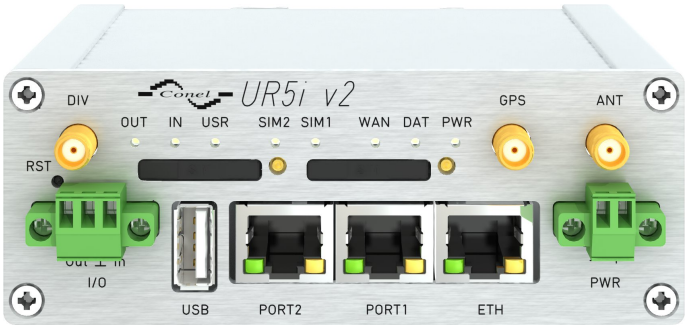
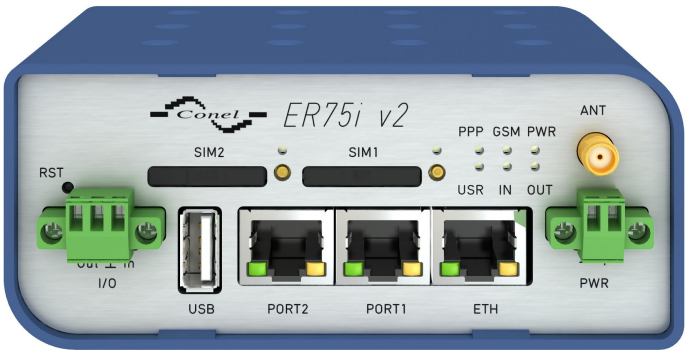
A B&B ELECTRONICS Company

User module

DNP3 Outstation

APPLICATION NOTE





Used Symbols

Danger – important notice, which may have an influence on the user's safety or the function of the device.

Attention – notice on possible problems, which can arise in specific cases.

Information, notice – information, which contains useful advice or special interest.

GPL License

Source codes under GPL license are available free of charge by sending an email to:

info@conel.cz.

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1. Description of user module

User module *DNP3 Outstation* is not contained in the standard router firmware. Uploading of this user module is described in the Configuration manual (see [1, 2]). Please note that in case of using v2 routers, this module requires firmware version 3.0.8 or later. The user module is v2 and v3 router platforms compatible.

DNP3 Outstation module allows the router to use DNP3 protocol (Distributed Network Protocol v. 3), which is intended for reading data from the router. It follows that the primary purpose of this protocol is the mutual communication between devices in a network. DNP3 supports communication model based on the principle of ISO OSI system, which only specifies the physical parameters of the communication, data link and application layers of this protocol.

DNP3 frame consists of a header with a fixed size of 10 bytes and data part (data payload), which consists of data blocks with a size of 1 to 16 bytes. Each data block is terminated by a Cyclic Redundancy Check (CRC) with a size of 16 bits (2 bytes). The total size of DNP3 frame is maximum of 292 bytes.

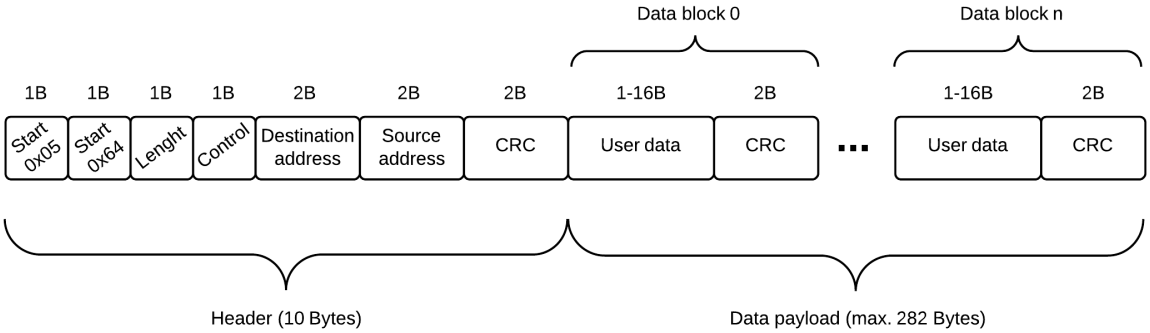


Figure 1: DNP3 frame

For configuration *DNP3 Outstation* user module is available web interface, which is invoked by pressing the module name on the *User modules* page of the router web interface. The left part of the web interface contains the menu with pages for *Configuration*, monitoring (*Status*) and *Customization* of the module. *Customization* block contains only the *Return* item, which switches this web interface to the interface of the router.

