# iMod User's Manual

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## Version

| Document version | Creation Date | Changes |
|---|---|---|
| 2.1.0 | 21.08.2012 | Extended base version (XML Tree - Possible Configuration Elements, F.A.Q. chapter supplemented) |
| 1.0.0 | 21.04.2010 | Base version |
| 1.1.0 | 01.06.2011 | Extended base version (1wire, Mbus, WWW chapter, Basic commands, XML Tutorial, Added chapter 8., Appendix A, Appendix B, Appendix C) |
| 2.0.0 | 01.05.2012 | Second version |

For further information on work with the device, consult the following documents:

1. NPE instructions
2. NxDynamics instructions

For further information or in case of finding any innacuracy, please use the technical supprt portal TechBase Support in order to submit an application.

This version of the document is a pre-release version, made public due to many requests from our customers. The folliwing content is not official technical documentation and may be used only as auxiliary information. TechBase SA reserves the right to change the contents of the document without notice.

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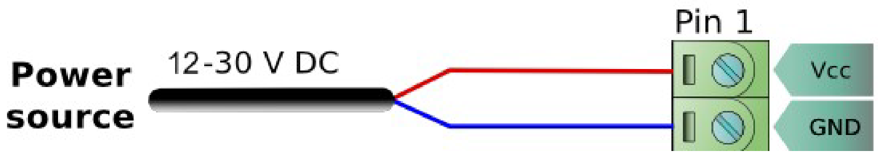
   In order to connect the device you need to prepare a power adapter according to the specification, with the minimum parameters of: 12VDC 1000 mA. You can use the DN-20-24 power adapter.
2. Network cable with RJ45 connector
   Network cable will be used to connect the device to a local area network (LAN) with access to the Internet, or for a direct computer connection.
3. SearchNPE Application
   The SearchNPE application enables detection of iMOD/NPE devices in the network. You should install this application on the computer.

# Connecting the device

The first step is to connect the power supply.



Next, connect the device to a computer or LAN with a network cable.

## Method 1. Direct connection

Direct connection between a computer and the device requires additional network interface configuration. The device should be connected directly to a computer with an Ethernet network cable.

The device automatically detects the connection cable type, so that you can use both crossover and standard cables.

## IP configuration

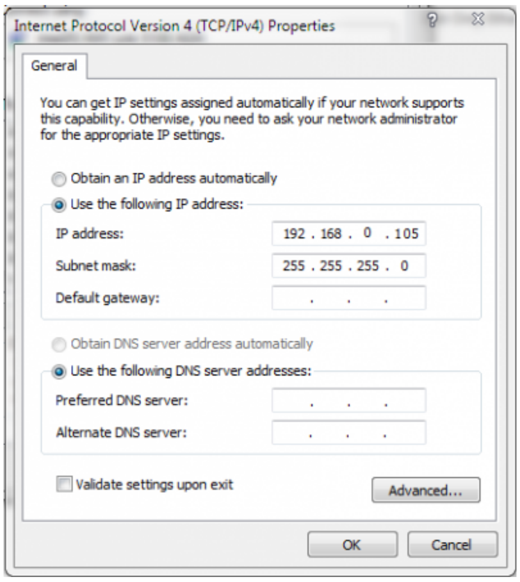
In order to establish a connection you need to configure the IP properly. The IP address should be on the same subnet as the device. The subnet of the computer (and the device) is defined by two parameters:

- IP address
- Subnet mask

Ethernet interface of the device has the following default configuration:

- IP address: 192.168.0.101
- Subnet mask: 255.255.255.0

This information will be used in the next step.



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically [✓ Use the following IP address:]

IP address: 192 . 168 . 0 . 105

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

Obtain DNS server address automatically [✓ Use the following DNS server addresses:]

Preferred DNS server: . . .

Alternate DNS server: . . .

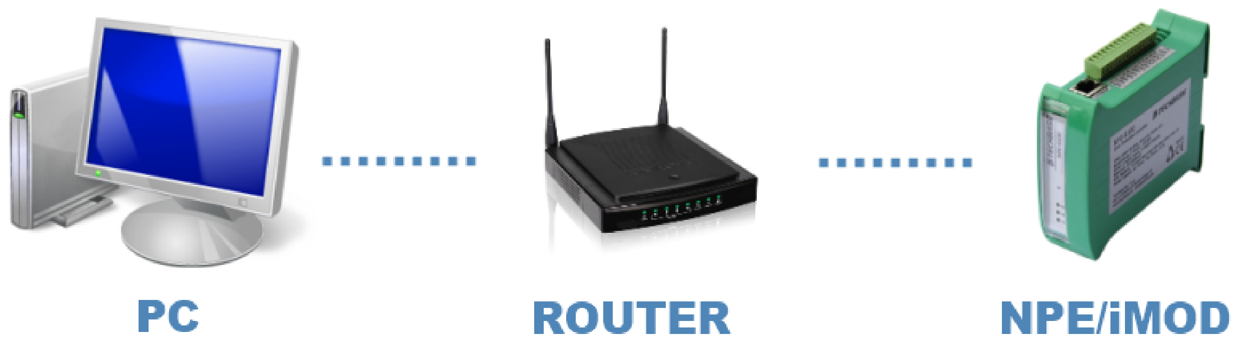
Validate settings upon exit

Above there are the device default parameters, assuming they have not been changed. The computer must have the following IP configuration:

- IP address: 192.168.0.105
- Subnet mask: 255.255.255.0

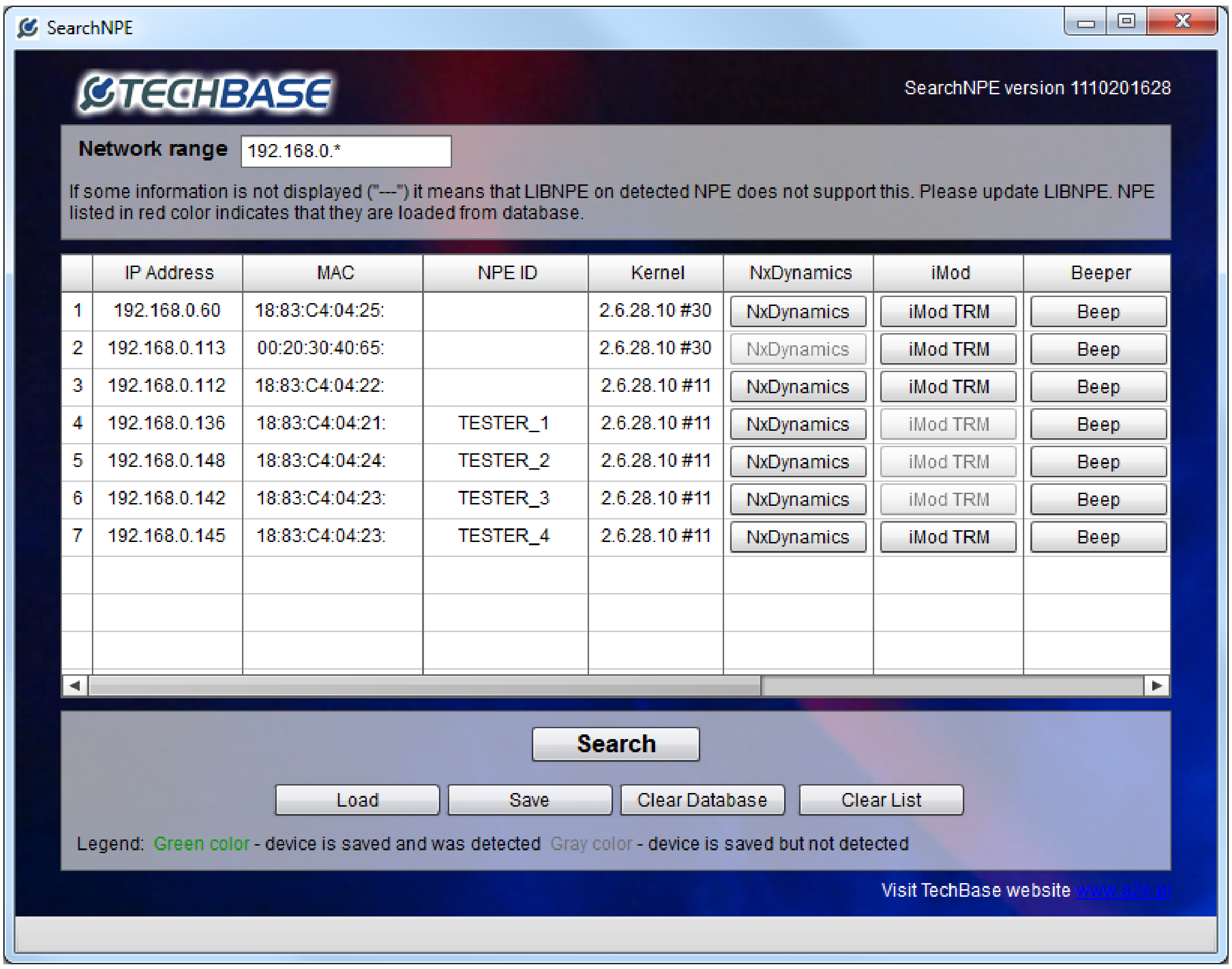
After the above mentioned network settings configuration you will be able to establish a connection with the iMod/NPE device.

## Method 2. LAN connection



Another method is connecting the device to a local area network (LAN). If a router in the network has the DHCP (Dynamic Host Configuration Protocol) service active, the device IP address will be randomly assigned after start. In order to improve searching for the addresses assigned to devices in the local area network the SearchNPE application has been created.

After launching the installed application a search window will appear:



SearchNPE version 1110201628

Network range 192.168.0.*

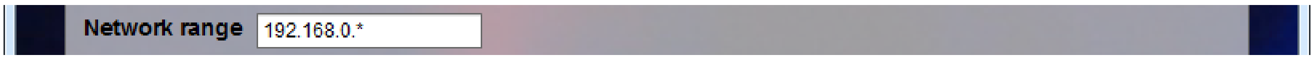
If some information is not displayed ("---") it means that LIBNPE on detected NPE does not support this. Please update LIBNPE. NPE listed in red color indicates that they are loaded from database.

| | IP Address | MAC | NPE ID | Kernel | NxDynamics | iMod | Beeper |
|---|---|---|---|---|---|---|---|
| 1 | 192.168.0.60 | 18:83:C4:04:25: | | 2.6.28.10 #30 | NxDynamics | iMod TRM | Beep |
| 2 | 192.168.0.113 | 00:20:30:40:65: | | 2.6.28.10 #30 | NxDynamics | iMod TRM | Beep |
| 3 | 192.168.0.112 | 18:83:C4:04:22: | | 2.6.28.10 #11 | NxDynamics | iMod TRM | Beep |
| 4 | 192.168.0.136 | 18:83:C4:04:21: | TESTER_1 | 2.6.28.10 #11 | NxDynamics | iMod TRM | Beep |
| 5 | 192.168.0.148 | 18:83:C4:04:24: | TESTER_2 | 2.6.28.10 #11 | NxDynamics | iMod TRM | Beep |
| 6 | 192.168.0.142 | 18:83:C4:04:23: | TESTER_3 | 2.6.28.10 #11 | NxDynamics | iMod TRM | Beep |
| 7 | 192.168.0.145 | 18:83:C4:04:23: | TESTER_4 | 2.6.28.10 #11 | NxDynamics | iMod TRM | Beep |

Legend: Green color - device is saved and was detected Gray color - device is saved but not detected

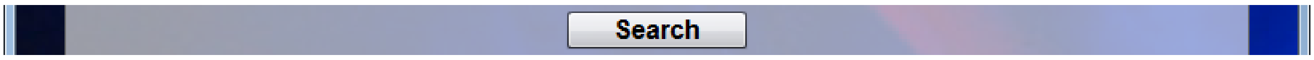
Visit TechBase website www.a2s.pl

Next, you need to set the scope of the addresses you search as default for the LAN. For example, for 192.168.5.x network addresses type in '192.168.5.*'



Network range 192.168.0.*

Click on the *Search* button in order to search the network.

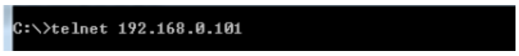


## Telnet connection

When you already know the IP address of a device, you can make a telnet connection in order to begin the device startup and configuration.

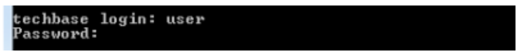
In Windows 7 you need to install the service manually.

• type in *telnet IP address* in the command-line interface



```
C:\>telnet 192.168.0.101
```

• The following window appears



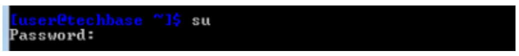
```
techbase login: user
Password:
```

You need to enter a login and a password in order to log in. The default values are:

• Login: *user*
• Password: *user*

The entered password is not visible on the screen.

• In order to get Administrator privileges, you need to use the su command



```
[user@techbase ~]$ su
Password:
```

Default password: *techbase*

# Checking Firmware Version

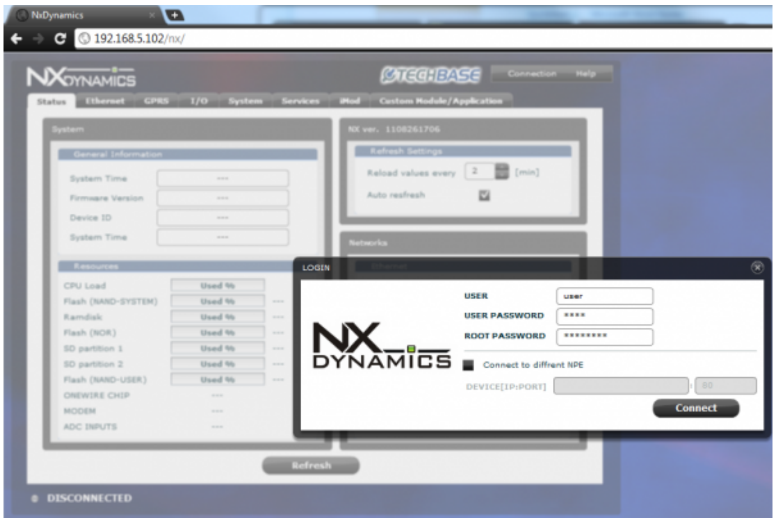
Technical support covers only the latest versions of software. After the first startup, please check if the current firmware version and the latest packages are installed.

- In order to do that, you need to execute the *softmgr update firmware* command
  This command checks if a more recent version of firmware is available and it updates the firmware together with the basic packages.

After firmware update a reboot of the device with the *reboot* command is required.

## Packages Update with NxDynamics

- In order to check if there are any active software packages for the device, you need to log in the NXDynamics interface (pre-installed 30 days trial version) typing the *deviceIP/nx* into the browser URL address:



192.168.5.102/nx/

NX ver. 1108261706

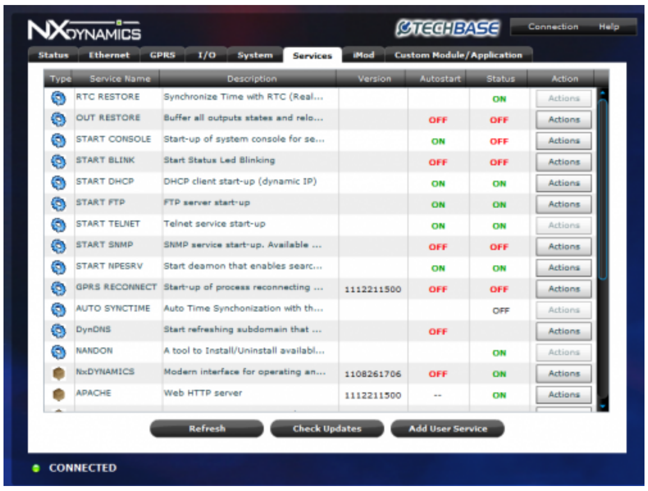
Reload values every 2 [min]

LOGIN

USER user
USER PASSWORD ****
ROOT PASSWORD *********
Connect to diffrent NPE
DEVICE[IP:PORT] : 80

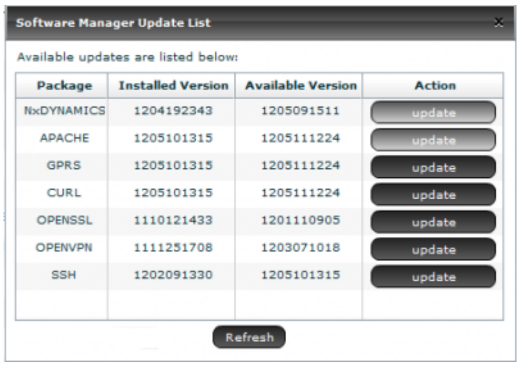
DISCONNECTED

- After logging in, you need to open the *Services* tab and check if there are any available updates with the *Check Updates* button



| Type | Service Name | Description | Version | Autostart | Status | Action |
|---|---|---|---|---|---|---|
| | RTC RESTORE | Synchronize Time with RTC (Real... | | | ON | Actions |
| | OUT RESTORE | Buffer all outputs states and relo... | | OFF | OFF | Actions |
| | START CONSOLE | Start-up of system console for se... | | ON | OFF | Actions |
| | START BLINK | Start Status Led Blinking | | OFF | OFF | Actions |
| | START DHCP | DHCP client start-up (dynamic IP) | | ON | ON | Actions |
| | START FTP | FTP server start-up | | ON | ON | Actions |
| | START TELNET | Telnet service start-up | | ON | ON | Actions |
| | START SNMP | SNMP service start-up. Available ... | | OFF | OFF | Actions |
| | START NPESRV | Start deamon that enables searc... | | ON | ON | Actions |
| | GPRS RECONNECT | Start-up of process reconnecting ... | 1112211500 | OFF | OFF | Actions |
| | AUTO SYNCTIME | Auto Time Synchonization with th... | | | OFF | Actions |
| | DynDNS | Start refreshing subdomain that ... | | OFF | | Actions |
| | NANDON | A tool to Install/Uninstall availabl... | | | ON | Actions |
| | NxDYNAMICS | Modern interface for operating an... | 1108261706 | OFF | ON | Actions |
| | APACHE | Web HTTP server | 1112211500 | -- | ON | Actions |

- If there are any updates for the packages, you need to use the *update* option



Available updates are listed below:

| Package | Installed Version | Available Version | Action |
|---|---|---|---|
| NxDYNAMICS | 1204192343 | 1205091511 | update |
| APACHE | 1205101315 | 1205111224 | update |
| GPRS | 1205101315 | 1205111224 | update |
| CURL | 1205101315 | 1205111224 | update |
| OPENSSL | 1110121433 | 1201110905 | update |
| OPENVPN | 1111251708 | 1203071018 | update |
| SSH | 1202091330 | 1205101315 | update |

# Introduction

## About Document

This documentation describes configuration of the iMod device.

### Device Version

Functionality of an iMod depends on the configuration of the device.

In the following part of this document, the term device is used to describe a device based on the iMod platform. Certain hardware resources of a device like e.g., a built-in GSM/GPRS modem are only in selected versions of the device – this is the reason why the '*' is used. The '*' means that the described functionality is applicable only to some versions of the device.

### Latest Version of Documentation

iMod is a dynamically developed product. This way you can receive new functionalities of the device by updating the software. A new version of documentation is released with each software update.

The newest version of the documentation can be found at www.a2s.pl or the ftp server:

```
Host: ftp.a2s.pl
Login: npe_imod@ftp.a2s.pl
Pass: npe_1m0d
```

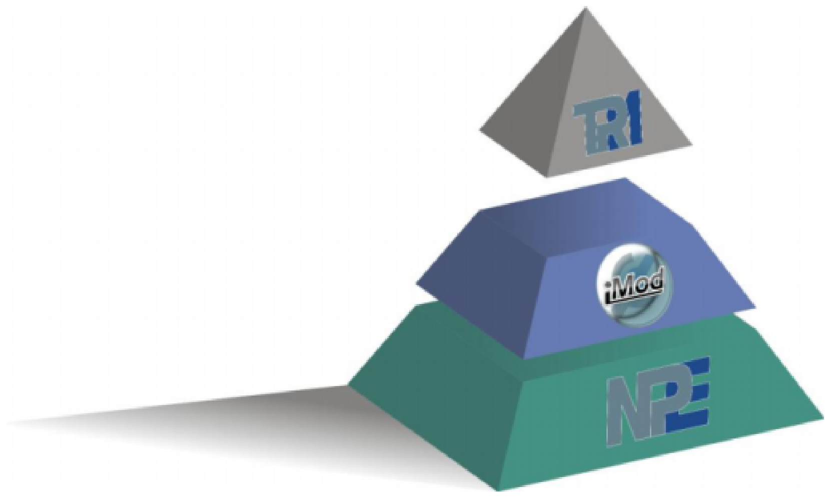
## About the Device

iMod is a telemetry module with an innovative solution based on the concept of three channels:

- source-channel
- access-channel
- message-channel

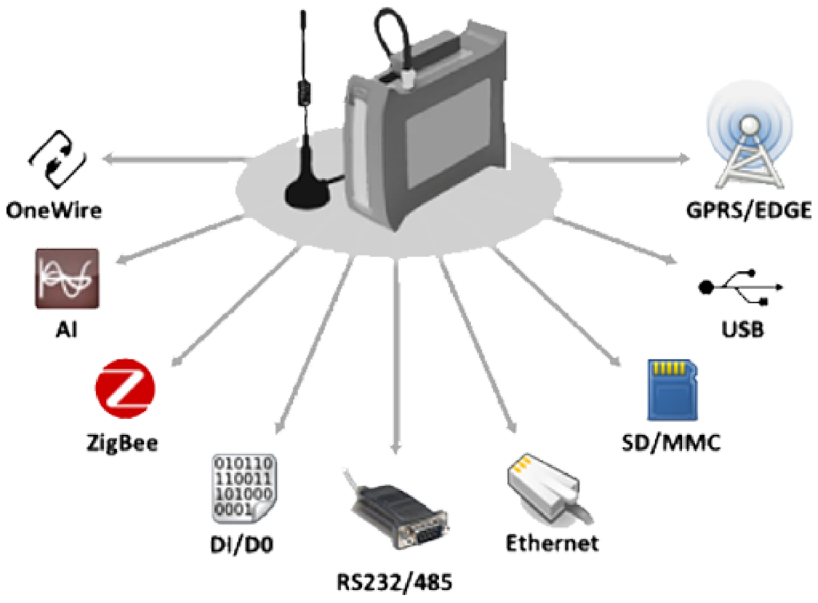
The whole operation logic of the device is described in one descriptive file – MainConfig.xml

The following scheme illustrates the system structure of the device:



## About the NPE system

As mentioned before, the platform operates on a NPE device. This means that it is possible to administer the device in a manner consistent with other devices or computers based on the Linux system using a terminal. You can access the hardware resources directly from the NPE system.



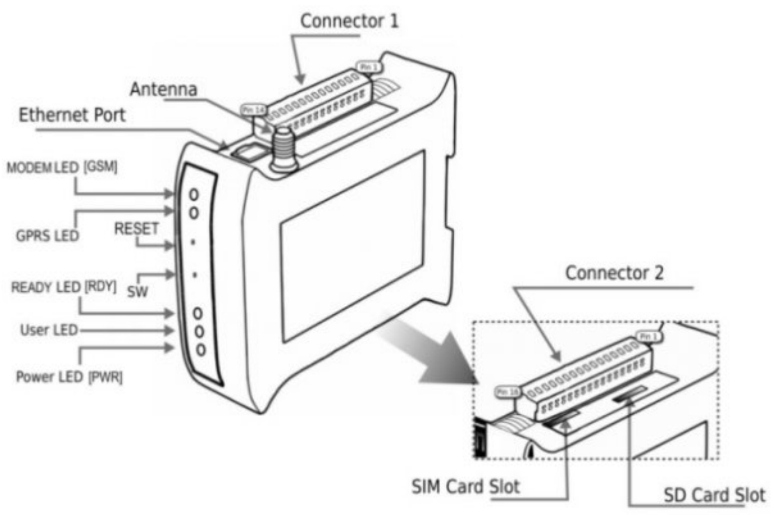
A detailed description of the NPE and Linux systems is beyond the scope of this document. Further information:
- NPE – User's Manual
- NxDynamics Manual

# Description of the Connectors

The iMod platform was developed based on the NPE device.

