User manual

M!DGE3
Cellular router

Quick start

Hardware

Configuration

Parameters

fw 2.2.4.0
2025-06-12
version 1.13

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1. Quick guide

M!DGE3 is a widely configurable and compact cellular router. All you have to do to put it into operation is to connect it to an antenna and a power supply and configure it using a PC (tablet, smartphone) and a web browser.

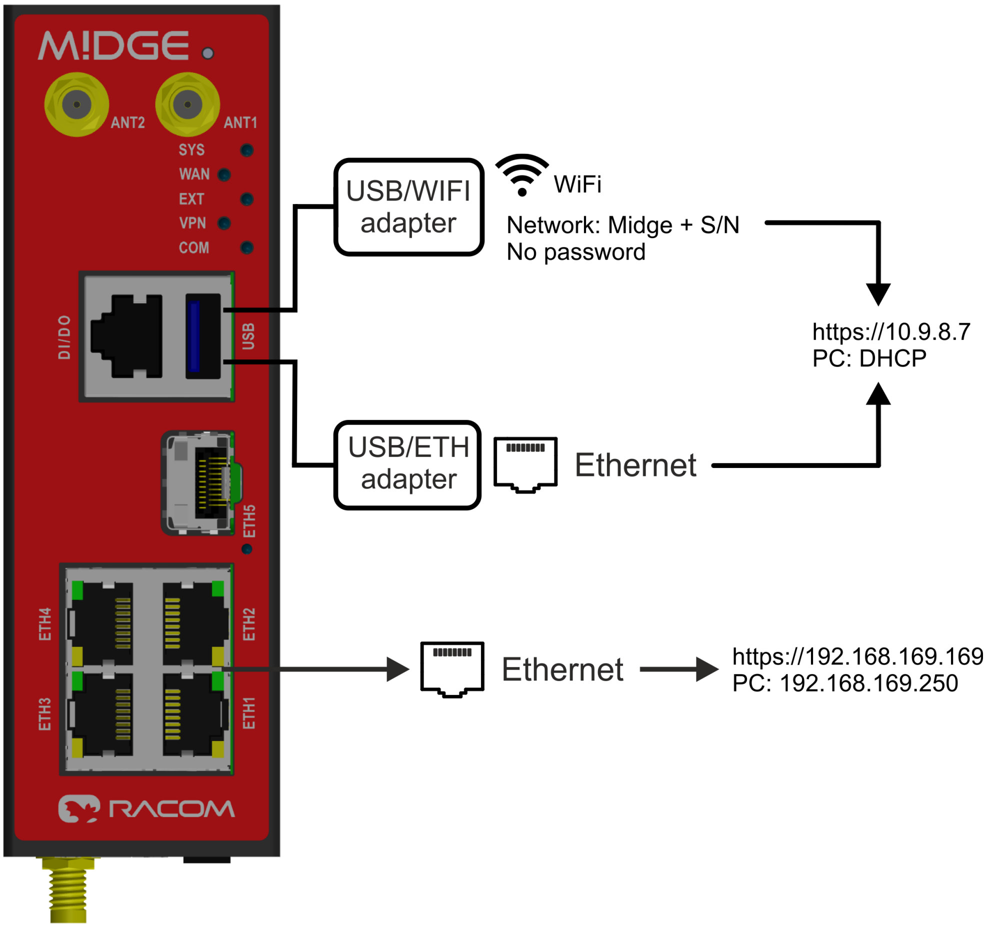


Fig. 1.1: Connecting M!DGE3 to a PC over WiFi, ETH/USB adapter, ETH interface

Unit has no Username and Password in default setting.

To configure M!DGE3 you can connect it to your PC in three ways:

PC (tablet, smartphone) connected via WiFi adapter

External WiFi adapter Part No. OTH-USB/WIFI-W2 (an optional accessory of the M!DGE3 see *USB adapter*[1]) needs to be used. Any other adapter will not work correctly when connected to M!DGE3 unit. Connect your PC, tablet or smartphone to M!DGE3 WiFi AP first. Its default SSID is Midge S/N. By default, the WPA2 PSK is disabled, so no password is required. The WiFi adapter contains a built-in DHCP server, so if you have a DHCP client in your PC (as most users do), you do not need to set anything up. The default IP address of M!DGE3 unit, for access over the USB adapter, is 10.9.8.7.

[1] https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories_ethusb

PC connected via ETH/USB adapter

External ETH/USB adapter Part No. OTH-USB/ETH-XR (an optional accessory of the M!DGE3 see *ETH/USB adapter*[2]). The ETH/USB contains a built-in DHCP server, so if you have a DHCP client in your PC as most users, you do not need to set anything up. The default IP address of M!DGE3 unit, for access over the ETH/USB adapter, is 10.9.8.7.

PC connected directly to an ETH port

The default IP address for access via ETH ports is 192.168.169.169.
Set a static IP address in PC within 192.168.169.0/24 (e.g. 192.168.169.250, subnet mask 255.255.255.0).

Important

When you change the M!DGE3 ETH address to a different IP address/mask, the IP address of your PC might be necessary to be updated to match the same subnet (mask).

Note

HTTPS - For security reasons the http protocol with SSL encryption can be used for the communication between the PC and M!DGE3. The HTTPS protocol requires a security certificate. You must install this certificate into your web browser. The first time you connect to the M!DGE3, your computer will ask you for authorisation to import the certificate into your computer. The certificate is signed by the RACOM s.r.o. certification authority. It meets all security regulations and you need not to be concerned about importing it into your computer. Confirm the import with all warnings and exceptions that your browser may display during installation.

Note

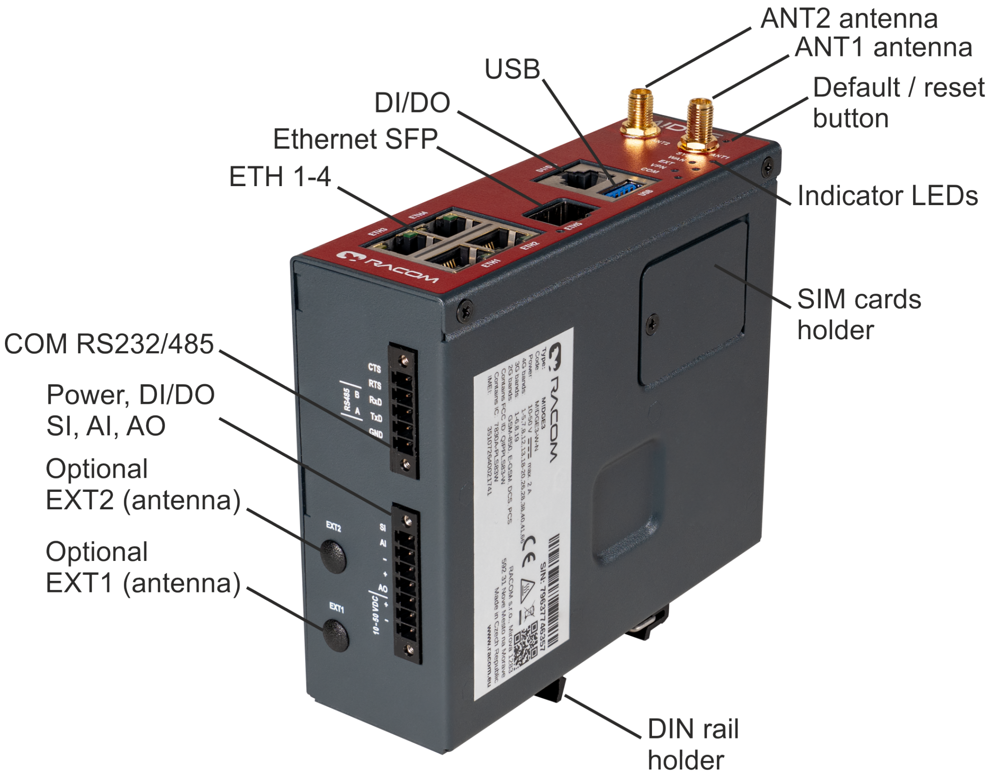
If you do not have the USB adapter or you have forgotten the password, you can reset the access parameters to defaults, see *Section 2.2.8, “HW button”*.

Note

Minimal required settings to set-up cellular connection.

[2] https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories_ethusb

2. Product



M!DGE3 is a cellular router platform designed for any real-time environment. M!DGE3 cellular routers are native IP devices, with Linux OS that have been designed with attention to detail, performance and quality.

M!DGE3 is built into a rugged metal casing that allows for multiple installation possibilities, see *Section 4.3, “Mounting”*.

Note

Variant M!DGE3e has some limitations in terms of HW interfaces and SW features. The details are mentioned in respective chapters / descriptions.

2.1. Dimensions

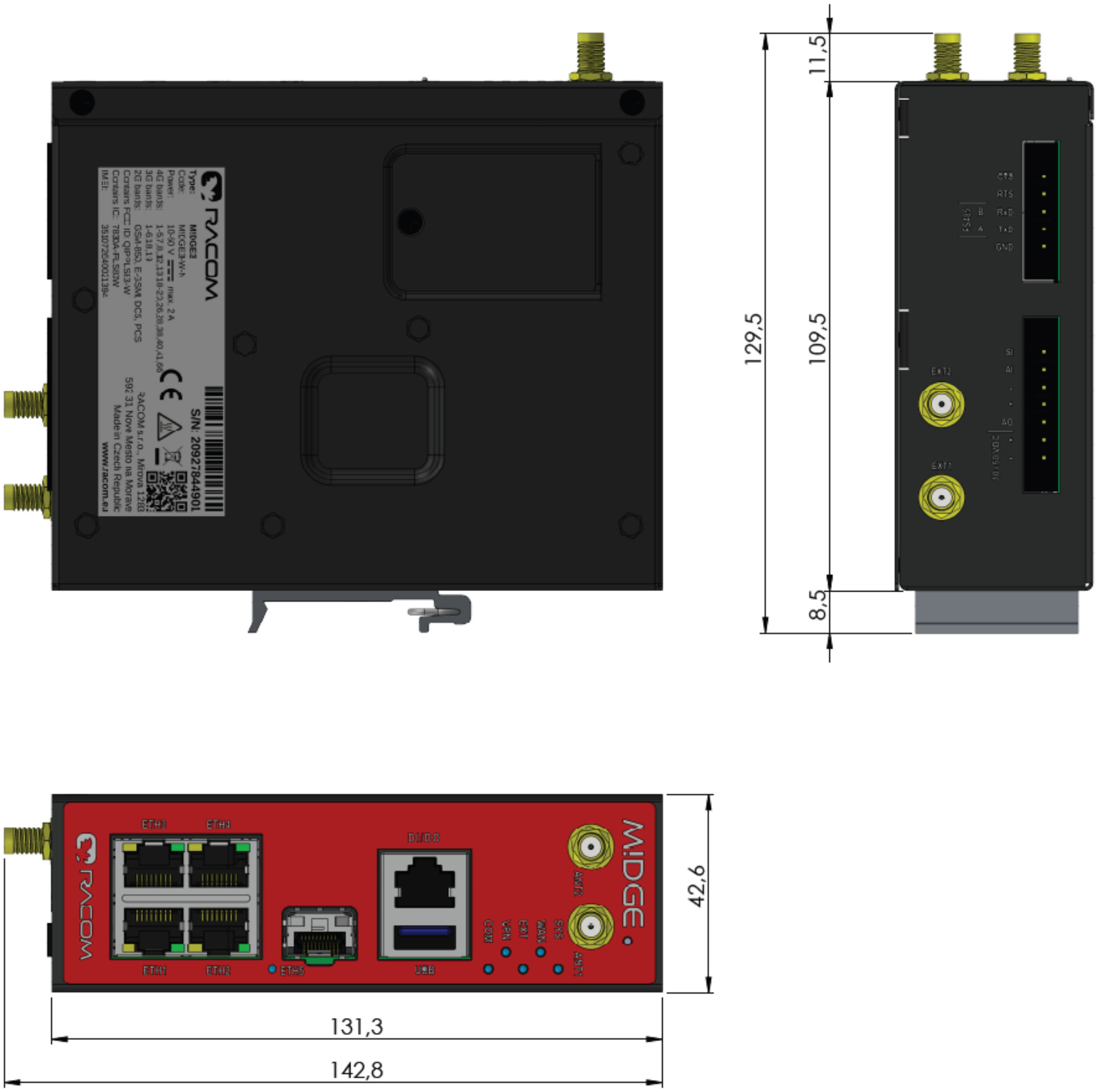


Fig. 2.1: M!DGE3 dimensions

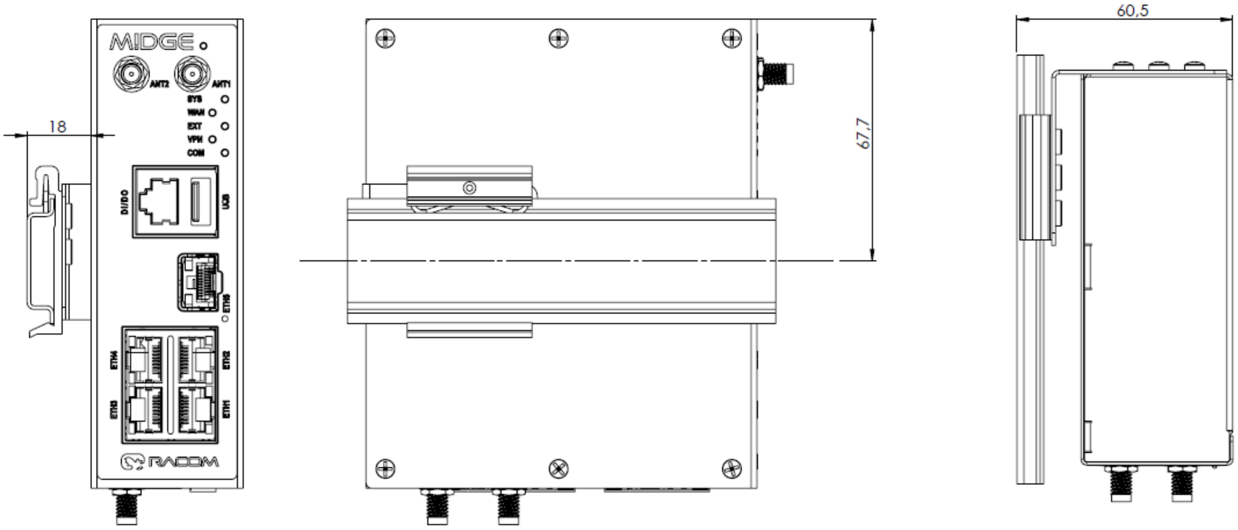


Fig. 2.2: M!DGE3 Edge-bracket dimensions

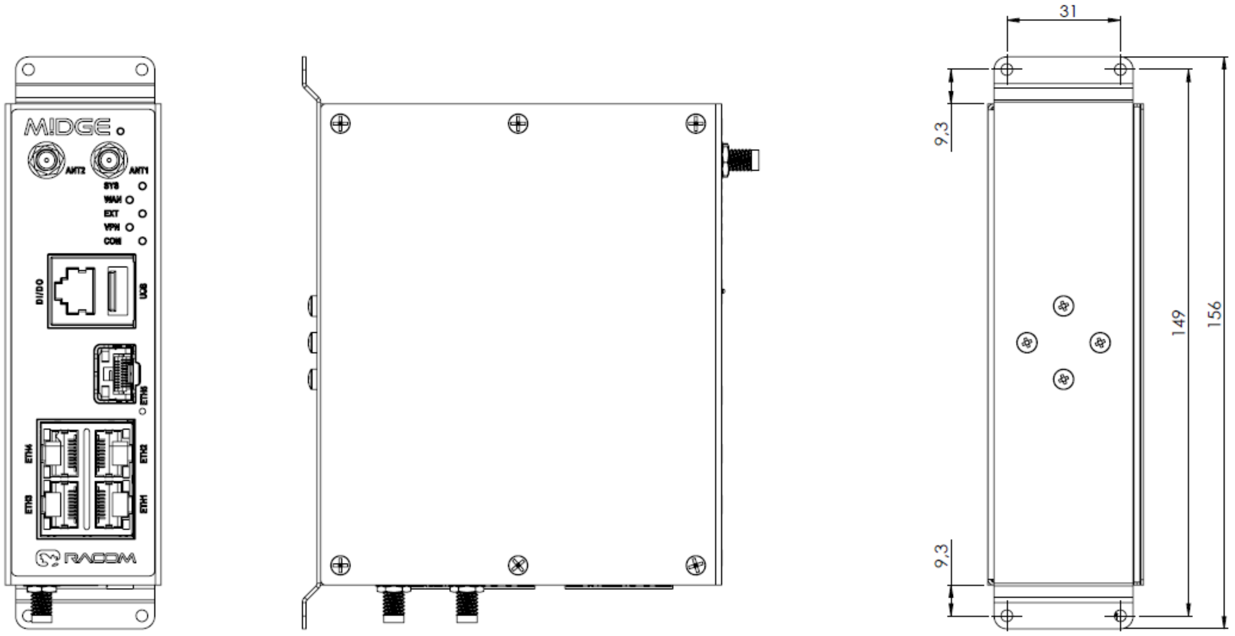


Fig. 2.3: M!DGE3 flat bracket dimensions

For more information see *Section 4.3.1, “DIN rail mounting”* and *Section 4.3.2, “Flat mounting”*.

2.2. Connectors

All connectors are located on the front and bottom panel. The front panel contains even LEDs. The HW button is located on the front panel as well (close to the upper edge).

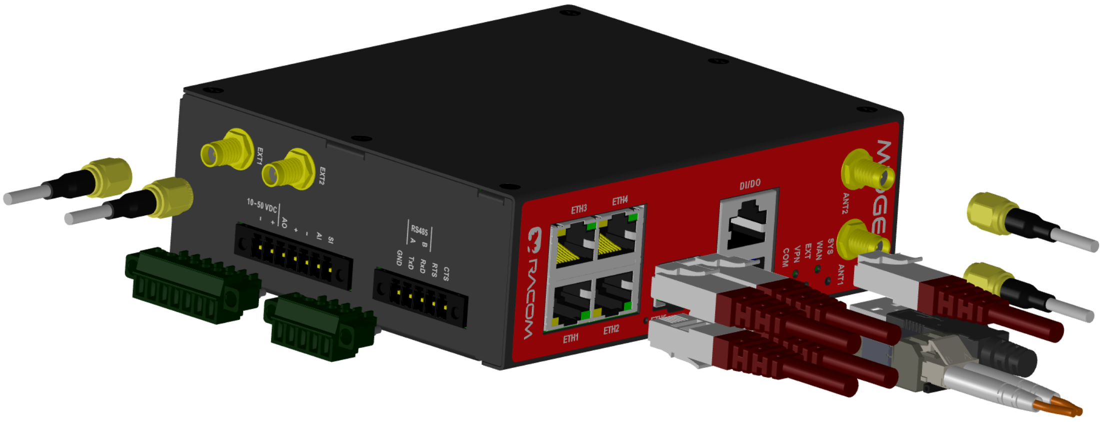


Fig. 2.4: Connectors

2.2.1. Antenna

An antenna can be connected to M!DGE3 via SMA female 50 Ω connector.

M!DGE3 is equipped with two connectors. The ANT1 connector will be used for common transmitting and receiving. The ANT2 connector will be used as a Rx diversity connector.

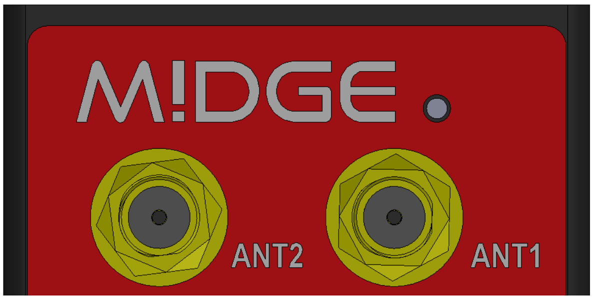


Fig. 2.5: Antenna connectors

Note

For optimal LTE connection, using both antennas (Rx diversity) is recommended.
If only one antenna is used, attach it to the ANT1 connector.

Warning

M!DGE3 cellular router may be damaged when operated without an antenna or a dummy load.

2.2.2. Power and Control

This rugged connector connects to a power supply and it contains control signals. A plug with screw-terminals and retaining screws for power and control connector is supplied with each M!DGE3. It is Tyco 7 pin terminal block plug, part No. 1776192-7, contact pitch 3.81 mm. The connector is designed for electric wires with a cross section of 0.5 to 1.5 mm^2. Strip the wire leads to 6 mm (1/4 inch). Isolated cables should receive PKC 108 or less end sleeves before they are inserted in the clip. Insert the cables in the wire ports, tightening securely.

Tab. 2.1: Pin assignment

Pin	Labeled	Signal
1	SI	SLEEP INPUT • pull below 1.1 VDC to activate (1.1 VDC / 1.9 VDC threshold hysteresis) • max. 50 VDC
2	AI	HW ALARM INPUT • pull below 1.1 VDC to activate (1.1 VDC / 1.9 VDC threshold hysteresis) • max. 50 VDC
3	−	−(GND) – for SLEEP IN, HW ALARM INPUT
4	+	+(POWER) – for HW ALARM OUTPUT
5	AO	HW ALARM OUTPUT open drain output max. 50 VDC, 1 A
6	+	+ POWER (10 to 50 V) Undervoltage threshold 8.5 VDC Overvoltage threshold 55 VDC
7	−	− POWER (GND)

Pins 3 and 7 are connected internally.
Pins 4 and 6 are connected internally.
Minus pole (GND) is internally connected with casing.

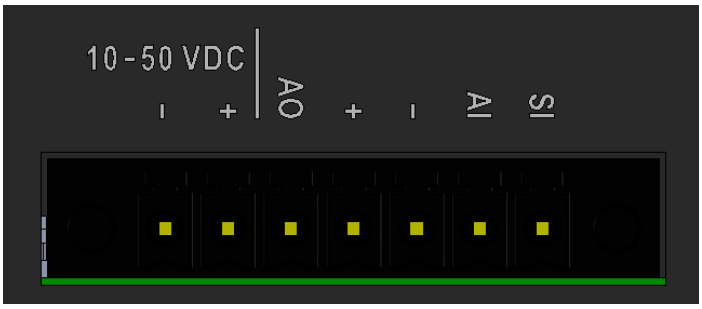


Fig. 2.6: Supply connector

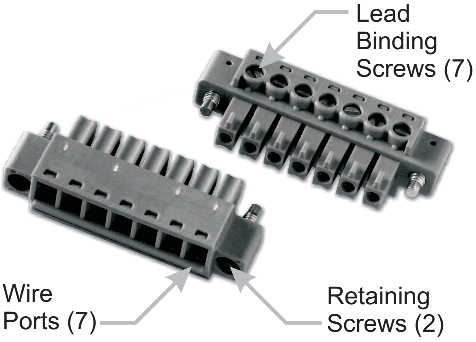
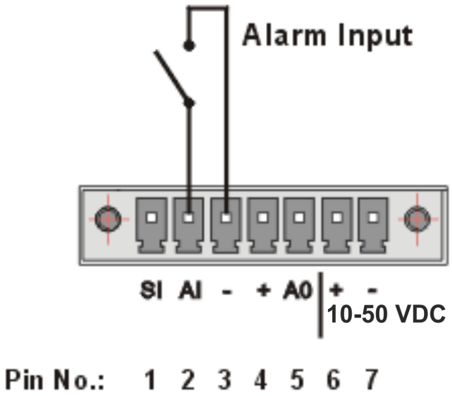


Fig. 2.7: Power and Control - cable plug

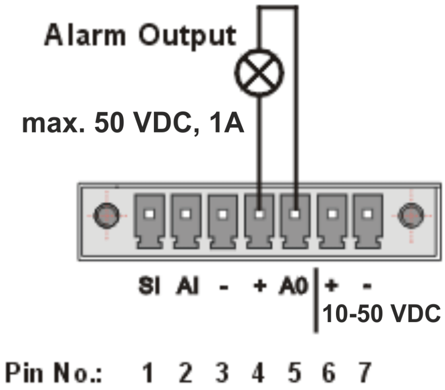
HW ALARM INPUT

HW ALARM INPUT is a digital input. If grounded (e.g. by connecting to pin 3), an external alarm is triggered.



HW ALARM OUTPUT

HW ALARM OUTPUT is a digital output.



POWER

The POWER pins labelled + and - serve to connect a power supply 10–50 VDC. The requirements for a power supply are defined in *Section 4.8, “Power supply”* and *Chapter 9, Technical parameters*.

2.2.3. ETH1 - ETH4

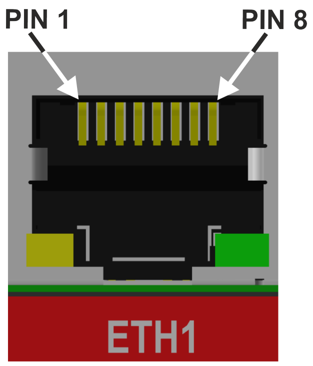
Standard RJ45 connectors for Ethernet connection. M!DGE3 has 10/100/1000Base-T Auto MDI/MDIX interfaces so it can connect to 10 Mb/s, 100 Mb/s or 1000 Mb/s Ethernet network. The speed can be selected manually or recognized automatically by M!DGE3. M!DGE3 is provided with Auto MDI/MDIX function which allows it to connect over both standard and cross cables, adapting itself automatically.

Note

M!DGE3e has only 2 ETH ports.

Pin assignment

Tab. 2.2: Ethernet to cable connector connections

Pin	Signal	Direct cable	Crossed cable	
1	TX+	orange – white	green – white	
2	TX-	orange	green	
3	RX+	green – white	orange – white	
4	—	blue	blue	
5	—	blue – white	blue – white	
6	RX-	green	orange	
7	—	brown – white	brown – white	
8	—	brown	brown	

2.2.4. ETH5 (SFP)

ETH5 is a standard SFP slot for 10/100/1000 Mb/s Ethernet SFP modules, user exchangeable with maximal power consumption 1.25 W. Both fibre optic and metallic Ethernet SFP modules are supported. For optical both single and dual mode fibre optics Ethernet modules (= 2 or 1 fibers) can be used. CSFP modules are not supported. RACOM offers all mentioned types of SFP modules, tested to be M!DGE3 compatible as a standard accessory.

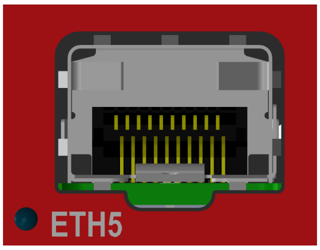


Fig. 2.8: SFP slot

The SFP status LED is located just next to the slot. It is controlled by SFP module. Its function is specific for each SFP module. The typical behavior is an indication the received signal from the fibre optic or metallic link to be within operational range.

Important

It is strongly recommended to use a high quality SFP module with industry temperature range. The SFP modules listed in Accessories are thoroughly tested by RACOM and are guaranteed to function with M!DGE3 units. It is possible to use any other SFP module, but RACOM cannot guarantee they will be completely compatible with M!DGE3 units.

Note

M!DGE3e has no SFP port.

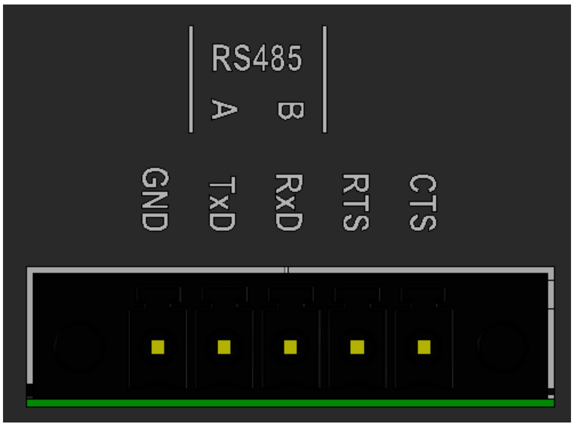
2.2.5. COM

M!DGE3 provides serial interface COM terminated by 5 pin terminal connector which is supplied with each M!DGE3 unit. It can be configured as RS232 or RS485. It is Tyco 5 pin terminal block plug, part No. 1776192-5, contact pitch 3.81 mm. The connector is designed for electric wires with a cross section of 0.5 to 1.5 mm^2. Strip the wire leads to 6 mm (1/4 inch). Isolated cables should receive PKC 108 or less end sleeves before they are inserted in the clip. Insert the cables in the wire ports, tightening securely.

RS232 of M!DGE3 is a hard-wired DCE (Data Communication Equipment) device. Equipment connected to the serial port of M!DGE3 unit should be DTE (Data Terminal Equipment).

RS485 of M!DGE3 is not galvanic isolated and it is not terminated.

Tab. 2.3: COM pin description

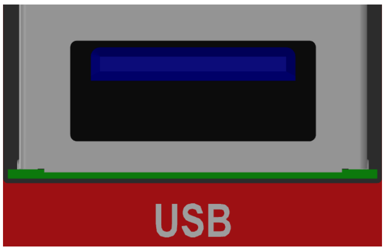
Terminal block	**COM – RS232**		**COM – RS485**		
Pin	**Signal**	**In/ Out**	**Signal**	**In/ Out**	
1	CTS	Out	—		
2	RTS	In	—		
3	RxD	Out	line B	In/Out	
4	TxD	In	line A	In/Out	
5	GND		GND		

M!DGE3 keeps pin 6 DSR at the level of 0 (state ON, approx. +6.2 V) by RS232 standard permanently.

2.2.6. USB

M!DGE3 uses USB 3.0, Host A interface. USB interface is wired as standard:

Tab. 2.4: USB A Pinout Cable Assembly

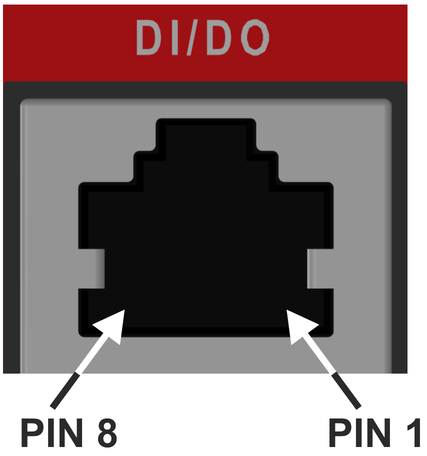
Pin	**Signal**	**Wire**	
1	VBUS	Red	
2	D-	White	
3	D+	Green	
4	GND	Black	
5	StdA_SSRX-	Blue	
6	StdA_SSRX+	Yellow	
7	GND_DRAIN	GROUND	
8	StdA_SSTX-	Purple	
9	StdA_SSTX+	Orange	
Shell	Shield	Connector Shell	

The USB interface is designed for the connection to an external ETH/USB adapter or a Wi-Fi adapter. They are optional accessories to M!DGE3, for more details see *www/ripex/accessories*[1]. The adapters are used for service access to web configuration interface of M!DGE3 unit.

The USB connector also provides power supply (5 V / 0.5 A). It can be used to temporarily power a connected device, for instance a telephone. The USB connector should not be used as permanent source of power supply.

2.2.7. DI/DO

Tab. 2.5: Digital Inputs and Outputs

Pin	Description	Signal	
1	DI1+	Digital input (differential) - Positive - (P)	
2	DI1-	Digital input (differential) - Negative - (N)	
3	GND	Ground	
4	DO1	Digital Output 1	
5	DO2	Digital Output 2	
6	GND	Ground	
7	DI2	Digital Input 2	
8	DI3	Digital Input 3	

Digital Outputs:
- Open drain output max. 50 VDC, 0.2 A

Isolated differential digital input:
- Input voltage difference (P-N) > 1.9 VDC Logic "H"
- Input voltage difference (P-N) < 1.1 VDC Logic "L"
- Maximum differential voltage 50 V

Digital inputs:
- Schmitt-triggered inverted input
- Pull below 1.1 VDC to activate (1.1 VDC / 1.9 VDC threshold hysteresis)
- Max. 50 VDC

Note

M!DGE3e has no dedicated DI/DO connector.

[1] https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories_ethusb

2.2.8. HW button

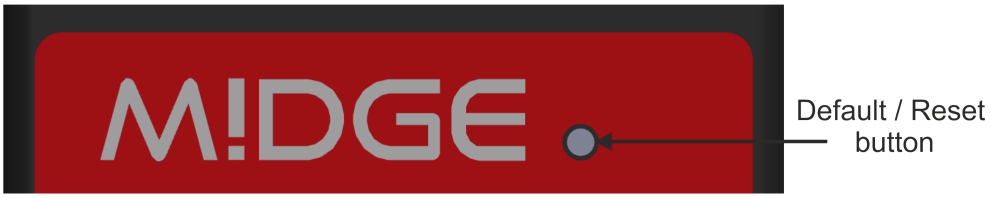


Fig. 2.9: HW button

HW button is placed on the right side of M!DGE3, next to the logo.

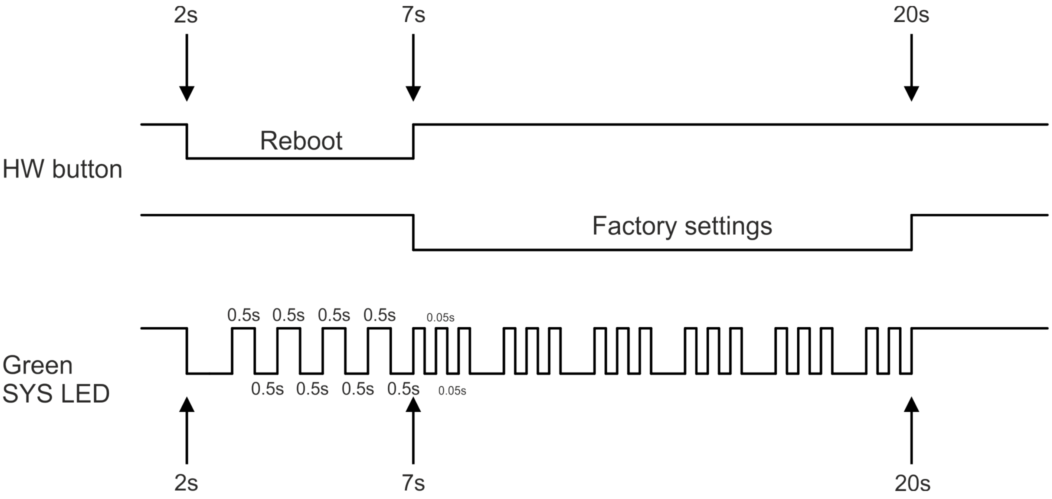


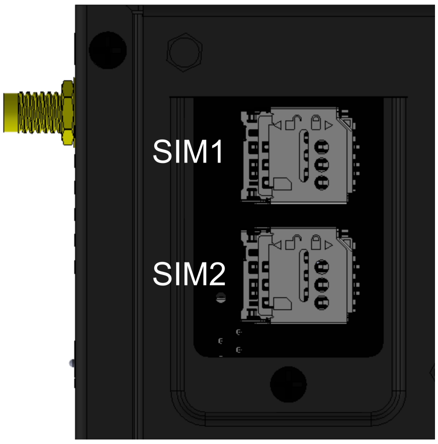
Fig. 2.10: HW button scheme

HW button operation

- Press less than 2 seconds - Nothing happens
- Press from 2 up to 7 seconds - Reboot is performed on button release
- Press from 7 up to 20 seconds - Factory settings are performed on button release
- Press more than 20 seconds - Nothing happens

2.2.9. SIM cards

Two SIM card holders for Micro SIM (3FF) are available under the screwed cover on the M!DGE3 right side.



Warning

Disconnect M!DGE3 unit from a power supply before opening the cover and manipulating with SIM cards.

2.3. Indication LEDs

LEDs indicator is placed on M!DGE3’s front panel.

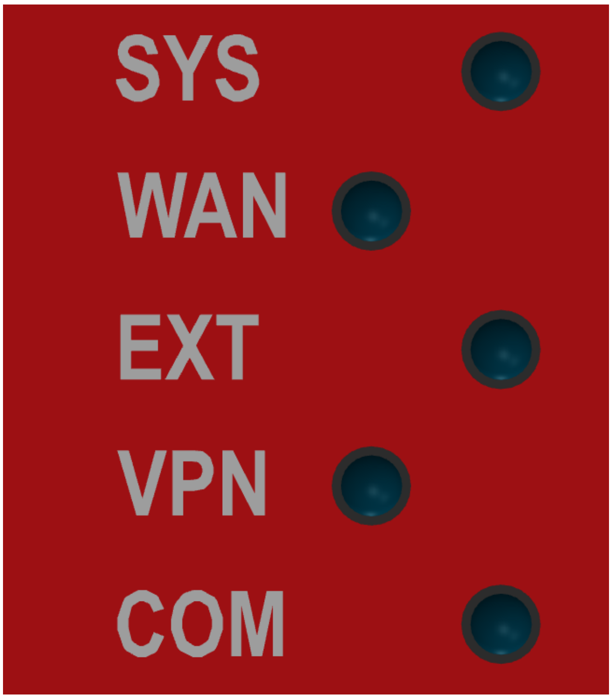


Fig. 2.11: Indication LEDs

Tab. 2.6: Key to LEDs

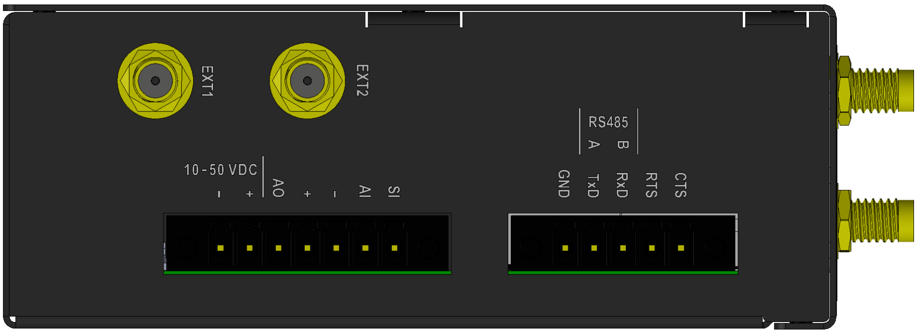
LED	Colour	Status	Function
SYS	Green	Permanently lit	System OK
		Flashing - period 500 ms	Reset button pushed
		Three fast (50 ms) flashes - pause (500 ms)	Reset button factory reset
		Flashing regularly - period 2000 ms	Sleep mode activated
	Red	Permanently lit	Alarm
		Flashing regularly - period 500 ms	Serious system error
	Orange	Permanently lit	Unit booting
		Three fast (75 ms) flashes	USB flash disc inserted
		Flashing fast (75ms) - period 1000 ms	Interaction with USB flash disc
	Green / Orange	Flashing regularly - period 300 ms	FW activation - do not shut down the device
WAN	Green / Orange / Red	Permanently lit, or flashing in 1 sec intervals	Permanently lit - connected to the cellular network. Color signalizes signal strength Flashing - connecting into the cellular network.
EXT	Green	Permanently lit	Activity of mPCIe connected equipment (like GPS fix, LTE connected, ...)
	Red	Permanently lit	Alarm of mPCIe connected equipment
	Table of Signal levels for individual services for cellular interface		
	Table of GNSS activity		
VPN	Green	Permanently lit	When all configured servers and clients are UP (listening or connected).
		Flashing regularly	When at least one server or client is UP (listening or connected) and at least one server or client is DOWN (not listening or not connected).
	Yellow	Permanently lit	When all servers and all clients are DOWN
	Not lit	-	When neither server nor client is set.
COM	Green	Permanently lit	Data receiving
	Orange	Permanently lit	Data transmitting

Alarm

An Alarm is triggered by any event with severity Error or higher (see *Section 8.4, “Events”*).

2.4. Extension

M!DGE3 cellular router can be delivered with additional (optional) second cellular module, GPS extension or COM extension. In case of Cellular or GPS it comes with two additional SMA connectors installed on the bottom panel (EXT1, EXT2). Activity of any extension module is signalized on M!DGE3's front panel (EXT LED).



Note

No extensions are available fot M!DGE3e version.

2.4.1. Cellular

It is recommended to use both antennas (Rx diversity) for the LTE connection. In case of using only one antenna, attach it to the EXT1 connector. The EXT1 connector is used for both transmitting and receiving, or for single-antenna setups. The EXT2 connector is specifically for Rx diversity.

When the 2nd cellular module is used, LED behavior of this extension is signalized by Green / Orange / Red LED

- Permanently lit - Connected to the cellular network (color signalize signal strength)
- Flashing in 1 sec interval - Connecting into the cellular network

2.4.2. Wi-Fi interface

M!DGE3 cellular router can be delivered with the Wi-Fi extension.

2.4.2.1. Antenna

It is possible to use either one or two antennas. Antenna configuration needs to be setup accordingly in the EXT1 and EXT2 antenna configuration parameters in the Settings > Interfaces > Wi-Fi menu.

2.4.3. GPS

M!DGE3 cellular router can be equipped with the GPS receiver with time pulse output. EXT1 connector is used for connection of the active GPS antenna, EXT2 connector is used for the precise time pulse output.

2.4.4. COM2 - COM3

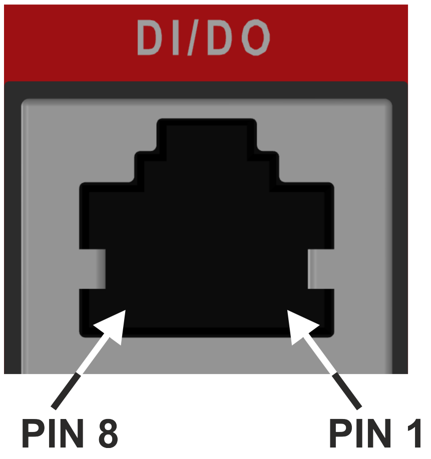
The 2nd and 3rd COM ports are available when the Extension module 'C' (2 x RS232) is installed. In such a case: The DI/DO connector is used as a connector for COM2 and COM3.

COM2 and COM3 parameters:

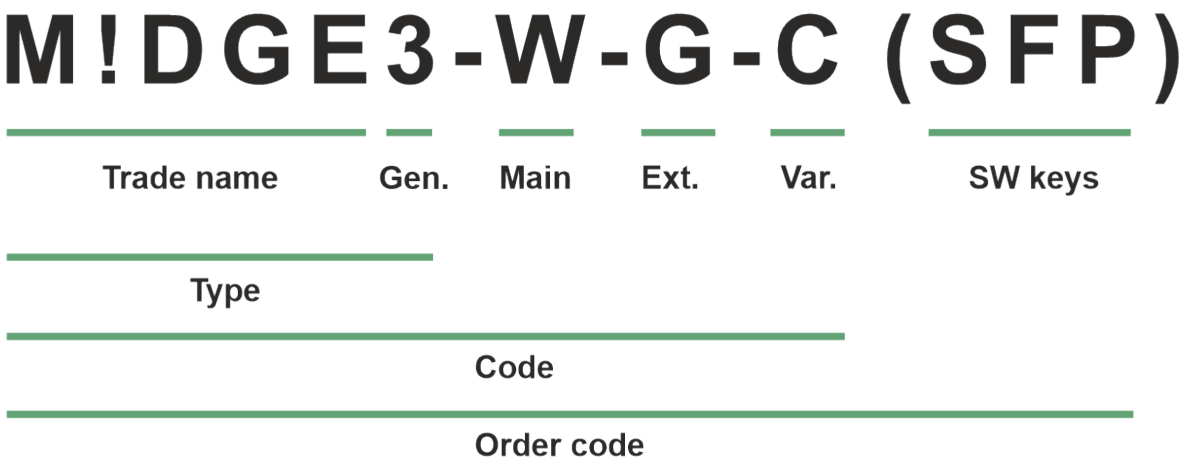
COM2: RS232 - 5 pin (RxD, TxD, GND, RTS, CTS) 600 b/s to 2 Mb/s

COM3: RS232 - 3 pin (RxD, TxD, GND) 2.4 kb/s to 921.6 kb/s

Tab. 2.7: DI/DO connector used by Extension module 'C'

Pin	Signal	In / Out	
1	RxD COM3	Out	
2	TxD COM3	In	
3	GND		
4	CTS COM2	Out	
5	RTS COM2	In	
6	GND		
7	RxD COM2	Out	
8	TxD COM2	In	

2.5. Ordering codes



Trade name – trade and marketing name of the product. This name is used for all products within the same product family.
  Possible values: **M!DGE**

Gen. – generation of the product of specific Trade name. The very first generation does not have any number in this position.
  Possible values: **3**

Main

Possible values:
N – not used
W – Main cellular module; Part No.: mPCIe-W
Bands W - 4G/3G/2G, Global

Ext. – Extension module embedded in mPCIe slot
Possible values:
N – not used
W – Extension cellular module; Part No.: mPCIe-W
Bands W - 4G/3G/2G, Global
M – Extension cellular module; Part No.: mPCIe-M
Bands M – LTE Cat M1/NB1/NB2, Global (incl. 450 MHz)
O – Extension cellular module; Part No.: mPCIe-O
Bands O – LTE Cat M1/NB1/NB2, Global
R – Extension cellular module; Part No.: mPCIe-R
Bands R – LTE Cat M1/NB1/NB2, LatAm (incl. 410 MHz, 450 MHz)
S – Extension cellular module; Part No.: mPCIe-S
Bands S – LTE Cat M1/NB1/NB2, Global
G – Extension GPS (GNSS) module; Part No.: mPCIe-GPS
C – Extension 2× RS232; Part No.: mPCIe-COMS
F – Extension Wi-Fi module; Part No.: mPCIe-WIFI

Note

Only one option for mPCIe slot is possible

Var. – Hardware variant (not used for M!DGE3)
Possible values:
C – M!DGE3e (essential version)
O - M!DGE3, Digital inputs and outputs DI1, DI2, DI3, DO1, DO2 never possible (available on special request only)

SW keys – if unit is ordered with SW keys, all keys are specified in this bracket. SW key can be ordered independently for specific S/N anytime later on.
Possible values:
SFP – enables SFP interface; Part No.: M!DGE3-SW-SFP

Type – specific product type
Possible values:
M!DGE3

Code – part of order code which is printed on Product label on the housing (SW keys are not HW dependent and can be ordered later on, so they are not printed on Product label).

Order code – the complete product code, which is used on Quotations, Invoices, Delivery notes etc.

In order to find out the correct Order code, please use *E-shop*[2].

[2] https://webservice-new.racom.eu/main/eshop.list?t=10

3. Accessories

Whole accessory list is available on *RACOM*[1] website.

1. Edge-bracket
2. Flat-bracket
3. USB adapters (ETH, WiFi)
   https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories_ethusb
4. Demo case
   https://www.racom.eu/eng/products/radio-modem-ripex.html#accessories_democase

[1] https://www.racom.eu/eng/products/cellular-router-midge.html#accessories

4. Installation

4.1. Step-by-step checklist

1. Mount M!DGE3 into cabinet (*Section 4.3, “Mounting”*).
2. Install antenna (*Section 4.4, “Antenna installation”*).
3. Install feed line (*Section 4.5, “Antenna feed line”*).
4. Ensure proper grounding (*Section 4.6, “Grounding”*).
5. Run cables and plug-in all connectors except from the SCADA equipment (*Section 2.2, “Connectors”*).
6. Apply power supply to M!DGE3.
7. Connect configuration PC (*Ripex2 "Connecting"*).
8. Configure M!DGE3.
9. Test radio link quality (e.g. using Monitoring tool).
10. Connect the SCADA equipment.
11. Test your application.

4.2. Minimal required settings to set-up cellular connection

1. Enter the PIN code for the particular SIM card, if required (SETTINGS > Interfaces > Cellular > SIM1/SIM2).

2. Enable and Configure the Access Point Name (APN) (SETTINGS > Interfaces > Cellular > MAIN/EXT > Enable & Add/Edit Cellular profile).

3. Add default route 0.0.0.0/0 via WWAN (MAIN or EXT) (SETTINGS > Routing > Static) or other routing rule required.

   - No route is added automatically, required routes must be added manually.

   - Without such routes, unit will be connected to the cellular network, but not communicating with any other device/IP.

4. Save the changes.

5. Check functionality

   - SETTINGS > Interfaces > Cellular > Status > Show more (<)

   - DIAGNOSTICS > Tools > ICMP ping

   - DIAGNOSTICS > Statistics > Cellular statistic tables (Interface, State, Signal)

6. In case of any issues, download a detailed Diagnostic package (DIAGNOSTICS > Information > Diagnostic package), include all the information except User credentials and send it to *support@racom.eu*[1].

[1] mailto:support@racom.eu

4.3. Mounting

4.3.1. DIN rail mounting

M!DGE3 cellular modem is directly mounted to the DIN rail by a holder (which comes with the modem).

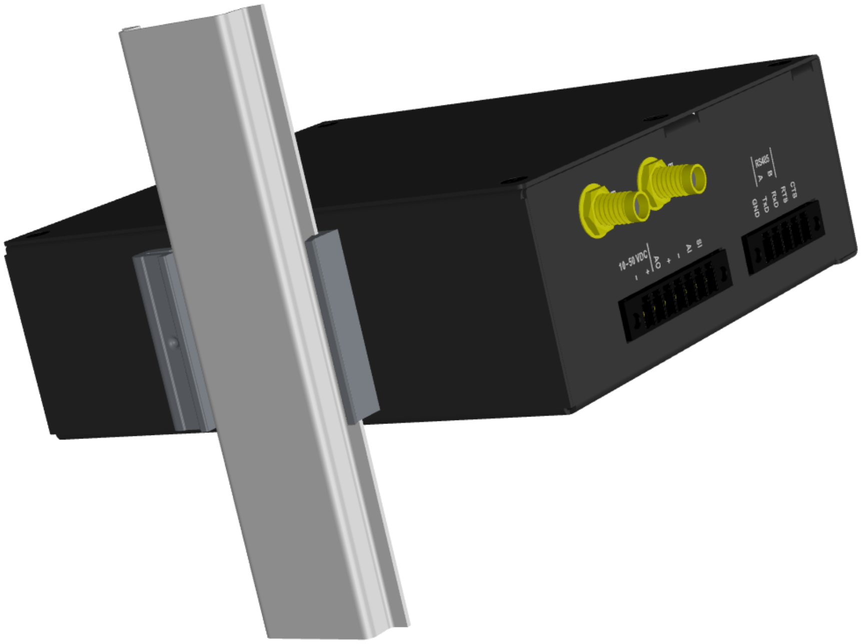
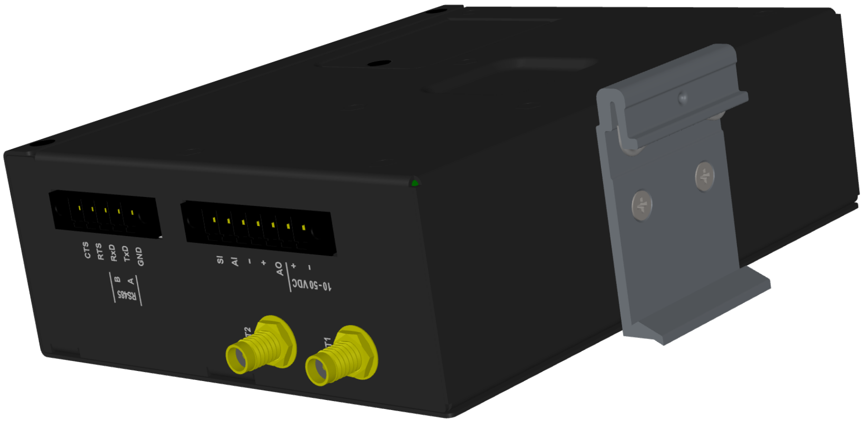


Fig. 4.1: DIN rail

Using this mounting M!DGE3 can be mounted in different angles (by 90° clockwise/counter clockwise).



For edged mounting to the DIN rail, Edge-bracket (optional accessory) is used. Use solely the M4×5 mm screws that are supplied.

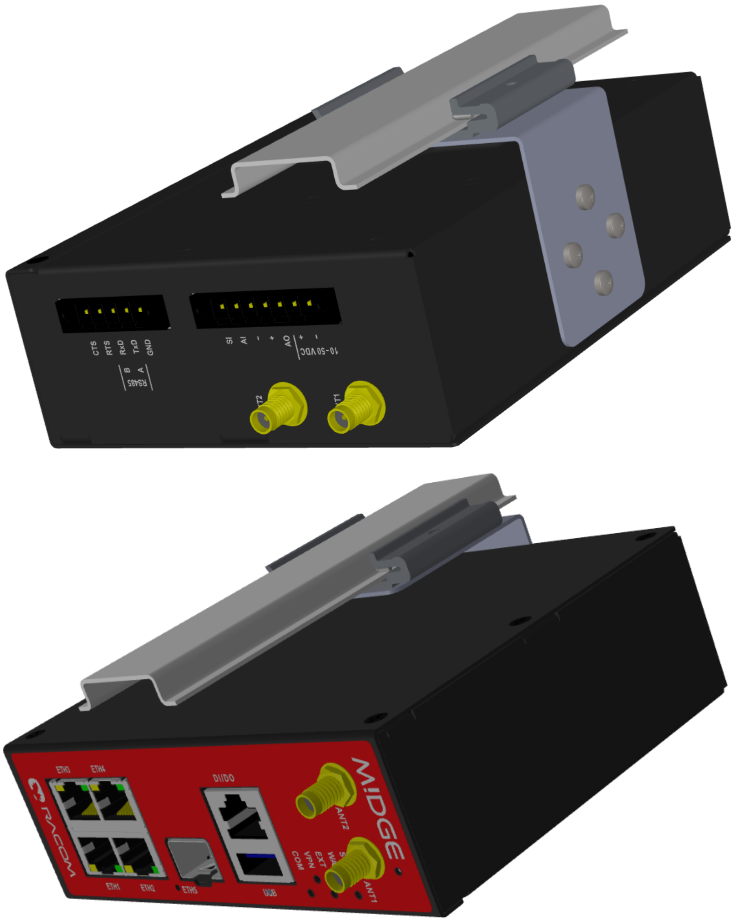


Fig. 4.2: Edged mounting to DIN rail

4.3.2. Flat mounting

For flat mounting directly to the support you must use the Flat bracket (an optional accessory). Use solely the M4×5 mm screws that are supplied.

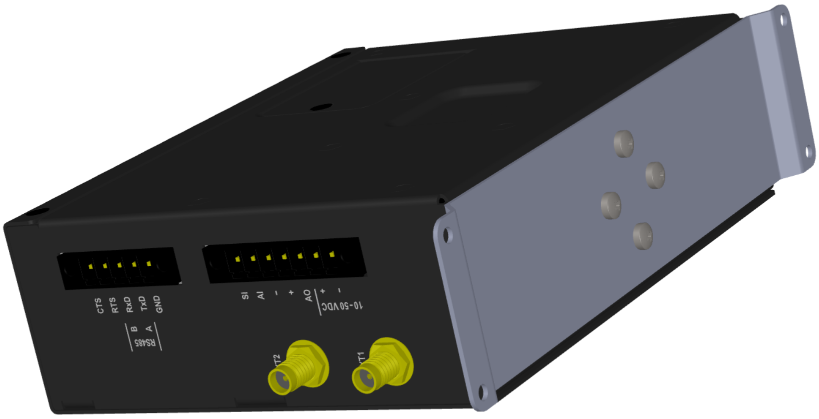


Fig. 4.3: Flat mounting using Flat bracket

4.4. Antenna installation

The type of antenna best suited for the individual sites of your network depends on the layout of the network and your requirements for signal level at each site.

The antenna should never be installed close to potential sources of interference, especially electronic devices like computers or switching power supplies.

Additional safety recommendations

Only qualified personnel with authorization to work at heights are entitled to install antennas on masts, roofs and walls of buildings. Do not install the antenna in the vicinity of electrical lines. The antenna and brackets should not come into contact with electrical wiring at any time.

The antenna and cables are electrical conductors. During installation electrostatic charges may build up which may lead to injury. During installation or repair work all open metal parts must be temporarily grounded.

The antenna and antenna feed line must be grounded at all times.

Do not mount the antenna in windy or rainy conditions or during a storm, or if the area is covered with snow or ice. Do not touch the antenna, antenna brackets or conductors during a storm.

4.5. Antenna feed line

The antenna feed line should be chosen so that its attenuation does not exceed 3 to 6 dB as a rule of thumb. Use 50 Ω impedance cables only.

The shorter the feed line, the better. If M!DGE3 is installed close to antenna, the data cable can be replaced by an Ethernet cable for other protocols utilizing the serial port, see *Section 7.1.3, “Terminal servers”*.

Always follow the installation recommendations provided by the cable manufacturer (bend radius, etc.). Use suitable connectors and install them diligently. Poorly attached connectors increase interference and can cause link instability.

4.6. Grounding

To minimize the odds of the transceiver and the connected equipment receiving any damage, a safety ground (NEC Class 2 compliant) should be used, which bonds the antenna system, transceiver, power supply, and connected data equipment to a single-point ground, keeping the ground leads short.

The M!DGE3 cellular router is generally considered adequately grounded if the supplied flat mounting brackets are used to mount the cellular router to a properly grounded metal surface. If the cellular router is not mounted to a grounded surface, you should attach a safety ground wire to one of the mounting brackets or a screw on cellular router’s casing.

If the antenna is installed outside the building, it is strongly recommended to install an appropriate lightning protection system where the antenna cable enters the building.

Note

All cabling, groundings and lightning protection must comply with the applicable standards and regulations.

4.7. Connectors

M!DGE3 uses standard connectors. Use only standard counterparts to these connectors.

You will find the pin-outs of connectors in *Section 2.2, “Connectors”*.

4.8. Power supply

We do not recommend switching on power supply of the M!DGE3 unit before connecting the antenna and other devices. Connecting the RTU and other devices to M!DGE3 while powered increases the likelihood of damage due to the discharge of difference in electric potentials.

M!DGE3 may be powered from any well-filtered 10 to 50 VDC power source. To avoid radio channel interference, the power supply must meet all relevant EMC standards. Never install a power supply close to the antenna. Connector (- pins) is internally connected to the casing of the M!DGE3 unit.

5. M!DGE3 in detail

5.1. Combination of IP and serial communication

M!DGE3 enables combination of IP and serial protocols within a single application.

Five independent terminal servers are available in M!DGE3. Terminal server is a virtual substitute for devices used as serial-to-TCP(UDP) converters. It encapsulates serial protocol to TCP(UDP) and vice versa eliminating the transfer of **TCP overhead** .

If the data structure of a packet is identical for IP and serial protocols, the terminal server can serve as a converter between TCP(UDP)/IP and serial protocols (RS232, RS485).

5.1.1. Detailed Description

Generally, a Terminal server (also referred to as Serial server) enables connection of devices with a serial interface to a M!DGE3 over the local area network (LAN). It is a virtual substitute for the devices used as serial-to-TCP(UDP) converters.

Examples of the use:

A SCADA application in the center should be connected to the network via serial interface, however, for some reason that serial interface is not used. The operating system (e.g. Windows) can provide a virtual serial interface to such application and converts the serial data to TCP (UDP) datagrams, which are then received by the terminal server in M!DGE3. This type of connection between M!DGE3 SCADA and application is beneficial in the following circumstances:

- There is no hardware serial interface on the computer
- Serial cable between M!DGE3 and computer would be too long. E.g. the M!DGE3 is installed very close to the antenna to reduce feed line loss.
- LAN already exists between the computer and the point of installation

In special cases, the Terminal server can reduce network load from TCP applications. A TCP session can be terminated locally at the Terminal server in M!DGE3. User data are extracted from the TCP messages and processed as if it came from a COM port. When the data reaches the destination M!DGE3, it can be transferred to the RTU either via the serial interface or via TCP (UDP), using the Terminal server again. Please note, that M!DGE3 Terminal server implementation also supports the dynamical IP port change in every incoming application datagram. In such a case the M!DGE3 sends the reply to the port from which the last response has been received. This feature allows to extend the number of simultaneously opened TCP connections between the M!DGE3 and the locally connected application up to 10 on each Terminal server.

6. Web interface

M!DGE3 can be easily managed from your computer using a web browser. If there is an IP connection between the computer and the respective M!DGE3, you can simply enter the IP address of any M!DGE3 in the network directly in the browser address line and log in. However, it is not recommended to manage an over-the-air connected M!DGE3 in this way, because high amounts of data would have to be transferred over the Cellular channel.

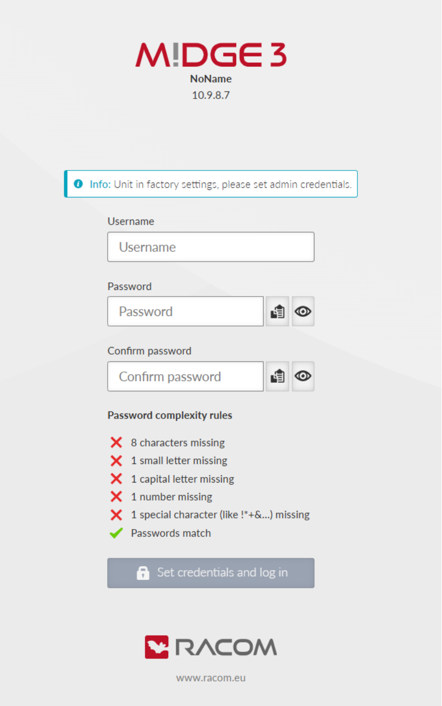
When you need to manage an over-the-air connected M!DGE3 (recommended), log-in to a M!DGE3, which your computer is connected to using either a cable (via LAN) or a high-speed WAN. The M!DGE3 which you are logged-in to in this way is called Local. Then you can manage any remote M!DGE3 in the network over-the-air in a throughput-saving way: all the static data (e.g. Web page graphic objects) is downloaded from the Local M!DGE3 and only information specific to the remote unit is transferred over the Cellular channel. M!DGE3 accessed in such a way is called Remote.

You can also connect to a RipEX2 unit to the hybrid networks in a same way.

For the sake of security only HTTPS protocol is used for the connection between the web browser and M!DGE3 unit. If the http://... is used into the web browser address line, the communication is immediately automatically redirected to HTTPS protocol.

For better protection against unauthorized access to the network there is a timer build within the M!DGE3 unit and the web interface (set to 24 hours by default), which is monitoring user activity. In case of user inactivity, the connection between the web interface and the unit will be interrupted (i.e. automatic logout). Timer is automatically launched in parallel both In the unit and in the web browser. In case of changing the timer setting, we recommend to logout and login, so the correct initialization of timeout inactivity can occur.

First time login page



M!DGE3

NoName

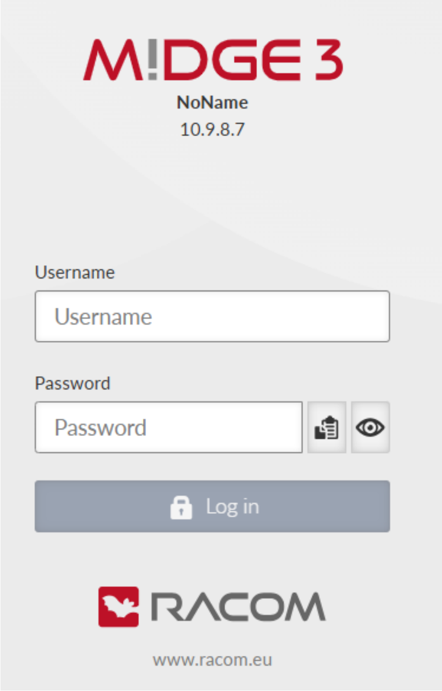
10.9.8.7

Info: Unit in factory settings, please set admin credentials.

Password complexity rules

- ✗ 8 characters missing
- ✗ 1 small letter missing
- ✗ 1 capital letter missing
- ✗ 1 number missing
- ✗ 1 special character (like !*+&...) missing
- ✓ Passwords match

Login page

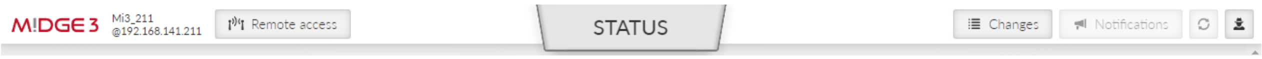


Note
Web interface for M!DGE3 is identical to RipEX2.

The login page informs you about the Unit name and IP address of the M!DGE3 unit you are trying to log in.
The login page allows to view and copy the password.
Web interface is designed for usage on all kinds of equipment - with different screen sizes and screen resolutions. Most of the pictures depicted in this User manual are taken on the desktop type of screen resolution.

Note
A mechanism against brute-force attack is implemented. When wrong combination of the Account / Password is entered you have to wait a while for the following attempt. The time is growing with every wrong attempt.

Web page header



The header of each web page contains:

- Unit name
- IP address of the M!DGE3 unit you are connected to
- Remote access button
- Identification of the current web page (2nd or 3rd level of the menu)
- Changes to commit button
- Notifications button

- Refresh settings button
- User menu button

6.1. Supported web browsers

Supported web browsers for desktop are current versions of:

- Edge
- Chrome
- Firefox
- Safari

Supported Web browsers for mobile equipment are current versions of:

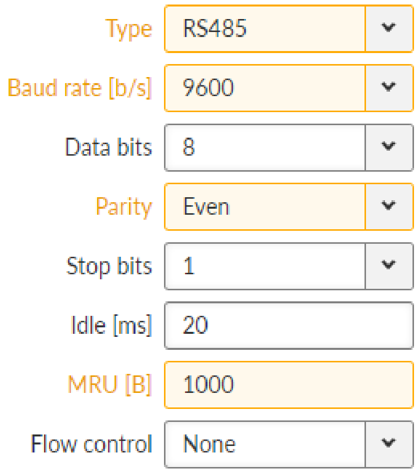
- Safari for iOS
- Chrome for Android

Note

For safety reasons, it is recommended to use a web browser without any extensions (especially extensions, which could get access to data).

6.2. Changes to commit

M!DGE3 is capable of remembering changes, which were done in its configuration and collecting them in a Changes to commit "basket". All changes of configuration parameters are highlighted by different color.



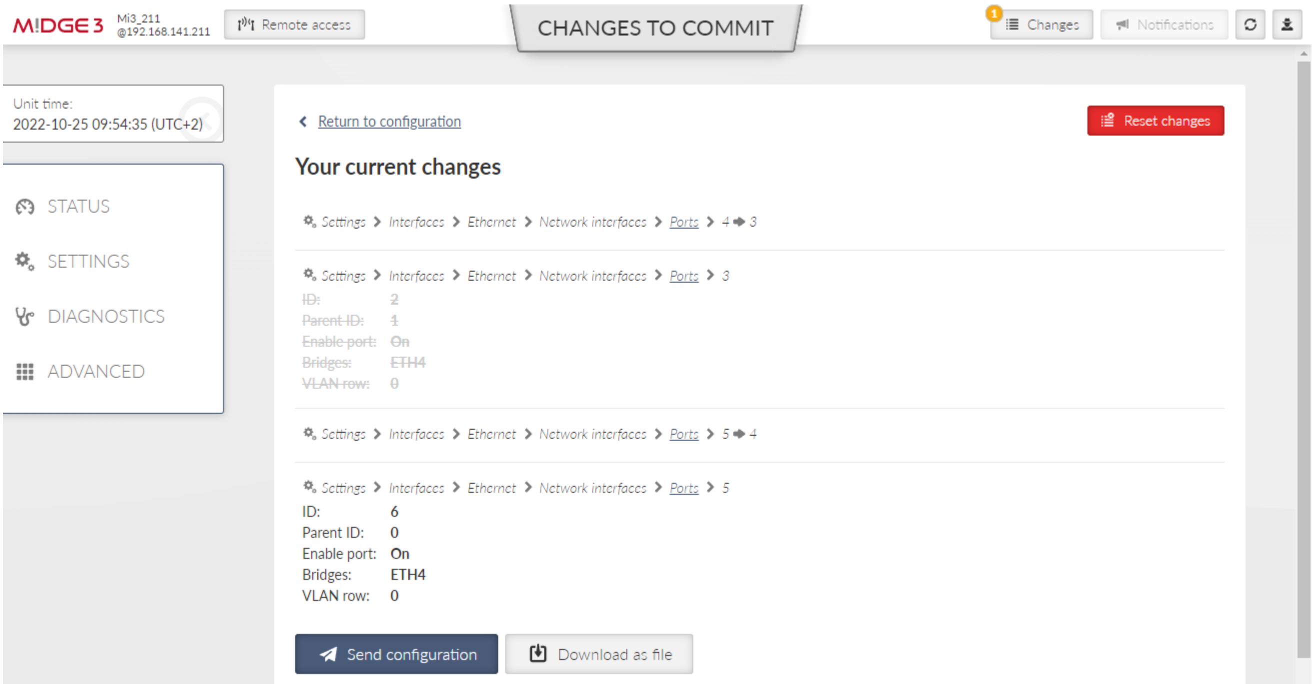
Type	RS485
Baud rate [b/s]	9600
Data bits	8
Parity	Even
Stop bits	1
Idle [ms]	20
MRU [B]	1000
Flow control	None

To access the Changes to commit "basket", click on the Changes button (top right corner in the Web page header) or use "Ctrl+Alt+C" shortcut.

Changes to commit "basket" collects all changed settings, which:

- Are separated in the menu alphabetically. Alphabetical separation is sorted hierarchically according to the name of items in the menu.

- Are displayed in the menu (including the path of their placement) and provided with a link for a quick transfer to its original placement.
- Carry an information about their changed values ("Old value" → "New value").



Unit time:
2022-10-25 09:54:35 (UTC+2)

Your current changes

Settings > Interfaces > Ethernet > Network interfaces > Ports > 4 ➡ 3

Settings > Interfaces > Ethernet > Network interfaces > Ports > 3

~~ID:~~	~~2~~
~~Parent ID:~~	~~1~~
~~Enable port:~~	~~On~~
~~Bridges:~~	~~ETH4~~
~~VLAN row:~~	~~0~~

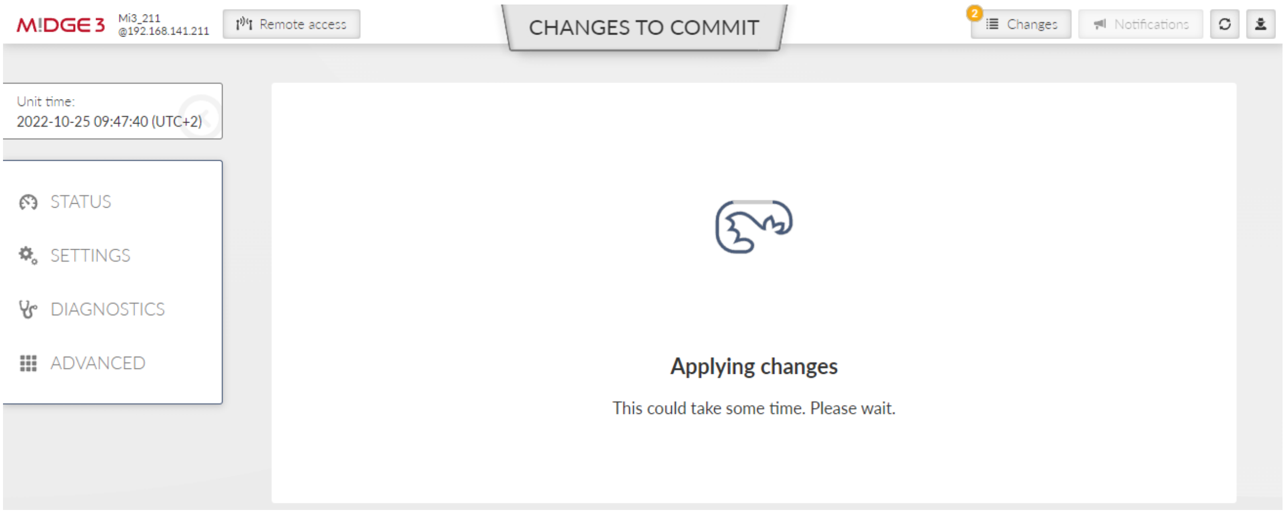
Settings > Interfaces > Ethernet > Network interfaces > Ports > 5 ➡ 4

Settings > Interfaces > Ethernet > Network interfaces > Ports > 5

ID:	6
Parent ID:	0
Enable port:	On
Bridges:	ETH4
VLAN row:	0

From this page, it is possible to:

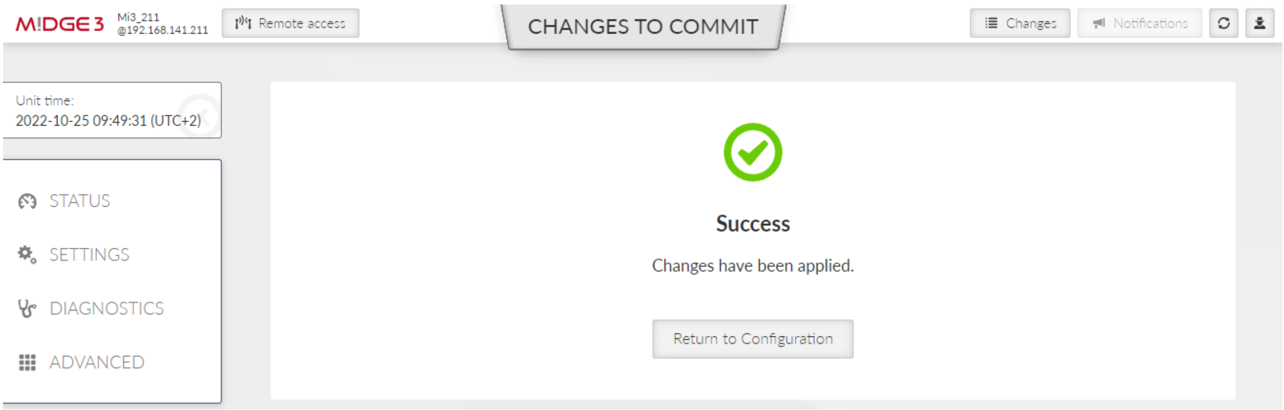
- Return to configuration - return to the last changed value's configuration menu.
- Reset changes - all changes will be reset back to their previously set value (not default).
- Send configuration - Apply (Save to the unit) all the changes.



Unit time:
2022-10-25 09:47:40 (UTC+2)

Applying changes

This could take some time. Please wait.



Unit time:
2022-10-25 09:49:31 (UTC+2)

Success

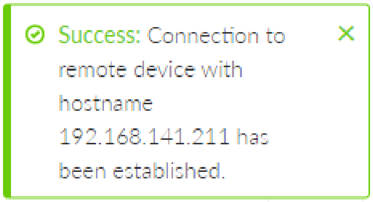
Changes have been applied.