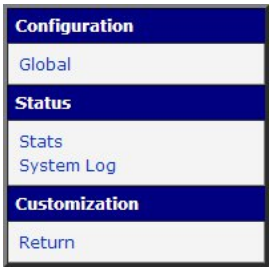


Figure 2: Menu of web interface

2. Configuration

Configuration of *DNP3 Outstation* user module is performed using pages *Global*, *Application Layer*, *Routing Targets* and *Routing Table* which are available in the *Configuration* part of the module web interface.

2.1 Global

Configuration form on the *Global* page allows user to configure the UDP/TCP connection and check of established TCP connection. The first item – *Enable DNP Outstation* – is used to activate this user module. Meaning of other items is described below.

Item	Description
Protocol	Protocol type: • **TCP** – communication using a linked protocol TCP • **UDP** – communication using a unlinked protocol UDP
Port	Specifies the port on which the router will communicate

Table 1: Connection configuration

If the *Check TCP connection* checkbox is ticked, check of established TCP connection is activated. It is possible to specify the following parameters:

Item	Description
Keepalive Time	Time after which it will carry out verification of the connection
Keepalive Interval	Waiting time on answer
Keepalive Probes	Number of tests

Table 2: An established TCP connection check

Then it is necessary to specify master and outstation devices:

Item	Description
Outstation Address	Address of outstation device
Master Address	Address of master device

Table 3: Device specification

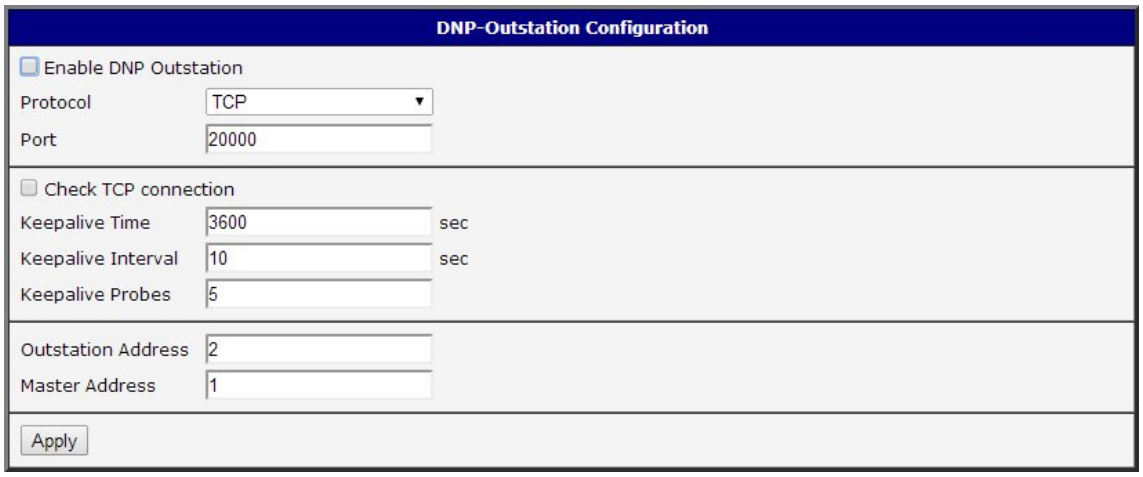


Figure 3: Configuration form *Global*

2.2 Application Layer

Configuration form *Application Layer* is intended to specify reading values. Selecting the value is done using check box in the *Enabled* column. The *Default Class* column allows user to set default class for selected value. This class is used for reading the selected value. The rule is that Class 1 has a higher priority than Class 2 and Class 2 has a higher priority than Class 3. The last column (*Status*) informs about the availability of a value (*OK* or *Not Installed*).

