\;"

would match the line, without quotes, "a:b:c:d;"

If g1, g2, g3, g4 had been entered in the component properties for Group 1-4, the values "a", "b", "c" and "d" would have been made available on the outputs.

TextOut

Can write data to a file.

I/O	SerialPort	This component is used to send and receive ASCII-data on a serial line. It takes a string (limited to ASCII-characters) and outputs them as bytes on the serial port. Use \n and \r to insert the corresponding values in the string. The string will be stripped of actual line breaks before parsing so you may split the input onto multiple lines if you wish. If an end-of-data character is specified, the input from the serial port will be buffered (up to 4096bytes) until the character is received upon which the entire buffer is output on the output pin. If no end-of-data character is specified, each received byte is output directly. \r and \r can be used as end-of-data character. If multiple characters are entered only the first one is used. The clock signal is pulsed for each change on the output.
Logic	AND	AND operation.
	CLK	Provides a clock pulse with the approximate interval specified by the properties.
	D.CLK	Delayed clock. This component will generate a clock signal after the configured interval whenever a clock pulse is sensed in its input. If another clock pulse is sensed before the interval expires, the interval starts over again without triggering a clock pulse on the output.
	Debounce	Debounces the input, i.e. does not set its output to the value of its input until the input value has been unchanged for the configured interval.
	D.Out	Transfers the input value to to the output value with a delay specified in the properties. Up to 50 changes are queued, after that the oldest change event is removed.
	Flank Triggered Pulse	This component gives a pulse (*false-true-false)* whenever the input signal changes.
	NAND	Not AND operation.
	NOR	Not OR operation.
	NOT	NOT operation.
	OR	OR operation.
	Pass through	Used for testing schematics. Normally just passes the input value to the output, but may be locked to high/low output using the context menu.
	Pull down	This component is the opposite to the Pull-up.
	Pull up	This component give a *true* signal on its output whenever the signal quality is bad on the input. Otherwise it will just give the same signal as that on the input.
	Shift	Shift register. Value is taken from input I1, to output O1, then O2 on each clock pulse. Enable determines if the component is active. Reset clears the outputs. Can be chained to create shift registers holding more values.

	Value View	A kind of mini-oscilloscope, allowing an easy view of boolean values within a schematic. The input signals is represented by three flags: • Black – bad quality • Red – false • Greed – true This component will always show the same color as the wire it is connected to, but may be easier to view than the wire, especially on higher resolutions.
	XOR	Exclusive OR operation.
Mail Gateway	Mail	Together with the Module: Mail Gateway, the Mail component adds the ability to send and receive e-mail from any number of different accounts. You need to set the account name to use in the component properties, otherwise the Mail Gateway won't be able to match the send-request to an e-mail account. You can send the same e-mail to multiple recipients by separating the input string on the To-pin with ';', e.g "one@domain.tld;two@domain.tld". Each send attempt will result in a clock signal on the *ResultCLK* pin, with the result indicated on the Result pin. If the Mail Gateway is configured for manual retrieval, use the *RequestCLK* to initiate a retrieval of messages from the configured account, otherwise set this pin to a pull-down state (indicated by red)
RFXtrx/*	Various components	Components under the RFXtrx tabs represents the different supported end devices. Components with a high "Forced" pin will attempt to keep the device in the state dictated by their inputs whenever they receive a notification that the device is in another state. Level-pins expects decimal values of 0-100%, i.e. 45.0 or simply "45". Each device must be configured with their id. "Lighting 4" components requires a Pulse Timing to be able to send commands, please refer to the RFXtrx User Guide to find the value that is correct for your device.
SMS Gateway	Modem	In conjunction with Module: SMS Gateway the Modem component provides the means to send and receive SMS messages and to act on incoming call notifications.

System	Execute	This component can start an an arbitrary process/application (.exe, .bat etc.) • Inputs ◦ The input clock triggers the execution when going from low to high. • Outputs ◦ ExecuteCLK – pulses when the configured command is successfully executed. ◦ ErrCLK – pulses when execution fails for whatever reason. ◦ ExitValue – if *Wait for exit* is selected, the exit value of the process will be available on this port when *ExitCLK* pulses. ◦ ExitCLK – pulses when the process has exited and *Wait for exit* is selected. ◦ StdOut – contains the output of the process, if any. ◦ StdErr – contains the error output of the process, if any. Note that, when *Wait for exit* is selected, a new process will not be started until the previous one has exited. If Wait for exit is not selected, the component will start a new process on each clock pulse, which can lead to multiple running processes if care is not taken. The standard output and standard error output of the process are also logged as Info-messages in the Rule Engine log file.
Tag	BT/I	Boolean Tag Input – acts as an input for tags from the current or another schematic. The property Tag Name (case insensitive) specifies the name of the tag the component should listen for and should match the name specified in a tag output component. Press the "..."-button to display all currently known boolean tags. The output "Tag Name" mirrors the configured tag name (see above) for use in the schematic. "Validity time" determines how old a value may be before it is considered invalid. When passed, the default value is provided on the output, and the Expired output pulses once. Any change on the outputs is followed by a clock pulse. See Tag Storage for information about the concept of Tags.