6.3. Notifications

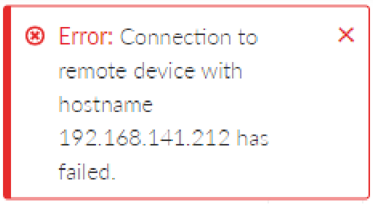
With M!DGE3 new way of showing important system events to the user is introduced. It is called Notification Center and is used consistently throughout the interface. Notification Center is located on the top right corner of the interface. It exists in two forms: active notification display and full Notification Center. Both the active notification display and the full Notification Center are displayed either below the top header of the interface or in the right hand sidebar depending on the size of user's display. The behavior is responsive so in case the user needs to make the browser window narrower, the notification center automatically changes place to use the most efficient location.

Note

To access Notifications it is possible to use shortcut "Ctrl+Alt+N".



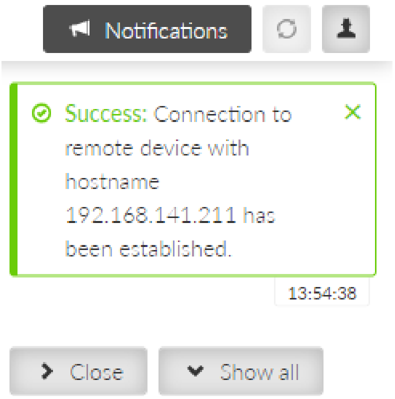
Success: Connection to remote device with hostname 192.168.141.211 has been established.



Error: Connection to remote device with hostname 192.168.141.212 has failed.

Notifications are mostly triggered by user actions in the interface, for example success or failure of Fast Remote Access connection. They are not to be confused with Events, which are triggered mostly by the system and are not shown in the Notification Center, but on Diagnostics > Events page. In other words Notifications are caused by the user, Events are caused by changing status of the unit.

Every new notification is displayed in the Notification Center drawer. User can either dismiss the notification by clicking the cross in the notification body, close all displayed notifications in the drawer or expand full Notification Center using buttons (“Close all” and “Show all”) on the right side of the Notification Center drawer.

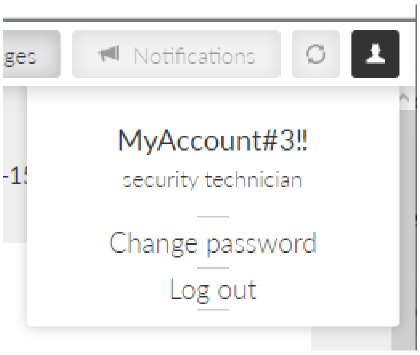


Success: Connection to remote device with hostname 192.168.141.211 has been established.

13:54:38

Notification Center collects all notifications that have not been dismissed and allows users to browse them.

6.4. User menu



MyAccount#3!!

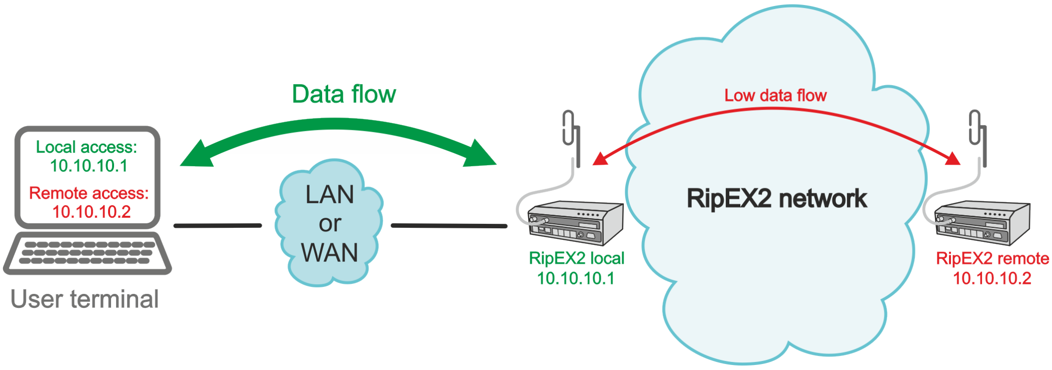
security technician

6.5. Remote access

M!DGE3 unit management is designed to work smoothly even when the unit under configuration is connected via relatively slow channel. In case of locally connected unit - direct configuration of the unit (accessing the unit IP address directly from the web browser) works fine. If the unit should be connected remotely via the network, the so-called "Remote access" needs to be used to configure and manage remote unit using bandwidth friendly volumes of transmitted data. Open the web browser, enter the IP address of a locally connected unit and connect to a remote unit (which needs to be accessible from the locally connected unit via the network).

Note

To access Remote access it is possible to use shortcut "Ctrl+Alt+R".



M!DGE3 local unit must have the newest firmware version in the whole network to ensure proper Remote access functionality. Nevertheless it is recommended to keep the same version of firmware in the whole network. See details in chapter *Section 7.6.5, “Firmware”*

Remote access can be activated by clicking on the Connect access button.

Once the Remote access is successful, the IP address line changes its color to black together with the web page identification.

The IP address of the currently connected M!DGE3 unit is displayed as a part of the Remote access button. All the configuration settings are remotely available using standard web interface. Some of the Diagnostic features are available via local connection only.

Remote access connection can be established directly by entering the IP address of the Remote unit as an additional parameter into the URL. The required format is:
https://LOCAL_UNIT_IP_ADDRESS?remoteAccessTarget=REMOTE_UNIT_IP_ADDRESS

for example: https://192.168.141.210?remoteAccessTarget=10.10.10.212

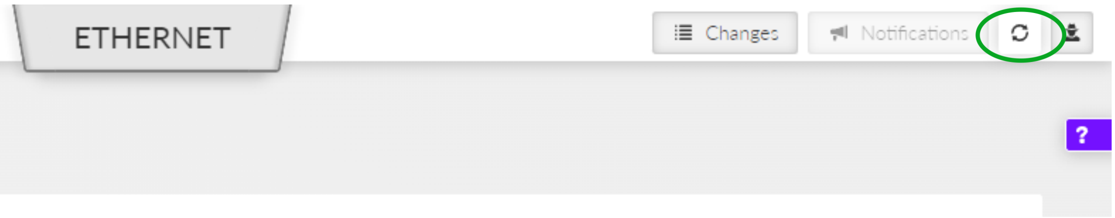
Note

It is possible to use this URL format to make a web browser’s bookmark. Such bookmarks can be used for faster access to remote units.

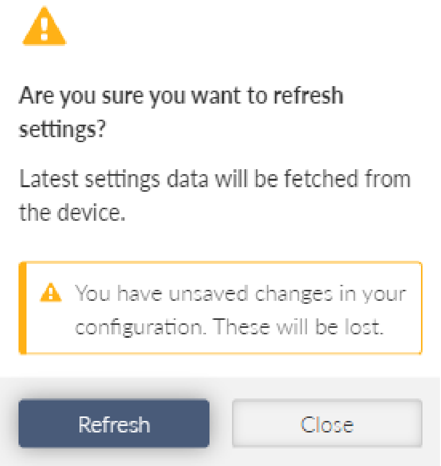
By default, remote access utilizes the **_RO_Rmt_Access_Host_Key** for establishing connections to remote units. However, for enhanced security purposes, we strongly recommend utilizing a custom **RMTACCESS Key** (menu SETTINGS > Security > Credentials).

6.6. Refresh settings

Refresh settings button (placed in the right corner of the web page header) triggers a feature which assures the user that he is working with current data.



Triggering the Refresh will upload current data from the unit to the web client.



Are you sure you want to refresh settings?

Latest settings data will be fetched from the device.

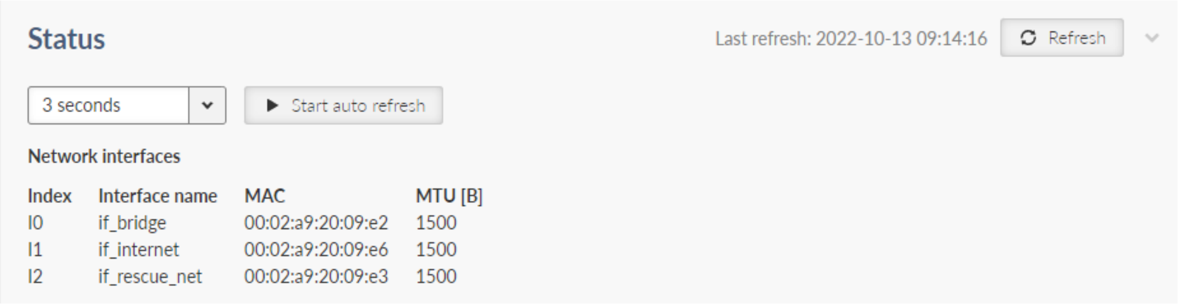
⚠ You have unsaved changes in your configuration. These will be lost.

Note

Refresh deletes all non-saved changes which were done in the client.

6.7. Status info area

Status info area provides a general overview about M!DGE3's individual SETTINGS (or DIAGNOSTICS) section by displaying diagnostic data relevant to the section. To update the data it is necessary to click the Refresh button. It is also possible to use auto refresh feature (Start auto refresh button), which automatically triggers Refresh after defined time period (3, 4, 5... 300 seconds).



Status

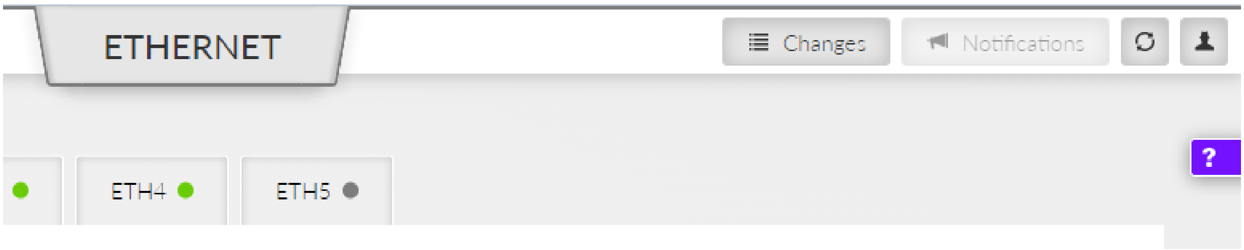
Last refresh: 2022-10-13 09:14:16

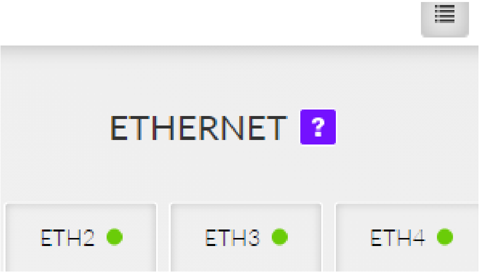
Network interfaces

Index	Interface name	MAC	MTU [B]
I0	if_bridge	00:02:a9:20:09:e2	1500
I1	if_internet	00:02:a9:20:09:e6	1500
I2	if_rescue_net	00:02:a9:20:09:e3	1500

6.8. Help

This feature is available on individual web pages of the graphical user interface by clicking on the purple box with the question mark on the right upper corner (or in the middle) of the screen (according to the width of the screen).





The content of the help is identical with the respective sub-chapter of the User manual.

6.9. Shortcuts

Tab. 6.1: Table of shortcuts

Shortcut	Access to
Ctrl+Alt+R	Remote Access
Ctrl+Alt+O	Diag>Overview
Ctrl+Alt+C	Changes
Ctrl+Alt+N	Notifications

7. Settings

Information provided in this chapter is identical with the content of Helps for individual menu. which will be gradually added on all screens.

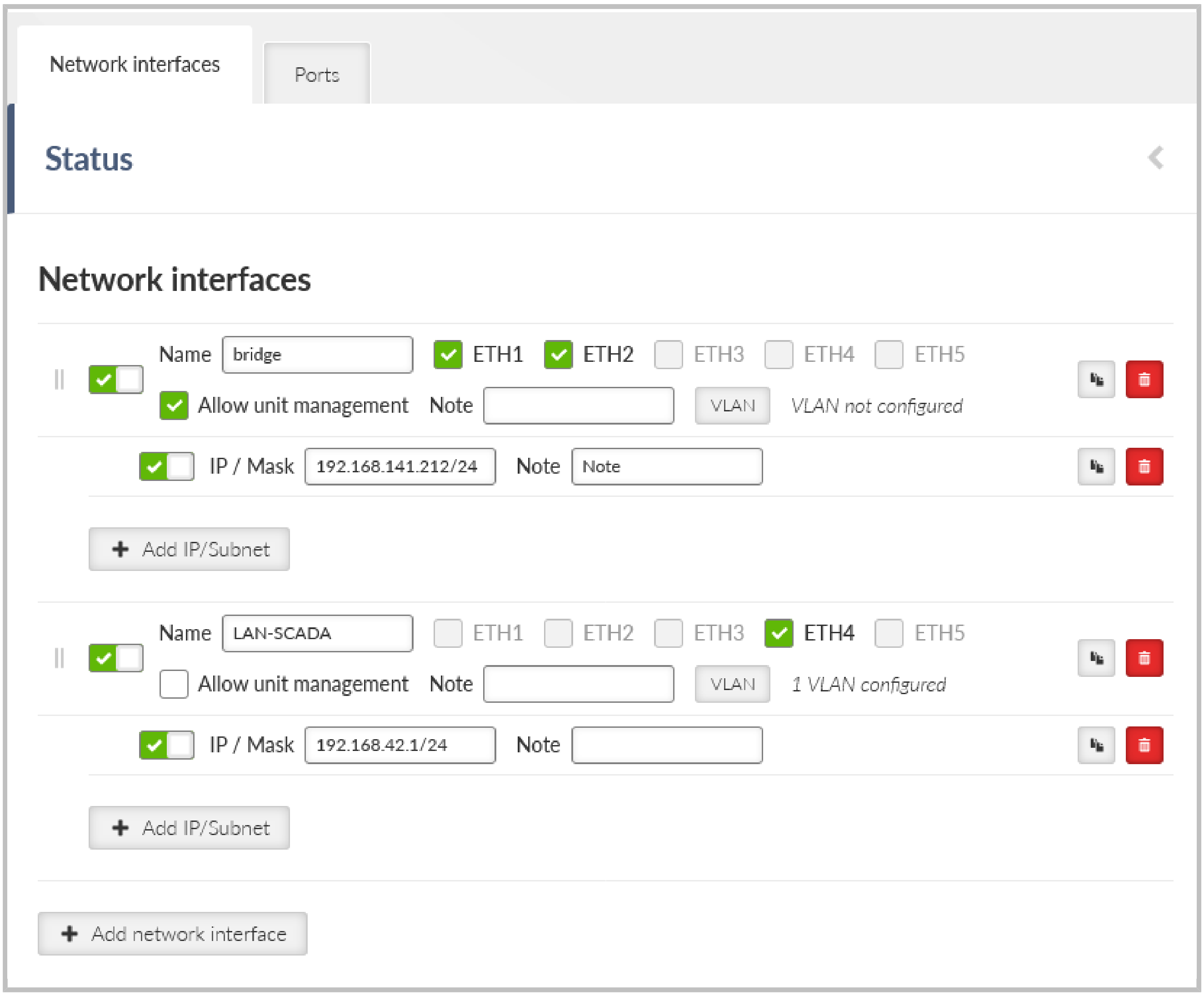
7.1. Interfaces

7.1.1. Ethernet

M!DGE3 provides 5 physical Ethernet ports ETH1, ETH2, ETH3, ETH4 and ETH5. ETH1 - ETH4 ports are metallic. ETH5 port is an SFP port. There is a possibility to define an Ethernet bridge - a logical Network interface - by bridging (joining) together multiple physical Ethernet interfaces. All interfaces bridged together share the same traffic.

7.1.1.1. Network interfaces

The Network interface (technically - an Ethernet bridge) is identified by a name. The name always begins with a "LAN-" prefix. Multiple Network interfaces can be defined. Multiple physical Ethernet interfaces can be bridged together by using single Network interface.



Network interfaces

☑ Name: bridge — ☑ ETH1 ☑ ETH2 □ ETH3 □ ETH4 □ ETH5
☑ Allow unit management — Note: — VLAN — *VLAN not configured*
☑ IP / Mask: 192.168.141.212/24 — Note: Note

☑ Name: LAN-SCADA — □ ETH1 □ ETH2 □ ETH3 ☑ ETH4 □ ETH5
□ Allow unit management — Note: — VLAN — *1 VLAN configured*
☑ IP / Mask: 192.168.42.1/24 — Note:

Fig. 7.1: SETTINGS > Interfaces > Ethernet > Nework interfaces

The cellular unit default setting bridges all Ethernet ports together. New Network interfaces can be defined to split the Ethernet traffic of the individual ports. Any single Ethernet port can be detached from an existing Network interface and added to another Network interface.

Single or multiple Ethernet subnets can be defined within one Network interface. Each subnet is identified by its IP / mask. Use the optional parameter Note to keep your network configuration in human readable manner.

Enable / Disable

Enables / disables the Network interface.

Name

Mandatory name of the Network interface.

ETH1 - ETH5

Range on Ethernet ports selected within the specific Network interface.

Note
If the Network interface has set up either a Radio interface or GRE L2 tunnel, it does not require any ETH ports.

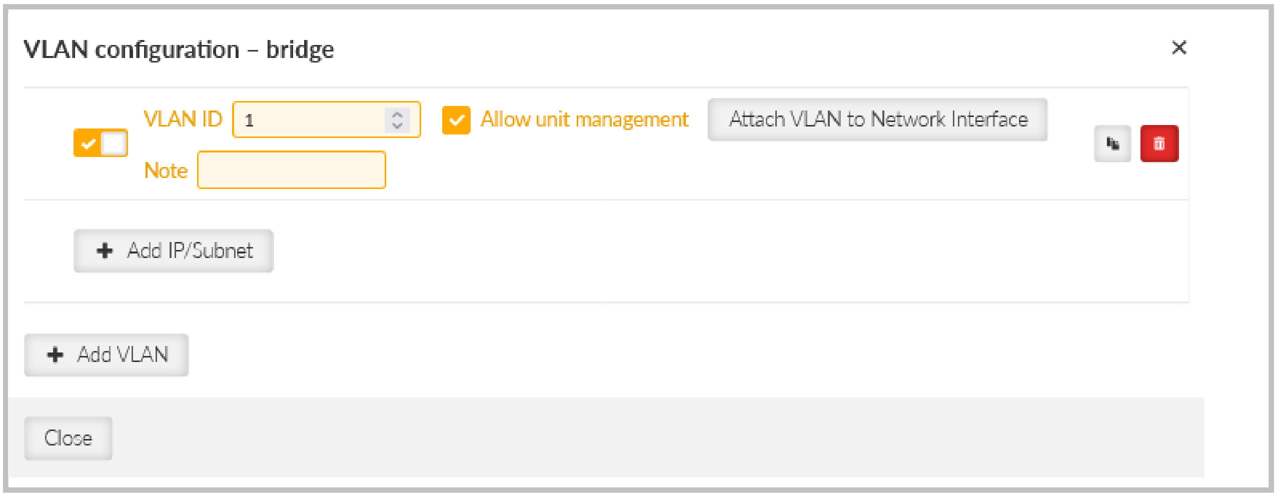
Allow unit management
Enables / disables unit management for the specific Network interface.

Add IP/Subnet
Adds defined subnet to the Network interface.

IP / Mask
IP / mask of the specific Ethernet subnet (in CIDR notation). IP address represents the Network interface in the Layer 3 Ethernet network.

Note
Optional comment.

VLAN
Each Network interface can have one or more attached VLANs with one or more Subnets.



Enable / Disable
Enables / disables VLAN.

VLAN ID
Number {0 – 4094}, default = 1
Specifies the VLAN ID according to IEEE 802.1Q

Allow unit management
Allows / denies unit management for the specific VLAN. This switch is not connected with the Network interface switch with the same name, so only this VLAN can be used for diagnostics.

VLAN priority mapping
Relates to QoS

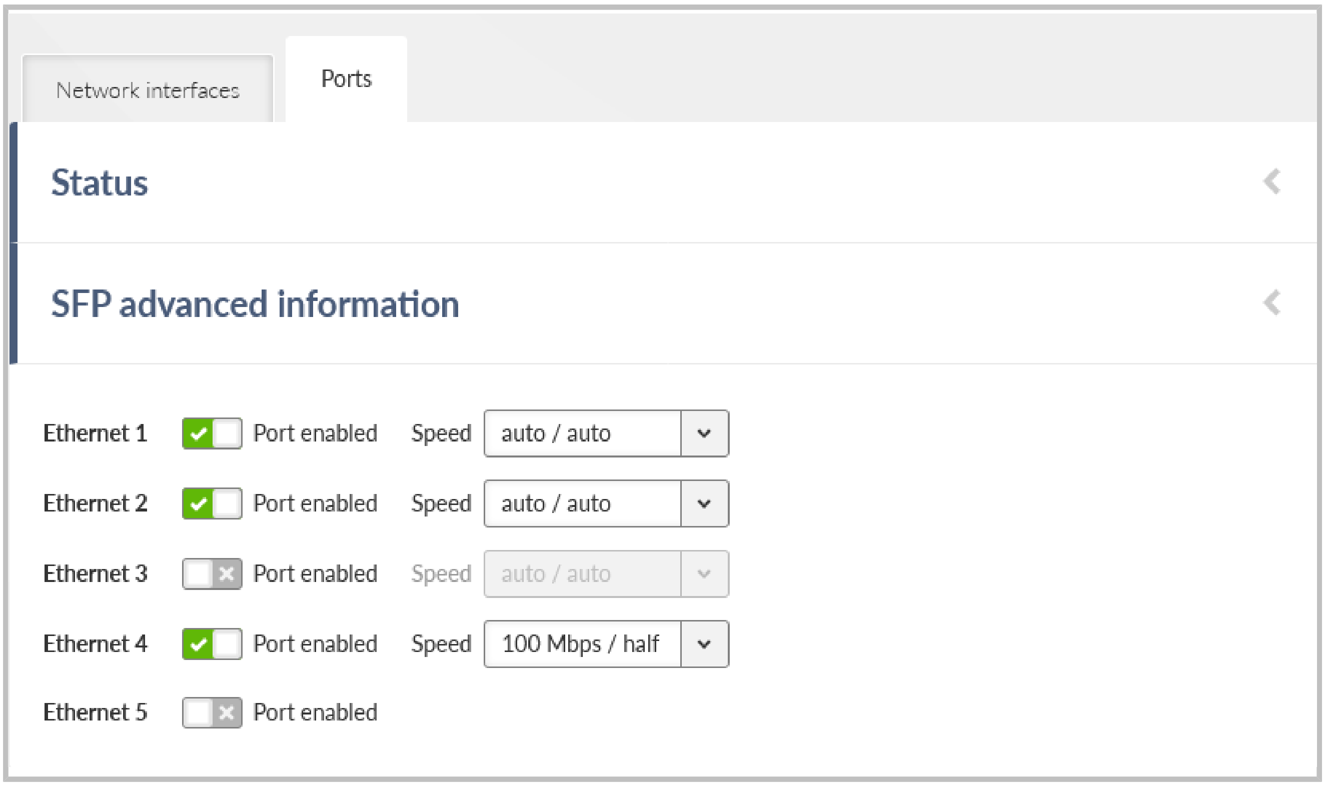
Attach VLAN to Network interface
Attaches VLAN to the defined network interface

Note
Optional comment.

Add IP/Subnet

Adds defined subnet to the VLAN.

7.1.1.2. Ports



Ethernet 1	☑ Port enabled	Speed	auto / auto
Ethernet 2	☑ Port enabled	Speed	auto / auto
Ethernet 3	☒ Port enabled	Speed	auto / auto
Ethernet 4	☑ Port enabled	Speed	100 Mbps / half
Ethernet 5	☒ Port enabled		

Fig. 7.2: SETTINGS > Interfaces > Ethernet > Ports

Enable / Disable

Enables / Disables ETH ports (1 - 5) SW control.

ETH1 - ETH4 speed

List box {auto / auto; auto / full; auto / half; 1000 Mbps / auto; 1000 Mbps / full; 1000 Mbps / half; 100 Mbps / auto; 100 Mbps / full; 100 Mbps / half; 10 Mbps / auto; 10 Mbps / full; 100 Mbps / half}, default = "auto / auto"

Defines the speed and half / full duplex traffic.

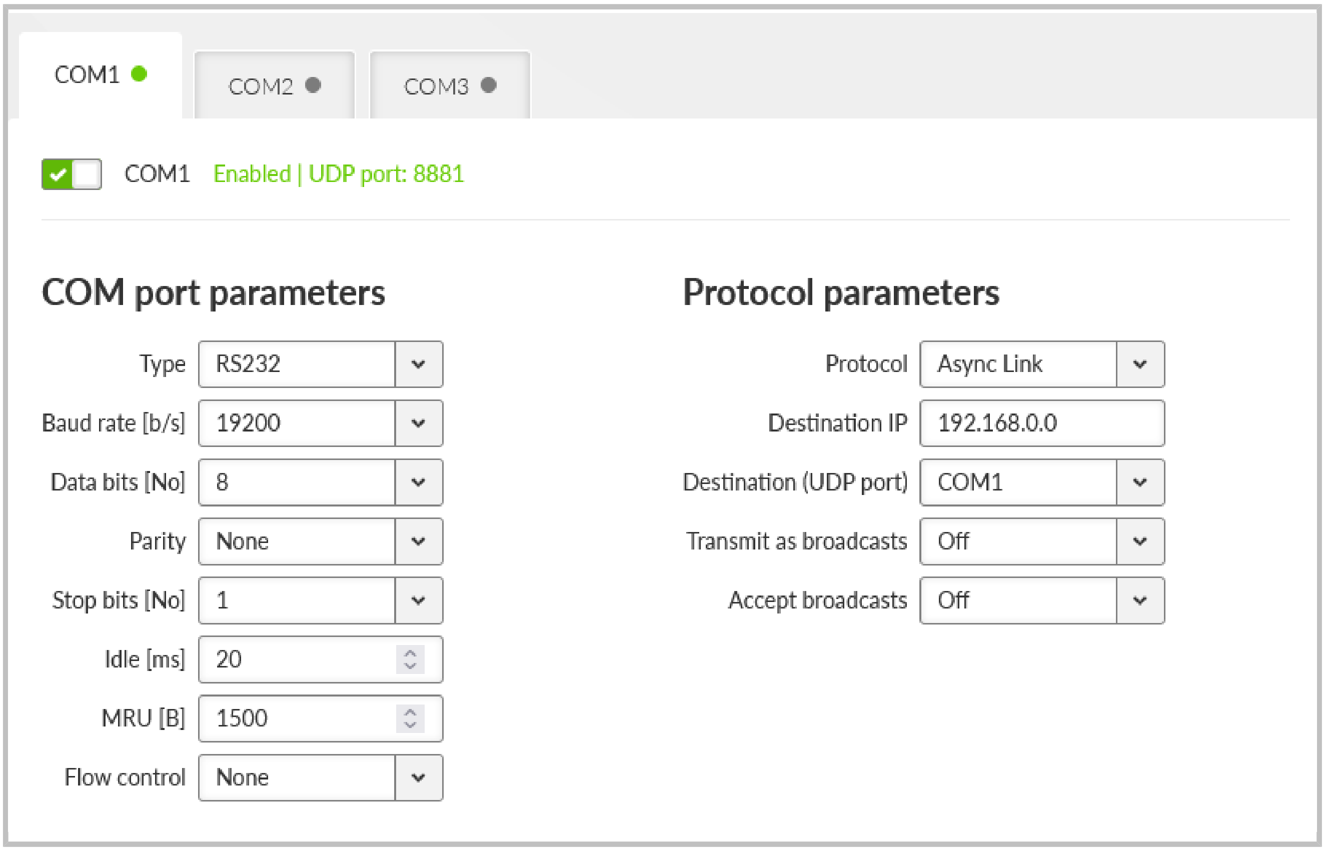
Note

When several bridges are interconnected in the network, it is appropriate to switch on Spanning Tree Protocol (ADVANCED > Interfaces > Ethernet > STP) to prevent bridge loops and build a loop-free logical topology.

7.1.2. COM

Data incoming to the M!DGE3 unit from the COM port are received by the Protocol module. The Protocol module behavior depends on the Protocol selected. the incoming frame from the COM port is processed by the Protocol module, translated into UDP frame, forwarded to the M!DGE3 router module and further processed according to router rules. Such UDP frames received by the M!DGE3 unit from the M!DGE3 network (based on the unit IP address and UDP port of the Protocol module) are translated into original frame format (by the Protocol module) and send out through the COM port.

When extension module "C" is installed, two additional COM ports (RS232) are available. Their setting is similar to the COM1 port.



☑ COM1 Enabled | UDP port: 8881

COM port parameters

Type	RS232
Baud rate [b/s]	19200
Data bits [No]	8
Parity	None
Stop bits [No]	1
Idle [ms]	20
MRU [B]	1500
Flow control	None

Protocol parameters

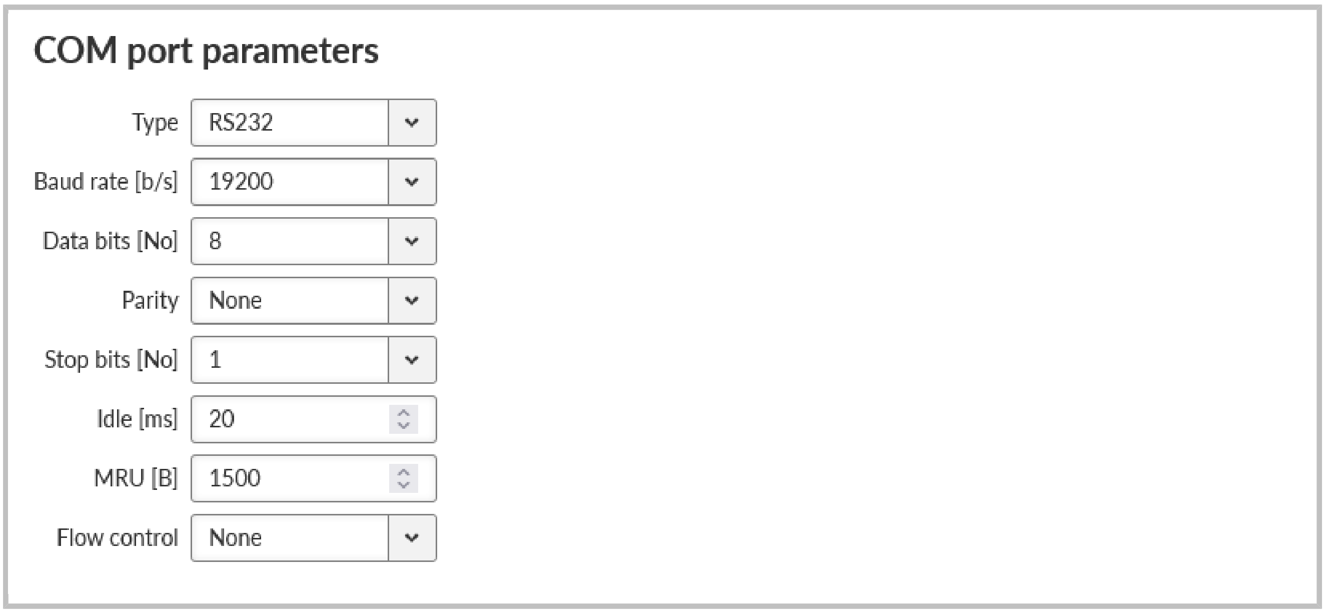
Protocol	Async Link
Destination IP	192.168.0.0
Destination (UDP port)	COM1
Transmit as broadcasts	Off
Accept broadcasts	Off

Fig. 7.3: SETTINGS > Interfaces > COM

The menu is divided to two parts:

7.1.2.1. COM port parameters

This settings of Baud rate, Data bits, Parity and Stop bits of COM port and setting of connected device must match.



COM port parameters

Type	RS232
Baud rate [b/s]	19200
Data bits [No]	8
Parity	None
Stop bits [No]	1
Idle [ms]	20
MRU [B]	1500
Flow control	None

Type

List box {possible values}, default = "RS232"
COM port can be configured to either RS232 or RS485.

Baud rate [b/s]

List box {standard series of rates from 600 to 1152000 b/s}, default = "19200"
Select Baud rate from the list box: 600 to 1152000 b/s rates are available.
Serial ports use two-level (binary) signaling, so the data rate in bits per second is equal to the symbol rate in bauds.

Data bits

List box {5; 6; 7; 8}, default = 8, for COM3 (optional) only 8
The number of data bits in each character.

Parity

List box: {None; Odd; Even}, default = "None"
Wikipedia: Parity is a method of detecting errors in transmission. When parity is used with a serial port, an extra data bit is sent with each data character, arranged so that the number of 1-bits in each character, including the parity bit, is always odd or always even. If a byte is received with the wrong number of 1-bits, then it must have been corrupted. However, an even number of errors can pass the parity check.

Stop bits

List box {1; 2 (1.5)}, default = 1, for COM3 (optional) only 1, for 5 data bits the 1.5 length of stop bits is used instead of 2
Wikipedia: Stop bits sent at the end of every character allow the receiving signal hardware to detect the end of a character and to resynchronize with the character stream.

Idle [ms]

Number {10 – 16383}, default = 20
This parameter defines the maximum gap (in milliseconds) in the received data stream. If the gap exceeds the value set, the link is considered idle, the received frame is closed and forwarded to the network.

MRU [B]

Number {1 – 2047}, default = 1500

MRU (Maximum Reception Unit) — an incoming frame is closed at this size even if the stream of bytes continues. Consequently, a permanent data stream coming to a COM results in a sequence of MRU-sized frames sent over the network.

Note

2. This MRU and the MTU in Cellular settings are independent, however MTU should be greater or equal to MRU.

Flow control

List box {None; RTS/CTS}, default = "None"

RTS/CTS (Request To Send / Clear To Send) hardware flow control (handshake) between the DTE (Data Terminal Equipment) and M!DGE3 (DCE - Data Communications Equipment) can be enabled in order to pause and resume the transmission of data. If RX buffer of M!DGE3 is full, the CTS goes down.

Note

RTS/CTS Flow control requires a 5-wire connection to the COM port.

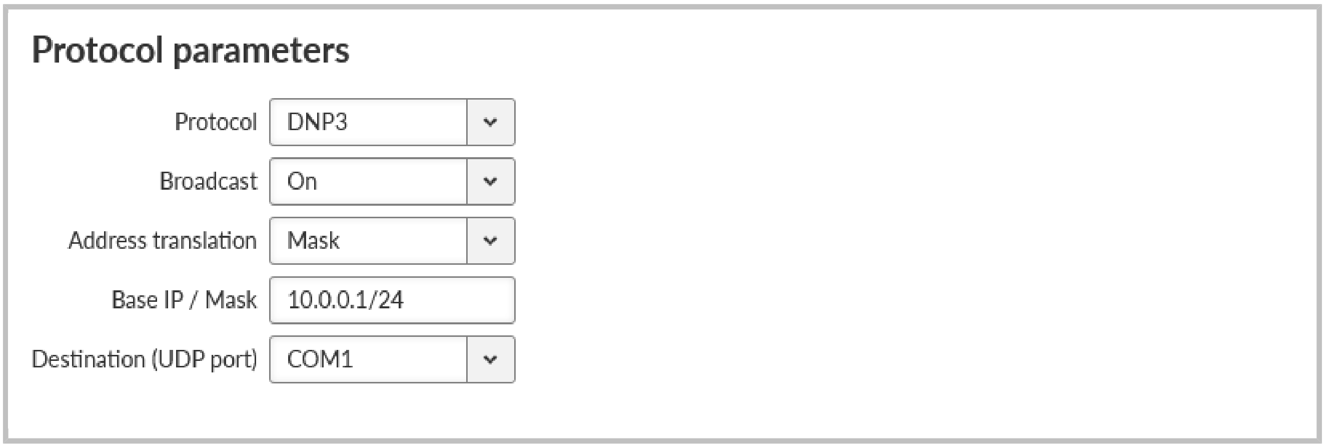
Buffer flush time [ms]

Number {0 – 65535}, default = 0

This parameter can be used to prevent unwanted deadlock of the serial communication. The timer is reset by every received or transmitted packet over the COM port. When the timer expires, the protocol status is reset and the packet buffer is cleared. Setting parameter to 0 disables the feature. This parameter is available only via ADVANCED menu.

7.1.2.2. Common Protocol parameters

Each SCADA protocol used on serial interface is more or less unique. The COM port protocol module performs conversion to standard UDP datagrams to travel across M!DGE3 Cellular network. The same settings are valid for Terminal servers as well (for more details about TS see *Section 7.1.3, “Terminal servers”*).



Protocol parameters

Protocol	DNP3
Broadcast	On
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1

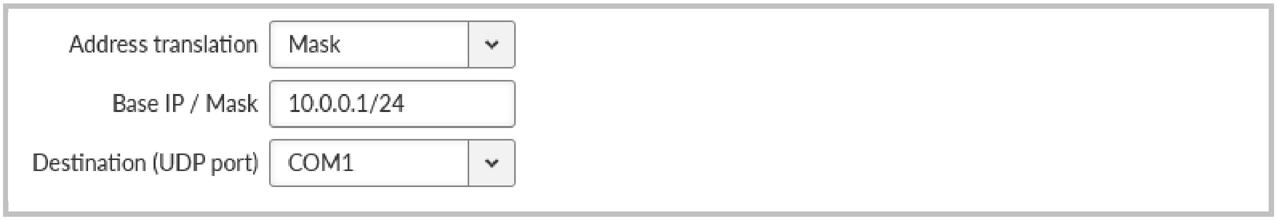
Protocol

List box {None; Async Link; COMLI; DNP3; DF1; IEC101; Mars-A; Modbus RTU; PR2000; RDS; S3964R; SAIA S-BUS; UNI}, default = "None"

Address translation

List box {Mask; Table}, default = "Mask"

SCADA protocol address is translated to the IP address using either Mask (common rule for all addresses) or Table (specific rule per address) type of conversion



Address translation: Mask

Base IP / Mask: 10.0.0.1/24

Destination (UDP port): COM1

Base IP / Mask

A part of Base IP address defined by this Mask is replaced by 'Protocol address'. The SCADA protocol address is typically 1 byte long, so Mask 24 (255.255.255.0) is most frequently used. This IP address is used as a destination IP address of the UDP datagram into which the serial SCADA packet received from COM is encapsulated.

Destination UDP port

List box {Manual; COM1 – COM3; TS1 – TS5}, default = "COM1"

The same UDP port will be used for all destination. This UDP port is used as the destination UDP port in UDP datagram in which serial SCADA packet received from COM is encapsulated. Default UDP ports for COM or Terminal servers can be used or UDP port can be set manually. If the destination IP address belongs to a M!DGE3 and the UDP port is not assigned to COM or to a Terminal server or to any other special SW module running in the destination M!DGE3, the packet is discarded.

Note

Default UDP port for serial interface in M!DGE2 is 8882. Keep this in mind if combining M!DGE2 with M!DGE3/RipEX2.

Protocol address (from)

This is the address which is used by SCADA protocol.

The typical Protocol address length is 1 Byte. Some protocols, e.g. DNP3 are using 2 Bytes long addresses.

Protocol address (to)

Several consecutive SCADA addresses shall be translated using one rule.

IP address (base)

IP address to which Protocol address will be translated. This IP address is used as a destination IP address of the UDP datagram into which the serial SCADA packet received from COM is encapsulated. When several addresses are used, this will be the first IP address, the following one will have +1 etc.

Destination (UDP port)

List box {MANUAL; COM1 – COM3; TS1 – TS5}, default = "COM1"

This is UDP port number which is used as destination UDP port into UDP datagram in which the serial SCADA message, received from COM, is encapsulated. Different Destination UDP ports can be used in different rules.

Address translation: Mask

Note

All IP addresses used have to be within the same subnet, which is defined by this Mask

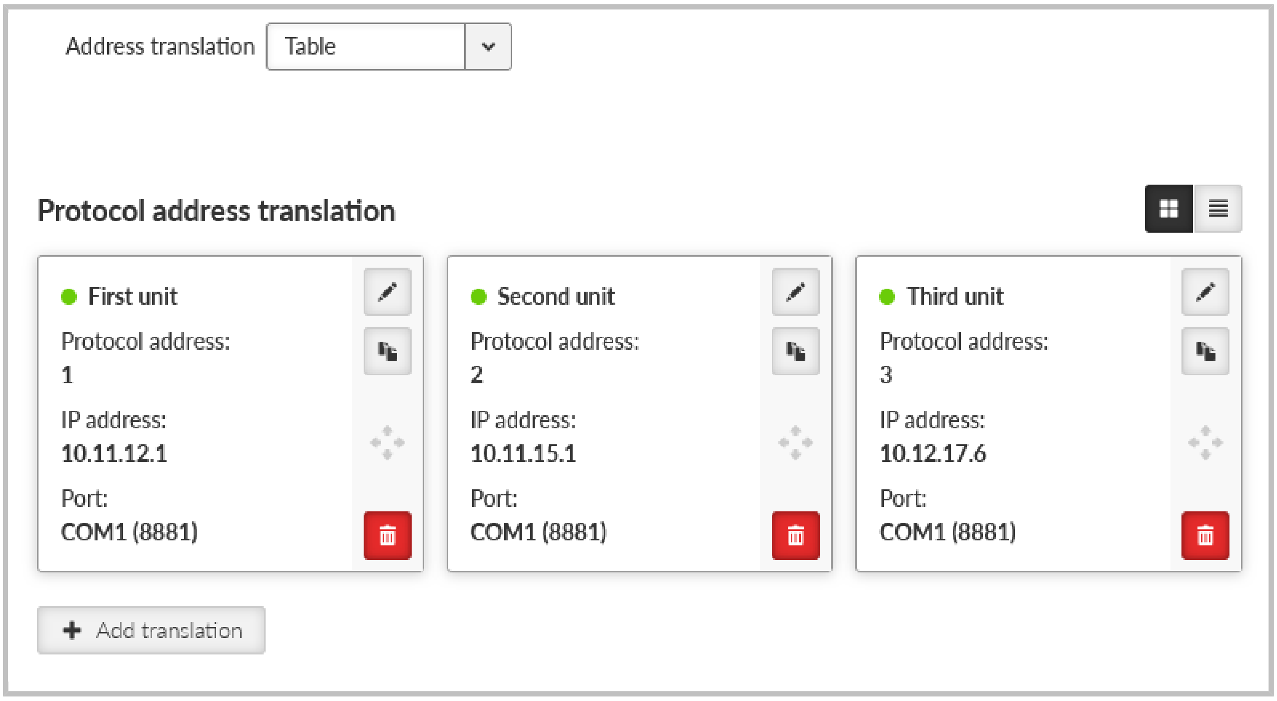
The same UDP port is used for all the SCADA units, which results in the following limitations:

SCADA devices on all sites have to be connected to the same interface

Only one SCADA device to one COM port can be connected, even if the RS485 interface is used.

Address translation: Table

The Address translation is defined in a table. There are no limitations such as when the "Mask" translation is used. If there are more SCADA units connected via the RS485 interface, their multiple "Protocol addresses" are translated to the same IP address and UDP port pair.



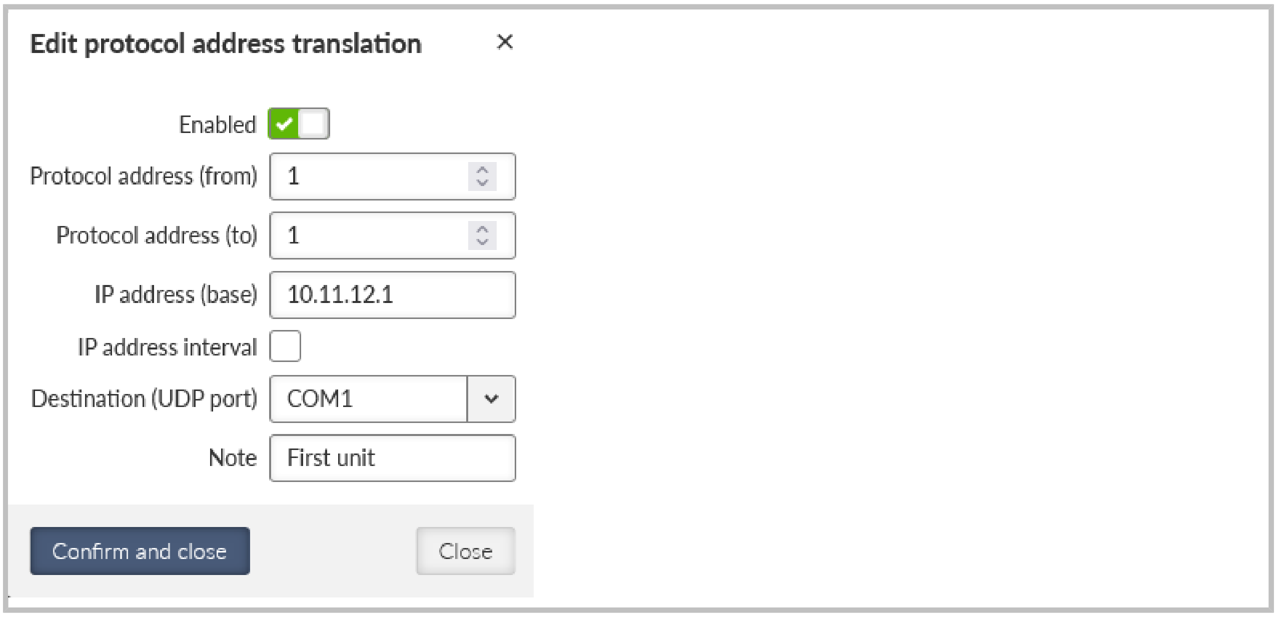
Address translation: Table

Protocol address translation

● First unit
Protocol address: 1
IP address: 10.11.12.1
Port: COM1 (8881)

● Second unit
Protocol address: 2
IP address: 10.11.15.1
Port: COM1 (8881)

● Third unit
Protocol address: 3
IP address: 10.12.17.6
Port: COM1 (8881)



Edit protocol address translation

Enabled: ✓
Protocol address (from): 1
Protocol address (to): 1
IP address (base): 10.11.12.1
IP address interval: □
Destination (UDP port): COM1
Note: First unit

Note

You may add a note to each address with your comments (UTF8 is supported) for your convenience.

7.1.2.3. Individual protocol parameters

Some of the SCADA protocols are able to setup additional Slave device response behavior.

Response target mode

List box {LASTRCV; TARGET}, default = "LASTRCV"

Response for the incoming frame shall be directed to the IP address of the Master which sent the frame (LASTRCV) or to a specified IP address (TARGET).

Response target IP

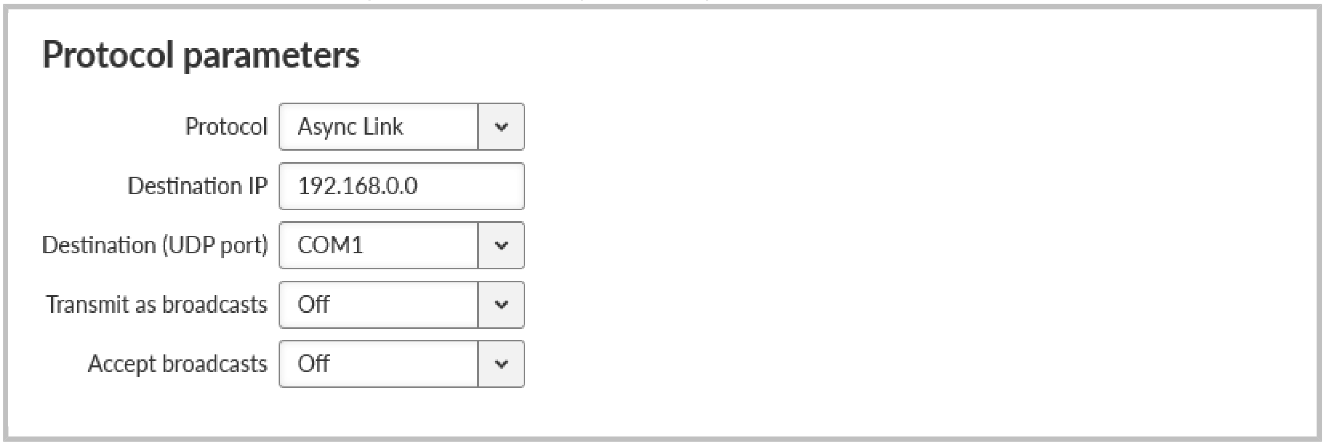
IP address to which the response is sent when TARGET is chosen in the Response target mode.

7.1.2.3.1. None

The None protocol switches the COM port off. All incoming data will be thrown away, no data will be sent into the COM interface.

7.1.2.3.2. Async link

Async link creates an asynchronous link between two COM ports on different RipEX2 or M!DGE3 units. Received frames from COM port or from a Terminal server are sent without any processing transparently via router to the set IP destination and UDP port. Received frames from the network are sent to COM or Terminal server according to Destination (UDP port) parameter.



Protocol parameters

Protocol	Async Link
Destination IP	192.168.0.0
Destination (UDP port)	COM1
Transmit as broadcasts	Off
Accept broadcasts	Off

Destination IP

Defines destination IP address of RipEX2 or M!DGE3).

7.1.2.3.3. COMLI

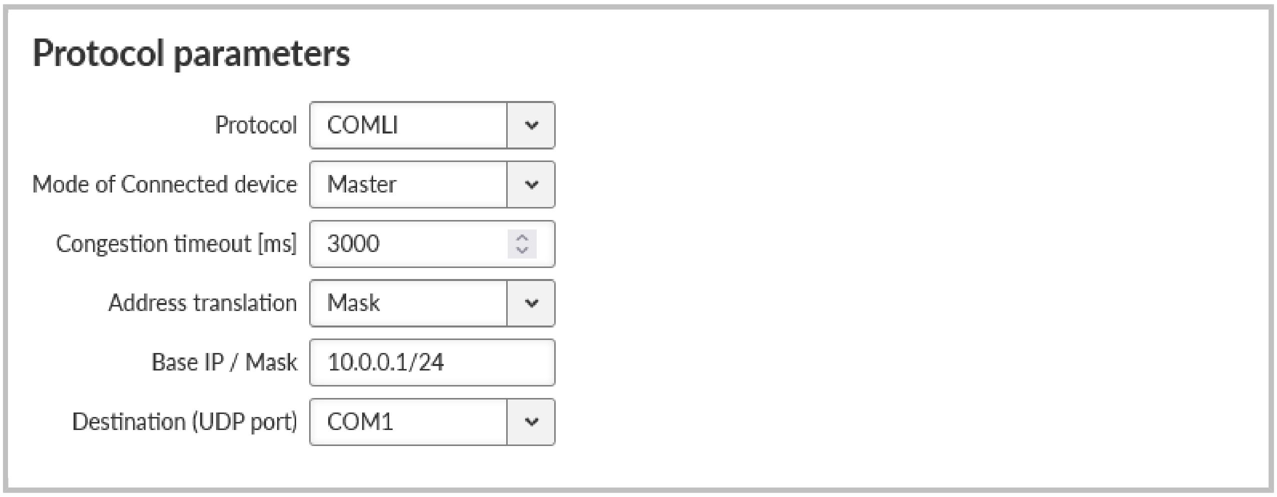
COMLI is a serial polling-type communication protocol used by Master-Slave application. Within one M!DGE3 network more COMLI Masters can be employed and one Slave can be polled by more Masters. Broadcast packets are not used.

The frame of COMLI protocol is sent transparently, but without STX, ETX and BCC. STX (start of data), ETX (end of data) and BCC (8-bit XOR) are added on the receiving participant. While transfer, data integrity is properly secured by individual protocol checksums.

Note

The COMLI protocol in the RipEX2 or M!DGE3 is not fully compatible on COM port with RipEX and MR modems. M!DGE3 implementation is not supporting “Intercharacter tx delay”.

Mode of Connected device: MASTER



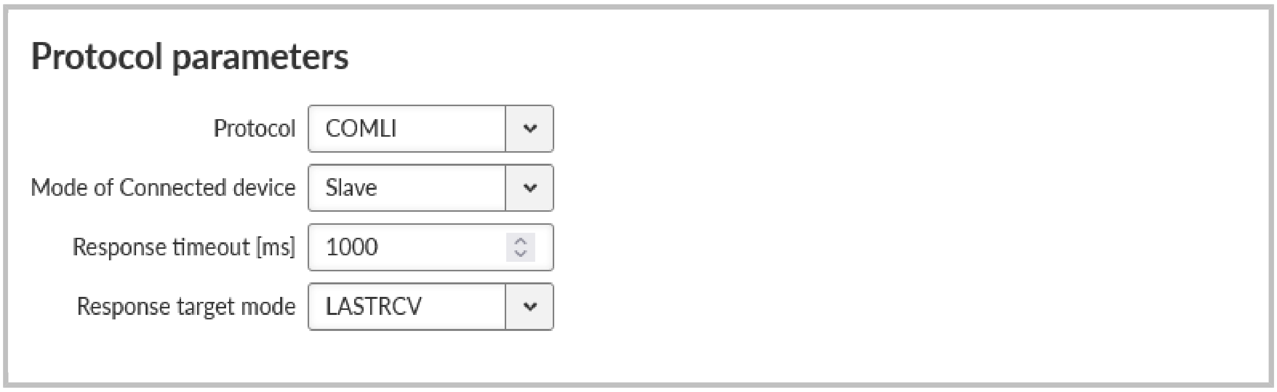
Protocol parameters

Protocol	COMLI
Mode of Connected device	Master
Congestion timeout [ms]	3000
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1

Congestion timeout [ms]

Number {0 – 65535}, default = 3000, 0 switches this functionality off
Timeout for checking of the duplicity of two following frames. Used when the very same frame is incoming via COM port within the timeout measured from the moment of dispatch of the previous frame.

Mode of Connected device: SLAVE



Protocol parameters

Protocol: COMLI

Mode of Connected device: Slave

Response timeout [ms]: 1000

Response target mode: LASTRCV

Response timeout [ms]

Number {0 – 16383}, default = 1000

COMLI protocol response timeout is used for waiting on COM port for the response of connected device.

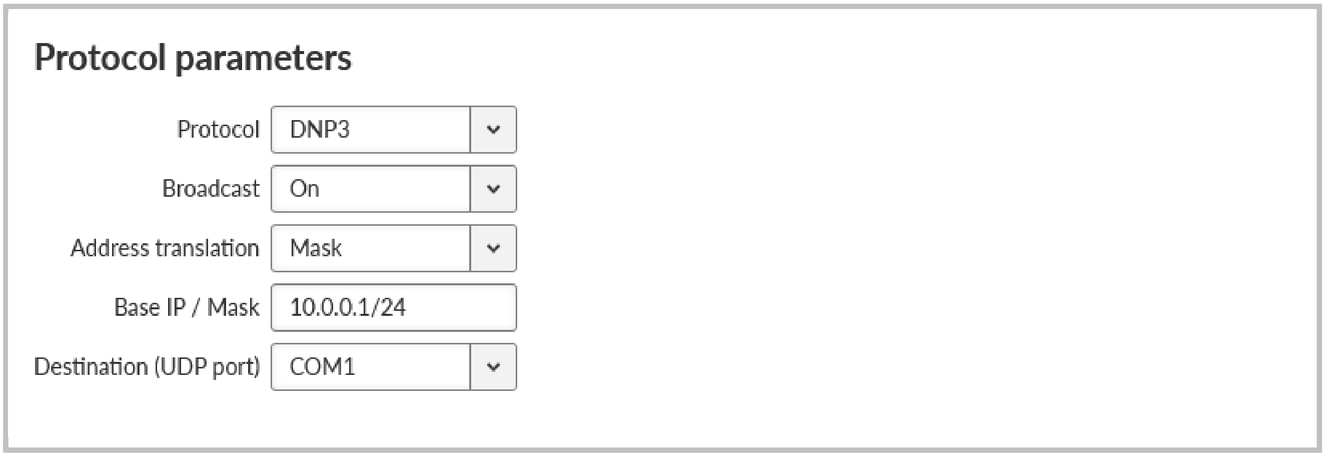
Response target mode

List box {LASTRCV; TARGET}, default = ”LASTRCV”

Slave response will be sent to the address of the last received request (LASTRCV) or to the specified **Response target IP** address (TARGET).

7.1.2.3.4. DNP3

Each frame in the DNP3 protocol contains the source and destination addresses in its header, so there is no difference between Master and Slave in terms of the M!DGE3 configuration. The DNP3 allows both Master-Slave polling as well as report-by-exception communication from the remote units.



Protocol parameters

Protocol: DNP3

Broadcast: On

Address translation: Mask

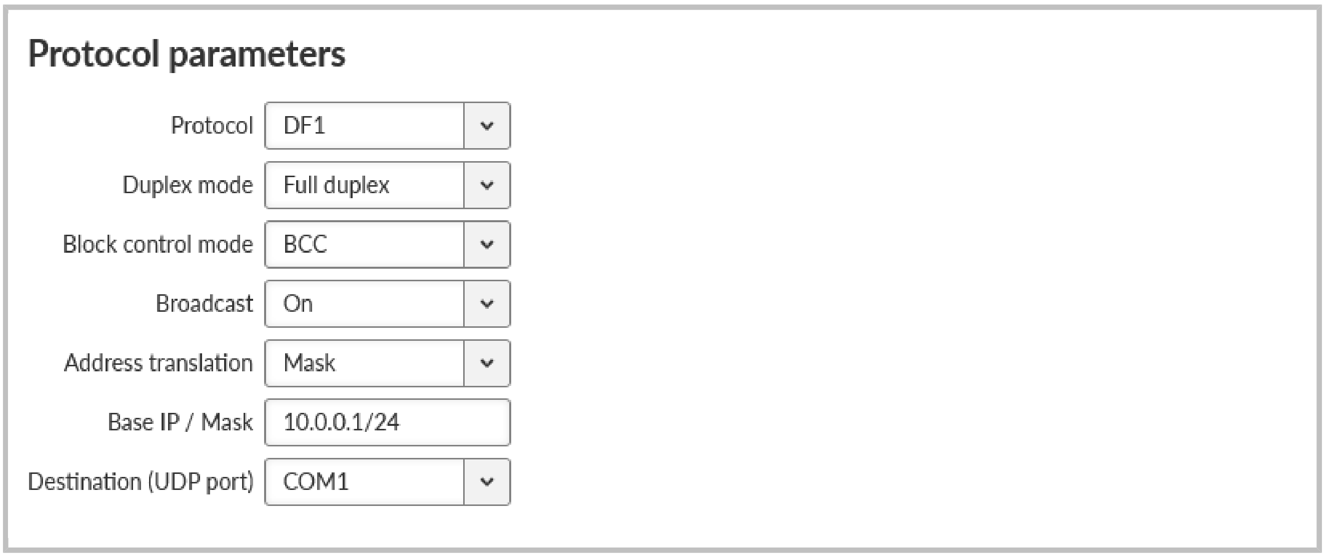
Base IP / Mask: 10.0.0.1/24

Destination (UDP port): COM1

The common parameters (e.g. address translation) shall be set.

7.1.2.3.5. DF1

Each frame in the Allen-Bradley DF1 protocol contains the source and destination addresses in its header, so there is no difference between Master and Slave in the Full duplex mode in terms of M!DGE3 configuration.



Protocol parameters

Protocol: DF1

Duplex mode: Full duplex

Block control mode: BCC

Broadcast: On

Address translation: Mask

Base IP / Mask: 10.0.0.1/24

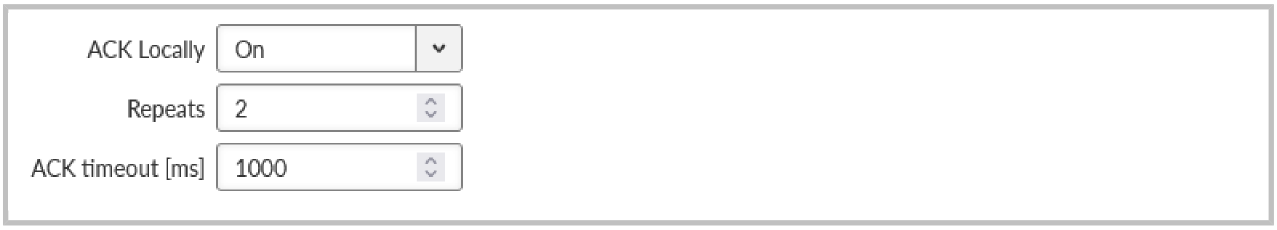
Destination (UDP port): COM1

Duplex mode

List box {Full duplex; Half duplex}, default = “Full duplex“
Mode of DF1 protocol operation: Only Full duplex mode is implemented now.

DF1 advanced parameters

Protocol DF1 supports protocol local acknowledgment. Typically the default setting shall be used. In case a need it is possible to change ACK parameters in ADVANCED > Generic > com_x_prot/Protocol_DF1 menu.



ACK Locally: On

Repeats: 2

ACK timeout [ms]: 1000

ACK locally

List box {On; Off}, default = ”On”
Allows to switch On / Of the local ACK

Repeats

Number {0 – 31}, default = 2
Sets number of repeats when local ACK is nor received.

ACK timeout [ms]

Number {0 – 1683}, default = 1000
Timeout of waiting for ACK.

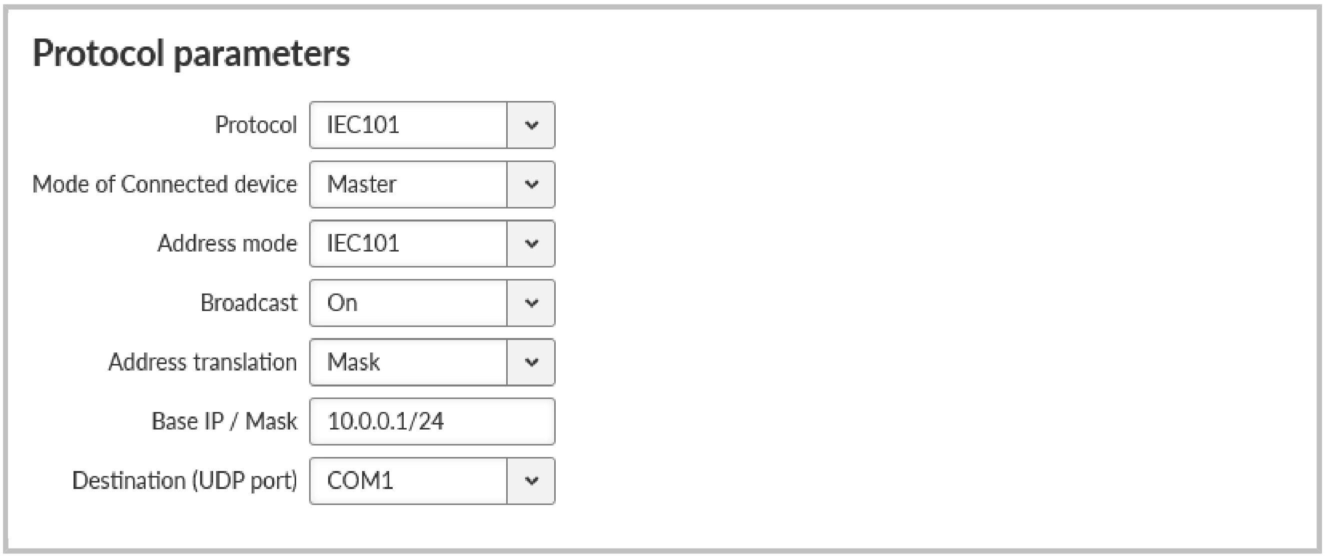
Block control mode

List box {BCC; CRC}, default = "BCC"
According to the DF1 specification, either BCC or CRC for Block control mode (data integrity) can be used.

Note

According to the DF1 specification, packets for the destination address 0xFF are considered broadcasts. Hence when Broadcast is On, packets with this destination are handled as broadcasts.

7.1.2.3.6. IEC101



Protocol parameters

Protocol: IEC101

Mode of Connected device: Master

Address mode: IEC101

Broadcast: On

Address translation: Mask

Base IP / Mask: 10.0.0.1/24

Destination (UDP port): COM1

Mode of Connected device
List box {Master; Slave; Combined}, default = “Master”

Note
For connected SCADA Master set Master, for connected SCADA Slave set Slave.

Address mode
List box {IEC101; 2B ADDR; TELEGYR; SINAUT; No addr}, default = “IEC101”

7.1.2.3.7. Mars-A

MARS-A is a full duplex protocol featuring:

- 32bit long addresses

- error detection (based on 16 bit checksum (XOR) or 16 bit CRC)

- error correction

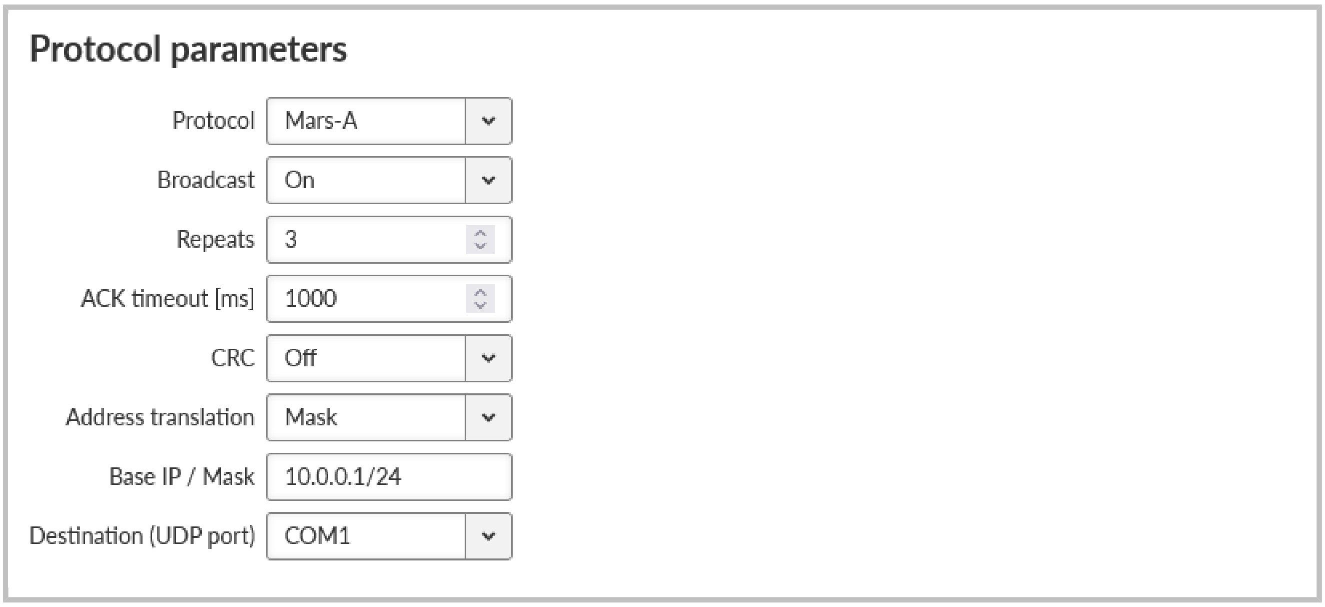
MARS-A was widely used by legacy RACOM radio modems in the MORSE system from the year 1999.

The new implementation of this protocol in M!DGE3 or M!DGE3 is limited to the parts of the complex protocol which can be used together with modern packet type of these routers:

USER DATA (0x09) from router to the serial interface (e.g. to RTU),

USER DATA (0x09) and PROT DATA (0x0A) from serial interface (e.g. from RTU) to the router.

Mars-A headers are removed from the packet prior to transmitting to the network - only data are transmitted.



Protocol parameters

Protocol	Mars-A
Broadcast	On
Repeats	3
ACK timeout [ms]	1000
CRC	Off
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1

ACK timeout [ms]

Number {0 – 16383}, default = 1000
Serial interface acknowledge timeout.

Repeats

Number {0 – 31}, default = 3
Number of repeats. Repetition is triggered when NAK frame is received or if ACK frame was not received within ACK timeout.

Security bit

List box {On; Off}, default = "Off"
Needed for compatibility with legacy MORSE network implementations. This parameter does not change protocol behavior.

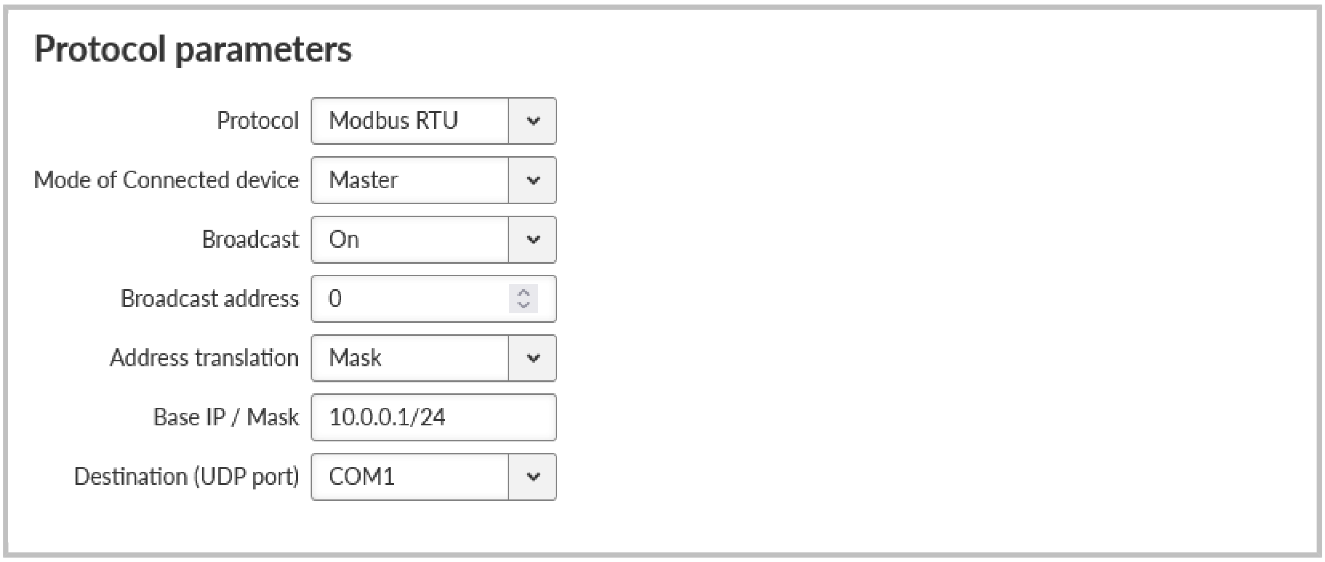
CRC

List box {On; Off}, default = "Off"
Error detection algorithm:

- On - CRC algorithm is used
- Off - XOR algorithm is used

7.1.2.3.8. Modbus RTU

Modbus RTU is a serial polling-type communication protocol used by Master-Slave application.



Protocol parameters

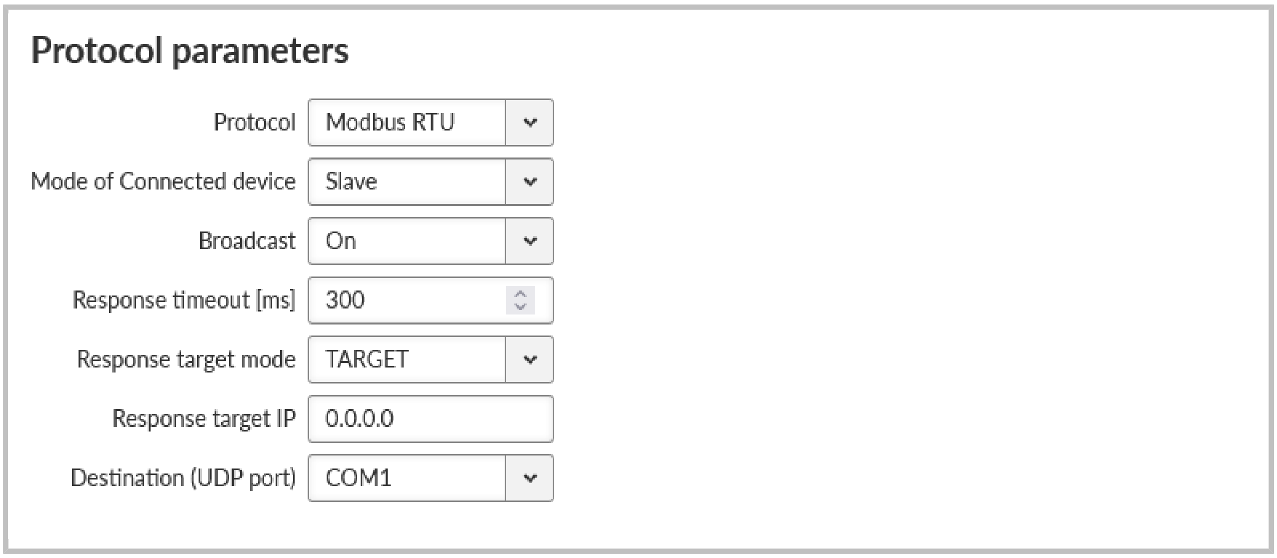
Protocol	Modbus RTU
Mode of Connected device	Master
Broadcast	On
Broadcast address	0
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1

Mode of Connected device

List box {Master; Slave}, default = "Master"

Mode of connected device: MASTER

Mode of connected device: SLAVE



Protocol parameters

Protocol	Modbus RTU
Mode of Connected device	Slave
Broadcast	On
Response timeout [ms]	300
Response target mode	TARGET
Response target IP	0.0.0.0
Destination (UDP port)	COM1

Response timeout

Number { 0 – 8190}, default = 300

The Response timeout parameter controls how long the unit waits for an acknowledgement frame. The timeout is started when the original frame received from the Cellular channel is transmitted to the connected device (over the serial channel). Transmission of any other frame to the connected device is temporarily blocked, whilst Response timeout is active. Response timeout = 0 disables this feature.

7.1.2.3.9. PPP protocol

The PPP protocol (Point-to-Point Protocol, specified in RFC 1661) is intended for a direct duplex connection between two network points. It works at the link layer as an extension of the HDLC protocol. Both network points receive a configuration on the basis of which they negotiate connection properties with each other over the serial line. The consequence of a successful negotiation is the creation of network interfaces on both sides. Depending on the selected network protocol, these can be interfaces of different types. In our case, the IPCP protocol (IPV6CP) is used and the resulting interface is of the TUN type (e.g. ppp1). The interface is assigned an IP address according to the configuration and user data are transferred through it. PPP encapsulation is used to encapsulate IP packets into frames transmitted over a serial line (see Frame format, RFC 1662).