2.2.1 Binary inputs

Index	Description
0	Binary input – build in (excludes Libratum series)
1	BIN1 XC-CNT board (position – PORT1)
2	BIN2 XC-CNT board (position – PORT1)
3	BIN3 XC-CNT board (position – PORT1)
4	BIN4 XC-CNT board (position – PORT1)
5	BIN1 XC-CNT board (position – PORT2)
6	BIN2 XC-CNT board (position – PORT2)
7	BIN3 XC-CNT board (position – PORT2)
8	BIN4 XC-CNT board (position – PORT2)

Table 4: Binary inputs

2.2.2 Analog values

In section *Analog Inputs* are additionally available columns *Low limit*, *High Limit* and *Deadband*. *Low limit* and *High Limit* specify the lower and upper limit for the value. *Deadband* item is important for situations where the value fluctuates around the low or high limit. If the value exceeds the low limit, a return to normality is identified at the time when the value is equal to *Low limit* + *Deadband*. This means that if the *Low limit* is set to 10 and *Deadband* is 2, a return to normality (when this low limit is exceeded) is identified at the time when the value is equal to 12.

For *High Limit* is the situation analogous. If the value exceeds the high limit, a return to normality is identified at the time when the value is equal to *Low limit* – *Deadband*.

Index	Description
0	AN1 XC-CNT board (position – PORT1)
1	AN2 XC-CNT board (position – PORT1)
2	AN1 XC-CNT board (position – PORT2)
3	AN2 XC-CNT board (position – PORT2)
4	(Input) supply voltage – value must be divided by 1000
5	Router temperature in °C
6	Signal strength of GSM module
7	GPS Latitude in degrees – value must be divided by 1000000
8	GPS Longitude in degrees – value must be divided by 1000000

Table 5: Analog values

Note: GPS values are available only in routers with GPS hardware support. GPS user module is necessary to be uploaded and run in these devices.