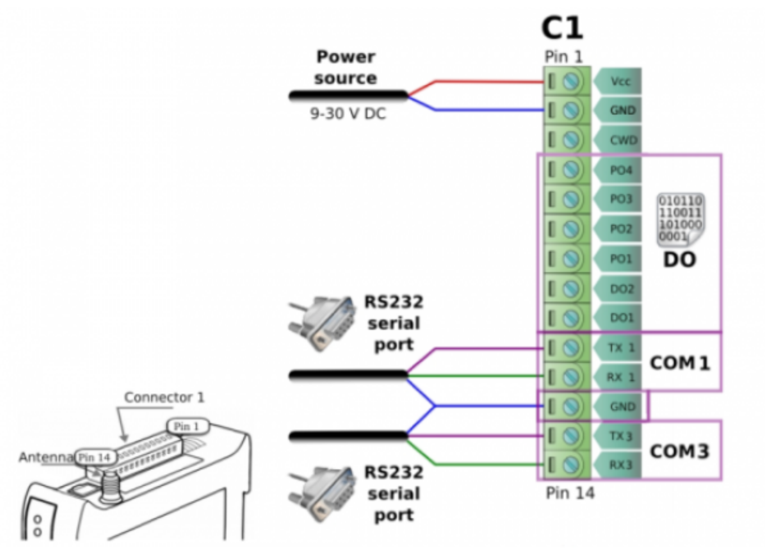
NPE has two screw connections (C1, C2) and a front panel. On the front panel there are two monostable buttons and LEDs indicating operation of the device. There is also a number of interfaces available, which are illustrated in the following scheme.

## Pin Description



| Element name | Description |
|---|---|
| Connector 1 | Connector no. 1 (14 pins) |
| Connector 2 | Connector no. 2 (16 pins) |
| Sim card slot | Sim card slot |
| SD Card Slot | SD/MMC Card Slot |
| Ethernet port | RJ45 socket |
| Antenna | GSM/GPRS antenna input |
| Power LED (PWR) | LED power indicator |
| User LED (USR) | LED available to the User |
| Status LED (RDY) | LED for the device operation status |
| GPRS LED | GPRS connection status LED |
| Modem LED (GSM) | LED for modem communication status |

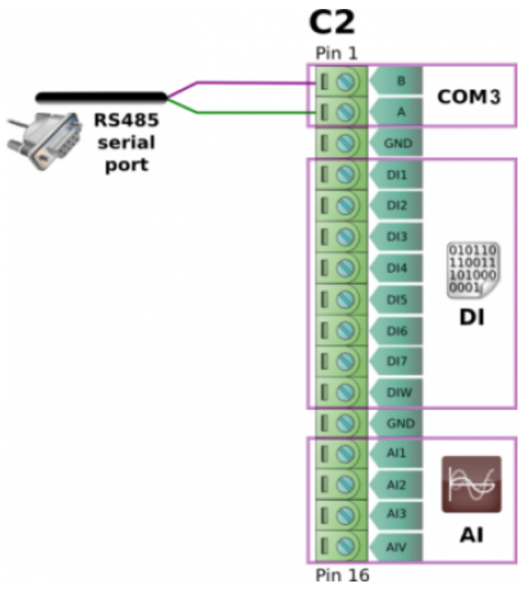
# 1 Screw Connection Description. (C1)



| Pin number | Label | Description |
|---|---|---|
| 1 | VCC | (+) Plus [12-30VDC, min. 1000mA] |
| 2 | GND | (-) Minus |
| 3 | CWD | Clamps for LEDs protecting the transistor outputs |
| 4 | PO4 | Open Collector digital output (This is Relay in the 'R' series models) |
| 5 | PO3 | Open Collector digital output (This is Relay in the 'R' series models) |
| 6 | PO2 | Open Collector digital output (This is Relay in the 'R' series models) |
| 7 | PO1 | Open Collector digital output (This is Relay in the 'R' series models) |
| 8 | DO2 | Open Collector digital output |
| 9 | DO1 | Open Collector digital output |
| 10 | TX1 | 1. RS-232 Serial port - Transmit data (com0) |
| 11 | RX1 | 1. RS-232 Serial port - Receive data (com0) |
| 12 | GND | Serial port common ground |
| 13 | TX3 | 3. RS-232 Serial port - Transmit data (com2) |
| 14 | RX3 | 3. RS-232 Serial port - Receive data (com2) |

The serial ports in the iMod configuration are defined 'com0'(RX1/TX1) and 'com2'(RX3/TX3), respectively.

## 2 Screw Connection Description. (C2)



| Pin number | Label | Description |
|---|---|---|
| 1 | B | (+) RS-485 Series port (com3) |
| 2 | A | (-) RS-485 Series port (com3) |
| 3 | GND | Ground |
| 4 | DI1 | Digital input |
| 5 | DI2 | Digital input |
| 6 | DI3 | Digital input |
| 7 | DI4 | Digital input |
| 8 | DI5 | Digital interrupt input |
| 9 | DI6 | Digital interrupt input |
| 10 | DI7 | Digital interrupt output |
| 11 | DI5 | Digital interrupt output or a 1Wire interface |
| 12 | GND | Ground |
| 13 | AI1 | 0-10VDC analog input |
| 14 | AI2 | 0-10VDC analog input |
| 15 | AI3 | 0-10VDC analog input |
| 16 | AIV | 0-10VDC analog input |

See the F.A.Q. chapter if you want to find out more about connection to hardware resources.

# Configuration of the Device (NPE)

The device based on the iMod platform is configured by two configuration files.

1. The (/mnt/mtd) *Syscfg* file s responsible for the startup options of the NPE system device. This configuration is called the *Startup Configuration*.
2. The (/mnt/mtd/iMod/config) *MainConfig.xml* file s responsible for the iMod application configuration. This is called the *Application Configuration*

In order to upload a configuration, you need to restart the iMod platform. You can do that by executing the *imod start* command from the console or the interface NxDynamics.

## Base Configuration (syscfg)

The startup configuration file is a text file with the following format: **Parameter=Value**

Do not put a space between the '=' sign and the text. Do NOT use quotation marks as well - “Value”.

| Parameter Name | Description | Default Value |
|---|---|---|
| HOST_NAME | Parameter which also describes a prompt on login screen. Whitespaces are not accepted | techbase |
| HOST_IP | IP of a device if it doesn't receive an address from the DHCP service | 192.168.0.101 |
| GW_IP | Gateway of the device | 192.168.0.1 |
| NET_MASK | Subnet mask | 255.255.255.0 |
| HOST_MAC | Mac address of the device | 18:83:C4:04:XX:XX |
| ETH_DNS_1 | DNS address if the device doesn't receive one from the router | 8.8.8.8 |
| ETH_DNS_2 | Second DNS address if the device doesn't receive one from the router | |
| RTC_RESTORE | Variable defining if the time should be synchronized with the RTC after the startup | Y |
| OUT_RESTORE | Variable defining if the state of digital inputs/outputs should be restored | Y |
| DEFAULT_ROUTE | Variable defining a default routing | ETH |
| START_CONSOLE | Startup of the system console on the COM0 serial port(/dev/ttyS0) | N |
| START_BLINK | NPE system operation indicator on the RDY diode | N |
| START_DHCP | IP lease from a router | Y |
| START_FTP | Variable defining if the FTP server starts at the device startup | Y |
| START_TELNET | Variable defining the telnet server startup | Y |
| START_SNMP | Variable defining if the SNMP server starts at the device startup | N |
| START_SMS | Variable defining if the SMS server starts at the device startup | Y |
| START_NPESRV | Service that helps to find the device in the network with the SearchNPE application | Y |
| START_INITSRV | Variable defining loading of the start scripts from the /mnt/mtd/init.srv directory | Y |
| START_APACHE | Variable defining the automatic startup of the apache server | Y |
| START_POSTGRESQL | Variable defining the automatic startup of the PSQL server | Y |
| START_SSH | Variable defining the automatic startup of the SSH server | Y |
| VPN_SERVER | Variable defining the address of the VPN server | 10.8.0.1 |

The *PostgreSQL* support and some components like e.g., *VPN* or *SSH* are not installed on the device. These packages require further installation with the packages manager ( *softmgr*).

# Startup Services Configuration (initsrv)

Activation of the packages dedicated to the NPE system uses the *initsrv* mechanism, which enables packages activation in a proper order.

### Startup Management of Packages

During the system startup all scripts from the */mnt/mtd/initsrv* directory with names in accordance with the convention are executed. If you want to exclude some of the scripts from the autostart, you only need to change their name - the best way is to add a prefix '_'.

For example, you can use the mv command

```
mv S600apache.sh _S600apache.sh
```

After executing this command and rebooting the device the Apache package will not be activated.

### Launching Order

During the installation of particular applications, scripts with a precise name, which are used during the device startup are created in the */mnt/mtd/initsrv* directory. The script name is created in the S[1-9999] package convention, where the number 1-9999 indicates the order of launching the scripts.

It is recommended not to modify the order assigned to the packages by default.

### How to Add Own Application to the Autostart

Adding own applications, which are run at the system startup is based on creating scripts in the /mnt/mtd/initsrv/ directory with a specified name (in accordance with the order of activation). Next, you need to give the rights to run (with the *chmod +x command*).

Following reboot of the device, the script will be activated after scripts with smaller indexes and before scripts with bigger indexes.

Do not double the SXX indexes in the script names. If there are two scripts with identical numbers - they will be activated in the alphabetical order.

## GPRS Connection Configuration

Configuration of basic GPRS connection parameters can be done from the web interface of the device - NxDynamics. In order to get the full access to all the options, you need to modify the section of GPRS connection in the *Syscfg* directory.

| Parameter Name | Description | Format | Default Value |
|---|---|---|---|
| GSM_BAUD | Communication speed with the GSM modem. For the EDGE modems it is the value of 230400 and for the GPRS modems it is the value of 115200. You can check the modem type with the modem info | Y/N | Autocomplete depending on the model |
| GPRS_AUTOSTART | Variable defining if the GPRS connection is automatic after the device startup(Y) or it is not automatically activated. | Y/N/B | N |
| GPRS_APN_NAME | The APN name for the GPRS connection. | String | empty |
| GPRS_RECONNECT | Activation of the GPRS reconnection process after disconnection. In case of setting the DEAFAULT ROUTE to B, In case of using a number, it is the indication (in seconds) of the speed of pinging the GPRS_PING addresses in order to verify if there is an active connection. | Y/integer | N |
| GPRS_PING_IP_1 | IP of the server for checking the GPRS connection related to GPRS_RECONNECT. | 1-255.1-255.1-255.1-255 | 208.67.222.222 |
| GPRS_PING_IP_2 | IP of the server for checking the GPRS connection related to GPRS_RECONNECT. | 1-255.1-255.1-255.1-255 | 208.67.220.220 |
| GPRS_AUTO_DNS | Definition of the Usepeerdns use while a connection attempt. | AUTO / 1-255.1-255.1-255.1-255 | Y |
| GRPS_DNS_1 | In case when the GPRS_AUTO_DNS option is set to N, the written DNS records are set for the GSM network. | 1-255.1-255.1-255.1-255 | 211.138.151.161 |
| GRPS_DNS_2 | In case when the GPRS_AUTO_DNS option is set to N, the written DNS records are set for the GSM network. | 1-255.1-255.1-255.1-255 | 202.101.103.55 |
| GRPS_DNS_3 | In case when the GPRS_AUTO_DNS option is set to N, the written DNS records are set for the GSM network. | 1-255.1-255.1-255.1-255 | 8.8.8.8 |
| GPRS_LOGIN | Login for the APN of the GPRS connection | String | empty |
| GPRS_PASSWORD | Password for the APN of the GPRS connection | String | empty |
| GPRS_PIN | SIM card PIN. In case of no PIN on a card this setting will be ignored. | Number | empty |
| GPRS_DYNDNS | Activation of the DynDNS service at every GPRS connection with options in the /etc/inadyn.conf file | Y/N | N |
| GPRS_MUX | GSM modem multiplex mode. Enables using the GPRS session (/dev/ttyS5) and SMS sending (/dev/ttyS6), leaving one channel for any usage (/dev/ttyS7). | Y/N | Y |

## DynDNS Configuration

iMod has a mechanism for using the DynDNS service for the PPP protocol (GPRS connections). This script uses the InaDynConf library.

Further information on this package can be found at: http://www.inatech.eu/inadyn/

The DynDNS service configuration is limited to creating a personal account in the www.dyndns.com service and editing the */mnt/mtd/iMod/config/inadyn.conf* file.

This is an example configuration:

```
# DynDNS configuration

--username test
--password test

alias test.homeip.net

iterations 1
```

# iMod Platform Quickstart

## Initial Information

In order to start with the iMod platform, you need to prepare the following software improving building of the configuration and verification of the iMod engine operation. This is the list of the necessary software:

- FTP client (e.g., FreeCommander)
- XML files editor (e.g., Notepad++)
- iMod configuration parser (available here for download)
- Internet browser (not earlier than: IE9, FF6, Opera 10, Chrome 8)
- Modbus master type software (e.g., modbus poll)
- Modbus slave type software (e.g., Modbus simulator)
- Telnet client (e.g., Putty)
- SearchNPE

The following examples illustrate an optimal configuration of the work environment with the iMod platform. All of the examples below and video tutorials showing the usage are available on the FTP server.

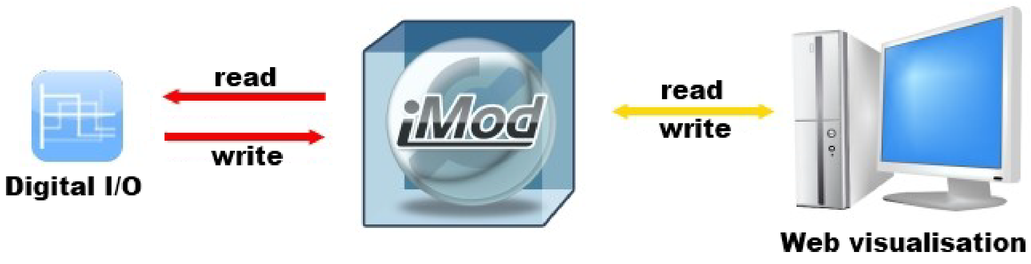
```
Host: ftp.a2s.pl
Login: npe_imod@ftp.a2s.pl
Pass: npe_1m0d
```

## Example Configuration of Receiving Access to Hardware Resources

The iMod platform enables multiple access both to the internal hardware resources and the external parameters. In case of building a proper configuration the data is stored in a database, available via a web template, Modbus protocol and SNMP.

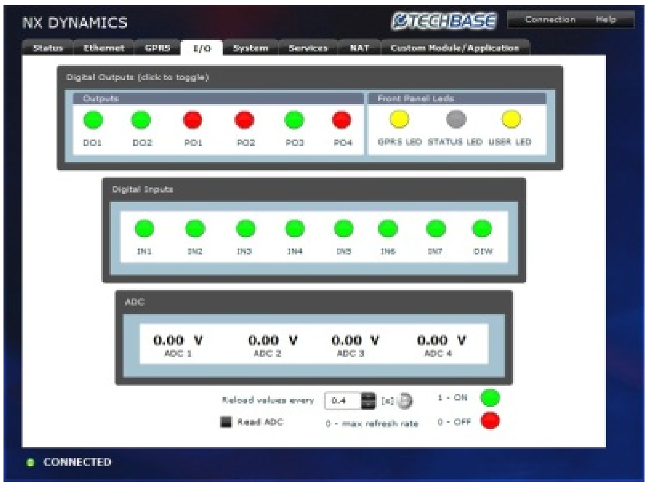
A few ways of gaining access to hardware resources are presented as an introductory example, this will be useful in further learning about the iMod platform operation.

## I/O access from NxDynamics



Each iMod device is delivered with a pre-installed trial version of the NXDynamics interface (The possibility of a free interface update ends after 30 days). It enables an easy preview of hardware resources and control of digital outputs via the web interface.

- Type: *<IP of the device>/nx* into the browser URL address bar
- Log into the website and click on the *I/O* tab
- On the screen you will see a hardware resources chart, which you can control with your mouse.

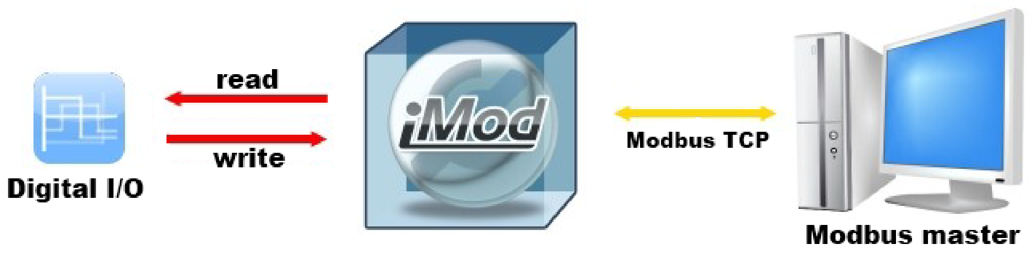


The NxDynamics interface uses a dedicated message channel with an application for interrupt support of hardware resources. It provides almost instant refresh of the parameters on the web without burdening bandwidth.

Available hardware resources and the precise look of the chart may differ depending on the version and model of the device.

Videotutorial: www.youtube.com/watch?v=psAXI8W3nTw

## I/O Access Via Modbus TCP Protocol



After uploading an appropriate configuration you can gain access to all the input/output resources that the platform is equipped with, using the Modbus protocol.

In order to gain access to the resources you need to upload the MainConfig.xml directory containing definitions of all the hardware resources for location of the *mnt/mtd/iMod/config* configuration and reboot the iMod.

A complete example configuration can be found on the FTP server.

### Configuration File Structure

The iMod configuration is saved in the MainConfig.xml file located in the */mnt/mtd/iMod/config/* directory on the device.

Upload the configuration which enables access to the hardware resources using the Modbus TCP protocol.

1. Run *Notepad++*
2. Enable the *NPP FTP* plugin
3. Configure the FTP connection with the device
4. Download current configuration of the device */mnt/mtd/iMod/config/MainConfig.xml*
5. Download current configuration from the */mnt/mtd/iMod/config/example1-hardware_access.xml* device
6. Copy the content of the *example1-hardware_access.xml* file into the MainConfig.xml file.
7. Save the configuration on the device (It is recommended to copy the previously uploaded configuration into the configuration parser in order to check if the configuration is correct. (This time you don’t have to do that, because you have a guarantee that the prepared example files are correct)
8. Log into the device with a console or the NxDynamics interface
9. reboot the iMod with the *imod start* command

Video tutorial - points 1. - 7.: www.youtube.com/watch?v=1ouYOkJQvBU?medium

**Startup of the Platform**

The iMod platform runs automatically after activation of the NPE firmware. If you modify the configuration, you need to reboot the iMod. You can do that by writing the *imod start* command from the command line.

There are different iMod startup modes - *debug* and *trace* which are useful in case of developing own configurations.

The iMod platform operation can be previewed in real time through so called live-logs. In order to preview with a live-log, execute the following commmand: *tail -f /mnt/data/logs/iMod.log* In case of a startup of the platform in the trace mode, you will see each parameter change and each supported question together with the sent answer.

**Operation Verification**

Verify if you can connect to the device with the modbus protocol.

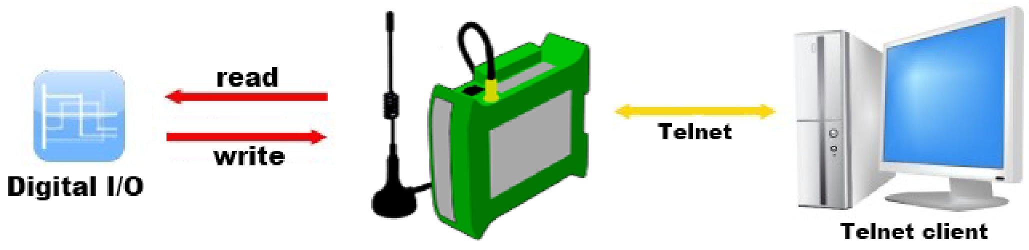
1. Run a modbus master type appllication (np. modbus poll)
2. Configure polling (2. parameters from the address 100)
3. Configure the connection setting with the device (Device id:1, Default IP: 192.168.0.101, default TCP port: 502)
4. Start polling
5. Check if the hardware resources on the NxDynamics chart change in accordance with the changes made by the actions performed via the TCP modbus protocol

Video tutorial illustrating points 1-5
www.youtube.com/watch?v=6tKCJUZSQMo

**Extensive Hardware Resources File**

Depending on the version of the device, you can extend the example configuration with additional parameters. On the FTP server you can find the example1-hardware_access-extended_version.xml configuration for the NPE 9000 series.

## I/O Access with Telnet Console



The NPE platform provides two access levels to hardware resources - with the uploaded into firmware of the device 'npe' application, which uses hardware resources library of the NPE device - via the npe-service application, which provides permanent readout of hardware resources.

### Readout with 'npe' Application

In order to use the built in 'npe' application, you need to log into the device as a super-user (root). The *npe* command is visible from any place on the device.

Readout is done by assigning one of the inputs/outputs to the variable '?' and calling the variable with the *echo $?* command.

```
npe ?DO1; echo $?;
```

More examples of the NPE application use can be found in the application manual on the device. Just type the following command: *npe* [ *Aplikaja npe - manual* ]

### Readout with npe_service

The NPE platform has a built in application for the event support of hardware resources. In order to preview or control the I/O in NPE you need to refer to the *npe-srv-client* application.

Example readout of a digital output:
```
[root@techbase /]# npe_srv_client -i DO1
```

Example writing of a digital output:
```
[root@techbase /]# npe_srv_client -i DO1,"0"
```

Video tutorial illustrating access to hardware resources from a console: www.youtube.com/watch?v=OyLaq0gEHGk

# Configuration File Structure

Configuration file is written in the XML format. The iMod engine reads a configuration from the *MainConfig.xml* file in */mnt/mtd/iMod/config/ directory.*

## Loading a Configuration

Configuration is loaded via the FTP protocol into */mnt/mtd/iMod/config* directory.

While using other programs, remember to copy onto NPE platform in *binary mode*.

## Configuration Verification

Each configuration and implemented changes should be verified in 3 stages.

1. User PC verification with configuration parser.
2. NPE platform verification with iMod built-in parser - it is done automatically after executing the *imod start* command.
3. Validation of configuration operation (to check if the implemented changes comply with your needs) with dedicated *use cases*.

It is crucial that the configuration is correct and optimal. Only then will iMod make full use of the NPE platform hardware resources. In order to check if it operates properly, see if there is no WARN and ERROR type information in the *iMod.log* file in normal mode.

## Rules of Construction

### General Rules

Configuration consists of elements. Each element must be closed. Closing the elements may be done in two ways. e.g.,

```
1. Opening and closing an element in one line:
<element />

2. Opening and closing an element in two lines:
<element>
...
</element>
```

An element may have a property. Possible values of a *property* strongly depend on an element they are in. The use of properties is precisely written out in chapters describing specific functionalities e.g.,

```
<property name="device-id" value="3" />
```

Other elements may be nested in an element. e.g.,

```
<element>
  <element1 />
</element>
```

All the elements must be inside the *imod* element e.g.,

```
<imod version="1.0.0" >
...
</imod>
```

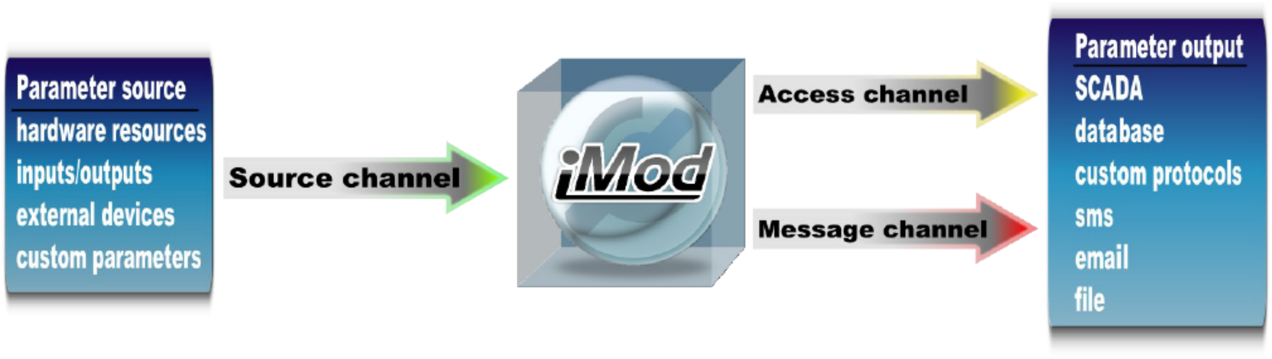
Elements may be grouped by closing them in a *group* element with a name e.g.,

```
 <group name="Channel definitions">
  ...
 </group>
```

Configuration is not case sensitive.

### Channel Definition

iMod logic is based on a three channels principle:



- Source-channel - data source channel
- Access-channel - data access channel
- Message-channel - event-triggered communication

### Name

Each channel must hold a separate name, which will be used in channel identification parameters. e.g.,

```
<access-channel name="Modbus_S1">
```

### Protocol

Each channel must contain a *protocol* element which defines the protocol. e.g.,

```
<protocol name="MODBUS"/>
```

### Other Elements

Definition of other elements depends on a channel type and a protocol. e.g.,

```
        <access-channel name="Modbus_Master">
                 <protocol name="MODBUS"/>
                <port>"ET-502-TCP"</port>
        </access-channel>

         <source-channel name="Modbus_Slave">
                 <protocol name="Modbus"/>
                <port>"com3-1200-8N1"</port>
                <gap>0</gap>
                <cycle>5s</cycle>
        </source-channel>

         <message-channel name="DiffrenceCounter">
                 <protocol name="SCRIPT"/>
                 <port>"/mnt/mtd/iMod/config/"</port>
                 <recipient>"difference"</recipient>
          </message-channel>
```

## Parameters Definition

### Parameter Element

Each parameter contains a series of elements, defining where data is taken from and a method of data access.