7.1.2.3.9.1. Typical course of establishing a connection

Line Parameter Negotiation (LCP)

Basic connection parameters at the serial line level
LCP (Link Control Protocol, RFC 1661)
Negotiated parameters:

- Maximum receive unit (MRU)
- Asynchronous Control Character Map (ACCM)
- Authentication protocol
- Compression of the protocol field in the PPP frame header
- Compression of the address and control fields in the PPP frame header

Authentication

Optional, if negotiated, the appropriate protocol will be used
It can be two-sided, where each side may require a different protocol
Protocols:

- PAP (Password authentication protocol)
- CHAP (Challenge Handshake Authentication Protocol)

Negotiation of data compression parameters (CCP)

Data compression type and parameters
Compression Control Protocol (CCP, RFC 1962)

Network Protocol (NCP) Negotiation

Connection parameters at the network layer level
Network Control Protocol (NCP):

- IPCP (Internet Protocol Control Protocol, RFC 1332)
- IPv6CP (IPv6 Control Protocol, RFC 5072)

7.1.2.3.9.2. Format of frames

The format of PPP frames (RFC 1661, RFC 1662) is based on the HDLC protocol standard.

7.1.2.3.9.3. Common frame format

Flag	Address	Control	Protocol	Information	Padding	FCS	Flag
0x7E	0xFF	0x03	8/16 bits	*	*	16/32 bits	0x7E

7.1.2.3.9.4. Meaning of individual fields

- **Flag**: value 0x7E defined in the protocol specification
- **Address field**: address field, value 0xFF defined in the protocol specification
- **Control field**: control field, value 0x03 defined in the protocol specification
- **Protocol field**: protocol field, indicates the type of data in the Information field

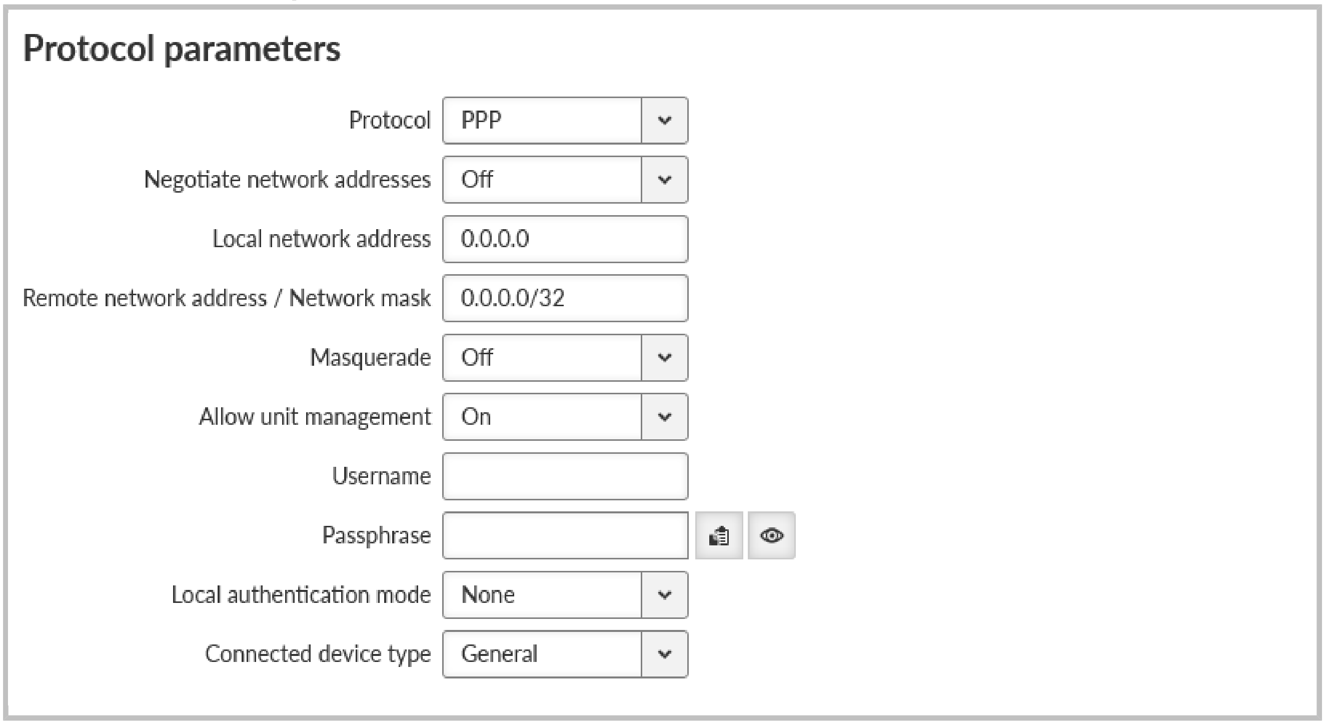
  - ○ Example: 0xC021 for LCP, 0xC023 for PAP
- **Information**: encapsulated data
  - ○ Example: IP packet
- **Padding**
- **Frame Check Sequence (FCS) field**: control sequence for detecting transmission errors

7.1.2.3.9.5. Configuration

Some configuration items are closely related to the native parameters of the pppd daemon. Individual parameters are listed in the text below in bullet points marked "pppd:" and detailed information about them can be found in the daemon's manual pages.

"<NR>" is used to indicate the PPP index (1/2/3).

7.1.2.3.9.6. Protocol parameters



Protocol parameters

Protocol	PPP
Negotiate network addresses	Off
Local network address	0.0.0.0
Remote network address / Network mask	0.0.0.0/32
Masquerade	Off
Allow unit management	On
Username	
Passphrase	
Local authentication mode	None
Connected device type	General

Negotiate network addresses

List box {On; Off}, default = ”Off”
Enables local/remote PPP interface address negotiation.
If disabled Local network address and Remote network address must be set manually.

Local network address

IP address; default = 0.0.0.0
Local IP address of the PPP interface

Remote network address / Network mask

IP address; default = 0.0.0.0/32
Remote IP address and mask of the PPP interface. Address and Mask are used to determine the target range of a rule routing to the PPP interface

Masquerade

List box {On; Off}, default = ”Off”

Enables/disables Source NAT (masquerade) on packets sent over the PPP interface.
With masquerade enabled, packets leaving the station over the PPP interface are rewritten with the source address to the address assigned to that interface

Allow unit management
List box {On; Off}, default = ”On”
Enables unit management access via PPP interface

Username
String {up to 50 char}, default = <empty>
The username to use when authenticating to the counterparty, regardless of the protocol that is required.
Printable ASCII characters are allowed, with the exception of the prohibited ", `, \, $, ;

Passphrase
String {up to 50 char}, default = <empty>
The passphrase to use when authenticating to the counterparty, regardless of the protocol that is required.
Printable ASCII characters are allowed, with the exception of the prohibited ", `, \, $, ;

Local authentication mode
Selection of the protocol with which the counterparty is to be authenticated when establishing a connection.
For PAP (legacy) and CHAP options, the credentials set by **Local authentication username** and **Local authentication password** are used

Local authentication username
String {up to 50 char}, default = <empty>
The username that the counterparty should use during authentication (see **Local authentication mode**).
Printable ASCII characters are allowed, with the exception of the prohibited ", `, \, $, ;

Local authentication password
String {up to 50 char}, default = <empty>
The password that the counterparty should use during authentication (see **Local authentication mode**).
Printable ASCII characters are allowed, with the exception of the prohibited ", `, \, $, ;

Connected device type
List box {General; TETRA terminal (Motorola MTM5x00)}, default = ”General”
Connected device type. Sets the corresponding command sequence to switch the connected device to PPP mode.
Negotiate network addresses must be enabled for TETRA.

Advanced menu parameters:

Asynchronous control character map
Number {0 – 65535}, default = 0
Async-Control-Character-Map (ACCM) settings.
A non-zero value can be used to select control characters that the counterparty should not include in sent PPP packets.

LCP keepalive failure count
Number {0 – 255}, default = 0

A non-zero value means the maximum number of sent LCP echo-request messages before the peer is marked as disconnected and the connection is closed (see **LCP keepalive interval** [s]).
A zero value disables the function.

LCP keepalive interval [s]
Number {0 – 255}, default = 10
Interval of sending LCP echo-request messages, to which the counterparty responds with an LCP echo-reply message in normal state.
Along with that entry **LCP keepalive failure count** can be used to detect if a party is connected
Active if **LCP keepalive failure count** is greater than 0

Idle timeout to reconnect [s]
Number {0 – 65535}, default = 0
Disconnects an inactive connection after a defined period of time

Enable using modem control lines
List box {On; Off}, default = ”Off”
Option to use "modem control lines" (DTR/DSR serial port signals).

Enable control messages logging
List box {On; Off}, default = ”Off”
Option to verbose pppd daemon control messages.
Messages are written to the standard log /var/log/pppd_<NR>/log, which is available in a Diagnostic package.

Compression negotiation mode
List box {Automatic; Manual}, default = ”Automatic”
Mode for selecting configuration parameters related to compression (all remaining items below). When Automatic is selected, the configuration items below are ignored and the pppd daemon uses its default values. When Manual is selected, the configuration items below are active and their values are used by the pppd daemon when negotiating with the counterparty.

Enable address and control field compression
List box {On; Off}, default = ”On”
Choice of whether to negotiate address and control field compression in the PPP frame header (Address/Control field compression, see Frame format), in both directions of data transfer.
Active if **Compression negotiation mode** is Manual.

Enable protocol field compression
List box {On; Off}, default = ”On”
Choice of whether to negotiate protocol field compression in the PPP frame header (Protocol field compression, see Frame format), in both directions of data transfer.
Active if **Compression negotiation mode** is Manual.

Van Jacobson IP header compression max slots
Number {0; 2 – 16}, default = 16
Option of Van Jacobson compression of IP headers.
A non-zero value is a parameter of the compression algorithm (number of connection slots).
A zero value disables the function.
Active if **Compression negotiation mode** is Manual.

Enable compression control protocol
List box {On; Off}, default = ”On”
Option to use CCP (Compression Control Protocol) to negotiate data compression parameters.

The option to disable CCP is provided for compatibility with legacy PPP clients that do not support data compression.
Active if **Compression negotiation mode** is Manual.

BSD data compression receive code size
Number {0; 9 – 15}, default = 15
A non-zero value is a parameter of the "BSD-Compress" algorithm for data compression in the incoming direction.
A zero value disables the function.
Active if **Compression negotiation mode** is Manual and **Enable compression control protocol** is disabled.

BSD data compression transmit code size
Number {0; 9 – 15}, default = 15
A non-zero value is a parameter of the "BSD-Compress" algorithm for data compression in the outgoing direction.
A zero value disables the function.
Active if **Compression negotiation mode** is Manual and **Enable compression control protocol** is disabled.

Deflate data compression receive code size
Number {0; 9 – 15}, default = 15
A non-zero value is a parameter of the "Deflate" algorithm for data compression in the incoming direction.
A zero value disables the function.
Active if **Compression negotiation mode** is Manual and **Enable compression control protocol** is disabled.

Deflate data compression transmit code size
Number {0; 9 – 15}, default = 15
A non-zero value is a parameter of the "Deflate" algorithm for data compression in the outgoing direction.
A zero value disables the function.
Active if **Compression negotiation mode** is Manual and **Enable compression control protocol** is disabled.

7.1.2.3.9.7. Routing

Routing Mode
The listbox is extended with PPP <NR> options
If the routing rule has one of the PPP <NR> options selected, routing is done to the appropriate PPP interface.

Routing Persistent
List box {On; Off}, default = ”Off”
The routing rule is persistent (see Cellular configuration for detailed explanation).

7.1.2.3.9.8. Protocol status

PPP status information is available in the Diagnostics > Information > Interfaces > PPP menu. Status provides following information

- Interface

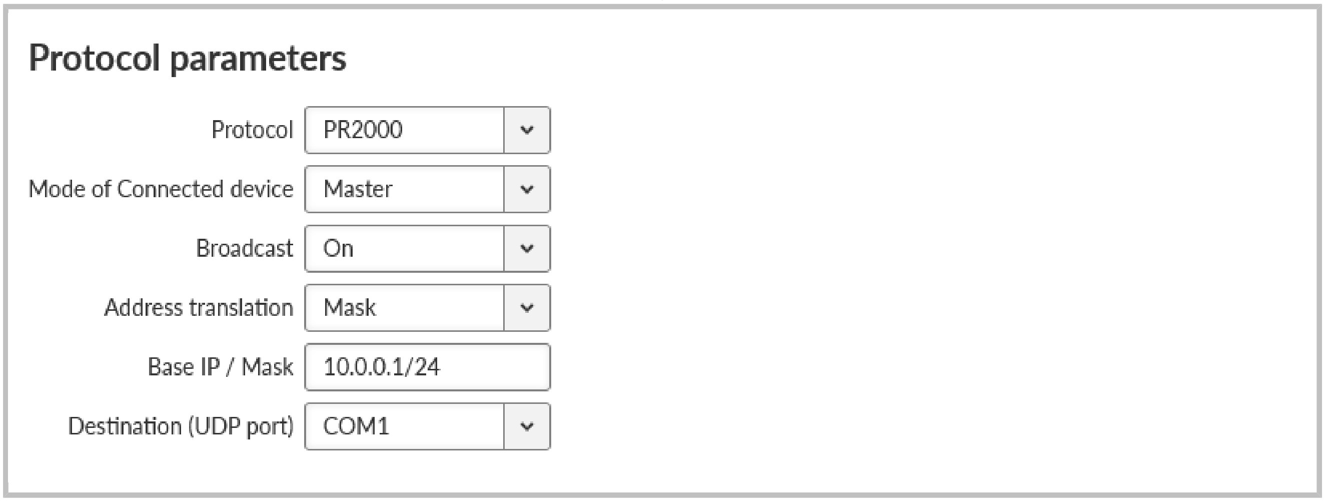
- PPP Interface name.

- State
  - Current state of the PPP interface daemon.
- Peer MRU
  - Maximum receive unit (MRU) in bytes requested during negotiation by the counterparty.
- Peer Auth. mode
  - Authentication protocol requested by counterparty.
- Peer ACCM
  - ACCM setting requested by counterparty.
- Negotiated compression options
  - Negotiated options of PPP compression.

7.1.2.3.10. PR2000

PR2000 is an abbreviation for the PROTEUS 2000 SCADA protocol. This protocol is used in Master-Slave applications.

The PR2000 protocol is implemented in a fully transparent manner. The original protocol frames are transported over the RipEX network in their entirety.



Protocol parameters

Protocol	PR2000
Mode of Connected device	Master
Broadcast	On
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1

7.1.2.3.11. Siemens 3964(R)

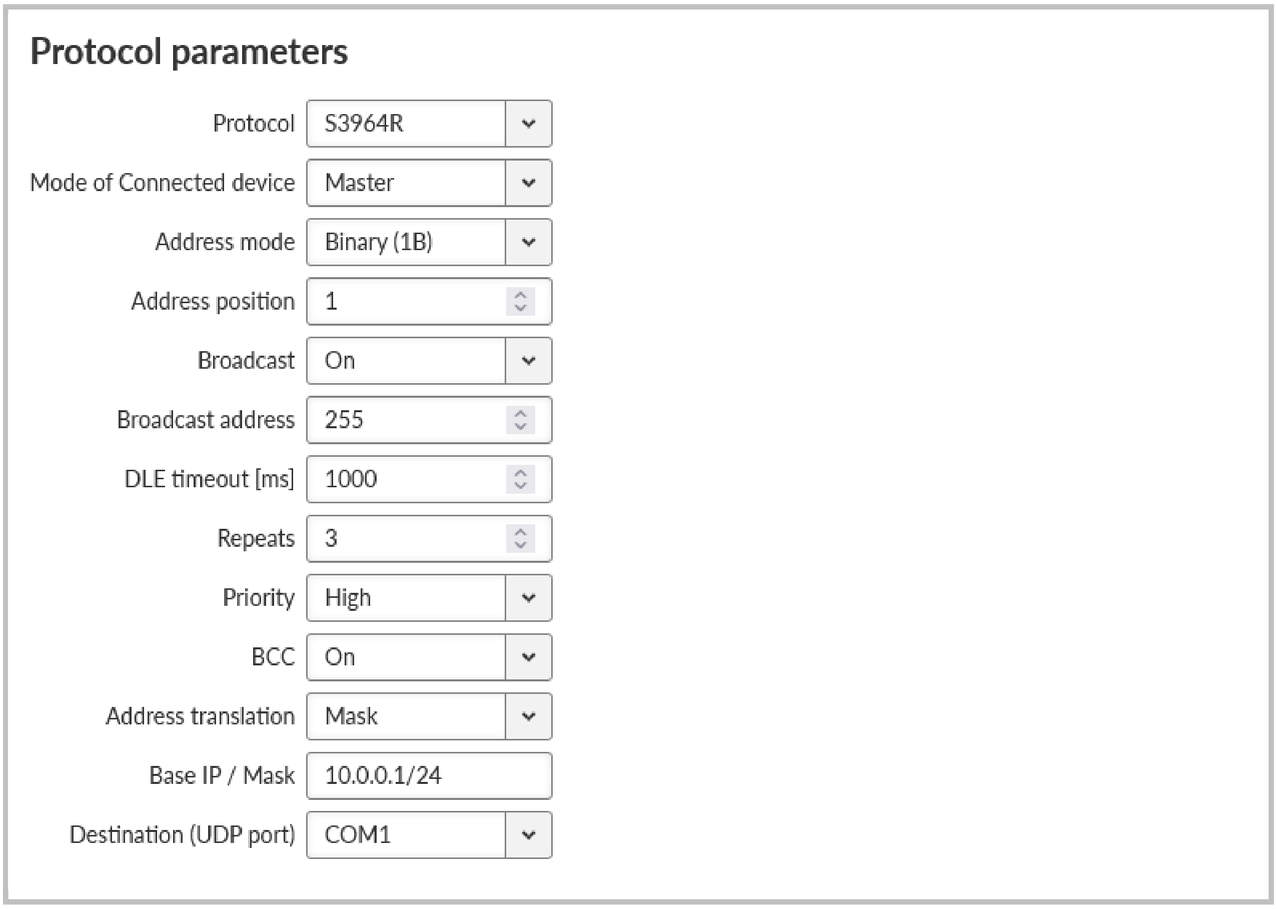
The 3964 protocol is utilized by the Siemens Company as a Point-to-Point connection between two controllers. Meanwhile it has developed into an industry standard that can be found on many devices as a universal communications interface. 3964R is the same as 3964, in addition it only uses BCC (Block Check Character). 3964(R) handles only the link layer (L2 in OSI model), hence RipEX uses a similar way to read “SCADA address” as in UNI protocol.

There is a handshake STX(0x02) – DLE(Ox10) on the start of communication and DLE+ETX – DLE on the end. This handshake is performed by RipEX locally, it is not transferred over the RipEX network.

Communication goes as follows:
LocalRTU –> STX –> LocalRipEX
LocalRipEX –> DLE –> LocalRTU
LocalRTU –> DATA+DLE+ETX+BCC –> LocalRipEX
LocalRipEX –> DATA –> RemoteRipEX*
LocalRipEX –> DLE –> LocalRTU
RemoteRipEX –> STX –> RemoteRTU
RemoteRTU –> DLE –> RemoteRipEX
RemoteRipEX –> DATA+DLE+ETX+BCC –> RemoteRTU
RemoteRTU –> DLE –> RemoteRipEX

* only this packet is transferred over the RipEX network, all the other ones are handled locally.

Master



Protocol parameters

Protocol	S3964R
Mode of Connected device	Master
Address mode	Binary (1B)
Address position	1
Broadcast	On
Broadcast address	255
DLE timeout [ms]	1000
Repeats	3
Priority	High
BCC	On
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1

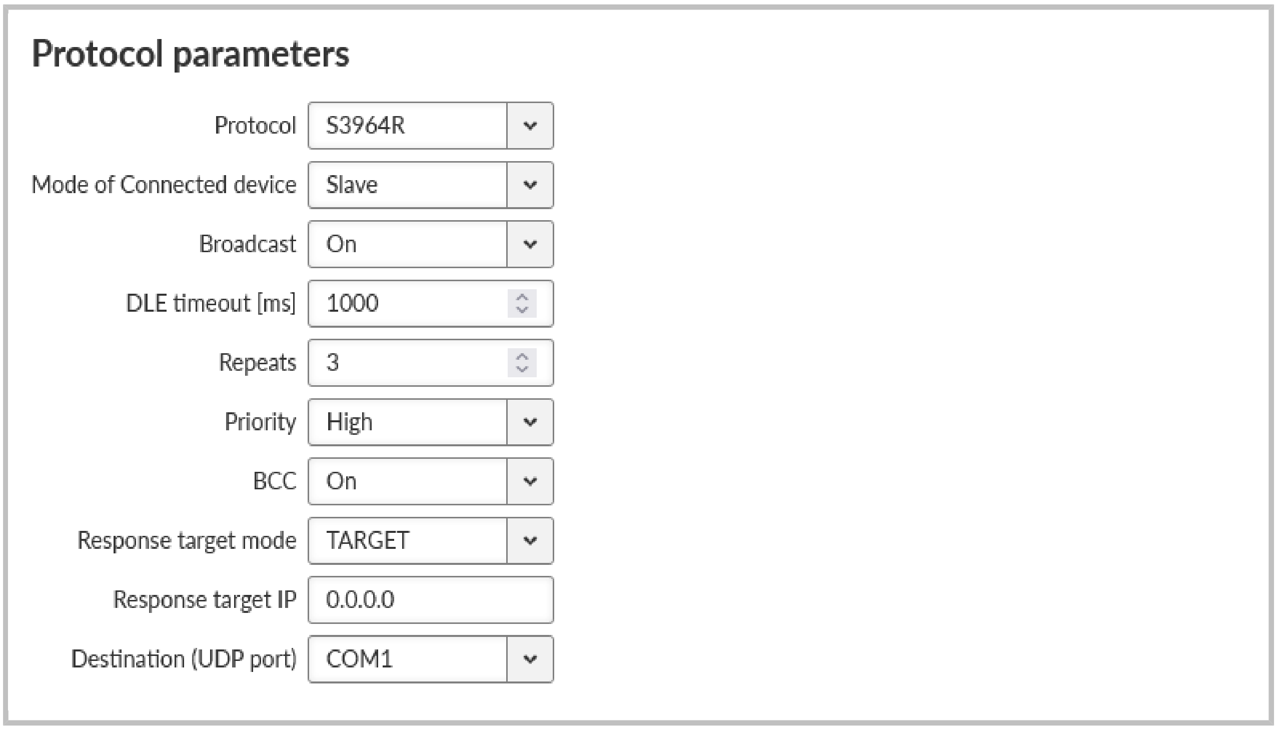
Address mode
List box {Binary (1 B); Binary (2B LSB first); Binary (2B MSB first)}, default = "Binary (1 B)"
RipEX reads the Protocol address in the format and length set (in Bytes).

Address position
Specify the sequence number of the byte, where the Protocol address starts.

Note
3964(R) protocol is using escape sequence (control sequence) for DLE(0x10). I.e. when 0x10 is in user data, 0x1010 is sent instead. When address position is calculated, the bytes added by escape sequence algorithm are not taken into account.

Note
The first byte in the packet has the sequence number 1, not 0.

Slave



Protocol parameters

Protocol: S3964R

Mode of Connected device: Slave

Broadcast: On

DLE timeout [ms]: 1000

Repeats: 3

Priority: High

BCC: On

Response target mode: TARGET

Response target IP: 0.0.0.0

Destination (UDP port): COM1

DLE timeout [ms]
Number {300 – 8190}, default = 1000
RipEX expects a response (DLE) from the connected device (RTU) within the set timeout. If it is not received, RipEX repeats the frame according to the “Retries” setting.

Retries [No]
Number {0 – 7}, default = 3
When DLE packet is not received from the connected device (RTU) within the set DLE timeout, RipEX retransmits the frame. The number of possible retries is specified.

Priority
List box {Low; High}, default = "Low"
When the equipment sends STX and receives STX instead of DLE, there is a collision, both equipments want to start communication. In such a case, one unit has to have a priority. If the Priority is High, RipEX waits for DLE. When it is Low, RipEX sends DLE.

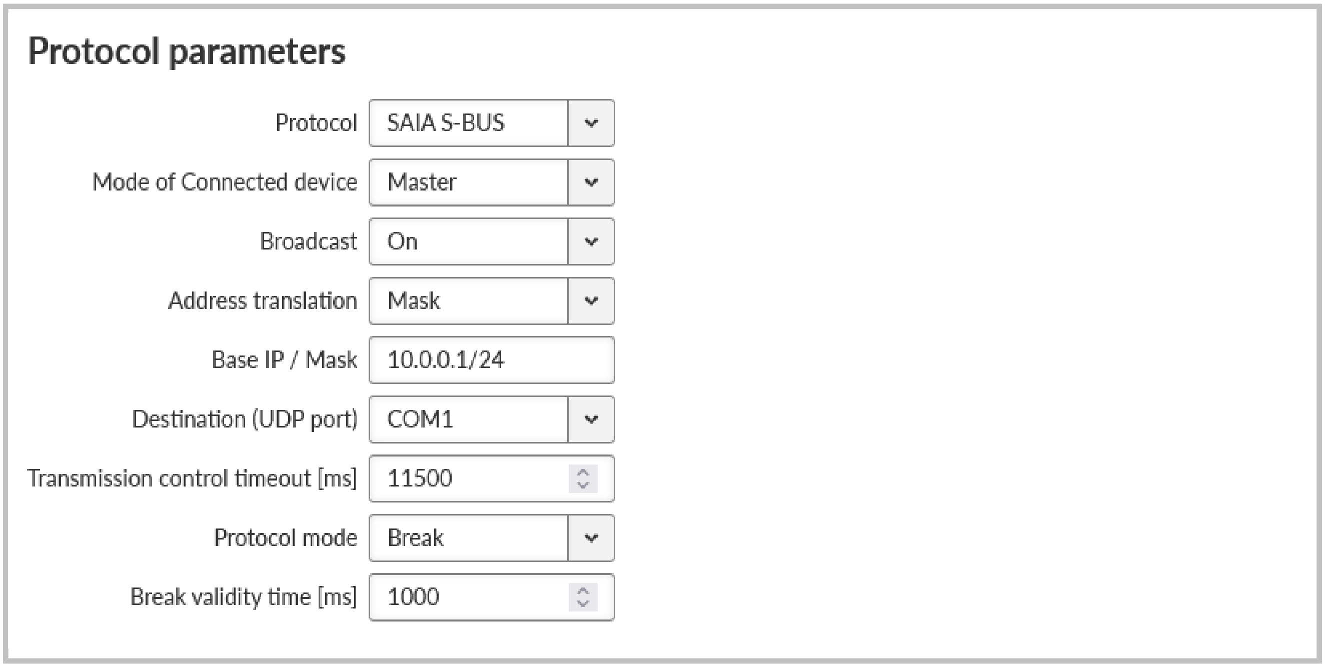
Note
Obviously, two pieces of equipment which are communicating together must be set so that one has High priority and the other has Low.

BCC
List box {On; Off}, default = "On"
BCC (Block Check Character) is a control byte used for data integrity control, it makes the reliability higher. BCC is used by 3964R, 3964 does not use it.
RipEX checks (calculates itself) this byte while receiving a packet on COM. RipEX transmits DLE (accepts the frame) only when the check result is OK. BCC byte is not transferred over the RipEX network, it is calculated locally in the end RipEX and appended to the received data.

7.1.2.3.12. SAIA S-Bus

SAIA S-Bus protocol was widely used by legacy RACOM radio modems in the MORSE system. The S-Bus protocol is implemented as an access module for communication with the SAIA PCD device. The protocol is a MASTER/SLAVE type; the MASTER does not have its own address. There can be at most 254 SLAVEs, the address 255 is reserved for broadcast transmitting which is not acknowledged. The physical layer of the S-Bus protocol uses the RS232 or RS485 interface. The broadcast address 255 is not supported for M!DGE3.

Protocol frame has to be as whole received in the one buffer, so the IDLE parameter should be set properly. The S-bus protocol header does not always contain the length of the data, so it is not possible to work with fragmented and defragmented frames.



Protocol parameters

Protocol	SAIA S-BUS
Mode of Connected device	Master
Broadcast	On
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	COM1
Transmission control timeout [ms]	11500
Protocol mode	Break
Break validity time [ms]	1000

Mode of connected device

List box {Master; Slave; Slave Plus}, default= “Master”

Master and **Slave** behaves like standard Master or Slave Saia PCD. The **Slave Plus** mode allows to behave in limited way as a Master and sends to other Slave/Slave Plus write command (read command is not allowed).

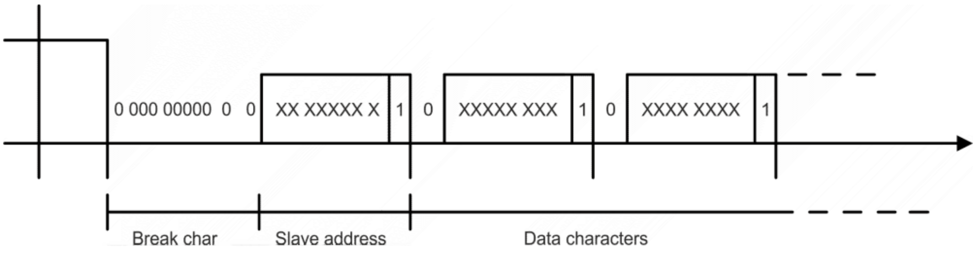
Protocol mode

List box {Break; Data}, default =”Break”

Break or Data protocol modes can be used.

Break mode (SM0)

The frames are synchronised by the break characters of a configured length which are sent before the addressed command.

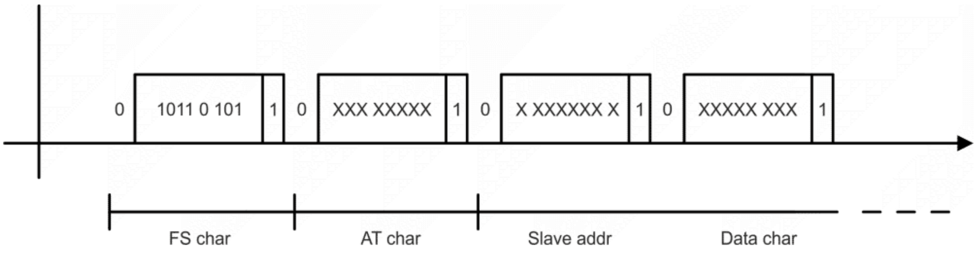


Break mode is available only with COM port, it is not implemented on TS (the break signal is not available there). The Break signal check is very rough (with step of 100 ms) due to Linux kernel limitations.

Data mode (SM2)

Frame synchronization is accomplished by inserting the character 0xB5 in the beginning of frame. If another character 0xB5 should appear in the frame, then it is replaced by the following DLE sequence:

Character	DLE sequence
0x85	0xC500
0xC5	0xC501



Note

See details of the RACOM’s implementation on *https://www.racom.eu/eng/support/prot/sbus/index.html* [1]

Mode of Connected device: MASTER

Transmission control timeout [ms]

Number {0 – 65535}, default = 11500

Master timeout. This timeout is reset after receiving of an answer from Slave or a frame incoming from the connected master.

Mode of Connected device: SLAVE

Response timeout [ms] Number {0 – 16383}, default = 300

Slave’s response timeout - waiting for response, otherwise the reply to master is resent.

Repeats

Number {0 – 7}, default = 3

Number of repeats when the response from master is not received.

Break mode

(additional parameter)

Master, Slave Plus

Break validity time [ms]

Number {0 – 5000}, default = 1000

Slave, Slave Plus

Break length [ms]

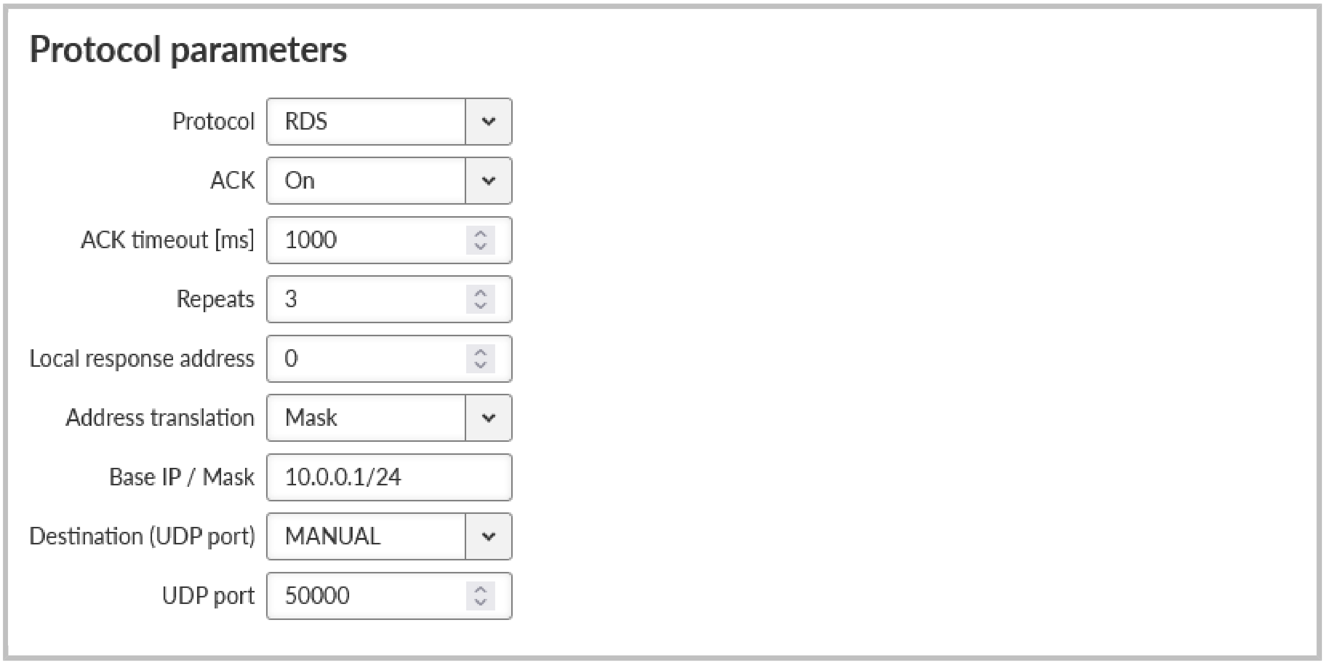
Number {0 – 128}, default = 2

Length of break in ms.

[1] https://www.racom.eu/eng/support/prot/sbus/index.html

7.1.2.3.13. RDS

RDS protocol is a protocol used in MRxx networks. It supports network communication; any node in the network can talk to any other (unlike Master-Slave type of protocols). The RDS protocol is typically used when combining RipEX and MRxx networks or SCADA networks adapted to MRxx networks. Frames are received from the Cellular channel and sent to COM1-3 or Terminal server 1-5 according to UDP port settings and vice versa - from wire to Cellular channel.



Protocol parameters

Protocol	RDS
ACK	On
ACK timeout [ms]	1000
Repeats	3
Local response address	0
Address translation	Mask
Base IP / Mask	10.0.0.1/24
Destination (UDP port)	MANUAL
UDP port	50000

ACK

List box {On; Off}, default = "On"

Frame acknowledgement when transmitted over wire (COM or Ethernet) interface. ACK (0x06) frames are transmitted on successful reception and NAK (0x15) on unsuccessful frame reception.

ACK timeout [ms]

Number {0 – 16383}, default = 1000

Note

ACK timeout is measured from the beginning of the packet transmission.

When "ACK" is enabled, RipEX is waiting "ACK timeout [ms]" after transmitting frame to receive acknowledgement. If the ACK frame isn't received, the frame is re-transmitted. Frame re-transmission happens up to "Repeats" number of times.

Repeats

Number {0 – 31}, default = 3

Number of frame re-transmissions.

Local response address

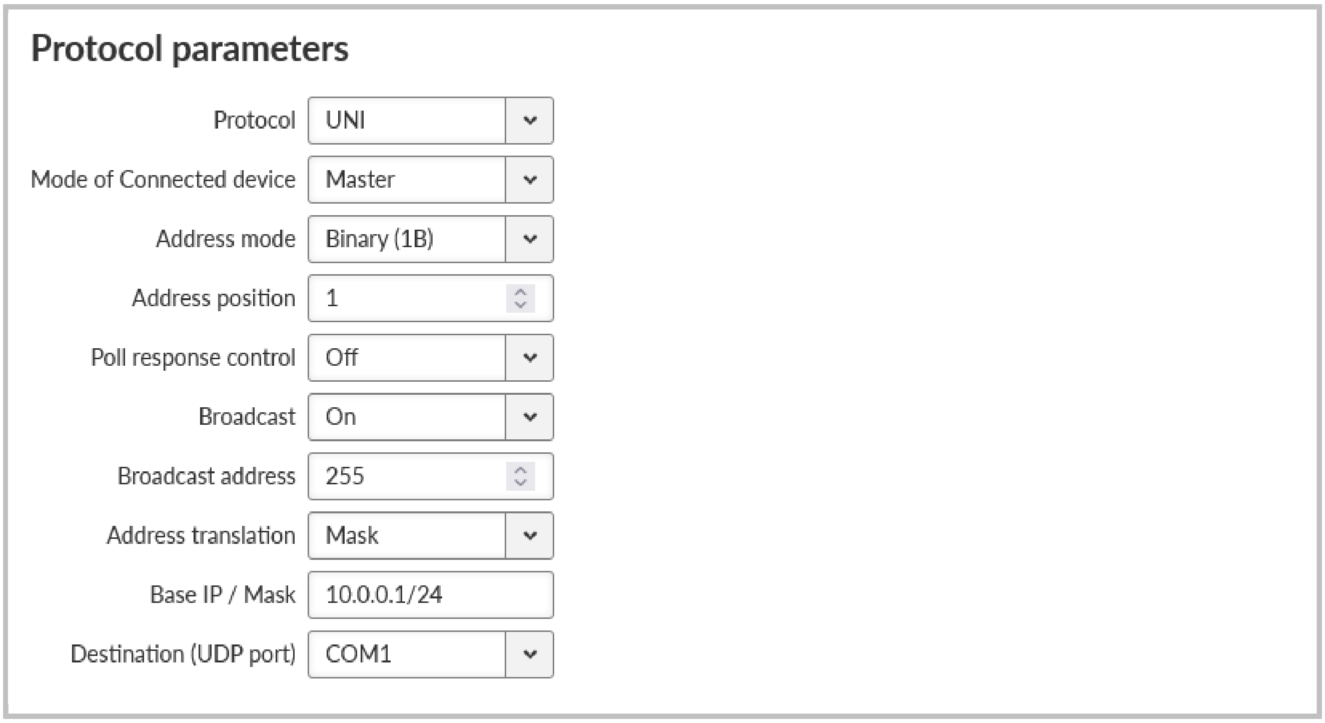
Number {0 – 255}, default = 0

This address is used only with status query (0x51). Response of M!DGE3 is "0x54 <Local response address> 0x00".

7.1.2.3.14. UNI

UNI is the 'Universal' protocol utility designed for RipEX. It is supposed to be used when the required application protocol is not available in RipEX and the network communication is using addressed mode (which is a typical scenario). The key prerequisite is: messages generated by the Master application device must always contain the respective Slave address and the address position, relative to the beginning of the message (packet, frame), is always the same (**Address position**). Generally, two communication modes are typical for UNI protocol: In the first one, communication is always initiated by the Master and only one response to a request is supported; in the second mode, Master-Master communication or combination of UNI protocol with ASYNC LINK protocol and spontaneous packets generation on remote sites are possible.

The UNI protocol is fully transparent, i.e. all messages are transported and delivered without any modifications.



Protocol parameters

Protocol: UNI
Mode of Connected device: Master
Address mode: Binary (1B)
Address position: 1
Poll response control: Off
Broadcast: On
Broadcast address: 255
Address translation: Mask
Base IP / Mask: 10.0.0.1/24
Destination (UDP port): COM1

Mode of Connected device
List box: {Master, Slave}, default = Master

Adress mode
List box {Binary (1B); ASCII (2B); Binary (2B LSB first); Binary (2B MSB first)}, default = "Binary (1B)"
Protocol address format and length (in Bytes). ASCII 2-Byte format is read as 2-character hexadecimal representation of one-byte value. E.g. ASCII characters AB are read as 0xAB hex (10101011 binary, 171 decimal) value (the ASCII-2-Byte format function will be available in a future FW release).

Address position
Number {1 – 255}, default = 1
Specify the sequence number of the byte, where the Protocol address starts. Note that the first byte in the packet has the sequence number 1, not 0.

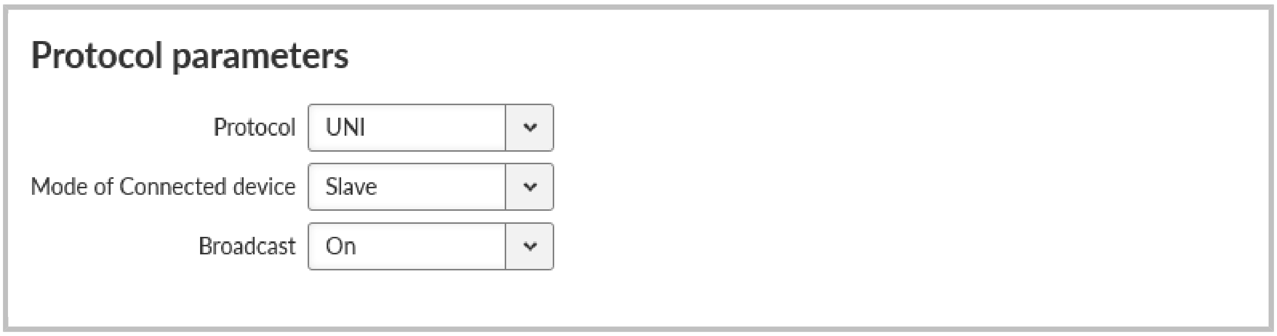
Poll response control
List box {On; Off}, default = "On"

"On" – The Master accepts only one response per a request and it must come from the specific remote to which the request has been sent. All other packets are discarded. This applies to the Master - Slave communication scheme.

Note
It may happen, that a response from a slave (No.1) is delivered after the respective timeout expired and the Master generates the request for the next slave (No.2) in the meantime. In such case the delayed response from No.1 would have been considered as the response from No.2. When Poll response control is On, the delayed response from the slave No.1 is discarded and the Master stays ready for the response from No.2.

"Off" – The Master does not check packets incoming from the RF channel - all packets are passed to the application, including broadcasts. That allows e.g. spontaneous packets to be generated at remote sites. This mode is suitable for Master-Master communication scheme or a combination of the UNI and ASYNC LINK protocols.

Mode of Connected device: SLAVE



Protocol parameters

Protocol: UNI

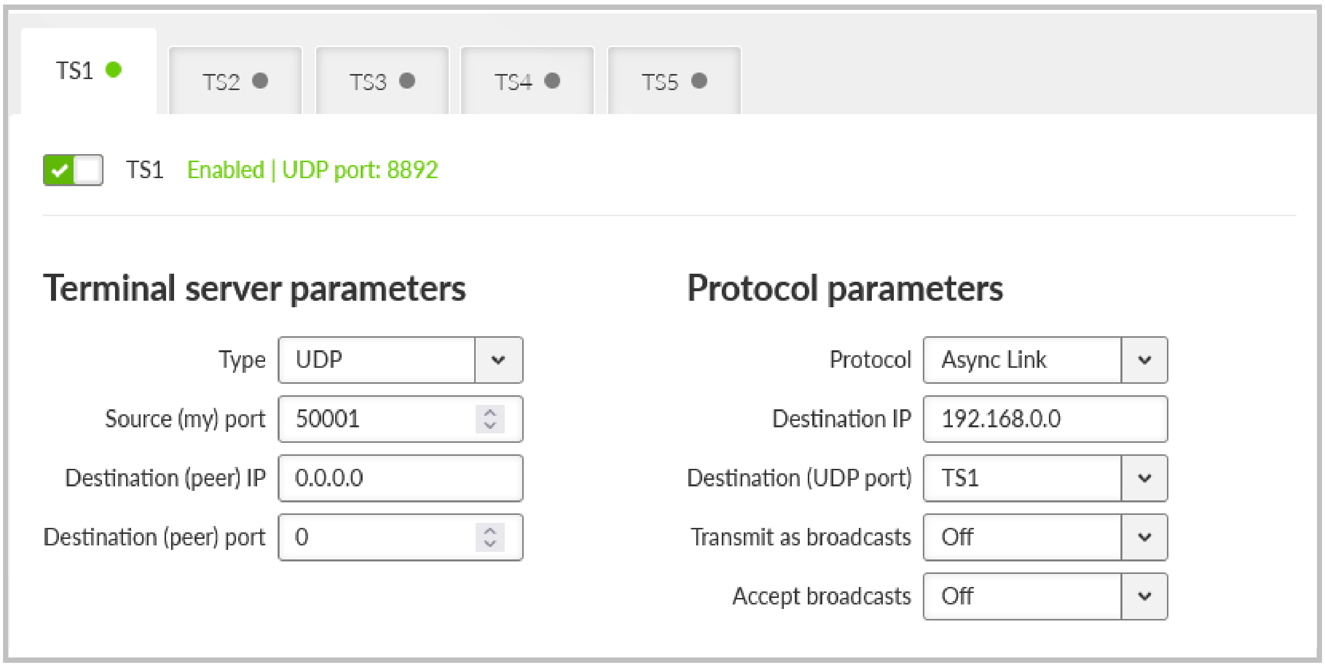
Mode of Connected device: Slave

Broadcast: On

7.1.3. Terminal servers

Generally, a Terminal Server (also referred to as a Serial Server) enables connection of devices with serial interface to a M!DGE3 over the local area network (LAN). It is a virtual substitute for devices used as serial-to-TCP (UDP) converters.

In some special cases, the Terminal server can be also used for reducing the network load from applications using TCP. A TCP session can be terminated locally at the Terminal server in M!DGE3, user data extracted from TCP messages and processed like it comes from a COM port. When data reaches the destination M!DGE3, it can be transferred to the RTU either via a serial interface or via TCP (UDP), using the Terminal server again.



☑ TS1 Enabled | UDP port: 8892

Terminal server parameters

Type	UDP
Source (my) port	50001
Destination (peer) IP	0.0.0.0
Destination (peer) port	0

Protocol parameters

Protocol	Async Link
Destination IP	192.168.0.0
Destination (UDP port)	TS1
Transmit as broadcasts	Off
Accept broadcasts	Off

Fig. 7.4: SETTINGS > Interfaces > Terminal servers

Up to 5 independent Terminal servers can be set up. Each one can be either TCP or UDP Type, **TCP Inactivity** is the timeout in seconds for which the TCP socket in M!DGE3 is kept active after the last data reception or transmission. As source IP address of a Terminal server will be used the IP address of the M!DGE3 ETH interface (**Local preferred source address** if exists see *Section 7.2.1, “ Static”*), **Source (my) port** can be set as required. **Destination (peer) IP** and **Destination (peer) port** values belong to the locally connected application (e.g. a virtual serial interface). In some cases, applications dynamically change the IP port with each datagram. In such a case set Destination port=0. M!DGE3 will then send replies to the port from which the last response was received. This feature allows to extend the number of simultaneously opened TCP connections between a M!DGE3 and locally connected application to any value up to 10 on each Terminal server. **Protocol** follows the same principles as a protocol on COM interface.

For details of settings see *Section 7.1.2.2, “Common Protocol parameters”*.

Note

Max. user data length in a single datagram processed by the Terminal server is 8192 bytes.

Note

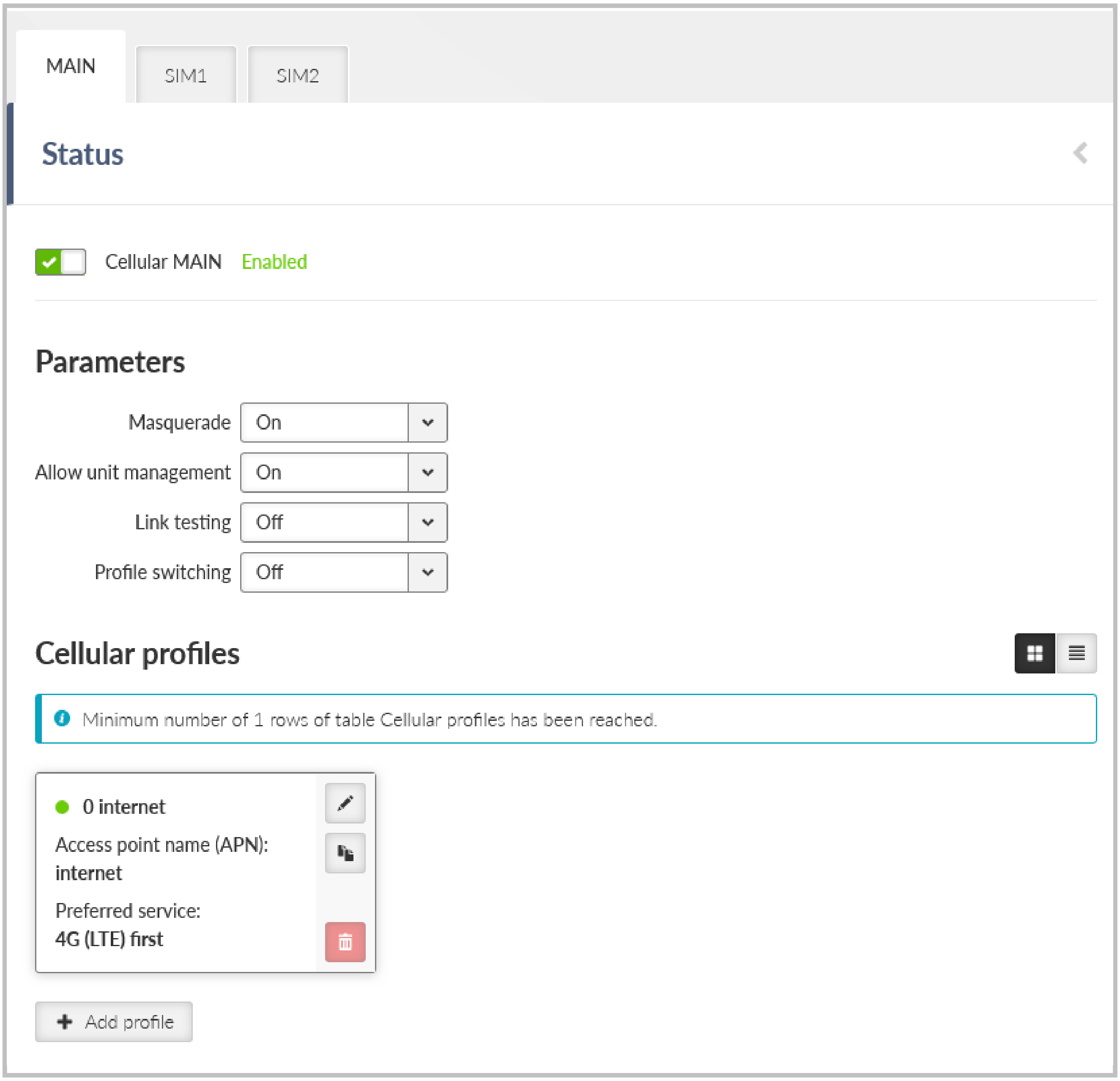
The port range 0-1023 is reserved and prohibited for Terminal Server. Port 502 is an exception for ModbusTCP.

7.1.4. Cellular

M!DGE3 can have up to two Cellular modules (MAIN and optional EXT). All features are identical for both. If both modules are used, each SIM card has to be assigned to a specific module.

APN must always be set up, all other parameters can keep their default values.

7.1.4.1. MAIN/EXT



Status

☑ Cellular MAIN Enabled

Parameters

Masquerade: On

Allow unit management: On

Link testing: Off

Profile switching: Off

Cellular profiles

Minimum number of 1 rows of table Cellular profiles has been reached.

● 0 internet

Access point name (APN): internet

Preferred service: 4G (LTE) first

Fig. 7.5: SETTINGS > Interfaces > Cellular

Enable / Disable cellular MAIN/EXT:
Enables / Disables the cellular MAIN/EXT. When disabled (default), the module power is off.

Note

Routing **Mode** “WWAN MAIN/EXT” is added to the Static routing rules definition. When this mode is selected, the routing Gateway parameter is ignored. The packet is forwarded to the Cellular (WWAN) interface instead.

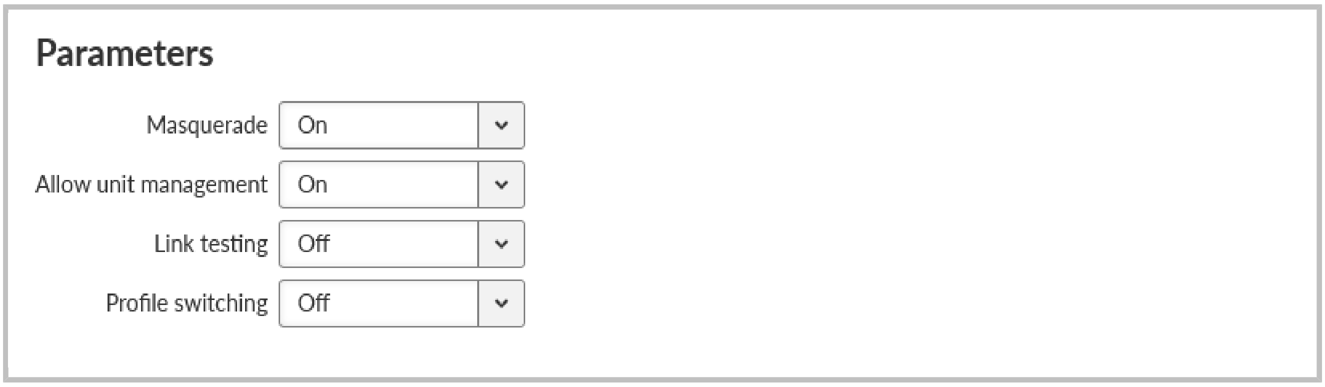
Routing rules are enabled / disabled automatically when the Cellular (WWAN) interface is opened / closed.

No routing rules are added automatically after configuring a new cellular profile. Add all appropriate routing manually (e.g., default route 0.0.0.0/0 via WWAN interface).

Note

This section closely cooperates with *Section 7.7.5, “SMS”*.

7.1.4.1.1. Parameters



Parameters

Masquerade: On

Allow unit management: On

Link testing: Off

Profile switching: Off

Masquerade
List box {On; Off}, default = "On"
Enables / Disables SNAT (MASQUERADE) for the packets outgoing from the WWAN interface. When on, the source address of packets outgoing via the Cellular WWAN interface will be changed to the address assigned to this interface (WWAN IP address is used instead of internal/LAN IP addresses). Returning packets will be correctly routed back to its original source (internal device).

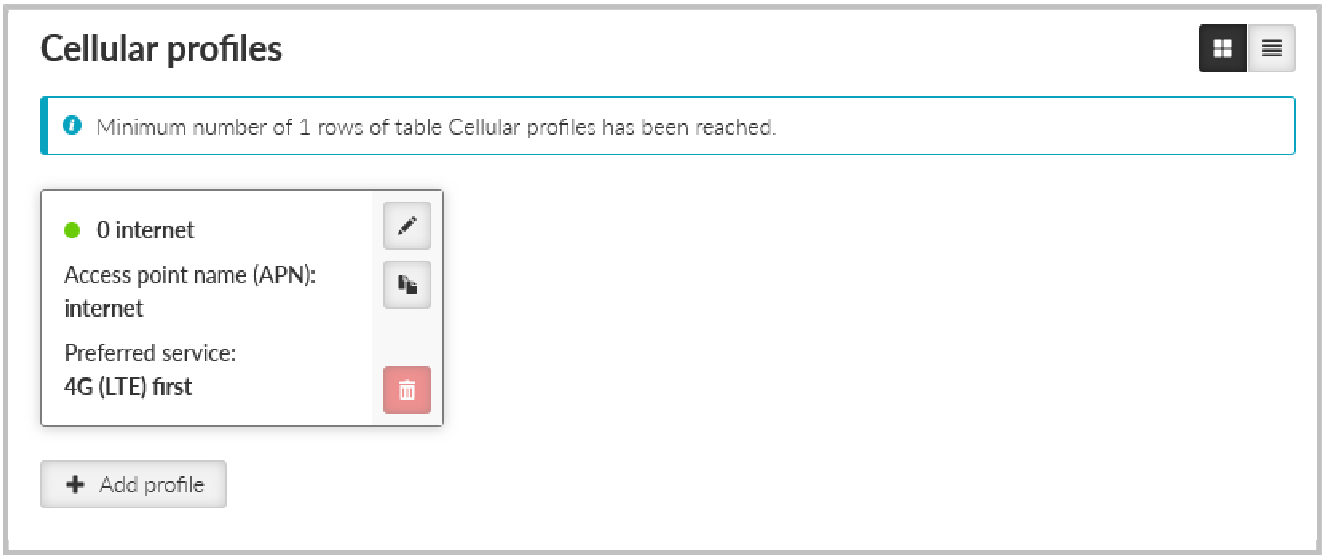
Allow unit management
List box {On; Off}, default = "On"
Allows to manage the unit over WWAN interface.

Link testing
List box {On; Off}, default = "Off"
Enables / Disables Link testing.

Profile Switching
List box {On; Off}, default = "Off"
Enables / Disables automatic Profile switching.

7.1.4.1.2. Cellular profiles

Set of defined profiles (at least one profile is required), which are setting parameters of requested service of the network (e.g APN).



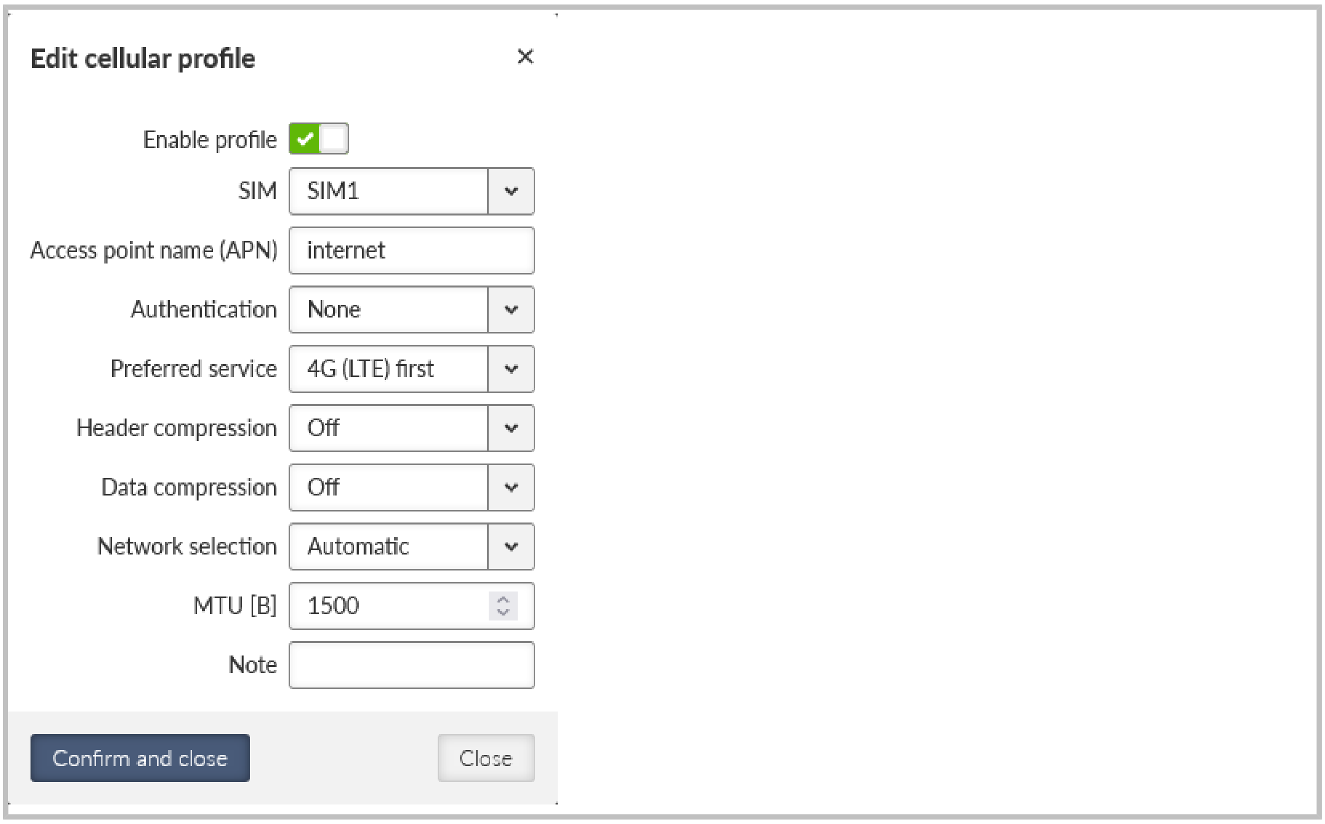
Cellular profiles

Minimum number of 1 rows of table Cellular profiles has been reached.

● 0 internet

Access point name (APN): internet

Preferred service: 4G (LTE) first



Edit cellular profile

Enable profile	☑
SIM	SIM1
Access point name (APN)	internet
Authentication	None
Preferred service	4G (LTE) first
Header compression	Off
Data compression	Off
Network selection	Automatic
MTU [B]	1500
Note	

Enable profile

Enables / Disables specific profile.

Access point name (APN)

String {up to 99 char}, default = <empty>

The APN for access into the cellular network. Valid APN is provided by customers Cellular provider.

Authentication

List box {None; PAP (legacy); CHAP}, default = "None"

Selects the method of authentication into the APN.

None
No authentication is used for the APN access.

PAP (legacy)
PAP (Password Authentication Protocol) authentication. We do not recommend to use this option because of security issues (the option is provided to offer legacy systems compatibility). Username and Password are required.

CHAP
CHAP (Challenge-Handshake Authentication Protocol) authentication. Username and Password are required.

Preferred service
List box {2G (GSM) first; 2G (GSM) only; 3G (UMTS) first; 3G (UMTS) only; 2G/3G (GSM/UMTS) only; 4G (LTE) first; 4G (LTE) only; 3G/4G (UMTS/LTE) only}, default = "4G (LTE) first"
Sets preferences and/or permission of the individual cellular network services.

Header compression
List box {On; Off}, default = "Off"
Enables / Disables the user data traffic IP headers compression. Not used with 4G service.

Data compression
List box {On; Off}, default = "Off"
Enables / Disables the user data traffic data compression. Not used with 4G service.

Network selection
List box {Automatic; Prefer manual; Lock to manual; Lock to home}, default = "Automatic"
Defines the network selection preferences:

Automatic
Network is selected automatically.

Prefer manual
The network according to the **Location area identity (LAI)** is preferred. Another network will be selected when the preferred network is not available.

Lock to manual
Only the LAI filled in the **Location area identity (LAI)** parameter will be used.

Lock to home
Only the home network will be used (if the SIM supports PLMN reading). This option can also be used as a “switch-off” for the roaming.

Location area identity (LAI)
String {00000 – 999999}, default = 00000
The Public Land Mobile Network (PLMN) identification number of the cellular network.
This parameter occurs only, if parameter **Network selection** is set to "Prefer manual" or "Lock to manual".

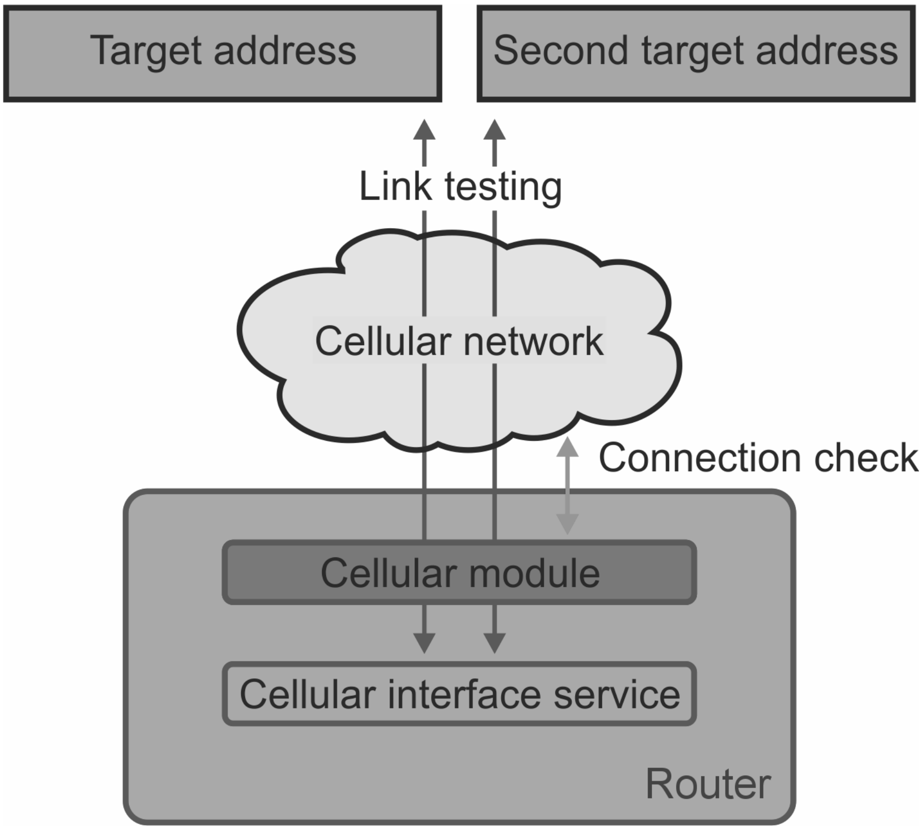
MTU [B]
Number {70 – 1500}, default = 1430
Outgoing packets MTU. Default value matches to the value of the mPLS83W module and it is the most common value within cellular networks.
Minimum MTU value for IPv6 (Babel) = 1280 B.

Note

Optional comment.

7.1.4.1.3. Link testing

To enable continuous checking of the functional connection via the Cellular interface, Link testing can be activated. This service (Link testing) adds to the basic testing of the connection to the cellular network (Connection check) a test of the end-to-end connectivity through the entire network up to the specified target address(es). The test is carried out by sending an ICMP ping to the defined address(es) and waiting for a response.It is possible to test against one or two target addresses.



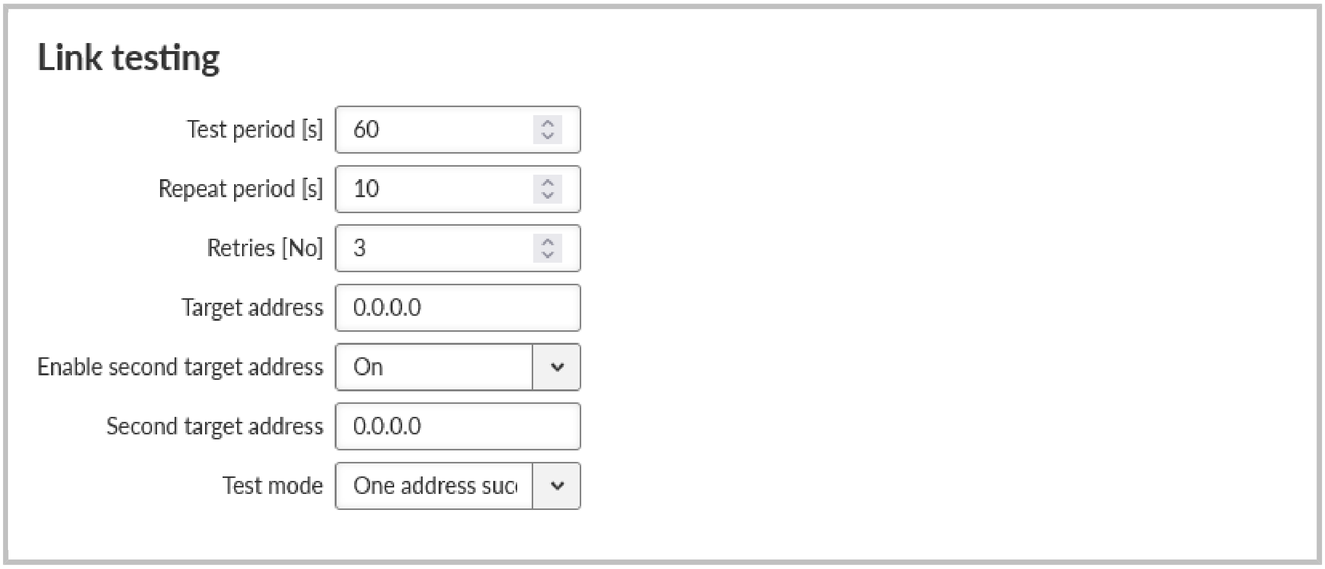
The test result is indicated by the link status:

- START - initial status before the start of testing
- RUNNING - the test succeeded, the link is considered to be OK, the test is performed with a Test period
- SUSPECT - the test began to fail, the test is performed with a Repeat period
- FAILED - the link is inoperative, the test is performed with a Repeat period

In a situation where the link is declared inoperative (test in FAILED status), the following actions are performed:

- If Profile switching is disabled, a disconnection and re-login to the Cellular network is initiated.
- If Profile switching is enabled, the switch to the next Profile is initiated.

Settings of Link testing for MAIN (EXT):



Link testing

Test period [s] 60

Repeat period [s] 10

Retries [No] 3

Target address 0.0.0.0

Enable second target address On

Second target address 0.0.0.0

Test mode One address suc

Test period [s]

Number {3 – 3600}, default = 60

Time period, during which is the connection being tested.

Repeat period [s]

Number {3 – 3600}, default = 10

If the test results as failed, the connection is tested again after defined time period.

Retries [No]

Number {1 – 20}, default = 3

Amount of failed tests, after which is the link declared to be non-functional.

Target address

IP address, default = 0.0.0.0

Primary tested IP address.

Enable second target address

List box {On; Off}, default = "On"

Enables / Disables testing of the second IP address.

Second target address

IP address, default = 0.0.0.0

Secondary tested IP address.

Test mode

List box {One address succeeds; Both addresses succeeds}, default = "One address succeeds"

Defines the success of the test:

- One address succeeds - only one address is enough to pass the test.

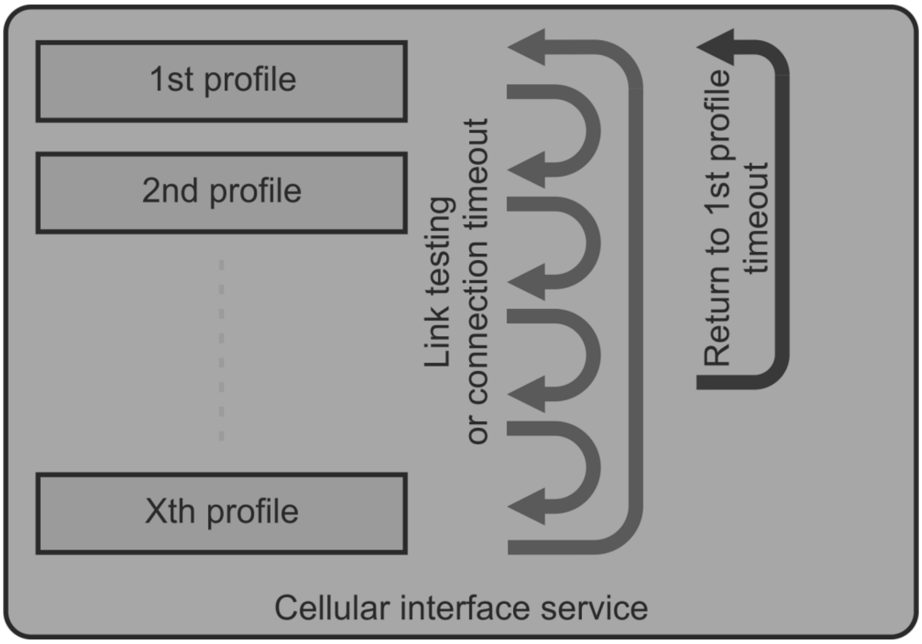
- Both addresses succeeds - both addresses must pass the test.

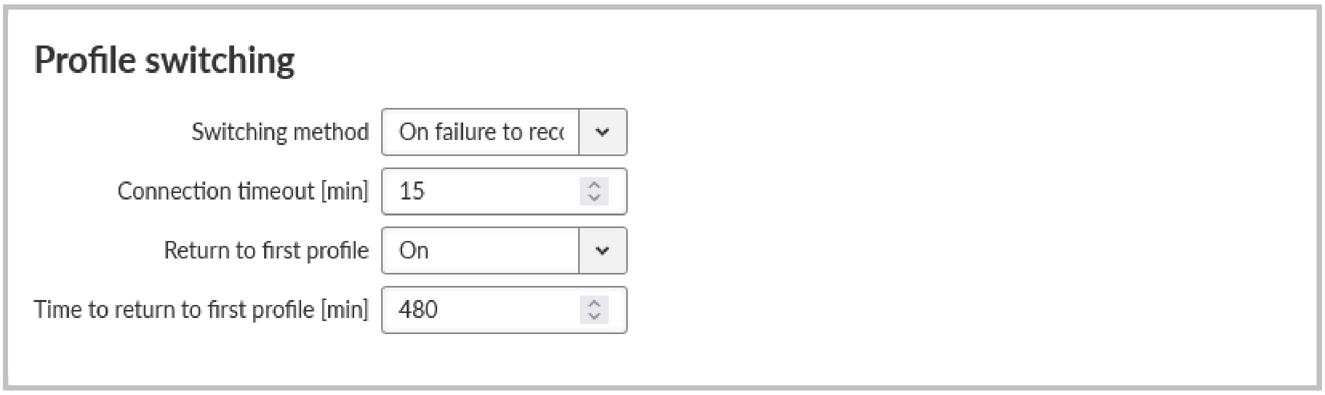
Note

If the connection to SIM card fails (missing SIM, wrong PIN), all profiles using that SIM will be blocked. If all profiles are blocked, the whole Cellular interface service will be blocked.

7.1.4.1.4. Profile switching

In case of a malfunction of the current running profile, the module switches automatically to another (if it is defined). If the module has no more defined profiles to switch to, it switches back to the first one. After defined time period, the module can try to reconnect via the first profile again (independently on the profile queue). This section occurs only, if parameter ***Profile switching*** is set to "On".





Profile switching

Switching method: On failure to reco

Connection timeout [min]: 15

Return to first profile: On

Time to return to first profile [min]: 480

Switching method

List box {On first failure; On failure to reconnect, On timeout}, default = "On first failure"
Defines the way of switching to the next profile, when the connection fails.

- On first failure - after first failure, the module switches to another profile.
- On failure to reconnect - after failure, the module tries to reconnect. If the reconnection is unsuccessful, the module switches to another profile.
- On timeout - the module keeps reconnecting to its current profile for the time period of its timeout (parameter **Connection timeout [min]**).

Connection timeout [min]

Number {3 – 60}, default = 15
Time period, during which is the module waiting for connection (after initial opening of the interface).

Return to first profile
List box {On; Off}, default = "On"
When enabled, the module will switch back to its first profile after defined time period.

Time to return to first profile [min]
Number {5 – 10080}, default = 480
Time period, after which is the current profile switched back to the first one.