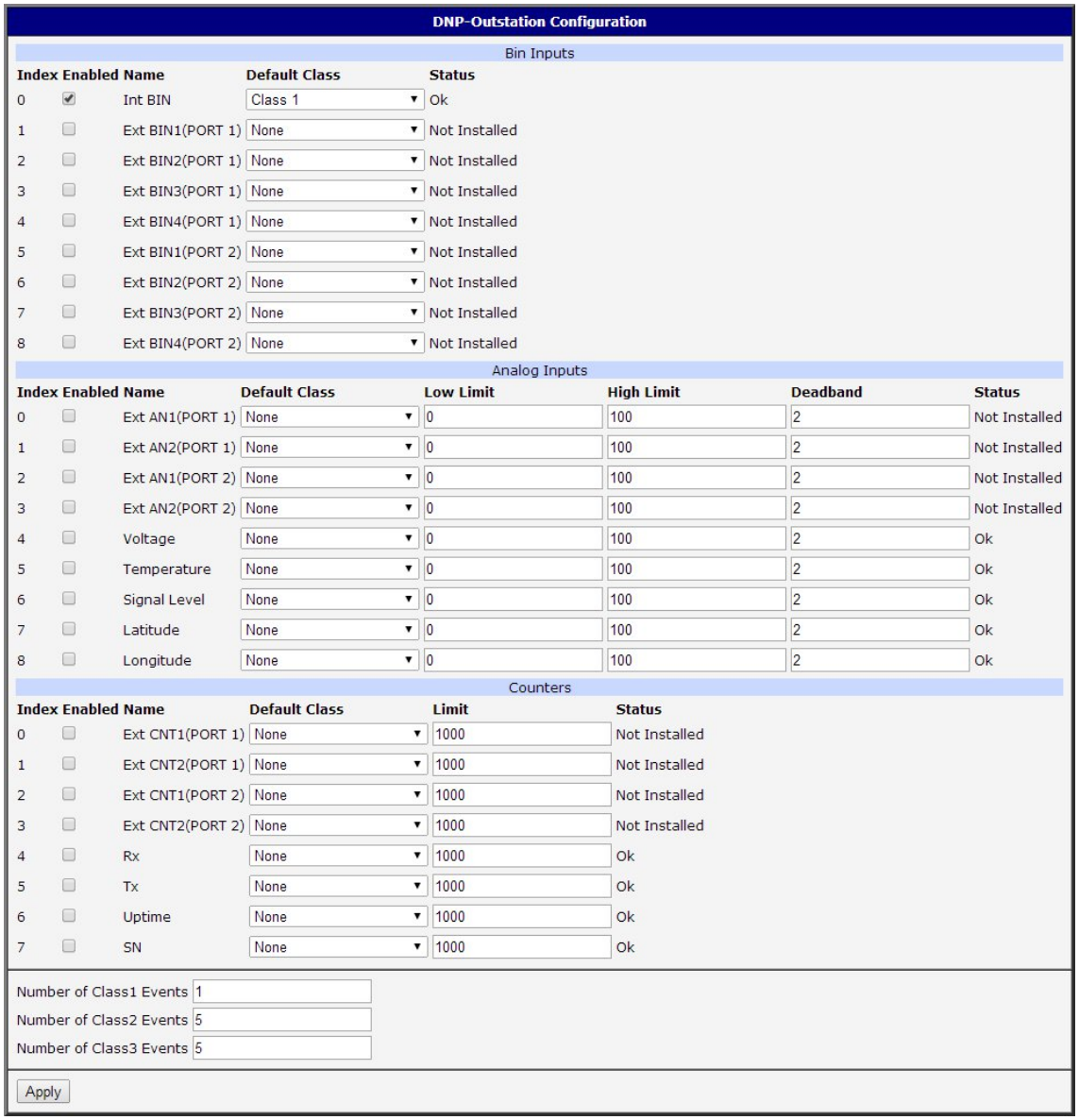
2.2.3 Counter inputs

Index	Description
0	Counter value CNT1 XC-CNT board (position – PORT1)
1	Counter value CNT2 XC-CNT board (position – PORT1)
2	Counter value CNT1 XC-CNT board (position – PORT2)
3	Counter value CNT2 XC-CNT board (position – PORT2)
4	Rx Data WLAN interface (in bytes)
5	Tx Data WLAN interface (in bytes)
6	Uptime in minutes
7	Router serial number

Table 6: Counter inputs

2.2.4 Number of Events

At the bottom of the *Application Layer* configuration form it is possible to set the number of events within a given class after which information about changing will be sent (items *Number of Class1 Events*, *Number of Class2 Events* and *Number of Class3 Events*).



DNP-Outstation Configuration

Bin Inputs

Index	Enabled	Name	Default Class	Status
0	☑	Int BIN	Class 1	Ok
1	☐	Ext BIN1(PORT 1)	None	Not Installed
2	☐	Ext BIN2(PORT 1)	None	Not Installed
3	☐	Ext BIN3(PORT 1)	None	Not Installed
4	☐	Ext BIN4(PORT 1)	None	Not Installed
5	☐	Ext BIN1(PORT 2)	None	Not Installed
6	☐	Ext BIN2(PORT 2)	None	Not Installed
7	☐	Ext BIN3(PORT 2)	None	Not Installed
8	☐	Ext BIN4(PORT 2)	None	Not Installed

Analog Inputs

Index	Enabled	Name	Default Class	Low Limit	High Limit	Deadband	Status
0	☐	Ext AN1(PORT 1)	None	0	100	2	Not Installed
1	☐	Ext AN2(PORT 1)	None	0	100	2	Not Installed
2	☐	Ext AN1(PORT 2)	None	0	100	2	Not Installed
3	☐	Ext AN2(PORT 2)	None	0	100	2	Not Installed
4	☐	Voltage	None	0	100	2	Ok
5	☐	Temperature	None	0	100	2	Ok
6	☐	Signal Level	None	0	100	2	Ok
7	☐	Latitude	None	0	100	2	Ok
8	☐	Longitude	None	0	100	2	Ok

Counters

Index	Enabled	Name	Default Class	Limit	Status
0	☐	Ext CNT1(PORT 1)	None	1000	Not Installed
1	☐	Ext CNT2(PORT 1)	None	1000	Not Installed
2	☐	Ext CNT1(PORT 2)	None	1000	Not Installed
3	☐	Ext CNT2(PORT 2)	None	1000	Not Installed
4	☐	Rx	None	1000	Ok
5	☐	Tx	None	1000	Ok
6	☐	Uptime	None	1000	Ok
7	☐	SN	None	1000	Ok