	BT/O	Boolean Tag Output The counterpart for the Boolean Tag Input. The input “Tag Name” allows for dynamic update of the tag name. The component will use the last updated name from either the configuration or the input when a clock-pulse is detected on the CLK-input. Please note that changing the tag name via the input pin in the editor will also update the configured tag name. The output “Tag Name” mirrors the currently active tag name.
	ST/I	String Tag Input Same as Boolean Tag Input, but for strings.
	ST/O	String Tag Output The counterpart for the String Tag Input
Tellstick	TS *	Components under the Tellstick tab represents the different supported end devices. Components with a high “Forced” pin will attempt to keep the device in the state dictated by their inputs whenever they receive a notification that the device is in another state. Level-pins expects decimal values of 0-100%, i.e. “45.0”, or simply “45”. Each device must be configured with their label, and in the case of the TS Sensor, also the data type. Components with the Result and ResultCLK pins signals the result of commands on these pins.
Terminal	B/I	Boolean Input. Creates an input pin in a composite component.
	B/O	Boolean Output. Creates an output pin in a composite component.
	D/I	Data Input. Creates an input pin in a composite component.
	D/O	Data Output. Creates an output pin in a composite component.
xAP		BSC stands for Basic Status and Control. Devices with the word “mirror” in the name mirrors the state of a physical device (such as a Netiom) and can also control it. The rest of the devices lives inside the schematic, but are also visible on the xAP network. Read more about xAP here.
	BSC Level Input Mirror	
	BSC Level Output	
	BSC Level Output Mirror	
	BSC State Input Mirror	
	BSC State Output	

	BSC State Output Mirror	
	XAP Reader	This device is capable of reading any xAP schema and retrieving one value for each output pin from a block/key pair. For example, take the following xAP message. *xap-header* *{* *v=12* *hop=1* *uid=FF400100* *class=Weather.Report* *source=mi4.weather.1* *}* *Weather.Report* *{* *tempf=19.2* *utc=21:59:52* *tempc=-7.1* *icon=Dry* *date=20110214* *}* By configuring the component with the addresses and uid, it is possible to retrieve the values from the key/value pairs within the Weather.Report block simply by entering the block and keys into the component properties.
	XAP Writer	This component is the opposite of the reader. By specifying block names and keys, an xAp message is built with the data retrieved from the inputs. You can specify the same block multiple times to add more than key to the same block.
XBMC	XBMC Player	Controls and reacts to events received through an XBMC Bridge module with the same Instance name as configured for the component. The *Video, Audio* and *Picture* outputs indicates which type of player that is active, if any. The *Connected* output indicates if the module with the same Instance name is connected to an XBMC instance. *Volume* input accepts a value between 0 to 100 and whenever a clock pulse is detected on the VolumeCLK, an attempt at setting the volume to the desired level is made. The rest of the inputs and outputs controls/represents the respective parts of the player as indicated by their names.

	XBMC Gui	This component can send a message to the XMBC Bridge module with the same *Instance name* as configured for the component, which will then display the message on screen in XBMC. The *Info*, *Warning and Error* determines the icon used and are prioritized from right to left and if neither is high, a default icon will be used. The *Duration* input accepts a value, in milliseconds (>1500) that determines how long the message shall be displayed. The *Title* and *Message* inputs accepts a string each that will be displayed when the *NotificationCLK* detects a clock pulse.
Web	Web Request	Based on the configuration, this component reads a web page and uses the configured expression for a match in the retrieved value. An example usage is to read a string from a web page for further action in the schema, or to report a value to a web server using the standard http protocol. • Inputs ◦ I1 through I5 can be used to replace the tokens '$1′ through '$5′ withing the URL property with data from outside the component, such as values read from external sources. ◦ CLK – triggers the retrieval of the configured URL. Only one retrieval can be active at any one time, so a high clock frequency does not result in multiple requests. • Outputs ◦ Value – If the request succeeds, the data retrieved from the URL, after the matching against the value expression, will be available on this pin. ◦ ValueFound – if a match is found then this pin will be high, otherwise low. ◦ Result – reflects the result of the retrieval of the URL; high for success, false for failure. ◦ D1 – contains the raw data retrieved from the URL or if the retrieval fails, a message that may provide some information on what when wrong. ◦ CLK – pulses when data on the outputs have been updated and is ready for reading.

Writing a plug-in for the External component

While there are already components available for many purposes, you may have very specific needs that cannot be fulfilled using those provided . So what can you do?

For complete freedom and access to all messages in the system, build a User Module that runs under the User Module Engine. but what if you don't need all that? This is where the External component comes into play.

By following a few simple rules, you can create your own custom component with the ability to interact with the schematic in which it is placed. The following step-by-step guide will show you how to do it and what rules that must be followed.

Disclaimer: Installing external code and/or using the external component voids any guarantees of the software functionality. Please be aware that loading unknown code into your system may cause loss of data and worse. Support for all external code may or may not be given by the authors themselves; the author of BM takes no responsibility for any external code.

Creating a Visual Studio project for your external component.

1. Create a new project, select .NET project type of “Class library”.
2. Set the target framework to .NET 4.
3. Add a reference to the assembly RuleEngineExtComponent.dll, located in the installation folder of BM.
4. Add a reference to the following .NET4 assemblies:
    1. PresentationCore
    2. PresentationFramwork
    3. System.Xaml
    4. WindowsBase
5. Create a class that implements the IExtComponentFactory interface. This class will be the factory for the component we're creating.

    ```
    public class MyClass : IExtComponentFactory
    {
       public string Author{ get { return "Name of author"; } }
       public IExtComponent Create() { return null; }
       public string Identifier {get { return "A unique string"; } }
       public string Name { get { return "An awesome thing"; } }
       public Version Version{ get { return new Version(0,1); } }
    }
    ```

    Implement each method and property. Be sure to specify a unique identifier, preferably using a Guid.
6. Next, create a class and that implements the IExtComponent interface. Implement the methods as needed.