It is possible to define a parameter which is not related to the Source-channel. Such a parameter is called *dummy*. It enables to create empty registers on the platform for any use.

In the *parameter* definition of an element you can declare its type as well.

There are the following types of parameters:

- int16 - Integer. A whole number from −32 768 to +32 767
- int32 - Double Integer. A whole number from −2 147 483 648 to +2 147 483 647
- word16 - A whole number from 0 to 65 535
- word32 - A whole number from 0 to +4 294 967 295
- real32 - A floating-point number from 3.4e-038 to 3.4e+03

An example parameter type definition:

```
<parameter type="real32" >
```

### ID Element

The value of the ID element must be unique in the entire configuration. It is alphanumeric data type. e.g.,

```
<id>"ExampleID1"</id>
```

### Source-channel Element

Data source assigned to a channel parameter. The assigned channel is identified by providing its name. You should provide the *parameter-id* properties along with the name. The *parameter-id* format strictly depends on a communication protocol assigned in the channel definition. Only 1 source-channel element may be assigned to each parameter. It is an optional element, so you may also omit its definition.

e.g., Data source as an analogue input I

```
        <source-channel channel-name="NPE_io" parameter-id="AI1" />
```

Data source from an external modbus device from a 101 register:

```
        <source-channel channel-name="ModbusSlave" parameter-id="101" />
```

Data source from a 1-wire sensor:

```
        <source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature9"/>
```

### Access-channel Element

Assigning a parameter to the access-channel. An assigned channel is identified by providing its name. Many elements may be assigned to one *access-channel* parameter. You should provide the *parameter-id* properties along with the name. The *parameter-id* format strictly depends on a communication protocol assigned in the channel definition e.g., for a modbus parameter the *parameter-id* is the starting address of the parameter.

```
        <access-channel channel-name="ModbusSlave" parameter-id="101" />
```

### Event Element

Each parameter may include the *event* element. Further information on this element may be found in the *event communication* chapter. This element is responsible for additional actions during values read-out.

### Optional Elements

A number of elements improving clarity of the configuration may be assigned to each parameter. Additionally, content of the elements will be saved together with the parameter value in the SQLite3 default database - *modbus.db*.

It enables further download of the values and presenting them on the website in an easy way

- Offset - displacement
- Scale - scale
- Description - an element enabling adding a parameter description
- Label - an element enabling labeling a parameter
- minVal - an element defining a minimum allowed parameter
- maxVal - an element defining a maximum allowed parameter

## Definition of Message Content

Further information on communication and message content is in the *Event-triggered definition* chapter (messages definition).

## Configuration Validation

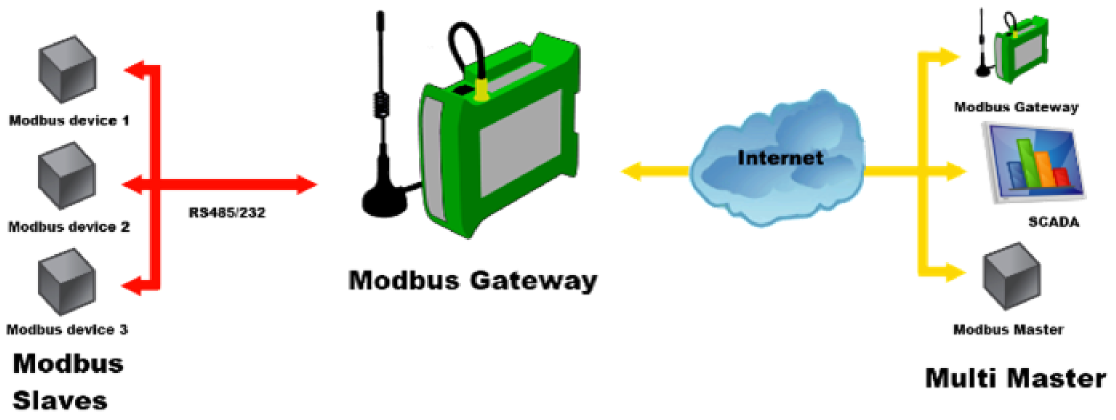
Before loading a configuration to a device you may validate the configuration on your computer. In order to do that, you need to download a parser from an FTP server for iMod clients or iMod product from the following website www.a2s.pl.

iMod configuration parser

# Modbus Gateway/Router/Proxy

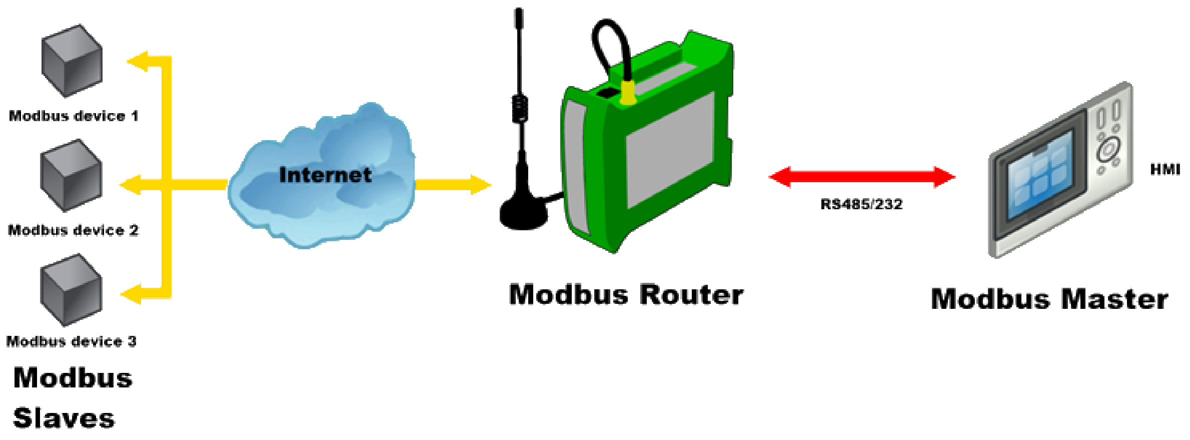
The iMod can perform functions of a modbus gateway, router or a proxy device at the same time. In the following chapter you will find a definition of the mentioned functionalities with configuration examples.

## Modbus Gateway



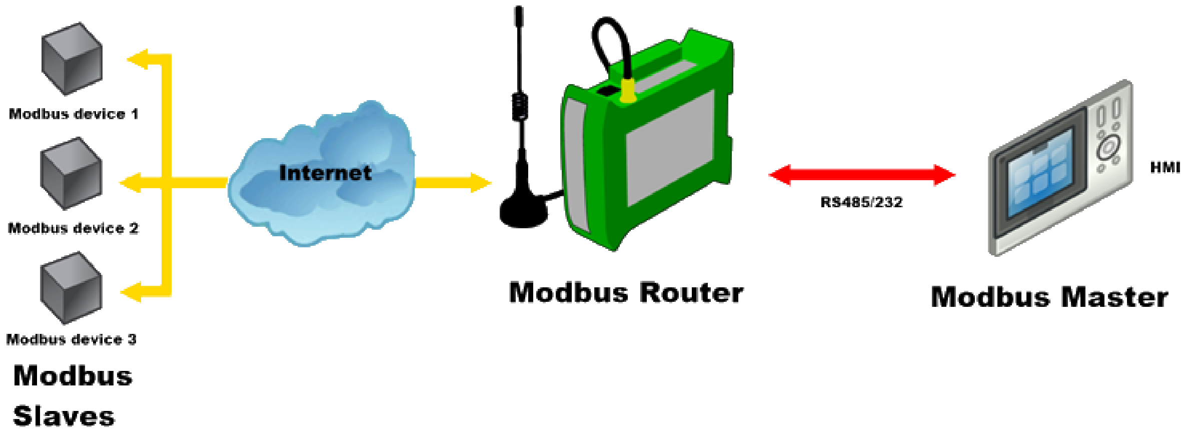
Information from Modbus slave (Modbus RTU, Modbus ASCII) devices received through a serial port is transmitted to the Ethernet network (Modbus TCP).

## Modbus Router



- Modbus slave devices can work in the Ethernet network.
- Modbus master device can communicate via serial port.

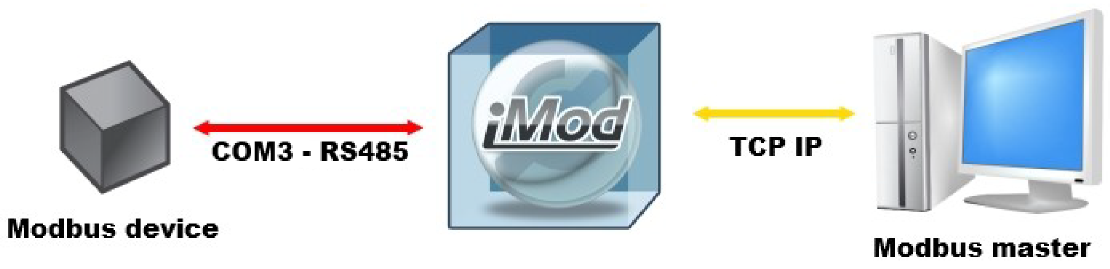
## Modbus Proxy



- Readout from slave type devices.
- Write in the buffer.
- Transmitting data to modbus masters.

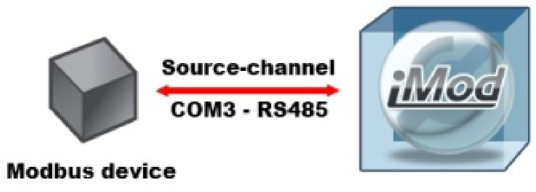
## Point-to-Point Connection

### Example Configuration Structure



This example demonstrates a method of communication of the iMod device with another device supporting the Modbus RTU protocol. An example configuration example2-modbus_proxy.xml can be found in the device directory: */mnt/mtd/iMod/config/examples/*

#### Add Source-channel



First, you need to define a serial port for the readout. This is a structure of the configuration of a channel supporting the Modbus RTU protocol on the COM3 port:

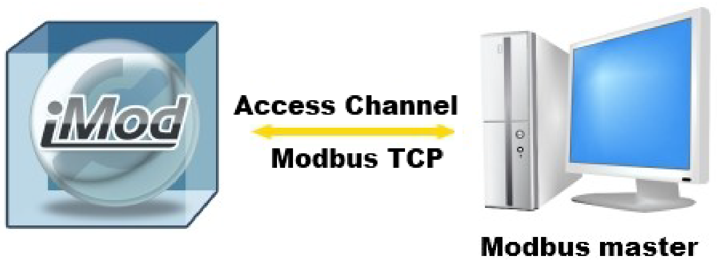
```
    <source-channel name="Modbus_M1">
      <protocol name="MODBUS"/>
      <port>"com3-19200-8E1"</port>
      <gap>0</gap>
      <cycle>6</cycle>
    </source-channel>
```

The parameters of the serial port are as follows:

- COM port: 3 RS-485
- baudrate: 19200 baud/s
- datatbits: 8
- datatbits: Even
- stop bits: 1
- protocol type (default): Modbus RTU

The above configuration contains only required elements. Remaining elements such as modbus ID of the device or response to a request time are default. Further information on the possible elements in defining the Modbus type source-channel can be found in the *XML* chapter.

**Add Access-channel**



After defining the data source, add the definition of access to the data. In this example it is the access via the Modbus TCP protocol.

```
    <access-channel name="Modbus_S1">
        <protocol name="MODBUS" />
        <port>"ET-502-TCP"</port>
    </access-channel>
```

**Add Parameter (modbus registers)**

Define the readout from selected modbus addresses and assign them to modbus addresses in the iMod.

In order to do that, you need to include a reference to access and source-channel in the <parameter> structure:

```
   <parameter>
      <id>1</id>
      <source-channel channel-name="Modbus_M1" parameter-id="1"/>
      <access-channel channel-name="Modbus_S1" parameter-id="1"/>
   </parameter>
```

The Modbus RTU register with the address of the 1 device connected to the COM3 port is converted to the TCP Modbus register with the same address. The following example enables users to buffer values and control a parameter in the external device supporting the modbus protocol.

The above configurations also contains only required elements. In iMod you can easily choose a function code that will be used for polling an external device, set a byte order reverse in the 32-bit parameters, force write of every same value, etc. Further information can be found in the *XML* chapter.

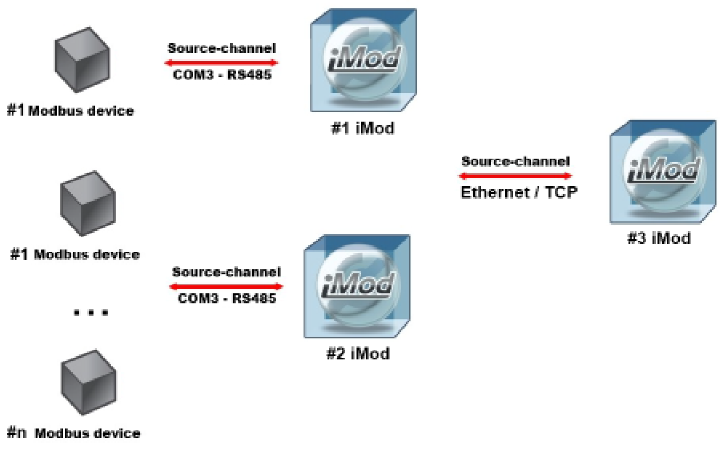
**Configuration Verification**

1. Connect iMod with a computer with the RS-485 serial port (e.g., with a converter ATC-820)
2. Download modbus slave application (e.g., mod_RSsim_eth)
3. Run modbus master software (e.g., modbus poll)
4. Run modbus slave output with register 1 simulation (0x03 function code)
5. Read and write values several times

Video tutorial illustrating points 4-5: www.youtube.com/watch?v=YsHrvpR_RS8

## Point-to-Multipoint Connection

In the distributed networks there are often many slaves. This chapter shows how to build a configuration for a point-to-multipoint network.



### Modbus TCP - Many Slave Type Devices

In the previous configuration there was an example of how to read parameter values from the Modbus Slave devices. The configuration contains a minimum configuration, which is required. Part of the not configured settings took default values. These included e.g., the *device-id* element.

#### How To Change iMod Modbus ID

The device ID enables its identification among other devices. iMod has a default ID = 1. You can change that by adding a *property* to the access-channel.

Example iMod ID change to ID = 2.

```
    <access-channel name="Modbus_S1">
             <protocol name="MODBUS" />
             <port>"ET-502-TCP"</port>
             <property name="device-id" value="2" />
     </access-channel>
```

## How to Set ID for Modbus Slave Device (modbus address)

There are two ways of an ID change for a modbus slave.

#### Deafult ID change for a Modbus Slave

Default modbus address for a source-channel (slave type devices) is 1. However, you can change the default setting by writing an ID in the source-channel definition:

```
<property name="device-id" value="NEW_ID"/>
```

Example source-channel with a changed default modbus address to address = 2:

```
        <source-channel name="Modbus_M1">
                 <protocol name="MODBUS"/>
                <port>"com0-19200-8E1"</port>
                 <property name="device-id" value="2"/>
                <gap>0</gap>
                <cycle>1</cycle>
                <delay>100ms</delay>
        </source-channel>
```

#### Device ID Change in Parameter

If you have several devices, you need to enter the ID which the parameter refers to, for parameters with a modbus address other than default (modbus register). The definition of a modbus address needs to be included in the <source-channel> element. Below there is an example parameter definition from a modbus device with the address 2 and register 3:

```
<parameter>
                <id>"2-3"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="3" >
                                <property name="device-id" value="2"/>
                </source-channel>
</parameter>
```

## TCP/RTU/ASCII Connection

iMod supports the modbus protocol in its three varations ASCII, TCP and RTU.

In order to define a modbus type protocol, you need to include the property type <protocol> in the element.

```
                 <protocol name="MODBUS">
                        <property name="type" value="RTU" />
                </protocol>
```

Example Modbus ASCII protocol declaration:

```
        <source-channel name="Modbus_M1">
                 <protocol name="MODBUS">
                        <property name="type" value="ASCII" />
                </protocol>
                <port>"com0-19200-8E1"</port>
                <gap>0</gap>
                <cycle>1</cycle>
                <delay>100ms</delay>
        </source-channel>
```

A change in the protocol type is made in an identical way both for the data source-channel and data access-channel.

## How to Adjust Configuration to the Poll?

### Modbus RTU / Modbus ASCII

For Modbus RTU the frame is built of the following fields:

| 1st byte | 2nd byte | 3rd-4th byte | 5th-6th byte | 7th-8th byte |
|---|---|---|---|---|
| Device-id (modbus address) | Function code | Initial register | Number of registers for readout | Checksum |

Example frame:

| 0A | 03 | 00 00 | 00 0A | B6 |
|---|---|---|---|---|
| Device-id=10 | Function code= 0x03 | Initial register=0 | 10 registers | Checksum |

#### Adjusting 1st Byte

The modbus address is set by adding the following element: <property name=„device-id” value=„XX” />

Further information can be found in the *Point-to-multipoint connection* section.

### Adjusting 2nd Byte - Functions Codes

There are four readout function codes in modbus:

| Function code | Name | Function description |
|---|---|---|
| 0x01 | Coil | Modbus register for reading and writing binary parameters (0/1) |
| 0x02 | Discrete | Modbus register for read only binary parameters (0/1) |
| 0x03 | Output | Modbus register for reading and writing |
| 0x04 | Input | Modbus register for read only. |

In iMod you change the sent function code in the poll, by adding a property element named „varspace” e.g.,

```
<property name="varspace" value="coil" />
```

The name 'varspace' is used, because in older devices function code also meant memory area from which a parameter was taken.

Example definition of a coil type modbus register.

```
<parameter>
                <id>"1"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="1">
                   <property name="varspace" value="coil" />
                </source-channel>
</parameter>
```

### Adjusting the 3rd and 4th byte - Initial Register

A shift of registers may occur in the modbus devices. If (in the modbus slave device documentation) there is a description that a parameter X is in the register at the N number, it may mean that it should be defined as N+1, N-1 or simply N in the iMod.

The initial value is taken from the parameter and its 'parameter-id’ element defined in the source-channel. i.e.,:

```
<parameter>
                <id>"1"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="100"/>
</parameter>
```

means sending a poll with the initial address:

```
 00 64
```

### Adjusting the 5th and 6th byte - Number of Registers for Polling

iMod internally groups the read parameters. It finds the initial address and adjusts polls together with the number of registers to read, in such a way to gather as much data in the smallest number of polls.

### Adjusting Checksum

iMod automatically calculates the correct checksum for each poll.

## 32-bit Parameters

Part of the modbus devices has 32-bit parameters in the registers table. iMod enables definition of such registers by changing a parameter.

```
<parameter type="real32">
...
```

When defining a 32-byte parameter, you need to remember to increment the following access-channel parameter ID by two.

There are five types of parameters in iMod:

| Parameter type | Description |
|---|---|
| int16 | 16-bit Parameter |
| int32 | 32-bit Parameter |
| word16 | 16-bit Parameter with no sign (unsign integer) |
| word32 | 32-bit Parameter with no sign (unsign integer) |
| real32 | 32-bit Parameter with a floating point value |

Example parameter definition:

```
<parameter type="int16">
                <id>"1"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="1" />
                <access-channel channel-name="Modbus_S1" parameter-id="1" />
</parameter>

<parameter type="int32">
                <id>"2"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="2" />
                <access-channel channel-name="Modbus_S1" parameter-id="2" />
</parameter>

<parameter type="word16">
                <id>"3"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="4" />
                <access-channel channel-name="Modbus_S1" parameter-id="4" />
</parameter>

<parameter type="word32">
                <id>"4"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="5" />
                <access-channel channel-name="Modbus_S1" parameter-id="5" />
</parameter>

<parameter type="real32">
                <id>"5"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="7" />
                <access-channel channel-name="Modbus_S1" parameter-id="7" />
</parameter>
```

### Property 'inverse'

Very often, there is an issue with value interpretation of the 32-bit parameters. If the 32-bit parameters have incorrect value, try to add bit inversion before calculating the value in such a way that the other 16 bits are at the front.

You can do that with the <*property*> element called *inverse*.

```
        <property name="inverse" value="true" />
```

The information on inversion of parameters, can be both in the source-channel and access-channel element. Example definition:

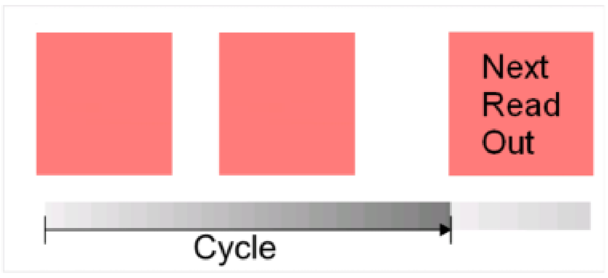
```
        <parameter type="real32">
                <id>"5"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="7">
                        <property name="inverse" value="true" />
                </source-channel>
                <access-channel channel-name="Modbus_S1" parameter-id="7" />
        </parameter>
```

## Gap / Cycle / Delay / Read Timeout

Polling frequency parameters are linked with the modbus protocol. The section below in short describes polling parameters available for modification. Example source-channel containing definitions of all elements related to polling on the channel.

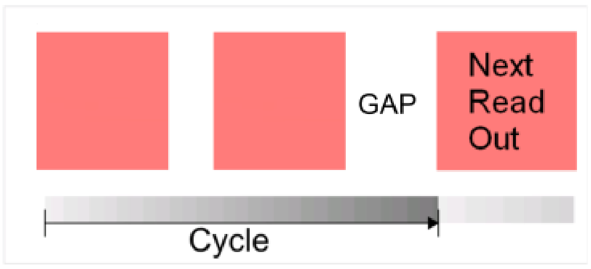
```
        <source-channel name="Modbus_M1">
                 <protocol name="MODBUS"/>
                <port>"com3-19200-8E1"</port>
                <gap>0</gap>
                <cycle>1</cycle>
                <delay>100ms</delay>
                <read-timeout>100ms</read-timeout>
        </source-channel>
```

### Cycle



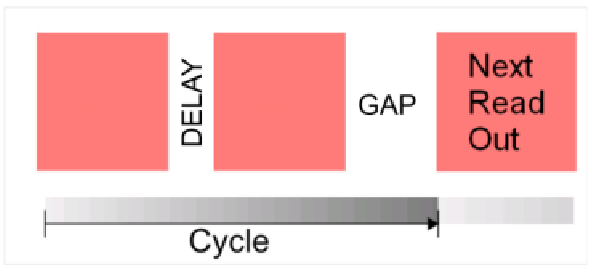
The <cycle> parameter defines the frequency of the modbus addresses series update. This is a required element. The default value unit is a second.

### Gap



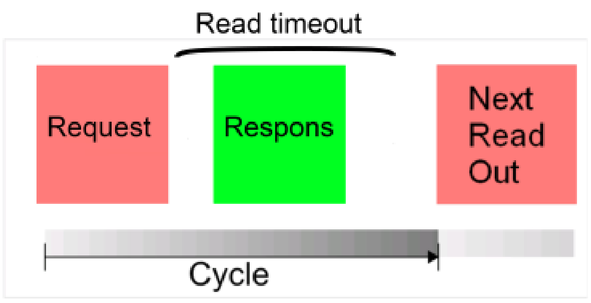
The <gap> parameter defines the min. require silent at the end of a cycle. This is a required element. The default value unit is a second.

## Delay



The <delay> parameter defines an interval between the modbus polls. Declared total values are seconds. The delay parameter is optional, lack of the parameter results in assigning a default value of 0ms

## Read-timeout



The <read-timeout> element defines time the iMod platform waits for a response from a device. This is an optional element. The default value is 1000ms.