Number of Class1 Events 1
Number of Class2 Events 5
Number of Class3 Events 5

Apply

Figure 4: Configuration form *Application Layer*

2.3 Routing Targets

The *Routing Targets* form is used to configure the gateway for sending DNP3 messages. If the router is equipped with an expansion port through which it is possible to send DNP3 messages, form offers the possibility to configure this port (If no expansion port is available, this part of the configuration form is not displayed). The user can specify the following parameters:

Item	Description
Baudrate	Communication rate
Data Bits	Number of data bits
Parity	Control parity bit • **none** – no parity will be sent • **even** – even parity will be sent • **odd** – odd parity will be sent
Stop Bits	Number of stop bits
Split Timeout	Time to rupture report (message). If the gap (between two characters) longer than the value in milliseconds is recognized when receiving, then message from all received data is created and sent.

Table 7: Configuration of expansion ports

In the last section of this form (*Remote Connections*), it is possible to configure individual connections to remote routers. These connections will be used for creating "DNP routing table" on the *Routing Table* page. The user can specify the following parameters:

Item	Description
Description	Name or description of the connection
Type	Protocol type: • **TCP** – communication using a linked protocol TCP • **UDP** – communication using a unlinked protocol UDP
IP Address	Router IP address
Port	TCP/UDP port on which the communication will be effected