    ```
    public class MyComponent : IextComponent
    {
       public void RequestPins( IPinSetup pinSetup ) {}
    ```



```
        public void Stop() {}
        public void Initialize( IConfiguration config ) {}
        public void Start() {}
        public string DisplayName { get { return"Name"; } }
        public void InputChanged( IBooleanInput input ) {}
        public void InputChanged( IDataInput input ) {}
        public void Tick() {}
        public FrameworkElement ConfigurationView{
           get{ return new MyConfigurationView(); } }
        public object ConfigViewModel{ get { return myViewModel; } }
    }
```

The following table briefly describes the available methods that must be implemented.

Method/property name	Purpose
RequestPins	Using the provided IPinSetup interface, you create the pins you want to have on your component. The interface returned via the IpinSetup interface is threadsafe. Please note that a change on the output pins is queued, so it is not possible to “revert” a output pin without the first set value being propagated.
Stop	This method is called when the parenting component is being destroyed. Your code must stop executing once the call to this method is made.
Initialize	Provides your code with the IConfiguration interface, that can be used to write and read from the configuration for your component instance. You may save a reference to the IConfiguration interface for later use, but be aware that it is *not* thread safe, so do not call it from a thread that you create.
Start	When this method is called, the component is fully created and you may start performing the operations needed to fulfill your requirements.
DisplayName	This property shall return the text that shall be displayed on the component in the schema editor.
InputChanged	When an input is changed, that input will be provided as a parameter in a call to the correct overload of this method.
Tick	This method is called approximately >= 100ms and can be used to perform quickly executed operations. Do not use for things that may execute for more than a few ms, as this will slow down the entire Rule Engine.

ConfigurationView	This property shall return an instance of a System.Windows.FrameworkElement (such as a UserControl) that provides the view used to visualize the object/data returned by the ConfigurationModel property.
ConfigurationModel	This property shall return an object that provides the properties/methods needed by the view that is returned by the ConfigurationView.

7. Implement the required logic for your component.
8. Implement the ViewModel and View for your component, if needed.
9. Compile the project and move the resulting assembly (and any dependencies) to a folder named *ExternalComponents* in BM's datafolder.. It is recommended to place your assemblies within a sub folder to separate your assemblies from other assemblies.
10. Start BM Tool and add one External component to a schema.
11. Select the component and choose your code in the drop-down box in the component properties. The component will now display the pins and name your defined in your code. The drop-down box will disappear once you have made a selection, it is not possible to change what code to load. Instead, repeat this step with a new component.
12. Your code is now running

There is a demo project bundled with the installation that shows all of the above mentioned items. You are recommended to have a look at it and to read the comments before writing your own code.

The project can be found in the installation folder, sub folder “External Component Demo”. You should copy the entire directory to a working folder of your choice outside the Program Files folder before opening the project, otherwise Visual Studio may as to restart in elevated mode, which is not necessary to compile the project.

Module: SMS Gateway

With a compatible cellphone or modem, the SMS Gateway brings the world of SMS, caller id and caller mode (voice/fax) into the schematics and User Modules.

It allows you to send and receive SMS messages, detect incoming calls, either with or without caller id and perform actions based on these events.

Adding/removing devices is done though the context menu (right-click) in the Devices list on the left hand side. Although the default settings works with most devices, there are some differences that might require you to make some adjustments, especially regarding the message settings. You will however always need to enter the COM-port number to which the device is connected. It can be found in the properties for the device via Windows' control panel.

You can set a maximum number of SMS messages to be sent for each device you add. When this limit has been reached, no more messages will be sent during the current 24h-period or until the module is restarted.

Compatible Devices

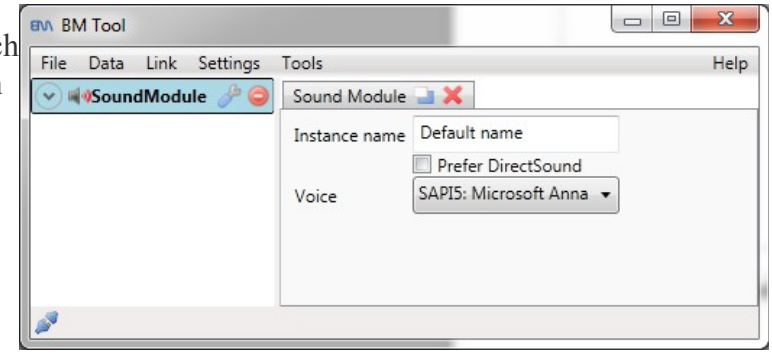
Any cellphone or modem that follows the GSM07.05 standard (ESTI, RE/SMG-040705PR5) should be compatible, but some may still not be due to vendor-specific differences. The device must also support communication via a serial port (either directly or via a Bluetooth or similar adapter).

The following devices have been known to work

- Mobile Phones
  - Sony Ericsson
    - K700i
    - P1i
- Modems
  - Multitech
    - MTCBA-G-F1
      - Requires the use of the "SR" storage setting.
  - Cinterion
    - MC55i

Module: Sound

This module adds the ability to play sound files and text-to-speech functionality.



Each instance of this module takes an instance name in its configuration, which is used to determine if a command from one of the sound components should be processed or not. If you leave the instance name empty, or set to "*" (no quotes), the module will process all commands, regardless of their actual target instance (see the descriptions for the components for more details).