## Forcing Each Write - Property Force

There are modbus elements which perform actions after update parameter value. iMod has an internal logic that does not forward the write command if the parameter value does not change. However, you can force such a transmission by adding a 'property' element.

```
<property name="force" value="true" />
```

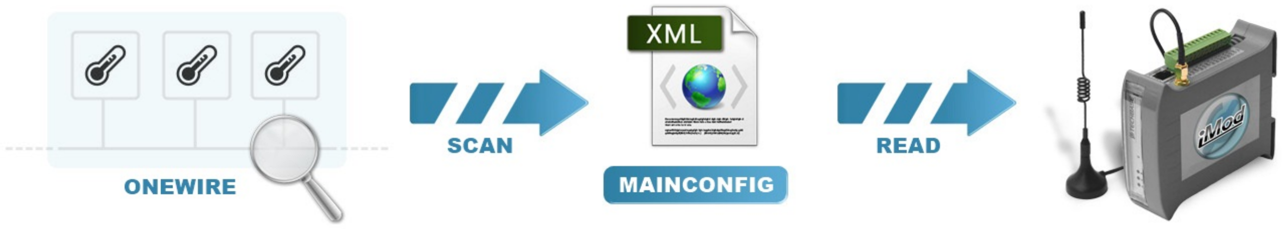
Example definition with a 'force' property implementation:

```
<parameter type="int32">
                <id>"1"</id>
                <source-channel channel-name="Modbus_M1" parameter-id="1" />
                <access-channel channel-name="Modbus_S1" parameter-id="1" >
                   <property name="force" value="true" />
                </access-channel>
</parameter>
```

# Integration of 1-Wire Bus with iMod Platform

The following chapter describes the way of using the iMod system for collecting information from a distributed system of sensors, transmitters, reed switches, etc. connected to the 1-Wire bus.

## Sensor Detection



First check if the sensors were detected by the one-wire server with the following command:

```
[root@techbase /]# owlist info
id: 28E616CA020000 chip: DS18B20 desc: THERMOMETER value: 24.125
```

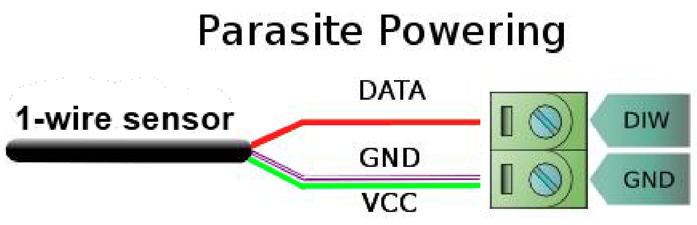
If the sensor has been detected, scan the one-wire bus with the *imod scan onewire* command.

This command results in generating a configuration containing parameters together with a readout from sensors and sharing the results via the modbus protocol in the *ONEWIREScan.xml* directory.

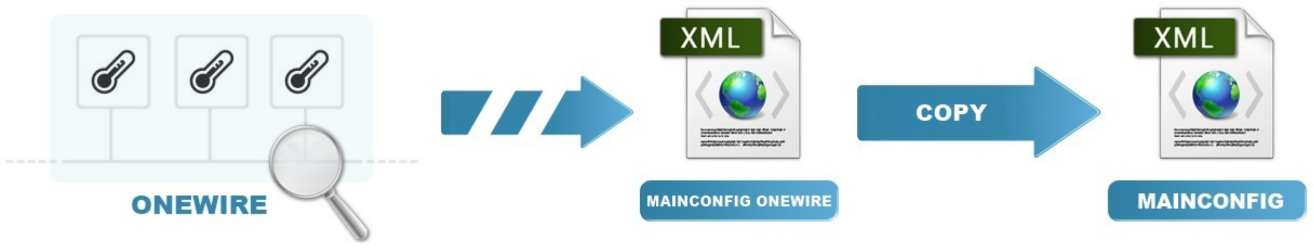
```
[root@techbase /]# imod scan onewire
iMod Tiger Engine [Version 1202171418]
Stopping iMod daemon. Please wait...
Killing iMod daemon: Succeeded
12:01:17,963 [main] INFO - Starting iMod Tiger Engine Version 1203271136, Xml Config Version
1.1.53
12:01:18,511 [main] INFO - Parsing the file: /mnt/mtd/iMod/config/MainConfig.xml
12:01:20,295 [main] INFO - Parsed the configuration file in: 1766 ms
12:01:21,155 [main] INFO - Interpretation took: 849ms
12:01:29,679 [main] INFO - Running Scanner...
12:01:29,750 [main] INFO - OneWire scanner initialization...
12:01:30,252 [main] INFO - Running owserver client thread on ip: 0.0.0.0 port: 4304
12:01:30,260 [main] INFO - Waiting for bus reset...
12:01:30,280 [main] INFO - Trying to run OneWire scanner...
12:01:30,392 [main] INFO - Scanning in progress. Please wait...
12:01:30,401 [ONEWIRE(4304)] INFO - Starting the scan on port: 4304 ip: 0.0.0.0
12:01:32,820 [ONEWIRE(4304)] INFO - Found 1-Wire slave: (id: 28E616CA020000 type:
THERMOMETER_DS18B20)
12:01:32,861 [ONEWIRE(4304)] INFO - Add OneWire parameter 28E616CA020000:temperature
definition.
12:01:32,875 [ONEWIRE(4304)] INFO - Add OneWire parameter 28E616CA020000:temperature9
definition.
12:01:32,889 [ONEWIRE(4304)] INFO - Add OneWire parameter 28E616CA020000:temperature10
definition.
```

```
12:01:32,903 [ONEWIRE(4304)] INFO - Add OneWire parameter 28E616CA020000:temperature11
definition.
12:01:32,917 [ONEWIRE(4304)] INFO - Add OneWire parameter 28E616CA020000:temperature12
definition.
12:01:32,928 [ONEWIRE(4304)] INFO - Close sensor detecting.
12:01:32,947 [main] INFO - Trying to write to XML file...
12:01:33,881 [main] INFO - XML file:/mnt/mtd/iMod/config/ONEWIREScan.xml successfully
generated
12:01:33,890 [main] INFO - Exit scanner...
12:01:33,929 [main] INFO - Exiting
12:01:34,262 [ShutdownHook] INFO - Shutdown complete
```

A way of connecting the sensors:



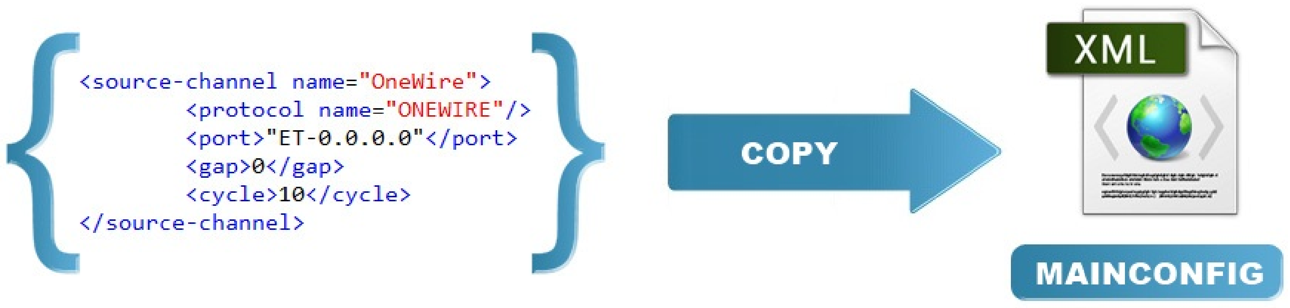
## Integration of the Configuration



After scanning the one-wire bus you need to copy part of the configuration into the main configuration - the MainConfig.xml file from the /mnt/mtd/iMod/config directory.

When you join the configurations, you need to reboot the iMod platform with the *imod start* command.

### Transferring Source-channel



```
<source-channel name="OneWire">
        <protocol name="ONEWIRE"/>
        <port>"ET-0.0.0.0"</port>
        <gap>0</gap>
        <cycle>10</cycle>
</source-channel>
```

The source-channel element can be completely transferred into the main configuration.

```
                <source-channel name="OneWire">
                        <protocol name="ONEWIRE"/>
                        <port>"ET-0.0.0.0"</port>
                        <gap>0</gap>
                        <cycle>10</cycle>
                </source-channel>
```

**Channel Name**

```
<source-channel name="OneWire">
```

You can freely modify the channel name. However, you need to remember that there are also references to the channel name in the parameters, where you need to change the name.

**Port**

```
<port>"ET-0.0.0.0"</port>
```

iMod can read the values of the one-wire sensors from another device. The default setting of the port is the device which the iMod is started from, you can just change the IP in order to receive values from another device.

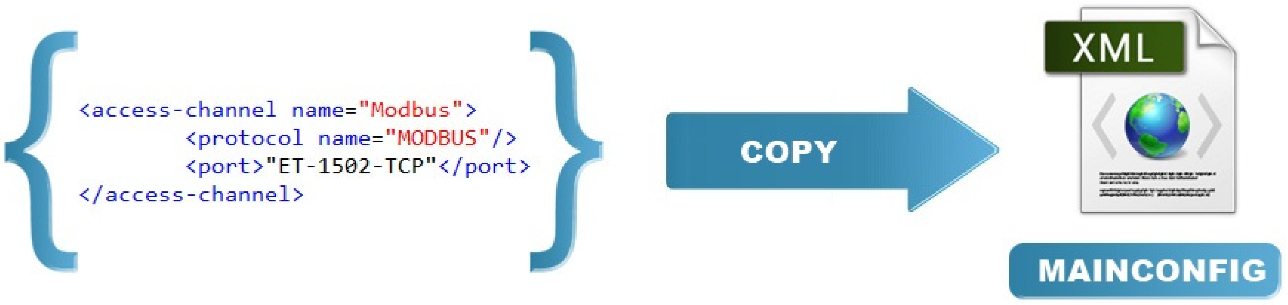
**Gap & Cycle**

```
                        <gap>0</gap>
                        <cycle>10</cycle>
```

The time intended for refreshing parameters, expressed in seconds.

- Gap - time free from readout
- Cycle - the amount of time intended for refreshing all the values of the channel

**Transferring Access-channel**

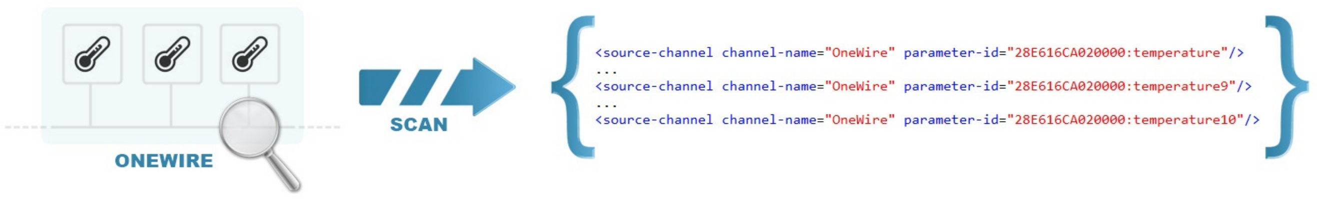


<access-channel name="Modbus">
<protocol name="MODBUS"/>
<port>"ET-1502-TCP"</port>
</access-channel>
COPY
XML
MAINCONFIG

```
                <access-channel name="Modbus">
                        <protocol name="MODBUS"/>
                        <port>"ET-1502-TCP"</port>
                </access-channel>
```

You can transfer the access-channel completely into the main configuration. The default data access is configured on the 1502 port. If you already have data access via Modbus TCP on the 502 port in the main configuration, you don't have to transfer the *access-channel* element. You just need to change the name of the *access* channel in the parameters.

**Transferring Parameters**


ONEWIRE
SCAN
<source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature"/>
...
<source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature9"/>
...
<source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature10"/>

The one-wire scan for the DS1820 sensors makes a set of parameters.

For each sensor, there are several parameters generated. In order to get correct one-wire readouts you need to transfer only ONE.

The generated parameters differ in measurement resolution, which is saved in the parameter-id of the *source-channel* element e.g.,

```
        <source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature"/>
        ...
        <source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature9"/>
        ...
        <source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature10"/>
```

Example one-wire parameter automatically generated through scanning:

```
<parameter type="real32">
        <id>"THERM1_1"</id>
        <description>"THERMOMETER_DS18B20"</description>
        <source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature"/>
        <access-channel channel-name="Modbus" parameter-id="11000"/>
</parameter>
```

**Parameter ID**

```
        <id>"THERM1_1"</id>
```

An ID is automatically generated and freely configurable. You can freely modify the ID into an alphanumeric value. It needs to be unique in the configuration.

**Description**

```
        <description>"THERMOMETER_DS18B20"</description>
```

*description* is automatically generated and freely configurable. You can freely modify the ID into an alphanumeric value.

**Source-channel of Parameter**

```
        <source-channel channel-name="OneWire" parameter-id="28E616CA020000:temperature9"/>
```

The generated *source-channel* element in a parameter refers to a default name of the *oneWire* channel. The *paramter-id* consists of a unique sensor ID and the resolution with which you want to read temperature after the ':' sign.

**Access-channel of Parameter**

```
        <access-channel channel-name="Modbus" parameter-id="11000"/>
```

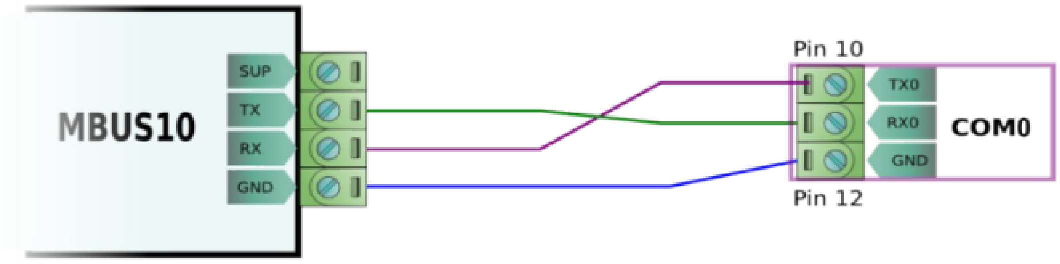
The generated *access-channel* element in a parameter refers to a default name of the *Modbus* channel. The *paramter-id* is automatically incremented from the value of 11000 and defines the modbus register where the parameter is available. Both the channel name and the *paramter-id* are freely configurable.

# Mbus Protocol

## Connecting Mbus meters

The meters, which communicate via Mbus protocol are connected with the Mbus10 device. A method of connecting meters to the Mbus converter depends on the kind of a meter. Please read the meter documentation in order to connect the Mbus interface with an external device in a correct way.

The Mbus10 converter has the RS-232 interface on the other side. Below there is an example scheme of connecting the converter to the iMod with a serial port.



### Preparing Working Environment

A working iMod using serial ports in configuration, blocks the readout via external applications. This is why you need to switch off the iMod application before polling the meters.

A set of commands turning off the platform:

```
[root@techbase /]# imod stop
```

After turning off the platform, you should download *heatmet*, which enables polling meters via console.

You can download the *heatmet* application from the ftp server dedicated for iMod uers. Ask for a password through the technical support portal: http://suppport.techbase.eu

### Checking Connection and Response time of a Meter (heatmet)

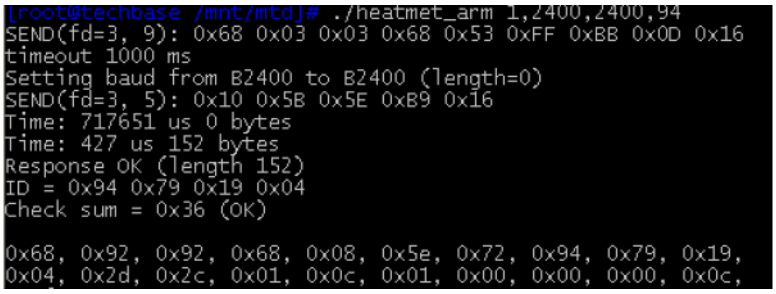
After connecting the Mbus meter to the iMod device, you need to check if the connection is correct. You can do that with the following application: *heatmet*. You need to copy the application onto the device and execute the following commands:

```
$ chmod 754 heatmet
$ ./heatmet 1,2400,2400,<METER_ID>
```

Heatmet <com_number>,<check_baudrate>,<set_baudrate>,<scan mode/ID>
Specify the COM port where the meter is plugged in as the first parameter. The second value is a baud rate where the meter currently works. The third value is the communication speed set in the metre. The fourth parameter can take a value from: -1 do 255.
-1 means scanning all the addresses in search for the meter. Instead of the -1 value it is better to enter the ID of a plugged meter.

In case of no response after sending a readout command, observe the Mbus10 converter. If you see that the green *RX* LED signals feedback data, it means that the meter replies slower than 1000ms. In this case use heatmet command with the '-t XXXX' parameter where XXXX is the response time in ms.

If you receive the CHECK sum (OK) message in response:



```
[root@techbase /mnt/mtd]# ./heatmet_arm 1,2400,2400,94
SEND(fd=3, 9): 0x68 0x03 0x03 0x68 0x53 0xFF 0xBB 0x0D 0x16
timeout 1000 ms
Setting baud from B2400 to B2400 (length=0)
SEND(fd=3, 5): 0x10 0x5B 0x5E 0xB9 0x16
Time: 717651 us 0 bytes
Time: 427 us 152 bytes
Response OK (length 152)
ID = 0x94 0x79 0x19 0x04
Check sum = 0x36 (OK)

0x68, 0x92, 0x92, 0x68, 0x08, 0x5e, 0x72, 0x94, 0x79, 0x19,
0x04, 0x2d, 0x2c, 0x01, 0x0c, 0x01, 0x00, 0x00, 0x00, 0x0c,
```

It means that you can proceed to the next step.

## Checking the Meter Support via Library (Mubs.jar)

The next step is to check if the mbus library detects the meter. Example query:

```
$ java -jar /mnt/mtd/iMod/jar/protocols/mbus.jar com0 2400-8E1 p94
```

Query structure: java -jar <path to the iMod installation directory>/jar/protocols/mbus.jar <serial-port> <communication parameters> <meter id>

<path to the iMod installation directory> - you can check it with the command:

```
getenv | grep IMOD
```

Available ports:

- com0 (RS-232 #1)
- com1 (RS-232 #2)
- com3 (RS-485)

Available message parameters:

- 2400 – connection baud rate.
- 8E1 – connection properties

Meter ID:

- p – address type (primery – p / secondary – s)
- ID – an integer from 0 to 255

When you detect Mbus registers in the meter, you need to go to the scanning stage with the iMod engine.

# Making Your own MBus Configuration

## Generating Configuration - iMod scan Mbus

iMod supports the process of scanning on the Mbus protocol on all the serial ports at the same time. In order to run a mechanism, execute this command:

```
$ imod scan mbus
```

In this moment the device will start the scanning with a default response time-out for meters. 2000ms. After finishing scanning, the *MBusScan.xml* resulting file is created. In this file there is a configuration containing all the available parameters detected during scanning.

If the meter is detected during scanning, you will be informed about it with a proper write. e.g.,

```
12:05:25,223 [/dev/ttyS0(com0)] INFO - Found MBUS slave: com0-2400-8E1:p2 (id: 09847273 type:
CF55)
```

## Consolidation of Configuration with Main File

After scanning the Mbus you need to copy part of the configuration into the main configuration - the MainConfig.xml file from the /mnt/mtd/iMod/config directory.

When you join the configurations, you need to reboot the iMod platform with the *imod start* command.

### Source-channel

The source-channel element can be completely transferred into the main configuration. Do not make any changes in this element.

```
        <source-channel name="MBUS_com0">
                <protocol name="MBUS"/>
                <port>"com0-2400-8E1"</port>
                <property name="device-id" value="2-MODEL_CF55"/>
                <gap>"0"</gap>
                <cycle>"60"</cycle>
        </source-channel>
```

#### Name Element

```
        <protocol name="MBUS"/>
```

You can freely modify the channel name. However, you need to remember that there are also references to the channel name in the parameters, where you need to change the name.

#### Port Element

```
        <port>"com0-2400-8E1"</port>
```

The port element consists of the serial port definition where the readout is performed and connection parameters.

#### Property "device-id" Elements

```
        <property name="device-id" value="2-MODEL_CF55"/>
```

There will be a number of property elements created, depending on the amount of detected meters. The value of this element is built in the following way: <meter id>-MODEL_<meter_name>

If the meter is seen as *Unknown* it means that during the configuration generation default parameters were used (cycle, read-timeout, etc.)

#### GAP, CYCLE, DELAY and READ-TIMEOUT Elements

At the end you need to define the frequency response parameters. In case of slower meters you should also add the optional *read-timeout* element.

Example of a complex channel definition:

```
<source-channel name="MBUS_com0">
  <protocol name="MBUS"/>
  <port>"com0-2400-8E1"</port>
  <property name="device-id" value="2-MODEL_UNKNOWN"/>
  <gap>"0"</gap>
  <cycle>"60"</cycle>
  <delay>"1000ms"</delay>
  <read-timeout>"5000ms"</read-timeout>
</source-channel>
```

### Access-channel

You can transfer the access-channel completely into the main configuration. The default data access is configured on the 1502 port. If you already have data access via Modbus TCP on the 502 port in the main configuration, you don’t have to transfer the access-channel element. You just need to change the name of the access channel in the Mbus parameters.

Double definition of access-channel on the same TCP port results in malfunction of the platform.

### Parameters

Mbus scanning creates a set of parameters read from a meter. Transfer only the parameters necessary for the project implementation to the main configuration. Example parameter:

```
<parameter type="int32">
                        <id>MBUS_09847273_2:2_4</id><!--Actual value: 0 (Integer)-->
                        <scale>10e3</scale>
                        <unit>"W"</unit>
                        <description>"POWER"</description>
                        <comment>"MAX_VAL"</comment>
                        <source-channel channel-name="MBUS_com0" parameter-id="2:2-4"/>
                        <access-channel channel-name="Modbus_SMBUS" parameter-id="157"/>
</parameter>
```

#### Parameter Element

The 'parameter’ element has

```
<parameter type="int32">
```

In case there is no 'type' in the paramter element, a default value of int16 is taken.

**ID**

ID is automatically generated and freely configurable. It consists of:

CHANNEL-NAMES_METER-SERIAL-NUMBER_METER-ID_FRAME-NUMBER

Example parameter ID:

```
<id>MBUS_09847273_2_10</id>
```

**Scale (multiplier)**

Scale is automatically generated and freely configurable.

```
<scale>10e7</scale>
```

The scale parameter is downloaded from the device by default and saved for ([J][W] [m^3], etc.).

Scaling of the values takes place in the following way:

```
<scale>10e7</scale>
```

it means: VALUE * 1*10^7 However, you can rescale the result by changing the parameter:

```
<scale>10e-2</scale>
```

Than if the previous value was in [J], after rescaling it will be presented in [GJ]. By changing a multiplier, you should remember to change also the *Unit* element after.

**Unit**

Unit is automatically generated and freely configurable. An element specifying the unit of read values.

```
<unit>"m^3"</unit>
```

**Description**

The *description* field is automatically generated and freely configurable. This is a short description of a Mbus field. It describes the value read from a meter.

```
        <description>"POWER"</description>
```

It is possible that the meter has several parameters with the same description. Than, you need to compare the read values during scanning. Compare them with the values on the meter display. In this way you will be able to type which value is the desired value.

**Comment**

The *comment* field is automatically generated and freely configurable. It often describes an additional information enabling property description of a read value.

```
        <comment>"MAX_VAL"</comment>
```

**Parameter Source-channel**

Example source-channel:

```
        <source-channel channel-name="MBUS_com0" parameter-id="2:2-10"/>
```

The *source-channel* element refers to the meter ID, frame in the meter and field in the frame. Syntax: *<meter id>:<frame-number>-<field in the frame>*

**Access-channel of Parameter**

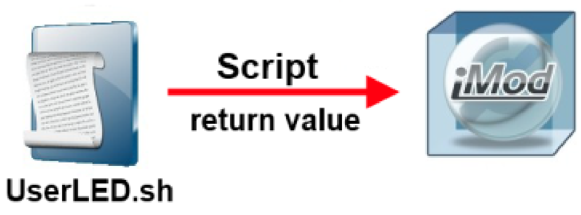
Example access-channel

```
        <access-channel channel-name="Modbus_SMBUS" parameter-id="100"/>
```

The generated *access-channel* element in the parameter refers to a default channel name - Modbus. The id-parameter is automatically incremented from the value of 100 and describes a modbus register where the parameter is available. Both the channel name and the paramter-id are freely configurable.

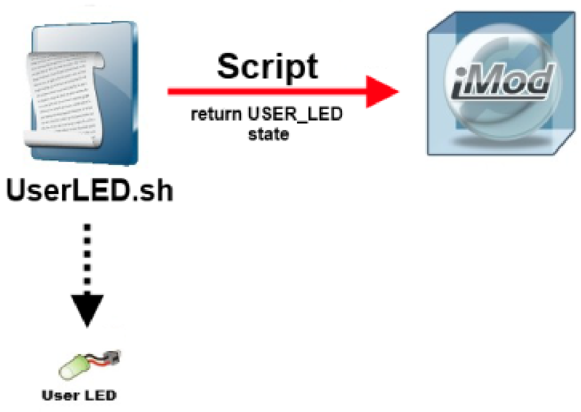
Double definition of the same modbus register will result in a malfunction of the iMod platform. Make sure that after joining the Mbus configuration into the main configuration, all the access-channel - parameter-id elements are unique.