7.1.4.2. SIM1 and SIM2

SIM1 and SIM2 tabs contain the same setting for SIM1 and SIM2 respectively.

PIN protection
List box {On; Off}, default = "Off"
Enables / Disables the SIM module PIN protection. It has to be switched on if the PIN is required. The parameter is ignored if the SIM does not require a PIN.

PIN code
String {0000 – 9999}, default = "0000"
The PIN is used only when PIN protection is On and the module requires the PIN.

7.1.4.3. Cooperation with other services

Firewall L3
Parameters **Input interface** and **Output interface** can filter the traffic either coming to WWAN or leaving to WWAN (List box WWAN or EXT).

NAT

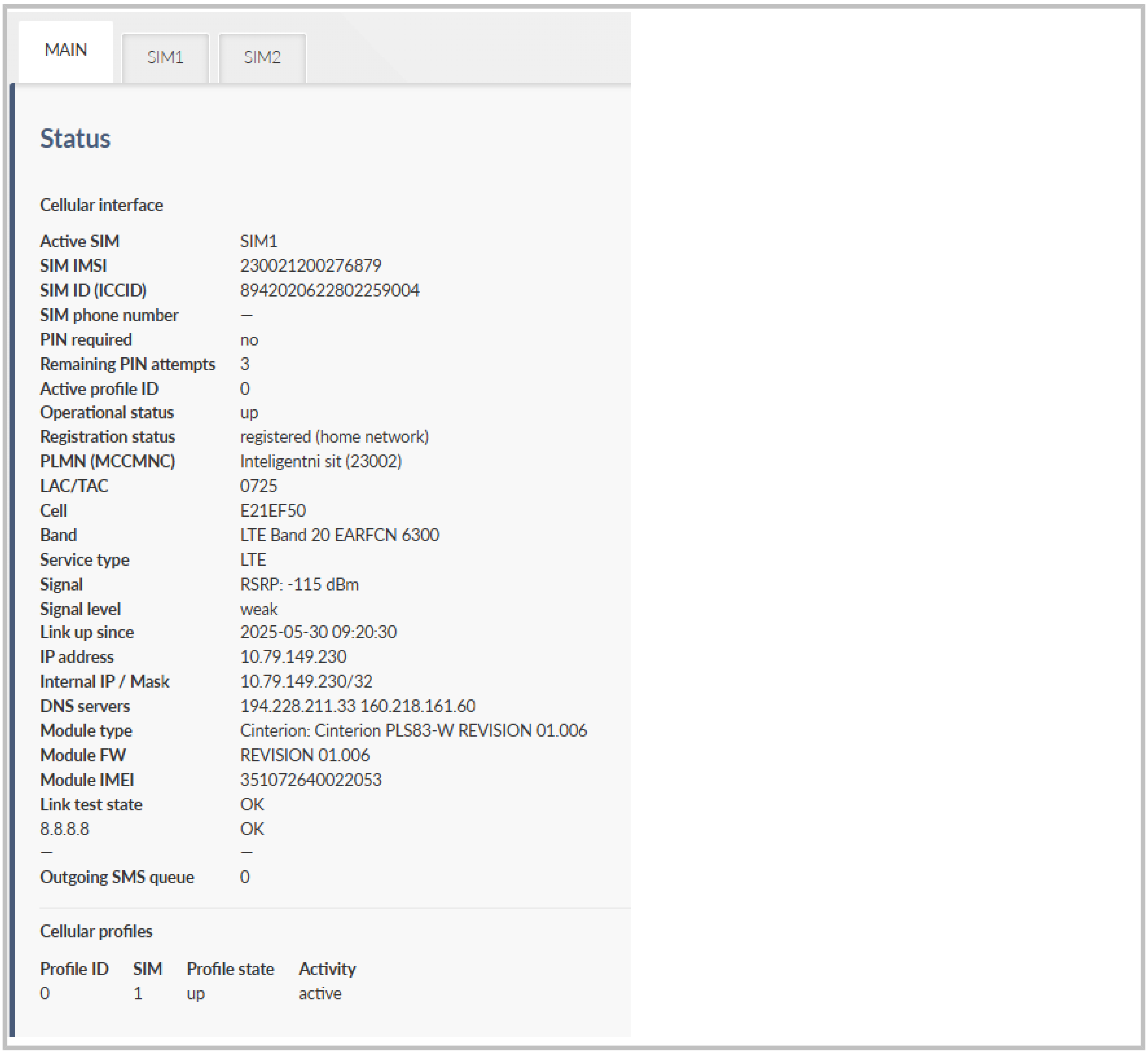
- SNAT - parameter **Output interface** can filter the traffic (List box WWAN or EXT).
  Rules of SNAT (user settings) have higher priority than rules of MASQUERADE in this section (parameter **Masquerade**).

- DNAT - parameter **Input interface** can filter the traffic (List box WWAN or EXT).

IPsec
Automatic rules of MASQUERADE do not overwrite the source address of packets, which are encapsulated into IPsec.
It is recommended for IPsec to enable MOBIKE, if guided through Cellular.

7.1.4.4. Status

Values are displayed from the moment of opening the SETTINGS menu. The values can be updated by using Refresh button.



Status

Cellular interface

Active SIM	SIM1
SIM IMSI	230021200276879
SIM ID (ICCID)	8942020622802259004
SIM phone number	–
PIN required	no
Remaining PIN attempts	3
Active profile ID	0
Operational status	up
Registration status	registered (home network)
PLMN (MCCMNC)	Inteligentni sit (23002)
LAC/TAC	0725
Cell	E21EF50
Band	LTE Band 20 EARFCN 6300
Service type	LTE
Signal	RSRP: -115 dBm
Signal level	weak
Link up since	2025-05-30 09:20:30
IP address	10.79.149.230
Internal IP / Mask	10.79.149.230/32
DNS servers	194.228.211.33 160.218.161.60
Module type	Cinterion: Cinterion PLS83-W REVISION 01.006
Module FW	REVISION 01.006
Module IMEI	351072640022053
Link test state	OK
8.8.8.8	OK
–	–
Outgoing SMS queue	0

Cellular profiles

Profile ID	SIM	Profile state	Activity
0	1	up	active

Fig. 7.6: SETTINGS > Interfaces > Cellular > Status

Common status information and SIMs information are available.

Tab. 7.1: Signal levels for individual services

Signal level	LED color	2G: RSSI	3G: RSCP	4G: RSRP
Weak / No signal	Red	<= -95 dBm	<= -100 dBm	<= -100 dBm
Medium	Orange	-95 to -84 dBm	-100 to -89 dBm	-100 to -80 dBm
Good	Green	-84 dBm <=	-89 dBm <=	-80 dBm <=

Note

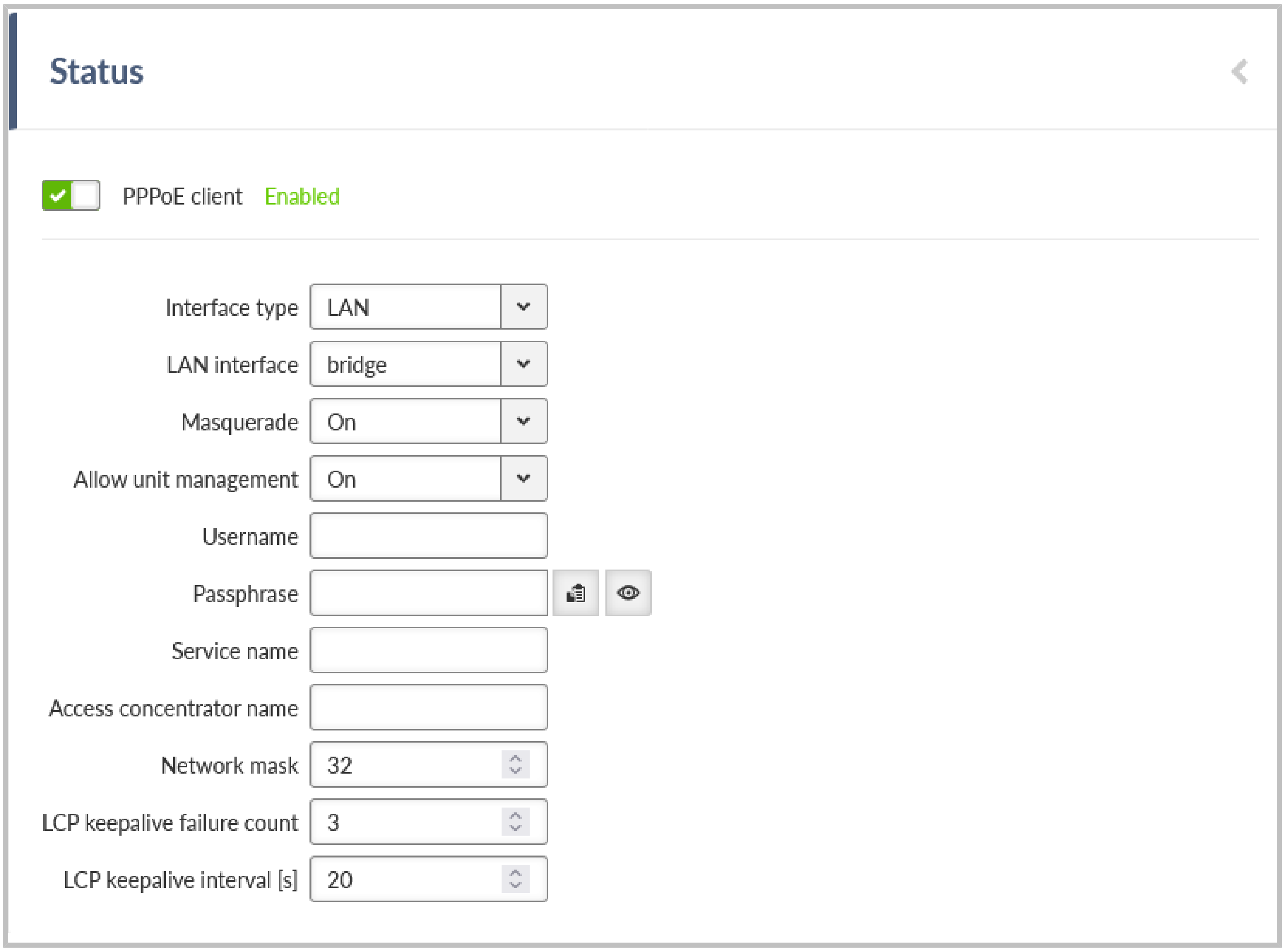
When using both antennas, the system measures the signal level on each antenna and uses the stronger signal. If ANT1 is disconnected, damaged, and ANT2 is connected, the menu (LED color) will display the signal level from ANT2, but transmission (Tx) communication will not be possible. Refer to *sub-chapter 7.1.4.1.3* for link testing instructions.

7.1.5. PPPoE client

PPPoE (Point-to-Point Protocol over Ethernet) is a network protocol that encapsulates PPP frames within Ethernet frames. The PPP protocol itself is already described among *serial protocols*. With PPPoE, we distinguish between two basic phases: "Discovery" and "PPP Session".

Discovery phase
The primary goal of the PPPoE Discovery Phase is to acquire essential information for establishing the PPP Session Phase. This information includes the MAC address of the peer device and the PPPoE session ID.

PPP Session phase
The primary goal of the PPP Session Phase is to establish and maintain a connection between the client and the server. This phase utilizes standard PPP frames for data exchange. All frames within this phase carry an ETHER_TYPE value of 0x8864 and are considered Ethernet unicasts.



Status

☑ PPPoE client Enabled

Interface type	LAN
LAN interface	bridge
Masquerade	On
Allow unit management	On
Username	
Passphrase	
Service name	
Access concentrator name	
Network mask	32
LCP keepalive failure count	3
LCP keepalive interval [s]	20

Fig. 7.7: SETTINGS > Interfaces > PPPoE client

Interface type
List box {LAN; VLAN}, default = "LAN"
This parameter specifies from which table the interface will be selected using a name.

- LAN - The name of the LAN interface to be used for PPPoE connection establishment.
- VLAN - The name of the VLAN interface to be used for PPPoE connection establishment.

Masquarade

List box {On; Off}, default = "On"

Enables/disables SNAT (masquerade) on packets sent over the PPP interface.

With masquerade, outgoing packets from the station over the PPP interface have their source address rewritten to the address assigned to this interface. Returning packets are then correctly routed back through the station.

Allow unit management

List box {On; Off}, default = "On"

Allows to manage the unit over PPP interface.

Username

String {up to 64 characters}, default = <empty>

The username to be used for authentication with the peer, regardless of the protocol required.

Passphrase

String {up to 64 characters}, default = <empty>

The passphrase to be used for authentication with the peer, regardless of the protocol required.

Service name

String {up to 64 characters}, default = <empty>

The service name to be used when searching for the server to connect to.

Access concentrator name

String {up to 64 characters}, default = <empty>

The name of the server to connect to.

Network mask

Number {0 – 32}, default = 0

Used together with the peer's IP address to determine the destination range of the routing rule pointing to the PPP interface.

LCP keepalive failure count

Number {0 – 255}, default = 3 (disabled if 0)

A non-zero value specifies the maximum number of LCP request messages sent before the peer is considered disconnected and the connection is terminated.

LCP keepalive interval

Number {0 – 255}, default = 10

The interval for sending LCP request messages, to which the peer normally responds with an LCP reply message.

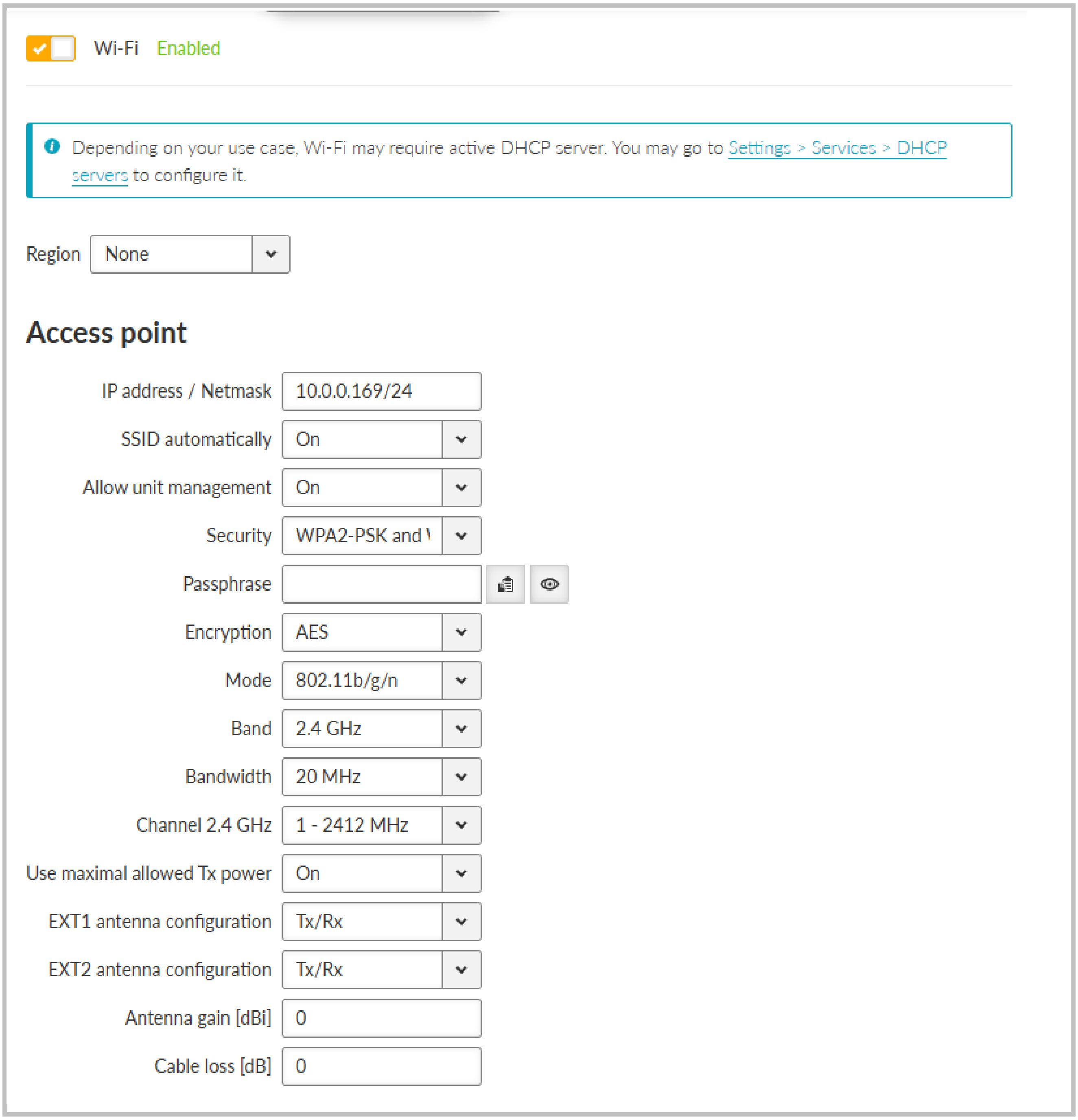
This parameter can be used in conjunction with LCP keepalive failure count to detect whether the peer is connected.

This parameter is active only when LCP keepalive failure count is greater than 0.

7.1.6. Wi-Fi

M!DGE3 optionally provides cellular Wi-Fi interface using embedded Wi-Fi module. Wi-Fi interface can be used in **Access point (AP) mode** only. Client mode is not implemented.

7.1.6.1. Settings



☑ Wi-Fi Enabled

Depending on your use case, Wi-Fi may require active DHCP server. You may go to Settings > Services > DHCP servers to configure it.

Region: None

Access point

IP address / Netmask	10.0.0.169/24
SSID automatically	On
Allow unit management	On
Security	WPA2-PSK and \
Passphrase	
Encryption	AES
Mode	802.11b/g/n
Band	2.4 GHz
Bandwidth	20 MHz
Channel 2.4 GHz	1 - 2412 MHz
Use maximal allowed Tx power	On
EXT1 antenna configuration	Tx/Rx
EXT2 antenna configuration	Tx/Rx
Antenna gain [dBi]	0
Cable loss [dB]	0

Fig. 7.8: SETTINGS > Interfaces > Wi-Fi

Enable/Disable Wi-Fi

Check box {On; Off}, default = "Off"
Enables / Disables the Wi-Fi.

Region

List box {ISO 3166-1 alpha-2 countries}, default = "None"
Setting the region in which the unit is operated. The purpose is to activate any regional restrictions on transmission power. These restrictions vary by region and by transmission band. The specific

value of the maximum allowed EIRP in the selected region can be verified in the Status - the value "Maximum allowed EIRP [dBm]".

IP address / Netmask

IP address, default = "10.0.0.169"
Netmask {0-32}, default = "24"
Wi-Fi interface IP address, must not conflict with another address range.

Allow unit management

List box {On; Off}, default = "On"
Enables access to unit management through the Wi-Fi interface.

Security

List box {Off, WPA-PSK (legacy), WPA2-PSK, WPA-PSK (legacy) and WPA2-PSK, WPA3-SAE, WPA2-PSK and WPA3-SAE}, default = "WPA2-PSK and WPA3-SAE"
Wi-Fi network security.

Passphrase

String {up to 63 characters}, default = <empty>
Passphrase to connect to Wi-Fi Access Point.

Encryption

List box {TKIP (legacy), AES (default), TKIP (legacy) and AES}, default = AES
Wi-Fi network encryption.

Mode

List box {802.11a, 802.11b, 802.11b/g, 802.11b/g/n , 802.11a/n, 802.11a/n/ac}, default = 802.11b/g/n
IEEE 802.11 mode in which the Wi-Fi module will operate.

Band

List box {2.4 GHz, 5 GHz}, default = 2.4 GHz
Band in which the Wi-Fi module will operate.

Bandwitdh

List box {20 MHz ,40 MHz, 80 MHz}, default = 20 MHz
Wi-Fi network bandwidth.

Channel 2.4 GHz

List box {1 - 2412 MHz, 2 - 2417 MHz, 3 - 2422 MHz, 4 - 2427 MHz, 5 - 2432 MHz, 6 - 2437 MHz, 7 - 2442 MHz, 8 - 2447 MHz, 9 - 2452 MHz, 10 - 2457 MHz, 11 - 2462 MHz, 12 - 2467 MHz, 13 - 2472 MHz, 14 - 2484 MHz}, default = 1 - 2412 MHz
2.4 GHz Wi-Fi network channel. Available options are dependant on the Wi-Fi bandwidth settings.

Channel 5 GHz

List box {36 - 5180 MHz , 40 - 5200 MHz, 44 - 5220 MHz, 48 - 5240 MHz, 52 - 5260 MHz, 56 - 5280 MHz, 60 - 5300 MHz, 64 - 5320 MHz, 100 - 5500 MHz, 104 - 5520 MHz, 108 - 5540 MHz, 112 - 5560 MHz, 116 - 5580 MHz, 120 - 5600 MHz, 124 - 5620 MHz, 128 - 5640 MHz, 132 - 5660 MHz, 136 - 5680 MHz, 140 - 5700 MHz, 144 - 5720 MHz, 149 - 5745 MHz, 153 - 5765 MHz, 157 - 5785 MHz, 161 - 5805 MHz, 165 - 5825 MHz}, default = 36 - 5180 MHz
5 GHz Wi-Fi network channel. Available options are dependant on the Wi-Fi bandwidth settings.

Note
Channels that require DFS cannot be used.

Use maximal allowed Tx power

List box {On; Off}, default = "On"
Automatic selection of the transmitting power of the Wi-Fi module.
If the option is disabled:

Maximal Tx power

Full number {0-16}, default = "16" [dBm]
Transmitting power of the Wi-Fi module.

EXT1 antenna configuration

List box {Off, Tx, Rx, Tx/Rx}, default = "Tx/Rx"
Determines the functionality of the antenna connected to the Wi-Fi module via EXT1 port.

EXT2 antenna configuration

List box {Off, Tx, Rx, Tx/Rx}, default = "Tx/Rx"
Determines the functionality of the antenna connected to the Wi-Fi module via EXT2 port.

Antenna gain

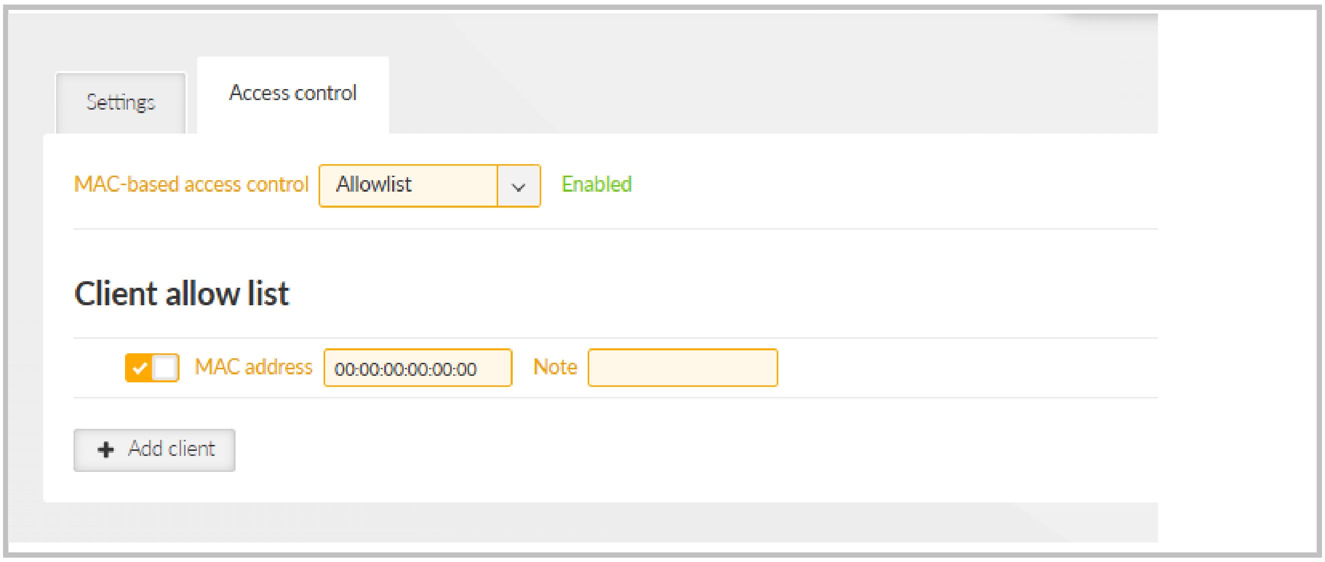
Full number {0-30}, default = "0" [dBi]
Gain of the antenna connected to the Wi-Fi module.
Used in the calculation of the transmit power of the Wi-Fi module with a positive sign.

Cable loss Full number {0-30}, default = "0" [dB]

Used in the calculation of the transmit power of the Wi-Fi module with a negative sign.

7.1.6.2. Access control

The Access Control table allows you to control client access based on their MAC addresses.



MAC-based access control Allowlist Enabled

Client allow list

☑ MAC address 00:00:00:00:00:00 Note

Fig. 7.9: SETTINGS > Interfaces > Wi-Fi > Access control

MAC-based access control

List box {Off, Allowlist, Blocklist}, default = "Off"
Manage client access by MAC address.

Allowlist
Alows only clients with MAC addresses in the list, others are blocked.

Blocklist
Blocks clients with MAC addresses in the list, others are allowed

Enable/Disable client
List box {On; Off}, default = "On"
Activates a rule for a given MAC address.

MAC address MAC address , default = 00:00:00:00:00:00

MAC address of the client

7.1.6.3. Cooperation with other services

DHCP server
It is possible to run a DHCP server over the Wi-Fi interface.
The DHCP server must be configured to allocate IP addresses from the address range specified by the configuration **IP address / Netmask** in the Wi-Fi interface.

Events
Connection and disconnection of clients to the Wi-Fi AP is reported by events "Wi-Fi AP (EXT) reports client connected" and "Wi-Fi AP (EXT) reports client disconnected"

Firewall L3
The firewall can filter traffic coming from the Wi-Fi interface by using the "EXT" option in the I/O interface settings.

HotStandby
Wi-Fi is deactivated in passive mode and activated in active mode.
In passive mode, the module's power supply is active, but the Wi-Fi interface is not active.

Link manager
The Wi-Fi interface can be used in Link Manager as a WWAN (EXT) interface when configuring the link.

NAPT
SNAT and DNAT rules can modify traffic passing through the Wi-Fi interface by using the "EXT" option in the I/O interface settings.
The Wi-Fi interface name can be used when setting the manual I/O interface name ("Other"), but only if Wi-Fi (EXT) is active.

Sleep mode
When sleep mode is active, it is possible to delay putting the device to sleep if user traffic is detected on the Wi-Fi interface.

7.2. Routing

M!DGE3 router supports both static and dynamic IP routing.

Static routing is based on fixed – static – definition of routing tables. Dynamic routing is based on automatic creating and updating of routing tables. Various methods and protocols are used for this purpose. Babel, OSPF and BGP standard routing protocols are available in M!DGE3 networks.

Link management option was added allowing to set the switchover of the main link (in the event of its failure) to an existing backup link by automatic changes of routing rules.

Note

Due to static internal routing to clients, OpenVPN L3 is incompatible with dynamic routing protocols. Dynamic routing over the OpenVPN L3 interface will not function.

Note

M!DGE3e not supports Dynamic routing functionalities (Link management, Babel, OSPF, BGP).

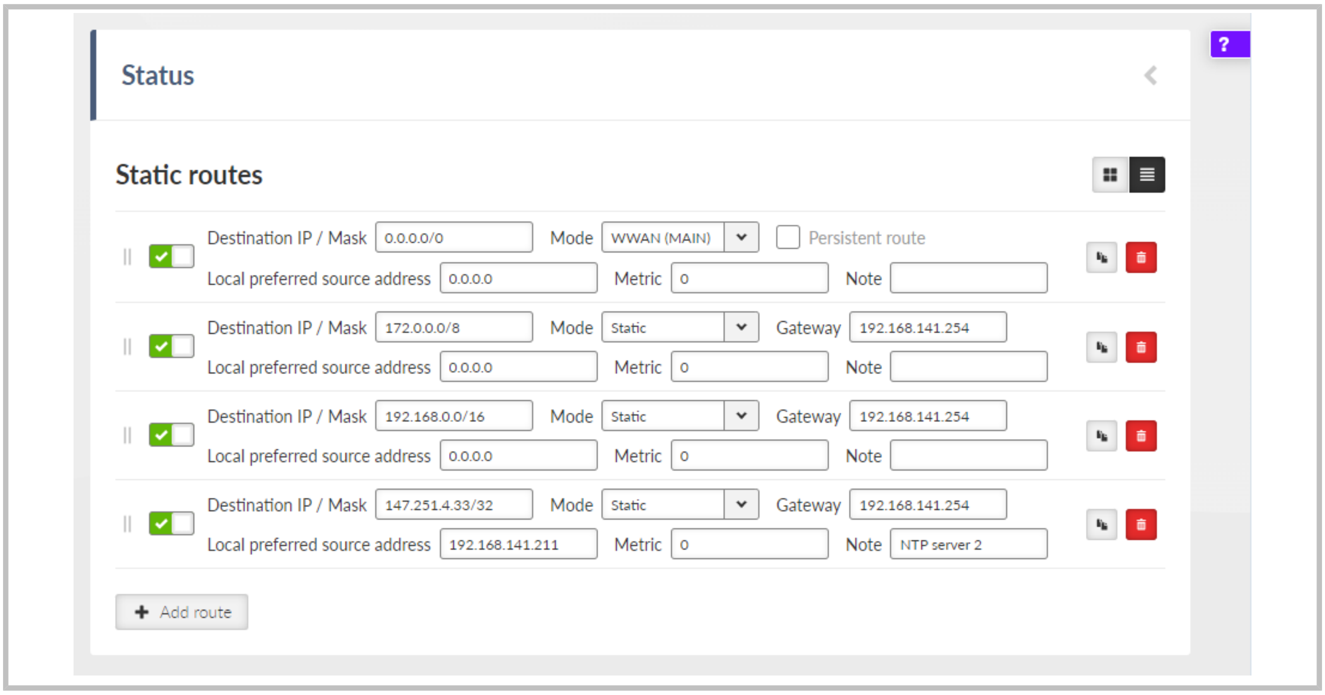
7.2.1. Static

M!DGE3 works as a standard IP router with multiple independent interfaces: Network interfaces (bridging physical Ethernet interfaces), COM ports, Terminal servers, Cellular interface etc. Each of the interfaces has its own IP addresses and Masks. All IP packets are processed according to the Routing table.

Unlimited number of subnets can be defined on the Network interface. They are routed independently.

The COM ports are treated in the standard way as router devices, messages can be delivered to them as UDP datagrams to selected UDP port numbers. Destination IP address of COM port is IP of a Network interface (bridging Ethernet interfaces). The IP address source of outgoing packets from COM ports is equal to IP address of interface (Network interface) through which packet has been sent. The source address can also be assigned to **Local preferred source address** value - see description below. Outgoing interface is determined in Routing table according to the destination IP.

The IP addressing scheme can be chosen arbitrarily, only 127.0.0.0/8 and 192.0.2.233/30 and 192.0.2.228/30 restriction applies. It may happen that also the subsequent addresses from the 192.0.2.0/24 subnet according to RFC5737 may be reserved for internal usage in the future.



Status

Static routes

☑ Destination IP / Mask 0.0.0.0/0 Mode WWAN (MAIN) □ Persistent route
Local preferred source address 0.0.0.0 Metric 0 Note

☑ Destination IP / Mask 172.0.0.0/8 Mode Static Gateway 192.168.141.254
Local preferred source address 0.0.0.0 Metric 0 Note

☑ Destination IP / Mask 192.168.0.0/16 Mode Static Gateway 192.168.141.254
Local preferred source address 0.0.0.0 Metric 0 Note

☑ Destination IP / Mask 147.251.4.33/32 Mode Static Gateway 192.168.141.254
Local preferred source address 192.168.141.211 Metric 0 Note NTP server 2

Fig. 7.10: SETTINGS > Routing > Static

Active

{On / Off}
Switches the rule on / off.

Destination IP / mask

IP address, default = 0.0.0.0/0
Each IP packet, received by M!DGE3 through any interface (ETH, COM, ...), has got a destination IP address. M!DGE3 (router) forwards the received packet either directly to the destination IP address or to the respective Gateway, according to the Routing table. Any Gateway has to be within the network defined by IP and Mask of one of the interfaces, otherwise the packet is discarded.
Each item in the routing table defines a Gateway (the route, the next hop) for the network (group of addresses) defined by Destination IP and Mask. When the Gateway for the respective destination IP address is not found in the Routing table, the packet is forwarded to the Default gateway, when Default gateway (0.0.0.0/0) is not defined, the packet is discarded.
The network (Destination IP and Mask) is written in CIDR format, e.g. 10.11.12.0/24.

Note
Network defined by the same combination of Destination IP and Mask cannot be used for two different rules.

Mode

List box {Static; WWAN (MAIN); WWAN (EXT); PPP1; PPP2; PPP3; Link manager; PPPoE Client}, default = Static

- Static - Used for static IP routing rules.
- WWAN (MAIN); WWAN (EXT) - Routing rule to the primary/secondary WWAN, which has a dynamically assigned address. The next hop will be directed through the "wwan" interface when it is open.
- PPP1; PPP2; PPP3 - Routing rule to the PPP interface associated with the COM protocol. The interface may have a dynamically assigned address. Can only be set if the corresponding COM port is enabled and with the PPP protocol.
- Link manager - Routing rule via active link selected by the Link manager. The rule will be dynamically switched in case of a link change or loss. It can be set if the Link manager is enabled.
- PPPoE Client - Routing rule to the PPP interface created by the PPPoE client. The interface has a dynamically assigned address. It can only be set if the PPPoE client is active.

Local preferred source address

IP address, default = 0.0.0.0
Local IP address used as a source address for packets originating in the local M!DGE3 unit being routed by this routing rule. It might be for example packets originating from the COM port or from the Terminal Server. If the address is set to 0.0.0.0 it is not considered active. The IP address has to belong to the Network interfaces.

Metric

Number {0 – 4294967294}, default = 0
Routing rule metric value.

Note

You may add a name to each route with your comments up to 16 characters (UTF8 is supported) for your convenience.

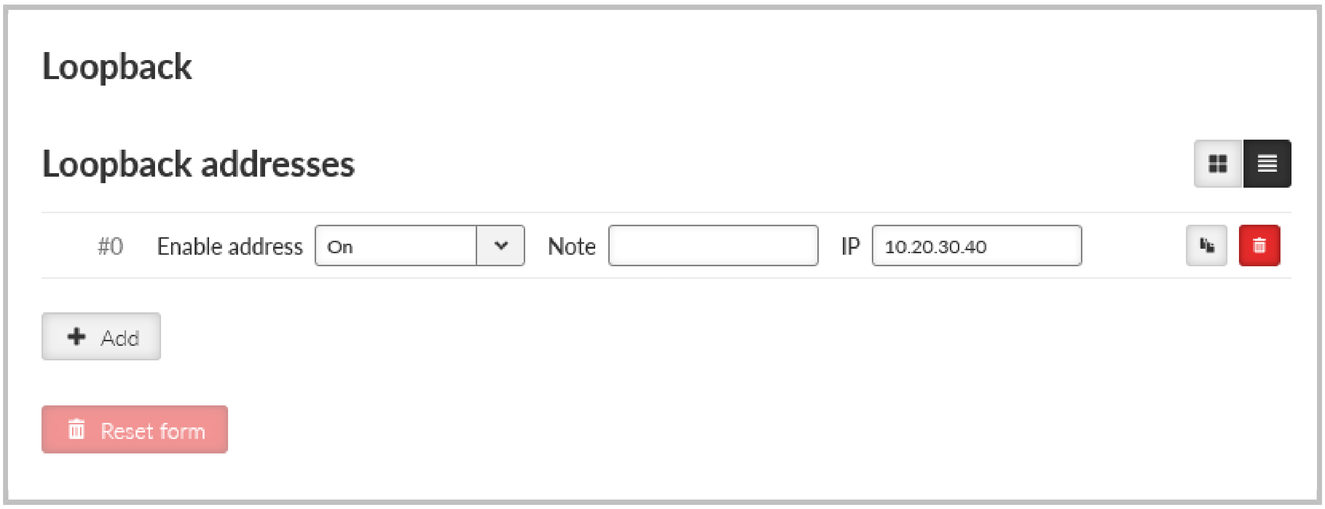
Persistent route

List box {On; Off}, default = Off
Sets the persistence (time of presence) of dynamic routing rule.
This parameter is available only if parameter **Mode** is set to "WWAN (MAIN)" or "WWAN (EXT)".

- On - Routing rule is always present. When the WWAN interface is closed, it reports "unreachable" messages (via ICMP) and the traffic cannot be caught by a different rule.
- Off - Routing rule exists only if the WWAN interface is open. If it is closed, the traffic can be caught by a different rule.

7.2.1.1. Loopback addresses

Table of loopback addresses contains IP addresses of M!DGE3, which are set on the loopback interface as "support" addresses independent on specific interface. Maximum number of addresses is 256. Loopback addresses can be useful e.g. for specific routing purposes or specific user data traffic. For example using different routing rules for different traffic.


Loopback

Loopback addresses

#0 Enable address On Note IP 10.20.30.40

Fig. 7.11: ADVANCED > Interfaces > Loopback

Enable address

List box {On; Off}, default = "On"

Note

Optional comment.

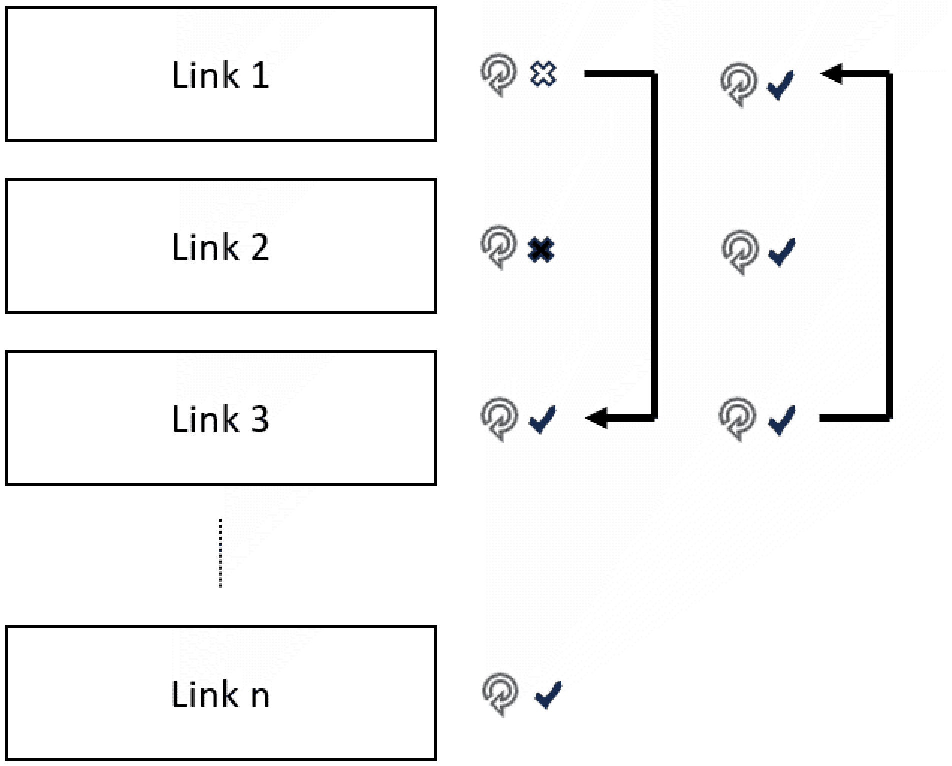
IP

IP address, default = 0.0.0.0
Defines the IP address which will be set on the loop-back interface. The mask is automatically /32.

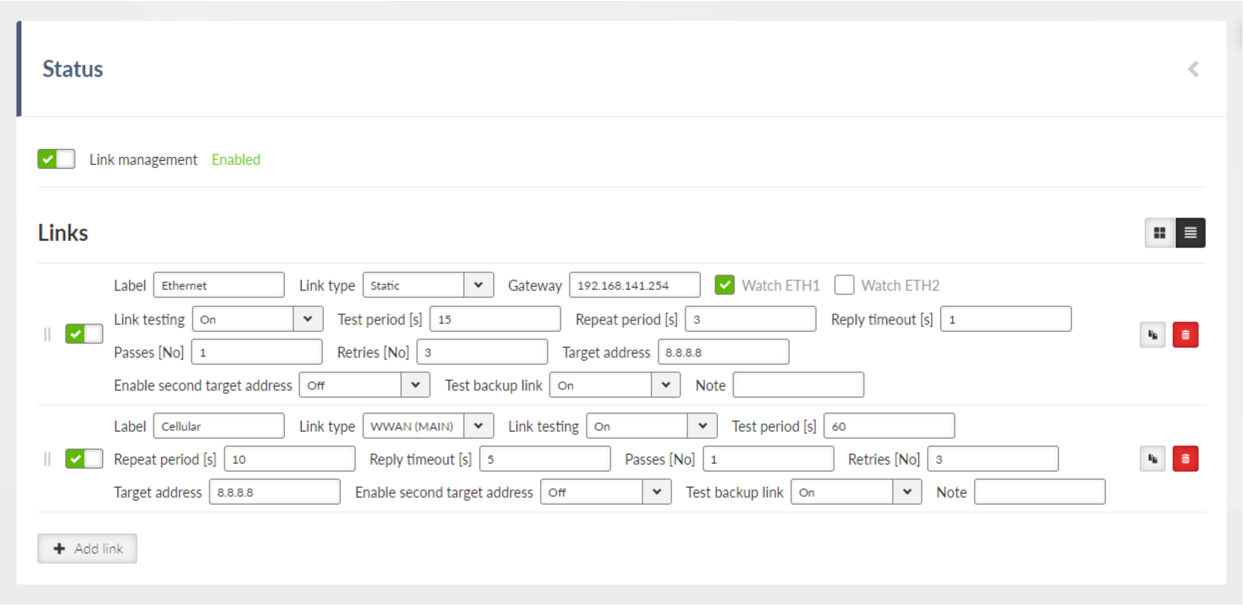
7.2.2. Link management

Link manager is a mechanism providing switching of several pre-configured alternative links (alternative routes). Link switch is triggered in case of the active link failure. Link failure can be detected passively – by checking link interface status (see **Watched interface** parameter) and actively by ICMP ping (see **Link testing** parameter).

Link testing is active on currently active link and all higher priority links (to detect when they are available again). Lower priority links can also be tested (see **Test backup link** parameter). When the current link fails, link manager switches to the next functional lower priority link. If the link is not being checked (Test backup link parameter is disabled), it is assumed to be functional. Routing rules are updated automatically on link switchover.



7.2.2.1. Parameters



Status

☑ Link management Enabled

Links

☑ Label: Ethernet; Link type: Static; Gateway: 192.168.141.254; ☑ Watch ETH1; ☐ Watch ETH2
Link testing: On; Test period [s]: 15; Repeat period [s]: 3; Reply timeout [s]: 1
Passes [No]: 1; Retries [No]: 3; Target address: 8.8.8.8
Enable second target address: Off; Test backup link: On; Note:

☑ Label: Cellular; Link type: WWAN (MAIN); Link testing: On; Test period [s]: 60
Repeat period [s]: 10; Reply timeout [s]: 5; Passes [No]: 1; Retries [No]: 3
Target address: 8.8.8.8; Enable second target address: Off; Test backup link: On; Note:

Fig. 7.12: SETTINGS > Routing > Link management

Enable Link manager

Enables/disables the Link manager

IPsec control

List box {Off; On}, default = “Off”

Enables / disables binding between a link and particular IPsec tunnel. This option is available only when IPsec is enabled and configured. Configuration parameter: SETTINGS > VPN > IPsec > IPsec associations > **Management mode** provides two options:

Link manager (Master)

One of the IPsec associations is declared as **Master**. Traffic selectors (CHILD SA) define the traffic to be encrypted.

Link manager (Slave)

All other associations are declared as **Slave**. No Traffic selectors are defined for such a tunnel. The Master’s traffic selectors are used.

7.2.2.2. Links

Every alternative link is configured separately. The priority of individual links is determined by their order. Maximal number of links is 16.

Possible link states:

- **down**: link is not present
- **untested**: link is present, no Link test result is available yet
- **up**: link is present and functional. Should the Link test be activated, the test result is successful
- **test failed**: link is present, the Link test failed

Possible link roles:

- **active**: link is selected as the active one. Only one of the links can be active
- **backup**: link has a lower priority compared to the active link
- **rejected**: link has a higher priority compared to the active link, but can not be used

Enable link

Enables / disables individual link

Label

String {a..z A..Z 0..9 @ _ -}, max 42 char, default = “LINK”

Name of the link that's used in the Status info and System logs

Link type

List box {Static; WWAN (MAIN); WWAN (EXT)}, default = “Static”

- Static – LAN, GRE or radio interfaces
  Gateway needs to be configured. Watched interfaces can be selected.

- WWAN (both MAIN or EXT)
  The cellular interface status is checked automatically (incl. Cellular Link tester – when enabled). The link state is up in case the Cellular interface is enabled and the link test succeeded. The gateway IP is not configured manually - IP address assigned by the cellular network is used.

Gateway

IP address, default = 0.0.0.0

Next-hop (gateway) address for the Static type of the link

Watched interface (ETH1 .. ETH5, Radio)

Enables / Disables checking of individual interface.
When all checked interfaces are down, the link state is **down**
ETHx Link status is checked for ETH1-ETH5 options. Successful establishment of Radio interface is checked for the Radio option

IPsec association

List box {list of available Peer IDs}, default = first Peer ID
When **IPsec control** is On, the individual link is paired with an individual IPsec tunnel defined by its **Peer ID**. In such a case the individual IPsec tunnel is activated/deactivated together with the respective link. It is automatically switched back to the higher priority link once it is restored..

Link testing

List box {Off; On}, default = “Off”
Enables active link testing. Links are tested using ICMP echo packets

Test period [s]

Number {3 – 3600}, default = 60
Testing period of a link that is in the **up** state

Repeat period [s]

Number {3 – 3600}, default = 10
Testing period of a link that has to be tested (above the active link) and it is normally not tested or the test failed

Reply timeout [s]

Number {1 – 60}, default = 5
ICMP ping reply timeout

Passes [No]

Number {1 – 20}, default = 1
Uninterrupted number of successful tests (pings) after which the link status is up

Retries [No]

Number {1 – 20}, default = 3
Uninterrupted number of failed tests (pings) after which the link status is **test failed**

Target address

IP address, default = 0.0.0.0
Primary tested IP address

Enable second target address

List box {Off; On}, default = "Off"
Enables / Disables testing of the second IP address

Second target address

IP address, default = 0.0.0.0
Secondary tested IP address.

Test mode

List box {One address succeeds; Both addresses succeed}, default = "One address succeeds"

- One address succeeds - only one address is enough to pass the test
- Both addresses succeed - both addresses must pass the test

Test backup link
List box {Off; On}, default = "Off"
Enables active link testing of a link having lower priority compared to **active** link

Note
String {0–42 char}, default = <empty>

NOTE: Link manager is not a full featured dynamic routing protocol (as Babel, OSPF or BGP). Dynamic routing protocols provide synchronization of alternative packet routes across the whole network. Link manager works locally – there is no synchronization of the selected link (route) with other units across the network. Keep in mind this fact when planning Link manager configuration across your network and preserve symmetrical behaviour. One effect of the fact that each Link manager instance in the network operates independently is the occasional asymmetric traffic when switching alternate routes.

NOTE: Link test packets (ICMP echo to test addresses) must actually test the individual link (be routed through it). In combination with IPsec control, it must not happen that the IPsec tunnel captures and encrypts these packets. Otherwise, non-standard behaviour may occur (oscillation, test never succeeds, stuck on broken link).

7.2.2.3. Status

Status info area provides list of all enabled link. Link state and Link role (see description above) provide information about individual status of each link and which of the links is the active one.

7.2.3. Babel

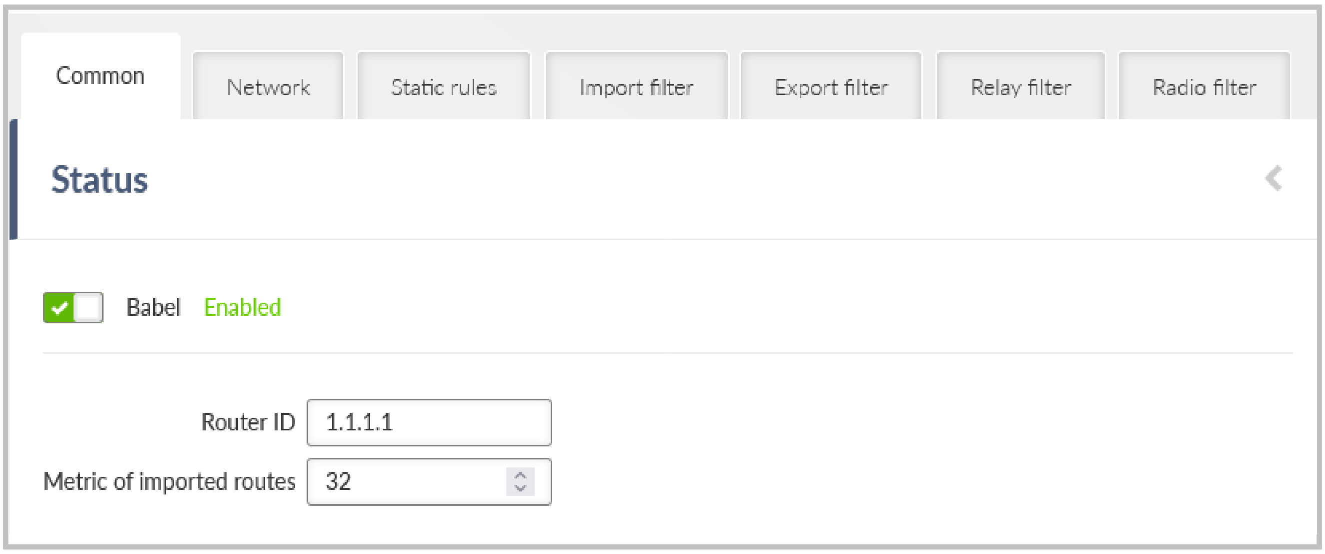
Babel is a loop-avoiding distance-vector routing protocol that is designed to be robust and efficient both in networks using prefix-based routing and in networks using flat routing ("mesh networks"), and both in relatively stable wired networks and in highly dynamic wireless networks (for more information see *RFC 6126*[2]).

Babel is also a dynamic routing protocol for Internet Protocol (IP) networks. It is an Interior Gateway Protocol (IGP) working within one Autonomous system. It is based on OSPF protocol (see the next chapter for OSPF protocol description) with the following differences:

- Works within one autonomous system
- Babel provides both wired and wireless type of network interface

Babel protocol is typically used within the network hops or other networks with limited data throughput.

[2] https://datatracker.ietf.org/doc/html/rfc6126.html#section-1.1



Status

☑ Babel Enabled

Router ID 1.1.1.1

Metric of imported routes 32

Fig. 7.13: SETTINGS > Routing > Babel

Configuration parameters are described in the following chapters. Several use case scenarios and configuration examples are described in the *Babel Application note*[3].

7.2.3.1. Description

Every router defines which interfaces are used for Babel protocol to search for available network neighbors.

Each router is periodically transmitting and receiving Hello packets to determine existence and quality of a connection to neighboring network nodes. The result information about available routes (paths) and their quality is shared across the network. Routing tables are exchanged periodically and also after their update.

Routing path decision is based on a “metric”:

- Metric is set on each interface. It reflects a “price” for the packet reception. The higher the metric value, the more disadvantageous is usage of such a path.
- Maximum value is 65535.

There are two types of interfaces:

- Wired: assumes a reliable link. The quality is evaluated according to the number of received Hello packets. If configured limit of lost packets is exceeded, the line is considered down.
- Wireless: assumes a variable connection quality. The price of the interface increases gradually witch each lost Hello packet until the line is declared down.

Routing decision:

- SETTINGS > Routing > Static routes are valid even if the Dynamic routing is enabled. Dynamic routing protocols “export” resulting routing rules into Linux and they are added to the existing (static) routing rules.

[3] https://www.racom.eu/download/hw/ripex/free/eng/1_application/ripex2-app-bab-en.pdf

- Particular routing decision takes IP mask as a primary decision rule (narrower mask has a higher priority) and metric as a secondary decision rule. Rules received from dynamic protocols have higher metric compared to Static routes (they always have the highest possible metric).
- Internal metrics of dynamic protocols are processed only inside them. Only the final set of routing rules is exported to the Linux router.

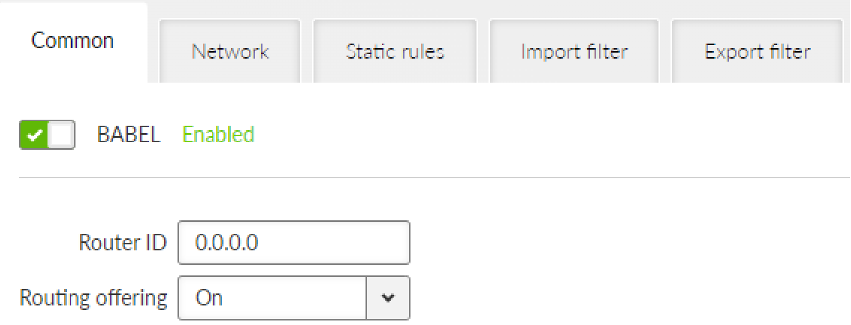
Example 1:

- SETTINGS > Routing > Static routes rule: 0.0.0.0/0 → 10.10.1.11
- Dynamic rule: 192.168.1.0/24 → 192.168.11.1 metric 32
- Packet with DST 192.168.1.42 will be routed to 192.168.11.1 because the dynamic rule has a narrower mask.

Example 2 – similar situation with additional static rule:

- SETTINGS > Routing > Static routes rule: 0.0.0.0/0 → 10.10.1.11
- SETTINGS > Routing > Static routes rule: 192.168.1.0/24 → 192.168.22.1
- Dynamic rule: 192.168.1.0/24 → 192.168.11.1 metric 32
- Packet with DST 192.168.1.42 will be routed to 192.168.22.1 because the static rule has the same mask, but better metric.

7.2.3.2. Common - Common settings



☑ BABEL Enabled

Router ID 0.0.0.0

Routing offering On

Router ID

IP address, default = 0.0.0.0
M!DGE3 unit acts in the Babel network as a dynamic router. Every router is identified by an ID having the format of IP address. This IP address does not have to be ‘real’.
Router ID is shared across all dynamic protocols.

Randomize ID

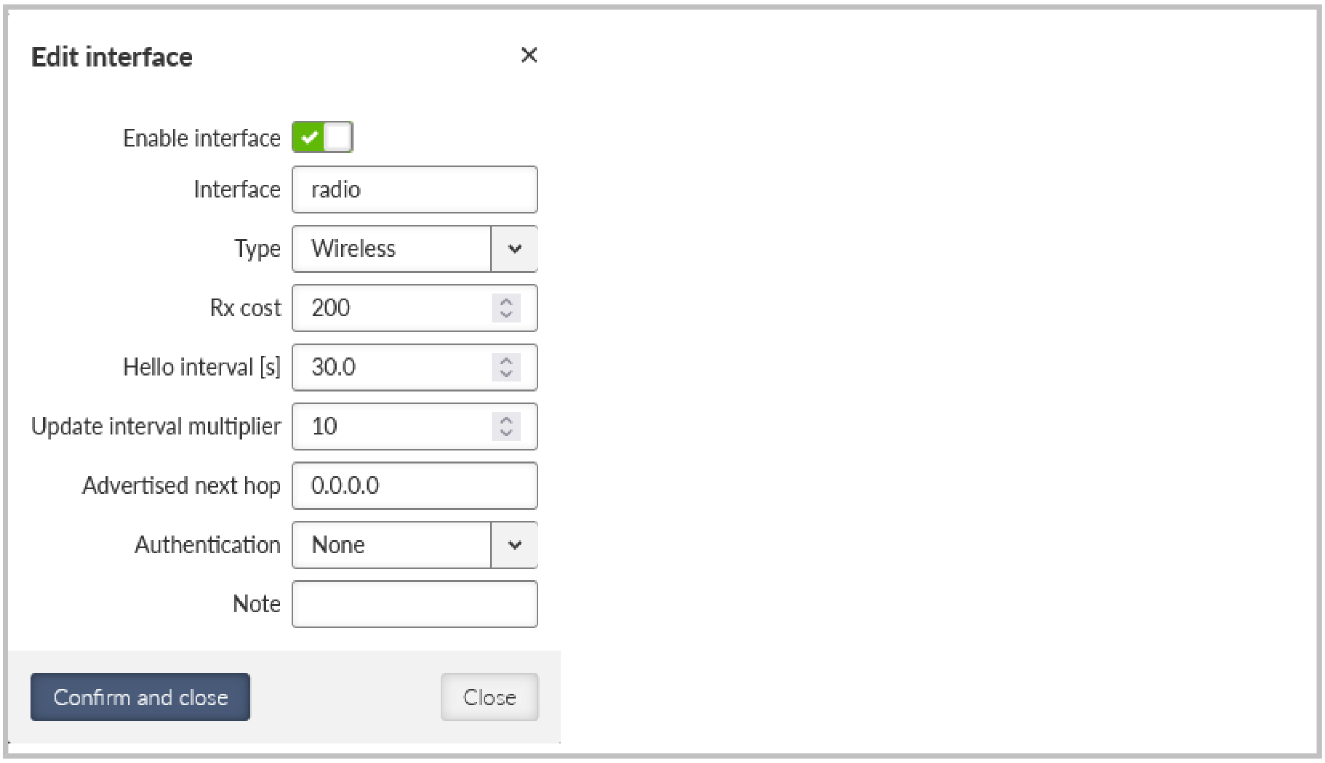
List box {On; Off}, default = "Off"
Advanced feature: Enables randomization of the upper 4 Bytes of the router identification. The lower 4 Bytes are set by a **Router ID** parameter. This feature might be used in a case the Babel node is often restarted resulting in refusing its messages by its neighbors.

Routing offering

List box {On; Off}, default = "On"

Enables propagation of routing rules acquired from the neighbors. When disabled, the incoming rules are not propagated to other routers and this router behaves as an end point terminal – network paths are started or terminated in such a point, but do not travel through.

7.2.3.3. Network - Interfaces



Edit interface ×

Enable interface ☑

Interface: radio

Type: Wireless

Rx cost: 200

Hello interval [s]: 30.0

Update interval multiplier: 10

Advertised next hop: 0.0.0.0

Authentication: None

Note:

Active

List box {On; Off}, default = "Off"
Enables / disables the interface.

Interface

String {a..z A..Z 0..9}, max 16 char, default = <empty>Interfaces which will be used by Babel for searching the available connections. Name of an existing unit interface has to be used. Following interfaces can be used:

LAN – “if_” prefix must be used followed by Network interface name, e.g. “if_LAN-141”

VLAN – “if_” prefix must be used followed by Network interface name, ‘.’ dot and VLAN number, e.g. “if_LAN-141.29”

GRE L3 – “gre_tunX” where ‘X’ is the tunnel number, starting from zero

Cellular – "wwan", "ext"
Interface MTU must be 1280 Bytes or bigger in order to operate Babel protocol correctly.

Type

List box {Wired; Wireless}, default = "Wireless"
Type of network interface and also the type of link status evaluation. “Wired” link status is evaluated by checking the limit of received Hello packets – if not met, the link is considered down. “Wireless” link is status is evaluated using ETX criteria – each lost Hello packet gradually decreases the link metric.

Rx cost

Number {1 – 65534}, default = 128
The cost of using this interface to receive packet from a neighbor. It is added to Babel path metric.

Hello limit

Number {1 – 16}, default = 12
For “Wired” interface only: limit of received Hello packets from the 16 expected; if not met, the link is considered down.

Hello interval

Number {0.1 – 327.0}, default = 4.0
Interval (in seconds) of sending Hello packets.

Update interval multiplier

Number {2 – 30}, default = 4
Interval of sending the routing table update packets – to share the network topology information across the Babel network. The update interval is calculated as a multiplication of this parameter and **Hello interval**. The maximum length of the update interval (after the multiplication) is 655 seconds.

Advertised next hop

IP address, default = 0.0.0.0
This is the Next hop address which is announced to neighbors to be routed over this interface. Should this interface serve more IP addresses, this parameter enables selection of which of the addresses should be used for this station in the network neighbors routing tables.

Authentication

List box {None; Full; Only sign}, default = "None"
Enables packets authentication of Babel protocol.

- Full - packets are signed during transfer and the signature is validated when receiving incoming packets. Packets with invalid signature are reported to the log and thrown away.

- Only sign - Packets are signed during transfer and the signature is validated when receiving incoming packets. Packets with invalid signature are reported to the log and accepted. This settings is intended for gradual network switch to safe mode.

Authentication algorithm

List box {HMAC SHA256; HMAC SHA384; HMAC SHA512; BLAKE2s-128; BLAKE2s-256; BLAKE2b-256; BLAKE2b-512}, default = "HMAC SHA256"
Selects the authentication algorithm. This parameter occurs only, if parameter **Authentication** is set either to "Full" or "Only sign".
Each algorithm has its own passphrase length limit.
HMAC SHA256 - string length up to 128 char
HMAC SHA384 - string length up to 128 char
HMAC SHA512 - string length up to 128 char
BLAKE2s-128 - string length up to 32 char
BLAKE2s-256 - string length up to 32 char
BLAKE2b-256 - string length up to 64 char
BLAKE2b-512 - string length up to 64 char

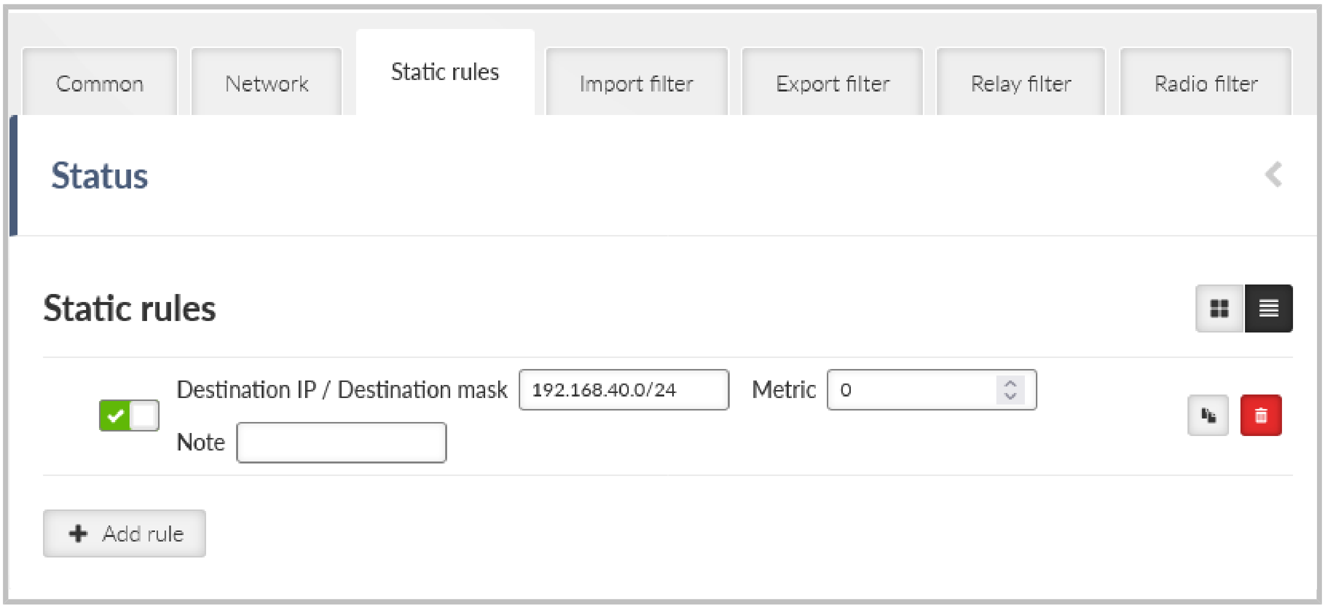
Passphrase

String {up to 128 char}
Defines the passphrase for packets authentication.

Note

Optional comment.

7.2.3.4. Static rules



☑ Destination IP / Destination mask 192.168.40.0/24 Metric 0

Note

Pre-defined static routing rules to be exported over the Babel protocol. Maximum number of rules is 256.

Active

List box {On; Off}, default = "On"
Enables / disables the static routing rule.

Destination IP / Destination mask

IP address, default = 0.0.0.0/0
IP address and mask defining the exported routing rule address range.

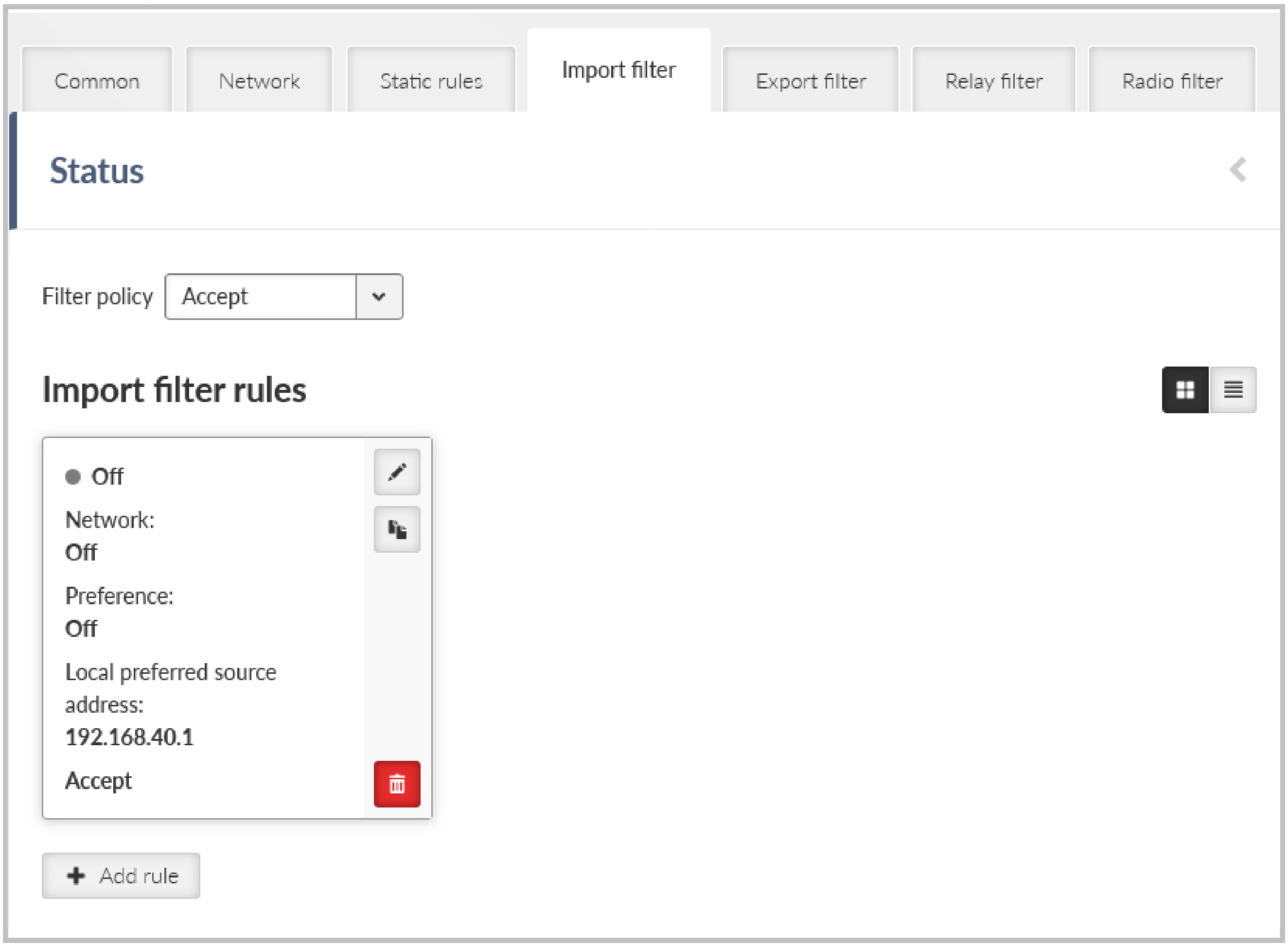
Metric

Number {0 – 65534}, default = 0
Routing rule metric value. The higher the value, the more “expensive” the path is.

Note

Optional comment.

7.2.3.5. Import filter



Filter policy: Accept

Import filter rules

● Off
Network:
Off
Preference:
Off
Local preferred source address:
192.168.40.1
Accept

Babel import filter rules. The order of rules matters. Each incoming routing rule is processed by those Import filters. Maximum number of filter rules is 256.

Active
List box {On; Off}, default = "On"
Enables / disables the filter rule.

Filter network
List box {Off; Match; Not match}, default = "Off"
Method of the routing rule target range comparison.

IP address / mask
IP address / mask, default = 0.0.0.0/0
IP address and mask defining the network range to be compared.

Mask from
Number {0 – 32}, default = 0

Mask to
Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.
Examples:

Rule 0.0.0.0/0 {0,32} captures all IP ranges

Rule 192.168.1.0/24 {24,32} captures 192.168.1.0/24 and all subnets (for example 192.168.1.1/32)

Rule 10.9.8.7/32 {8,32} captures all ranges having the mask longer than 8 covering the address 10.9.8.7 (e.g. 10.9.0.0/16)

Action

List box {Accept; Reject; Pass}, default = "Accept"
Type of action to be performed when the filter rules above matches the incoming routing rule. When “Pass” is selected, the packet processing continues.

Set preference

List box {On; Off}, default = "Off"
When enabled, the Preference (see next parameter) will be set to this rule.

Preference

Number {0 – 65535}, default = 210
Routing rule preference in the routing table (to be used when Set preference is enabled). The higher the number the better the preference.

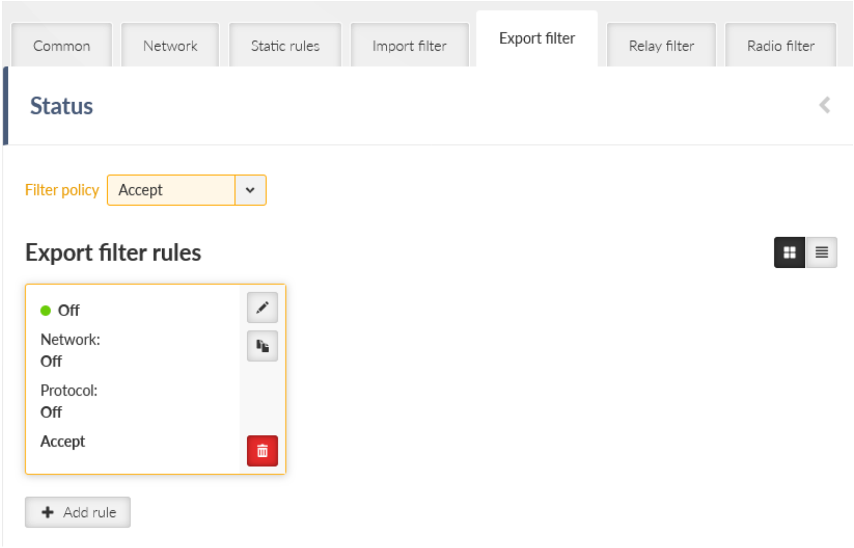
Local preferred source address

IP address, default = 0.0.0.0
Preferred source IP address for the locally generated packets. When disabled (default value 0.0.0.0 is used), the source IP address is set according to the outgoing interface.

Note

Optional comment.

7.2.3.6. Export filter



Status

Filter policy: Accept

Export filter rules

● Off
Network: Off
Protocol: Off
Accept

Babel export filter rules define set of routing rules to be exported from the unit to other Babel routers. The order of rules matters. Maximum number of filter rules is 256.

Active

List box {On; Off}, default = "On"
Enables / disables the filter rule.

Filter network

List box {Off; Match; Not match}, default = "Off"

Method of the routing rule target range comparison.

IP address / mask

IP address / mask, default = 0.0.0.0/0
IP address and mask defining the network range to be compared.

Mask from

Number {0 – 32}, default = 0

Mask to

Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.

Filter protocol

List box {Off; Match; Not match}, default = "Off"
Selects the way how the routing rule source protocol is compared.

Protocol

List box {System; BGP; BGP external; BGP internal; OSPF}, default = "System"
Selection of the protocol origin. “System” – stands for rules from the ordinary routing table.

Filter BGP path

List box {Off; Is empty; Not empty}, default = "Off"
Compares BGP routing rule path if it is empty (i.e. the rule originates in this AS).

Filter OSPF source

List box {Off; Match; Not match}, default = "Off"
Selects the way how the routing rule from the OSPF protocol is compared.

OSPF source

List box {Internal; Inter-area; External type 1; External type 2}, default = "External type 2"
OSPF sources. "Internal" – stands for internally generated rule (e.g. interface range). "Inter-area" – stands for rule generated on the area borders.

Filter OSPF tag

List box {Off; Match; Not match}, default = "Off"
OSPF tag based filtering method.

OSPF tag

Number {0 – (2^{32}-1)}, default = 0
OSPF tag to be compared.

Action

List box {Accept; Reject; Pass}, default = "Accept"
Defines what action is taken on the routing rule. When “Pass” is selected, the packet processing continues.

Metric from other protocol

List box {Off; BGP MED; OSPF Metric 1; OSPF Metric 2; OSPF Metric Sum}, default = "Off"
Defines source of metric.

Off: The static **Metric** value (see the following parameter) is used.

BGP MED: MED (Multi-Exit Discriminator) rules from the BGP protocol. If the rule does not have a MED value filled in, the static Metric value is used.

OSPF metric 1: Metric of OSPF type 1. If the rule does not have a metric value filled in, the static Metric value is used.

OSPF metric 2: Metric of OSPF type 2. If the rule does not have a metric value filled in, the static Metric value is used.

OSPF metric sum: Sum of OSPF type 1 a type 2 metrics. If the rule does not have both metric values filled in, the static Metric value is used.