Table 8: Configuration of remote connections

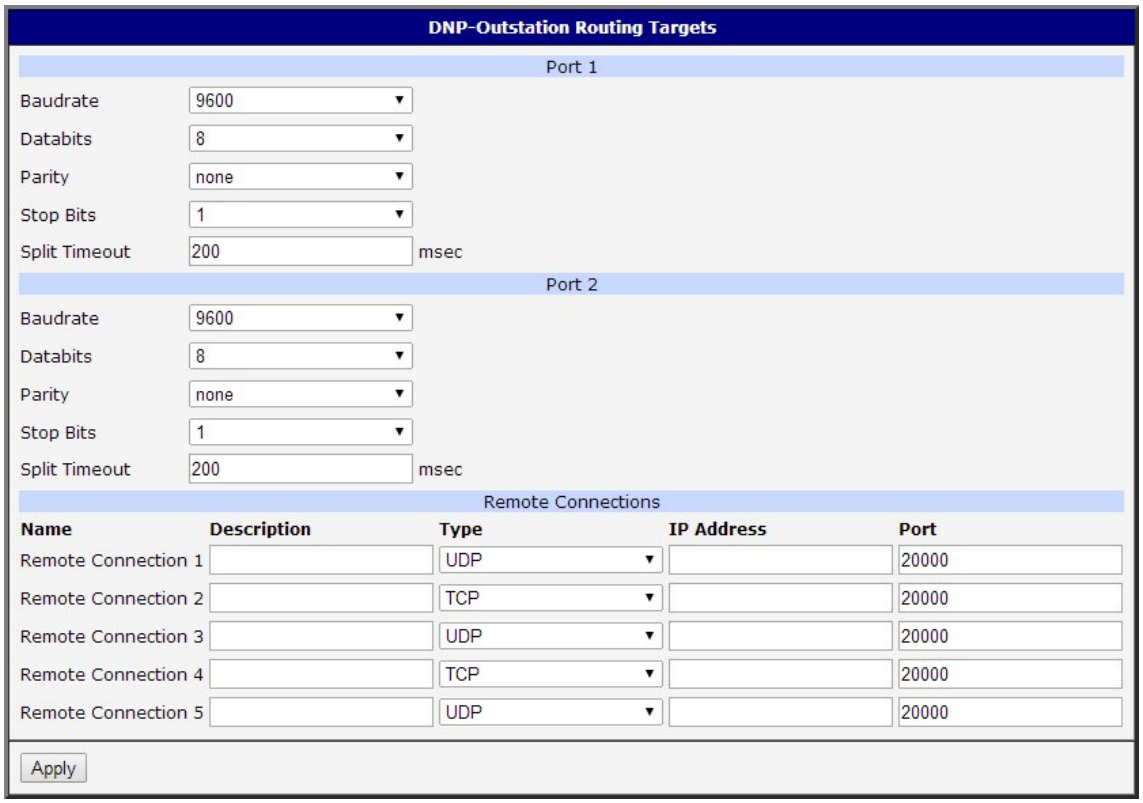


Figure 5: Configuration form *Routing Targets*

2.4 Routing Table

The *Routing Table* form defines "DNP routing table". This simply means that every *DNP Address* has been assigned to a specific connection defined on the *Routing Targets* page. Messages intended for specified DNP address are sent and received within this connection. The individual columns have the following meaning:

Item	Description
Name	Designation of the route (Route 1 – Route 10 by default)
Description	Name or description of the route (can be blank)
DNP Address	DNP Address
Target	Connection which is used for the selected DNP address. There are connections defined on the *Routing Targets* page (i.e. *Port 1*, *Port 2* and connections from the *Remote Connections* table).

Table 9: Configuration form *Routing Table*

At the bottom of this configuration form is *Send all remaining DNP3 messages to* _____ item using which it is possible to specify connection which is used for sending DNP3 messages in case that none of the above routes oblige.

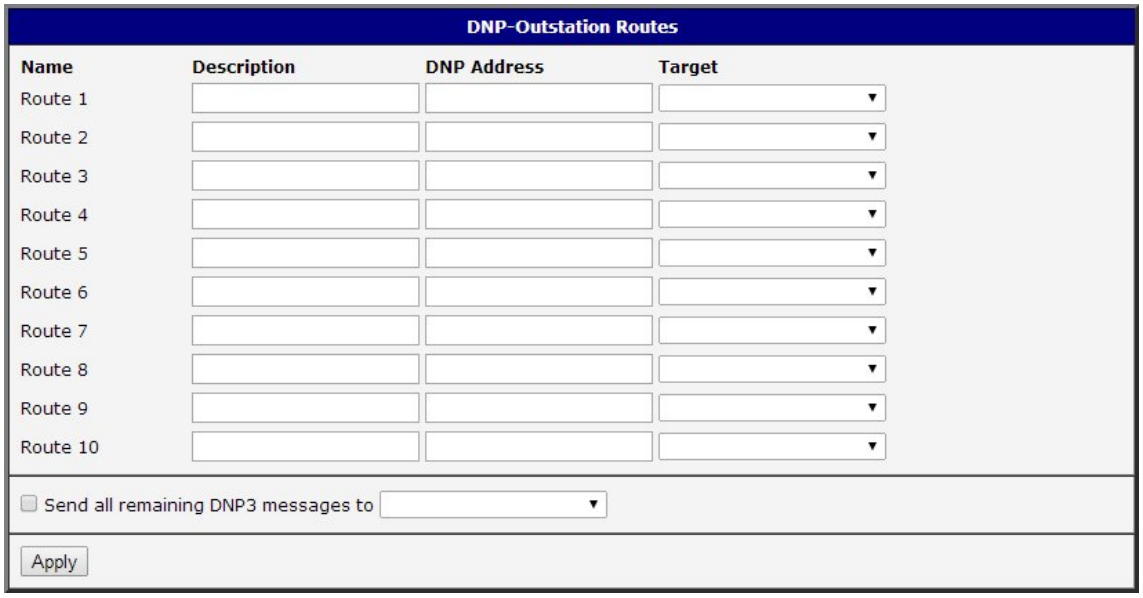


Figure 6: Configuration form *Routing Table*

3. Module activity monitoring

3.1 Statistical information

Page with statistical information can be invoked by clicking on the *Stats* item in the *Status* section of the module web interface. There is information such as number of sent and received frames, number of CRC errors and so on.