When a command is processed, and it is determined that the sound should be played, the module will use the default sound device, as configured in Windows. The volume is determined by the system's overall volume setting, in addition to the volume specified in the command.

The module can only play one sound at a time, and all received commands (up to 30 in total) are held in a queue until all previous sounds have been played, or a command to clear the play queue is received.

Text-to-speech Setting

The module allows you to select among the compatible voices installed on your system. If no voice is selected, no TTS operation can be performed. There are two supported TTS-interfaces; COM (Component Object Model) and SAPI5, where the latter is preferred (there have been instances reported where COM doesn't work when the kernel is run as a service). The drop down box will indicate the type of interface the voice is accessed through. Some voices are accessible through both interfaces, but may be named differently.

Installing Additional Voices (TTS engines)

Any engine you install must be either SAPI5-compliant, or support the COM (Component Object Model) API. It is recommended to evaluate the compatibility with BM using a trial before buying the full product.

Two providers that provide downloads for SAPI5-compliant trial versions are: IVONA and Cepstral.

Acapela Group laims to provide SAPI5-compliant voices for personal use, but their voices are not listed as such by the .NET framework. However, by using COM-API, these voices are still usable in BM.

Module: Switch King Bridge

The Switch King Bridge integrates the Switch King application into Beyond Measure by translating data sources, scenarios and system modes into specially named Tags. By reading and setting the values of these tags, it is possible to control Switch King and Beyond Measure from each other. For example, you can use the status of a scenario as input to a schematic or enable a scenario from a schematic.

Tag naming

Data sources, scenarios and system modes translated into tags according to the following naming scheme:

```
SK::<type>::<name>
```

where SK stands for Switch King, `<type>` determines the type of the translated function and `<name>` is the name of the item as configured in Switch King.

- Data sources uses the type DS.
- Scenarios uses the type SC.
- System modes uses the type SY.

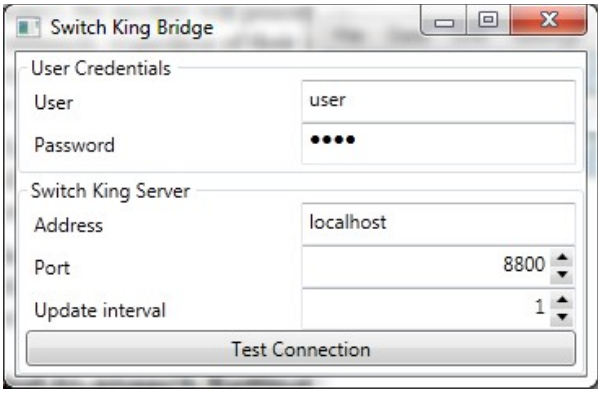
Scenarios and system modes are translated to boolean tags, while data sources are translated as string tags. The translation works both ways; if you set the value of a tag named SK::DS::Data1, a data source named Data1 in Switch King will be updated with that same value.

Example

A data source in Switch King named “My data” becomes: `SK::DS::My Data`.

For an explanation of Tags, see the Tag Storage module.

Configuration



This module has only a few configuration options and it performs its work without any user intervention. The user and password must match those configured for REST access in Switch King. If no authentication is to be used, leave them empty.

The address to the server can be entered either as the DNS name or as an IP address. The port must match what is configured in Switch King.

The update interval determines how information is retrieved from the Switch King server; information *to* Switch King is sent immediately.

Devices

Devices are not handled by this module; instead you use a component in the Rule Engine to control/read the status of them.

Module: Tag Storage

The Concept

The idea behind Tags are two-fold: to provide a way to separate physical devices from logical functions and to provide a way to create your own 'signals' that can be shared between different levels of a schematic, and even between separate schematics.

Why would you want to separate the physical device from the logical function? Imagine that you have a device of an arbitrary type which monitors the state of your front door (open/closed). Wherever you want to use this status you are not interested in *how* it is read (*physically*) but only what the actual reported value is (the *function*). So instead of using the status directly from the physical device (e.g. xAP or 1-Wire) when you create a Tag named 'front door' and read that tag wherever needed. You have now gained two benefits: 1) replacing the physical device will be much simpler (since it exists in just one instance) and 2) you can set it to a default to a value used before the physical device has had a chance to report the actual value (during start-up) and a maximum age before reverting to the default value, should the physical device ever stop reporting its default value.

Creating your own tags can greatly simplify your schematics since they are shared both within and between schematics.

A Tag does not have an expiry time. Instead, they know when they where last updated/created and it is up to the reader of the Tag to determine how old a value may be before using the default value instead.

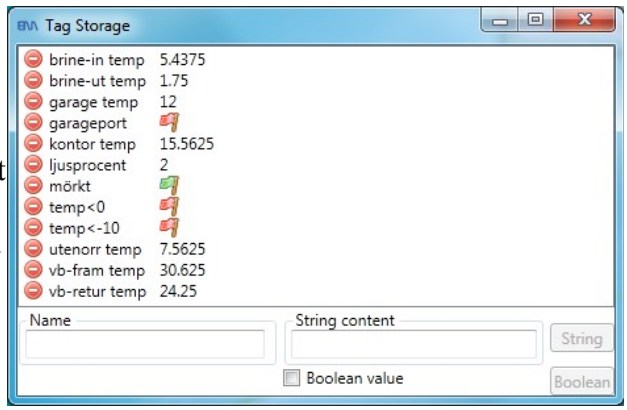
Tags sent between multiple computers

The last-update time stamp of a tag is set by the creator of the Tag. The time used is always that of the local computer. Normally you do not have to consider the implications of this, but if you transfer tags between to or more computers using the Network Binder module, it is important that both computers have synchronized their clocks, otherwise the time calculations for the tags will give unexpected results. A typical example of when this situation may occurs is when running a schema within a Rule Editor in BM Tool when connected to a kernel on another computer.