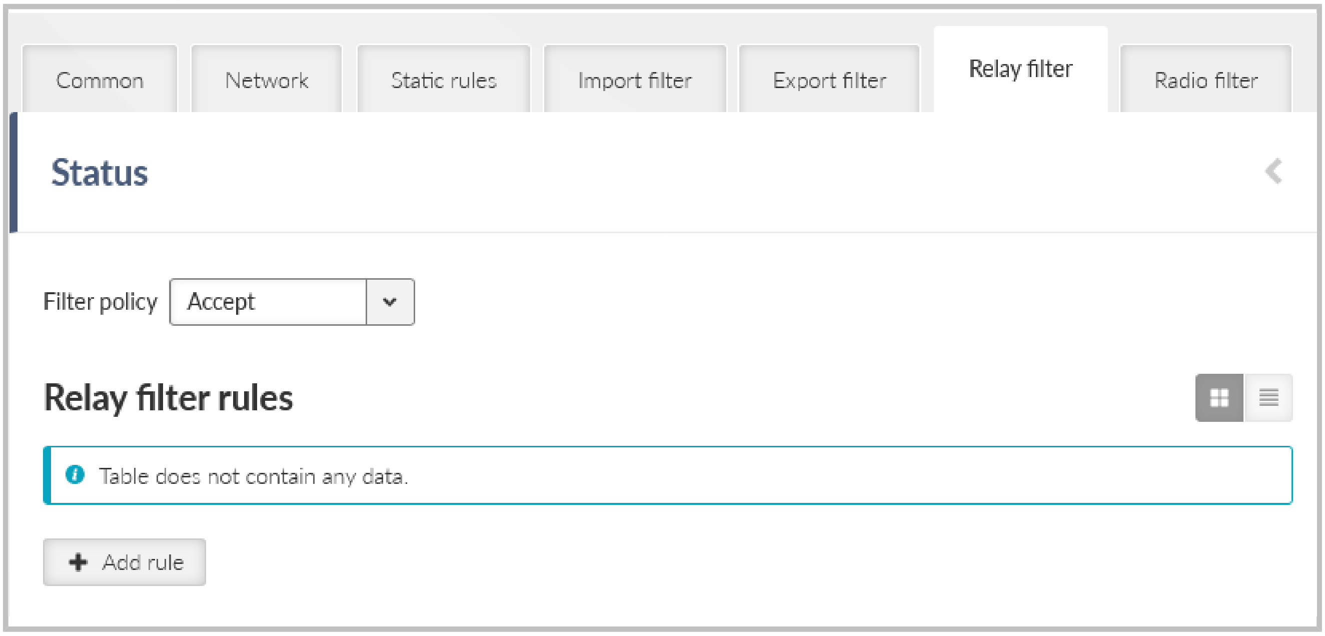
Metric

Number {0 – 65534}, default = 0
Routing rule metric value. The higher the value, the more “expensive” the path is.

Note

Optional comment.

7.2.3.7. Relay filter



Status

Filter policy: Accept

Relay filter rules

Table does not contain any data.

Relay filter selects what happens to a rule received from another Babel instance that were not captured in the filter. When disabled, the rules will not be forwarded to other routers and this station will act as a terminal where paths begin and end in the Babel network, but do not pass through it.

Filter policy

List box {Accept; Reject}, default = "Accept"

Enable rule

Check box {On; Off}, default = "On"
Activates/disables the rule

Filter network

List box {Off; Match; Not match}, default = "Off"
Selects a way to compare the target range of the rule

Network IP/Network mask	IP address / mask, default = 0.0.0.0/0
	Compares network prefix

Mask from Number {0 – 32}, default = 0

Defines the allowed mask length range of the compared rule

Mask to Number {0 – 32}, default = 32

Defines the allowed mask length range of the compared rule

Action

List box {Accept; Reject; Pass}, default = "Accept"
Chooses what to do with the rule

Filter metric

List box {Off; <; <=; >=; >}, default = "Off"
Selects a way to compare Babel metrics rules

Metric value Number {0 – 65534}, default = 0

The compared value of the rule metric

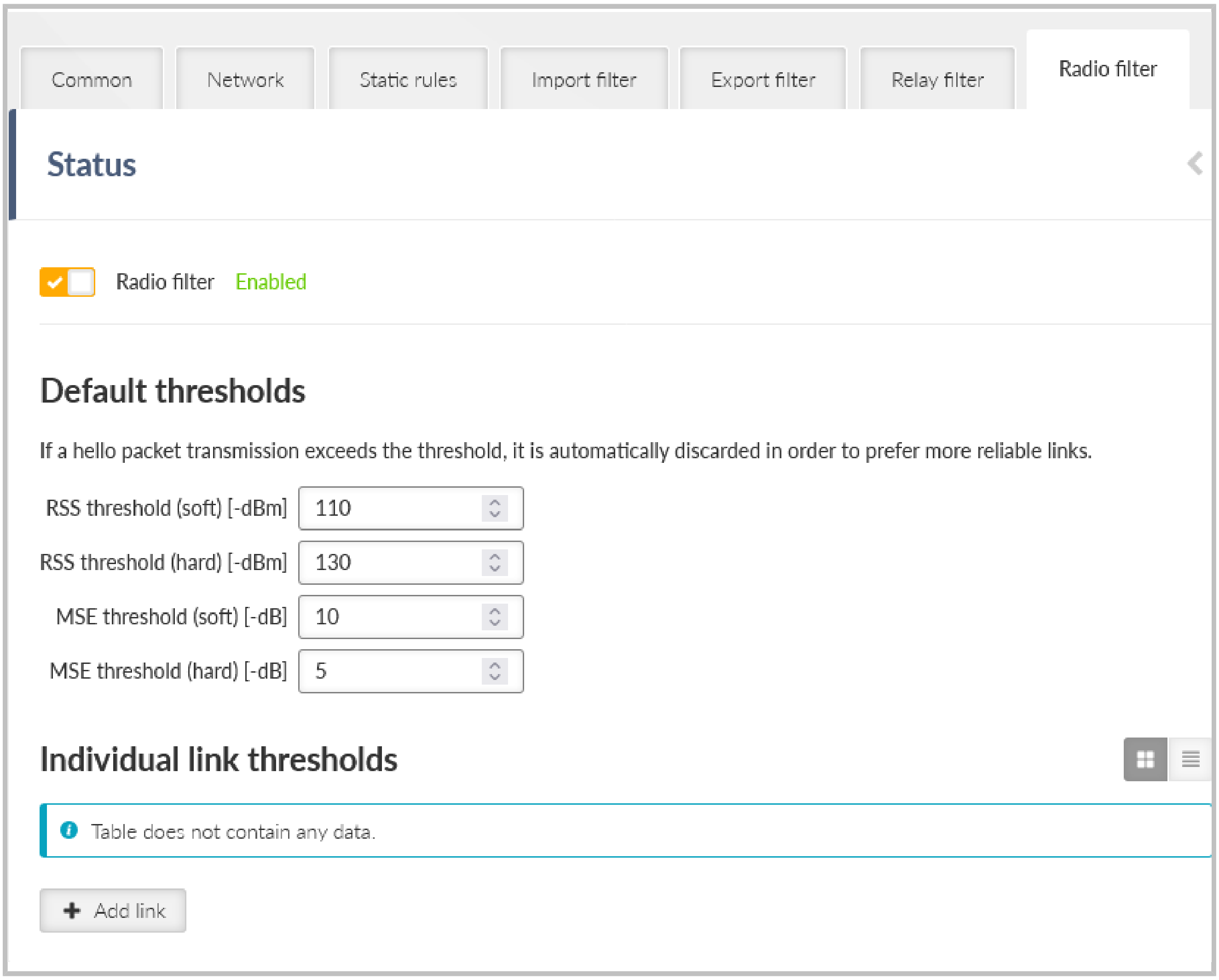
Increase metric

List box {Off; On}, default = "Off"
Enables incrementing Babel rule metrics on forwarding. It is used to penalize paths through this router. Only when Action is Accept or Pass.

Added metric Number {1 – 65534}, default = 1

Value added to the rule metric

7.2.3.8. Radio filter



Status

☑ Radio filter Enabled

Default thresholds

If a hello packet transmission exceeds the threshold, it is automatically discarded in order to prefer more reliable links.

RSS threshold (soft) [-dBm]	110
RSS threshold (hard) [-dBm]	130
MSE threshold (soft) [-dB]	10
MSE threshold (hard) [-dB]	5

Individual link thresholds

Table does not contain any data.

Contains global Babel Hello packet filter settings in the radio protocol. This function is used to exclude radio links that do not have sufficient radio signal strength or signal quality to transmit standard packets, although short hello packets come through well.

RSS threshold (soft)

Number {50 – 150}, default = 110
RSS level limits [-dBm] of the received Hello packet
Soft limit is the worst value below which the packet is not discarded

RSS threshold (hard)

Number {50 – 150}, default = 130
RSS level limits [-dBm] of the received Hello packet
Hard limit is the best value to always discard the packet

Note
Must be Soft threshold <= Hard threshold

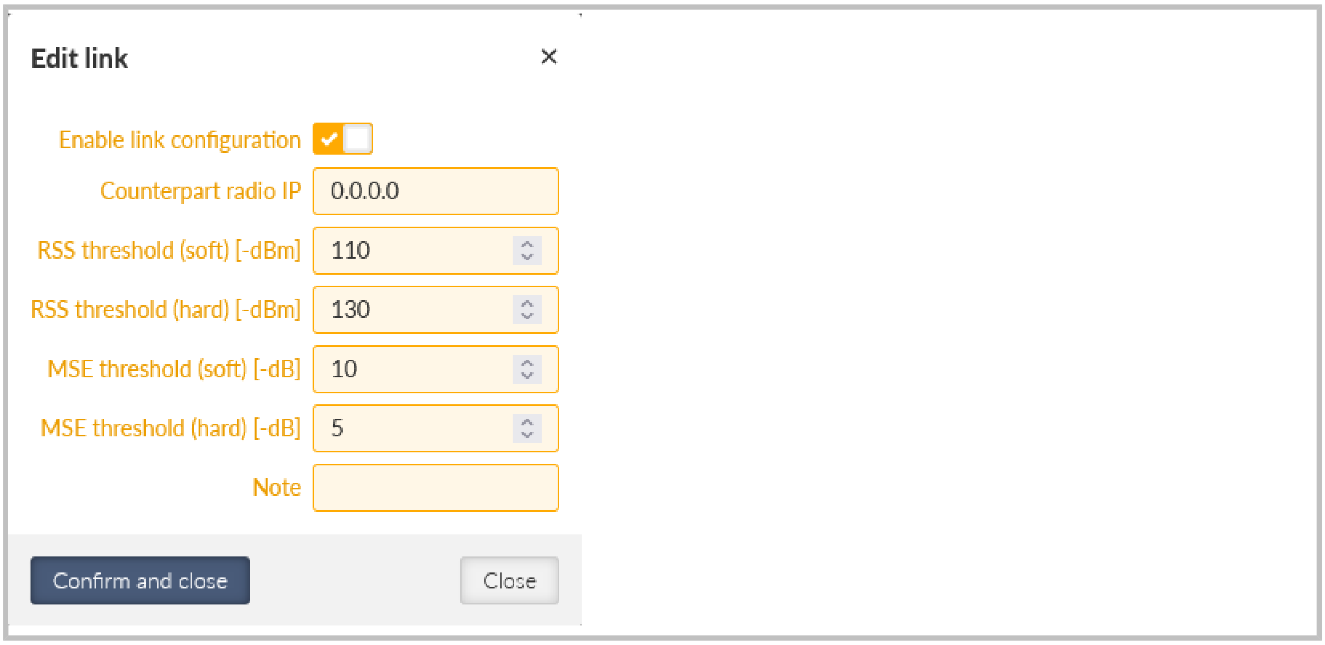
MSE threshold (soft)

Number {0 – 60}, default = 10
MSE data level limits [-dB] of the received Hello packet
Soft limit is the worst value below which the packet is not discarded

MSE threshold (hard)

Number {0 – 60}, default = 5
MSE data level limits [-dB] of the received Hello packet
Hard limit is the best value to always discard the packet

Note
Must be Soft threshold >= Hard threshold



Edit link ×

Enable link configuration ☑

Counterpart radio IP: 0.0.0.0

RSS threshold (soft) [-dBm]: 110

RSS threshold (hard) [-dBm]: 130

MSE threshold (soft) [-dB]: 10

MSE threshold (hard) [-dB]: 5

Note:

Enable link configuration

List box {Off; On}, default = "On"
Activates individual settings

Counterpart radio IP

IP address, default = 0.0.0.0
Radio IP address of the Hello packet source for which the individual filter setting applies

RSS threshold (soft)

Number {50 – 150}, default = 110
RSS level limits [-dBm] of the received Hello packet
Soft limit is the worst value below which the packet is not discarded

RSS threshold (hard)

Number {50 – 150}, default = 130
RSS level limits [-dBm] of the received Hello packet
Hard limit is the best value to always discard the packet

Note
Must be Soft threshold <= Hard threshold

MSE threshold (soft)

Number {0 – 60}, default = 10
MSE data level limits [-dB] of the received Hello packet
Soft limit is the worst value below which the packet is not discarded

MSE threshold (hard)

Number {0 – 60}, default = 5
MSE data level limits [-dB] of the received Hello packet
Hard limit is the best value to always discard the packet

> **Note**
> Must be Soft threshold >= Hard threshold

Note

Optional note

7.2.4. OSPF

Open Shortest Path First (OSPF) is a routing protocol for Internet Protocol (IP) networks. It uses a link state routing (LSR) algorithm and falls into the group of interior gateway protocols (IGPs), operating within a single autonomous system (AS). OSPF Version 2 defined in RFC 2328 (1998) for IPv4 is implemented in the RipEX router. OSPF provides Layer 2 dynamic routing. In the context of RipEX networks it is typically used for the backhaul network routing.

OSPF splits the network into “areas” to simplify the network topology. There is a primary “backbone” (0.0.0.0) area and the other areas are connected to this backbone area via border routers.

The route decision process is affected by the path “metric”. There are two types of metrics:

- Metric Type 1 – path length; individual interfaces pass-over costs are added.
- Metric Type 2 – is setup on the rules which are exported to the OSPF from outside. Rules having metric ‘Type 2’ are always treated as worse (i.e. longer path) comparing to metric ‘Type 1’.

Routers in a specific area are always connected via interfaces.

- An address range can be defined for an interface where is the OSPF working. Multiple address ranges can be defined (behaving as another interface).
- Router to router interconnection can be protected by encryption with the passphrase.
- Specific “Cost” is defined for each interface which is added to metric ‘Type 1.’
- There are multiple types of interfaces:
  - Stub – interface only announces to OSPF: its presence and its address ranges to be propagated further to the network.
  - Broadcast – to be used in the network where all the participants always hear each other (Ethernet). Designated Router (DR) and Backup DR (BDR) are setup between the neighbors. They are responsible for the update propagation (broadcast).
  - NBMA (Non-Broadcast Multiple Access) – to be used in the network where only specific participants can communicate between each other; all the participants hear each other but multicast is not available. DR and BDR is setup.
  - Point2Point – network having only two participants. They discover each other using multicast.
  - Point2Multipoint – network where only predefined pairs of participants can hear each other (e.g. star topology); multicast is not available.

- Static rules can be defined. Such a routing rules are propagated to the network from this router.
- It is possible to define exported routing rules aggregation or specific routing rule hiding.
- It is possible to control the routing rules which are imported into the RipEX unit from the OSPF protocol and those that are exported into the OSPF protocol from the unit by using ‘filters’.
  - ○ Export filters – to control rules exported from the unit to the OSPF protocol which is propagating them further.
  - ○ Import filters – to control rules imported from the OSPF into the unit.

7.2.4.1. OSPF Common - Common settings

Active
List box {On; Off}, default = "Off"
Enables the dynamic routing and the OSPF protocol.

Router ID
IP address, default = 0.0.0.0
M!DGE3 unit acts in the OSPF network as a dynamic router. Every router is identified by an ID having the format of IP address. This IP address does not have to be ‘real’. Router ID is shared across all dynamic protocols.

Instance ID
Number {0 – 255}, default = 0
OSPF protocol instance number. This number is needed in case of running multiple OSPF protocols (for example on the border of 2 independent OSPF networks).

7.2.4.2. OSPF Network - Areas and interfaces

7.2.4.2.1. Areas and interfaces

OSPF areas RipEX unit belongs to are described here. Maximum number of areas is 32.

Enable / Disable
Enables / disables the specific area.

Area ID
IP address, default = 0.0.0.0
OSPF area identifier. The ID has a format of an IP address. This IP address does not have to be ‘real’. The ‘Router ID’ value is used typically. The default value of 0.0.0.0 is called ‘backbone’ and it has to be present somewhere in the OSPF network.

Stub area
Click box {On; Off}, default = "Off"
Defines if the area is of a ‘stub’ type – which means, the traffic is not routed through such an area. Every traffic is originated or terminated in the ‘stub’ area.

Stub default GW (ADVANCED parameter)
List box {On; Off}, default = "On"
If ‘On’ – only default GW is routed to the ‘stub’ area. Of ‘Off’ – individual routes are routing the traffic into the area. It may be effective to disable this parameter when multiple border routers are present.

Note

Optional comment. It is a good practice to enter some descriptive area name since this value is displayed (when filled) instead of the **Area ID** as an **Area** name in other configuration dialogs (e.g. Networks configuration).

OSPF interfaces of the respective OSPF area are defined here. Maximum number of interfaces is 128.

Active

List box {On; Off}, default = "Off"
Enables / disables the interface.

Interface

String {a..z A..Z 0..9}, max 16 char, default = <empty>
OSPF interface name. Name of an existing unit interface has to be used. Following interfaces can be used:

- LAN – “if_” prefix must be used followed by Network interface name, e.g. “if_LAN-141”
- VLAN – “if_” prefix must be used followed by Network interface name, ‘.’ dot and VLAN number, e.g. “if_LAN-141.29”
- GRE L3 – “gre_tunX” where ‘X’ is the tunnel number, starting from zero
- Cellular – "wwan", "ext"

IP address / mask

IP address / mask, default = 0.0.0.0/0
IP address and mask of the address range above which the OSPF protocol will be working on this interface. The default value is 0.0.0.0/0, which means the whole address range on this interface is available for the OSPF protocol.

Network type

List box {Broadcast; Point2Point; Point2Multipoint; NBMA; Stub}, default = "Broadcast"
Defines the type of the network behind the interface.

Cost

Number {1 – 65535}, default = 10
The cost of traffic over this interface. The higher the Cost, the worse the path. It is added to OSPF metric ‘Type 1’.

Hello interval

Number {1 – 3600}, default = 10
Interval (in seconds) of sending Hello packets. The interval must be the same for the all participants of the given interface.

Poll interval

Number {1 – 3600}, default = 20
Interval (in seconds) of sending Hello packets to inactive neighbors in the NMBA type of interface.

Retransmit interval

Number {1 – 3600}, default = 5
Interval (in seconds) of repeating unacknowledged packets.

Dead count

Number {2 – 64}, default = 4

Number of lost Hello packets from the neighbor to treat the connection as interrupted.

TTL security

List box {On; Off}, default = "On"
Protection against OSPF packets spoofing.

Authentication, Passphrase

List box {None; Keyed MD5 (OSPFv2); HMAC SHA256; HMAC SHA384; HMAC SHA512}, default = "None"
Selection of a method to authenticate the OSPF messages. Passphrase is used as a secret key for the selected hash function. Maximum length of the passphrase is 128 characters.

Priority

Number {0 – 255}, default = 1
Priority is used to select primary or backup router responsible for the routing updates propagation. The higher the number, the higher the priority. ‘0’ states the router cannot be used as a primary or backup router.

Use broadcast

List box {On; Off}, default = "Off"
Defines if OSPF packets distribution is provided using multicasts (default behavior) or broadcasts (nonstandard behavior).

Note

Optional comment. It is possible to enter some descriptive OSPF interface name. This value is used (when filled) instead of the original **Interface** identification as an **Interface** name in other configuration dialogs (e.g. Neighbors configuration).

7.2.4.2.2. Neighbors

Network neighbors of Point2Multipoint and NBMA types of OSPF interfaces are defined here. Maximum number of neighbors is 512.

Active

List box {On; Off}, default = "Off"
Enables / disables the interface.

Interface

List box {list of existing OSPF interfaces}
OSPF interface the neighbor belongs to. The interface – **Note** value is used when defined. The interface – **Interface** value is used otherwise.

IP

IP address, default = 0.0.0.0
IP address of the neighbor.

Note

Optional comment.

7.2.4.2.3. Networks

The Networks table modifies networks announced out of the area. It enables partial networks aggregation into the common prefixes or specific network hiding. Maximum number of rules is 256.

Active
List box {On; Off}, default = "Off"
Enables / disables the interface.

Area
List box {list of existing OSPF areas}
OSPF area the record belongs to.

IP address / mask
IP address / mask, default = 0.0.0.0/0
IP address and mask of the range (i.e. network) which will be aggregated or hidden.

Action
List box {Aggregate; Hide}, default = "Aggregate"

- Aggregate – small network prefixes will be exported from this area aggregated into this range (defined by **IP / mask**)

- Hide – this network prefix will be hidden and will not be exported

Example:
Area 0.0.0.1 exports two subnets: 192.168.1.0/24 and 192.168.2.0/24. Area border router between Area 0.0.0.1 and 0.0.0.0 defines a rule for network aggregation: 192.168.0.0/16. As a result of this, the area border router announces to the area 0.0.0.0 only one route 192.168.0.0/16 instead of the two individual routes.

Note
Optional comment.

7.2.4.3. OSPF Static rules

Pre-defined static routing rules to be exported over the OSPF protocol. Maximum number of rules is 256.

Active
List box {On; Off}, default = "Off"
Enables / disables the static routing rule.

Destination IP / Destination mask
IP address, default = 0.0.0.0/0
IP address and mask defining the exported routing rule address range.

Metric type
List box {Type 1; Type 2}, default = "Type 1"
Metric type of the routing rule. Metric 1 is added to the path cost. Metric 2 stays apart and compared to metric 1 is always bigger.

Metric
Number {1 – 65535}, default = 1000
Routing rule metric value.

OSPF tag
Number {0 – (2^{32}-1)}, default = 0
OSPF tag is added to a rule at the moment of its insertion to the network. The tag travels through the OSPF without any modification so it can be used to distinguish the rule in the filters.

Note
Optional comment.

7.2.4.4. OSPF Import filter

OSPF import filter rules. The order of rules matters. Each incoming routing rule is processed by those Import filters. Maximum number of filter rules is 256.

Active
List box {On; Off}, default = "Off"
Enables / disables the filter rule.

Filter network
List box {Off; Match; Not match}, default = "Off"
Method of the routing rule target range comparison.

IP address / mask
IP address / mask, default = 0.0.0.0/0
IP address and mask defining the network range to be compared.

Mask from
Number {0 – 32}, default = 0

Mask to
Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.
Examples:

- Rule 0.0.0.0/0{0,32} captures all IP ranges
- Rule 192.168.1.0/24{24,32} captures 192.168.1.0/24 and all subnets (for example 192.168.1.1/32)
- Rule 10.9.8.7/32{8,32} captures all ranges having the mask longer than 8 covering the address 10.9.8.7 (e.g. 10.9.0.0/16)

Filter source
List box {Off; Match; Not match}, default = "Off"
Method of the OSPF routing rule source comparison.

Source
List box {Internal; Inter-area; External type 1; External type 2}, default = "External type 1"
Source types comments:

- Internal – internally generated rule, for example interface range
- Inter-area – rule generated on the area border

Filter OSPF tag
List box {Off; Match; Not match}, default = "Off"
Method of the OSPF routing rule OSPF tag comparison

OSPF tag
Number {0 – (2^{32}-1)}, default = 0
OSPF tag to be compared.

Action
List box {Accept; Reject; Pass}, default = "Accept"
Type of action to be performed when the filter rules above matches the incoming routing rule.

Set preference
List box {On; Off}, default = "Off"
When enabled, the **Preference** (see next parameter) will be set to this rule.

Preference
Number {0 – 65535}, default = 200
Routing rule preference in the routing table (to be used when **Set preference** is enabled). The higher the number the better the preference.

Local preferred source address
IP address, default = 0.0.0.0
Preferred source IP address for the locally generated packets. When disabled (default value 0.0.0.0 is used), the source IP address is set according to the outgoing interface.

Note
Optional comment.

7.2.4.5. OSPF Export filter

OSPF export filter rules define set of routing rules to be exported from the unit into the OSPF area. The order of rules matters. Maximum number of filter rules is 256.

Active
List box {On; Off}, default = "Off"
Enables / disables the filter rule.

Note
Optional comment.

Filter network
List box {Off; Match; Not match}, default = "Off"
Selects a method of the routing rule destination range comparison.

IP address / mask
IP address / mask, default = 0.0.0.0/0
IP address and mask defines the network prefix to be compared.

Mask from
Number {0 – 32}, default = 0

Mask to
Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.

Filter protocol
List box {Off; Match; Not match}, default = "Off"
Selects the way how the routing rule source protocol is compared.

Protocol
List box {System; BGP; BGP external; BGP internal}, default = "System"

Selection of the protocol origin. “System” – stands for rules from the ordinary routing table.

Filter BGP path

List box {Off; Is empty; Not empty}, default = "Off"
Compares BGP routing rule path if it is empty (i.e. the rule originates in this AS).

Action

List box {Accept; Reject; Pass}, default = "Accept"
Defines what action is taken on the routing rule. "Pass" continues in processing.

7.2.5. BGP

Border Gateway Protocol (BGP) is a standardized exterior gateway protocol designed to exchange routing and reachability information among autonomous systems. BGP is classified as a path-vector routing protocol, and it makes routing decisions based on paths, network policies, or rule-sets configured by a network administrator.

BGP splits the network into Autonomous Systems (AS) which are identified by a specific number. Individual BGP routers are interconnected with their neighbors using TCP connections. Any connection can travel over multiple hops. Any connection can be secured using MD5 signatures.

Connections inside the AS are called ‘internal’ (iBGP):

- All BGP routers within given AS must be fully interconnected – every router must have connection to all other routers.
- It is possible to define ‘Route reflectors’ – they must be fully interconnected. The other routers behave as Route reflector clients and they need a connection to their reflector only. Route reflector and its clients form a ‘cluster’. It is possible to create a cluster with multiple Route reflectors for the purpose of backup.
- The iBGP router having a higher local preference will be preferred during the internal AS path selection.

Connections to another AS are called ‘external’ (eBGP):

- It is possible to communicate from the router to the neighbor AS the MED (Multi-Exit Discriminator) metric designating which of the AS border routers will be used as an input point.

When the routing rules are spread across the multiple AS, those AS are added into the accumulated path (BGP path). Path length is the primary criteria during the decision which of the routing rules will be used.

It is possible to prescribe routing rules toward this router which will be spread across the network (Static rules).

It is possible to control the routing rules which are imported into the RipEX unit from the BGP protocol and those that are exported into the BGP protocol from the unit by using ‘filters’.

Import IGP filter – controls which of the routing rules from the BGP are accepted to the dynamic routing table and how

Export IGP filter – controls which of the routing rules from the dynamic routing table are exported to the BGP and how

Import OUT filter – controls which of the routing rules from the other AS are accepted to the BGP and how

Export OUT filter – controls which of the routing rules are exported from the BGP to other AS and how

Routing rules passed on between iBGP and BGP tables are not filtered

7.2.5.1. BGP Common - Common settings

Active

List box {On; Off}, default = "Off"
Enables the dynamic routing and the BGP protocol.

Router ID

IP address, default = 0.0.0.0
RipEX unit acts in the BGP network as a dynamic router. Every router is identified by an ID having the format of an IP address. This IP address does not have to be ‘real’. Router ID is shared with the OSPF protocol.

Local AS

Number {0 – (2^{32}-1)}, default = 65000
Local Autonomous System identification number. AS numbers are assigned by IANA. Part of the range is reserved for private network usage: 64512 – 65534 and 4200000000 – 4294967294. AS numbers from this range can be safely used by anyone.

Preference

Number {0 – (2^{32}-1)}, default = 100
Router preference within the local AS. The higher the number, the higher the preference.

MED (Multi-Exit Discriminator)

List box {Off; Static; OSPF metric 1}, default = "Off"
Setting of MED (Multi-Exit Discriminator) on the routing rules being exported to other AS. MED makes it possible to advertise which of the routers in the local AS is the preferred input point to the AS. "Static" option sets the fixed value for all rules (**Static MED**). "OSPF metric 1" copies the OSPF metric to MED; for the rules which are not from the OSPF it enters the fixed value **Static MED**.

Static MED

Number {0 – (2^{32}-1)}, default = 0
Metric to be used for the preferred input point to the AS selection (see MED (Multi-Exit Discriminator) description). The higher the number the lower the preference.

Route reflector

List box {Off; On}, default = "Off"
Enables the Route reflector function on this router. iBGP requires connection in between all routers under normal circumstances. Route reflector makes it possible to avoid this requirement by distributing routing updates to all its clients. Such clients do not need any other connection except connection to this Route reflector. Route reflector and its clients form a ‘cluster’. See more details at the beginning of the BGP chapter.

Cluster ID type

List box {Router ID; Manual}, default = "Router ID"

Controls the iBGP cluster identification. Cluster identification must be the same inside the cluster and it has to be different in another cluster. If the "Router ID" is selected, the **Router ID** value is used as a cluster id.

Cluster ID
IP address, default = 0.0.0.0
Cluster identification in the format of an IP address. This IP address does not have to be ‘real’ (valid).

7.2.5.2. BGP Neighbors

Neighboring BGP routers. Maximum number of neighbors is 256.

Active
List box {On; Off}, default = "On"
Enables the specific neighbor.

Note
Optional comment.

Neighbor type
List box {Internal; External}, default = "External"
Neighbor router type selection. "Internal" neighbor belongs to the same AS (iBGP). "External" belongs to other AS (eBGP).

Neighbor AS
Number {0 – (2^{32}-1)}, default = 65000
Neighbor AS number.

Neighbor IP
IP address, default = 0.0.0.0
Neighbor router IP address.

Local IP of the connection
IP address, default = 0.0.0.0
Local IP address of the connection. Default value 0.0.0.0 provides automatic set up of this address – from the routing.

Neighbor connection
List box {Direct; Multihop}, default = "Direct"
Network connection type between the neighbors. "Direct" means direct – one hop – connection. This is typical for eBGP routers. "Multihop" means connection over the multiple routers. This is typical for iBGP routers.

MD5 authentication
List box {On; Off}, default = "Off"
Enables BGP packets authentication using TCP MD5 Signature extension.

Passphrase
String {up to 128 char}
Passphrase for the **MD5 authentication**.

Passive
List box {On; Off}, default = "Off"

Passive BGP router does not initiate connection to a neighbor, it is waiting for the neighbor activity.

Hold interval [s]
Number {3 – 10800}, default = 240
Time (in seconds) to wait for the keepalive message from the neighbor. It is negotiated with the neighbor. When it expires, the connection is treated as interrupted.

Keepalive interval [s]
Number {1 – 3600}, default = 80
Period (in seconds) of sending keepalive messages. It should not be longer than 1/3 of the **Hold interval**.

Connection retry interval [s]
Number {1 – 3600}, default = 120
Time (in seconds) to wait before trying to re-connect the interrupted connection.

TTL security
List box {On; Off}, default = "On"
Protection against BGP packets spoofing. [PP1] The Generalized TTL Security Mechanism (GTSM – RFC 5082) is used. BGP transmits packets with known TTL value. Incoming packets having lower than expected value (expected number of hops) are discarded.

Expected hops
Number {2 – 32}, default = 2
Number of expected hops between the neighbors.

Route reflector client
List box {On; Off}, default = "Off"
Defines if this neighbor is a client of this Route reflector.

Set cost
List box {On; Off}, default = "Off"
Enables to set a specific **Cost** of the BGP connection.

Cost
Number {0 – (2^{32}-1)}, default = 10
The cost of connection to this neighbor. The higher the number the higher the cost. It enables to make decisions inside the router between multiple paths from the same neighbor.

Next hop self
List box {Off; Always; Internal; External}, default = "Off"
Defines it the exported routing rules should have ‘next hop’ addresses overwritten to the address of this router. "Internal" overwrites only the rules from the local AS. "External" overwrites only the rules from the other AS.

7.2.5.3. BGP Static rules

Pre-defined static routing rules to be exported over the BGP protocol. Maximum number of rules is 256.

Active
List box {On; Off}, default = "Off"
Enables / disables the static routing rule.

Destination IP / Destination mask
IP address, default = 0.0.0.0/32
IP address and mask defining the exported routing rule destination address range.

Note
Optional comment.

7.2.5.4. BGP Import IGP filter

Import IGP filter [PP1] rules. The order of rules matters. Maximum number of filter rules is 256.

Filter policy
List box {Accept; Reject}, default = "Reject"
Defines what action is taken on the routing rules which were not captured (i.e. fallback) in the **Import IGP filter**.

Active
List box {On; Off}, default = "On"
Enables / disables the filter rule.

Note
Optional comment.

Filter network
List box {Off; Match; Not match}, default = "Off"
Selects a method of the routing rule destination range comparison.

IP address / mask
IP address / mask, default = 0.0.0.0/0
IP address and mask defines the network prefix to be compared

Mask from
Number {0 – 32}, default = 0

Mask to
Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.

Filter source
List box {Off; Internal; External}, default = "Off"
Selection based on the routing rule source. "Internal" selects rules received from the internal (iBGP) connection. "External" selects rules received from the other AS (eBGP).

Filter BGP path
List box {Off; Is empty; Not empty; Contain; Not contain}, default = "Off"
Filtering based on the BGP Path (routing rule path over different AS). "Is empty" – defines an empty path (routing rule from the local AS). "Contain" – defines paths containing specific AS.

Path position
List box {Any; Neighbor; Source}, default = "Any"
Selects position of the specific AS (**Path AS**). "Any" – anywhere on the path. "Neighbor" – the path was received from this AS (last on the path). "Source" – routing rule was originated from this AS (first on the path).

Path AS
Number {0 – (2^{32}-1)}, default = 65000
The number of the AS searched for.

Action
List box {Accept; Reject; Pass}, default = "Accept"
Defines what action is taken on the captured [PP1] routing rule. "Pass" continues in processing.

Set preference
List box {Off; On}, default = "Off"
Defines if the specific **Preference** will be set up for this rule.

Preference
Number {0 – 65535}, default = 100
Routing rule preference in the routing table. The higher the number the higher the preference.

Local preferred source address
IP address, default = 0.0.0.0
Preferred source IP address for the locally generated packets. When disabled (default value 0.0.0.0 is used), the source IP address is set according to the outgoing interface.

7.2.5.5. BGP Export IGP filter

Export IGP filter rules. The order of rules matters. Maximum number of filter rules is 256.

Filter policy
List box {Accept; Reject}, default = "Reject"
Defines what action is taken on the routing rules which were not captured (i.e. fallback) in the **Export IGP filter**.

Active
List box {On; Off}, default = "On"
Enables / disables the filter rule.

Note
Optional comment.

Filter network
List box {Off; Match; Not match}, default = "Off"
Selects a method of the routing rule destination range comparison.

IP address / mask
IP address / mask, default = 0.0.0.0/0
IP address and mask defines the network prefix to be compared

Mask from
Number {0 – 32}, default = 0

Mask to
Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.

Filter protocol
List box {Off; Match; Not match}, default = "Off"

Selects the way how the routing rule source protocol is compared.

Protocol

List box {System; OSPF}, default = "System"
Selection of the protocol origin. "System" – stands for rules from the ordinary routing table. "OSPF" stands for rules from the OSPF protocol.

Filter OSPF source

List box {Off; Match; Not match}, default = "Off"
Selects the OSPF routing rule source comparison mode.

OSPF source

List box {Internal; Inter-area; External type 1; External type 2}, default = "External type 2"
OSPF sources. "Internal" – stands for internally generated rule (e.g. interface range). "Inter-area" – stands for rule generated on the area borders.

Filter OSPF tag

List box {Off; Match; Not match}, default = "Off"
Selects the way of filtering based on OSPF tag.

OSPF tag

Number {0 – (2^{32}-1)}, default = 0
OSPF tag to be compared. The tag is added to a rule when inserted to OSPF.

Action

List box {Accept; Reject; Pass}, default = "Accept"Defines what action is taken on the routing rule. "Pass" continues in processing.

7.2.5.6. BGP Import OUT rules

Import OUT filter [PP1] rules. The order of rules matters. Maximum number of filter rules is 256.

Filter policy

List box {Accept; Reject}, default = "Accept"
Defines what action is taken on the routing rules which were not captured (i.e. fallback) in the **Import OUT filter**.

Filter limit

Number {1 – 65535}, default = 1024
Limit of the accepted routing rules from the neighbor. The limit applies before this Import OUT filter. Excess rules are dropped.

Active

List box {On; Off}, default = "On"
Enables / disables the filter rule.

Note

Optional comment.

Filter network

List box {Off; Match; Not match}, default = "Off"
Selects a method of the routing rule destination range comparison.

IP address / mask

IP address / mask, default = 0.0.0.0/0
IP address and mask defines the network prefix to be compared

Mask from

Number {0 – 32}, default = 0

Mask to

Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.

Filter BGP path

List box {Off; Is empty; Not empty; Contain; Not contain}, default = "Off"
Filtering based on the BGP Path (routing rule path over different AS). "Is empty" – defines an empty path (routing rule from the local AS). "Contain" – defines paths containing specific AS.

Path position

List box {Any; Neighbor; Source}, default = "Any"
Selects position of the specific AS (**Path AS**). "Any" – anywhere on the path. "Neighbor" – the path was received from this AS (last on the path). "Source" – routing rule originates from this AS (first on the path).

Path AS

Number {0 – (2^{32}-1)}, default = 65000
The number of the AS searched for.

Action

List box {Accept; Reject; Pass}, default = "Accept"
Defines what action is taken with the matching routing rule. "Pass" continues in processing.

Prepend local AS

Number {0 – 8}, default = 0
Enables to append (even multiple times) local AS number to the BGP path end – making the path virtually longer. The longer path is handicapped during the comparisons and selections.

7.2.5.7. BGP Export OUT filter

Export OUT filter rules. The order of rules matters. Maximum number of filter rules is 256.

Filter policy

List box {Accept; Reject}, default = "Accept"
Defines what action is taken on the routing rules which were not captured (i.e. fallback) in the **Export OUT filter**.

Active

List box {On; Off}, default = "On"
Enables / disables the filter rule.

Note

Optional comment.

Filter network

List box {Off; Match; Not match}, default = "Off"
Selects a method of the routing rule destination range comparison.

IP address / mask

List box {Off; Match; Not match}, default = "Off"
IP address and mask defines the network prefix to be compared

Mask from

Number {0 – 32}, default = 0

Mask to

Number {0 – 32}, default = 32
Definition of the enabled range of the mask length of the processed routing rule.

Filter protocol

List box {Off; Match; Not match}, default = "Off"
Selects the way how the routing rule source protocol is compared.

Protocol

List box {System; OSPF; BGP; BGP external; BGP internal}, default = "System"
Selection of the protocol origin. "System" – stands for rules from the ordinary routing table.

Filter OSPF tag

List box {Off; Match; Not match}, default = "Off"
Selects the way of filtering based on OSPF tag.

OSPF tag

Number {0 – (2^{32}-1)}, default = 0
OSPF tag to be compared. The tag is added to a rule when inserted to OSPF.

Filter BGP path

List box {Off; Is empty; Not empty; Contain; Not contain}, default = "Off"
Filtering based on the BGP Path (routing rule path over different AS). "Is empty" – defines an empty path (routing rule from the local AS). "Contain" – defines paths containing specific AS.

Path position

List box {Any; Neighbor; Source}, default = "Any"
Selects position of the specific AS (**Path AS**). "Any" – anywhere on the path. "Neighbor" – the path was received from this AS (last on the path). "Source" – routing rule was originated from this AS (first on the path).

Path AS

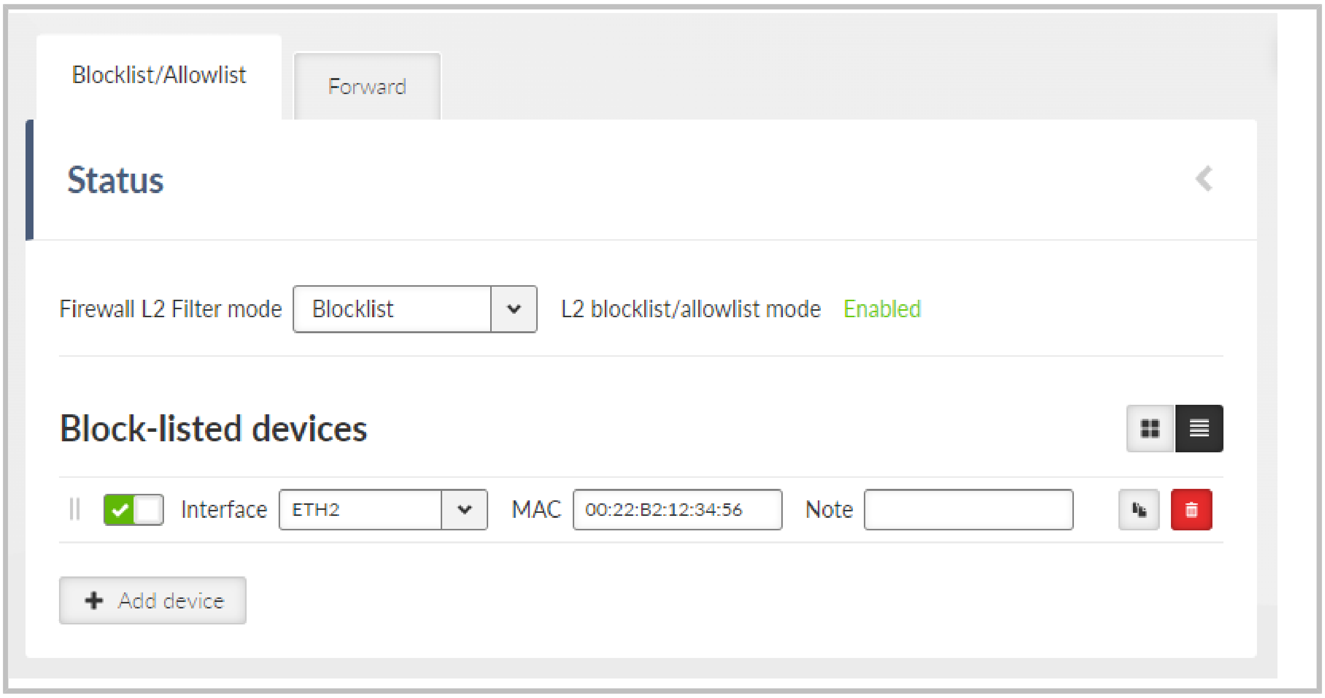
Number {0 – (2^{32}-1)}, default = 65000
The number of the AS searched for.

Action

List box {Accept; Reject; Pass}, default = "Accept"
Defines what action is taken on the routing rule. "Pass" continues in processing.

7.3. Firewall

7.3.1. Firewall L2



Firewall L2 Filter mode: Blocklist

L2 blocklist/allowlist mode: Enabled

Block-listed devices

☑ Interface: ETH2 MAC: 00:22:B2:12:34:56 Note:

Fig. 7.14: SETTINGS > Firewall > L2

Filter mode

List box {Off; Blocklist; Allowlist}, default = "Off"

Blocklist

The MAC addresses listed in the table are blocked, i.e. all packets to/from them are discarded. The traffic to/from other MAC addresses is allowed.

Allowlist

Only the MAC addresses listed in the table are allowed, i.e. only packets to/from them are allowed. The traffic to/from other MAC addresses is blocked.

Active

List box {Off; On}, default = "On"

If "On", Layer 2 Linux firewall rule is activated.

Interface

List box {All; ETH1..ETH5}, default = "All"

MAC

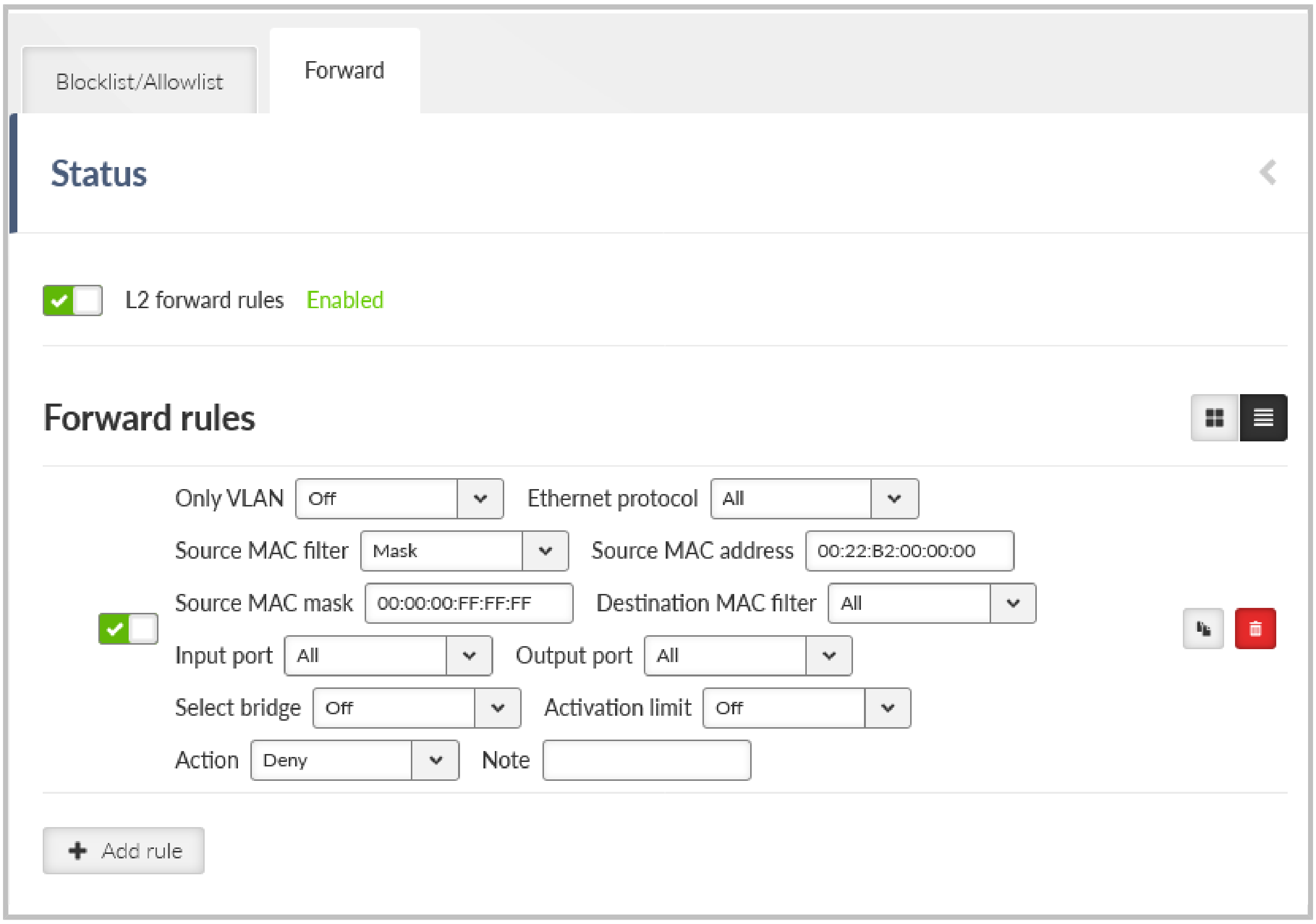
IPv4 MAC address

Note

L2 firewall settings do not impact the local ETH access, i.e. settings never deny access to a locally connected M!DGE3 (web interface, ping, ...).

7.3.1.1. Forward

L2 Forward filters packets that pass through a bridge from one port to another. Does not filter packets originating from or terminating at the station or directed between different interfaces.



Status

☑ L2 forward rules Enabled

Forward rules

☑ Only VLAN: Off; Ethernet protocol: All
Source MAC filter: Mask; Source MAC address: 00:22:B2:00:00:00
Source MAC mask: 00:00:00:FF:FF:FF; Destination MAC filter: All
Input port: All; Output port: All
Select bridge: Off; Activation limit: Off
Action: Deny; Note:

Fig. 7.15: SETTINGS > Firewall > L2 > Forward

L2 forward rules
Enables / disables L2 forward rules; default = "Off"
Each individual firewall rule is described by following parameters:

Only VLAN
List box {Off; On}, default = "Off"
Enables packet filtering for a specific VLAN and deep packet inspection.
If enabled:

VLAN
Number (0-4094), default = 1
ID of the filtered VLAN

Ethernet protocol
List box {All; Not VLAN; All VLAN; IPv4; IPv6; ARP; Other}, default = "All"
Filter based on EtherType (protocol carried in the Ethernet frame).

Source MAC filter
List box {All; Mask; Unicasts; Multicasts; Broadcasts}, default = "All"
Enables filtering based on the source MAC address of the packet.

For Mask option:

Source MAC address
Address used to compare against the source MAC address of packets.

Source MAC mask
Mask used to compare against the source MAC address of packets.

Destination MAC filter
List box {All; Mask; Unicasts; Multicasts; Broadcasts}, default = "All"
Enables filtering based on the destination MAC address of the packet.
For Mask option:

Destination MAC address
Address used to compare against the destination MAC address of packets.

Destination MAC mask
Mask used to compare against the destination MAC address of packets.

Input port
List box {All; Radio; All ETH; ETH1; ETH2; ETH3; ETH4; ETH5; GRE L2; OpenVPN L2; Other"}, default = "All"
Filters based on the port that the packet entered the bridge through.
For Other option:

Input port name
String {0–16 char}, default = <empty>
Name of the input port. Must be the name of an existing interface used as a bridge port.

Output port
List box {All; Radio; All ETH; ETH1; ETH2; ETH3; ETH4; ETH5; GRE L2; OpenVPN L2; Other"}, default = "All"
Filters based on the port that the packet exits the bridge through.
For Other option:

Output port name
String {0–16 char}, default = <empty>
Name of the output port. Must be the name of an existing interface used as a bridge port.

Select bridge
List box {Off; On}, default = "Off"
Enables limiting of the rule to a specific bridge. The rule will only be applied to packets that pass through the selected bridge.

Activation limit
List box {Off; On}, default = "Off"
Enables limiting the number of times the rule can be triggered per time unit.
If enabled:

Frame count
Number (1-10000), default = 3
Average packet/activation rate limit per time unit.

Measurement period
List box {Second, Minute, Hour, Day}, default = "Minute"

Time unit for limiting the packet/activation rate.

Burst size

Number (1-10000), default = 3

Initial and maximum number of TBF tokens. After a period of inactivity, TBF allows a burst of traffic to pass through at once. Must be greater than or equal to Frame count.

Action

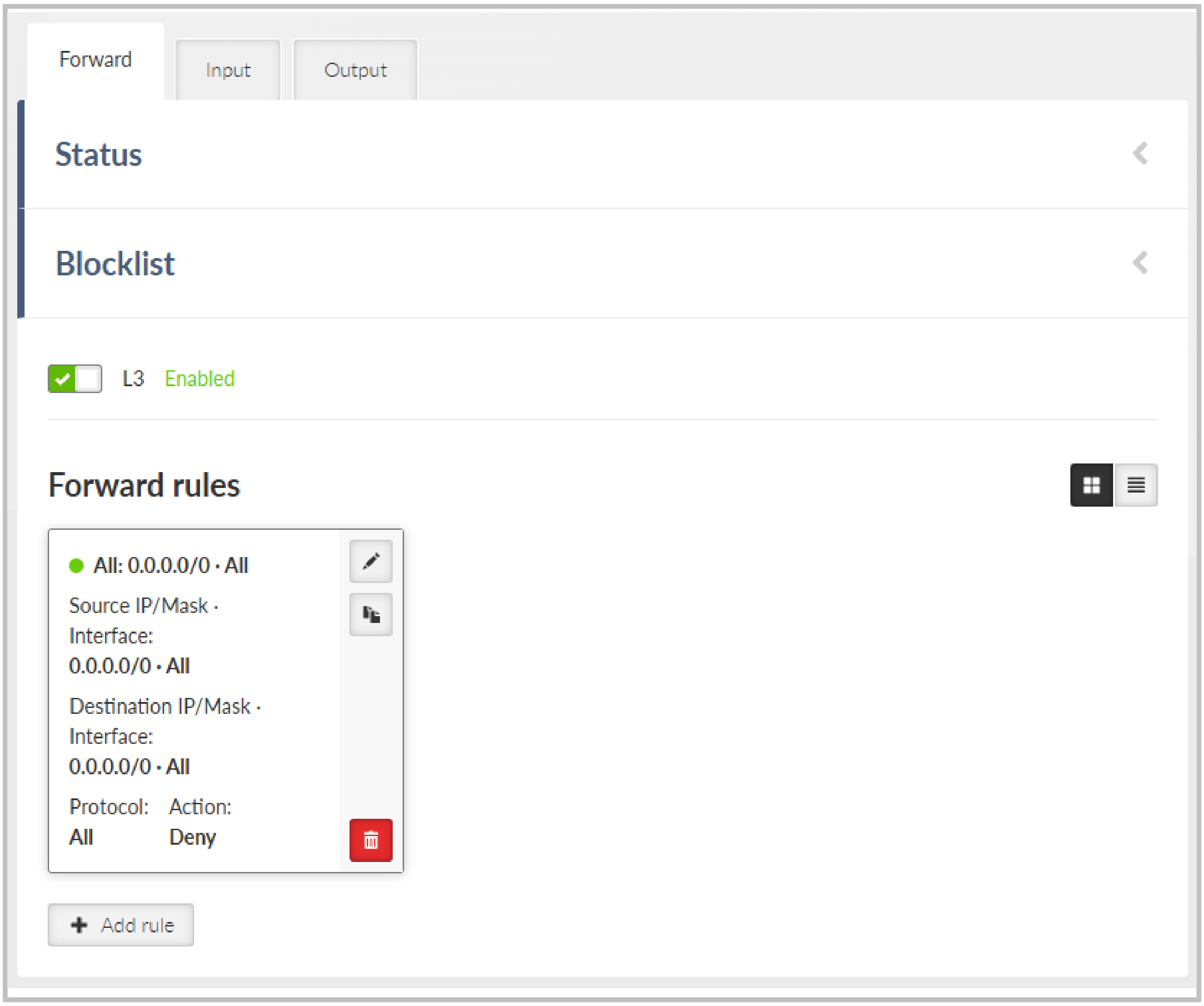
List box {Deny; Allow}, default = "Deny"

Selects the action to be taken on a packet that matches the configured filter.

7.3.2. Firewall L3

7.3.2.1. Forward

Set of rules applying for the traffic coming through the cellular router.



L3 Enabled

Forward rules

● All: 0.0.0.0/0 · All

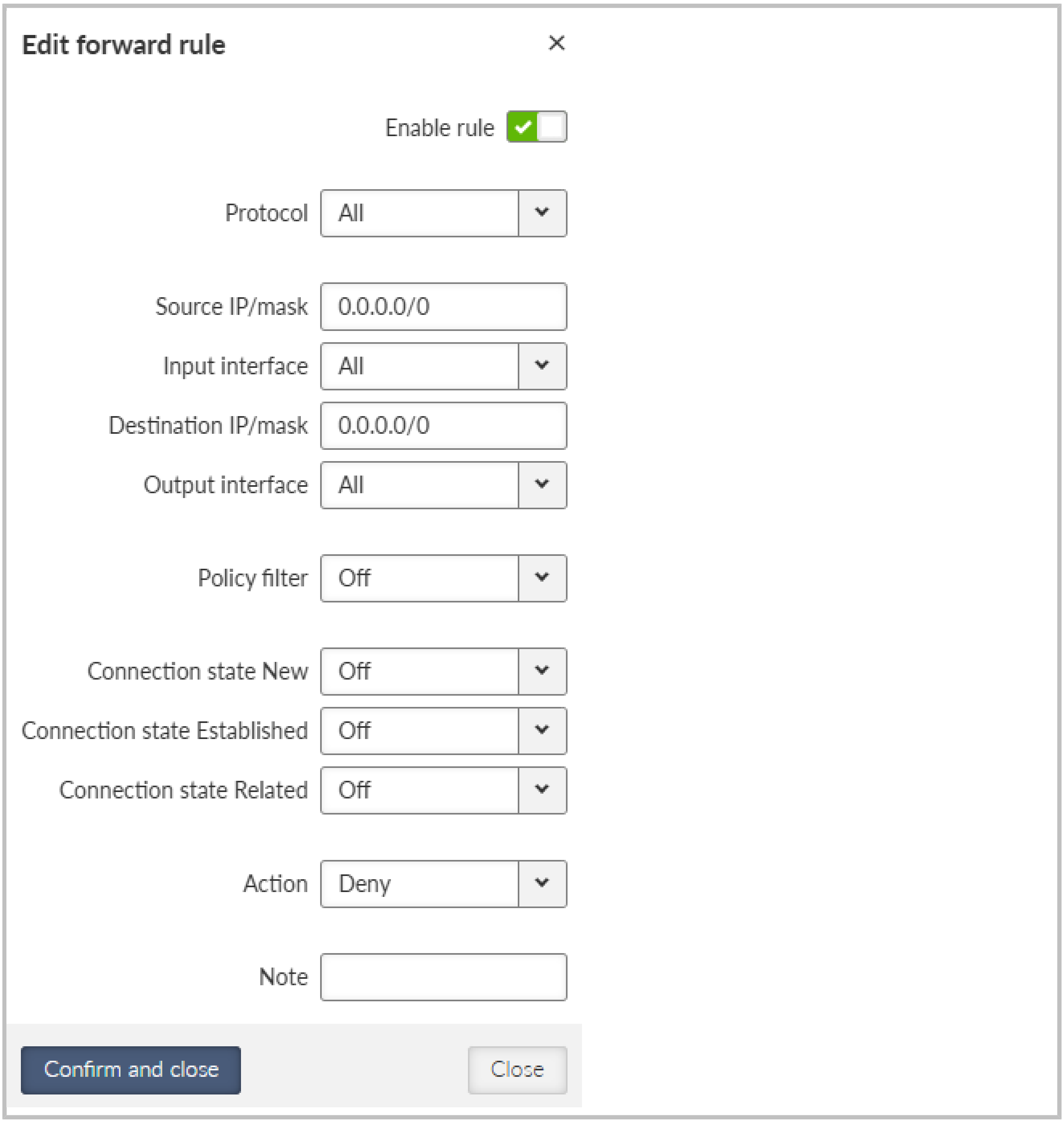
Source IP/Mask · Interface:
0.0.0.0/0 · All

Destination IP/Mask · Interface:
0.0.0.0/0 · All

Protocol: All

Action: Deny

Fig. 7.16: SETTINGS > Firewall > L3



Edit forward rule

Enable rule	☑
Protocol	All
Source IP/mask	0.0.0.0/0
Input interface	All
Destination IP/mask	0.0.0.0/0
Output interface	All
Policy filter	Off
Connection state New	Off
Connection state Established	Off
Connection state Related	Off
Action	Deny
Note	

Fig. 7.17: SETTINGS > Firewall > L3 forward

Enable rule

Check box {On; Off}, default = "Off"
Enables / disables L3 firewall rule.
Each individual firewall rule is described by following parameters:

Protocol

List box {All; ICMP; UDP; TCP; GRE; ESP; Other}, default = "All"
Select the transport protocol to filter by. The “All” option disables filtering by protocol.

Protocol number

Number (1-255), default = 1

The transport protocol number by which it is filtered. This parameter occurs only when parameter **Protocol** is set to "Other".

Source IP / Mask

IP address, Mask, default = 0.0.0.0/0
Source IP address/Mask of the packet. If mask is set to 0, it is not filtered by source IP address.
The rule with narrower mask has higher priority. The rules order does affect priority.

Source port (from) / Source port (to)

Number (0-65536), default = 0
Interval of source ports. This parameter occurs only when parameter **Protocol** is set either to "UDP" or "TCP".

Input interface

List box {All; WWAN; All ETH; EXT; ETH1..ETH5; All serial PPP; PPPoE client; GRE L2; GRE L3; OpenVPN L2; OpenVPN L3; Other}, default = "All"
Selects the input device (interface, port) from which the packet came.

Input interface name

String (0-16 symbols), default = <empty>
The name of the input interface (or bridge port) of the packet.
This parameter occurs only when parameter Input interface is set to "Other".

Destination IP / Mask

IP address, Mask, default = 0.0.0.0/0
Destionation IP address/Mask of the packet. If mask is set to 0, it is not filtered by destination IP address.
The rule with narrower mask has higher priority. The rules order does affect priority.

Destination port (from) / Destination port (to)

Number (0-65536), default = 0
Interval of destination ports. This parameter occurs only when parameter **Protocol** is set either to "UDP" or "TCP".

Output interface

List box {All; WWAN; All ETH; EXT; All serial PPP; PPPoE client; GRE L3; OpenVPN L3; Other}, default = "All"
Selects the output interface from which the packet leaves. Cannot select the bridge port.

Policy filter

List box {Off; On}, default = "Off"
Enables packet filtering according to the applied policy - IPsec.

Direction

Listbox: {In (Decapsulation), Out (Encapsulation)}, default = "Out (Encapsulation)"
Filters by packet processing direction.

Policy

Listbox: {None, IPsec}, default = "None"
Filters according to the policy applied to the packet:
None - The packet will not be processed by IPsec (decapsulation and encapsulation)
IPsec - The packet will be processed by IPsec

Connection state New

List box {Off; On}, default = "Off"
Relates to the first packet when a TCP connection starts (Request from TCP client to TCP server for opening a new TCP connection). Used e.g. for allowing to open TCP only from M!DGE3 network to outside.

Connection state Established

List box {Off; On}, default = "Off"
Relates to an already existing TCP connection. Used e.g. for allowing to get replies for TCP connections created from M!DGE3 network to outside.

Connection state Related

List box {Off; On} default = "Off"
A connection related to the "Established" one, e.g. FTP typically uses 2 TCP connections control and data, where data connection is created automatically by using dynamic ports.

Note

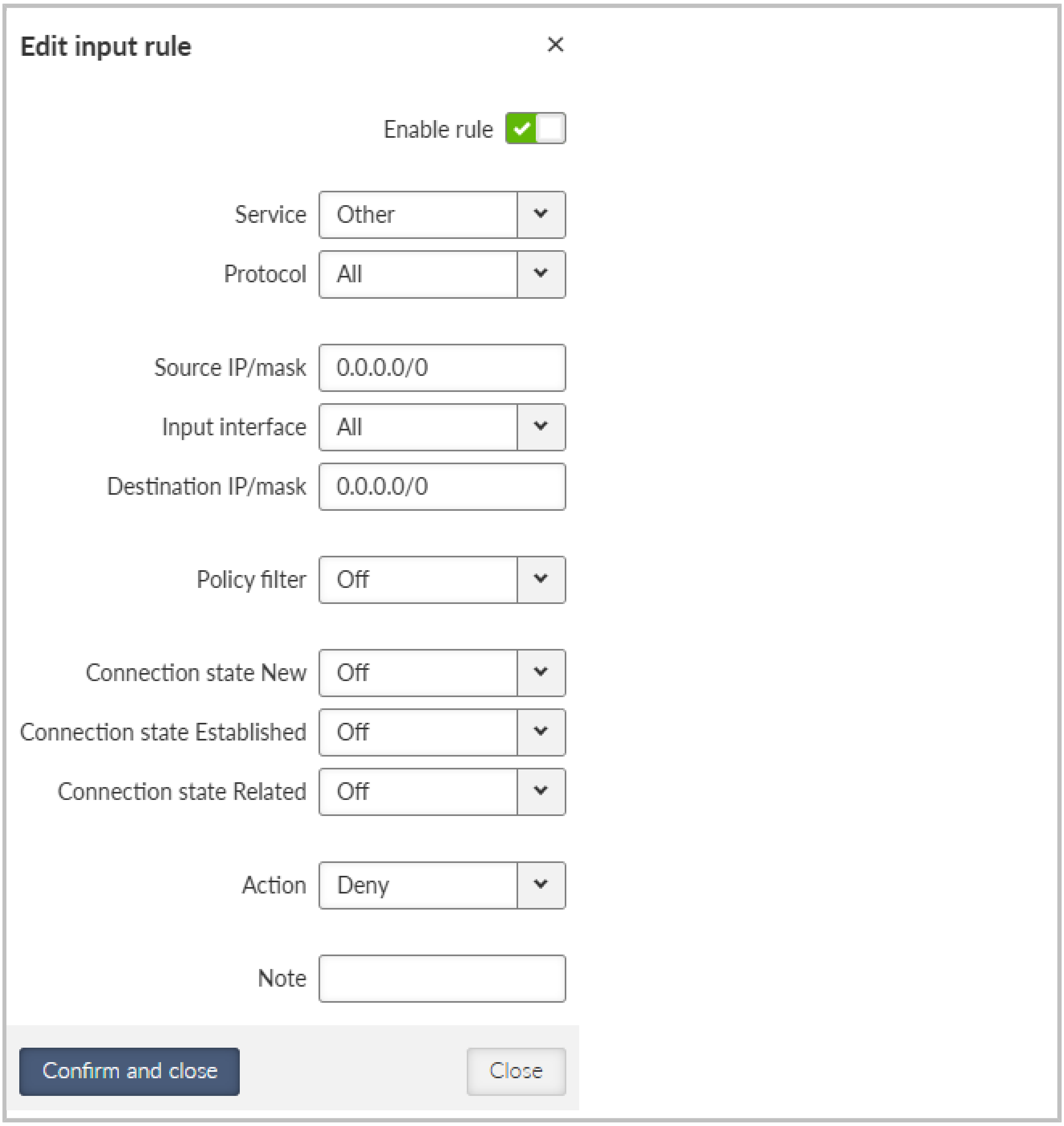
Management connection to a remote M!DGE3 may be lost, when another M!DGE3 acts as a router along the management packets path and TCP port 8889 (Remote Access) is disabled (DENY rule) in L3 firewall settings of that routing M!DGE3 (FORWARD chain).

Action

List box {Deny; Allow}, default = "Deny"
Selects the action to perform on a packet that matches the configured filter.

7.3.2.2. Input

Set of rules applying for traffic heading into the cellular router. Incoming traffic from unwanted source addresses can be blocked by setting parameter *Action* to "Deny, add to the blocklist".



Edit input rule

Enable rule	☑
Service	Other
Protocol	All
Source IP/mask	0.0.0.0/0
Input interface	All
Destination IP/mask	0.0.0.0/0
Policy filter	Off
Connection state New	Off
Connection state Established	Off
Connection state Related	Off
Action	Deny
Note	

Fig. 7.18: SETTINGS > Firewall > L3 input

Enable rule

Check box {On; Off}, default = "Off"
Enables / disables L3 firewall rule.
Each individual firewall rule is described by following parameters:

Service

List box {Other; COM1; COM2; COM3; TS1; TS2; TS3; TS4; TS5; SSH; HTTP; HTTPS; Remote access; SNMP; NTP}, default = "Other"
Allows you to select a known service on the station whose protocol and destination port the rule filter will capture.

Protocol

List box {All; ICMP; UDP; TCP; GRE; ESP; Other}, default = "All"
Select the transport protocol to filter by. The “All” option disables filtering by protocol.

Protocol number

Number (1-255), default = 1
The transport protocol number by which it is filtered. This parameter occurs only when parameter **Protocol** is set to "Other".

Source IP / Mask

IP address, Mask, default = 0.0.0.0/0
Source IP address/Mask of the packet. If mask is set to 0, it is not filtered by source IP address.
The rule with narrower mask has higher priority. The rules order does affect priority.

Source port (from) / Source port (to)

Number (0-65536), default = 0
Interval of source ports. This parameter occurs only when parameter **Protocol** is set either to "UDP" or "TCP".

Input interface

List box {All; WWAN; All ETH; EXT; ETH1..ETH5; All serial PPP; PPPoE client; GRE L2; GRE L3; OpenVPN L2; OpenVPN L3; Other}, default = "All"
Selects the input device (interface, port) from which the packet came.

Input interface name

String (0-16 symbols), default = <empty>
The name of the input interface (or bridge port) of the packet.
This parameter occurs only when parameter Input interface is set to "Other".

Destination IP / Mask

IP address, Mask, default = 0.0.0.0/0
Destionation IP address/Mask of the packet. If mask is set to 0, it is not filtered by destination IP address.
The rule with narrower mask has higher priority. The rules order does affect priority.

Destination port (from) / Destination port (to)

Number (0-65536), default = 0
Interval of destination ports. This parameter occurs only when parameter **Protocol** is set either to "UDP" or "TCP".

Policy filter

List box {Off; On}, default = "Off"
Enables packet filtering according to the applied policy - IPsec.

Policy

Listbox: {None, IPsec}, default = "None"
Filters according to the policy applied to the packet:
None - The packet will not be processed by IPsec (decapsulation)
IPsec - The packet will be processed by IPsec

Connection state New

List box {Off; On}, default = "Off"

Relates to the first packet when a TCP connection starts (Request from TCP client to TCP server for opening a new TCP connection). Used e.g. for allowing to open TCP only from M!DGE3 network to outside.

Connection state Established

List box {Off; On}, default = "Off"
Relates to an already existing TCP connection. Used e.g. for allowing to get replies for TCP connections created from M!DGE3 network to outside.

Connection state Related

List box {Off; On} default = "Off"
A connection related to the "Established" one. e.g. FTP typically uses 2 TCP connections control and data, where data connection is created automatically by using dynamic ports.

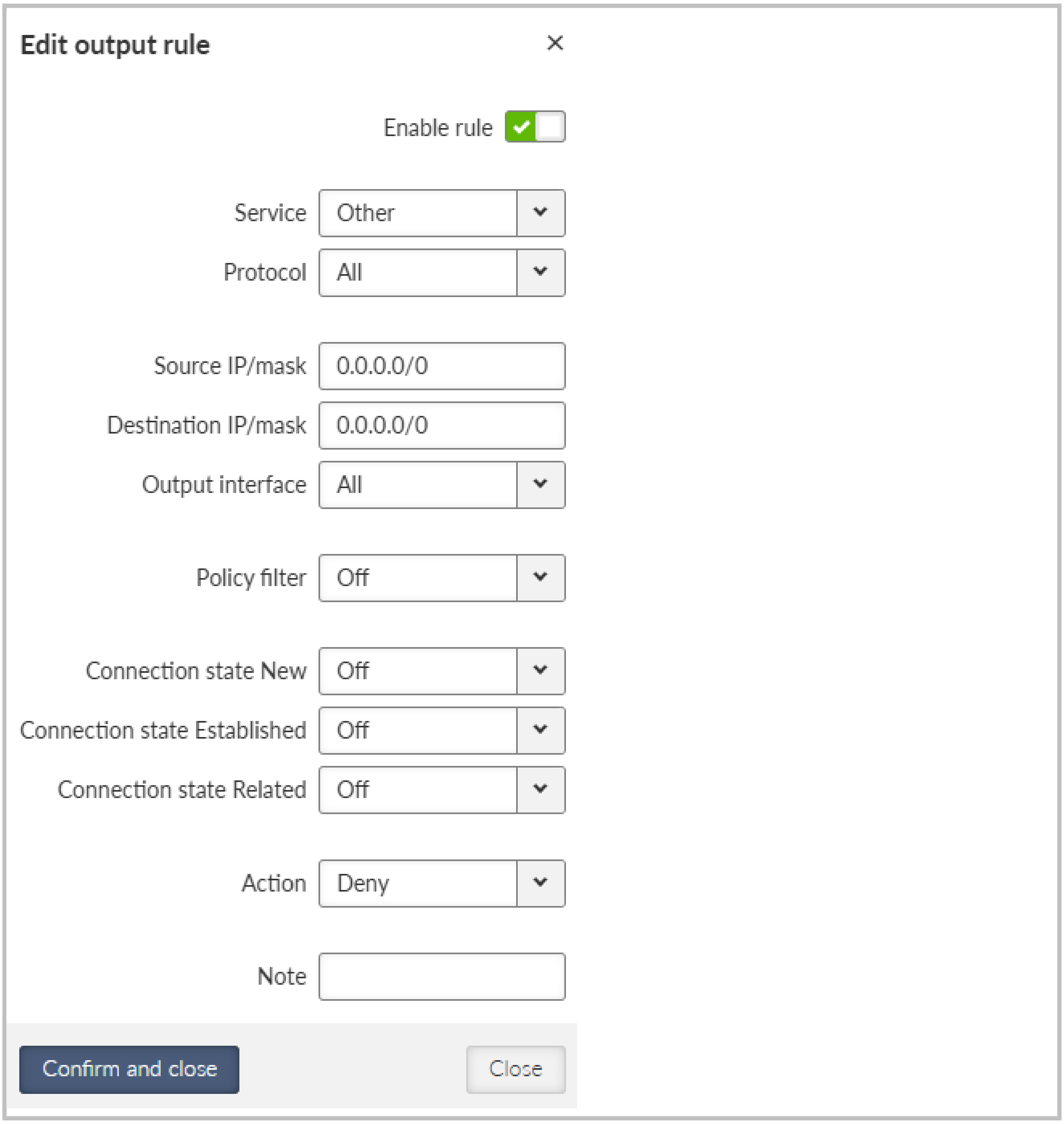
Note
Management connection to a remote M!DGE3 may be lost, when another M!DGE3 acts as a router along the management packets path and TCP port 8889 (Remote Access) is disabled (DENY rule) in L3 firewall settings of that routing M!DGE3 (FORWARD chain).

Action

List box {Deny; Allow; Deny, Add to Blocklist}, default = "Deny"
Selects the action to perform on a packet that matches the configured filter.
Deny, Add to Blocklist - all traffic from the particular address will be automatically dropped. Blocklist has limited capacity of 512 addresses. Once its capacity is exceeded, the oldest address is overwritten. Addresses added to the blocklist remain in for one week (604,800s) and are deleted from it afterwards. Change of configuration including firewall, or unit reboot will delete those addresses as well.

7.3.2.3. Output

Set of rules applying for the traffic leaving from the cellular router.



Edit output rule

Enable rule	☑
Service	Other
Protocol	All
Source IP/mask	0.0.0.0/0
Destination IP/mask	0.0.0.0/0
Output interface	All
Policy filter	Off
Connection state New	Off
Connection state Established	Off
Connection state Related	Off
Action	Deny
Note	

Fig. 7.19: SETTINGS > Firewall > L3 output

Enable rule

Check box {On; Off}, default = "Off"
Enables / disables L3 firewall rule.
Each individual firewall rule is described by following parameters:

Service

List box {Other; COM1; COM2; COM3; TS1; TS2; TS3; TS4; TS5; SSH; HTTP; HTTPS; Remote access; SNMP; NTP}, default = "Other"
Allows you to select a known service on the station whose protocol and destination port the rule filter will capture.

Protocol

List box {All; ICMP; UDP; TCP; GRE; ESP; Other}, default = "All"
Select the transport protocol to filter by. The “All” option disables filtering by protocol.

Protocol number

Number (1-255), default = 1
The transport protocol number by which it is filtered. This parameter occurs only when parameter **Protocol** is set to "Other".