# Scripts as Data Source



iMod can define the bash script as a data source. The value that the script sends back becomes a parameter value.

## Example - User_LED readout



The configuration structure that contains source-channel as data source will be presented through reading the *USER_LED*.

- Script will be run cyclically every 2 seconds
- Parameter value will equal the value send back by the script with the expression

```
return $USER_LED_VALUE
```

### Source-channel Definition

```
<source-channel name="SCRIPT_CHANNEL">
<protocol name="SCRIPT"/>
<port>"/mnt/nand-user"</port>
<cycle>2</cycle>
</source-channel>
```

Script channel definition consists of the following:

- *Channel name* - You can freely modify the channel name. However, you need to remember that there are also references to the channel name in the parameters.
- *Port* - the port element contains the path to directory with a script(s).
- *Cycle* - script execution frequency.

### Parameter Definition

```
<parameter>
<id>"100"</id>
<source-channel channel-name="SCRIPT_CHANNEL" parameter-id="UserLed.sh"/>
<access-channel channel-name="Modbus_S1" parameter-id="100"/>
</parameter>
```

By assigning a script name to the parameter-id property in the source-channel element, you define the script file name. The script will be run cyclically in accordance with the value at the channel definition. The run script is with the read argument. Each read cycle executes a script with the *read* argument.

In the example above, the execution will be equal to running the script with the following command:

```
/mnt/nand-user/UserLed.sh read
```

The definition above enables a change of a parameter via modbus protocol. Than, the script is run with the *write <written value>* arguments:

```
/mnt/nand-user/UserLed.sh write <value>
```

### Script Structure

The bash script is a text file beginning with the following line:

```
#!/bin/sh
```

In order to get familiar with the script structure create a file with the name - *userLed.sh*.

#### Arguments of Running a Script

Running the script with a parameter, makes it available as variables in the script. e.g.,

```
./UserLed.sh read
```

It makes that behind the *$1* variable there is a sign of the *read* value.

#### Checking the First Argument - Read or Write

At the beginning, you should detect the value of the first parameter - should the parameter execute the (*read*) or (*write*) action.

```
if [ " class="code bash"" == "read" ]; then
...
elif [ " class="code bash"" == "write" ]; then
...
fi
```

#### Action for Read Argument

Next, enter proper actions for proper conditions. For the 'read' action return the USER_LED state with the echo state function.

```
npe ?USER_LED;
echo $?;
```

**Action for Write Argument**

For the (*write*) action, check the value of the second argument. If it equals 0, set the USER_LED to 0 (turn off the user LED) If the value of the second argument is a nonzero value, set it to high status. At the end, look at the current value of the USER_LED.

```
if [ if [ $2 -eq 0 ]; then npe -USER_LED; npe ?USER_LED; echo $?; else npe +USER_LED; npe
?USER_LED; echo $?; fi -eq 0 ]; then
npe -USER_LED;
npe ?USER_LED;
echo $?;
else
npe +USER_LED;
npe ?USER_LED;
echo $?;
fi
```

Further information on bash scripts can be found in the documents fully available on the Internet.

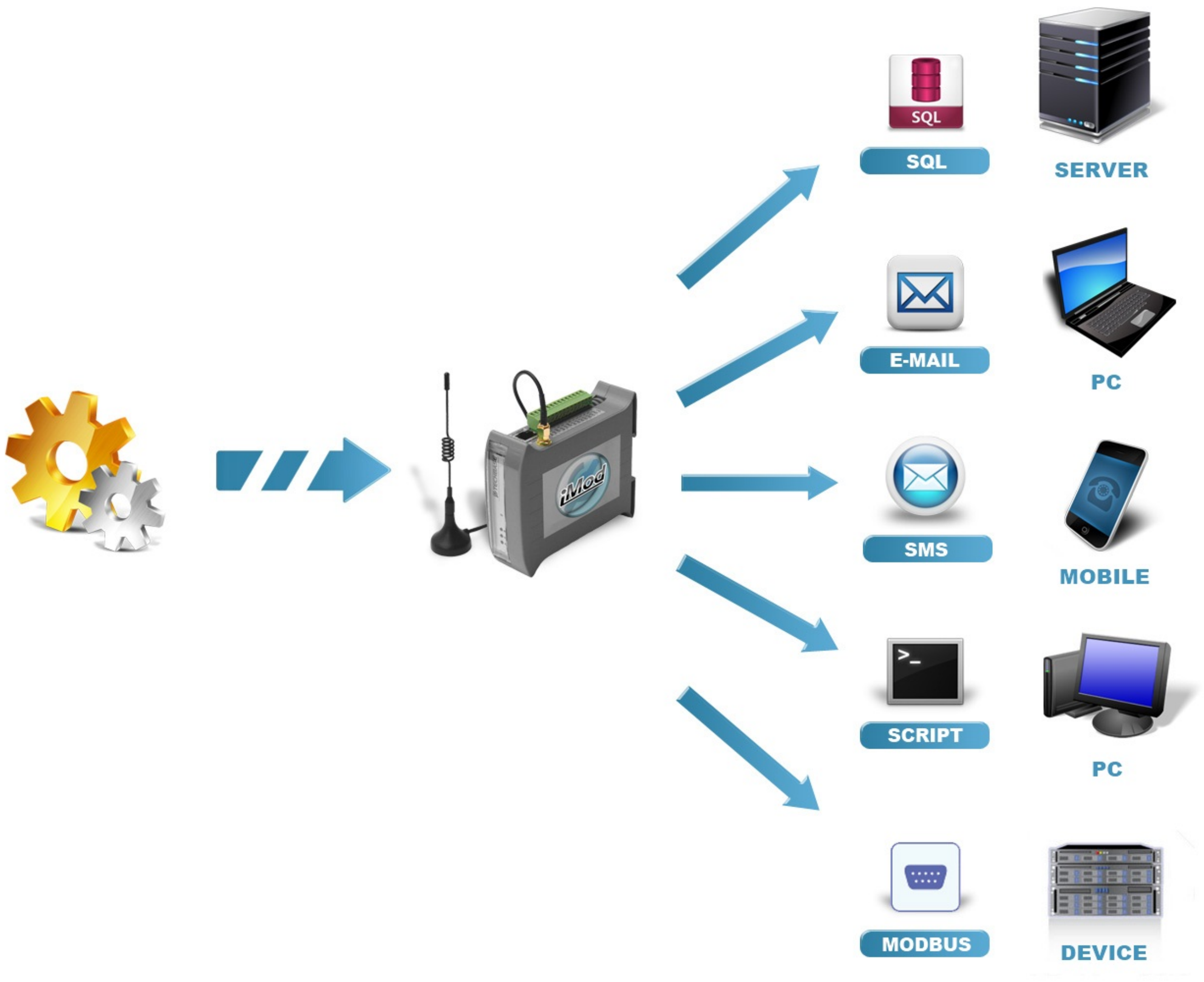
After copying the script file into the NPE device, you need to execute the following commands
- *dos2unix <file name>* [corrects the line breakes]
- *chmod 754 <file name>* [gives properly previlages to run a file]. Otherwise, the iMod platform will not have the permission to execute the script.

**Verification of Actions**

1. read the 100 parameter via the modbus protocol and verify if it matches the USER_LED status.
2. Save the 100 parameter value and check if the the value changes according to the conditions written in the script
3. Change 'USER_LED' into 'DO1' in the script
4. Check if the DO1 parameter changes instead of the USER_LED

Video tutorial presenting points from 1 to 3 www.youtube.com/watch?v=W6wBm_GtWX8

# Event Communication



The iMod platform has a built-in event-triggered action performance mechanism. There are a few types of action e.g., e-mail sending, bash scripting. There are also a few conditions of triggering an event e.g., after crossing the value with a set threshold. In addition, it has force read and force write mechanisms.

The following chapter describes the event configuration method.

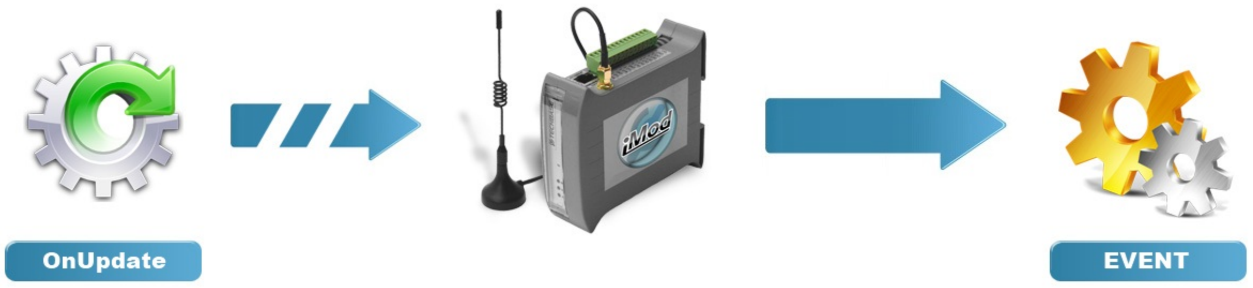
Each event must be within the *parameter* element and must contain message-channel (action type) elements.

## Triggering Conditions

Together with the *<event>* element definition, a triggering condition is defined. An example event:

```
<event type="OnChange">
        <message-channel channel-name="Email_sender"/>
        <message-id>"Mess_1"</message-id>
</event>
```

### OnUpdate



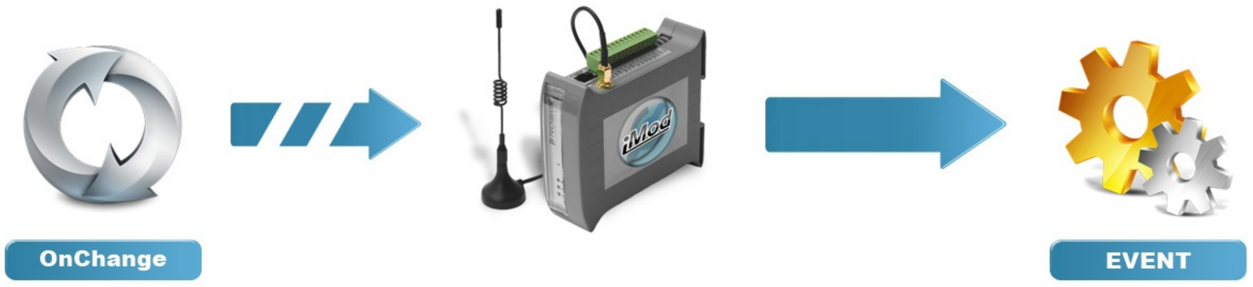
The first triggering type is the event type, which takes place at each parameter readout. The event will be triggered regardless of the value.

It is useful in typical event-triggered communication like e.g., RFID reader support. The same user may enter or quit. Then the card ID doesn't change, however, the event sends a value with the event time to a database.

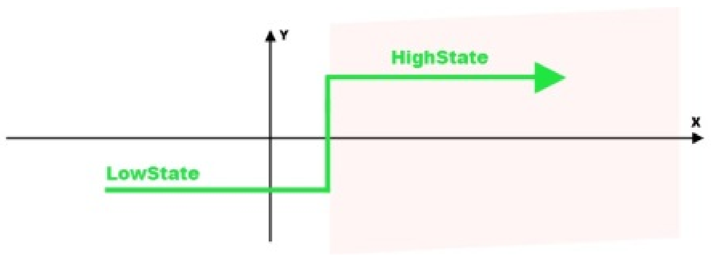
Example definition:

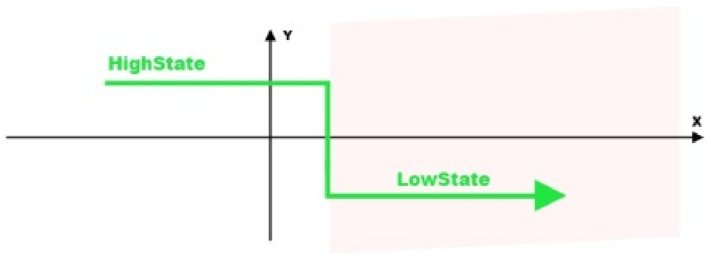
```
<event type="OnUpdate">
   <message-channel channel-name="BashScript"/>
</event>
```

### OnChange



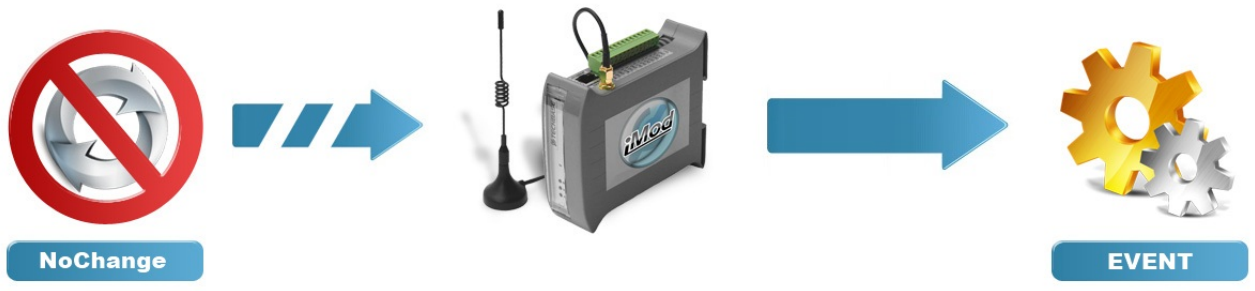
*OnChange* is a type of event which is triggered each time a parameter changes its value.



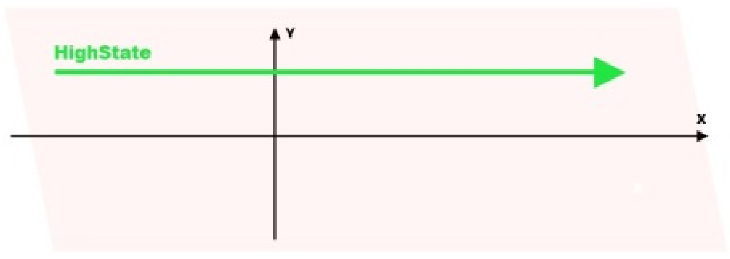

Y
X
HighState
LowState

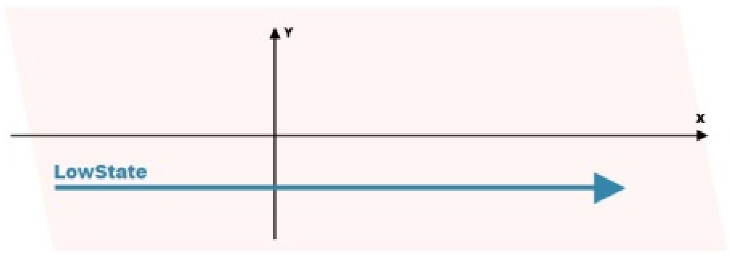
```
<event type="OnChange">
        <message-channel channel-name="BashScript"/>
</event>
```

## NoChange



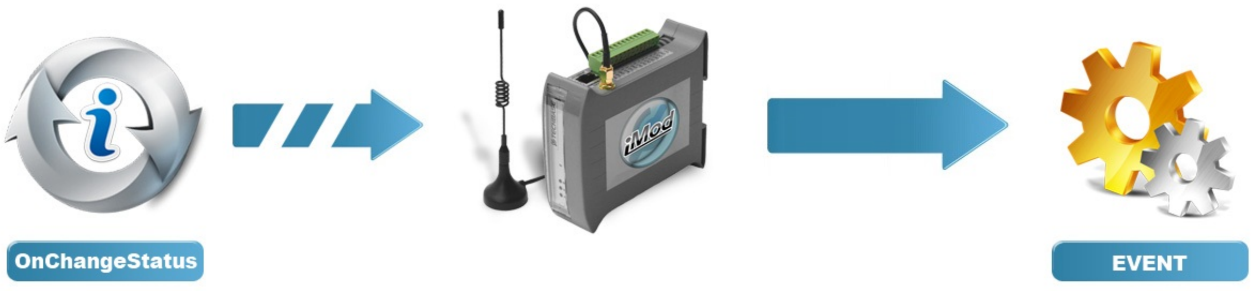
*NoChange* is a type of event which is triggered each time a parameter doesn't change its value.



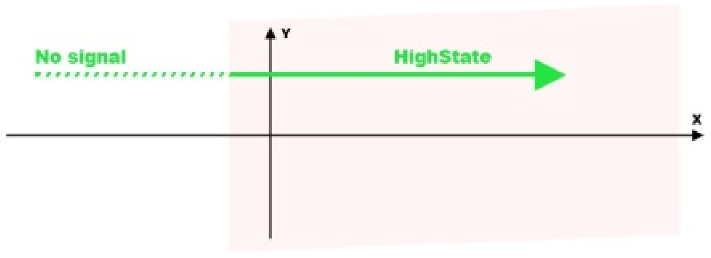


```
<event type="NoChange">
        <message-channel channel-name="BashScript"/>
</event>
```

## OnChangeStatus



*OnChangeStatus* is a type of event which is triggered each time it is impossible to read a parameter or when it is possible again, after a communication breakdown.

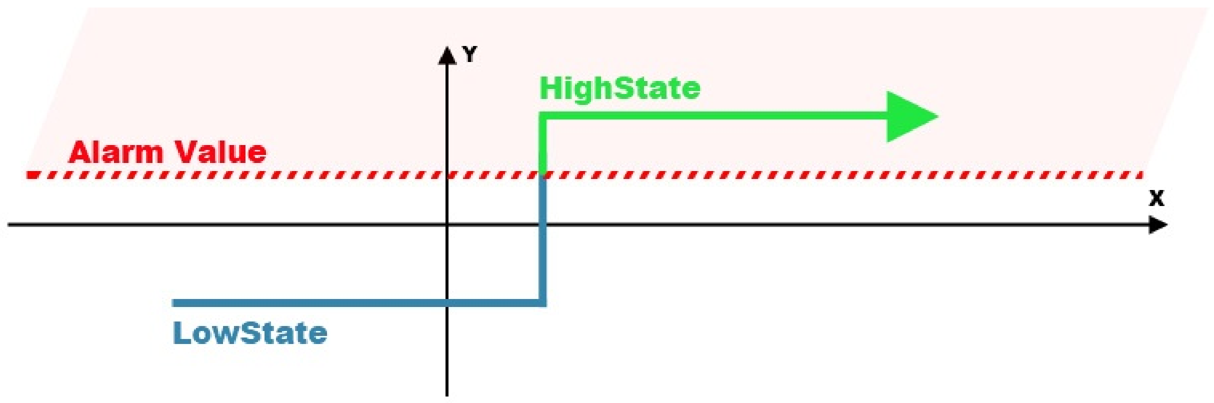

No signal
HighState
Y
X

```
<event type="OnChangeStatus">
        <message-channel channel-name="BashScript"/>
        <property name="trigger" value="1"/>
</event>
```

## HiAlarm

HiAlarm
EVENT

*HiAlarm* is a type of event which is triggered each time a parameter exceeds a set trigger. It is an equivalent condition to 'greater than'.

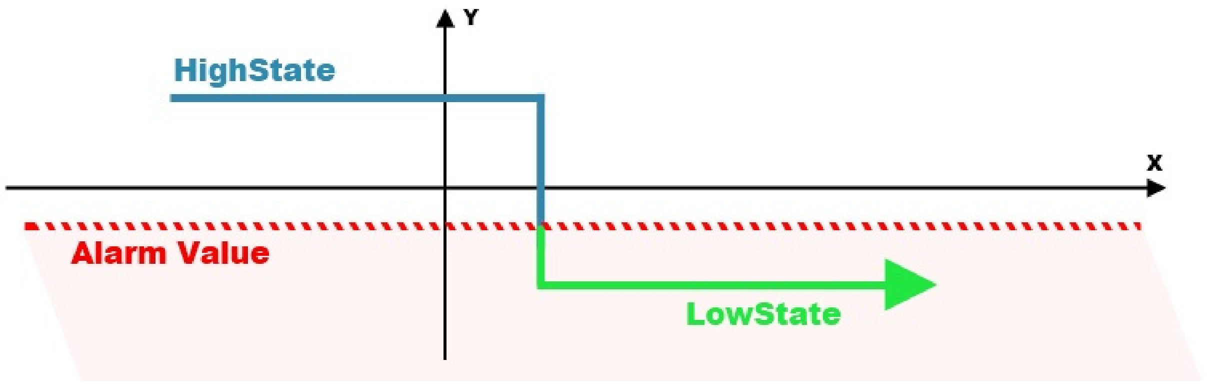


```
<event type="HiAlarm">
        <message-channel channel-name="BashScript"/>
        <property name="trigger" value="1"/>
</event>
```

## LoAlarm

LoAlarm
EVENT

*LoAlarm* is a type of event which is triggered each time a parameter exceeds a set trigger. It is an equivalent condition to 'less than'.


Y
HighState
X
Alarm Value
LowState

```
<event type="LoAlarm">
        <message-channel channel-name="BashScript"/>
        <property name="trigger" value="1"/>
</event>
```

## Hysteresis

HiAlarm/LoAlarm type events may contain a hysteresis element. When a parameter value exceeds/drops below the 'trigger' value – an event is triggered. An event is not triggered until it exceeds/drops below the hysteresis value.

For example, an event is triggered if a parameter exceeds the (HiAlarm) trigger value=27. If hysteresis is '2', it means that the value must drop below 25 in order to trigger the event again.

If an event is defined to be triggered at a decrease (LoAlarm) of the trigger value=27 and hysteresis is set to '2', it means that the value must increase to 29 in order to trigger the event again after the decrease below 27.

In case of events definition without hysteresis, it has its default value of 0.

```
<parameter>
       <id>"110"</id>
       <access-channel channel-name="Modbus_S1" parameter-id="110"/>
               <event type="LoAlarm">
                       <message-channel channel-name="Script"/>
                       <property name="trigger" value="27"/>
                       <histeresis>2</histeresis>
               </event>
 </parameter>
```

## Action Types

An action may be assigned to each event. Very often a message is related to an action. Actions are defined by ( *message-channel*) and contents are defined by declared messages (*message*).

### Script

The simplest type of action is an execution of a script. If an event occurs, a bash script is run.

#### Message-channel Definition

If you want to assign a script to an event, you need to define a message channel first.

Example definition:

```
        <message-channel name="ScriptChangeLED">
                        <protocol name="script" />
                        <port>"/mnt/mtd/iMod/config/examples"</port>
                        <recipient>"changeLED"</recipient>
        </message-channel>
```

Provide the path to the (*port* element) file and the (*recipient* element) file in the (*message-channel*) definition.

The script files should be given permissions by the *chmod 754 <file name>* command.

It is important that the script file has correct run time permissions. Otherwise the script will not be executed.

#### Assigning Script to an Event

If you add a line in the *event* element, you assign a script execution to an event:

```
<message-channel channel-name="Script"/>
```

An example parameter with executing a script:

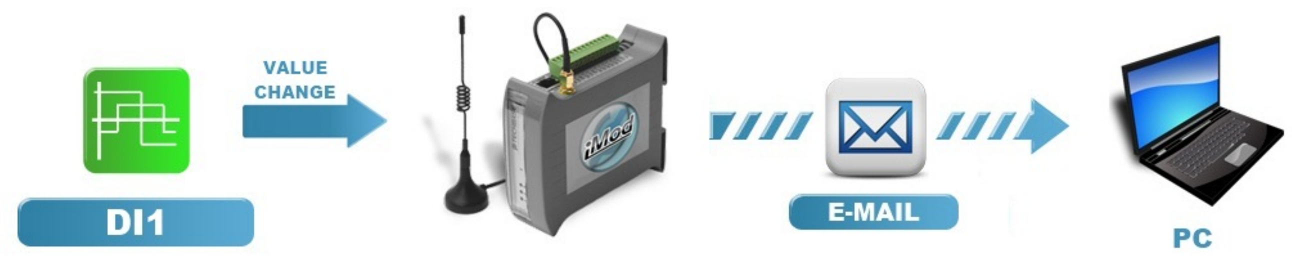
```
<parameter>
        <id>"110"</id>
        <access-channel channel-name="Modbus_S1" parameter-id="110"/>
                <event type="OnChange">
                        <message-channel channel-name="ScriptChangeLED"/>
                </event>
</parameter>
```

#### Verifying Script Running

You can check script running in the iMod logs. In order to do this execute the following command: *tail -f /mnt/data/logs/iMod.log | grep <channel name>* . An example entry from an execution of the 'Script' channel:

```
13:24:29,589 | INFO  | pool-1-thread-9 | Added to Script's queue event [eid: ff36-a633]
(pos:3/200) parameter id: 110 [mid:110->did:none]
13:24:29,783 | INFO  | Script | The channel Script received the event [eid: ff36-a633]
(pos:3/200)  parameter id: none message: 23
```

## E-mail



iMod can send e-mail messages via a given e-mail account. It has no limitations on the amount of receivers, groups of receivers or the message content structure.