It is recommended to set up all affected computers to synch their clock against an NTP-server to avoid any problem related to unsynchronized clocks.

The Module

The purpose of this module is to provide persistent storage for Tags between different sessions (computer restarts etc.) and to oversee distribution of existing tags whenever a third-party (module or otherwise) requests an update. This module does not have any configuration options, but it does provide a user interface that lets you view, create, delete and modify tags (requires a connection to the kernel through the Network Binder module).



Module: Tellstick Gateway

Acting as a gateway between BM and Telldus' Tellstick Duo (or the older one-way Tellstick), this module enables you to control wireless devices and receive values from wireless sensors together with the Rule Engine module.

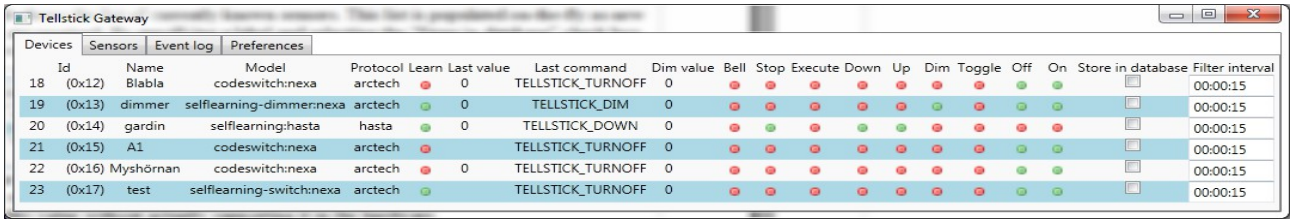
Requirements

Use of this device/module requires that Telldus' drivers are installed. You can find them on Telldus' webpage. Direct link to latest driver.

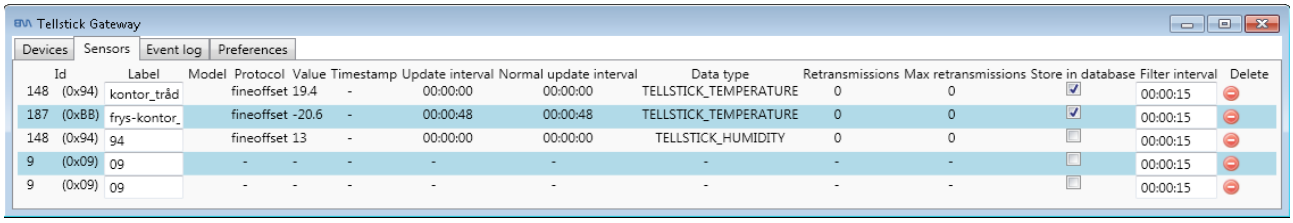
Configuration

Configuration of this module is carried out through the use of both Telldus Center and BM Tool. In TC you define the devices devices you wish to control, these will then show up in the configuration for the module. Sensors cannot be configured though TC and are handled directly in BM. Please note that you need to be connected to an instance of the Network Binder module in order to receive sensor data.

The Devices tab shows what types of commands a device supports, and also lets you log commands/events for the respective devices to a database (requires Database Storage).

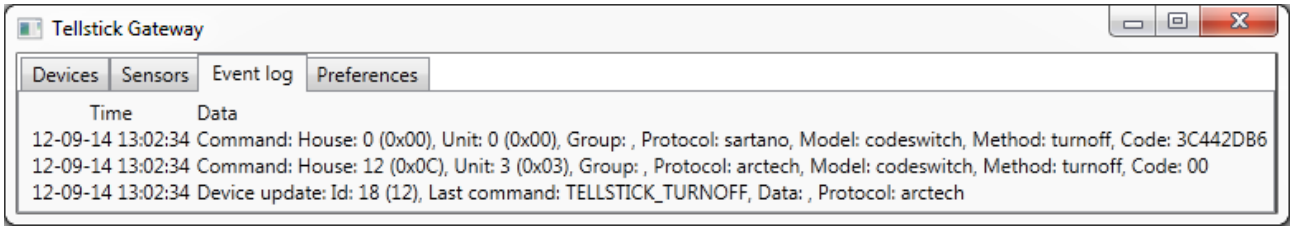


The Sensors tab shows the list of currently known sensors. This list is populated on-the-fly as new sensors values are received. By specifying a label and selecting the “Store in database” check box, you enable storing of received values through the Database Storage module.

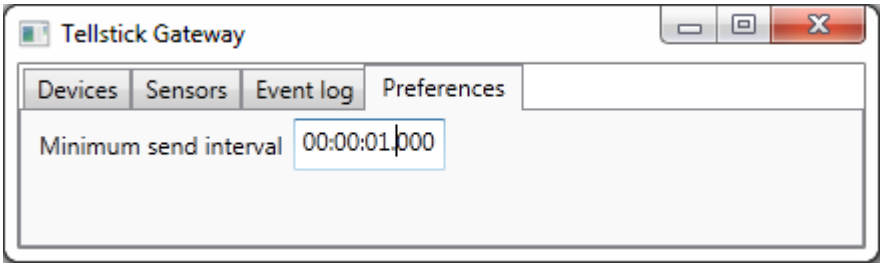


Please note that there are devices that report both temperature and humidity values; these will be represented by two rows with the same Id, but different Data Types. There are also devices that reports a humidity value without actually supporting it in the hardware.