Source IP / Mask

IP address, Mask, default = 0.0.0.0/0
Source IP address/Mask of the packet. If mask is set to 0, it is not filtered by source IP address.
The rule with narrower mask has higher priority. The rules order does affect priority.

Source port (from) / Source port (to)

Number (0-65536), default = 0
Interval of source ports. This parameter occurs only when parameter **Protocol** is set either to "UDP" or "TCP".

Destination IP / Mask

IP address, Mask, default = 0.0.0.0/0
Destionation IP address/Mask of the packet. If mask is set to 0, it is not filtered by destination IP address.
The rule with narrower mask has higher priority. The rules order does affect priority.

Destination port (from) / Destination port (to)

Number (0-65536), default = 0
Interval of destination ports. This parameter occurs only when parameter **Protocol** is set either to "UDP" or "TCP".

Output interface

List box {All; WWAN; All ETH; EXT; All serial PPP; PPPoE client; GRE L3; OpenVPN L3; Other}, default = "All"
Selects the output interface from which the packet leaves. Cannot select the bridge port.

Output interface name

String (0-16 symbols), default = <empty>
The name of the output interface of the packet.
This parameter occurs only when parameter Input interface is set either to "Other".

Policy filter

List box {Off; On}, default = "Off"
Enables packet filtering according to the applied policy - IPsec.

Policy

Listbox: {None, IPsec}, default = "None"
Filters according to the policy applied to the packet:
None - The packet will not be processed by IPsec (encapsulation)
IPsec - The packet will be processed by IPsec

Connection state New

List box {Off; On}, default = "Off"

Relates to the first packet when a TCP connection starts (Request from TCP client to TCP server for opening a new TCP connection). Used e.g. for allowing to open TCP only from M!DGE3 network to outside.

Connection state Established

List box {Off; On}, default = "Off"

Relates to an already existing TCP connection. Used e.g. for allowing to get replies for TCP connections created from M!DGE3 network to outside.

Connection state Related

List box {Off; On} default = "Off"

A connection related to the "Established" one. e.g. FTP typically uses two TCP connections control and data, where data connection is created automatically by using dynamic ports.

Note

Management connection to a remote M!DGE3 may be lost, when another M!DGE3 acts as a router along the management packets path and TCP port 8889 (Remote Access) is disabled (DENY rule) in L3 firewall settings of that routing M!DGE3 (FORWARD chain).

Action

List box {Deny; Allow}, default = "Deny"

Selects the action to perform on a packet that matches the configured filter.

7.3.3. NAT - Network address translation

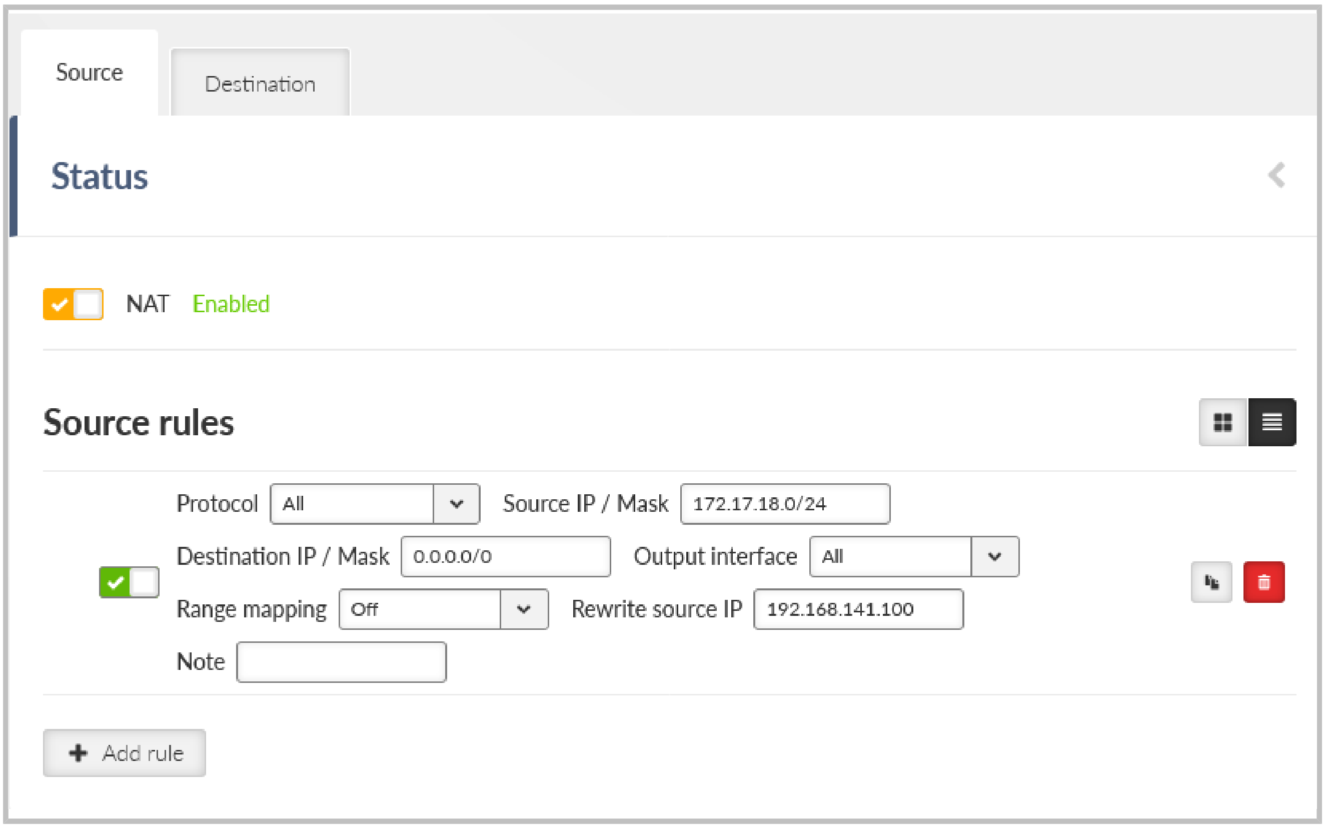
Network address and port translation (**NAPT**) is a method of mapping an IP address (or port) space into another by modifying network address information in the IP header of packets while they are in transit across a traffic routing device.

7.3.3.1. Source NAT

Source Network Address Translation (SNAT) - rewrites the source address and/or port within the leaving connection and performs opposite changes for returning packets.

SNAT:

- Allows to pretend, that the packets come from a device, that performs SNAT.
- Performs during packet output from a device (after routing and filtering in firewall).



Protocol: All
Source IP / Mask: 172.17.18.0/24
Destination IP / Mask: 0.0.0.0/0
Output interface: All
Range mapping: Off
Rewrite source IP: 192.168.141.100
Note:

Fig. 7.20: SETTINGS > Firewall > NAT

Enable

List box {Enable; Disable}, default = "Disable"
Enables / disables all Source NAT rules.

Parameters “**Protocol**”, “**Source IP / Mask**”, “**Destination IP / Mask**”, **“Output Interface”**,“**Source port from**”, “**Source port to**”, “**Destination port from**”, “**Destination port to**” and “**Protocol number**” define a filter, which is capturing specified packets. SNAT rule applies for those packets.

Parameters “**Source port from**”, “**Source port to**”, “**Destination port from**” and “**Destination port to**” occur only if parameter “**Protocol**” is set to “UDP” or “TCP”.

Parameter “**Protocol number**” occurs only if parameter “**Protocol**” is set to “Other”.

Protocol

List box {All; ICMP; UDP; TCP; GRE; ESP; Other}, default = "All"
Filters selected protocol. If none of the mentioned values suits, select “Other”.

Protocol number

Number {0 – 255}, default = 1
This parameter occurs only, if parameter “**Protocol**” is set to “Other”.

Source IP / Mask

IP address, default = 0.0.0.0/0
Defines the source IP subnet.

Source port (from) / Source port (to)

Number {0 – 65535}, default = 0

Defines the range of values of source port. Value 0 means, that it is not filtered according to the source port. If only one port is required, set both parameters to the same number. These parameters occur only, if parameter “**Procotol**” is set to “UDP” or “TCP”.

Destination IP / Mask
IP address, default = 0.0.0.0/0
Defines the destination IP subnet.

Destination port (from) / Destination port (to)
Number {0 – 65535}, default = 0
Defines the range of values of destination port. Value 0 means, that it is not filtered according to the destination port. These parameters occur only, if parameter “**Procotol**” is set to “UDP” or “TCP”.

Output Interface
List box {All; ; ;WWANAll ETH; EXT; GRE L3; Other}, default = "All"
Filters selected interfaces.

Output interface name
Has to be set as one of existing interfaces (the name of LAN (or VLAN) interface, the name of GRE tunnel, etc.). This parameter occurs only, if parameter “**Output Interface**” is set to “Other”.

Range mapping
List box {Off; IP address to IP address}, default = "Off"
Off – Source address and (or) port will be replaced by values from parameters “**Rewrite source IP**” and “**Rewrite source port**”. This applies only if those parameters are set (they are not set as 0.0.0.0).
IP address to IP address (NETMAP) – Rewriting the Range mapping of source IP address. New source address will contain prefix from parameters “**Rewrite Source IP**” and “**Rewrite Source IP / Mask**”. Rest of the source address will be filled by the original source address.

Rewrite source IP
IP address, default = 0.0.0.0/0
Defines a new source address. Value 0.0.0.0/0 means, that the source address is not changed.

Rewrite source port
Number {0 – 65535}, default = 0
Defines a new source port (rewriting multiple defined ports into one). Value 0 means, that the source port is not changed.

Note
Optional comment.

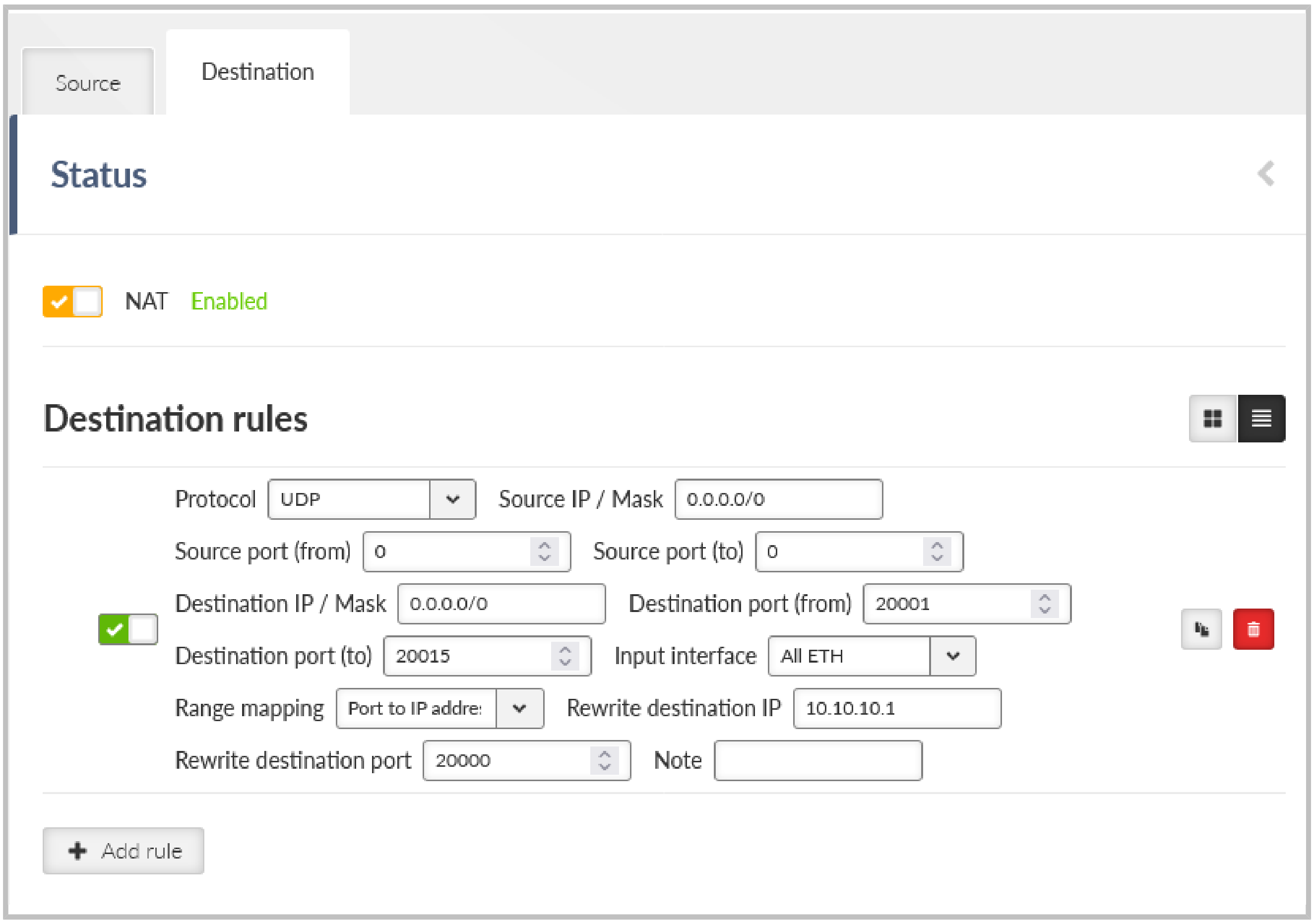
7.3.3.2. Destination NAT

Destination Network Address Translation (DNAT) - rewrites the destination address and/or port within incoming connection and performs opposite changes for returning packets.

DNAT:

- Allows to redirect connection destination to a device, that performs DNAT.

- Performs during packet input to a device (before redirecting and filtering in firewall).



Status

☑ NAT Enabled

Destination rules

☑
Protocol: UDP
Source IP / Mask: 0.0.0.0/0
Source port (from): 0
Source port (to): 0
Destination IP / Mask: 0.0.0.0/0
Destination port (from): 20001
Destination port (to): 20015
Input interface: All ETH
Range mapping: Port to IP addre
Rewrite destination IP: 10.10.10.1
Rewrite destination port: 20000
Note:

Fig. 7.21: SETTINGS > Firewall > NAT > Destination

Enable

List box {Enable; Disable}, default = "Disable"
Enables / disables all Destination NAT rules.

> Parameters “**Protocol**”, “**Source IP / Mask**”, “**Destination IP / Mask**”, **“Output Interface”**,“**Source port from**”, “**Source port to**”, “**Destination port from**”, “**Destination port to**” and “**Protocol number**” define a filter, which is catching specified packets. SNAT rule applies for those packets.
>
> Parameters “**Source port from**”, “**Source port to**”, “**Destination port from**” and “**Destination port to**” occur only if parameter “Protocol” is set to “UDP” or “TCP”.
>
> Parameter “**Protocol number**” occurs only if parameter “**Protocol**” is set to “Other”.

Protocol

Filters selected protocol. If none of the mentioned values suits, select “Other”.

Protocol number

Number {0 – 255}, default = 1
This parameter occurs only, if parameter “**Protocol**” is set to “Other”.

Source IP / Mask

IP address, default = 0.0.0.0/0
Defines the source IP subnet.

Source port (from) / Source port (to)

Number {0 – 65535}, default = 0

Defines the range of values of source port. Value 0 means, that it is not filtered according to the source port. If only one port is required, set both parameters on the same number. These parameters occur only, if parameter “**Procotol**” is set to “UDP” or “TCP”.

Destination IP / Mask

IP address, default = 0.0.0.0/0

Defines the destination IP subnet.

Destination port (from) / Destination port (to)

Defines the range of values of destination port. Value 0 means, that it is not filtered according to the destination port. These parameters occur only, if parameter “**Procotol**” is set to “UDP” or “TCP”.

Input interface

List box {All; WWAN; All ETH; EXT; GRE3; Other}, default = "All"

Filters selected interfaces.

Input interface name

Has to be set as one of existing interfaces (the name of LAN (or VLAN) interface, the name of GRE tunnel, etc.). This parameter occurs only, if parameter “**Input Interface**” is set to “Other”.

Range mapping

List box {Off; IP address to IP address}, default = "Off"

- Off – Destination address and (or) port will be replaced by values from parameters “**Rewrite destination IP**” and “**Rewrite destination port**”. This will apply only if those parameters are set (they are not set as 0.0.0.0).

- IP address to IP address (NETMAP) – Rewriting the Range mapping of source IP address. New source address will contain prefix from parameters “**Rewrite Source IP**” and “**Rewrite Source IP / Mask**”. Rest of the source address will be filled by the original source address.

- Port to IP address (PORTMAP): Range mapping of destination ports (parameters “**Destination port from**”, “**Destination port to**”). New range mapping of destination ports origins in parameter “**Rewrite destination IP**”. It can be additionally overwritten to parameter “**Rewrite destination port**”.
  Explanation of non-typical and interesting parameters:

  Destination port (from) and Destination port (to)

  DNAT rule applies to UDP data with destination ports within the 20001-20015 range only

  Input interface

  Data must be received on any ETH port

  Range mapping

  Set to “Port to IP address” - i.e., destination ports change the destination IP address(es) accordingly.

  Rewrite destination IP and Rewrite destination port

  Set to IP 10.10.10.1 and port 502 - resulting in a range of IPs 10.10.10.1 - 10.10.10.15 due to Destination ports of received UDP data in a range of 20001-20015 (15 ports = 15 IP addresses). A new port is always 20000 (i.e., DNP3 default port).

Rewrite destination IP

IP address, default = 0.0.0.0/0

Defines a new destination address. Value 0.0.0.0/0 means, that the destination address is not changed.

Rewrite destination port

Number {0 – 65535}, default = 0

Defines a new destination port (rewriting multiple defined ports into one). Value 0 means, that the destination port is not changed.

Note

Optional comment.

Note

FTP connection is a special type of TCP with multiple sessions being opened and internal functionality. If you configure DNAT for the connected FTP server, enable the “FTP connection tracker” parameter and specify a correct port (default is 21). These parameters can only be set in the Advanced menu.

7.3.3.3. Cooperation with other services

- MASQUERADE rule for Cellular connection has lower priority that user NAT (it is tested after the NAT), thus it is possible to create exceptions in NAT settings.
- By using DNAT it is possible to intercept a passing connection and redirect it into the M!DGE3 (similar to a proxy behavior).
- For redirection
  - ○ Local IP address will be filled into “**Rewrite destination IP**” parameter.
  - ○ Service port, to which is the local address being redirected will be filled into “**Rewrite destination port**” parameter.

NAT and IPsec

- DNAT can be used before packing a packet into the IPsec. For more information see *Section 7.4.1.3.3, “Interaction with DNAT”*.
- SNAT works on packets unpacked from IPsec.
- SNAT can be used before packing a packet into the IPsec (parameter “**Output interface**” must be set to “All”)
- Rules of SNAT and MASQUERADE (from Cellular) changes packets addresses before capturing by IPsec traffic selector.

7.4. VPN

VPN (Virtual Private Network) extends a private network across a public network, and enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network. Applications running across the VPN may therefore benefit from the functionality, security, and management of the private network.

7.4.1. IPsec

Internet Protocol Security (IPsec) is a network protocol suite that authenticates and encrypts the packets of data sent over a network. IPsec includes protocols for establishing mutual authentication between agents at the beginning of the session and negotiation of cryptographic keys for use during the session. IPsec uses cryptographic security services to protect communications over Internet Protocol (IP) networks. IPsec supports network-level peer authentication, data-origin authentication, data integrity, data confidentiality (encryption), and replay protection. IPsec is an end-to-end security scheme operating within the Internet Layer of the Internet Protocol Suite. IPsec is recognized as a secure, standardized and well-proven solution by the professional public.

There are 2 modes of operation, M!DGE3 offers both the Tunnel mode and the Transport mode. In Tunnel mode, the entire IP packet is encrypted and authenticated. It is then encapsulated into a new IP packet (ESP – Encapsulating Security Payloads) with a new IP header. In Transport mode, only the payload of the original IP packet is encrypted and authenticated. The original IP header remains intact, allowing for direct routing, while the data itself is secured using AH or ESP protocols.

Symmetrical cryptography is used to encrypt the packets. The symmetric keys must be safely delivered to the peer. In order to maintain a secure connection, symmetric keys must be regularly exchanged. The protocol used for secure key exchange is IKE (Internet Key Exchange). Both IKE version 1 and the newer version 2 are available in M!DGE3.

IKE protocol communication with the peer is established using UDP frames on port 500. However, if NAT-T (NAT Traversal) or MOBIKE (MOBile IKE) are active, the UDP port 4500 is used instead.

Note

NAT-T is automatically recognized by IPsec implementation in M!DGE3.

The IPsec tunnel is provided by Security Association (SA). There are 2 types of SA:

- IKE SA: IKE Security Association providing SA keys exchange with the peer.
- CHILD SA: IPsec Security Association providing packet encryption.

Every IPsec tunnel contains 1 IKE SA and at least 1 CHILD SA. In M!DGE3 can be set maximum of 24 IKE_SA and 48 CHILD_SA (TS).

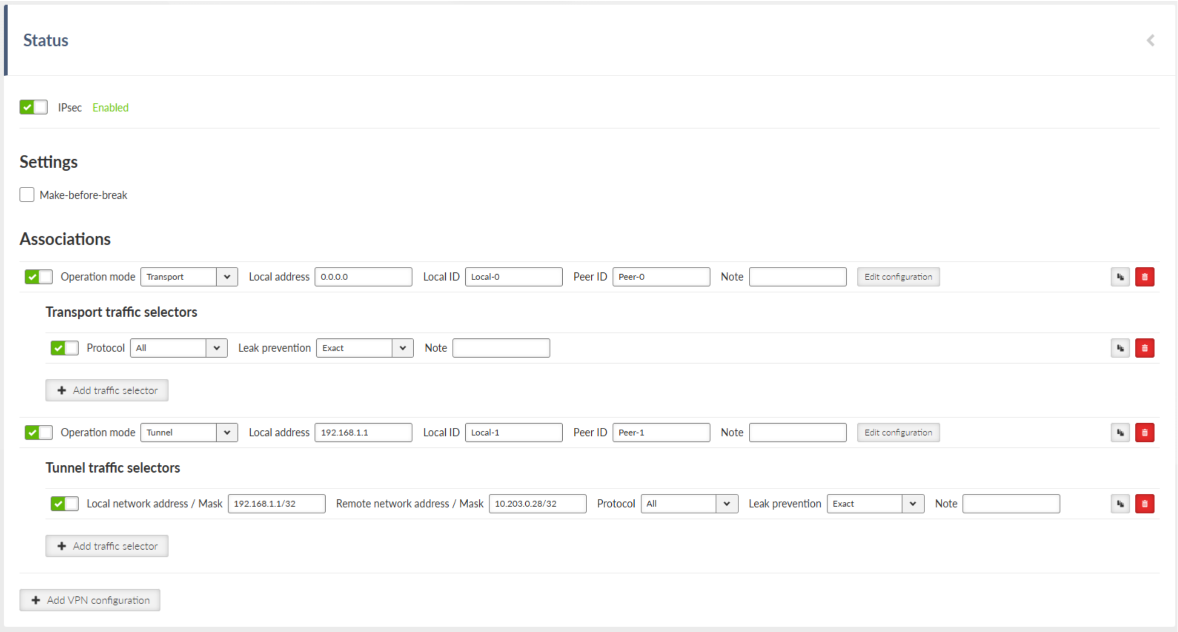
Link partner (peer) secure authentication is assured using Pre-Shared Key (PSK) authentication method: Both link partners share the same key (passphrase).

As and when the CHILD SA expires, new keys are generated and exchanged using IKE SA.

As and when the IKE SA version IKEv1 expires - new authentication and key exchange occurs and a new IKE SA is created. Any CHILD SA belonging to this IKE SA is re-created as well.

As and when the IKE SA version IKEv2 expires one of two different scenarios might occur:

- If the re-authentication is required - the behavior is similar to IKEv1 (see above).
- It the re-authentication is not required - only new IKE SA keys are generated and exchanged.



Status

☑ IPsec Enabled

Settings

□ Make-before-break

Associations

☑ Operation mode: Transport | Local address: 0.0.0.0 | Local ID: Local-0 | Peer ID: Peer-0 | Note:

Transport traffic selectors

☑ Protocol: All | Leak prevention: Exact | Note:

☑ Operation mode: Tunnel | Local address: 192.168.1.1 | Local ID: Local-1 | Peer ID: Peer-1 | Note:

Tunnel traffic selectors

☑ Local network address / Mask: 192.168.1.1/32 | Remote network address / Mask: 10.203.0.28/32 | Protocol: All | Leak prevention: Exact | Note:

Fig. 7.22: SETTINGS > VPN > IPsec

IPsec

{Enable; Disable}, default = "Disable"
IPsec system turning On/Off
There can be a maximum of 16 active CHILD SA (in total over all Active IKE SA).
Every "Active" line must have an equivalent on the peer side with reversed "Local network..." and "Remote network..." fields.
"Local network..." and "Remote network..." fields must contain different address ranges and must not interfere with the USB service connection (10.9.8.7/28) or internal connection to FPGA (192.0.2.233/30).
Each "Active" Traffic selector in the configuration table must be unique.

7.4.1.1. IPsec settings

Make-before-break

{On; Off}, default = "Off"
This parameter is valid for all IKE SA using IKEv2 with re-authentication. A temporary connection breaks during IKE_SA re-authentication is suppressed by this parameter. This function may not operate correctly with some IPsec implementations (on peer side).

7.4.1.2. IPsec associations

To further configure IPsec VPN tunnel, click the **Add VPN configuration** button.

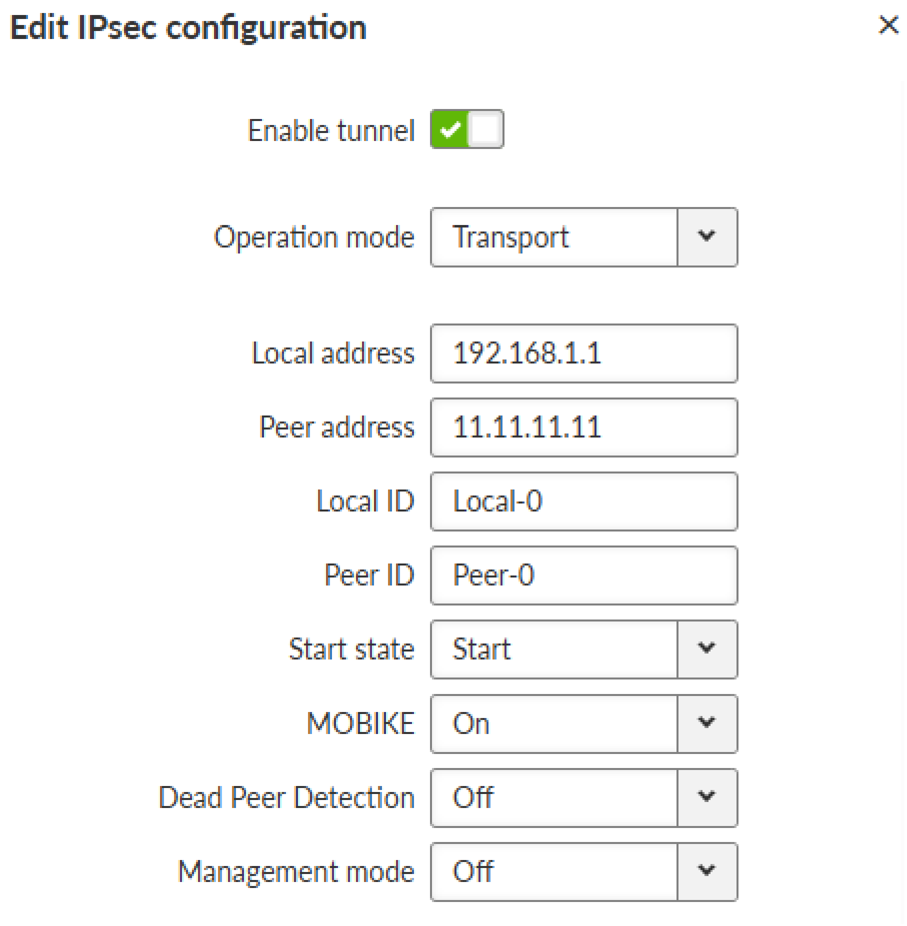
Operation mode

List box {Tunnel; Transport}, default = "Tunnel"
Selects IPsec mode

Note
The Tunnel mode is usually used for site-to-site and host-to-site connections. The Transport mode is used for host-to-host connection and very often combined with GRE and dynamic routing.

Add / Edit IPsec VPN tunnel associations

Every item in the table represents one IKE SA. There can be a maximum of 24 active IKE SA (limited by system resources).



Edit IPsec configuration

Enable tunnel ☑

Operation mode: Transport

Local address: 192.168.1.1

Peer address: 11.11.11.11

Local ID: Local-0

Peer ID: Peer-0

Start state: Start

MOBIKE: On

Dead Peer Detection: Off

Management mode: Off

Local address

IP address, default = "0.0.0.0"

IP address used as the source address for IKE negotiation. If specified, must be a valid local address.

When left at 0.0.0.0 the Local address becomes dynamic.

Peer address

IP address, default = "0.0.0.0"

IP address of the peer running the IKE daemon that will be negotiated with. It must not be the same as Local address.

Local ID

IP address or FQDN (Fully Qualified Domain Name), default = "Local-0"

IP address or FQDN used as the Local side identification. It must be the same as "Peer ID" of the IKE peer.

Peer ID

IP address or FQDN (Fully Qualified Domain Name), default = "Peer-0"

IP address or FQDN used as the IKE peer identification. It must be the same as "Local ID" of the IKE peer. The "Peer ID" must be unique in the whole table.

Start state

List box {Passive; On demand; Start}, default = "Passive"
Passive - the connection is not established, it is waiting for the other side.
On Demand - The connection will start to establish when a packet tries to pass through it.
Start - the connection is established immediately.

MOBIKE

List box {On; Off}, default = "On"
Enables MOBIKE for IKEv2 supporting mobility or migration of the tunnels. Please note IKE is moved from port 500 to port 4500 when MOBIKE is enabled. The peer configuration must match. It is strongly recommended to use MOBIKE mode in case of routing the traffic over the Cellular interface.

Dead Peer Detection

List box {On; Off}, default = "Off"
Detection of lost connection with the peer. IKE test packets are sent periodically. When packets are not acknowledged after several attempts, the connection is closed (corresponding actions are initialized). In the case when Detection is not enabled, a connection loss is discovered when regular key exchange process is initiated.

DPD period [s]

Number {5 - 28800}, default = 30
Dead Peer Detection check period.
This parameter is available only if parameter **Dead Peer Detection** is set to "On".

DPD action

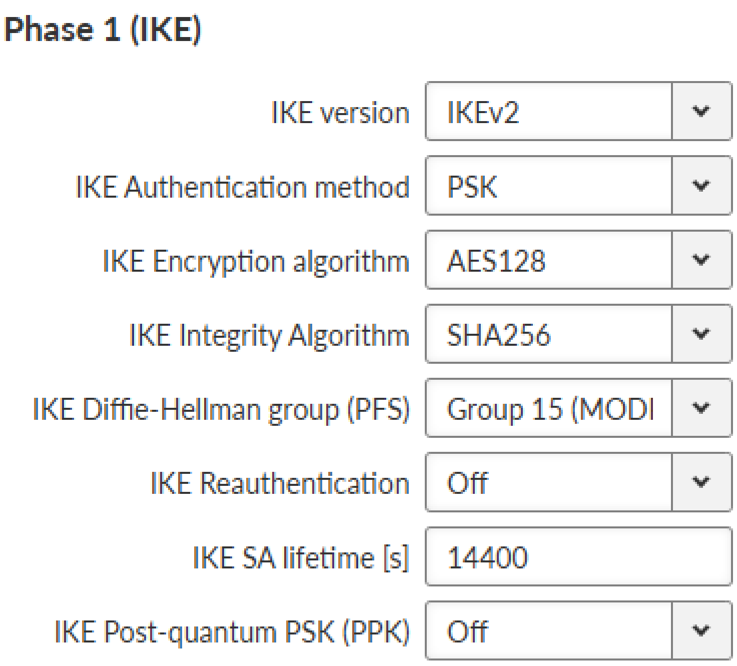
List box {Clear; Hold; Restart}, default = "Hold"
One of three connection states automatically activated when connection loss is detected:
Clear – connection is closed and waiting
Hold – connection is closed. Connection is established when first packet transmission through tunnel is attempted.
Restart – connection is established immediately
This parameter is available only if parameter **Dead Peer Detection** is set to "On".

Management mode

List box {Off; Master; Slave}, default = "Off"
Selects how to manage the IPsec association.
Master - Managed by the Link Manager. Defines the Traffic selector of the tunnel.
Slave - Managed by the Link Manager. Takes over Traffic selectors from the Master Association.
This parameter is available only if parameter **Link management** is set to "On".

Phase 1 IKE

Parameters related to IKE SA (IKE Security Association) provide SA keys exchange with the peer.



Phase 1 (IKE)

IKE version	IKEv2
IKE Authentication method	PSK
IKE Encryption algorithm	AES128
IKE Integrity Algorithm	SHA256
IKE Diffie-Hellman group (PFS)	Group 15 (MODI
IKE Reauthentication	Off
IKE SA lifetime [s]	14400
IKE Post-quantum PSK (PPK)	Off

IKE version

List box {IKEv2, IKEv1}, default = "IKEv2"
IKE version selection.
Must match the settings on the peer.

IKE Authentication method

List box {PSK}, default = "PSK"
Peer authentication method. Peer configuration must match.
The "main mode" negotiation is the only option supported. The "aggressive mode" is not supported; it is recognized as unsafe when combined with PSK type of authentication.

IKE Encryption algorithm

List box {3DES (legacy); AES128; AES192; AES256; AES128CCM (AEAD); AES192CCM (AEAD); AES256CCM (AEAD); AES128GCM (AEAD); AES192GCM (AEAD); AES256GCM (AEAD); ChaCha20Poly1305 (AEAD)}, default = "AES128"
IKE SA encryption algorithm. The "legacy" marked methods are recognized as unsafe. Peer configuration must match.

IKE Integrity Algorithm

List box {MD5 (legacy); SHA1 (legacy); SHA256; SHA384; SHA512}, default = "SHA256"
IKE SA integrity algorithm. The "legacy" marked methods are recognized as unsafe. Peer configuration must match.

IKE Diffie-Hellman group (PFS)

List box {None (legacy); Group 2 (MODP1024, legacy); Group 5 (MODP1536, legacy); Group 14 (MODP2048); Group 15 (MODP3072); Group 25 (ECP192); Group 26 (ECP224); Group 19 (ECP256); Group 20 (ECP384); Group 21 (ECP521); Group 27 (ECP224BP); Group 28 (ECP256BP); Group 29 (ECP384BP); Group 30 (ECP512BP); Group 31 (X25519); Group 32 (X448)}, default = "Group 15 (MODP3072)"
The PFS (Perfect Forward Secrecy) feature is performed using the Diffie-Hellman group method.
PFS increases IKE SA key exchange security. The "legacy" marked methods are recognized as unsafe. Peer configuration must match.

The higher the Diffie-Hellman group, the higher the security but also the higher the network and CPU load.

IKE Reauthentication

List box {On; Off}, default = "Off"
This parameter is valid if IKEv2 is used. It determines the next action after IKE SA has expired. When enabled: the new IKE SA is negotiated including new peer authentication. When disabled: only the new keys are exchanged.

IKE SA lifetime [s]

Number {180 – 86400}, default = 14400 s (4 hours)
Time of SA validity. The new key exchange or re-authentication is triggered immediately the key expires. The true time of expiration is randomly selected within the range of 90-110%. Unfortunately, the more frequent the key exchange, the higher the network and CPU load.

Note
If low capacity channel is used, the M!DGE3's channel load can affected during the key exchange process.

IKE Post-quantum PSK (PPK)

List box {On; Off}, default = "Off"
Enables additional protection using PPK when using IKEv2.

IKE PPK ID

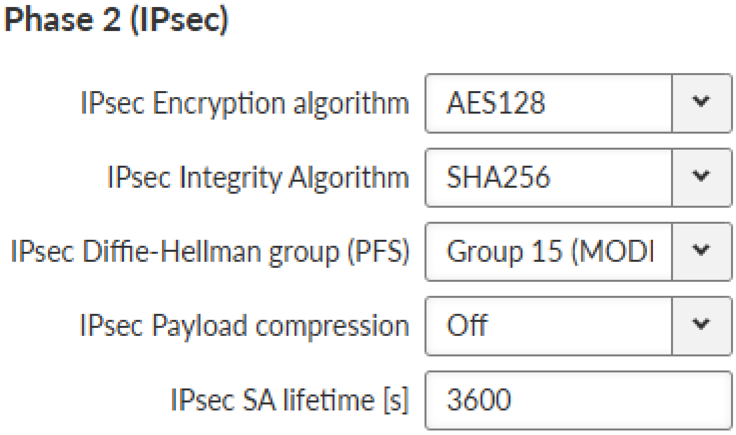
String {0–64 char}, default = <empty>
PPK key identifier, which can be an FQDN. It must not be empty or the same as the identifier in another IKE SA. It is used to identify and select the PPK key between peers, and they must have the same identifier.

IKE PPK KEY ID

List box {None; Radio Encryption Key}, default = "None"
Key identifier in the keyring. The key must exist and be populated with the type 'psk' and a length of at least 32B (256 bits).

Phase 2 – IPsec

Certain parameters are shared by all subordinate CHILD SA. IPsec Security Association provides packet encryption (user traffic encryption).



Phase 2 (IPsec)

IPsec Encryption algorithm	AES128
IPsec Integrity Algorithm	SHA256
IPsec Diffie-Hellman group (PFS)	Group 15 (MODI
IPsec Payload compression	Off
IPsec SA lifetime [s]	3600

Encryption algorithm

List box {3DES (legacy); AES128; AES192; AES256}, default = "AES128"

IKE CHILD SA encryption algorithm. The "legacy" marked methods are recognized as unsafe. Peer configuration must match.

IPsec Integrity algorithm

List box {MD5 (legacy); SHA1 (legacy); SHA256; SHA384; SHA512}, default = "SHA256"
IKE CHILD SA integrity algorithm. The "legacy" marked methods are recognized as unsafe. Peer configuration must match.

IPsec Diffie-Hellman group (PFS)

List box {None (legacy); Group 2 (MODP1024, legacy); Group 5 (MODP1536, legacy); Group 14 (MODP2048); Group 15 (MODP3072); Group 25 (ECP192); Group 26 (ECP224), Group 19 (ECP256); Group 20 (ECP384); Group 21 (ECP521); Group 27 (ECP224BP); Group 28 (ECP256BP); Group 29 (ECP384BP); Group 30 (ECP512BP); Group 31 (X25519); Group 32 (X448)}, default = "Group 15 (MODP3072)"
The PFS (Perfect Forward Secrecy) feature is performed using the Diffie-Hellman group method.
PFS increases IKE CHILD SA key exchange security. The "legacy" marked methods are recognized as unsafe. Peer configuration must match.
The higher the Diffie-Hellman group, the higher the security but also the higher the network and CPU load.

Payload compression

List box {On; Off}, default = "Off"
This parameter enables payload compression. This takes place before encryption. Peer configuration must match.

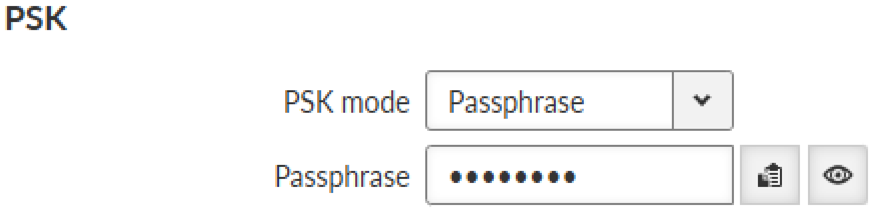
IPsec SA lifetime [s]

Number {180 – 86400}, default = 3600
Time of CHILD SA validity. The new key exchange or re-authentication is triggered immediately the key expires. The true time of expiration is randomly selected within the range of 90-110%. The SA lifetime for CHILD SA is normally much shorter than SA lifetime for IKE SA because the CHILD SA normally transfers much more data than IKE SA (key exchange only). Changing the keys serves as protection against breaking the cypher by analyzing big amounts of data encrypted by the same cypher.

Note
If low capacity channel is used, the M!DGE3’s channel load can affected during the key exchange process.

PSK

PSK (Pre-shared key) authentication is used for IKE SA authentication. The relevant peer is identified using it's "Peer ID". The key must be the same for both local and peer side of the IPsec.



PSK

PSK mode: Passphrase

Passphrase: ••••••••

Mode

List box {Passphrase; Key ID}, default = "Passphrase"

Passphrase

The PSK key is entered as a passphrase. An empty passphrase is not allowed (max. length is 128 characters). Passphrase for the FW version 2.1.1.0 must not contain any unsupported characters. Unsupported characters are: ", `, \, $, ;. The full UTF-8 character set is available since FW 2.1.2.0.

Note

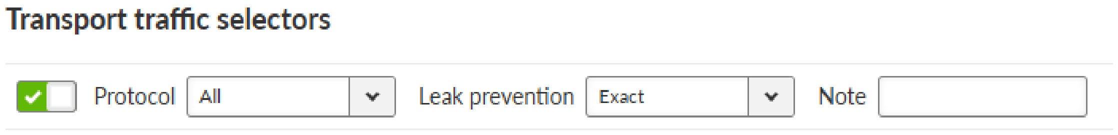
If the passphrase starts with the characters 0x or 0s, then the connection between M!DGE3 with FW 2.1.2.0 (and newer) and M!DGE3 with FW 2.1.1.0 (and older) will not be established. Likewise, any other device that writes the passphrase into its configuration as a plain string (not 'hexa' or 'base64' encoded).

Key

It is possible to set 256 bits long Key instead of Passphrase. This parameter occurs only, if parameter **Mode** is set to "Key".

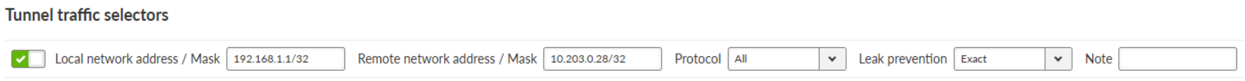
7.4.1.2.1. Transport/Tunnel Traffic selectors

Defines which traffic is forwarded to the IPsec tunnel. The rule that defines this selection matches an incoming packet to "Local network ..." and "Remote network ..." address ranges.



Transport traffic selectors

☑ Protocol All Leak prevention Exact Note



Tunnel traffic selectors

☑ Local network address / Mask 192.168.1.1/32 Remote network address / Mask 10.203.0.28/32 Protocol All Leak prevention Exact Note

Local network address / Mask

IP address/Mask, default = "0.0.0.0/32"
Source IP address and mask of the packets to be captured and forwarded to the encrypted tunnel.

Remote network address / Mask

IP address/Mask, default = "0.0.0.0/32"
Destination IP address and mask of the packets to be captured and forwarded to the encrypted tunnel.

Protocol

List box {All; ICMP; UDP; TCP; GRE; ESP; Other}, default = "All"
Defines the transport protocol of packets which will be caught and encrypted.

Protocol number

Number {1 – 255}, default = 1
Defines the number of the transport protocol of packets which will be caught and encrypted. This parameter is available only if parameter **Protocol** is set to "Other".

Leak prevention

List box {Off; Exact; Paranoid}, default = "Exact"
The level of automatic protection against leaking or receiving unencrypted traffic.
Off - No automatic protection rules. The user must write his own in the L3 firewall.
Exact - Automatic rules exactly copy the CHILD SA settings.
Paranoid - For input/forward rules it's the same as Exact. For output, the automatic rules are stricter because they do not filter by the source address of the packet.

7.4.1.3. Cooperation with other services

7.4.1.3.1. Automatically generated routing rules

For Tunnel mode, a special IPsec routing table is created to correctly fill in the source IP address of packets sent from the unit over IPsec.

For each traffic selector (CHILD SA), the service tries to find a local IP address that matches the address and mask of the local part of the selector. If such an address exists, an auxiliary routing rule is created in the IPsec table that has the address and mask of the remote part of the selector as the destination and the found local address as the local preferred source address. With this rule, the locally generated packets will have addresses that match the CHILD SA selector and will be encrypted.

At the same time, the existence of a routing rule for the packet is ensured. If the routing rule did not exist, the packet would be dropped before being captured and encrypted by IPSec.

Note

If the selector is limited to a specific protocol, however, a routing rule will not be created because it would cover all protocols, including traffic that the selector does not capture.

User routing is required for Transport mode; without it, the IKE SA association could not be established. This mode does not use the special IPsec routing table.

7.4.1.3.2. Manually created firewall rules

A user-defined firewall filters packets before or after encryption in IPsec. If automatic protection against leakage of unencrypted traffic is disabled, custom protection rules (**Policy filter**) can be applied.

Handwritten protection rules must prevent

Sending traffic to be encrypted as unencrypted (data leakage).
Receiving unencrypted traffic that should have been encrypted (data insertion).

Tunnel mode

INPUT - For each traffic selector (CHILD SA) a rule discarding traffic with **Policy** “None” and with swapped address ranges.
OUTPUT - For each traffic selector (CHILD SA) a rule discarding traffic with **Policy** “None” and with the same address ranges.
FORWARD - For each traffic selector (CHILD SA) 2 rules:
Discarding traffic with **Policy** “None” and **Direction** “Out (Encapsulation)” and with the same address ranges.
Discarding traffic with **Policy** “None” and **Direction** “In (Decapsulation)” and with swapped address ranges.

Transport mode

INPUT - For each traffic selector (CHILD SA), a rule to discard traffic with a **Policy** set to “None” and with a source address of the IPsec peer address and a destination address of the IPsec local address.
OUTPUT - For each traffic selector (CHILD SA), a rule to discard traffic with a **Policy** set to “None” and with a source address of the IPsec local address and a destination address of the IPsec peer address.

7.4.1.3.3. Interaction with DNAT

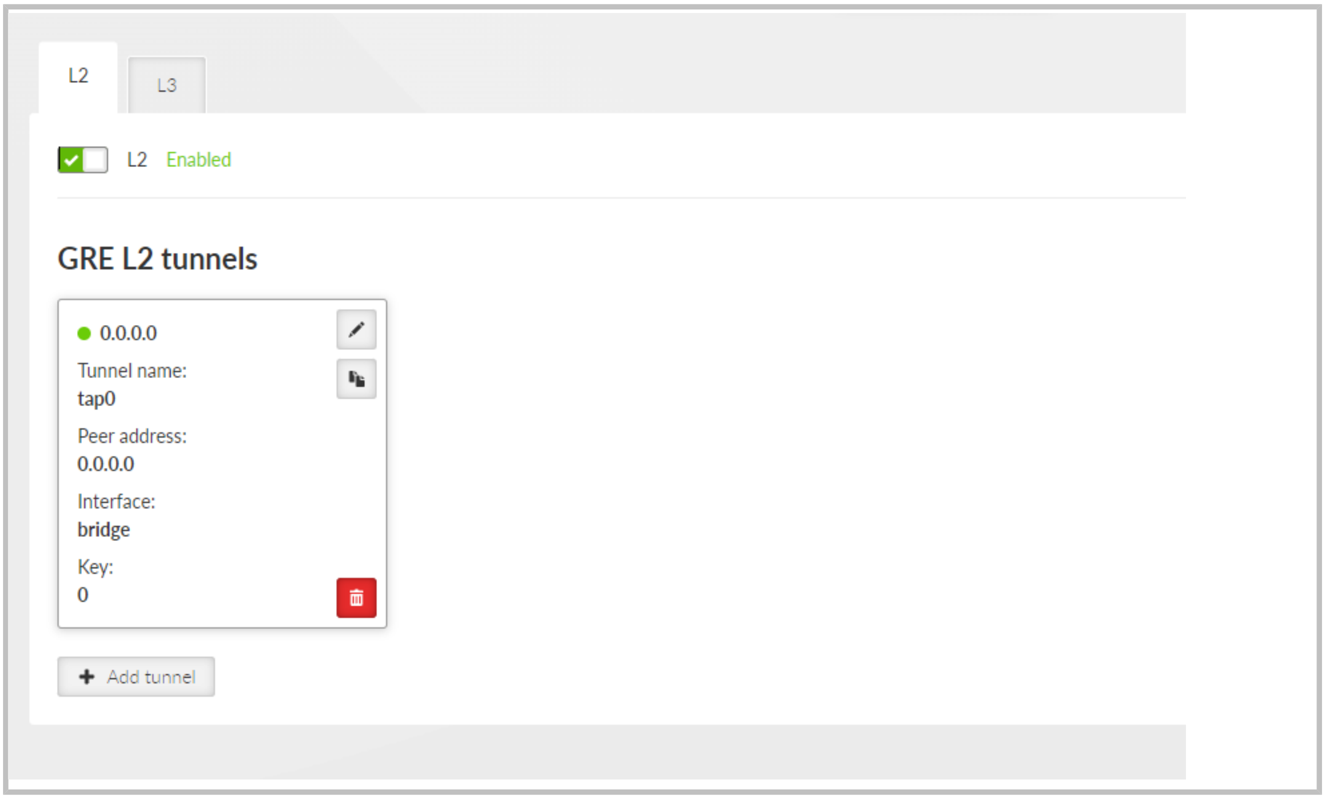
If IPsec captures packets which were modified by DNAT, routing rules automatically created by IPsec rules will not apply to them, because DNAT rewrites their destination address. Therefore a new static routing rule must be created (SETTINGS > Routing > Static) for those packets.

7.4.2. GRE

7.4.2.1. GRE L2

GRE L2 tunnel is interconnected to the bridge (LAN interface) as one of the bridge’s port, it captures Ethernet frames of the bridge and sends them to the other end of the tunnel. It enables to build bridge via the complex network and combine the local partial networks to one network.

GRE L2 tunnel can be used to tunnel the Q-in-Q and IPv6 traffic over the RipEX IPv4 network.



GRE L2 tunnels

● 0.0.0.0

Tunnel name:
tap0

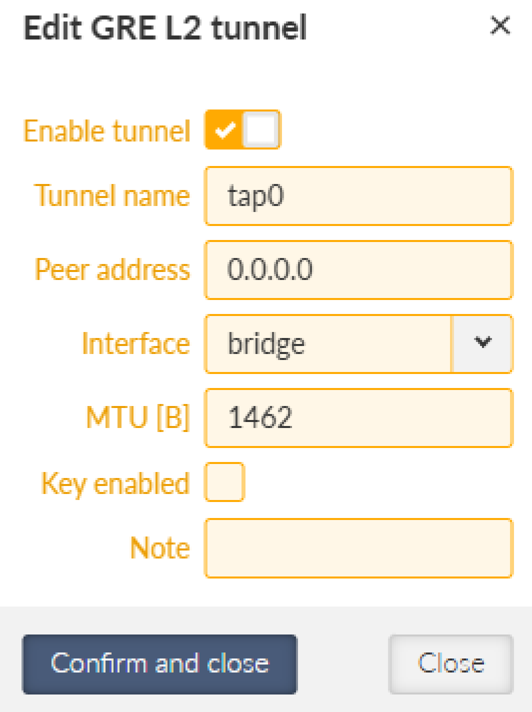
Peer address:
0.0.0.0

Interface:
bridge

Key:
0

Fig. 7.23: SETTINGS > VPN > GRE

GRE L2 Enable
Switches all L2 tunnels On or Off.



Edit GRE L2 tunnel

Enable tunnel	☑
Tunnel name	tap0
Peer address	0.0.0.0
Interface	bridge
MTU [B]	1462
Key enabled	□
Note	

Individual L2 tunnels:

Enable

Enables particular L2 tunnel. Maximum number of configurable tunnels is 256.

Tunnel name

The base of the tunnel interface name, prefixed with "gre_".

Peer address

IP address of the equipment with the second end of the tunnel. This address is the expected source address of incoming GRE packets from the peer.

Interface

Has to be set as one of existing bridge's name in SETTING/Interfaces/Ethernet/ Network interface Name.

MTU [B]

MTU of the L2 tunnel. Number {74 – 1500}, default = 1430 B
Overhead of the L2 tunnel is 38 B, so it should be GRE MTU = Path MTU - 38.
Minimum MTU value to establish TCP between M!DGE3 units = 576 B.

Note
For traffic in bridged network (e.g. when using Transparent protocol), it is necessary to set the MTU to a proper value, otherwise there is a risk of packet fragmentation and thus compromising efficiency and reliability of the transfer.

Key enabled

Enables using key identification of the tunnel from/to the same peer.

Key

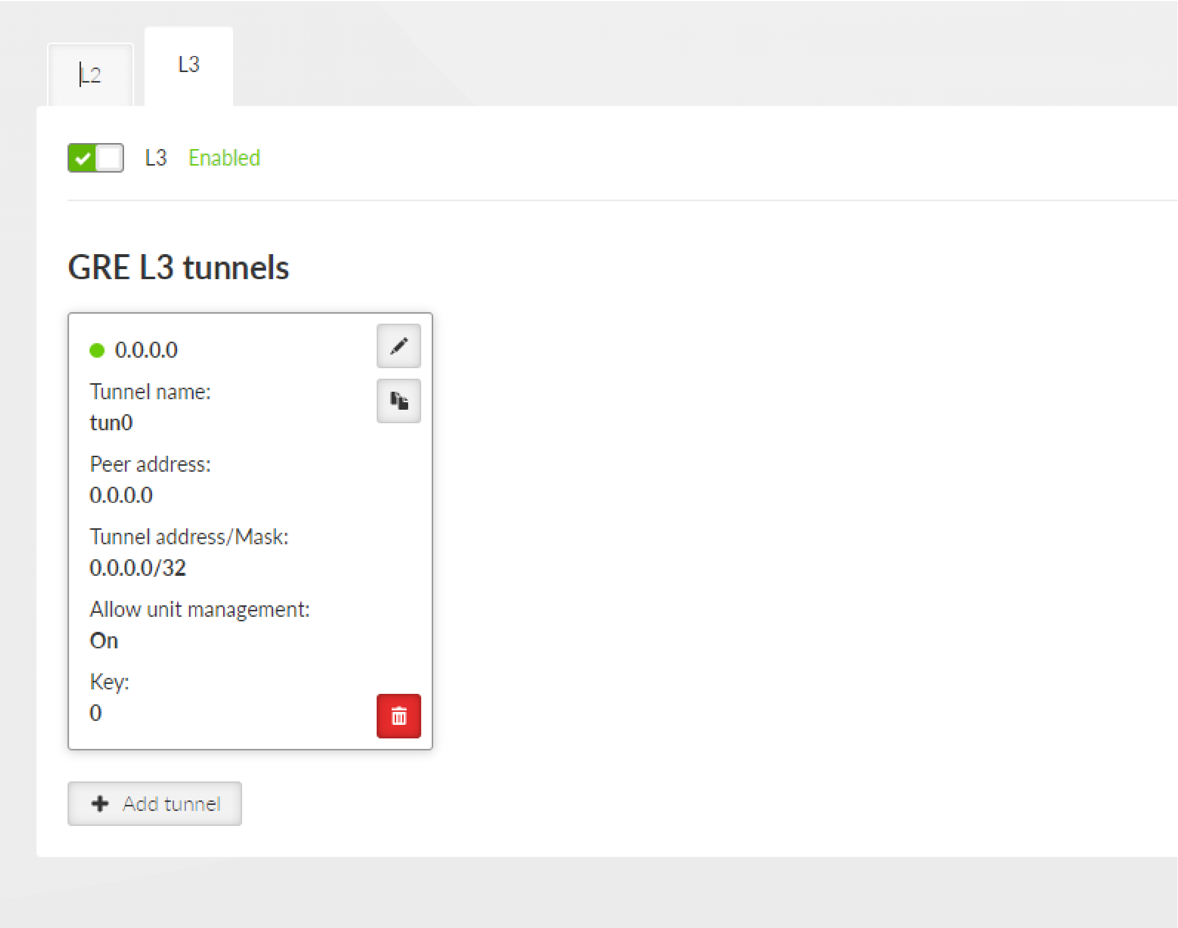
Identification number of the tunnel Number {0 – 4,294,967,295}, default = 0

Note

Optional comment.

7.4.2.2. GRE L3

GRE L3 tunnel works as an additional unit’s interface with its own IP address (and mask). The routing rules are used for sending packets to this interface. It bridges part of the network, so it seems to be one hop for the user traffic.



☑ L3 Enabled

GRE L3 tunnels

● 0.0.0.0

Tunnel name:
tun0

Peer address:
0.0.0.0

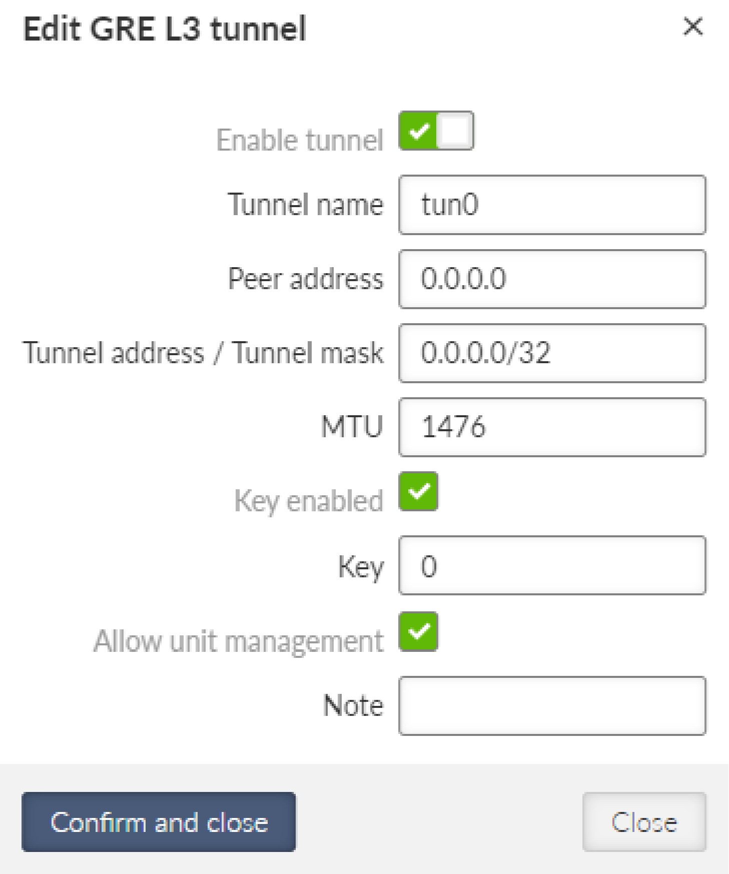
Tunnel address/Mask:
0.0.0.0/32

Allow unit management:
On

Key:
0

GRE L3 Enable

Switches all L3 tunnels On or Off.



Edit GRE L3 tunnel

Enable tunnel	☑
Tunnel name	tun0
Peer address	0.0.0.0
Tunnel address / Tunnel mask	0.0.0.0/32
MTU	1476
Key enabled	☑
Key	0
Allow unit management	☑
Note	

Individual L3 tunnels:

Enable
Enables particular L3 tunnel. Maximum number of configurable tunnels is 256.

Tunnel name
The base of the tunnel interface name, prefixed with "gre_".

Peer address
IP address of the equipment with the second end of the tunnel. This address is the expected source address of incoming GRE packets from the peer.

Tunnel address / Mask
IP address and mask of the GRE tunnel interface

MTU
MTU of the L2 tunnel. Number {70 – 1476}, default = 1476
Overhead of the L3 tunnel is 24 B, so it should be GRE MTU = Path MTU - 24. If the MTU is bigger than is allowed along the route, the GRE packets will be discarded and ICMP report will be send back to the source of the original packet (Path MTU discovery).
Minimum MTU value to establish TCP between M!DGE3 units = 576 B.

Key enabled
Enables using key identification of the tunnel from/to the same peer.

Key
Identification number of the tunnel Number {0 – 4,294,967,295}, default = 0

Allow unit management
Allows / disables unit management via GRE tunnel.

Note
Optional comment.

7.4.3. OpenVPN

OpenVPN is a virtual private network (VPN) system that allows to create secure encrypted point-to-multipoint connections in routed (TUN) or bridged (TAP) modes. Up to four instances (clients and/or servers) can be used simultaneously in one unit. Each server is capable of establishing connections with several tens of clients.

OpenVPN allows peers to authenticate to each other using pre-shared secret keys and certificates. An OpenVPN server is capable to release an authentication certificate for every client, using signatures and certificate authority (certificates can be generated / uploaded in the SETTINGS>Security>Credentials menu).

A time synchronisation of individual units is required for proper OpenVPN function.

Link for *OpenVPN application note*[4].

Warning

Attention is required to prevent routing loops, where traffic from the link between OpenVPN endpoints is directed back into the OpenVPN tunnel. Unlike IPsec, there is no protective mechanism against packet wrapping.

7.5. Security

User authentication is required to access RipEX unit management. There are two types of user authentication which differ in the user account location:

Local authentication – user accounts are stored directly in the RipEX unit

Remote authentication – user accounts are stored on a remote authentication server (RADIUS is implemented)

There are four different levels of user access privileges – they are bound with four different user access roles:

Guest (role_guest)
Read only access for configuration parameters (except secured part of configuration). Diagnostics tools are available.

Technician (role_tech)
All privileges of Guest role plus: write access for non-secured part of configuration; unit firmware up/down-grade.

Security technician (role_sectech)
All privileges of Technician role plus: write access for secured part of configuration (except unit authentication related parts).

[4] https://www.racom.eu/eng/products/m/ripex/app/openvpn/index.html

Administrator (role_admin)

No access level restrictions. All privileges of Security technician role plus: user accounts management; remote authentication configuration.

Limitations:

Tab. 7.2: Overview of roles and rights in each section

Section	Features		Roles / Rights			
			Guest	Tech	Sec tech	Admin
SETTINGS	Interfaces	Ethernet, COM, Terminal servers, Cellular	Read-only	Write	Write	Write
	Routing	Static	Read-only	Write	Write	Write
		Babel, OSPF, BGP, Link management	Non-visible	Non-visible	Write	Write
	Firewall	L2, L3, NAT	Read-only	Write	Write	Write
	VPN	IPsec	Non-visible	Non-visible	Write	Write
		OpenVPN	Non-visible	Non-visible	Write	Write
		GRE	Read-only	Write	Write	Write
	Quality of service		Read-only	Write	Write	Write
	Security	Policy	Non-visible	Non-visible	Non-visible	Write
		Local authentication	Non-visible	Non-visible	Non-visible	Write
		Credentials	Non-visible	Non-visible	Non-visible	Write
		Management access	Non-visible	Non-visible	Non-visible	Write
		RADIUS	Non-visible	Non-visible	Non-visible	Write
		Tamper reset	Non-visible	Non-visible	Non-visible	Write
	Device	Unit	Read-only	Write	Write	Write
		Configuration	Read-only	Write	Write	Write
		Events	Read-only	Write	Write	Write
		Software keys	Read-only	Write	Write	Write
		Firmware	Non-visible	Write	Write	Write
	Services	Firmware distribution	Non-visible	Write	Write	Write
		SNMP	Non-visible	Non-visible	Write	Write
		SMS	Non-visible	Non-visible	Write	Write
		Hot standby	Read-only	Write	Write	Write
DIAGNOSTICS	Monitoring		Non-visible	Write	Write	Write
	Tools		Read-only	Write	Write	Write

At least one Administrator type of account must be defined in the unit.

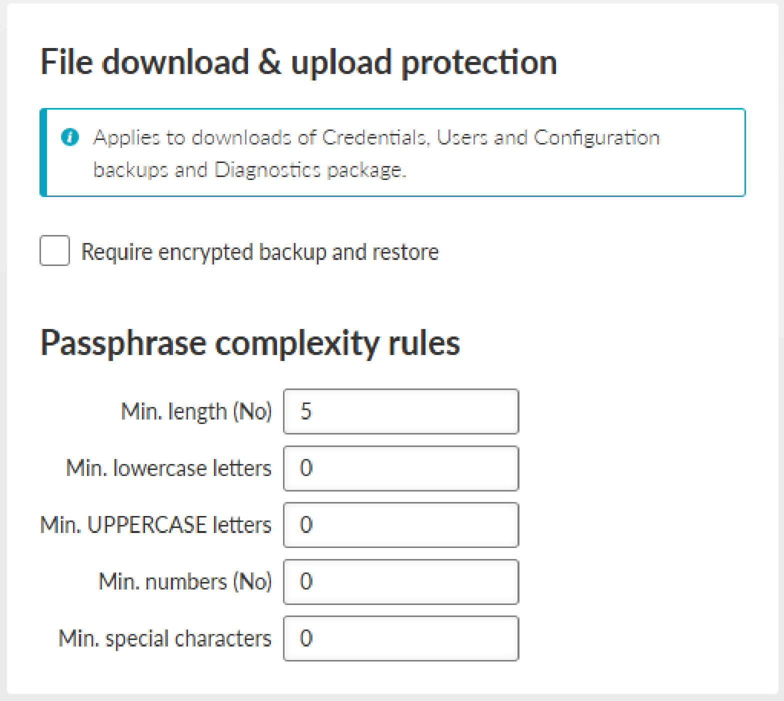
Maximal number of concurrently active sessions is 64. One user can have multiple sessions opened in the same time. If this limit is reached and a new session is to be opened, the oldest active session is deactivated and a new one is opened.

Maximal number of Local user accounts (all roles together) is 100.

Note

The **Remote access** uses local identity and role of the user – there is no additional login to the remote unit (the login into local unit serves as login to the whole network).

7.5.1. Policy



File download & upload protection

Applies to downloads of Credentials, Users and Configuration backups and Diagnostics package.

□ Require encrypted backup and restore

Passphrase complexity rules

Min. length (No)	5
Min. lowercase letters	0
Min. UPPERCASE letters	0
Min. numbers (No)	0
Min. special characters	0

Fig. 7.24: SETTINGS > Security > Policy

Passphrase - Minimal length
Number {5 – 64}, default = 5
The minimum length of the passphrase.

Passphrase - Minimal number of lower case characters
Number {0 – 5}, default = 0
The minimum number of lowercase letters (English letters) which are required in the passphrase.

Passphrase - Minimal number of uppercase characters
Number {0 – 5}, default = 0
The minimum number of uppercase letters (English letters) which are required in the passphrase.

Passphrase - Minimal number of digits
Number {0 – 5}, default = 0
The minimum number of number characters (0 to 9) which are required in the passphrase.

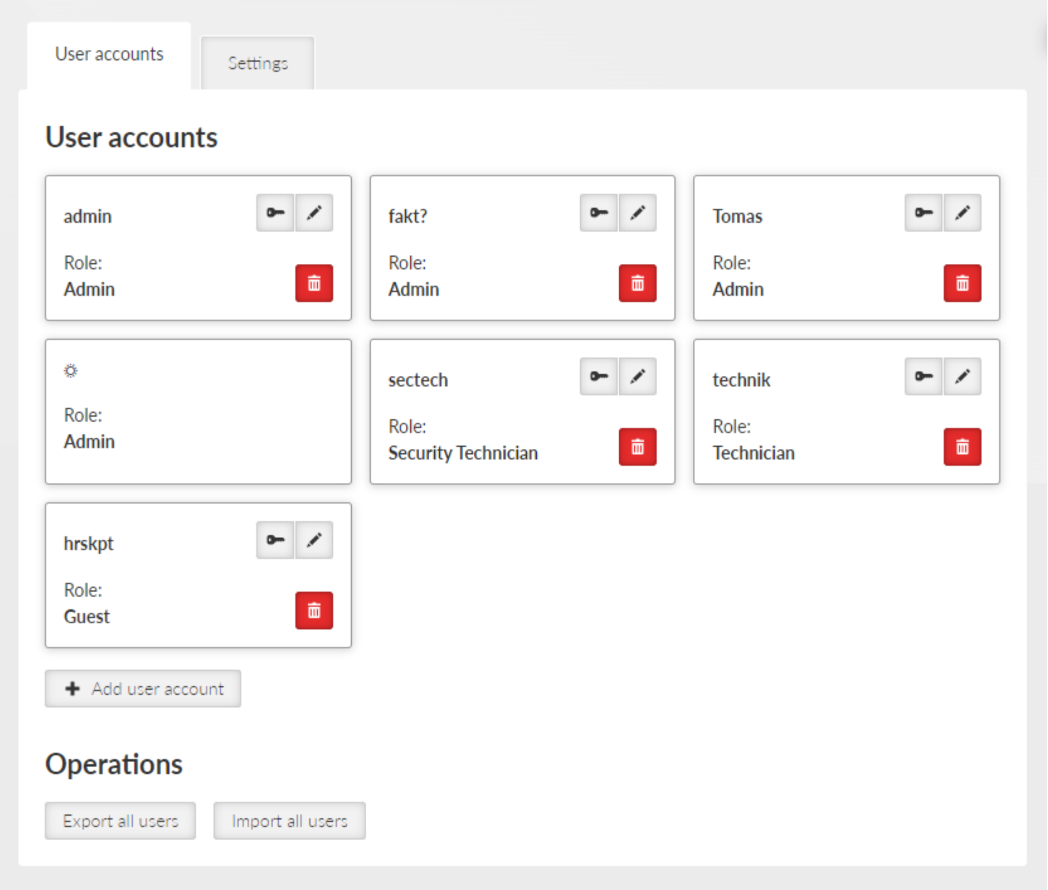
Passphrase - Minimal number of special characters
Number {0 – 5}, default = 0
The minimum number of special characters (not English upper or lower cases or numbers) which are required in the passphrase. Non-English letters (like Greek, Russian, Arabic) are counted as special characters.

This setting applies to the download of Credentials, Users, Configuration backups, and Diagnostics packages. The **Require encrypted backup and restore** parameter enforces the use of encrypted files for all users. The following parameters allow you to define passphrase complexity rules for encryption.

7.5.2. Local authentication

7.5.2.1. User Accounts

The following settings are available only for user with the Administrator role.



User accounts | Settings

User accounts

admin
Role:
Admin

fakt?
Role:
Admin

Tomas
Role:
Admin

☼
Role:
Admin

sectech
Role:
Security Technician

technik
Role:
Technician

hrskpt
Role:
Guest

+ Add user account

Operations

Export all users | Import all users

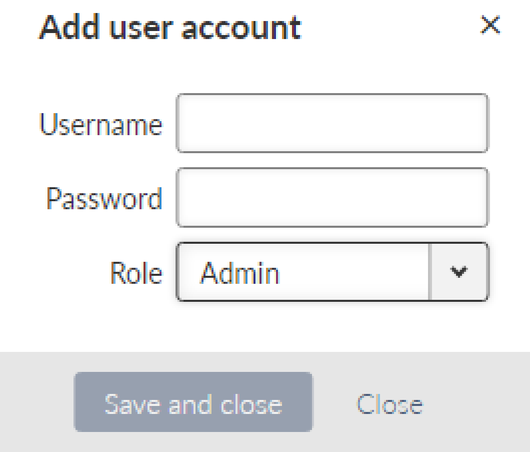
Fig. 7.25: SETTINGS > Security > Local authentication

Following user account parameters can be changed: password, user role. Any account (expect the last one of Administrator role) can be deleted.

Export all users button provides backup of all Local user accounts into a file.

Import all user button provides restoration of all Local user accounts from a backup file. Active session is logged out automatically after this command.

+ Add user account button invokes new user account creation dialog:



Add user account ×

Username

Password

Role Admin

Username

String {1–128 char}, default = <empty>
New Username. Every username in the unit must be unique.

Password

String {5–128 char}, default = <empty>
Password is stored in a secure way.

Role

List box {Admin; Security Technician; Technician; Guest}, default = "Admin"

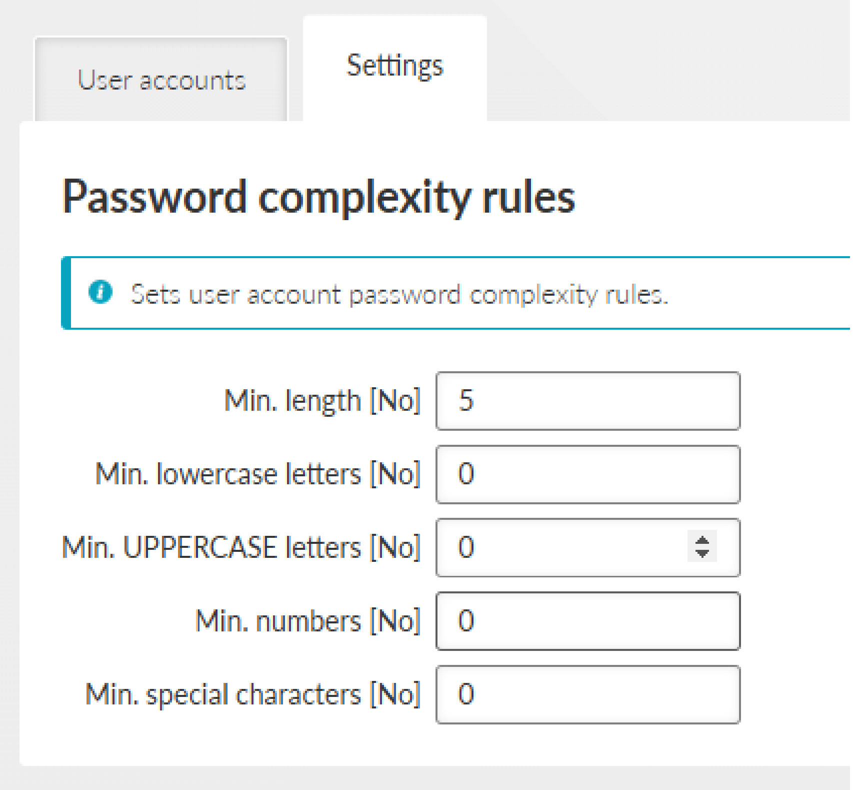
> **Note**
> It is highly recommended to create a new administrator type of account and delete the default “Admin” account.

Advanced feature

When the user account is not active for some time, the user will be automatically logged-out. The inactivity timeout of the account is set for 1 day by default. It is possible to change in the range of 5 minutes up-to 2 days (menu ADVANCED > Generic > UserAccess > **Web inactivity timeout**).

7.5.2.2. Settings

Allows to set password complexity rules.



Password complexity rules

Sets user account password complexity rules.

Min. length [No] 5

Min. lowercase letters [No] 0

Min. UPPERCASE letters [No] 0

Min. numbers [No] 0

Min. special characters [No] 0

Fig. 7.26: SETTINGS > Security > Local authentication > Settings

Min. length [No]
Number {8 – 64}, default = 8
The minimum length of the password for all users.

Min. lowercase letters [No]
Number {0 – 5}, default = 1
The minimum number of lowercase letters (English letters) which are required in the user password.

Min. UPPERCASE letters [No]
Number {0 – 5}, default = 1
The minimum number of uppercase letters (English letters) which are required in the user password.