The Current iMod version does not support e-mail accounts requiring TLS encryption.

### Channel Definition

Example channel definition:

```
<message-channel name="Email_sender">
   <protocol name="EMAIL">
     <property name="user" value="testnpe"/>
     <property name="password" value="123npe"/>
   </protocol>
   <port>"mail.a2s.pl"</port>
   <recipient>"techbase@a2s.pl"</recipient>
</message-channel>
```

In order to define a message sending channel, you need to provide:

- freely configurable *channel-name* element
- *protocol* element (it must equal EMAIL)
- the *protocol* element must contain the definition of user’s account (*user* and *password* to log into the server)
- *port* element defining the (SMTP) e-mail server
- list of recipients (each recipient must be located between a *recipient* element).

There are no limitations on the number of recipients.

### Message Definition

A message must be defined in accordance with the format presented in the Messages Definition chapter.

### Assigning e-mail to an event

In the <*event*> element you need to provide a reference to an e-mail channel and an ID of a message to be sent. Example definition:

```
        <event type="LoAlarm">
                <message-channel channel-name="Email_sender"/>
                <message-id>"EmailMessage1"</message-id>
                <property name="trigger" value="1"/>
        </event>
```

## SMS

iMod has the function to send an SMS with a dynamically generated content.

Example of a configuration sending messages to *48123456789* when the 102 parameter value changes:

```
   <message-channel name="SMS_sender">
             <protocol name="SMS"/>
             <recipient>"48123456789"</recipient>
    </message-channel>

   <message id="SMSMessage1">
           <![CDATA[
         "REG_NAME[THIS] changed to Value: REG_VALUE[THIS] REG_UNIT[THIS]"
         ]]>
    </message>

    <parameter>
        <id>102</id>
        <access-channel channel-name="Modbus_S1" parameter-id="102"  />
        <event type="OnChange">
                <message-channel channel-name="SMS_sender"/>
                <message-id>"SMSMessage1"</message-id>
                <property name="trigger" value="1"/>
        </event>
</parameter>
```

### Channel Definition

The channel definition consists of:

- freely configurable *channel-name* element
- protocol element (must equal SMS)
- list of recipients (each recipient must be located between *recipient* element). There are no limitations on the number of recipients.

```
   <message-channel channel-name="SMS_sender">
             <protocol name="SMS"/>
             <recipient>"48123456789"</recipient>
    </message-channel>
```

The recipient’s number must contain a dialing code of a country.

In order to define several recipient groups you can define several SMS channels.

**Message Definition**

A message must be defined in accordance with the format presented in the Messages Definition chapter.

**Assigning SMS to an Event**

In the <*event*> element you need to provide a reference to an SMS channel and an ID of a message to be sent. Example definition:

```
        <event type="LoAlarm">
                <message-channel channel-name="SMS_sender"/>
                <message-id>"SMSMessage1"</message-id>
                <property name="trigger" value="1"/>
        </event>
```

You can also define a recipient in the event. In order to do that, you need to add the *message-channel channel-name=„SMS_sender”* element to the *parameter-id=„phone-number”* element.

Definition of a recipient in a channel reference:

```
        <message-channel channel-name="SMS_sender" parameter-id="48987654321"/>
```

Example of assigning SMS sending to an event with a recipient definition:

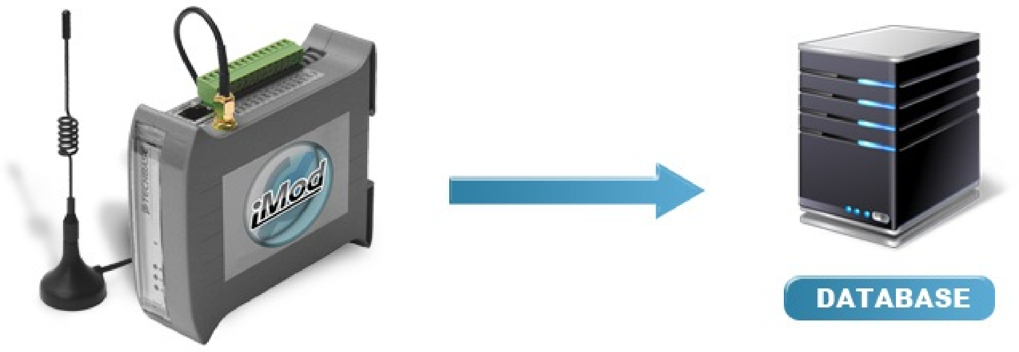
```
        <event type="LoAlarm">
                <message-channel channel-name="SMS_sender" parameter-id="48987654321"/>
                <message-id>"SMSMessage1"</message-id>
                <property name="trigger" value="1"/>
        </event>
```

**Action Verification**

In order to verify the operation of SMS sending, you can define a simple configuration which sends a message at a parameter change. You will see the following entry in the *iMod.log* file:

```
11:15:05,502 | INFO | SMS_CHANNE_NAME | The channel SMS_CHANNE_NAME received the event [eid:
73f9-d98a] (pos:1/200) parameter id: none message: YOUR_MESSAGE_CONTENT
```

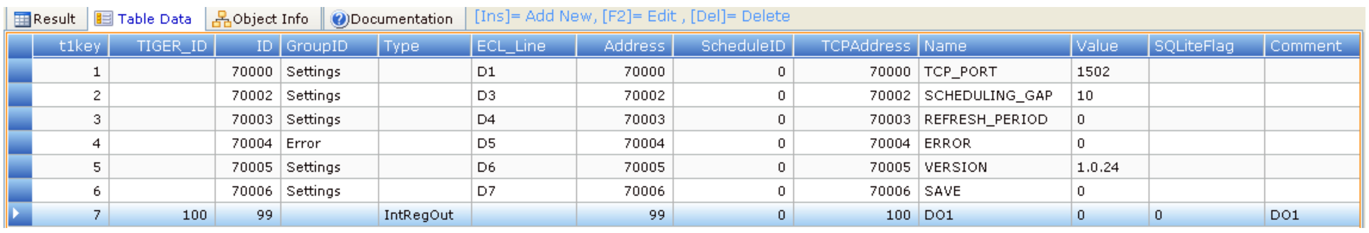
## Database Entry



iMod has a built-in mechanism for writing to a database. It cooperates by default with the SQLite3 database, however there is another way to define the communication with the PostgreSQL database in iMod. Moreover, there is a possibility to add another plugin to connect with the custom database.

### Default SQLite Database Entry

iMod holds a current value of parameters in the *DANE* table in the *modbus.db* database. The *modbus.db* file is in the */mnt/ramdisk*  directory. You can preview the database with any database software e.g., *SQLite2009Pro*.



| t1key | TIGER_ID | ID | GroupID | Type | ECL_Line | Address | ScheduleID | TCPAddress | Name | Value | SQLiteFlag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 70000 | Settings | | D1 | 70000 | 0 | 70000 | TCP_PORT | 1502 | | |
| 2 | | 70002 | Settings | | D3 | 70002 | 0 | 70002 | SCHEDULING_GAP | 10 | | |
| 3 | | 70003 | Settings | | D4 | 70003 | 0 | 70003 | REFRESH_PERIOD | 0 | | |
| 4 | | 70004 | Error | | D5 | 70004 | 0 | 70004 | ERROR | 0 | | |
| 5 | | 70005 | Settings | | D6 | 70005 | 0 | 70005 | VERSION | 1.0.24 | | |
| 6 | | 70006 | Settings | | D7 | 70006 | 0 | 70006 | SAVE | 0 | | |
| 7 | 100 | 99 | | IntRegOut | | 99 | 0 | 100 | DO1 | 0 | 0 | DO1 |

A default database contains columns corresponding with the elements that a user is able to define in the iMod configuration:

| Configuration element name | SQLite database element name |
|---|---|
| ID | TIGER_ID |
| Description | Name |
| Offset | Offset |
| Scale | Scale |
| Comment | Comment |
| Unit | Unit |
| minval | minval |
| maxval | maxval |
| data-logging | data-logging |

If you do not use the database, you can disable creating it by adding the *parameter_db=false* properties to the *imod* element to improve performence.

```
<imod version="1.0.25" paramter_db="false">
```

If you assign value 1 in the *SQLiteFlag* column, the iMod engine will try to enter the value from the *VALUE* column and to change the flag with value 0 automatically.

**Message-channel Definition**

Example channel definition:

```
<message-channel name="PSQL_Alarms">
               <protocol name="SQL"/>
               <port>"0.0.0.0:5432/databaseName"</port>
               <property name="mode" value="direct"/>
               <property name="driver" value="POSTGRESQL"/>
               <property name="user" value="postgres"/>
               <property name="password" value=""/>
</message-channel>
```

PSQL type message-channel element contains the following elements:

- protocol - protocol definition. Must equal SQL
- *port* - IP definition where the PSQL server is located.

The /0.0.0.0/ value indicates an iMod device where it is started. After entering the IP you need to type in the TCP PORT where the database listening has been launched. The Default value is 5432. The last value in the *port* field is the name of the database you want to connect to.

- mode - database connection mode. Must equal 'direct'
- driver - database driver. Must equal POSTGRESQL
- user - database user’s login
- password - database password

If you do not enter the direct operation mode iMod will create its own ALARM table where it will insert entries in case of an event.

**SQL Expression Definition**

The SQL expression which is to be executed must be entered in the messages element content. It can contain any SQL question and in place of parameters content it can use MACROS. Further information on communications structure can be found in the *event communication* section.

Example expression recorded in a message content:

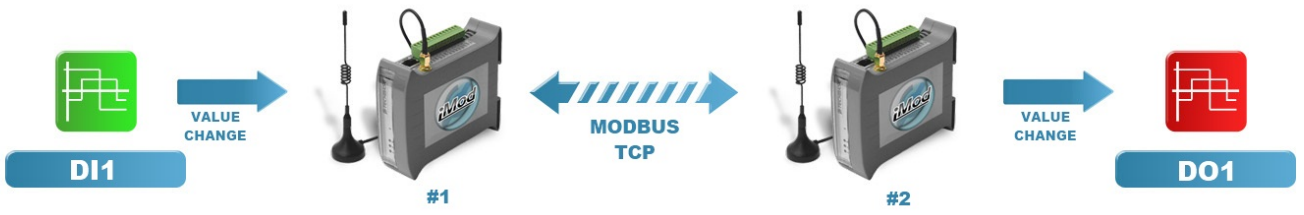
```
<message id="Alarm1">
 <![CDATA[
   INSERT INTO TABLE (value, name, description, Date) VALUES ('REG_VALUE[100]',
'REG_NAME[100]', 'Some text message', 'NOW()')
 ]]>
</message>
```

## Modbus

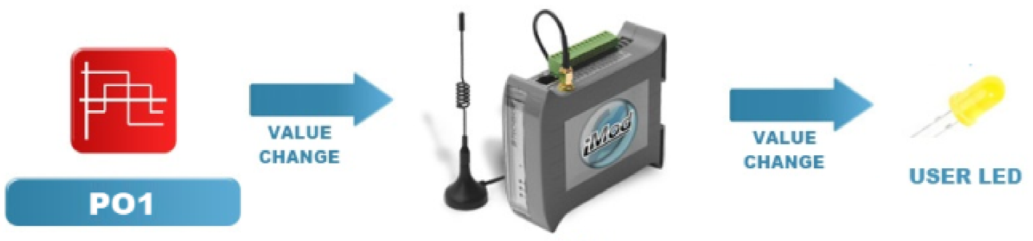
The iMod engine is supported by a unique modbus event-triggered messages mechanism. It enables minimization of the transmission between two iMod devices. There is also an option of a force write or read of selected parameters on the basis of:

1. exceeding a set value
2. dropping below a set value
3. parameter value change by the set hysteresis

There is also an option of sending a read value or saving it on another modbus device. e.g.,



An example below helps to illustrate a channel operation based on the 'onChange' event and a configuration where only one device is enough. A change on the PO1 digital output results in a change in the USER_LED as well.



Declaration of the event-triggered modbus channel:

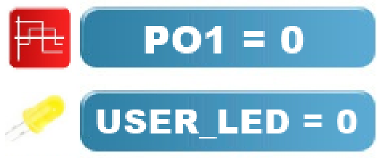
```
<message-channel name="ModbusEvent">
    <protocol name="modbus"/>
    <port>"ET-localhost-502-TCP"</port>
</message-channel>
```

After a change of the value in the 104 parameter, the parameter value is propagated to the 105 address, which is indicated by the USER_LED.

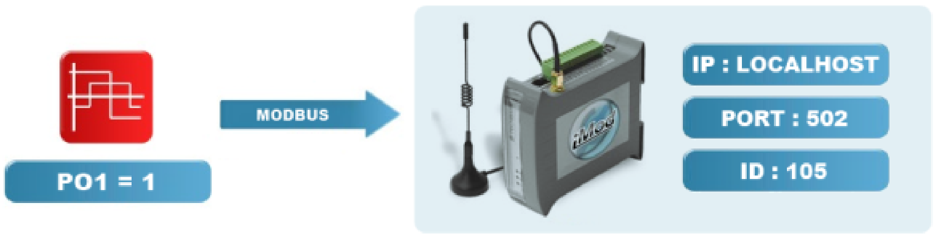
```
<parameter>
   <id>"104"</id>
   <description>"P01"</description>
   <source-channel channel-name="NPE_io" parameter-id="P01"/>
   <access-channel channel-name="Modbus_S1" parameter-id="104"/>
     <event type="OnChange">
        <message-channel cannel-name="ModbusEvent" parameter-id="105"/>
     </event>
</parameter>
```

These are the three stages:

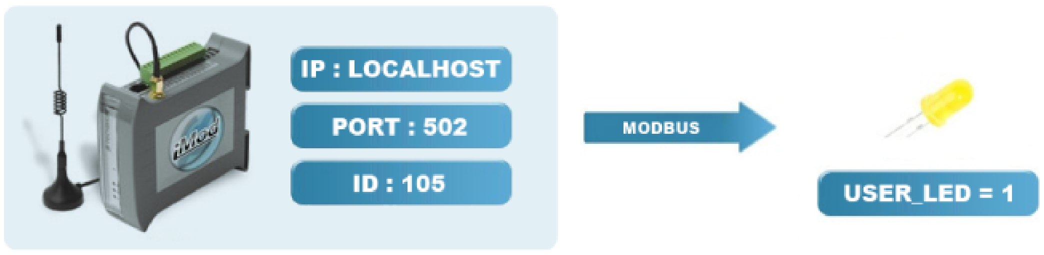
PO1 input and USER LED have low status.



PO1 has been changed. PO1 value has been sent to modbus 105 address of the 502 port of a device with the following IP: *Localhost.*

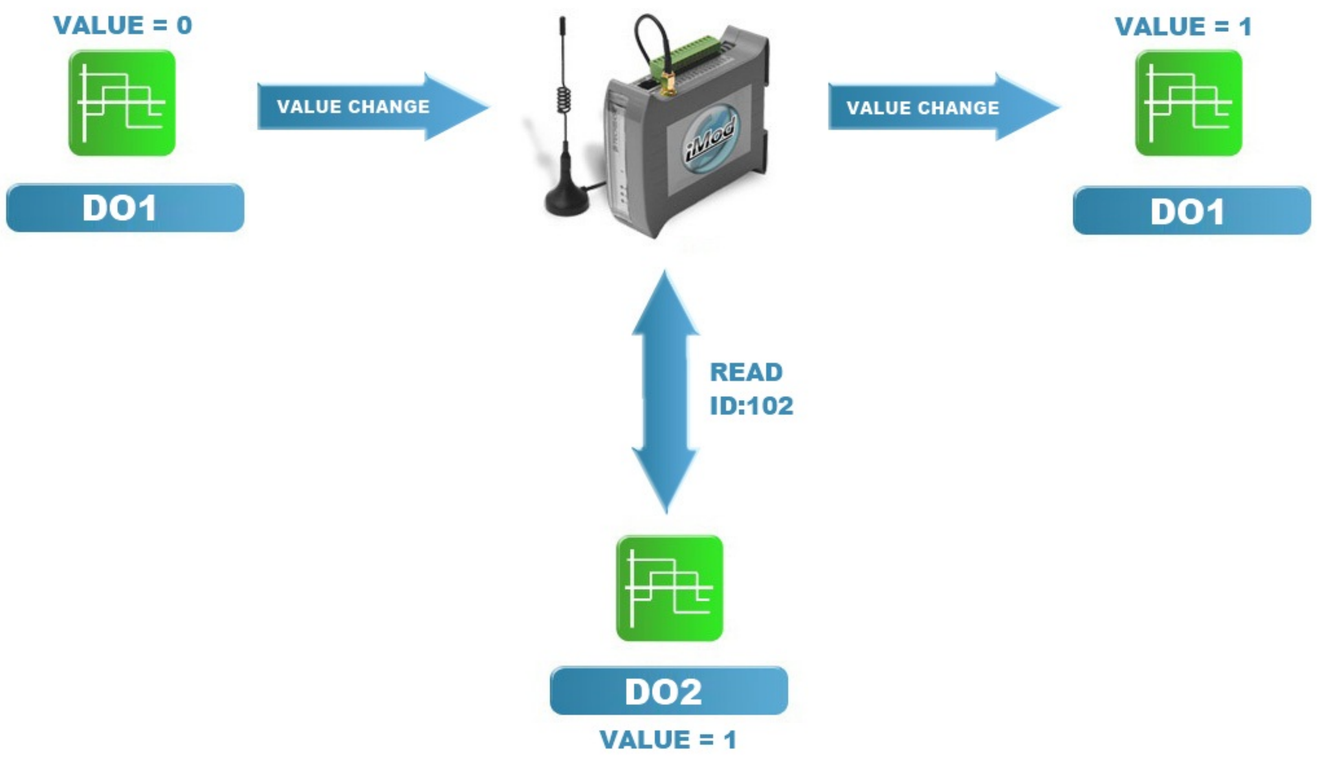


iMod has read the writing report in the 105 modbus address (USER_LED) and changes the parameter.



**Force Read**

Modbus message for reading values is the least frequently used type, but for some solutions it is irreplaceable. This type of message enables a refresh (read) at an event of other parameters defined on the iMod platform.



Channel declaration is carried out similarly to other messages. There is a possibility of defining the receiver both when defining the channel and during an event execution in the parameter. In this case the declaration takes place at the parameter, this is why a channel definition takes only three lines:

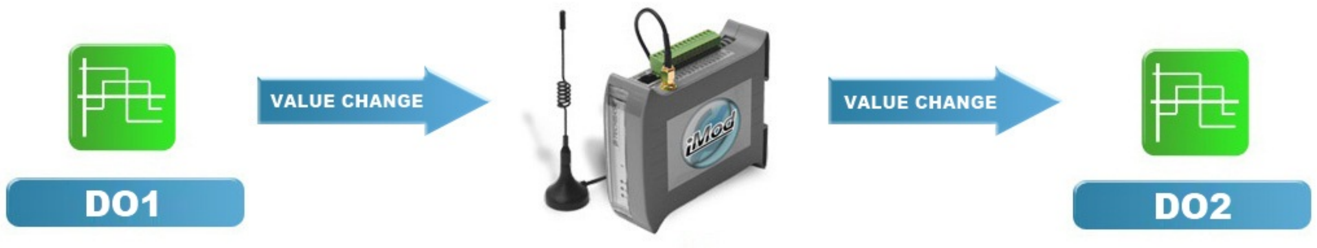
```
<message-channel name="ForceRead">
   <protocol name="forceread"/>
</message-channel>
```

Setting a 'noChange' type event forces a refresh of the 102 parameter in the iMod internal parameter array, each time the USER_LED doesn’t change its value at the read:

```
<parameter>
   <id>"105"</id>
   <comment>"USR LED"</comment>
   <description>"USR LED"</description>
   <source-channel channel-name="NPE_io" parameter-id="USER_LED"/>
   <access-channel channel-name="Modbus_S1" parameter-id="105"/>
   <event type="NoChange">
      <message-channel channel-name="ForceRead" parameter-id="102"/>
   </event>
</parameter>
```

**Force Write**

Force write type message is a modbus message which enables to write a value of another parameter at an event. In the following example a method in which the DO1 value change results in the DO2 change.



- Declaration of the channel is made by giving the channel a unique name. Enter '*forcewrite'* as the protocol.
- There is a possibility of defining several receivers. Enter a parameter ID where the parameter value is written as a receiver.
- A parameter value where the event 'comes out' is sent by default.

There is a possibility of overwriting that by entering the value to be written in the message declaration, however, such a case is not presented in the examples:

```
   <message-channel name="ForceWrite">
      <protocol name="forcewrite"/>
      <recipient>"103"</recipient>
   </message-channel>
```

Each time a parameter value changes, it will be rewritten to the 103 parameter:

```
<parameter>
   <id>"102"</id>
   <comment>"DO1"</comment>
   <init-value>"0"</init-value>
   <description>"DO1"</description>
   <source-channel channel-name="NPE_io" parameter-id="DO1"/>
   <access-channel channel-name="Modbus_S1" parameter-id="102"/>
   <event type="OnChange">
      <message-channel channel-name="ForceWrite"/>
   </event>
</parameter>
```

# Messages Definition

An event can send a message with a static or a dynamically completed content.

## Static Content Definition

```
<message id="Mess_1">
 <![CDATA[
   "Connected to ground"
  ]]>
</message>
```

Each communication definition must contain a unique ID, which will be assigned to an event.

The content of a message is written between the elements:

```
<![CDATA[

]]>
```

For the force-write type events it is recommended to enter the numerical value by which we want to update a selected parameter.

The SMS messages do not support national characters like e.g., ą, ć.

## Dynamic content definition

In message contents, you can use MACROS. Those macros, will be replaced dynamicaly by temporary value.

Below is presented list of available macros:

- *REG_NAME[id]* – ID content of parameter with ID = id
- *REG_VALUE[id]* – current value parameter with ID = id
- *REG_UNIT[id]* – value from UNIT element defined in parameter with ID = id
- *REG_LABEL[id]* – value from Label element defined in parameter with ID = id

In macros, instead of specify ID, you could use word THIS. It means that value written in this macro, will be taken from parameter value which trigger parent event. Such mechanism enable better performance, and more transparency configuration. For example: REG_VALUE[THIS].

# Web Visualization

The iMod platform has a bult-in Apache2 web server. Two kinds of web interfaces were created on the basis of this server. A system integrator can use them for building the visualization.

## NXDynamics

NXDynamics is a modern web visualization platform (web SCADA) dedicated to cooperation with the NPE/iMod devices via web browser.

The main advantages are:

- quick refresh of parameters
- efficient data transfer (without overloading bandwidth)

Further information on the NXDynamics interface and examples of its use can be found in the NXDynamics product card.

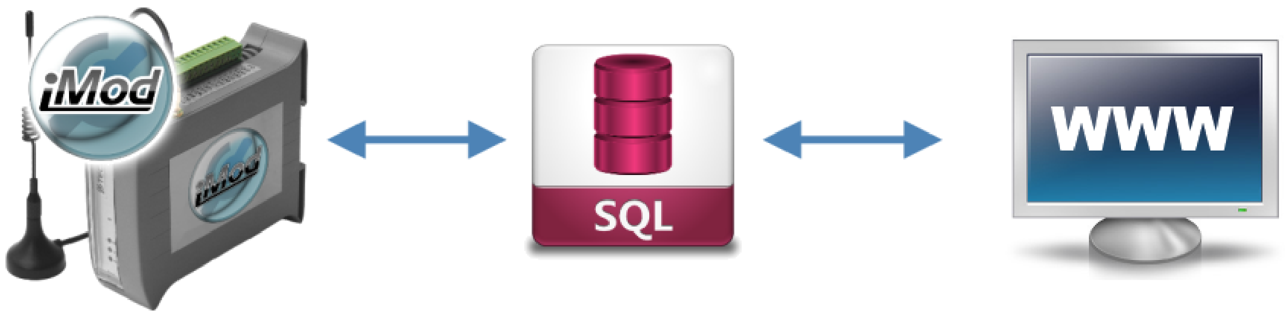
## TRM Template

There is a default TRM interface template uploaded to the device. Source files are in the */mnt/nand-user/htdocs_src* directory. At the startup, they are copied into the */mnt/ramdisk/htdocs* ramdisk.

The template contains an example PHP code, which enables downloading data from database and its presentation.

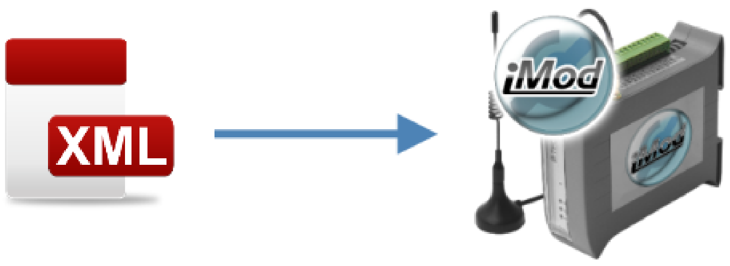
A detailed description of the used functions can be found in the synoptyka.php file.