The Event log tab displays a raw log of the events reported by the Telldus driver, mostly used for trouble shooting and to determine the identity of a device or remote.



The Preferences tab allows you to select the minimum time between to outgoing commands. This setting is useful to prevent flooding devices with commands when there are multiple devices to handle.



To control devices/act on received values, have a look at the Rule Engine module.

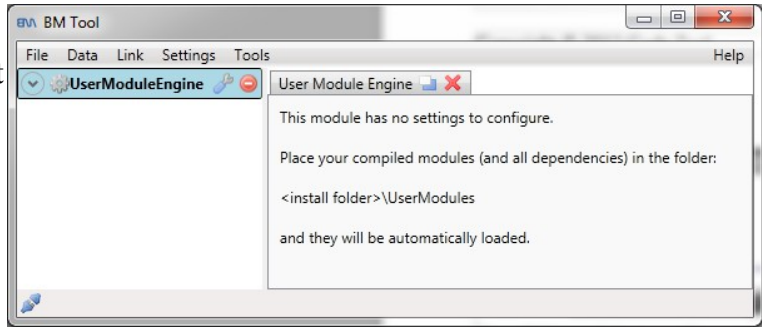
Hint

If you want to user devices such as remotes, doorbells and motion sensors, create a matching device and use the listen functionality in TelldusCenter to discover the codes used by the remote etc.

Module: User Module Engine

Use of this module generally requires knowledge of programming in C#.

A User Module (hence forth abbreviated UM) is a piece of compiled source code that runs within BM and that can interact with other modules through the use of the common messaging system and also leverage the power of the entire .NET framework. The User Module Engine is responsible for handling the loading and communication with the configured UMs.



Development Environment

A UM is written in C# under Visual Studio (The free Express or a commercial version) or another development tool of your own choosing. This manual assumes that you are using Visual Studio.

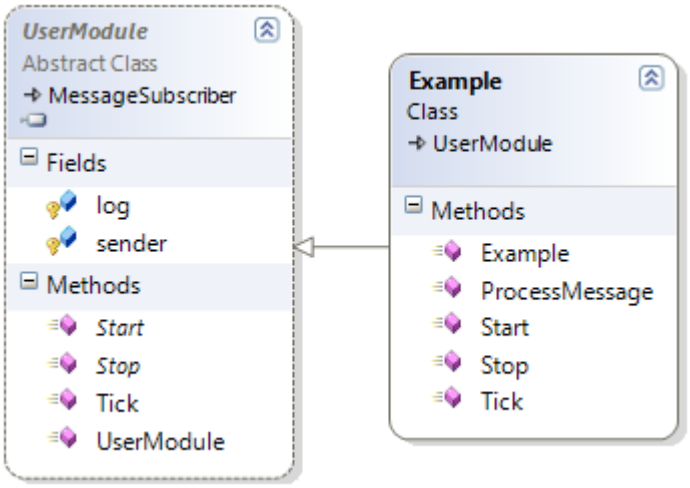
User Module Development

During installation, a Visual Studio Solution is installed in the <install-dir>\UMDevelopment folder, containing an example User Module and the required items to run it from within Visual Studio for debugging purposes as if they were run inside the Rule Engine Module, with the exception that they are run on your development machine (if different from the computer running BM) and that they are run as the user account used by Visual Studio. Note: A running instance of the Network Binder (in server mode) is required on the machine you want to connect the development environment to.

The default solution consists of the following parts:

UMDevelopment.sln	The solution file
UMDevelopment.csproj	The development tool/UM runner making it possible to run your own UM outside of BM.
ExampleModule.csproj	Example User Module project. When you wish to create your own project from scratch, you must reference the following assemblies: • BMMessage.dll • UserModuleBase.dll • PluggableLogger.dll Output type must be Class Library. You must also add a reference to the new project in the UMDevelopment project so it can find the new classes.
Program.cs	The main application that sets up your environment during development.

UMEnviroment.cs	Provides the API/Enviroment required by all User Modules. You should never edit this file.
Example.cs	An example User Module.



- Messages from other modules are handled in the different overloads of the *ProcessMessage()* method.
- All UM runs within the same thread, so lengthy operations should be avoided whenever possible. Use a separate thread or other asynchronous method to handle such operations. Not honoring this requirement may cause a performance penalty and increased memory footprint, and eventually too old messages being dropped by the UME.
- All UM must inherit from the UserModule class, and be decorated with the UM attribute, otherwise they are not discoverable by the UME or development environment.

```
[UM]
public class Example : UserModule
{
	public Example()
	{
	}
}
```

You will likely want to change the first code line in the Main() method of the Program-class of the development project so that it connects to your Network Binder module (assuming you want to communicate with other modules).

```
// Create the User Module environment, configured to connect to a
// Network Binder module running at the local host on port 6001
UMEnviroment ev = new UMEnviroment( "localhost", 6001 );
```

During development, the environment will automatically load and instance all UM found in the 'Modules'-folder located in the same folder as the project and solution files. The the example project has its output folder set to that directory already.

Life cycle of a User Module

1. Discovered and instanced by the UME or development environment.

2. Start() is called.
3. Approximately every 100ms, a call to Tick() is made.
4. Incoming messages are passed to the UM through the ProcessMessage() overloads.
5. Repeat 3 - 4 until the UME is terminated (either through application shutdown or being disabled in the configuration).
6. Stop() is called.