Min. numbers [No]
Number {0 – 5}, default = 1
The minimum number of number characters (0 to 9) which are required in the user password.

Min. special characters [No]
Number {0 – 5}, default = 1
The minimum number of special characters (not English upper or lower cases or numbers) which are required in the user password. Non-English letters (like Greek, Russian, Arabic) are counted as special characters.

Note
The settings are applicable for new passwords only, already existing passwords will not be affected.

7.5.3. Credentials

M!DGE3 units feature a unified storage solution for keys, certificates and other credentials. This storage is secured and only accessible to users with Sectech permission and higher.

Credentials are separate from configuration to improve security and it also is protected using checksum to prevent unauthorised modification. Because of this all Repository/Key changes are executed immediately and do not go through the “Changes” workflow like the regular configuration.

Note: In this manual and in the user interface we are calling all Credential storage entries “Keys”. While this is a simplification, we believe it is understandable. Further on “Keys” are all keys, public and private certificates, DH parameters, CA chains etc.

Warning: Downgrading the Unit will always reset all Credentials to defaults.

7.5.3.1. General

Credentials are stored in Repositories. Repository is a reserved space, which contains 0-1 Key and is addressable via its ID in the rest of the unit configuration. This construct, while it may seem complicated at first, brings major benefits. Mainly the user can simply update expired certificates in a repository without any need to change configuration using that Repository.

There are two types of Keys: Read-only, easily identifiable by a lock icon and “_RO_” prefix. These Keys are built into firmware, or generated automatically on device. The rest are user-defined keys.

Admin website allows users to perform various operations with the keys and repositories.

Using buttons on the bottom of the page we also allow users to download complete credential backup.

There are two ways to restore credentials: Replace, which replaces all Keys with ones from the file, and Update, which merges current and new Keys.

7.5.3.2. Credentials

Credentials show all Repositories and Keys currently on the device. Users can filter them by type and show only valid or all Keys. The card border and bottom label indicate whether the Repository is empty, or whether the Key is valid or invalid.

Each card represents a Repository. Card title is Repository ID. All user-defined repositories can be edited using the “Edit” button and deleted using the red “Delete” button.

ID

Unique identifier used to reference Repository in configuration.
Validated according to regular expression: [a-zA-Z0-9_]\\{1,128\\}. IDs starting with underscore “_” are reserved for Read Only keys.

Type

Defines the type of Key the Repository can contain.

Note

Optional comment.
There are several operations, that can be performed on a repository:

Info
Displays Key info including checksums.

Generate
Generates a new Key using local Certification authority (see below).

Update
Updates the Key with a new one. Both file and text, encrypted and unencrypted Keys are supported.

Download
Allows download of the Key. Both encrypted and unencrypted downloads are supported, according to Setting (see below).

Generate CSR (Certificate Signing Request)
Generates and downloads CSR from eligible Keys.

Sign CSR (Certificate Signing Request)
Signs CSR. Both file and text certificates are supported. Signed certificate is automatically downloaded. It is possible to add “extended key usage” Certificate modifier for OpenVPN client/server.

Operation “Add repository” creates an empty Repository.

Shortcut operations “Generate credential” and “Add credential” allow users to create a Repository and generate/upload a key into it. These buttons cannot be used to modify existing repositories.

7.5.3.3. Read-only keys

_RO_Ssh_Host_Key
Type: SSH Key (PRI)
The SSH host key used to authenticate the server on the client. If missing, it is generated when the station boots.

_RO_Rmt_Access_Host_Key
Type: RMTACCESS Key (PRI)
Host key for the Remote access server (QSSH). It is used to authenticate the server.
If missing, it is generated when the station starts.

_RO_Rmt_Access_Client_Key
Type: RMTACCESS Key (PRI)
Key for Remote access (QSSH) client login to the server. Must be present on both sides.
Obtained from FW. If it differs from the version in FW, it is updated.

_RO_Web_Private_Key
Type: Certificate (PRI)
Web server private key (default).
Obtained from FW. If it is different from the version in FW, it is updated.

_RO_Web_Cert
Type: Certificate Key (PUB)
Web server certificate (default).
Obtained from FW. If it is different from the version in FW, it is updated.

_RO_Web_CA_Chain
Type: CA Chain (PUB)

The certificate string of the authority that signed the Web server certificate. If self-signed, it will be empty.
Retrieved from FW. If it differs from the version in FW, it is updated.

_RO_Web_DH_Param
Type: DH Parameters (PUB)
Parameters for the Diffie-Hellman key exchange in the Web server.
Retrieved from FW. If it differs from the version in FW, it is updated.

_RO_File_Distribution_Key
Type: UFTP Key (PRI)
Key for authenticating stations in the "File distribution" (UFTP) service.
Obtained from FW. If it differs from the version in FW, it is updated.

7.5.3.4. Settings

This tab displays additional settings needed for Local CA authority and Passphrase complexity rules for Key downloads.

Local authority

Private key ID
Private key used for local certification authority.

Certificate ID
Public certificate used for local certification authority.

Signature algorithm
Algorithm used for certificate signing. It depends on the Certification Authority key algorithm and may not be used in case CA uses a specific algorithm.

Expiration period (days)
Expiration period in days. Default 7300.

7.5.3.5. Organisation

Contains organisation identification used for certificate generation.

- Country
- Country code (pre filled automatically, possible to manually set by using “Other” in “Country”)
- Organisation
- Department
- Location
- State
- Common name
- E-mail

7.5.3.6. Creating Local Certification Authority

To create local CA you need to follow these steps:

1. Generate a new private certificate “Certificate key (PRI)”

2. Generate a new “CA Chain (PUB)” using certificate created in previous step as “Certificate key”

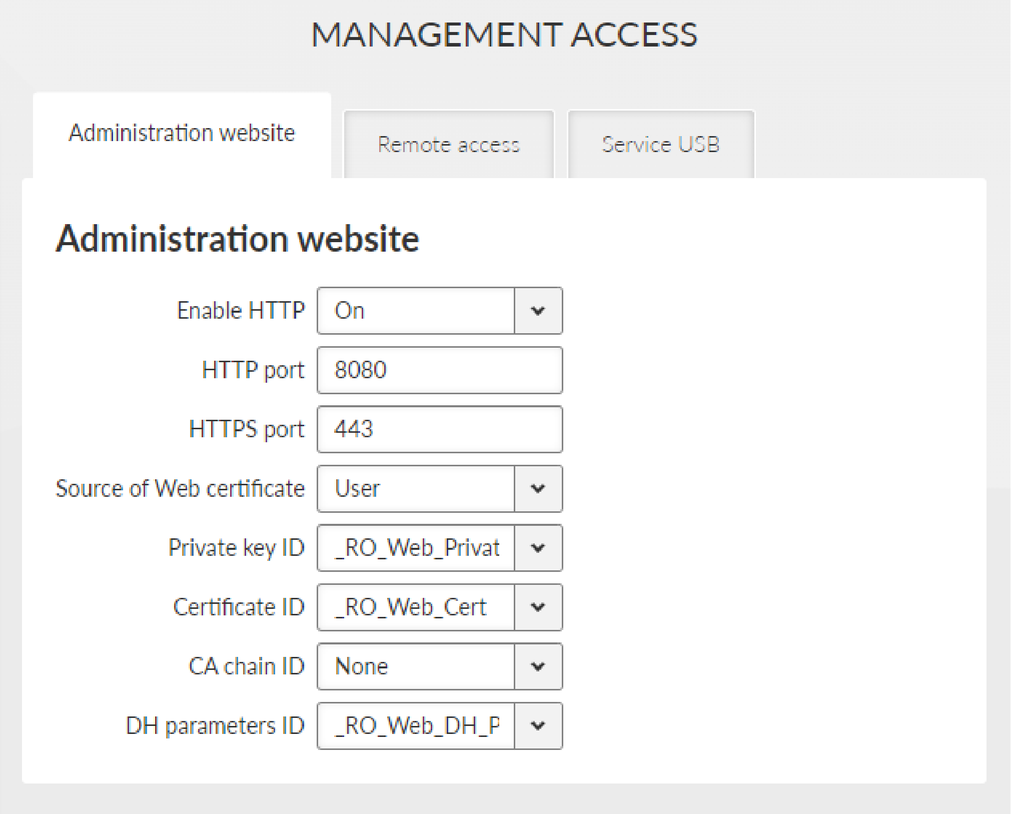
3. Activate Local CA by going to Settings tab and activating Local CA, selecting newly created “Private key ID” (= new private certificate “Certificate key (PRI)”) and “Certificate ID” (= new “CA Chain (PUB)”)

Note

Web server private key must use “RSA” or “EC (ECDSA)” algorithms. Other algorithms are not supported by web browsers.

7.5.4. Management access

7.5.4.1. Administration website



Administration website

Enable HTTP	On
HTTP port	8080
HTTPS port	443
Source of Web certificate	User
Private key ID	_RO_Web_Privat
Certificate ID	_RO_Web_Cert
CA chain ID	None
DH parameters ID	_RO_Web_DH_P

Fig. 7.27: SETTINGS > Security > Management access > Administration website

Enable HTTP   List box {On; Off}, default = "On"

Enables HTTP access to the station. When enabled, HTTP immediately redirects to HTTPS.

HTTP port   Number {1 – 65535}, default = 80

The TCP port number on which HTTP access is available.

HTTPS port	Number {1 – 65535}, default = 443 The TCP port number on which HTTPS access is available.

Source of Web certificate

List box {Default; User}, default = "Default"

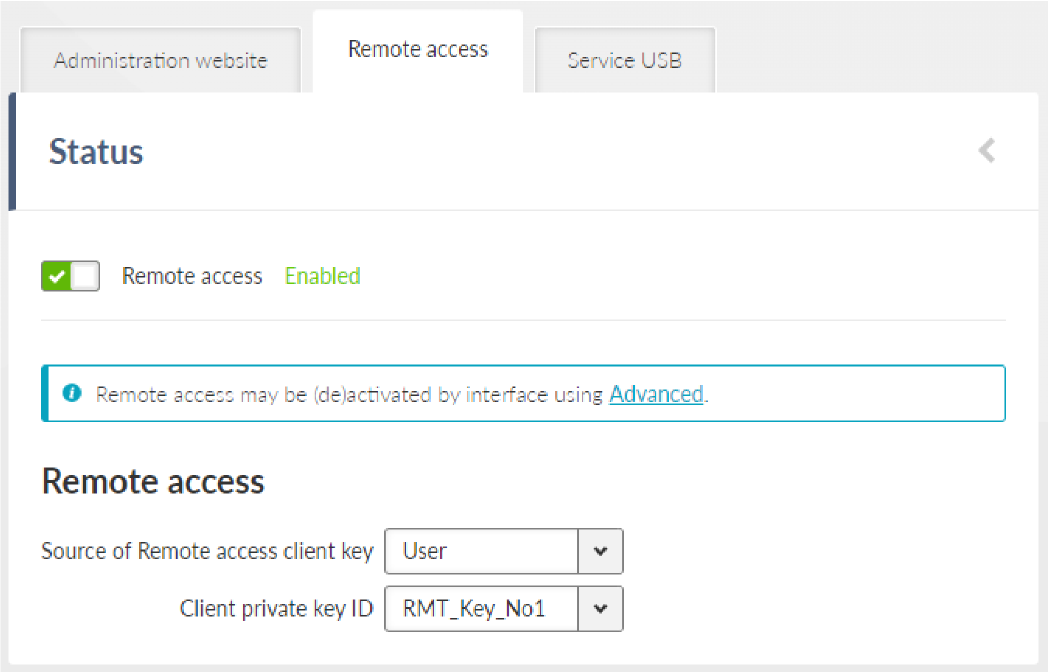
Choses source of Web server certificate. "Default" uses key, certificate and DH parameter distributed in FW (see SETTINGS > Security > Credentials), default values are as follows:

- Private key: _RO_Web_Private_Key
- Certificate : _RO_Web_Cert
- CA chain: _RO_Web_CA_Chain": CA chain, of the CA which signed the certificate. For self-signed certificate shall remain empty - None).
- DH parameters: _RO_Web_DH_Param

Web inactivity timeout [min]	Number {5 – 2880}, default = 1440 When the inactivity timeout is reached, the HTTPS session terminates. Available in ADVANCED > Security > Management access menu.

“User” allows to use user key and certificate included in the Credentials storage. Add your certificate and other files using menu SETTINGS > Security > Credentials. In the individual list boxes will be shown available certificate of keys for each category and you can choose those previously added.

7.5.4.2. Remote access



Status

☑ Remote access Enabled

Remote access may be (de)activated by interface using Advanced.

Remote access

Source of Remote access client key: User

Client private key ID: RMT_Key_No1

Fig. 7.28: SETTINGS > Security > Management access

Enable/Disable

If enabled, allows the unit to be accessed via the Remote access feature.

Note

Remote access is enabled or disabled globally in this menu. Individual settings for each interface are available in the ADVANCED menu. By default, Cellular and Ethernet interfaces are enabled, while all other interfaces are disabled. The current settings are displayed in the Status area.

Source of Remote access client key

List box {Default; User}, default = "Default"

Client private key ID

When the User in list box above is chosen, then you cab select a key previously downloaded to the Credentials storage (SETTINGS > Security > Credentials) or or generated in the same menu. The Remote access key has to be the same for the whole network (or the part of it for which you will use the Remote access). The remote access to the unit with different Remote access key is not possible.

Note

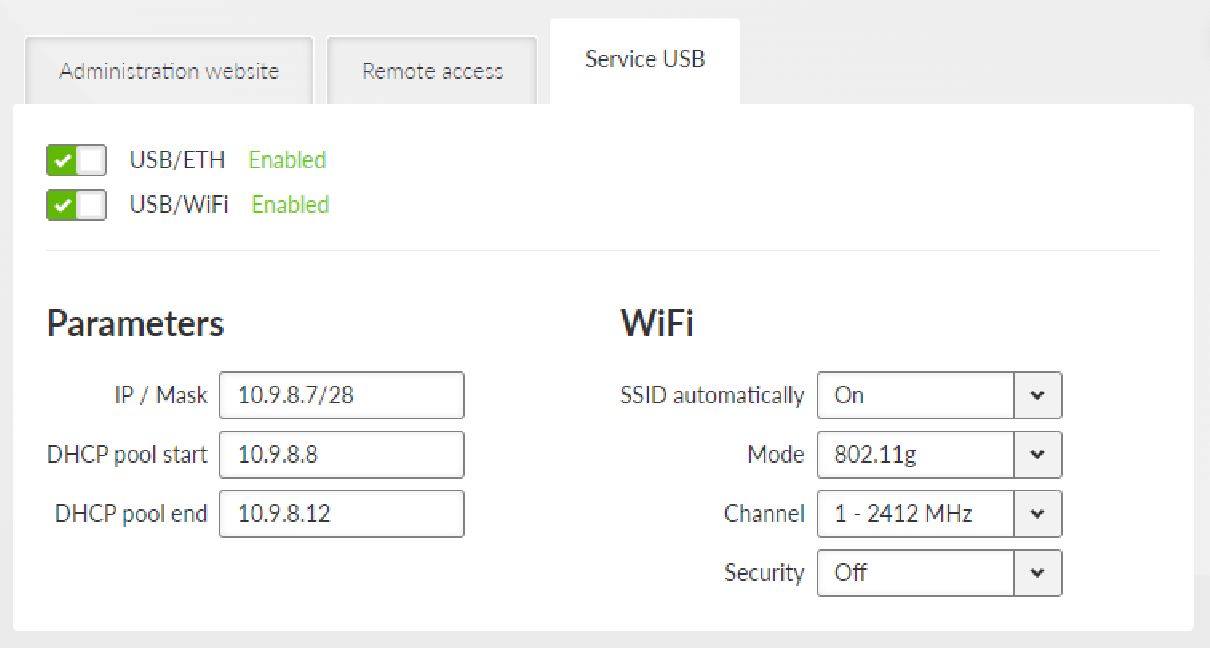
The use of a dedicated **Client private key** is highly recommended.

7.5.4.3. Service USB

The USB service interface primary purpose is to provide unit service and management access. Ethernet or Wi-Fi connection can be established using an external ETH/USB or Wi-Fi adapter.

Only adapters supplied with the product can be used for this purpose.

See *list of available adapters*[5].



☑ USB/ETH Enabled
☑ USB/WiFi Enabled

Parameters

IP / Mask: 10.9.8.7/28
DHCP pool start: 10.9.8.8
DHCP pool end: 10.9.8.12

WiFi

SSID automatically: On
Mode: 802.11g
Channel: 1 - 2412 MHz
Security: Off

Fig. 7.29: SETTINGS > Security > Management access

The DHCP server is running on this service interface to enable easier connection of the management device (PC, tablet or smart phone).

Enable / Disable

Each of the ETH or Wi-Fi service can be enabled or disabled separately. When the Wi-Fi is enabled, the unit acts as a Wi-Fi Access Point (AP).

IP address / Mask

IP address, default = 0.0.0.0/0
IP address of the DHCP server. This is the IP address to be used when accessing the unit management via this serial interface.

DHCP pool start

Default = IP address of the DHCP server + 1
DHCP Server assigns addresses to connected clients starting from this address.

DHCP pool end

DHCP server assigns IP addresses to connected clients in the range defined by **DHCP pool start** and **DHCP pool end** (inclusive).

Wi-Fi

Wi-Fi AP parameters can be customized.

SSID automatically

List box {On; Off}, default = "On"
When automatic definition of SSID is enabled, the SSID contains unit Serial number.

[5] https://www.racom.eu/eng/products/cellular-router-midge.html#usb_adapters

SSID

Wi-Fi AP SSID. When entered manually, it must follow SSID naming conventions.

Mode

List box {802.11g; 802.11g }, default = "802.11g "
Wi-Fi AP mode.

Channel

Selected Wi-Fi channel.

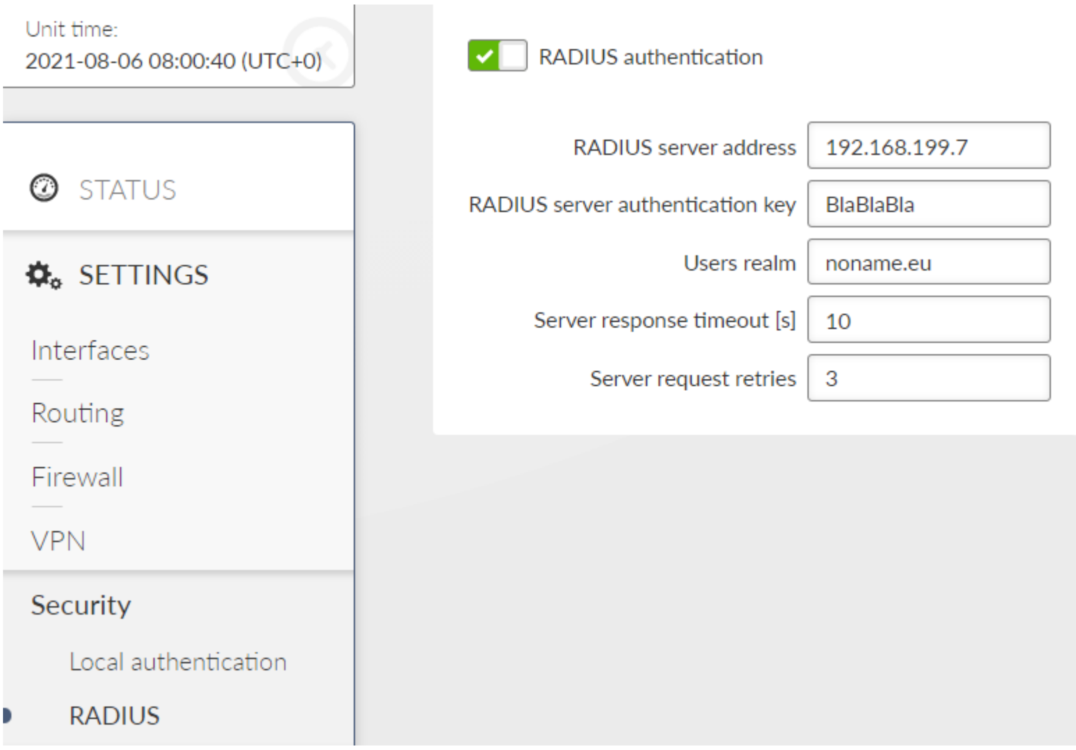
Security

List box {Off; WPA2-PSK}, default = “Off”
It is a good practice to use WPA2-PSK secured connection together with a strong password. It is highly recommended in case of permanent Wi-Fi adapter installation.

7.5.5. RADIUS

User accounts can be managed centrally with an authentication server. RADIUS client-server protocol is used for remote authentication. RADIUS accounts can be mapped to one of the four user roles. This is either managed by the server itself or by local M!DGE3 settings.

Local accounts are checked first and if the account does not exist, RADIUS accounts will be used. If the RADIUS server is not accessible, users may use the local username/password to “fall back” to local authentication.



☑ RADIUS authentication

RADIUS server address: 192.168.199.7
RADIUS server authentication key: BlaBlaBla
Users realm: noname.eu
Server response timeout [s]: 10
Server request retries: 3

Menu SETTINGS > Security > RADIUS allows to set all the main parameters.

RADIUS server address

IP Address of RADIUS server used for authentication.

RADIUS server authentication key

Text {0 – 32 characters}

Password to authenticate against the RADIUS server.

User realm

Text {must contain at least one dot “.”}
Realm allows to shorten the login name - e.g. when the full login name is "tech@noname.eu" and the realm is "noname.eu" the Username filled in the login page is only "tech".

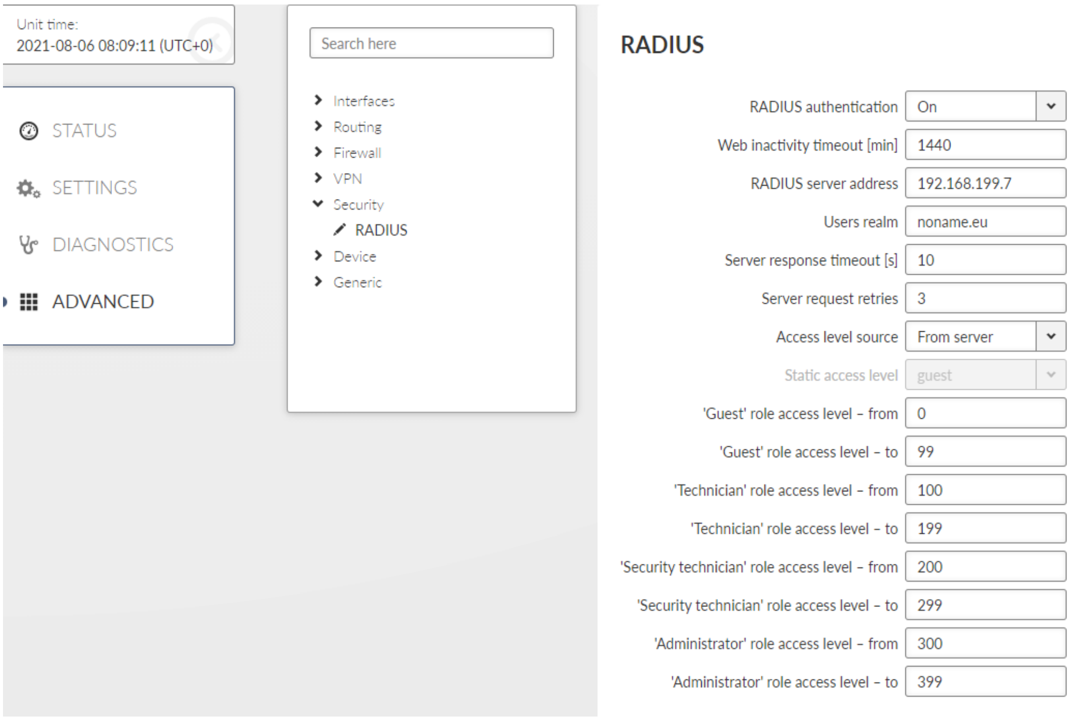
Server response timeout [s]

Number {1 – 30}, default = 10
Time measured while waiting to the server's response before sending a request retry.

Server request retries

Number {1 – 7}, default = 3
Number of request retries in case of M!DGE3 did not receive a valid reply.

Additional expert parameters shall be set in the ADVANCED menu.



RADIUS

RADIUS authentication	On
Web inactivity timeout [min]	1440
RADIUS server address	192.168.199.7
Users realm	noname.eu
Server response timeout [s]	10
Server request retries	3
Access level source	From server
Static access level	guest
'Guest' role access level – from	0
'Guest' role access level – to	99
'Technician' role access level – from	100
'Technician' role access level – to	199
'Security technician' role access level – from	200
'Security technician' role access level – to	299
'Administrator' role access level – from	300
'Administrator' role access level – to	399

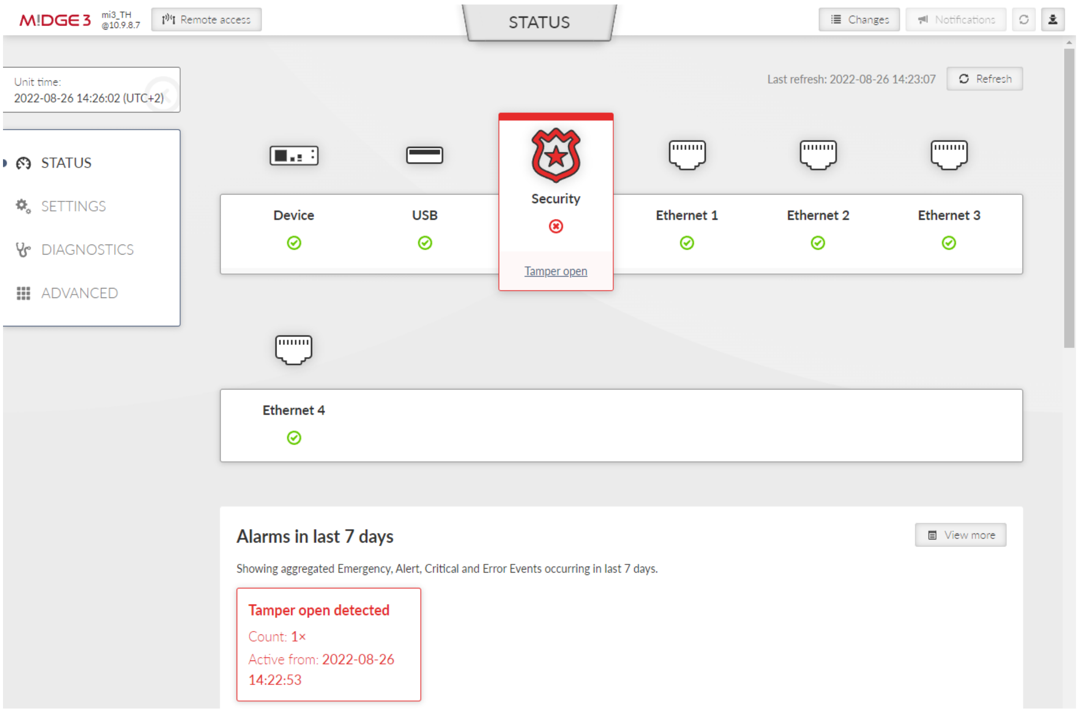
The level of access is realised by Management-Privilege-Level (RFC 5607, index 136, type integer). The level for each account shall be set during the server configuration. The user access level will be granted according to the integer ranges for individual role levels. When the server does not allow setting of Management-Privilege-Level the static account level option (for all users) has to be used.

7.5.6. Tamper reset

Tamper is a detection service, which is triggered, when the M!DGE3 chassis is physically opened. There are 2 contacts (securing top and bottom casing) and the event is triggered even if the unit is without power. When the chassis is opened an alarm is triggered and shown in Status report. Triggered Tamper stops the RTC (real time clock) which means, that every unit reboot resets the unit timer back to the time, when the Tamper was triggered.

Note

M!DGE3e has not the Tamper detection functionality.



Alarms in last 7 days

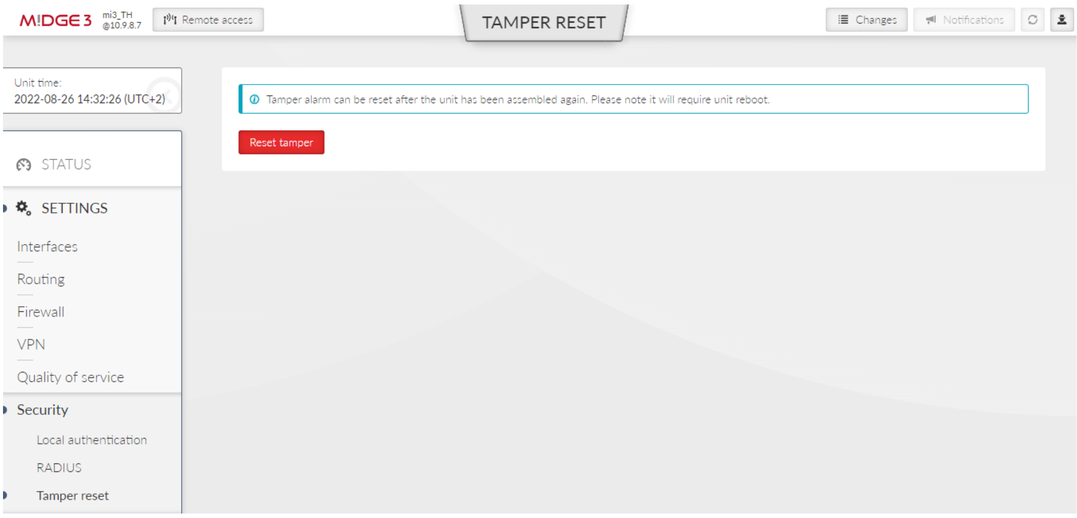
Showing aggregated Emergency, Alert, Critical and Error Events occurring in last 7 days.

Tamper open detected

Count: 1×

Active from: 2022-08-26 14:22:53

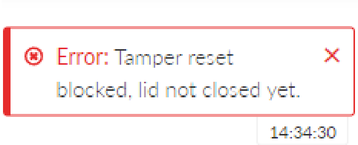
To solve Tamper alarm, re-assemble the unit, via admin user account see SETTINGS/Security/Tamper reset in the menu and click the "Reset tamper" button.



Tamper alarm can be reset after the unit has been assembled again. Please note it will require unit reboot.

Note

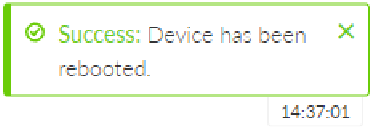
The unit must be re-assembled before clicking the "Reset tamper" button, otherwise it returns an error.



Error: Tamper reset blocked, lid not closed yet.

14:34:30

Whole process can take a while and ends by rebooting the unit.



Success: Device has been rebooted.

14:37:01

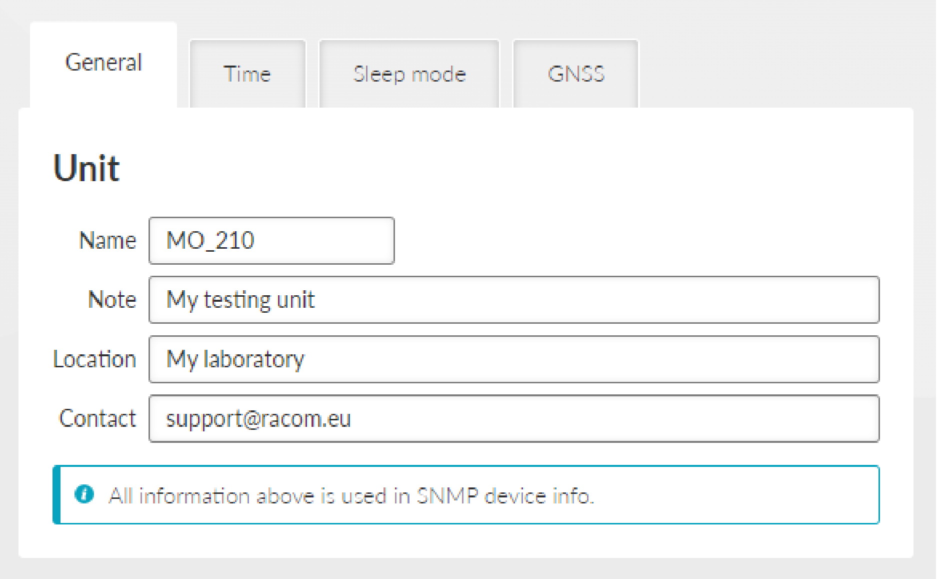
If an automatic time synchronization is not set, the time in the RTC needs to be set manually.

7.6. Device

7.6.1. Unit

7.6.1.1. General

The general settings affecting the whole unit.



Unit

Name	MO_210
Note	My testing unit
Location	My laboratory
Contact	support@racom.eu

All information above is used in SNMP device info.

Fig. 7.30: SETTINGS > Device > Unit

Unit name

This name is used as a real name of the Linux router, so the allowed characters are strictly limited to:

Text; default = _a..zA..Z0..9

Unit note

Text; default = _a..zA..Z0..9

Longer unit name without special characters restrictions.

Unit location, Unit contact

Text; default = _a..zA..Z0..9

Additional SNMP information. All the fields above are typically used in the NMS systems to identify the specific unit.

7.6.1.2. Time

Unit Event time stamps, unit Statistics records and unit internal logs are using Unit time. It is good practice to keep the Unit time synchronized to ease unit and network diagnostics.

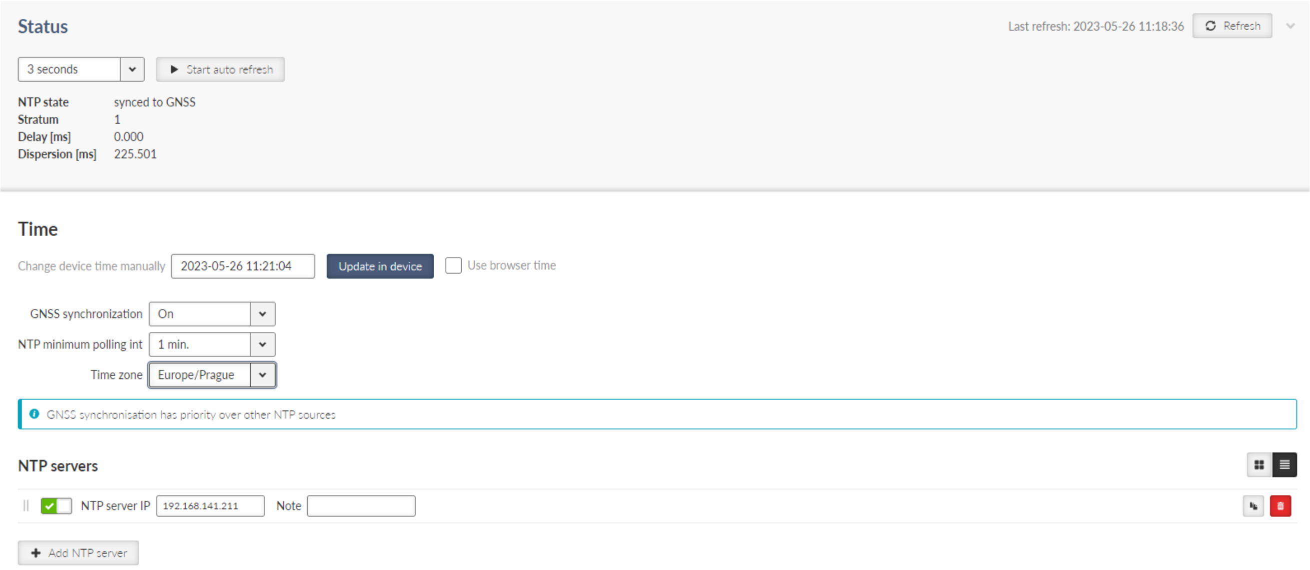
Unit time can be setup manually or it can be synchronized with an NTP server. NTP server synchronization is recommended.

The unit itself serves as an NTP server providing the time synchronization to another IP clients. If no NTP server is defined or no one is available, the unit runs in an “orphan” mode. The unit internal NTP server Stratum is set to 8 in this case. If the unit is synchronized with an NTP server, the unit NTP server Stratum is set a 1 higher comparing to Stratum of the NTP server providing the time synchronization to the unit.

If the unit is synchronized to a time source and the unit (synchronized) time differs from the unit RTC time (by more than 8 seconds), the RTC time is updated.

Note

Each unit can serve as NTP server for further IP equipment, this functionality is always on.



Status

Last refresh: 2023-05-26 11:18:36

NTP state	synced to GNSS
Stratum	1
Delay [ms]	0.000
Dispersion [ms]	225.501

Time

Change device time manually 2023-05-26 11:21:04 Update in device □ Use browser time

GNSS synchronization On

NTP minimum polling int 1 min.

Time zone Europe/Prague

GNSS synchronization has priority over other NTP sources

NTP servers

☑ NTP server IP 192.168.141.211 Note

Fig. 7.31: SETTINGS > Device > Unit > Time

Status

The Status field provides information about NTP synchronization status. Refresh button is used to update the Status information.

7.6.1.2.1. Time

Change device time manually

This field is used to setup unit time manually.

Update in device

Sets the given time to the unit.

Use browser time checkbox

Continuously updates the Change device time manually field to minimize the delay between the time input and the moment of time setup.

NTP client synchronization source

Synchronization source of the NTP client. The only option “NTP server” is implemented at this firmware version.

GNSS synchronization

List box {On; Off }, default = "Off"

Enables / disables synchronization with the GNSS (GPS) (when optional GNSS module is used). Not only GNSS data, but also precise time pulses generated by the GNSS module are used for time synchronization. GNSS (GPS) synchronisation has priority over other NTP sources. This parameter occurs only if GNSS (GPS) is enabled in *Section 7.6.1.4, “GNSS (GPS)”*.

NTP server minimum polling time

Minimal period of the NTP server queries. NTP client is allowed to prolong this time in case of poor quality of the server or connection to the server.

Time zone

Time zone to represent unit internal time. All the unit timestamps are displayed using this time zone. Changing the time zone does not affect unit internal records – they are always recorded using UTC time zone.

NTP status information is based on standard ntpq daemon status output (ntpq -c lpeers, ntpq -c rv) - see *https://docs.ntpsec.org/latest/ntpq.html* (system, peer and clock variables) for details.

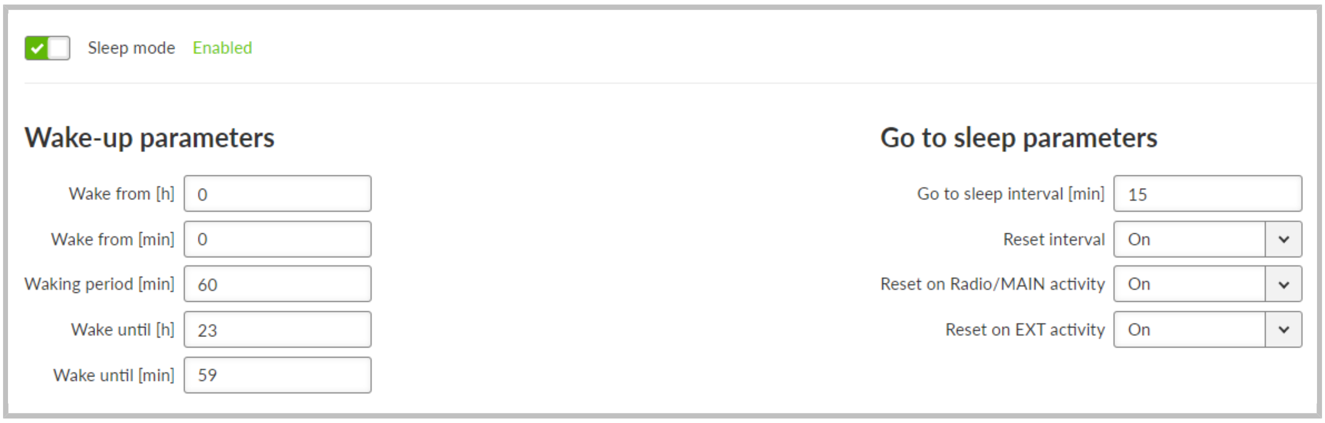
7.6.1.2.2. NTP servers

Multiple NTP servers can be configured to get more precise time synchronization or to have a backup solution in case of an individual NTP server unavailability. Maximum number of records in the list is 32. The unit runs in an “orphan” mode if the **NTP client synchronization source** is set to “NTP server” and there is no NTP server defined in this list.

Enable / Disable	Enables / Disables a NTP server.
NTP server IP	Defines the IP address of the NTP server.
Note	Informational comment.

7.6.1.3. Sleep mode

M!DGE3 offers a mode which periodically switches between the full traffic mode and low power consumption mode. This mode is suitable e.g. for power-consumption sensitive applications. When in Sleep mode, M!DGE3 has extremely low power consumption (10 mW). The time needed for a complete wake-up from the Sleep mode (booting time) is approx. 30 seconds or more - depending on the configuration. Sleeping unit indicates its state by green flashing SYS LED.



☑ Sleep mode Enabled

Wake-up parameters

Wake from [h]	0
Wake from [min]	0
Waking period [min]	60
Wake until [h]	23
Wake until [min]	59

Go to sleep parameters

Go to sleep interval [min]	15
Reset interval	On
Reset on Radio/MAIN activity	On
Reset on EXT activity	On

Fig. 7.32: SETTINGS > Device > Unit > Sleep mode

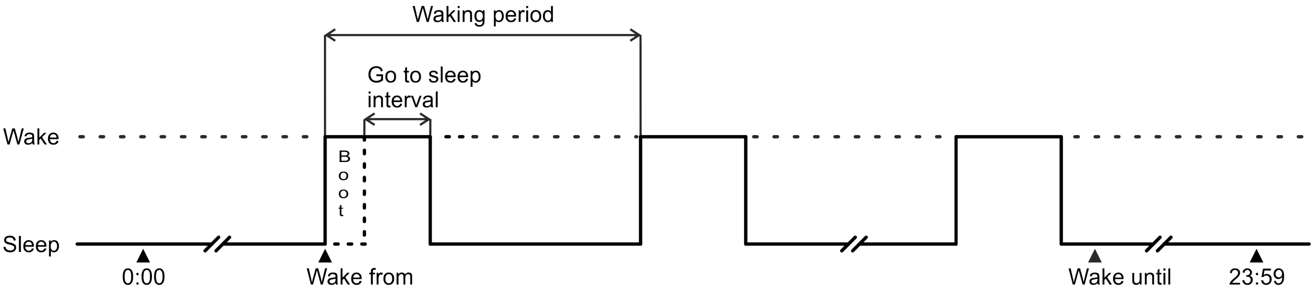
Sleep mode

Enable / disable, default = disable

Enables / disables Sleep mode. When enabled, the unit will periodically go into Sleep mode depending on conditions defined by the following configuration.

7.6.1.3.1. Wake-up parameters

Waking up the M!DGE3 from Sleep mode is possible via setting the time of its awakening. It is also possible to set an interval during which the unit will be woken up regularly. Sleep mode time boundaries are counted in a set **Time zone** (SETTINGS > Device > Unit > Time).



Wake from [h]

Number {0 – 23}, default = 0

Defines the first wake-up time in a day - hour.

Wake from [min]

Number {0 – 59}, default = 0

Defines the first wake-up time in a day - minute.

Waking period [min]

Number {0 – 1439}, default = 60

Defines the length of time period (min) between individual wake-ups.

Wake until [h]

Number {0 – 24}, default = 23

Defines the time in a day after which the unit will not be awaken - hour.

Wake until [min]

Number {0 – 59}, default = 59

Defines the time in a day after which the unit will not be awaken - minute.

Note

Set time from parameters **Wake from [h]** and **Wake from [min]** must be smaller or equal to set time from parameters **Wake until [h]** and **Wake until [min]**.

7.6.1.3.2. Go to sleep parameters

M!DGE3 will go into the Sleep mode after the set time passes. It is possible to delay the Sleep mode to assure that all data transfer is complete. Connecting USB-ETH or USB-Wi-Fi adapters to the service port will also delay the Sleep mode. Falling into the Sleep mode will generate an event to the Event log.

Note

If the M!DGE3 is in the Sleep mode and a power outage occurs (for approx. 10s), the Sleep mode will be interrupted and the unit will wake up (boot).

Go to sleep interval [min]
Number {5 – 1439}, default = 15
Defines the length of time (min) after which the unit will go into Sleep mode. The countdown starts, when the unit is completely awake.

Reset interval
List box {On; Off }, default = "Off"
Allows to set conditions causing the unit to delay transition into Sleep mode by resetting the count down timer back to the initial value **Go to sleep interval [min]**.

Reset on Radio/MAIN activity
List box {On; Off }, default = "On"
If the unit shows activity on the Cellular-MAIN interface, the count down timer is reset back to the initial value **Go to sleep interval [min]**.

Note
ICMP ping on Cellular-MAIN interface will not trigger the **Reset on Radio/MAIN activity**.

Reset on EXT activity
List box {On; Off }, default = "On"
If the unit shows activity on the Cellular-EXT interface, the count down timer is reset back to the initial value **Go to sleep interval [min]**.

Note
ICMP ping on Cellular-EXT interface will not trigger the **Reset on Radio/EXT activity**.

Example 1:
With following settings M!DGE3 will be periodically woken up every hour for 10 minutes (all day long):
Wake from [h] = 0
Wake from [min] = 0
Waking period [min] = 60
Wake until [h] = 23
Wake until [min] = 59
Go to sleep interval [min] = 10
Reset interval = Off

Example 2:

With following settings M!DGE3 will be periodically woken up from 7:00 to 16:00 every 30 minutes for 10 minutes:
Wake from [h] = 7
Wake from [min] = 0
Waking period [min] = 30
Wake until [h] = 16
Wake until [min] = 00
Go to sleep interval [min] = 10
Reset interval = On
Reset on Radio/MAIN activity = On - this parameter will ensure that M!DGE3 stays awake in case of any Cellular activity at the scheduled sleep time.

7.6.1.3.3. Wake up on Sleep Input (SI)

Sleep Input (SI) is a trigger signal that can be used to wake up a station from sleep.

SI is trigged/activated if it is pulled below 1.1 VDC. See more details in *Pin assignment*

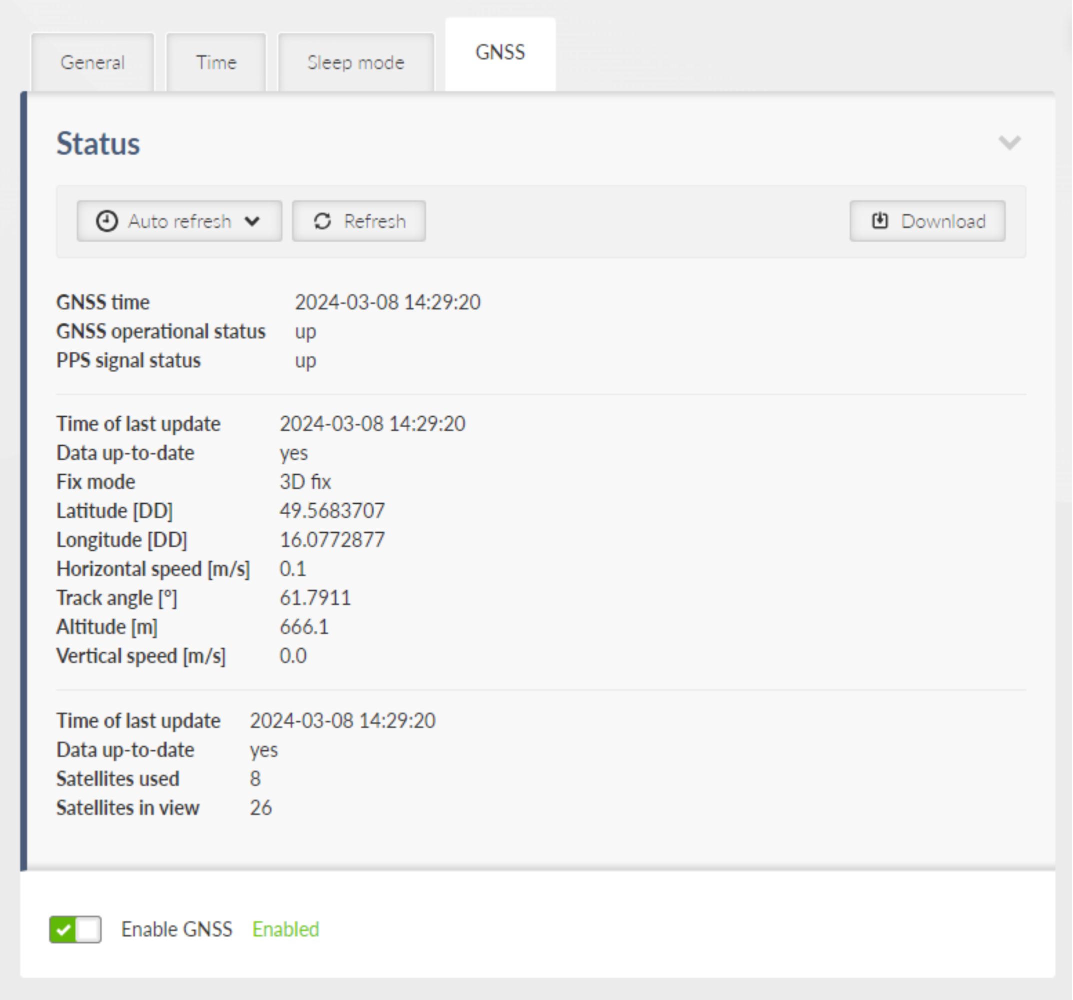
If the M!DGE3 is in the Sleep mode and SI is triggered, the unit will wake up for the set awake period and go back to sleep. The Sleep Input signal is not monitored while M!DGE3 is awake so any additional SI trigger does not increase the awake period.

Example:

The unit is set to be waking up every hour for 10 minutes.
If a unit were to receive a SI command at 10:15 it will wake up and be awake until 10:25.
Unless another SI command is received after 10:25 the unit will stay asleep until 11:00

7.6.1.4. GNSS (GPS)

GNSS (Global navigation satellite system) allows the optional extension module to provide information about the units location and enable a precise time synchronization.



GNSS time 2024-03-08 14:29:20
GNSS operational status up
PPS signal status up

Time of last update 2024-03-08 14:29:20
Data up-to-date yes
Fix mode 3D fix
Latitude [DD] 49.5683707
Longitude [DD] 16.0772877
Horizontal speed [m/s] 0.1
Track angle [°] 61.7911
Altitude [m] 666.1
Vertical speed [m/s] 0.0

Time of last update 2024-03-08 14:29:20
Data up-to-date yes
Satellites used 8
Satellites in view 26

☑ Enable GNSS Enabled

Fig. 7.33: SETTINGS > Device > Unit

Enable; Disable, default = "Disable"
Enables / Disables the GNSS (GPS).

To set up GNSS (GPS) see *Section 7.7.6, “GNSS server”*.

Tab. 7.3: LED behavior of GNSS (GPS)

LED	Colour	Status	Function
EXT	Green	Flashing regularly - period 1000 ms	GNSS (GPS) is active, awaiting for data about location and PPS signal.
EXT	Green	Permanently lit	GNSS (GPS) is active, data about location and PSS signal is available.

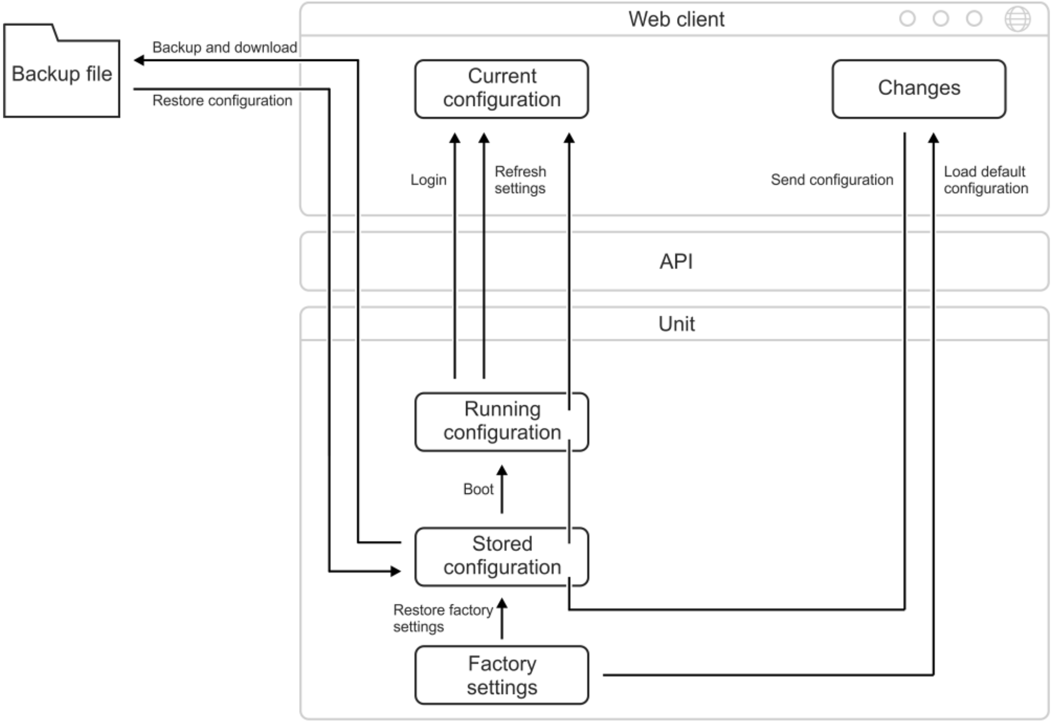
7.6.1.4.1. Cooperation with other services

- HotStandby - GNNS (GPS) is disconnected in passive mode and activated in active.

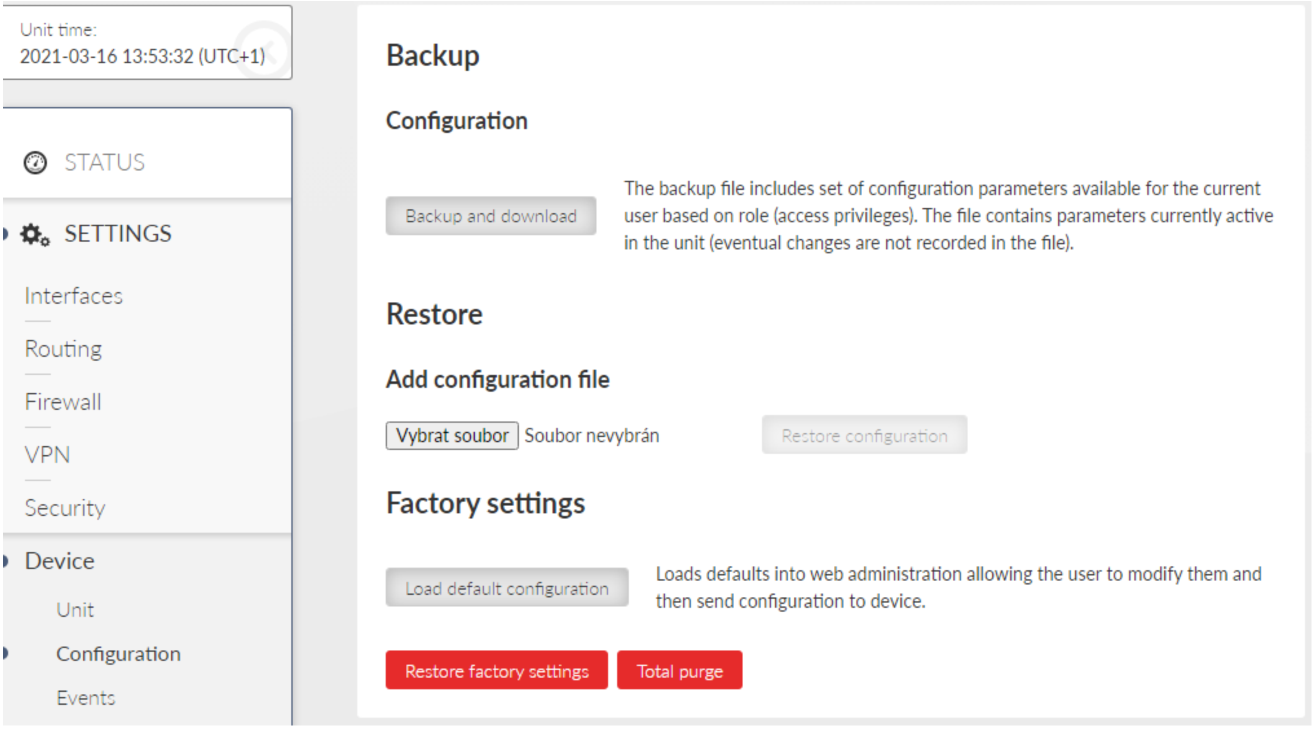
7.6.2. Configuration

Configuration in M!DGE3 operates on following system:

- Current configuration - displayed configuration, which is seen in the web client.
- Running configuration - actual configuration, running in the M!DGE3 unit.
- Stored configuration - configuration stored in the M!DGE3 unit. This configuration is stored in the unit, even when its turned off.
- Factory settings - default configuration.
- Changes - all changes done to the Current configuration (in the web client). For more information see *Section 6.2, “Changes to commit”*.



There are several tools to operate full unit configuration:



The backup file includes set of configuration parameters available for the current user based on role (access privileges). The file contains parameters currently active in the unit (eventual changes are not recorded in the file).

Loads defaults into web administration allowing the user to modify them and then send configuration to device.

Backup

It is a good practice to make a configuration backup into an external file every time the configuration is changed, to be able to restore the configuration into another unit in case of unit maintenance. **Backup and download** button triggers the web browser Download action. The specific behavior depends on your web browser personal settings - whether the configuration backup file is downloaded to a predefined download folder or the file Download dialog to select destination folder is shown. The configuration is stored in a text file (.json file type).
The backup configuration has following limitations:

- The set of configuration data is limited by a user access privileges of the user who performed the backup. The full configuration backup can only be issued by a user with the Administrator (role_admin) access privileges. The same user access limit applies when the configuration is restored (i.e. the full configuration Restore can only be issued by a user with the Administrator (role_admin) access privileges).

Configuration version is stored in the parameter called “CNF version” which can be checked in the menu: DIAGNOSTICS > Information > Device > Advanced information.

Restore

The configuration can be restored from a backup file (containing the same configuration version as the configuration version currently running in the unit - see above).

Choose File Button

Triggers the file selection dialog. Once the configuration backup file is selected, it is uploaded to the unit. The upload action can take some time - depends on the speed of your service connection to the unit.

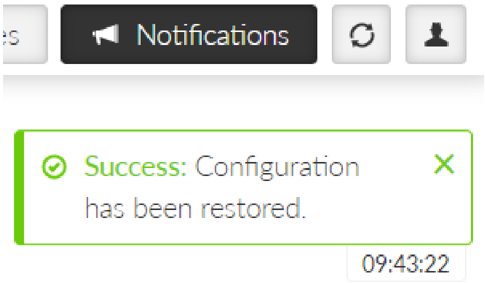
Factory settings

Load default configuration button loads default values of all configuration parameters into the web interface. All parameters whose current value differs from the default are marked as changed. They are listed in the Changes to commit dialog. They do not affect the running unit until eventually sent to the unit by the Send configuration button.

Note
This action can be used (for example) to check which set of parameters differs from the default value.

Restore configuration button

Enabled after the backup configuration is uploaded. Press the button to restore the unit configuration. The configuration restore result is reported as an error message (in case of failure) or Notification center success message:



Success: Configuration has been restored.

09:43:22

Restore factory settings

Restores all configuration parameters to default setup (including monitoring settings). Logout from station will apply.
Deletes user database.

Total purge

Restores all configuration parameters to default setup (including monitoring settings). Logout from station will apply.
Deletes user database.
Deletes all diagnostic logs and statistics.

Note

Basic data such as Code, Region, SW keys will always remain in the unit.

Warning

This action can take up to two minutes - do not power off the unit until finished.

Configuration validation

FW from version 2.2.0.0 introduces an improved configuration validation process. In older FW versions, some configuration item validations (e.g., allowed value range, string length) were validated only in the web application (front-end). When modifying the configuration in other ways (API calls, direct editing of the backup configuration file), it was possible to enter a value into a configuration item that caused the resulting unit configuration to be invalid. Recently, full configuration validation is performed directly in the unit (back-end). No method of configuration change (web interface, API, text backup modifications) can cause the unit to use an invalid configuration.

Notice for upgrading FW from older versions to version 2.2.0.0 and higher:
Units with FW older than 2.2.0.0 may have worked with a configuration that is not fully valid. Upon upgrading the unit to FW 2.2.0.0, or higher, a configuration validity check will be performed during startup the unit. If the configuration fails this check, the user will be informed by the generation of the system event "EVENT_CNF_BOOT_ERROR". The notification center will provide detailed alarm messages referencing individual invalid configuration items. However, the unit will continue to operate with this configuration as it did before the FW upgrade. The functions of the unit are not affected by this situation.

Consequences of running the unit with an invalid configuration:
The system event "EVENT_CNF_BOOT_ERROR" is active. The event has a default severity of Alarm, which causes the SYS status LED to light up red.

Until all items that failed the validation process are corrected, no configuration changes can be saved. The updated configuration can only be activated once the entire configuration successfully passes validation.

Tab. 7.4: Configuration versions

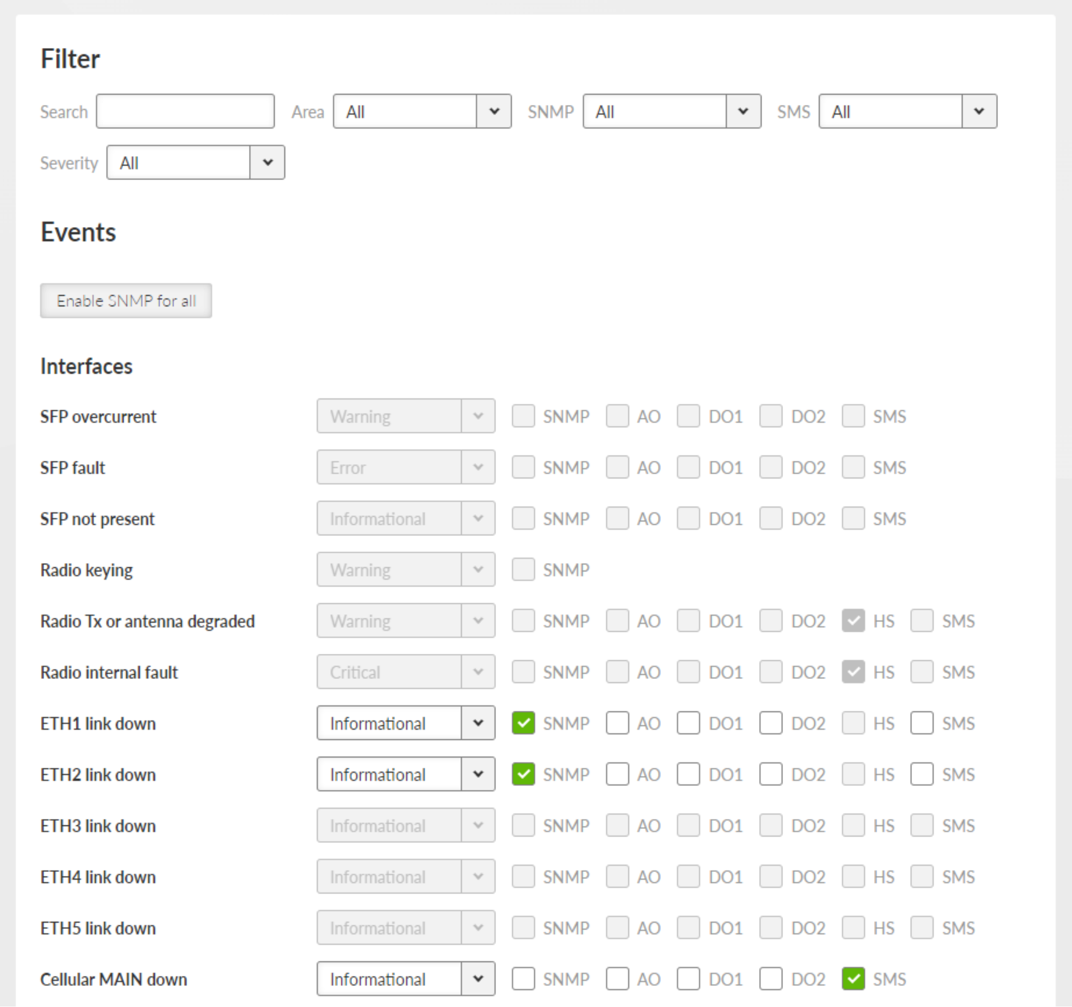
CNF version	FW version
27	2.2.4.0
26	2.2.2.0
25	2.2.1.0
24	2.2.0.0
23	2.1.7.0
22	2.1.6.0
21	2.1.2.0
20	2.1.1.0
19	2.1.0.0
18	2.0.18.0
17	2.0.16.0
16	2.0.14.0
15	2.0.13.0

The Status section displays the **Configuration checksum**. This checksum is unique to each unit and its current settings. Any modification to the configuration will result in a different checksum value. The checksum can also be retrieved via an API call.

7.6.3. Events

Settings of the severities of the individual events. Some events can generate SNMP notification and can change level of the HW alarm outputs (AO, DO1, DO2) see *Section 2.2.2, “Power and Control”*. Events can also generate SMS notifications, which are being sent to a defined phone number (see *Section 7.7.5, “SMS”*).

7.6.3.1. Test event



Filter

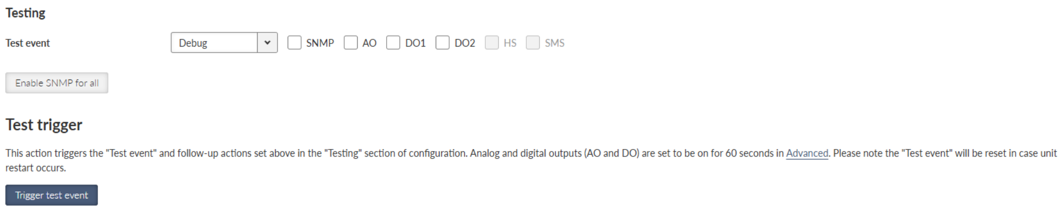
Search:
Area: All
SNMP: All
SMS: All
Severity: All

Events

Interfaces

SFP overcurrent	Warning	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☐ SMS	
SFP fault	Error	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☐ SMS	
SFP not present	Informational	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☐ SMS	
Radio keying	Warning	☐ SNMP					
Radio Tx or antenna degraded	Warning	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☑ HS	☐ SMS
Radio internal fault	Critical	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☑ HS	☐ SMS
ETH1 link down	Informational	☑ SNMP	☐ AO	☐ DO1	☐ DO2	☐ HS	☐ SMS
ETH2 link down	Informational	☑ SNMP	☐ AO	☐ DO1	☐ DO2	☐ HS	☐ SMS
ETH3 link down	Informational	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☐ HS	☐ SMS
ETH4 link down	Informational	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☐ HS	☐ SMS
ETH5 link down	Informational	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☐ HS	☐ SMS
Cellular MAIN down	Informational	☐ SNMP	☐ AO	☐ DO1	☐ DO2	☑ SMS	

Fig. 7.34: SETTINGS > Device > Events



Testing

Test event Debug □ SNMP □ AO □ DO1 □ DO2 □ HS □ SMS

Test trigger

This action triggers the "Test event" and follow-up actions set above in the "Testing" section of configuration. Analog and digital outputs (AO and DO) are set to be on for 60 seconds in Advanced. Please note the "Test event" will be reset in case unit restart occurs.

Fig. 7.35: SETTINGS > Device > Events

Pressing the "Trigger test event" button will activate the 'Test event' along with any subsequent actions defined in the 'Testing' configuration section . Specifically, the analog and digital outputs (AO and DO) will be active for 60 seconds (can be changed in Advanced menu).

Note

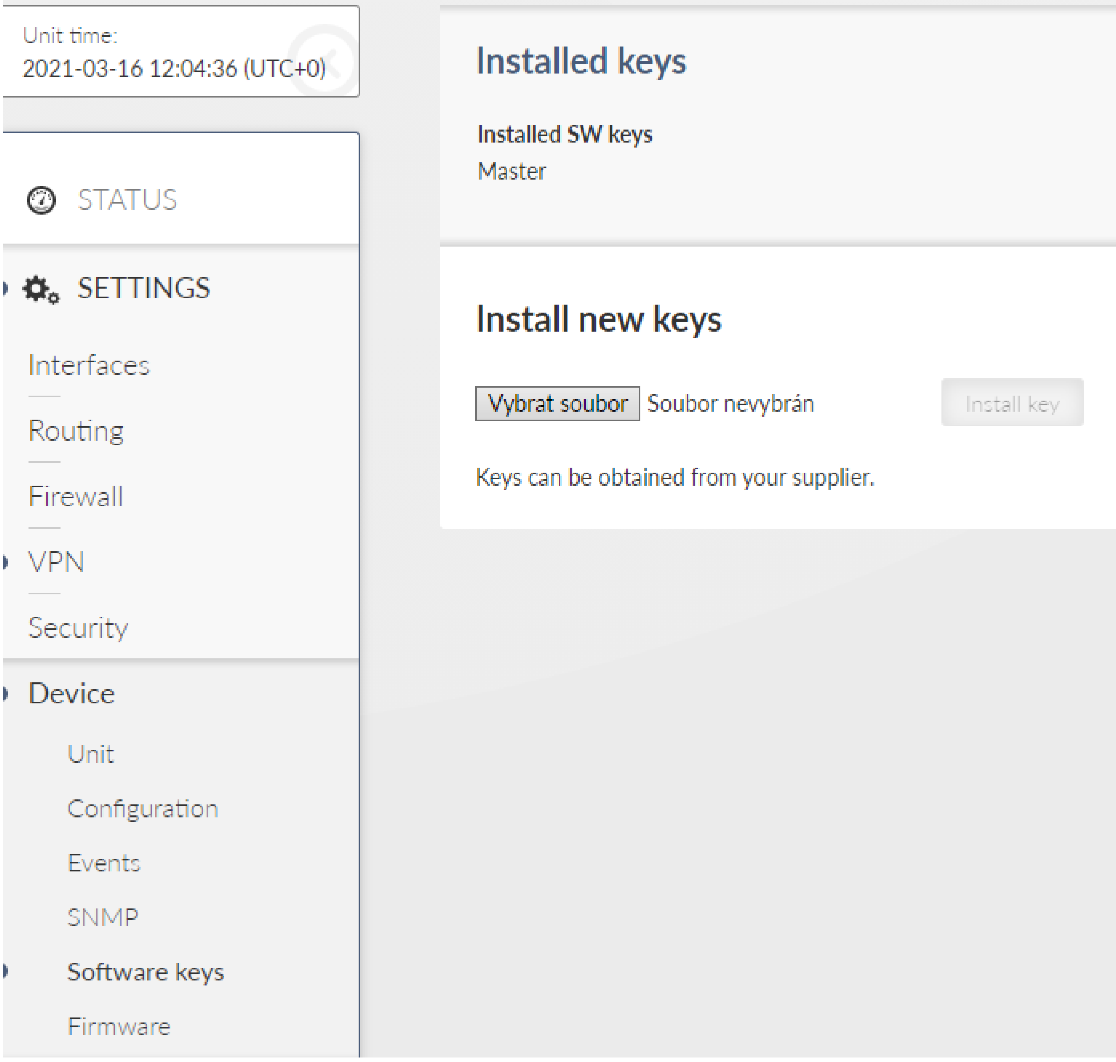
Unit restart will reset the Test event.

7.6.4. SW keys

Certain M!DGE3 features needs to be activated by a SW key to be available. When the respective SW key is not present, the feature cannot be configured. If the feature is enabled in a configuration backup file and the file is loaded to a unit which is not equipped with the respective key, the configuration is refused (no changes are made in the unit).

Here is the list of available SW keys and their assignment to offered SW key packages.

SW key(s) can be obtained from your supplier. It is delivered as a text file containing the key(s). Every SW key is unique for the specific unit (specific serial number). Use Choose File dialog to select the file and Install key button to install the key(s) to unit.



Unit time:
2021-03-16 12:04:36 (UTC+0)

Installed keys

Installed SW keys
Master

Install new keys

Soubor nevybrán

Keys can be obtained from your supplier.

Differences with the previous generation of RipEX:

- SW keys are always installed as a file (there is not a clipboard option)

- Single file can contain multiple SW keys

- SW keys are not time limited

Tab. 7.5: List of atomic SW keys

Atomic key	Shortcut	SW key	Without Key
BGP**	BGP	By defaults	NA
OSPF**	OSPF		NA
Babel**	Babel		NA
Link management**	LMgmt		NA
PPPoE*,**	PPPoE		NA
IPsec	IPsec	By defaults	NA
OpenVPN	OpenVPN		NA
Multiple users	Users		Only one user
RADIUS	Radius		NA
Tamper detection**	Tamp		NA
SFP**	SFP	SFP	NA

*By defaults from 03/2024, if you've purchased M!DGE3 before this date and want to use this functionality, you will need to request the atomic key from the supplier.

**Not available for M!DGE3e

Note

The newly added atomic keys are not included in the delivery of the previously ordered SW key (Link management for units dispatched before 07/2023, OpenVPN for units dispatched before 10/2023). Dispatch date is a part of Quality Inspection Report, which is available for each individual S/N via RACOM's WebService.

Installed atomic keys you can check using menu SETTINGS > Device > SW keys.

Master key substitutes all atomic keys (even these newly and in future added)

7.6.5. Firmware

7.6.5.1. Local

Unit firmware defines the unit functionality. There are several principles for managing the firmware in the running network:

- Maintain the same version of firmware in the network (recommended). RipEX units are able to cooperate with different versions of firmware running, but using the same firmware version in all units is the best way to keep the network maintenance simple.

- Upgrading firmware to a newer version is not obligatory, unless there are bug/security fixes etc.