## Own Website



The iMod telemetry module uses a built-in Apache2 web server with PHP and database (SQLite and PSQL) support for sharing data. In order to build a simple web interface you just need to know basics of HTML, PHP and be familiar with database support.

## iMod Device Configuration



In order to read the data with a web browser, you need to configure the iMod device in a proper way first. Use the example1-hardware_access.xml file in the */mnt/mtd/iMod/config/examples* directory. This configuration is a default configuration on the iMod device and it enables access to the hardware resources of the device.

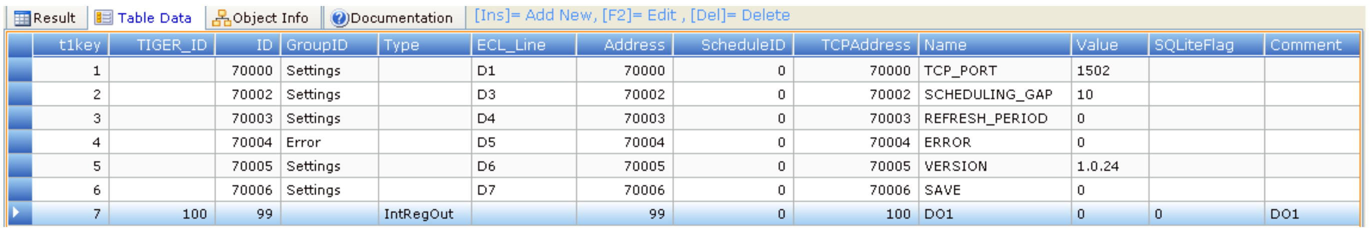
- User LED
- DI1 digital input

Registering data in the database of the iMod device is assigned by default to the SQLite database. However, there is an option of sending the value directly from the iMod engine to a local or external postgreSQL database.

## Database

The second step is creating an example php file, which will read the previously declared parameters and control them. All the parameters defined in the configuration file are registered in the SQLite database, which is in the following directory: /mnt/ramdisk/modbus.db

In order to read the value of a selected parameter, you need to refer to the variable value in the *VALUE* column.



| t1key | TIGER_ID | ID | GroupID | Type | ECL_Line | Address | ScheduleID | TCPAddress | Name | Value | SQLiteFlag | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 70000 | Settings | | D1 | 70000 | 0 | 70000 | TCP_PORT | 1502 | | |
| 2 | | 70002 | Settings | | D3 | 70002 | 0 | 70002 | SCHEDULING_GAP | 10 | | |
| 3 | | 70003 | Settings | | D4 | 70003 | 0 | 70003 | REFRESH_PERIOD | 0 | | |
| 4 | | 70004 | Error | | D5 | 70004 | 0 | 70004 | ERROR | 0 | | |
| 5 | | 70005 | Settings | | D6 | 70005 | 0 | 70005 | VERSION | 1.0.24 | | |
| 6 | | 70006 | Settings | | D7 | 70006 | 0 | 70006 | SAVE | 0 | | |
| 7 | 100 | 99 | | IntRegOut | | 99 | 0 | 100 | DO1 | 0 | 0 | DO1 |

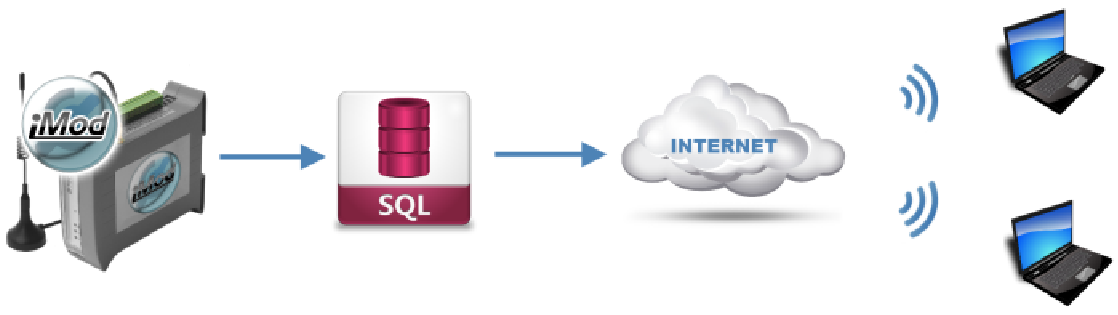
## PHP Configuration

### Defining Database

First, define the access path to the database, by specifying its location. The SQLite database on the iMod device uses an universal interface for connection with the PDO database, this is why there is a reference to this interface in the database definition. The *$db* variable is assigned to the *modbus.db* database:

```
define(‘DB_SQLLITE’,‘/mnt/ramdisk/modbus.db’);
$db = new PDO(‘sqlite:’.DB_SQLLITE);
```

### Readout of Values from Database



The next step is referring to the database and reading proper values for selected parameters - in this situation the parameters for which the *Description* in the *MainConfig.xml* file was defined as USER_LED and DI1:

```
$sqlite = „SELECT TIGER_ID, Name, Value, SQLiteFlag FROM dane WHERE name=’USR_LED’ or name=
’DI1′”;
```

The SQLiteFlag variable enables writing selected values directly in the NPE/iMod device. Next, you need to view the parameters, which are interesting for a user.

You need to create a table with a template fragment, where a user can change the value of a selected parameter. As an example, a 4×3 table will be created:

```
echo „<table>”;
echo „<tr><td><b>ID</b></td><td><b>Name</b></td><td><b>Value</b></td></tr>”;
foreach($dbh->query($sqlite) as $row)
{
   print „<tr><td>”.$row['TIGER_ID'].„</td>”;
   print „<td>”.$row['Name'].„</td>”;
   print ‘<td><form action=”test.php?a=update” method=”post”>
             <input type=”hidden” name=”id” value=”‘.$row['TIGER_ID'].‘”/>
             <input type=”text” name=”value_new” value=”‘.$row['Value'].‘”/></td>’;
   print ‘<td><input type=”submit” value=”upgrade”/>
             </form></td></tr>’;
}
echo „</table>”;
```

## Writing Value into Database

The *action* attribute value from the form is defined as the *test.php?a=update* address. The *$a* variable is introduced. When you press the upgrade button next to a selected parameter, the *$a* variable takes the update value. Writing the parameter value takes place by means of using a logical function - at the moment when the *$a* variable takes update value.

In this case the ID and the value of a selected parameter is read from the form and saved in the database.

It is important to assign the ‘1′ value to the SQLite variable. Setting the SQLiteFlag to ‘1′ makes the iMod download a value from the table and write it into a parameter. Next, it resets the change flag. Such a solution improves the efficiency of monitoring the changes made via the Web. At the end, the website is refreshed in order to load the current values from the database.

```
if($_GET['a']==„update”)
{
   $id2=$_POST['id'];
   $value2=$_POST['value_new'];
   $sth = $dbh->exec(„UPDATE dane SET SQLiteFlag = 1, Value = ‘$value2‘ WHERE TIGER_ID = ‘
$id2‘”);
   header(„location: „ . $_SERVER['REQUEST_URI']);
}
```

### Finishing Work with Database

Disconnecting with a database is an important element. In order to do that you can use the following function:

```
$dbh = null;
```

At the end, there is a function that views error messages. During a correct operation of the device, the function is not triggered:

```
catch (PDOException $e)
{
   print „Error!: „ . $e->getMessage() . „<br/>”;
   die();
}
```

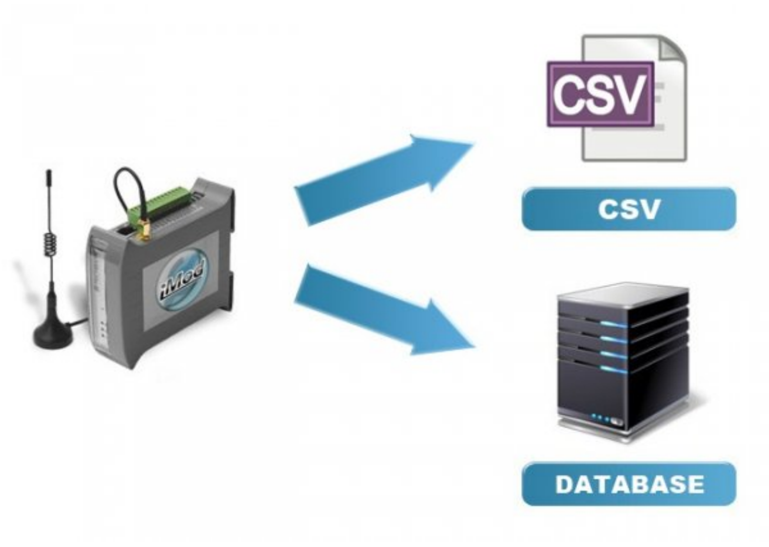
For testing purposes, there is an option of uploading PHP files to the *mnt/ramdisk/htdocs* directory. However, it is a part of volatile memory, which means that after a reboot of the iMod platform all the saved files will disappear. This is why it is advised to put all the tested files in the */mnt/nand-user/htdocs_src* directory. This procedure saves all the files permanently and they will be visible after a reboot of the device.

## Apache Server Configuration

You can configure the Apache through configuration of the *httpd.conf* file in the */<home_apache_directory>/conf* .

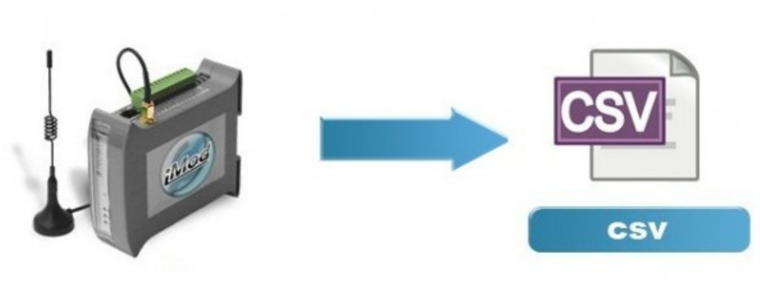
In order to change setting of the Apache server you need to reboot it.

# Data Registering



The iMod engine enables saving buffered values into a file or a database.

## Into CSV Files



iMod enables two ways of registering data.

- The first way - *Simple registration* enables to register selected parameters in one file, with selected frequency since the moment of start of the iMod engine.
- The second way - *Registration with Message-channel* enables to register selected parameters into selected files with frequency that doesn’t depend on the start of the iMod engine.

## Simple Registration

In order to begin registration of parameters into one file you need to do two things:

- Add the *acuqisition_period* property into the *imod* element, by entering the value in seconds you define how often you want to register selected parameters.

```
<imod version="1.0.0" acquisition_period="10">
```

- Add the *data-logging* element into a selected parameter.

```
<data-logging>ture</data-logging>
```

The parameters will be registered in the data.csv file in the */mnt/data/SQL* directory.

The values saved into a csv file are previously counted by the *scale* and *offset* elements.

Example configuration registering the value of the USER_LED every ten seconds:

```
<?xml version="1.0" encoding="UTF-8"?>
<imod version="1.0.0" acquisition_period="10">
 <group name="Definicje kanalow">
    <access-channel name="Modbus_S1">
            <protocol name="MODBUS" />
            <port>"ET-502-TCP"</port>
    </access-channel>

        <source-channel name="NPE_io">
         <protocol name="HARDWARE"/>
         <gap>0</gap>
         <cycle>5</cycle>
    </source-channel>

    <parameter>
        <id>100</id>
        <data-logging>true</data-logging>
        <description>"USR_LED"</description>
        <source-channel channel-name="NPE_io" parameter-id="USER_LED"/>
        <access-channel channel-name="Modbus_S1" parameter-id="100"/>
    </parameter>
 </group>
</imod>
```

The *data.csv* files are rotated each time after start of the iMod or after reaching a configured file size. The amount and the files and the size after they are rotated is configured in the *log4j.xml* file in the */mnt/mtd/iMod/config/log4j.xml* directory.

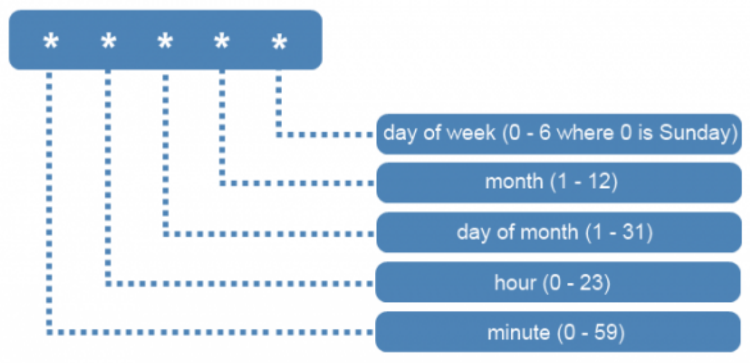
## Registration with Message-channel

iMod can write values of selected parameters into CSV files or databases (SQLite or PSQL) at certain minutes, hours, days, weeks or even years.

The schedule of the tasks implemented in the iMod device can be used in a variety of ways e.g., to write selected parameters into CSV files.

### Cron Format

The schedule of tasks functionality is performed with message-channel connected to the CRON functionality - a Linux program enabling periodic launching of programs and events. It enables to define time and date with accuracy of 1 minute. Time and date is defined by using separate combinations of signs, where each one is responsible for another variable.



Apart from the values presented above, there is a possibility of using the * sign, which describes execution of a command for each available time interval value. As an example the " * * * * * " write means execution of a command every minute.

You can put the properly configured time and date in the *cycle* type element in the iMod configuration file.

### Example CSV message-channel

An example of use of the event schedule is presented below.
In this example, a write into the *data1.csv będzie* file will be executed at 16:15 everyday:

```
<message-channel name="RegisterAt1615">
    <protocol name="CSV"/>
    <port>"/mnt/nand-user/exampleCSV.csv"</port>
    <cycle>"15 16 * * *"</cycle>
    <property name="separator" value=";"/>
</message-channel>
```

#### Location and Name of Registered File

Enter the path and file name where you want to register data into the *port* element:

```
    <port>"/mnt/nand-user/exampleCSV.csv"</port>
```

#### Separator

In the channel definition you can enter a whitespace between columns:

```
    <property name="separator" value=";"/>
```

### Assigning Message-channel in Parameter

Enter a reference to the *message-channel* element in the *parameter* element. Example definition:

```
<parameter>
        <id>"100"</id>
        <access-channel channel-name="Modbus_S1" parameter-id="100"/>
        <message-channel channel-name="CSV"/>
</parameter>
```

# SNMP

The iMod engine contains a plugin to convert its parameters into SNMP values. A MIB file is ganerated automatically and enables easy conversion of the NPE hardware resources or modbus parameters to SNMP protocol. Moreover, the plugin contains an event mechanism called a TRAP in SNMP.

## Example configuraion - Modbus to SNMP

The configuration below presents how to declare a place for creating SNMP files and roots of parameters (access-channel definition).

## Access-channel

In access-channel, you must define a place for generating MIB files (configuration), and roots of parameters in an OID tree.

```
<access-channel name="SNMP_Slave_1">
                <protocol name="SNMP" />
                <port>"ET-161-UDP"</port>
                <property name="device-id" value="1" />
                <property name="mib-file" value="/etc/snmp/NPE2-MIB.txt" />
                <property name="ip-address" value="0.0.0.0" />
                        <property name="parametersRootName" value="techbaseObjects" />
                        <property name="groupRootName" value="techbaseGroups" />
            </access-channel>
```

## Traps

iMod enables to sent SNMP traps, when event conditions become true.

Firstly you need to declare a message-channel, then include reference to that channel in the _event_ element.

Example SNMP type message-channel:

```
  <message-channel name="SNMP_Msg_1">
                      <protocol name="SNMP" />
                      <port>"ET-162-UDP"</port>
                      <property name="device-id" value="1" />
                      <property name="mib-file" value="/etc/snmp/NPE2-MIB2.txt" />
                      <property name="ip-address" value="0.0.0.0" />
                      <property name="parametersRootName" value="techbaseObjects" />
                      <property name="groupRootName" value="techbaseGroups" />
                      <recipient>"192.168.1.11/162"</recipient>
                  </message-channel>
```

Example of setting reference to access-channel:

```
 <parameter type="int32">
                      <id>"1120"</id>
                      <description>"ParamInt2"</description>
                      <access-channel channel-name="SNMP_Slave_1" parameter-id="1120" />
                      <event type="HiAlarm">
                              <message-channel channel-name="SNMP_Msg_1" />
                              <message-id>"trap_1"</message-id>
                              <property name="SnmpDescr" value="Trap description" />
                              <property name="SnmpTrapType" value="inform" />
                              <property name="trigger" value="12"/>
```

```
                </event>
            </parameter>
```

## Parameters / OIDs

The last thing you need to do in order to build the SNMP configuration of the iMod device is to add parameters.

This is the whole example configuration:

```
<?xml version="1.0" encoding="UTF-8"?>
<imod version="1.0.25">
        <group name="Channels definition">

            <access-channel name="SNMP_Slave_1">
                <protocol name="SNMP" />
                <port>"ET-161-UDP"</port>
                <property name="device-id" value="1" />
                <property name="mib-file" value="/etc/snmp/NPE2-MIB.txt" />
                <property name="ip-address" value="0.0.0.0" />
                        <property name="parametersRootName" value="techbaseObjects" />
                        <property name="groupRootName" value="techbaseGroups" />
            </access-channel>

                <message-channel name="SNMP_Msg_1">
                        <protocol name="SNMP" />
                        <port>"ET-162-UDP"</port>
                        <property name="device-id" value="1" />
                        <property name="mib-file" value="/etc/snmp/NPE2-MIB2.txt" />
                <property name="ip-address" value="0.0.0.0" />
                        <property name="parametersRootName" value="techbaseObjects" />
                        <property name="groupRootName" value="techbaseGroups" />
                        <recipient>"192.168.1.11/162"</recipient>
                </message-channel>

                <source-channel name="Modbus_M1">
                        <protocol name="MODBUS"/>
                        <port>"com3-19200-8E1"</port>
                        <gap>0</gap>
                        <cycle>60</cycle>
                        <delay>1000ms</delay>
                        <read-timeout>250ms</read-timeout>
                </source-channel>


        <message id="trap_1">
                        <![CDATA[
                        "Exceed edge value"
                        ]]>
        </message>

</group>


        <group name="Parameters">

                <parameter type="int32">
                        <id>"1100"</id>
                        <description>"ParamInt1"</description>
                        <access-channel channel-name="SNMP_Slave_1"     parameter-id="1100"
/>
```

```
                </parameter>

                <parameter>
                        <id>"1102"</id>
                        <description>"ParamInt1"</description>
                        <source-channel channel-name="Modbus_M1" parameter-id="1102" />
                        <access-channel channel-name="SNMP_Slave_1"     parameter-id="1102"
/>
                </parameter>

                <parameter type="int32">
                        <id>"1120"</id>
                        <description>"ParamInt2"</description>
                        <access-channel channel-name="SNMP_Slave_1" parameter-id="1120" />
                        <event type="HiAlarm">
                                <message-channel channel-name="SNMP_Msg_1" />
                                <message-id>"trap_1"</message-id>
                                <property name="SnmpDescr" value="Trap description" />
                                <property name="SnmpTrapType" value="inform" />
                                <property name="trigger" value="12"/>
                        </event>
                </parameter>
        </group>

</imod>
```

# iMod SDK

The iMod engine enables adding user protocols with a simple API in JAVA.

A precise API description can be found in a separate document describing an example addition of a plugin to the iMod engine.

Use this link to download the document: http://www.a2s.pl/products/imod/SDK-iMod-Manual-PLv3.pdf

# iMod PLC

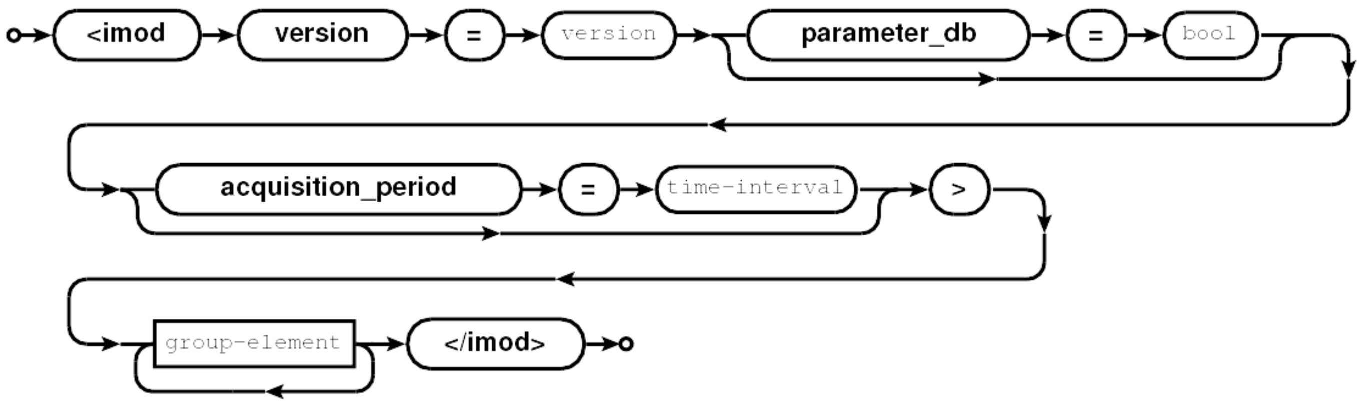
You can use the iMod platform as a PLC. You can program its functionalities in Ladder Logic.

A precise description of use of the iMod platform as a PLC can be found in the following document:
http://www.a2s.pl/products/imod/iMod_PLC_PL.pdf

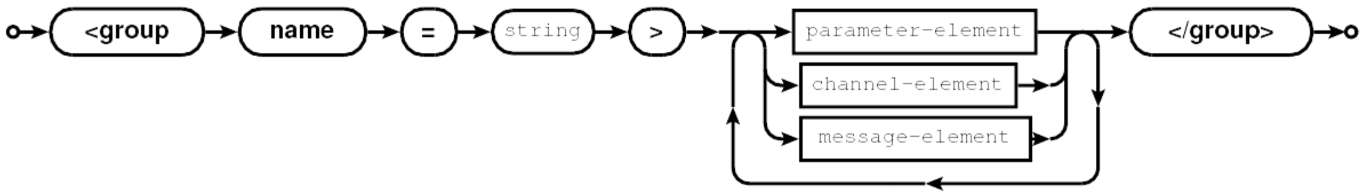
In order to use the iMod PLC engine, you need to prepare the iMod configuration, which enables using the iMod parameters with the Ladder Logic (LAD), in an XML file.