Available Message Types

All message types that can be sent or received lives within the BMMessage assembly, namespace BeyondMeasure.Message and other namespaces beneath it. It should be noted that most of these message types should not be sent from a UM as that can cause unwanted side effects so use care.

Installing a User Module

When you want to run the User Module from within the User Module Engine, follow these steps:

- Compile the UM in either release or debug mode.
- Place the resulting assembly (.dll file) in the 'UserModules' folder beneath the installation folder.

When next (re)started, the User Module Engine loads and starts the added UM.

Take care when updating BM

Whenever you update BM, you should make sure that your user module are compatible with the new version in terms of the messaging API. You should at least recompile all UM against the new assemblies installed by the update.

Module: WebAPI

The WebAPI module enables external applications to read and write data via HTTP-requests. Such applications include regular desktop applications but also web browsers.

Configuration

There are two settings to configure in this module:

- Listen port
  - This is the port that the module expects to listen for incoming requests. The default is port 6002 (TCP/IP). It must not be used by another application at the same time.
- Authentication method
  - No authentication.
    - No authentication is required. This means that anyone can can send requests to the module and expect them to be processed.
  - Basic Authentication
    - When this mode is selected, any non authorized client is challenged with the following header:

      ```
      WWW-Authenticate: basic realm="/auth/basic"
      ```

      For example, when a service is called via a web browser a dialog will be shown, asking for user name and password. You can provide the user name and password directly in the URL (this is not supported in all browsers), like this:

      http://user:password@server.tld:6002/service/
  - Normal Credentials.
    - When this mode is selected, any connected client must be authenticated before requests are allowed. Authentication is made by POSTing user name and password to /auth/credentials. The expected parameters are 'UserName' and 'Password'.
- Web root
  - This location is where plain content files are being served from. For example, you can have the graph module output its graphs here for easy viewing from a web browswer.

Please note that is is not possible to run multiple instances of this module.

Configuring to run in desktop mode

Due to limitations in Windows, additional configuration is required to run this module in *desktop mode* instead of as a service. If these steps are not taken an “Access Denied” message will be logged by the module. The required steps are explained in detail here, but in short, do like this:

1. Start a command prompt with administrative rights.
2. Enter the following command and press enter (for Windows Vista, Server 2008 or W7):


```
netsh http add urlacl url=http://*:6002/ user=YOUR_DOMAIN\USER
```

where
YOUR_DOMAIN is the name of either your domain or the name of the computer, USER is the name of the user account that will be running BM in desktop mode.

Provided services

Index Service/Web Server

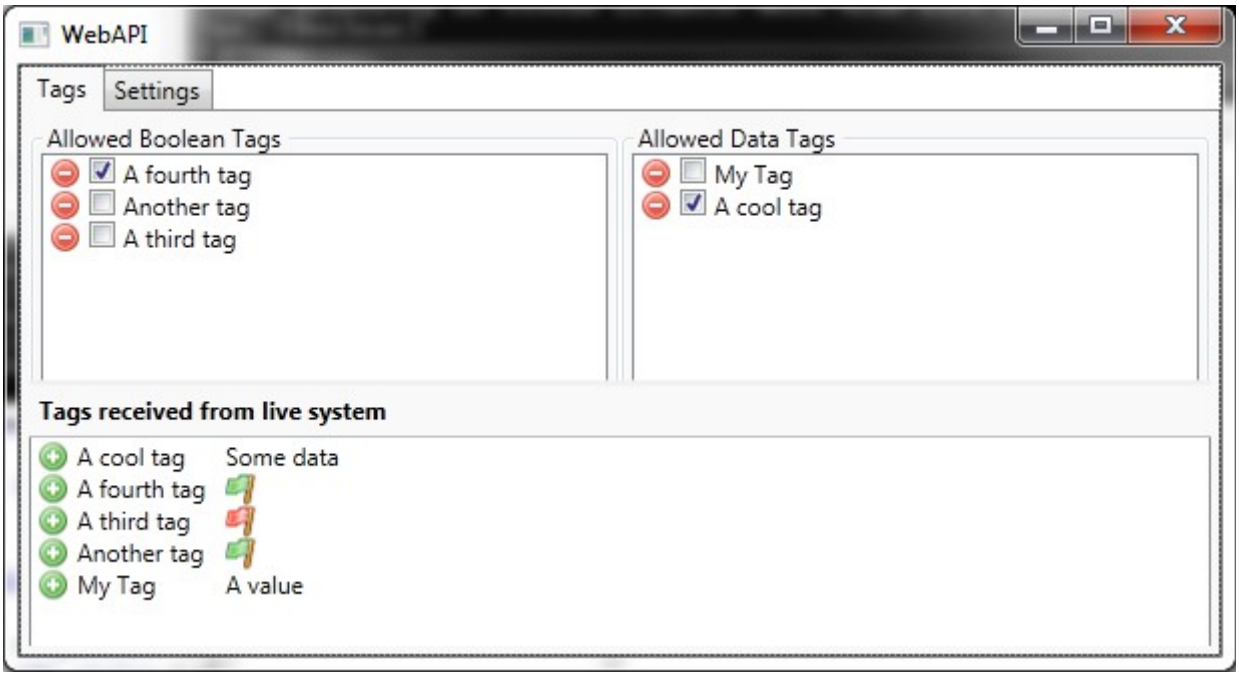
Upon installation, a default web page (index.html) is placed in the <application data folder>\WebRoot (see General Configuration). Any request to the root URL (i.e. http://server.tld:6002/) will be forwarded to the /Index service and be served this file. Requests to other non-api-mapped URLs are treated as requests for physical files beneath the WebRoot folder.