DNP-Outstation Stats

Datalink:	Rx Frames:	0
Datalink:	CRC Errors:	0
Datalink:	Rx Acks:	0
Datalink:	Rx Link Status:	0
Datalink:	Rx Reset Link:	0
Datalink:	Rx Test Link:	0
Datalink:	Rx User Data (Confirm):	0
Datalink:	Rx User Data (No Confirm):	0
Datalink:	Rx Request Link Status:	0
Datalink:	Rx FCB Incorrect:	0
Datalink:	Rx FCV Incorrect:	0
Datalink:	Tx Frames:	0
Datalink:	Tx Acks:	0
Datalink:	Tx Nacks:	0
Datalink:	Tx Link Status:	0
Datalink:	Tx User Data (No Confirm):	0
Transport:	Rx Unauth Seg:	0
Transport:	Rx Rouge Seg:	0
Transport:	Rx Segment:	0
Transport:	Rx Bad Sequence number:	0
Transport:	Rx Bad CRC:	0
Application:	Tx Confirm:	0
Application:	Rx Unknown function code:	0
Application:	Tx Response:	0

Figure 7: Statistics

3.2 System log

In case of any problems it is possible to view the system log by pressing the *System Log* menu item. In the window are displayed detailed reports from individual applications running in the router including possible reports relating to the *DNP3 Outstation* module.

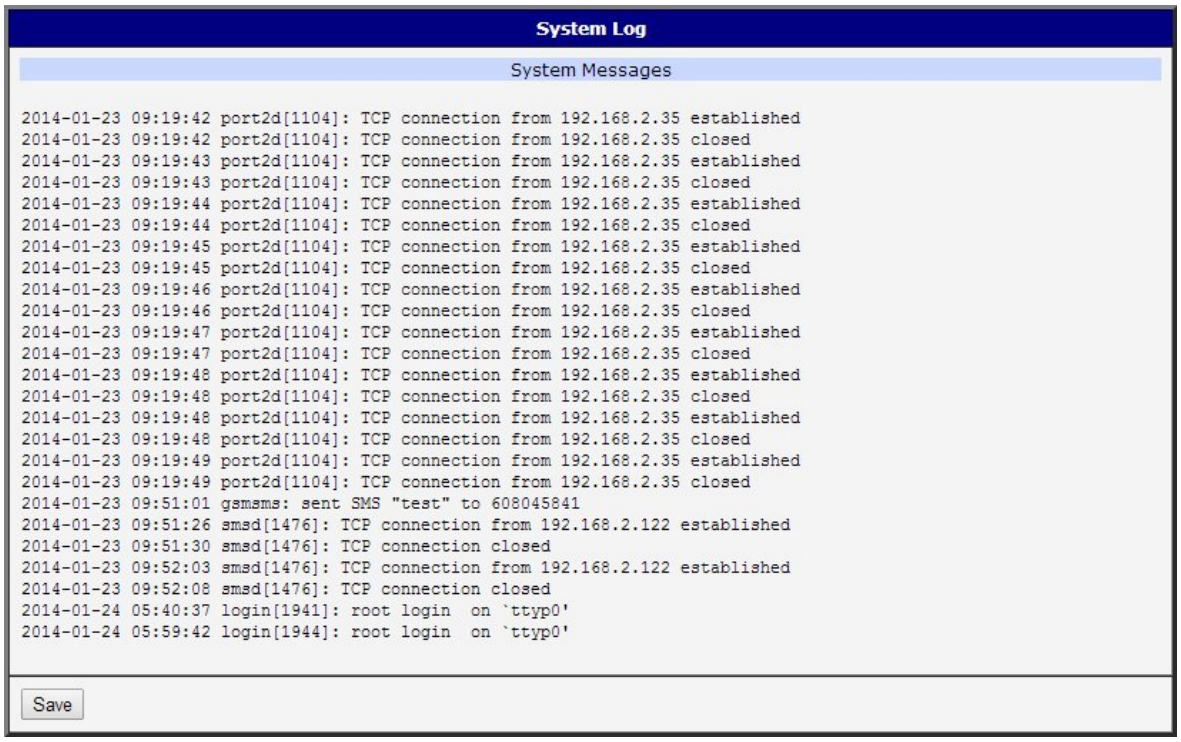


Figure 8: System log

4. Recommended literature

[1] Conel: **Configuration manual for v2 routers**
[2] Conel: **Configuration manual for v3 routers**