## XML Tree - Possible Configuration Elements

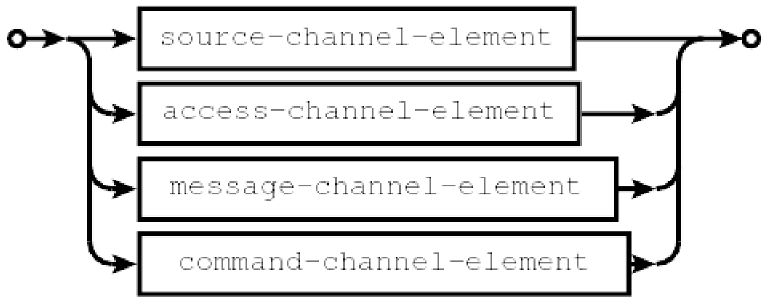
**imod-element:**



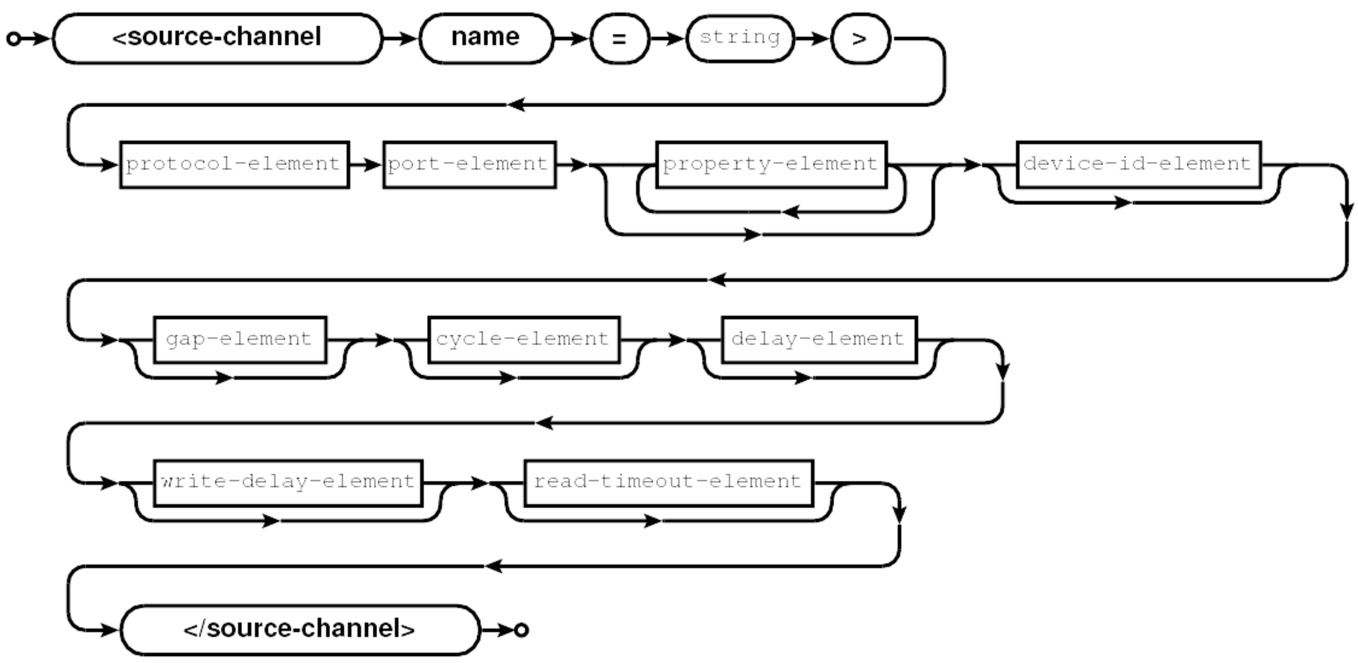
**group-element:**



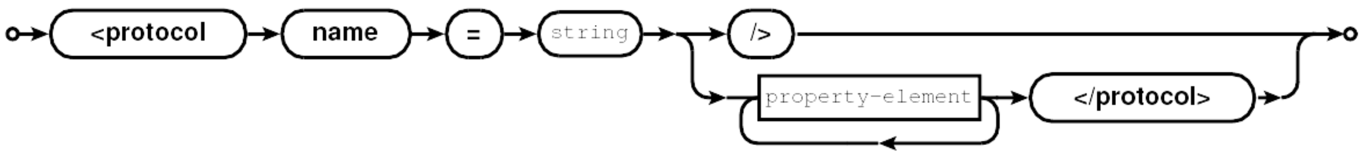
**channel-element:**



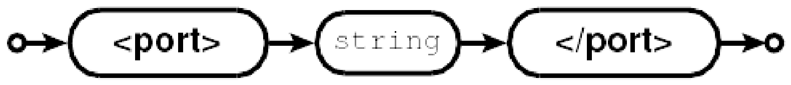
**source-channel-element:**



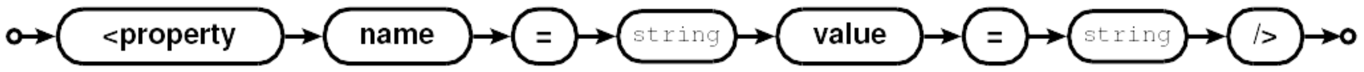
**protocol-element:**



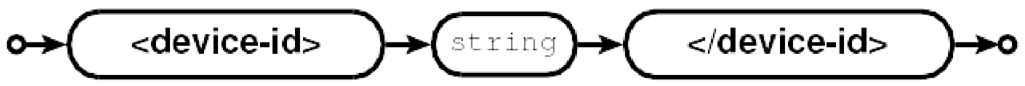
**port-element:**



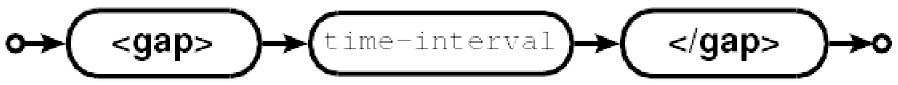
**property-element:**



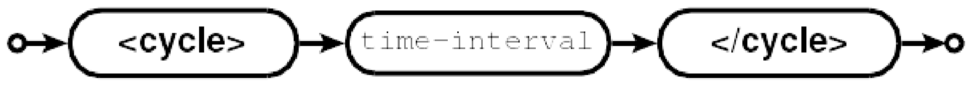
**device-id-element:**



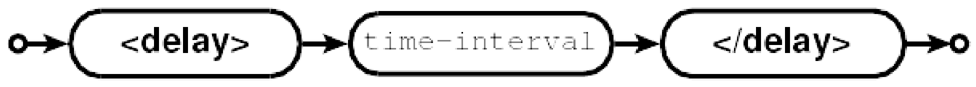
**gap-element:**



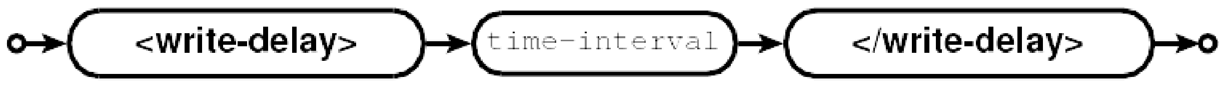
**cycle-element:**



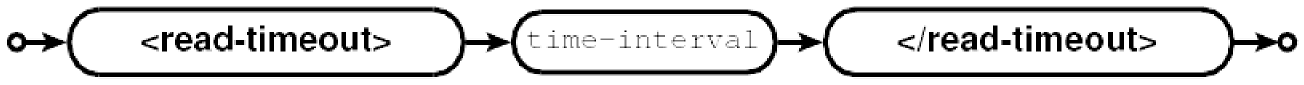
**delay-element:**



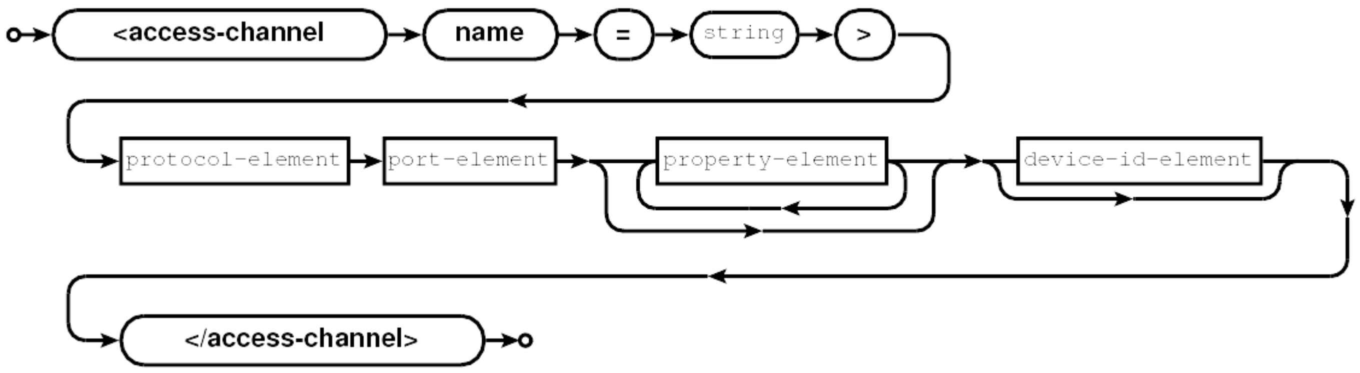
**write-delay-element:**



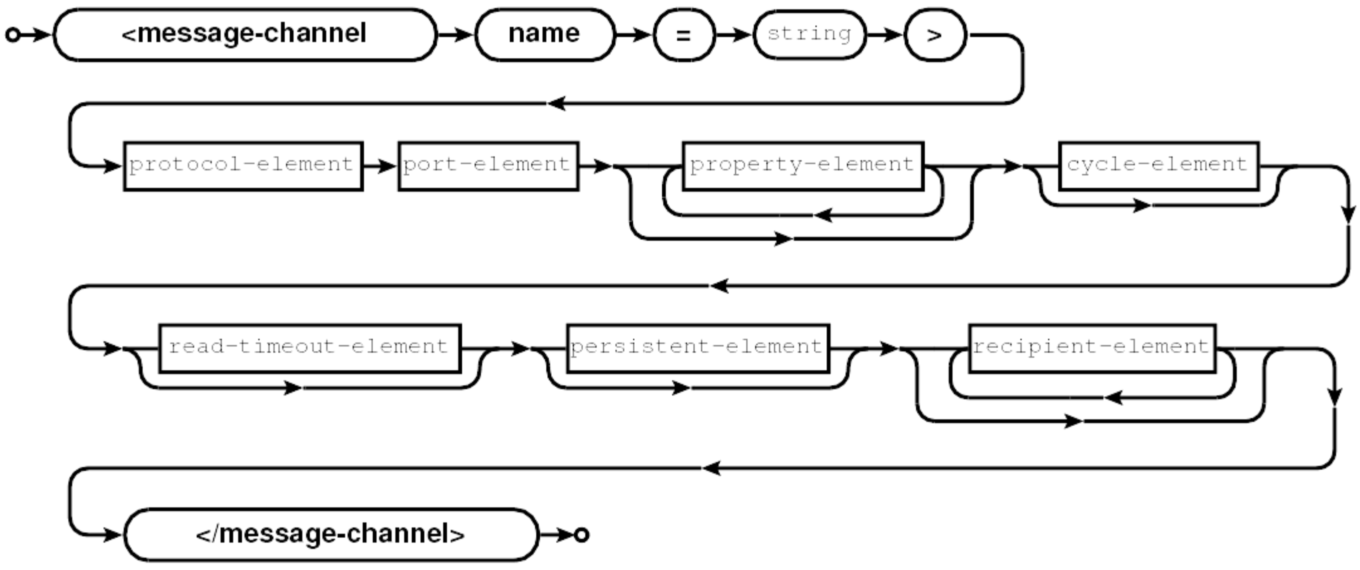
**read-timeout-element:**



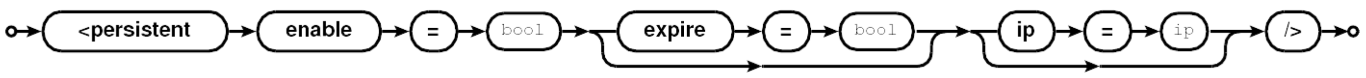
**access-channel-element:**



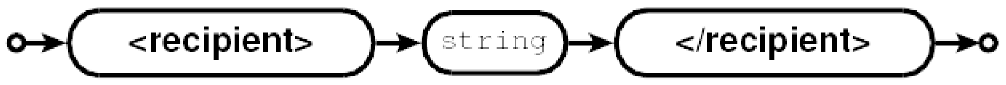
**message-channel-element:**



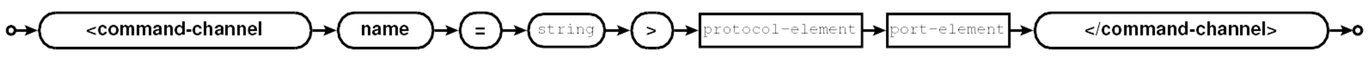
**persistent-element:**



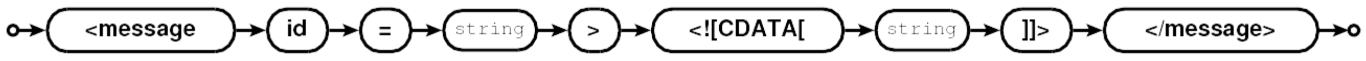
**recipient-element:**



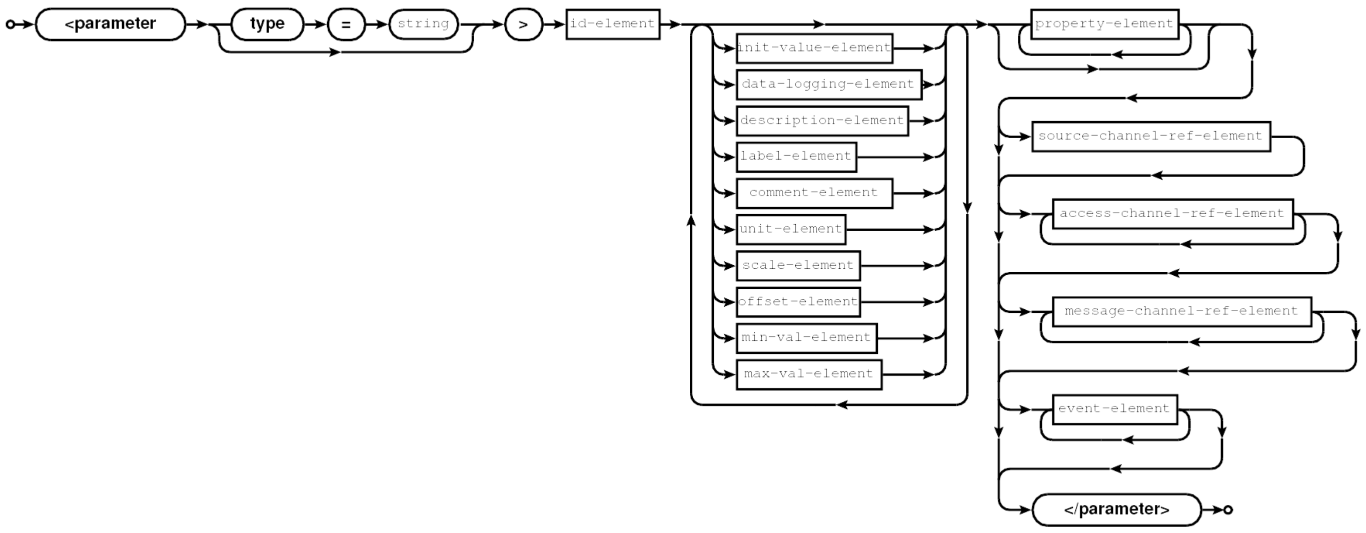
**command-channel-element:**



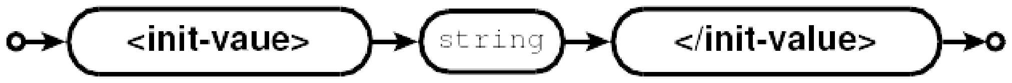
**message-element:**



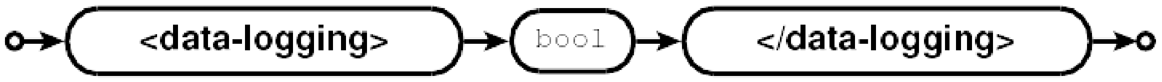
**parameter-element:**



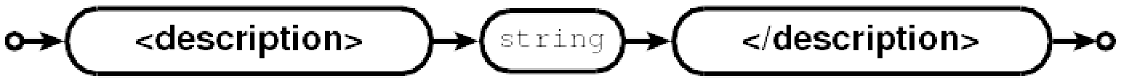
**init-value-element:**



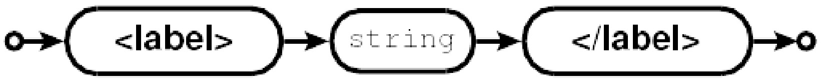
**data-logging-element:**



**description-element:**



**label-element:**



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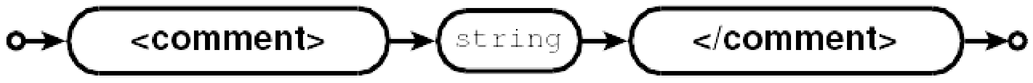

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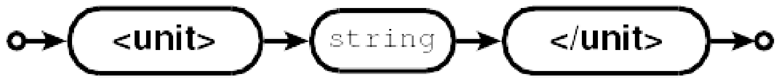

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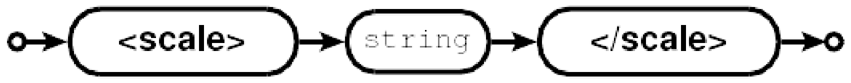

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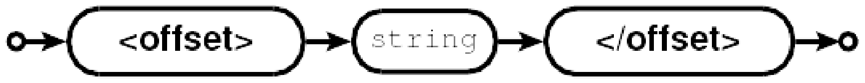

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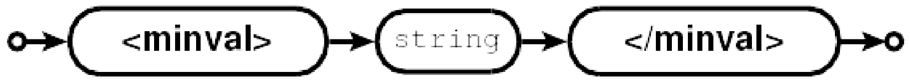

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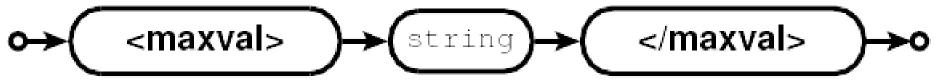

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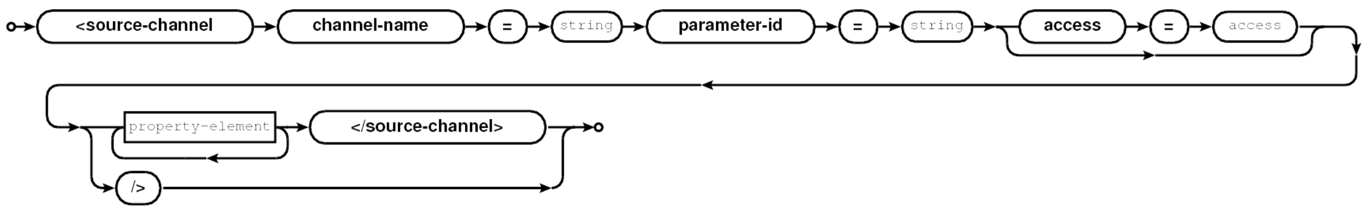
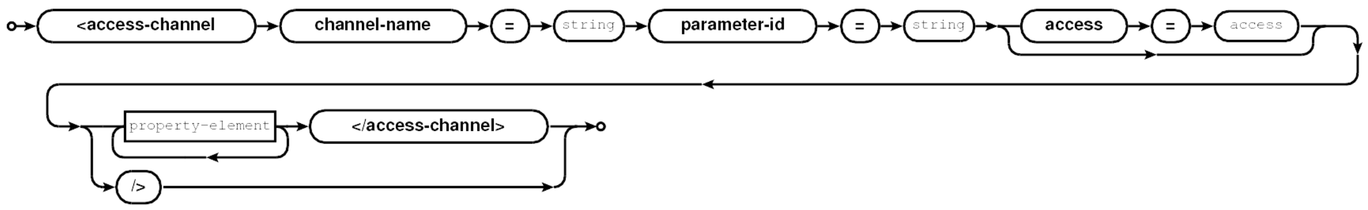
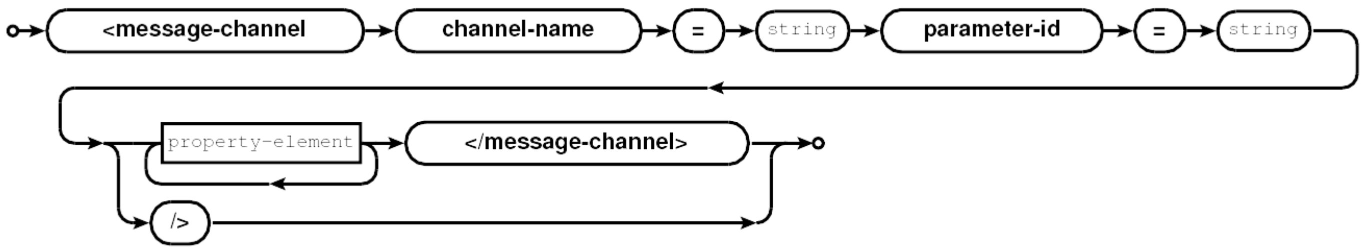


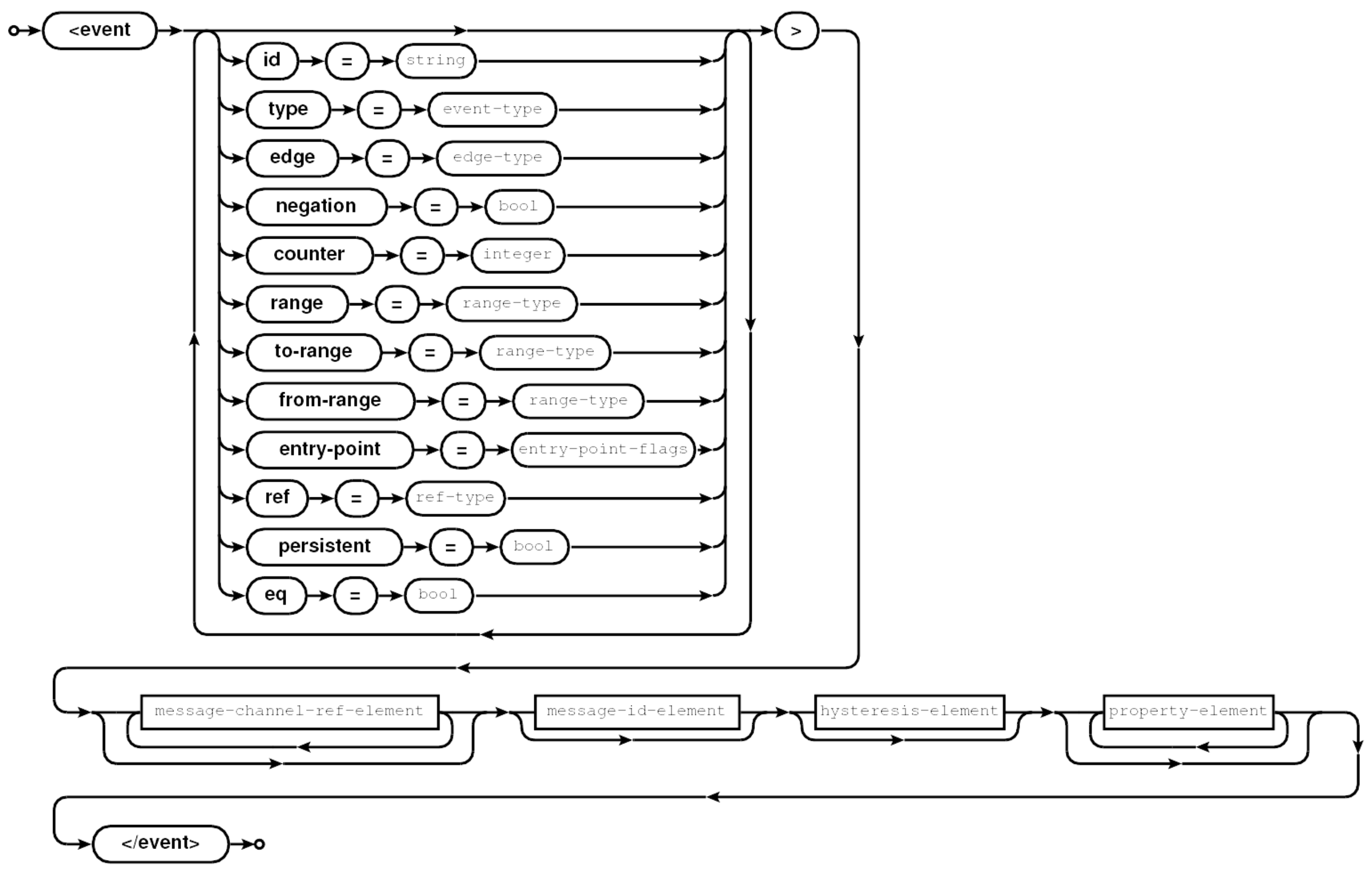
## access-channel-ref-element:



## message-channel-ref-element:



## event-element:



# F.A.Q.

Q. How to connect a relay to a digital output?
A. A scheme illustrating the connection of relays is in the NPE manual.

Q. What are the parameters of the digital output?
A. If a digital output is set to low state (‘0’), than after using a pull-up resistor externally, you can get maximum 24VDC. Digital output load is 500 mA.

Q. What are the parameters of the relay output?
A. 230VAC, 1000mA.

Q. How can I easily check if my digital output is working?
A. You just need to connect a digital output with a digital input.

Q. How can I check the output with the software?
A. You can check the digital output with the NxDynamics Web interface or a console with the following command: # npe ?DO1; echo $?;

Q. What is the voltage range in the analog input?
A. For the 9×00 version it is 4x 0-10VDC. For the 9×01 version it is 3x 0-10VDC and 1x 0-70VAC.

Q. How do I connect voltage to the analog input?
A. Connect Plus(+) to AI input and minus(-) to GND input.

Q. Do analog inputs in the NPE 9000 have galvanic separation?
A. No, they don’t.

Q. How do I read voltage?
A.

- With the iMod configuration HardwareResources.xml
- Through telnet console with the command:  *# npe ?AIU1; echo $?;*
- With the NXDynamics interface and the *I/O* tab.

Q. Does the RS-485 port have polarizing resistors?
A. Biasing polarizing resistors are built-in all the NPE devices produced since 01.02.2012.

Q. What is the analog and digital input resolution in the 9000 series?
A. Analog inputs: 12 bit, digital inputs: 45Hz

Q. Does iMod operate in continuous mode as a TCP master and a TCP slave, or do I need to reconfigure?
A. iMod operates as a router. It can be both a master and a slave.

Q. Can I reset the digital input counter with the Modbus TCP?
A. Yes, you can.