Tag Service

This service provides functionality to read, write and modify Tags within the BM system.

Configuration

The service only publishes and allow modification of tags explicitly configured for it.



In the lower part of the windows all tags currently discovered are displayed. By clicking on the green plus, the tag is added to one of the two the lists of tags to be published. By checking the check box next to it, you allow it to be modified via service requests to the WebAPI module. Removing a tag from publishing is done by clicking the red minus beside the added tag.

Accessing the service

All Tag services are accessed beneath the /api/tag/ path:

- Listing all published data tags: http://yoursite.tld:6002/api/tag/string/list
- Listing all published boolean tags: http://yoursite.tld:6002/api/tag/bool/list
- Retrieving a single data tag: http://yoursite.tld:6002/api/tag/string/TagName
- Setting a single data tag: http://yoursite.tld:6002/api/tag/string/TagName?Value=MyValue
- Retrieving a single boolean tag: http://yoursite.tld:6002/api/tag/bool/TagName
- Setting a single boolean tag: http://yoursite.tld:6002/api/tag/bool/TagName?Value=true

Module: xAP Gateway

xAP is an open protocol intended to support the integration of telemetry and control devices primarily within the home (quote). In BM you can create virtual xAP devices and also create mirroring devices that represent xAP devices that exists outside BM. This module is only a gateway for components created within a schema so to harvest the power of xAP you must also enable and configure the Rule Engine.

All devices on an xAP network requires a unique identifier and address (details), and the xAP Gateway is no exception. You will need to enter a UID that matches either the v1.2 (NNDDDDSS) or v1.3 (NN.DDDDDDDD:SSSS) format.

The default UID, FF0100, may have to be changed not to conflict with an existing xAP device on your network. If you change it, remember to set the sub-uid part to all zeros. The default instance name is the same as the network name of the local computer.

Module: XBMC Bridge

Xbox Media Center, or XBMC for short, is a very competent media player for various platforms. Through the XBMC Bridge module, Beyond Measure has the ability to control, and be controlled by, XBMC via components in the Rule Engine.

Configuration

The module only needs to know three things:

- Instance name – this is used to separate multiple instances of the module, for when multiple instances of XBMC shall be integrated into BM.
- The server address, either as an IP address or DNS address to where the XBMC server is located.
- The server port. Default is 9090.

You must also enable the JSON-RPC interface in XBMC so that BM can connect to it. Please refer to XBMC's manual for instructions on how to do this. Make sure that you use the same port number as configured above.

Limitations

Please note that due to limitations in XBMC's API, some statuses, e.g. Paused & Muted, may not reflect the actual status after a reconnection between BM and XBMC has occurred until. Once a status message has been received from XBMC, the correct status will be indicated.

Usage

The module acts as a bridge between BM and XBMC; please refer to the components in the XBMC category of the Rule Engine module for further information.

Cron

Cron is a very flexible format used to specify a series of times when an event is to take place. This format is mostly known from the Crontab service found in Unix/Linux (the equivalent of Windows' Scheduler). BM uses an extended version of this format, adding the possibility to specify seconds in addition to the other five time parameters.

Fields

Each cron-setting has the following fields

Second Minute Hour Day-Of-Month Month Day-Of-Week

where

- Second is 0-59
- Minute is 0-59
- Hour is 0-23
- Day-Of-Month is 0-31
- Month is 1-12 (January = 1, December = 12)
- Day-Of-Week is 1-7 (Monday = 1, Sunday = 7)

Field Rules

- Each field is separated by a space-character
- It is not allowed to insert a space-character inside a field value; “1 -2”, “1,2, 3” and so on are invalid.
- All fields, except Day-Of-Week are mandatory. If present, Day-Of-Week takes precedence over Day-Of-Month, unless specified as '*'.

Operators

There are four operators available:

- Comma (',') operator is used to specify a list of values, for example “5,7,9”.
- Dash ('-') operator is used to specify a range of values, for example “2-8”.
- Asterisk ('*') operator is used to match all valid values. For example, an asterisk in the minute field means “every minute”.
- Slash ('/') operator (known as the “step”-operator) can be used together with the asterisk operator to skip a given number of values. For example, “*/2” in the hour field would mean “every second hour”, or “all hours evenly dividable by two”. “*/2” is equivalent to “0,2,4,6,8,10,12,14,16,18,20,22…58". Note that 0 is evenly dividable by any number.

Examples

Fields	**Description**
* * * * *	Matches every second
0,30 * * * *	Matches seconds 0 and 30 every minute, same as */30 * * * * *

*/30 * * * *	Matches seconds 0 and 30 every minute, same as 0,30 * * * * *
* 15 * * *	Matches every second every 15:th minute past the hour.
0 */15 * * *	Matches four times every hour; second 0, minutes 0, 15, 30, 45
* * * 1-5 *	Matches every second of every hour during the 1st—5th of every month
15 * * 1-5 7,8	Matches the 15th second of every minute during the 1st—5th of months July and August
10 40 13 * *	Matches 13:40:10 every day
0 0 0 * * 1-2	Matches midnight (00:00:00) of every Monday and Tuesday
* * * * * *	Equivalent to * * * * *