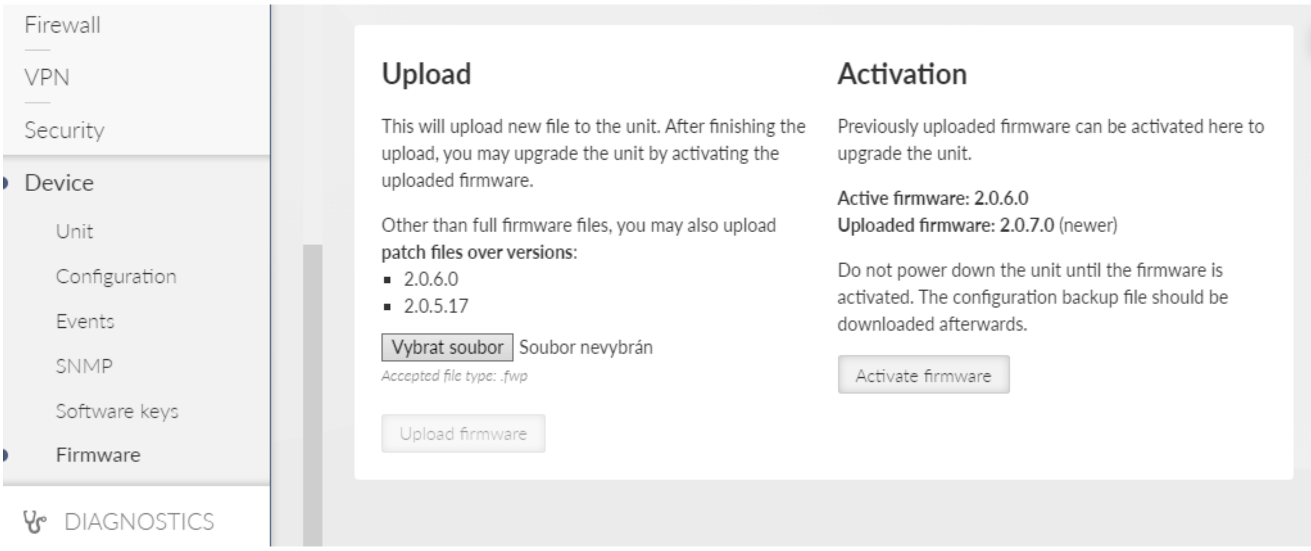
- The cyber security issues may force the firmware to be upgraded e.g. when some serious security vulnerability was fixed.

There are 3 stages of the firmware upgrade procedure:

- Choosing new firmware and loading it into the web browser.

- Uploading new firmware into the unit’s internal archive.
- Activating the unit firmware.

Every operation can take up to several tens of seconds.



Upload

This will upload new file to the unit. After finishing the upload, you may upgrade the unit by activating the uploaded firmware.

Other than full firmware files, you may also upload **patch files over versions**:

- 2.0.6.0
- 2.0.5.17

Vybrat soubor Soubor nevybrán

Accepted file type: .fwp

Upload firmware

Activation

Previously uploaded firmware can be activated here to upgrade the unit.

Active firmware: 2.0.6.0
Uploaded firmware: 2.0.7.0 (newer)

Do not power down the unit until the firmware is activated. The configuration backup file should be downloaded afterwards.

Activate firmware

The Status section displays the Firmware checksum. This checksum is unique to each individual unit, differing even between units with the same firmware version. The checksum can also be retrieved via an API call.

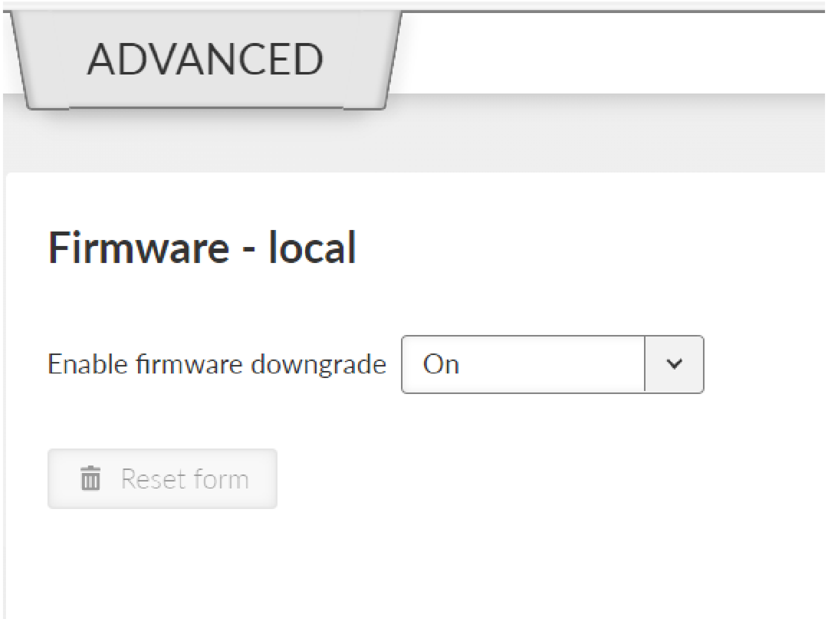
Note

Unit configuration backup is recommended after the firmware upgrade. See *Section 7.6.2, “Configuration”*for details.

To upgrade the firmware:

1. Optional (recommended): Backup the current unit configuration (menu SETTINGS > Device > Configuration – Backup and download).
2. Download the required firmware from the *Racom web*[6]: Products – M!DGE3 – Download – Firmware M!DGE3 – midge3-fw-x.x.x.0.fwp
3. Click the **Choose File** button (the button label may differ based on your web browser localization) to select the firmware file.
4. Click the **Upload firmware** button to transfer the firmware file into the unit. The upload can take a long time – depending on the connection speed between the management PC and the M!DGE3 unit. In case of slow connection and file transfer longer than 120 s, the web browser will shut down the connection and the action will not finish successfully. This action does not update the running unit firmware yet. There is no affection on the other communication running through this unit. Successful uploading of the new firmware into the archive is announced in the Notifications and the available firmware version is highlighted under the "Activation" heading as "**Uploaded firmware:**".

[6] https://www.racom.eu/eng/products/cellular-router-midge.html#dnl_fwr3



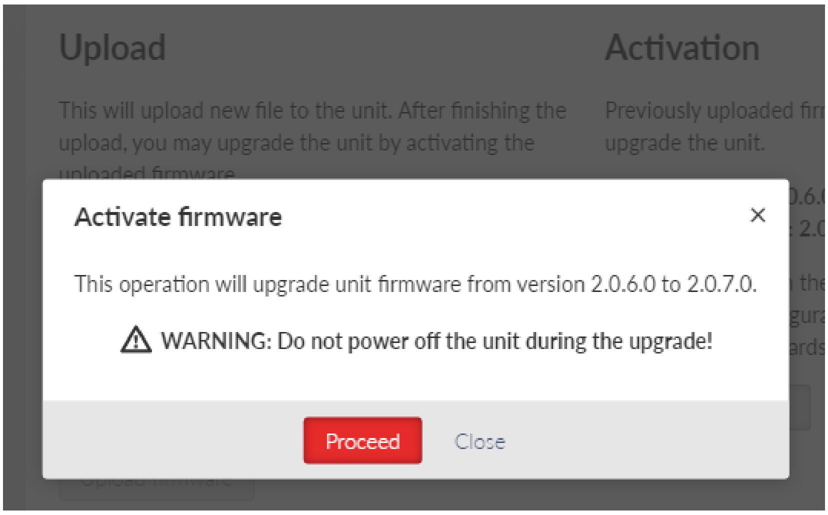
Firmware - local

Enable firmware downgrade: On

Note

Admin level account has a possibility to dissable FW downgrade (menu ADVANCED > Firmware > Firmware - local by seting of the **Enable firmware downgrade** to Off), by default is this functionality allowed.

5. Click the **Activate firmware** button to upgrade (i.e. reinstall) the unit firmware. The upgrade process takes approx. one minute. The user data communication running through this unit is interrupted for a while. All the processes are restarted in a certain moment (e.g. VPN tunnels need to be re-established).



Activate firmware

This operation will upgrade unit firmware from version 2.0.6.0 to 2.0.7.0.

⚠ WARNING: Do not power off the unit during the upgrade!

Warning

Do not shut down the unit during the firmware update process. It may permanently damage the unit.

6. It is possible not only to upgrade the firmware version, but to even downgrade it, although this operation is not recommended. Be aware of eventual security issues of firmware downgrade as

eventually outdated security code can be part of an old firmware. After FW downgrade, all unit parameters will be set to factory defaults.

Note

Direct firmware upgrade from version 2.0.3.0 (or lower) to version 2.0.13.0 (or higher) is not possible. You have to upgrade the firmware to any version from 2.0.5.0. to 2.0.10.0 prior to upgrading to 2.0.13.0 (or higher).

Note

Direct firmware upgrade to 2.1.1.0 or newer from version 2.0.18.0 or older is possible in one of two ways.

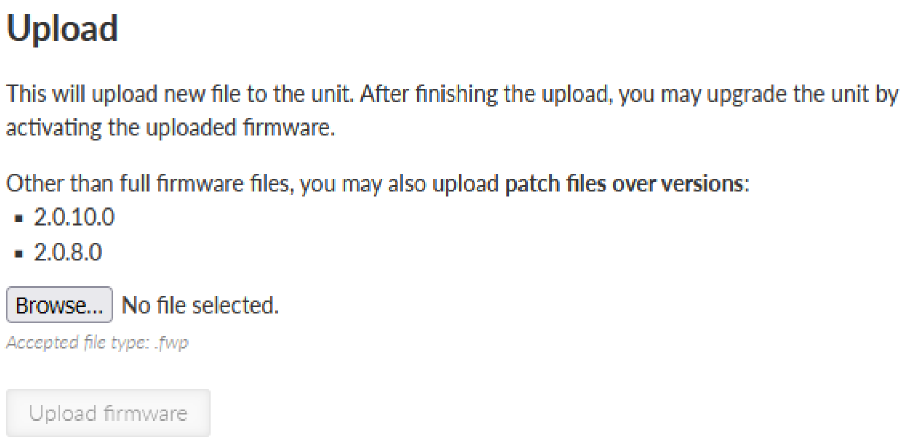
- Upgrade firmware to version 2.1.0.0 prior to upgrading to 2.1.1.0 or newer
- Use special upgrade package including the FWD abbreviation in its name. See the *Firmware archive*[7] for download options.

7.6.5.1.1. Patch files

In some cases, instead of uploading and activating full FW version, patch files can be used. Advantage of the patch files is that they are smaller comparing to the full version files. For successful activation a compatibility between the patch file and active firmware (or uploaded firmware) must be ensured. Patch files for M!DGE3 can be downloaded from *RACOM's web site*[8]. FW versions stored in M!DGE3 are displayed in SETTINGS > Device > Firmware.

[7] https://www.racom.eu/eng/products/radio-modem-ripex.html#dnl_archive

[8] https://www.racom.eu/eng/products/cellular-router-midge.html#dnl_fwr3



Upload

This will upload new file to the unit. After finishing the upload, you may upgrade the unit by activating the uploaded firmware.

Other than full firmware files, you may also upload **patch files over versions:**

- 2.0.10.0
- 2.0.8.0

Browse... No file selected.

Accepted file type: .fwp

Upload firmware

Example: There are 2 older FW versions (2.0.8.0 and 2.0.10.0) stored in M!DGE3 (picture above).

For successful activation of newer FW version (e.g. 2.0.13.0) using patch file either:

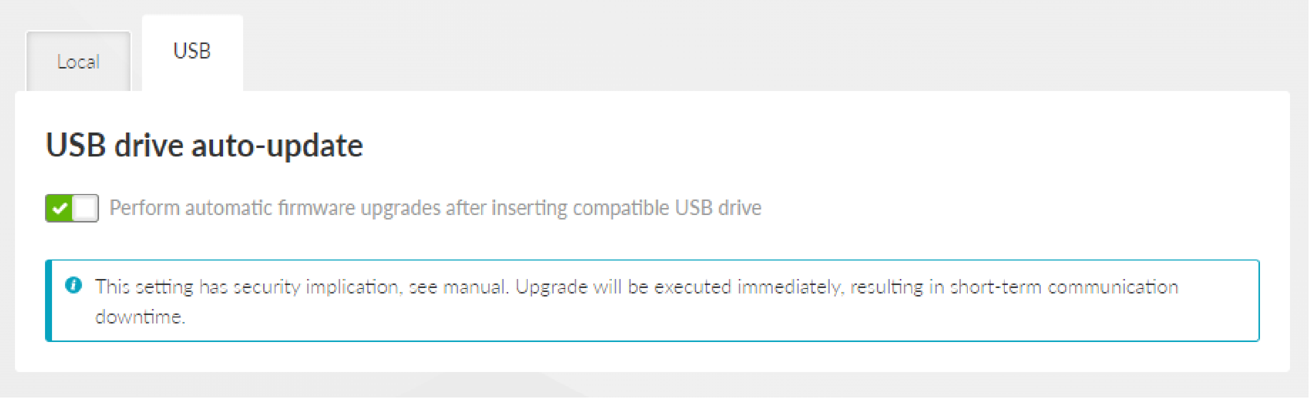
- Download patch files version upgrading from 2.0.8.0 to 2.0.13.0 or
- Download patch files version upgrading from 2.0.10.0 to 2.0.13.0 (recommended, because this patch file will be smaller).

The result will be the very same in both cases.

Note

FW versions (both patch files and full versions) are stored in *M!DGE3 archive*[9] .

7.6.5.2. USB



USB drive auto-update

☑ Perform automatic firmware upgrades after inserting compatible USB drive

This setting has security implication, see manual. Upgrade will be executed immediately, resulting in short-term communication downtime.

Fig. 7.36: SETTINGS > Device > Firmware > USB

Switch **Perform automatic firmware upgrades after inserting compatible USB drive** allowing FW upgrade from a USB flash disk. Downgrading using a USB disk is not possible. The change of this setting is activated after a new boot process.

The FW of the unit itself will be upgraded (not the FW of an eventual embedded module).

[9] https://www.racom.eu/eng/products/cellular-router-midge.html#dnl_archive

When allowed, the FW upgrade (from the USB flash disk) starts automatically after inserting the USB flash disk into the USB connector. The user is informed about the process via the SYS LED signalization (see Chapter 2.4. *Indication LEDs*).

The following conditions apply to processing:

- The USB drive must contain at least one partition. If there are more partitions, only the first one will be connected to the device.
- The first partition must be primary (physical) and must be formatted with the FAT12, FAT16, or FAT32 file system.
- The FW files must be located in the root directory. Subdirectories are not searched. FW files can be either standard files or soft links.
- The FW file name must have a .fwp or .cpio.enc extension. It does not matter whether the characters are lowercase or uppercase (case insensitive).
- There are no restrictions on the name of the FW file, only the extension rules must be followed. The character set allowed by the file system of the given USB drive (but we still recommend using the standard ASCII set).
- Any number of FW files (FW packages) can be stored on the USB drive (not all of them even have to be for a given device). From these, the device then "chooses" the FW that suits the given HW and has the highest version.
- If two or more suitable FWs are found on the disk, which have the same version, the first one is selected in order according to the lexicographic arrangement (this can happen, for example, if one file is full FW, while the other is FW-patch).

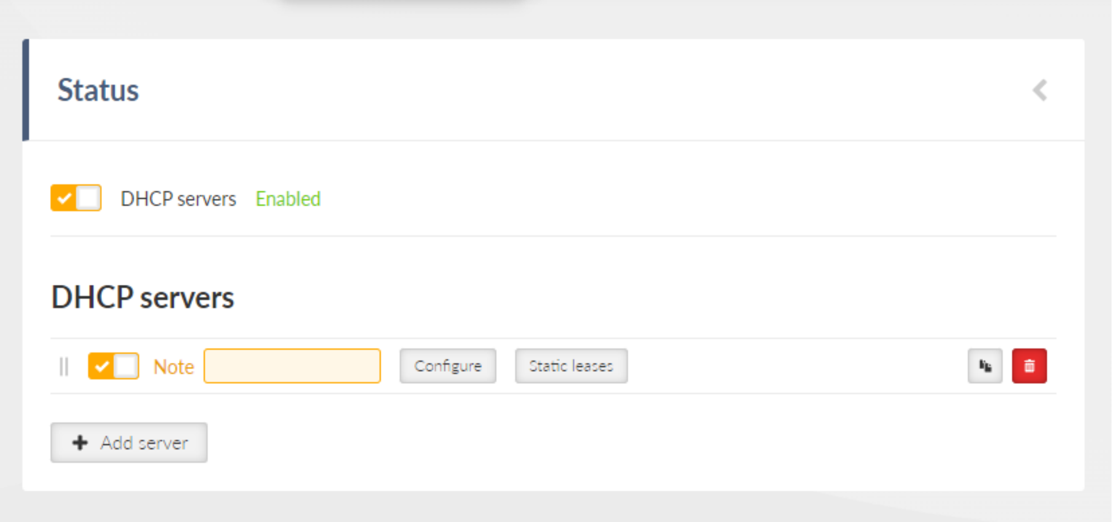
7.7. Services

7.7.1. DHCP servers

The DHCP server listens on selected interfaces. When a client from another station requests it, it assigns an IP address (DHCP lease) from the specified range.

Corresponding network interface must have a defined network range that includes the allocated range.

The DHCP server is then used specifically for this interface (ETH1 - ETH5, Wi-Fi).



Status

☑ DHCP servers Enabled

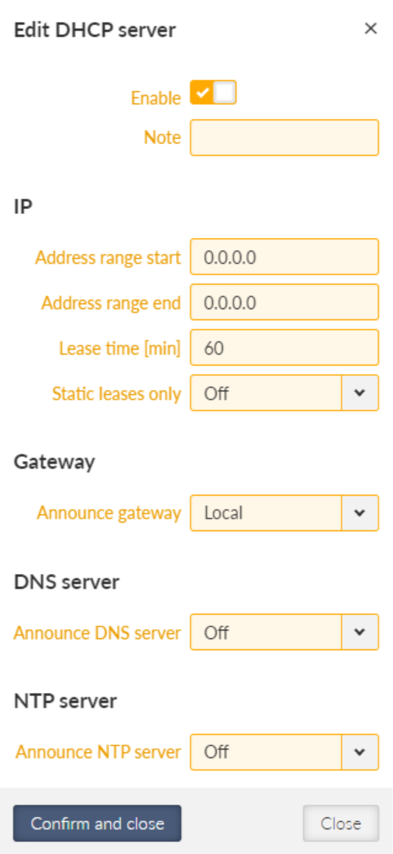
DHCP servers

☑ Note [ ] Configure Static leases

+ Add server

Fig. 7.37: SETTINGS > Services > DHCP servers

7.7.1.1. DHCP servers configuration



Edit DHCP server ×

Enable ☑

Note

IP

Address range start: 0.0.0.0

Address range end: 0.0.0.0

Lease time [min]: 60

Static leases only: Off

Gateway

Announce gateway: Local

DNS server

Announce DNS server: Off

NTP server

Announce NTP server: Off

Confirm and close Close

Fig. 7.38: SETTINGS > Services > DHCP servers > Configure

Enable

{Enable; Disable}, default = "Enable"
Enables the currently selected DHCP server.

Note
Informational note.

Address range start
IP address, default = 0.0.0.0
The start of the range of IP addresses allocated. It must be the case that **Address range start** <= **Address range end**.
Address must be in the address range of the ETH, LAN, VLAN, or Wi-Fi interface.

Address range end
IP address, default = 0.0.0.0
The end of the range of IP addresses allocated. It must be the case that **Address range start** <= **Address range end**.
Address must be in the address range of the ETH, LAN, VLAN, or Wi-Fi interface.

Note
The ranges of active DHCP servers must not overlap.

Lease time [min]
Number {2 – 10080}, default = 60
Address lease period. It is applied to both dynamic and static addresses.

Static leases only
List box {Off; On}, default = "Off"
Specifies whether the range is used only for allocating fixed (static) addresses. If enabled, it must be in the Static Leases table.

Announce gateway
List box {Off; Local; Manual}, default = "Local"
Configures the announcing of the router to clients.
Off: Gateway is not announced.
Local: The router’s IP is announced as a gateway.
Manual: Manually set IP address is announced as a gateway.

Gateway address
IP address, default = 0.0.0.0
The IP address of the gateway being announced.

Announce DNS
List box {Off; Local; Manual}, default = "Local"
Configures the announcing of the DNS server to clients.
Off: DNS server is not announced.
Local: The router’s IP is announced as a DNS server. Only if **DNS Forwarding** is enabled.
Manual: Manually set IP address is announced as a DNS server.

Primary DNS server
IP address, default = 0.0.0.0
The IP address of the primary DNS server being announced.

Set secondary DNS server
List box {Off; On}, default = "Off"
Determines if the secondary DNS server is announced.

Secondary DNS server

IP address, default = 0.0.0.0
The IP address of the secondary DNS server being announced.

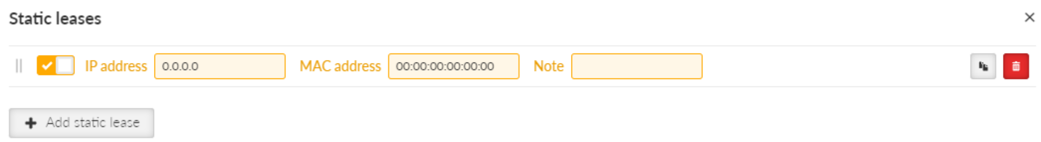
Announce NTP server

List box {Off; Local; Manual}, default = "Off"
Configures the announcing of the NTP server to clients.
Off: NTP server is not announced.
Local: The router’s IP is announced as an NTP server.
Manual: Manually set IP address is announced as an NTP server.

NTP server

IP address, default = 0.0.0.0
The IP address of the NTP server being announced.

7.7.1.2. Static leases



Static leases

IP address 0.0.0.0 MAC address 00:00:00:00:00:00 Note

Fig. 7.39: SETTINGS > Services > DHCP servers > Static leases

Each line defines a static assignment of a fixed IP address to the client based on the MAC address.

Enable

Listbox {Enable; Disable}, default = "Enable"
Enables/Disables selected line.

IP address

IP address, default = 0.0.0.0
The fixed IP address assigned to the client.
Must be unique in the Static Leases table.
Must belong to the parent range in the DHCP Servers table.
It must not conflict with the local station address.

MAC address

MAC address, default = 00:00:00:00:00:00
The MAC address of the client for which the fixed IP address is assigned.
Must be unique in the Static Leases table.

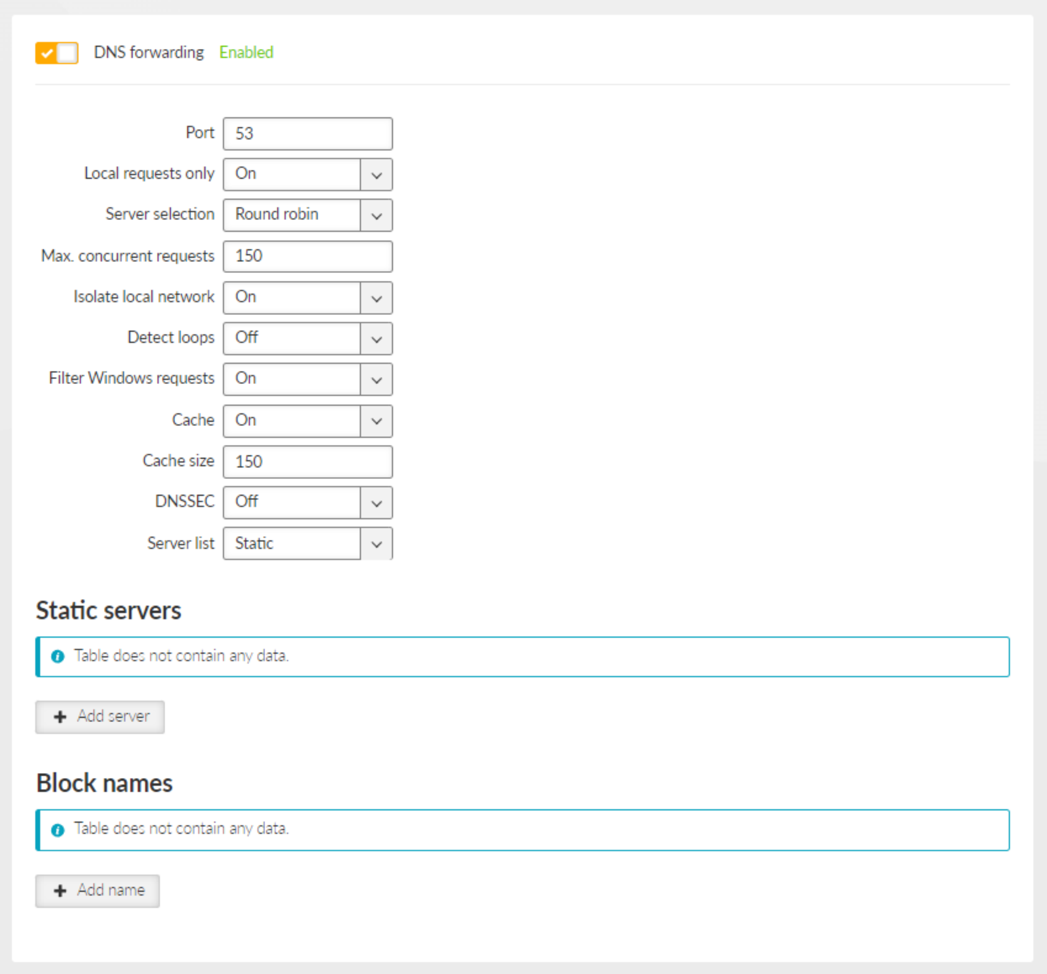
Note

Informational note.

7.7.2. DNS

DNS forwarding functions as a DNS proxy server. Receives DNS queries from clients on selected interfaces. Filters queries. Translation of selected names can be blocked. Sends custom queries to a specified list of servers. Maintains a cache from which the client can respond immediately without querying parent servers.

7.7.2.1. Configuration



DNS forwarding Enabled

Port	53
Local requests only	On
Server selection	Round robin
Max. concurrent requests	150
Isolate local network	On
Detect loops	Off
Filter Windows requests	On
Cache	On
Cache size	150
DNSSEC	Off
Server list	Static

Static servers

Table does not contain any data.

Block names

Table does not contain any data.

Fig. 7.40: SETTINGS > Services > DNS forwarding

Enable

Listbox {Enable; Disable}, default = "Enable"
Enables/Disables DNS forwarding.

Port

Number {1 – 65535}, default = 53
The port number (both UDP and TCP) on which the server listens for client requests.

Local requests only

Listbox {Off; On}, default = "On"
Determines if the server only serves requests from addresses on the local network (from addresses in ranges set on the interfaces). Requests from other addresses will be rejected.

Server selection

List box {Round robin; Strict order; All simultaneously}, default = "Round robin"
Sets how servers are selected for the query.

Round robin

Selects servers one by one, preferring those that answered.

Strict order
Always starts with the first server in the list, and tries the next in the sequence if it fails.

All simultaneously
The request is sent to all servers at the same time and the first response is awaited.

Max. concurrent requests
Number {5 – 250}, default = 150
The maximum number of DNS requests running simultaneously.

Isolate local network
Listbox {Off; On}, default = "On"
Determines whether the server isolates the local network. If enabled, it blocks forcing translation of local addresses from parent servers, it does not send reverse queries to private addresses to parent servers.

Detect loops
Listbox {Off; On}, default = "Off"
Enables loop detection between DNS servers.

Filter Windows requests
Listbox {Off; On}, default = "On"
Filters periodic DNS requests generated by Windows.

Cache
Listbox {Off; On}, default = "On"
Enables cache responses to DNS requests. If the response to the client request is cached, it is returned immediately and there is no need to make further requests to the parent servers.

Cache size
Number {50 – 10000}, default = 150
Maximum number of entries in the cache.

DNSSEC
Listbox {Off; On}, default = "Off"
Enables authentication of responses from parent servers using DNSSEC and chain of trust (**DNS trust anchors** table).

Server list
Listbox {Static; Dynamic}, default = "Static"

Static
Static list of servers in the **Static servers** table.

Dynamic
Listbox {WWAN (MAIN); WWAN (EXT); PPP 1; PPP 2; PPP 3; PPPoE client}, default = "PPPoE client"
The list of servers is obtained from the dynamic WAN interface parameters. The corresponding interface must be active.

7.7.2.1.1. Static servers

The rows define the addresses of the parent DNS servers in the static list.

The maximum number of DNS servers is 32.

Active only if Server list is set to Static.

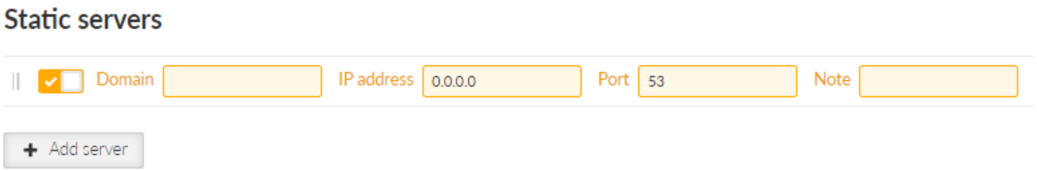


Fig. 7.41: SETTINGS > Services > DNS forwarding > Static servers

Enable
Listbox {Enable; Disable}, default = "Enable"
Enables/Disables selected line.

Domain
String {0–128 char}, default = <empty>
Domain name.

IP address
IP address, default = 0.0.0.0
IP address of the static server.

Port
Number {1 – 65535}, default = 53
The destination port on which the server listens for DNS requests.

Note
Informational note.

7.7.2.1.2. Block names

Each line defines DNS names whose translation is blocked.

The maximum number of blocked names is 128. The order does not matter.

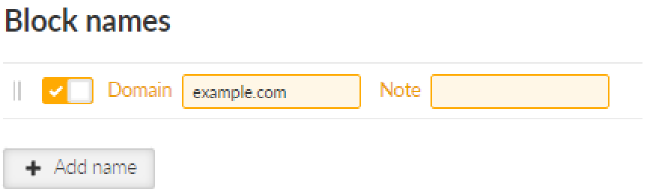


Fig. 7.42: SETTINGS > Services > DNS forwarding > Block names

Enable
Listbox {Enable; Disable}, default = "Enable"
Enables/Disables selected line.

Domain
String {0–128 char}, default = "example.com"
Domain name, which translation to the address will be blocked.

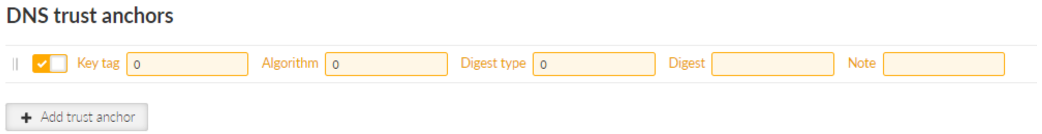
Note
Informational note.

7.7.2.1.3. DNS trust anchors

Each line defines a DNSSEC Trust Anchor.

The maximum number of DNSSEC Trust Anchors is 8. The order does not matter.

Active only if Cache and DNSSEC are turned On.



DNS trust anchors

☑ Key tag 0 Algorithm 0 Digest type 0 Digest Note

Fig. 7.43: SETTINGS > Services > DNS forwarding > DNS trust anchors

Enable
Listbox {Enable; Disable}, default = "Enable"
Enables/Disables selected line.

Key tag
Number {0 – 65535}, default = 0
Key identifier. Must be unique among the active lines in the table.

Algorithm
Number {0 – 255}, default = 0
Key algorithm identifier.

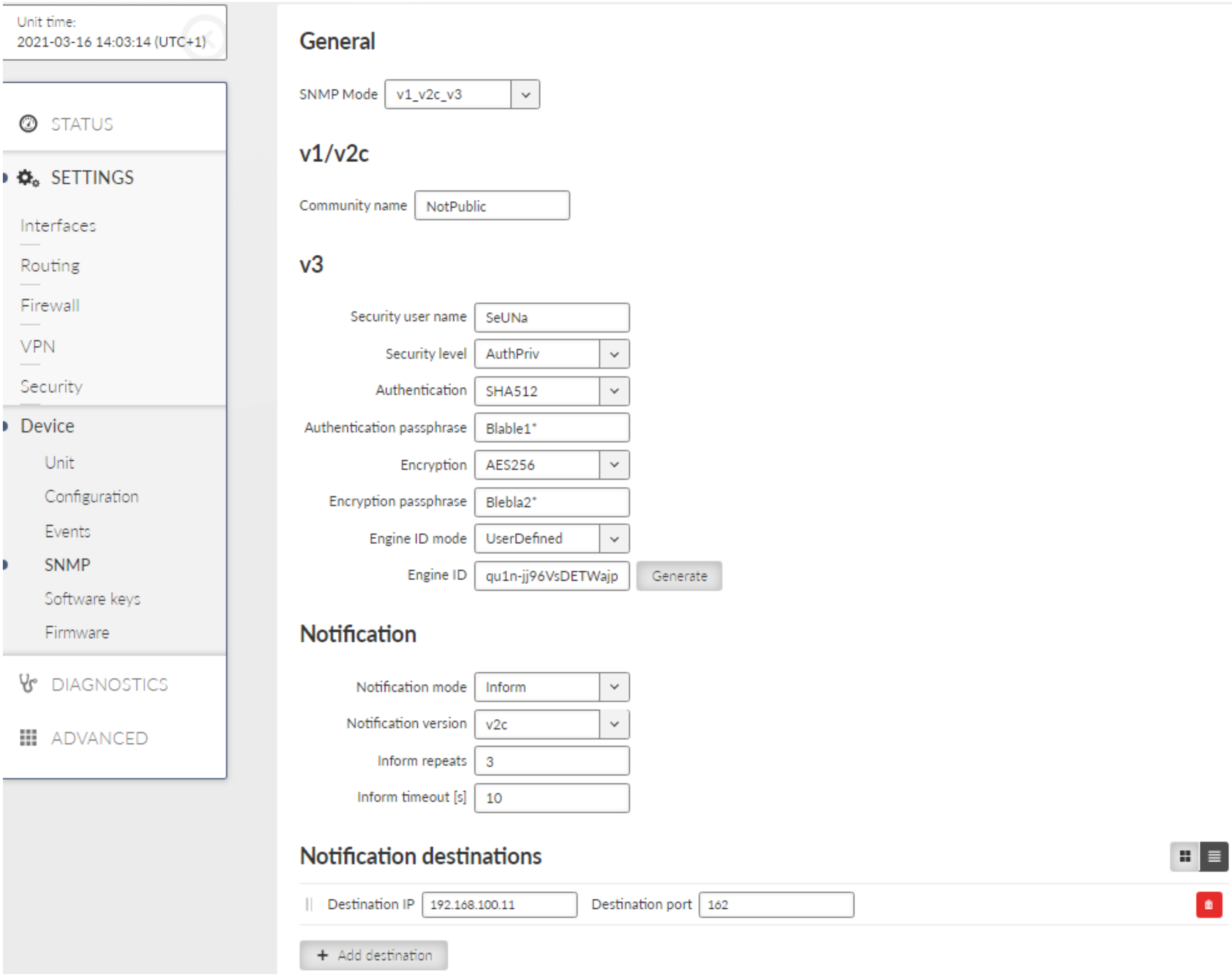
Digest type
Number {0 – 255}, default = 0
Key digest algorithm identifier.

Digest
Hexadecimal string, default = <empty>
Digest (hash) key.

Note
Informational note.

7.7.3. SNMP

SNMP (Simple Network Management Protocol) implementation in M!DGE3 provides three SNMP versions: v1, v2c and v3.



General

SNMP Mode: v1_v2c_v3

v1/v2c

Community name: NotPublic

v3

Security user name: SeUNa
Security level: AuthPriv
Authentication: SHA512
Authentication passphrase: Blable1*
Encryption: AES256
Encryption passphrase: Blebla2*
Engine ID mode: UserDefined
Engine ID: qu1n-jj96VsDETWajp

Notification

Notification mode: Inform
Notification version: v2c
Inform repeats: 3
Inform timeout [s]: 10

Notification destinations

Destination IP: 192.168.100.11 Destination port: 162

Note

Following characters are prohibited in SNMP communication:
" (Double quote) ` (Grave accent) \ (Backslash) $ (Dollar symbol) ; (Semicolon)

SNMP mode

List box {Off; v1_v2c_v3; v3}, default = "Off"
Enables the SNMP and defines which protocol versions are available.

Community name

String {1–32 char}, default = "public"
Community name used by v1 and v2c. When mode v1_v2c_v3 is used, this parameter is mandatory.

Version 3 settings

Security username

String {1–32 char}, default = <empty>
Username for SNMPv3. When v3 protocol is selected, this parameter is mandatory.

Security level

List box {NoAuthNoPriv; AuthNoPriv; AuthPriv}, default = "NoAuthNoPriv"
The v3 protocol security level. Switches on/off Authentication (Auth) and the SNMP data encryption (Priv).

Authentication

List box {MD5_legacy; SHA1_legacy; SHA224; SHA256; SHA384; SHA512}, default = "SHA256"
Authentication algorithm. Legacy algorithms are not recommended to use, they are available for compatibility reasons only.

Authentication passphrase

String {8–128 char}, default = <empty>
Passphrase used for authentication with SNMP server.

Encryption

List box {DES_legacy; AES128; AES192; AES256}, default = "AES128"
Encryption algorithm.

Encryption passphrase

String {8–128 char}
Passphrase used for data encryption when communicating with SNMP server.

Engine ID mode

List box {Default; User defined}, default = "Default"
Engine ID serves for unique identification of the SNMP instance (i.e. the M!DGE3 unit) according to RFC3411. When the "Default" Engine ID mode is selected the MAC address of the ETH1 interface is used for the unique part of the Engine ID (the whole Engine ID example: 800083130302a92006ef).

Engine ID

String {1–27 char}
When "User defined" Engine ID mode is selected the differentiated part of the Engine ID can be entered as ASCII characters or generated (e.g. U3qPrisWoDYbBVNsAWluZYGL3M5). This string is converted into HEX number (i.e. 55 33 71 50 72 69 73 57 6f 44 59 62 42 56 4e 73 41 57 6c 75 5a 59 47 4c 33 4d 35). The whole Engine ID for mentioned example: 800083130455337150726973576f44596242564e7341576c755a59474c334d35.

Notification

Notification is used for asynchronous notification from a M!DGE3 unit into the SNMP server.

Notification mode

List box {Off; Trap; Inform}, default = "Off"
Mode of notification; Inform is not supported by SNMPv1.

Notification version

List box {v1; v2c; v3}, default = "v2c"
Notification packets version.

Inform repeats

Number {0 – 10}, default = 3
Number of repeats used when Inform acknowledge was not received.

Inform timeout [s]

Number {1 – 20}, default = 10
Inform acknowledge timeout.

Notification destinations

Destination IP

IP address, default = 0.0.0.0

IP address of SNMP server receiving notification packets.

Destination port

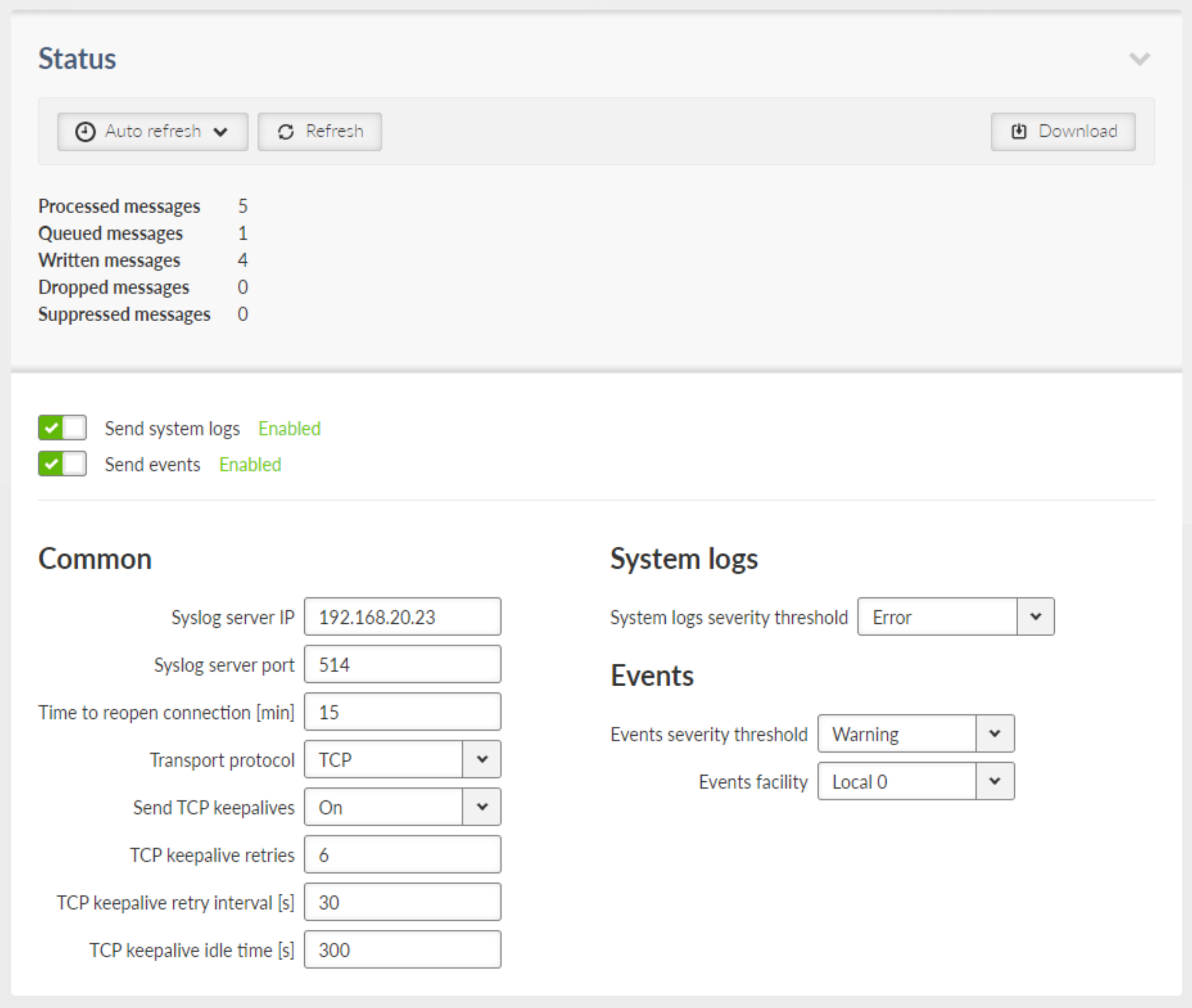
Number {1 – 65535}, default = 162
Notification packets destination port.

For more detailed information, please see *SNMP application note*[10].

7.7.4. Syslog

Syslog enables logging of events on a remote server. Syslog messages are created in the unit in accordance with RFC5424 and sent to a remote server. Messages can be sent using UDP or TCP.

New system logs and events start to be sent to the remote server after the station boots. Incase of unavailability of the remote server, the logs are stored in the disk buffer and sent to the remote server after re-establishing a connection with it.



Processed messages	5
Queued messages	1
Written messages	4
Dropped messages	0
Suppressed messages	0

☑ Send system logs Enabled
☑ Send events Enabled

Common

Syslog server IP	192.168.20.23
Syslog server port	514
Time to reopen connection [min]	15
Transport protocol	TCP
Send TCP keepalives	On
TCP keepalive retries	6
TCP keepalive retry interval [s]	30
TCP keepalive idle time [s]	300

System logs

System logs severity threshold	Error

Events

Events severity threshold	Warning
Events facility	Local 0

Fig. 7.44: SETTINGS > Services > Syslog

[10] https://www.racom.eu/eng/products/m/ripex/app/snmp-ripex2/index.html

Send system logs

{Enable; Disable}, default = "Disable"
Activates/Deactivates sending of system logs to the remote server

Send events

{Enable; Disable}, default = "Disable"
Activates/Deactivates sending of system events to the remote server

Common

Syslog server IP

IP address, default = 0.0.0.0
IP address of the remote syslog server

Syslog server port

Number {1 – 65535}, default = 514
Syslog remote server port number

Time to reopen connection [min]

Number {1 – 240}, default = 15
Time (in minutes) to wait to retry of the connection to the remote server when the connection was closed

Transport protocol

List box {UDP; TCP}, default = "UDP"
Type of the protocol for the data transport

When TCP:

Send TCP keepalives

List box {Off; On}, default = "On"
Switches On/Off sending of the TCP keepalives messages

TCP keepalive retries

Number {1 – 15}, default = 6
Number of keepalive retries when the reply was not received.

TCP keepalive retry interval [s]

Number {10 – 240}, default = 30
The interval (in seconds) at which a TCP keepalive message is re-sent if no response is received.

TCP keepalive idle time [s]

Number {60 – 64800}, default = 300
Connection inactivity time (in seconds) waiting for the TCP keepalive message to be sent.

System logs

System logs severity threshold

List box {Emergency; Alert; Critical; Error}, default = "Emergency"
System messages with this and higher severities will be sent to the remote server. Messages with lower severities will not be sent.

Events

Events severity threshold

List box {Emergency; Alert; Critical; Error; Warning; Notice; Informational}, default = "Emergency"
System events with this and higher severities will be sent to the remote server. Events with lower severities will not be sent.

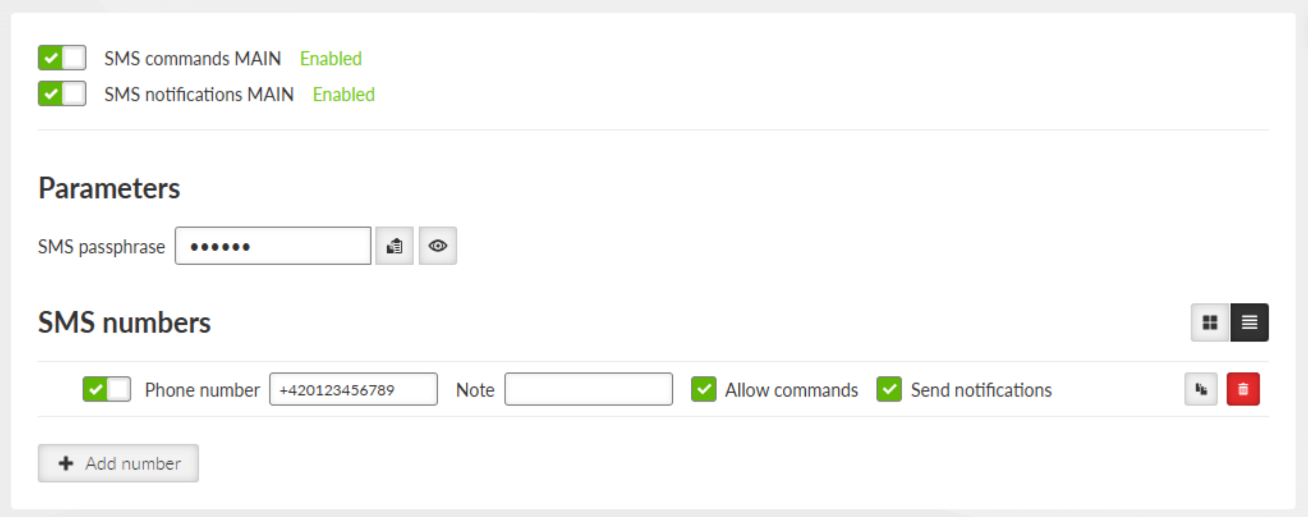
Events facility

List box {Local 0; Local 1; Local 2; Local 3; Local 4; Local 5; Local 6; Local 7}, default = "Local 7"
Classification of system events into facilities as per RFC 5424 for local use: Local 0 to Local 7 (numerical codes 16 to 23) can be set. Consult with your Syslog server administrator about which facility will be used for individual groups of units.

7.7.5. SMS

M!DGE3, fully connected into the cellular network (status CONNECTED), is capable of receiving and sending SMS.

- Receiving and sending SMS is provided by a linux service.
- The queue of SMS waiting for sending is controlled by appropriate diagnostic linux service.
- The length of the SMS depends on the type of module and coding. If longer SMS is required (only **SMS notifications**), it is divided into a Chained SMS.



☑ SMS commands MAIN Enabled
☑ SMS notifications MAIN Enabled

Parameters

SMS passphrase: ••••••

SMS numbers

☑ Phone number: +420123456789 Note: ☑ Allow commands ☑ Send notifications

Fig. 7.45: SETTINGS > Services > SMS

Note

This section closely cooperates with *Section 7.1.4, “Cellular”*.

SMS commands MAIN/EXT

{Enable; Disable}, default = "Disable"
Enables / Disables SMS commands for Cellular MAIN/EXT. When enabled, the software module allows all incoming SMS and proceeds to initiate commands.

- To process an SMS command from a phone number:
  - The specific phone number must be defined in parameter **SMS numbers**. If the phone number is not defined, the SMS will be not processed.

  - The SMS must contain a passphrase to pass the authentication (parameter **SMS passphrase)**.
  - The SMS must contain a valid *format of a command*.

- Only regular SMS are supported (Chained SMS are not).
- Some commands generate an automatic reply, which is sent to a defined phone number(s), if this feature is enabled.
- If this parameter is disabled, all incoming SMS will be deleted.

SMS notifications MAIN/EXT
{Enable; Disable}, default = "Disable"
Enables / Disables SMS commands for Cellular MAIN/EXT.
When enabled, any change (if configured in *Section 7.6.3, “Events”*) will generate a notification SMS, which will be sent to all defined phone numbers with active notification.

- To send an SMS notification to a phone number:
  - The specific phone number must be defined in parameter **SMS numbers**. If the phone number is not defined, it will not receive any notification.
- Chained SMS are supported.
- Sending SMS notifications can be activated in *Section 7.6.3, “Events”*.

7.7.5.1. Parameters

SMS passphrase
String {2–16 ASCII char}, default = "public"
Sets an SMS passphrase, which serves as an authentication to send SMS from defined phone number(s). The range of length of the passphrase is between 2–16 characters. SMS passphrase must not contain any unsupported characters. Unsupported characters are: ", `, \, $, ;.

7.7.5.2. SMS numbers

Phone number
{Enable; Disable}, default = "Enable"
Enables / Disables phone number. When enabled, defined phone number can either send or receive (or both) SMS. Amount of phone numbers, which can receive and send SMS is limited to 10.

Note
Optional comment.

Allow commands
{On; Off}, default = "On"
Allows to accept commands from defined phone number.

> **Note**
> This parameter will work only if parameter SMS commands MAIN/EXT is enabled.

Send notifications
{On; Off}, default = "On"
Allows to send notifications to defined phone number.

Note
This parameter will work only if parameter SMS notifications MAIN/EXT is enabled.

7.7.5.3. SMS commands

All commands must match following format:

<passphrase>"space"<command>"space"[<param1>...]

SMS commands:

cellstatus

Example: public cellstatus
Request for SMS with extract of Cellular status of the module, which received the SMS.
Reply of command "cellstatus":
Station: *<station_name>*
<module_type> *<SIM>* Profile *<profile_id>*
Status: *<connection_state>*
Reg: *<registration_state>*
Net: *<PLMN>*
Svc: *<service_type>*
Band: *<band>*
Signal: *<signal_strength>*
APN: *<username_APN>*
IP: *<assigned_IP>*
Example of reply for command "cellstatus":
Station: Alef
EXT SIM2 Profile 1
Status: CONNECTED
Reg: RegHome
Net: 23002
Svc: 2G_EDGE
Band: ARFCN 77
Signal: RSSI: >=-48 dBm
APN: internet
IP: 100.110.103.173

smsevent <param>

Example: public smsevent raise
This command is used to turn on/off alarms which can be set in *Section 7.6.3, “Events”* by using its parameters ("raise", "clear").
This command does not generate an automatic reply.

7.7.6. GNSS server

GNSS server collects data from a GNSS (GPS) receiver and provides the data to potentially multiple client applications in a server-client application architecture. Internally is used by the NTP.

Data retrieval is possible using a gpsd client application (such as cgps or gpspipe). JSON data format is supported, and TPV, SKY, and PPS data frames are available.

Enable GNSS

List box {On; Off}, default = Off

Enables / disables GNSS subsystem. This parameter occurs only, if GNSS module is available in the unit.

Enable GNSS server - Advanced menu

List box {On; Off}, default = Off

Enables / disables GNSS server. This parameter can be set only, if parameter **Enable GNSS server** is set to "On".

GNSS server port

Number {1 – 65535}, default = 2947

Sets a TCP port number of the GNSS server. This parameter can be set only, if parameters **Enable GNSS server** and **GNSS server port** are set to "On".

Maximal GNSS downtime [min]

Number {1 – 65535}, default = 15

Sets a timer which counts for how long the unit does not need new data about location (when GNNS active). If the time runs out, security actions are triggered (linux service restart, module restart). This parameter can be set only, if parameter **Enable GNSS server** is set to "On".

7.8. Advanced

M!DGE3 introduces new concept for expert settings and rapid deployment of new features called “Advanced” section. Advanced section displays all configuration set points currently present in the device automatically, without need to design a special configuration page (like the ones in “Settings”). This allows us to deploy new features rapidly with each new firmware and also allows experienced users to fine-tune their M!DGE3.

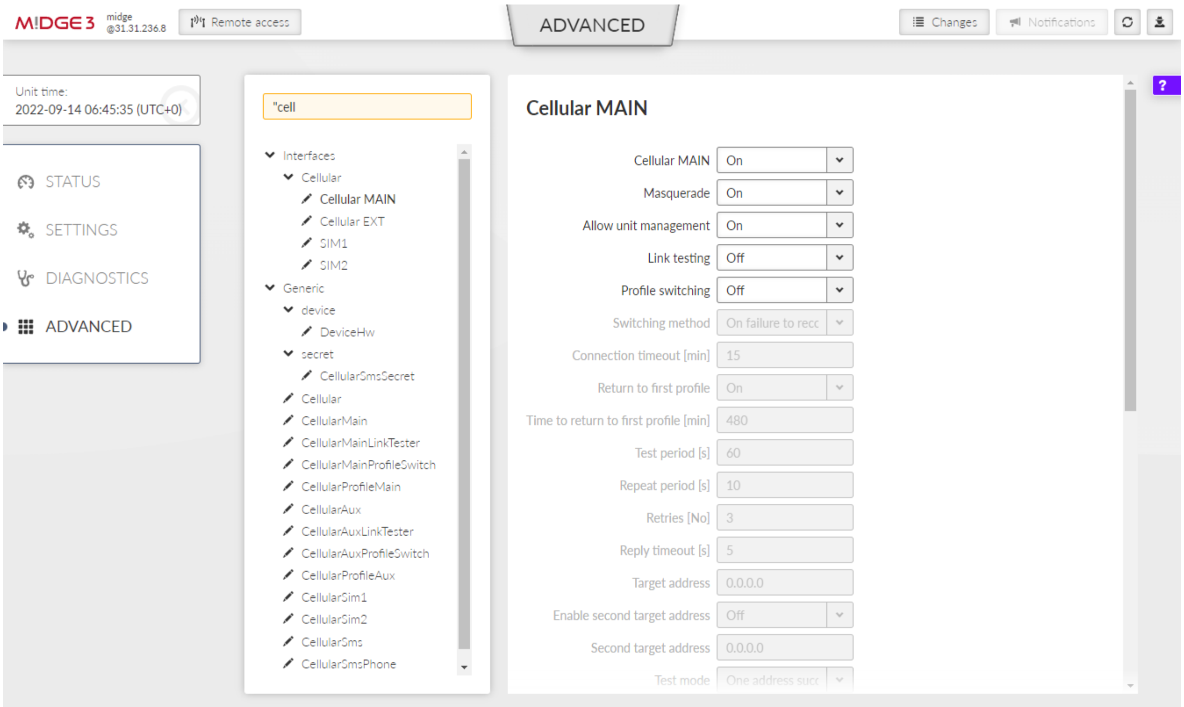
Please note, that M!DGE3 is a very powerful device and it really shows all parameters in the Advanced section.

When you visit the page for the first time, you will see a search field and below a tree of configuration pages.

Search field looks through all labels and the tree itself and is capable of showing all relevant configuration pages. It features so called “fuzzy” search capable of returning right answers even when there is a typo in search query. Try searching for “Ethernet” or “BGP” to see the feature in action. To use the whole tree again, simply delete search query.

Configuration tree has two parts. For your convenience first few items (Interfaces, Routing, …) use similar hierarchy to “Settings”, but include all advanced settings. The newest features then can be found in the last item called “General”, which contains all configuration tables there are in the unit.

By selecting a configuration page (marked with pencil icon) a window is shown on the right side of the screen containing selected configuration page set points. You can change settings and then send them to the device the same way you know from “Settings”.



Unit time: 2022-09-14 06:45:35 (UTC+0)

"cell

Cellular MAIN

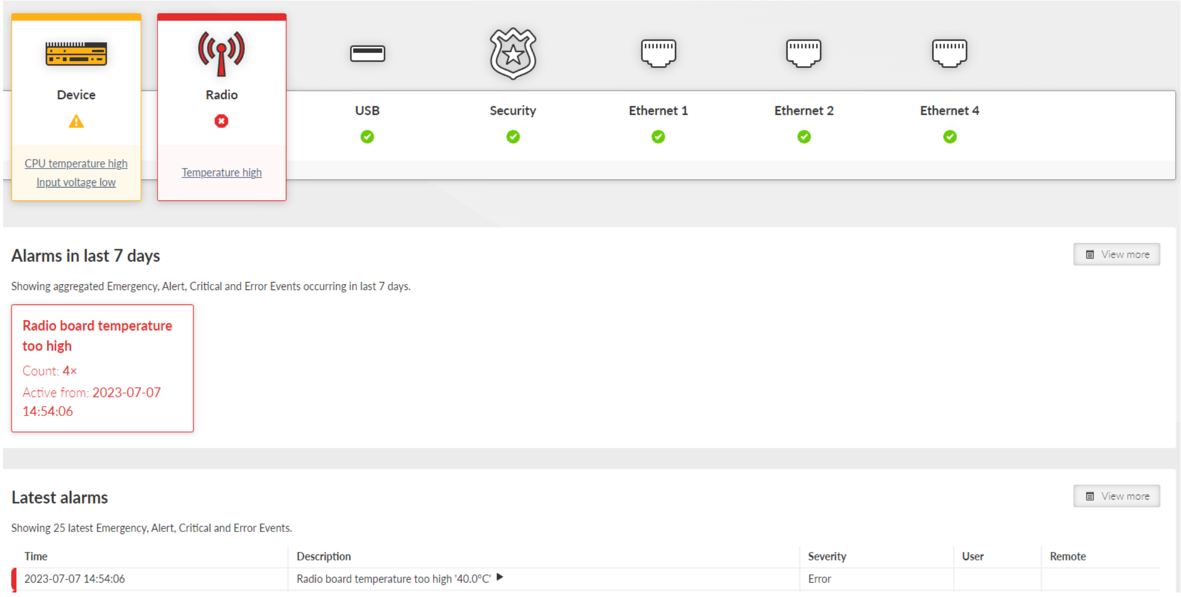
Cellular MAIN	On
Masquerade	On
Allow unit management	On
Link testing	Off
Profile switching	Off
Switching method	On failure to recc
Connection timeout [min]	15
Return to first profile	On
Time to return to first profile [min]	480
Test period [s]	60
Repeat period [s]	10
Retries [No]	3
Reply timeout [s]	5
Target address	0.0.0.0
Enable second target address	Off
Second target address	0.0.0.0
Test mode	One address succ

Be careful when adjusting settings in Advanced section and review the “Changes” page in detail before sending changes to the device.

8. Diagnostics

8.1. STATUS overview

Provides overview information about individual sections of the unit. ach section is linked with an area of Events (see Section 8.4, *“Events”*).



Alarms in last 7 days

Showing aggregated Emergency, Alert, Critical and Error Events occurring in last 7 days.

Radio board temperature too high

Count: 4×

Active from: 2023-07-07 14:54:06

Latest alarms

Showing 25 latest Emergency, Alert, Critical and Error Events.

Time	Description	Severity	User	Remote
2023-07-07 14:54:06	Radio board temperature too high '40.0°C' ▶	Error		

When any event with severity higher than Notice occurs in the unit, corresponding icon will change the color according to the severity of the event, the link leads to further information about the event in the DIAGNOSTICS menu. STATUS also shows and describes alarms in last week which are highlighted under icons. Latest 25 Emergency, Alert, Critical and Error Events are displayed at the bottom of the page.

Tab. 8.1: Unit section icons

	Device
	USB
	Security
	Ethernet 1-5

Note

The number of visible Ethernet icons is depended on the units settings. (SETTINGS > Interfaces > Ethernet > Ports)

To each event an individual severity can be assigned. When multiple Events with different severities are triggered in the same section, the priority goes: Error > Warning > Notice.

Tab. 8.2: Severity icons

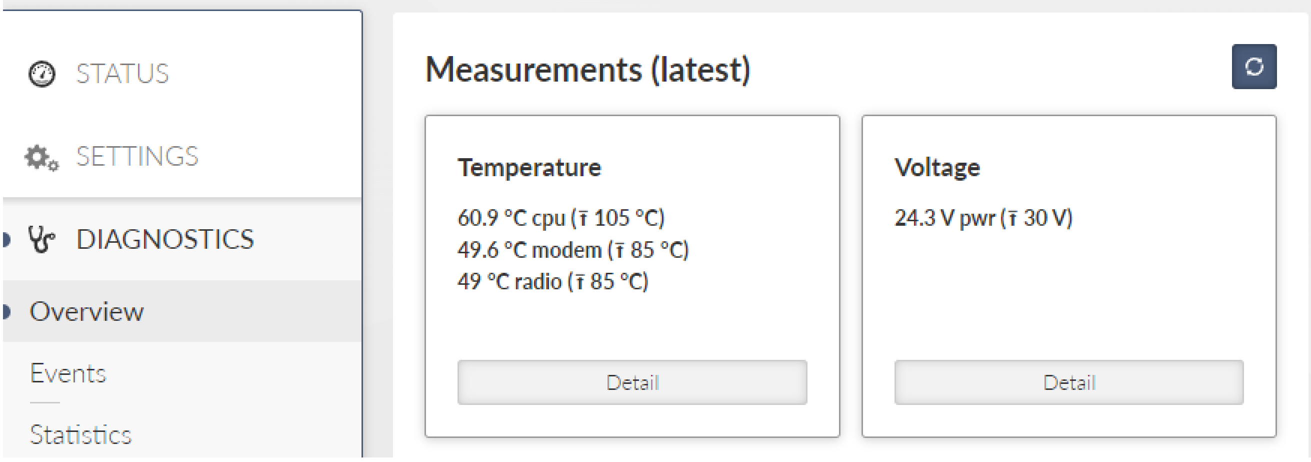
✓	Unit works flawlessly
ℹ	Informational, Notice
⚠	Warning
✖	Error, Critical, Alert, Emergency

8.2. Overview

The Overview section serves to give general information about the M!DGE3.

8.2.1. Measurements

Section Overview - Measurements contains current data measurement (obtained from sensors).



Measurements (latest)

Temperature

60.9 °C cpu (ī 105 °C)
49.6 °C modem (ī 85 °C)
49 °C radio (ī 85 °C)

Voltage

24.3 V pwr (ī 30 V)

- Card Temperature - provides data about temperature (on CPU, modem).
- Card Voltage - provides data about voltage measured on input connector.

Arrow-headed symbols (↑, ↓, →) have following meaning:

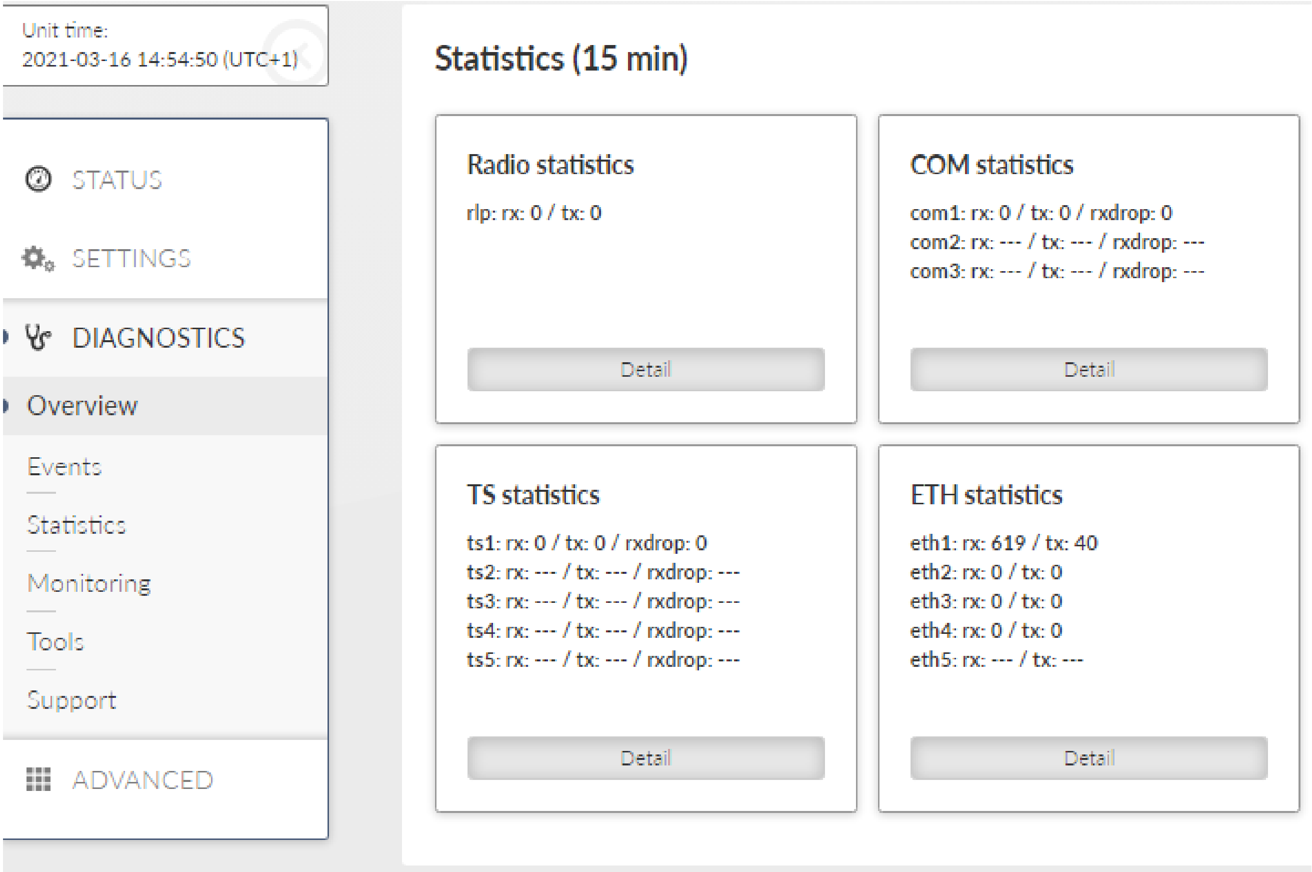
- ↑ - Maximum-limit value. An alarm is triggered, when the value (displayed in brackets) is exceeded.
- ↓ - Minimum-limit value. An alarm is triggered, when the value falls under the value, which is displayed in the brackets.
- →- Value is supposed to head to another one.

Note

Value measurements are collected once per 10s.

8.2.2. Statistics

Section Overview - Statistics shows a short view of the statistics over last 15 minutes (from the time of opening the window or pressing Refresh button).



Statistics (15 min)

Radio statistics

rlp: rx: 0 / tx: 0

COM statistics

com1: rx: 0 / tx: 0 / rxdrop: 0
com2: rx: --- / tx: --- / rxdrop: ---
com3: rx: --- / tx: --- / rxdrop: ---

TS statistics

ts1: rx: 0 / tx: 0 / rxdrop: 0
ts2: rx: --- / tx: --- / rxdrop: ---
ts3: rx: --- / tx: --- / rxdrop: ---
ts4: rx: --- / tx: --- / rxdrop: ---
ts5: rx: --- / tx: --- / rxdrop: ---

ETH statistics

eth1: rx: 619 / tx: 40
eth2: rx: 0 / tx: 0
eth3: rx: 0 / tx: 0
eth4: rx: 0 / tx: 0
eth5: rx: --- / tx: ---

- Cards Statistics are always displayed for all interfaces.
- If the interface is off, its statistics (record) is displayed as “-“.
- Statistics collection is updated every 1 s (each second is possible to see new values).
- 15-min interval is collected by taking 14 mins from history + seconds passed from current minute.

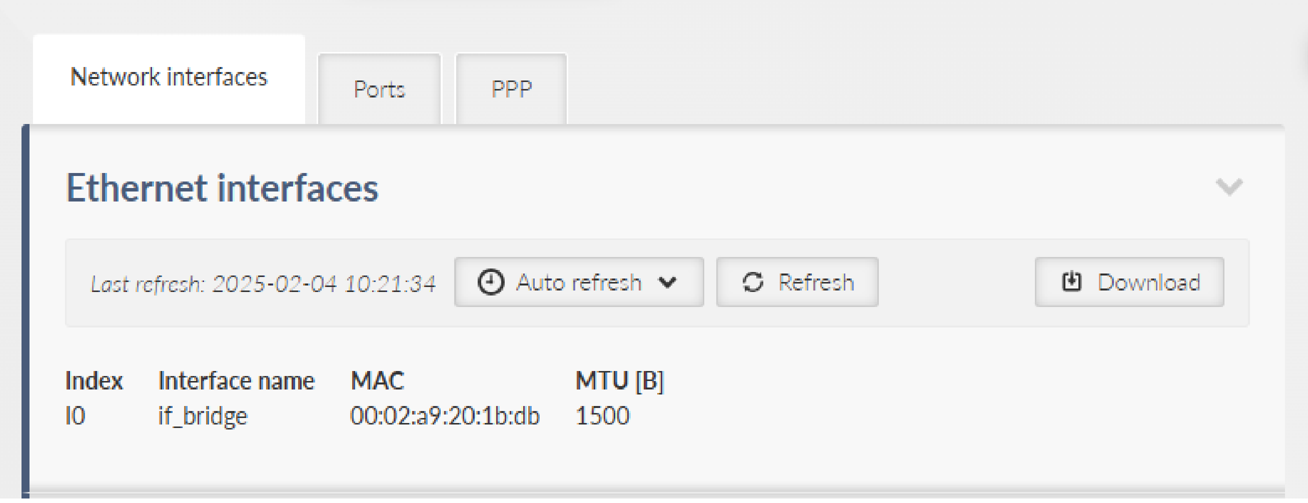
8.3. Information

This section provides more detailed information (data extract) about settings of M!DGE3 unit. It provides also a deeper explanation about some of set values and interfaces. Diagnostic data are provided as well.

8.3.1. Interfaces

Provides a complete information extract about all active interfaces (addresses, details and statistics included). All interfaces used by the linux router (including all internal interfaces like npi, loop, ag, ip6tnl, etc.) are displayed in this section.

8.3.1.1. Ethernet Interfaces



Last refresh: 2025-02-04 10:21:34

Index	Interface name	MAC	MTU [B]
I0	if_bridge	00:02:a9:20:1b:db	1500

Fig. 8.1: DIAGNOSTICS > Information > Interfaces > Ethernet

Interfaces used in M!DGE3 units are in general either Bridged ports (BP-L2) or Routed interfaces (RI-L3).

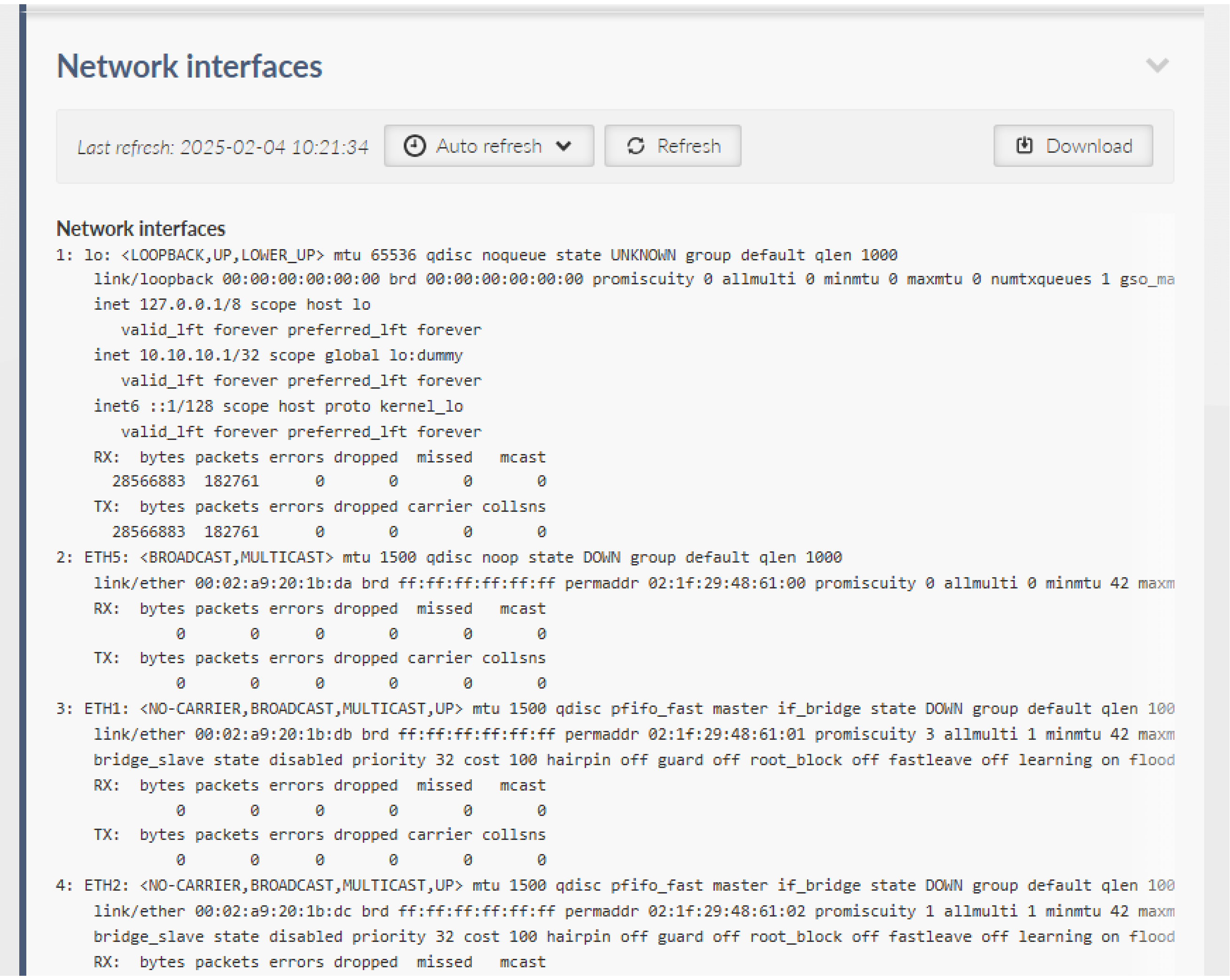
All interfaces used by the linux router (internal interfaces excluded) are displayed in the following list.

if_*<LanIface_Name>*
LAN bridge interface RI-L3 type
(SETTINGS > Interfaces > Ethernet > Network interfaces)

if_*<LanVlan_IfName>*.*<LanVlan_VlanId>*

- VLAN BP-L2 interface type (if used as a port in LAN bridge) (SETTINGS > Interfaces > Ethernet > Network interfaces>VLAN)
- VLAN RI-L3 interface type (if not used as a port in LAN bridge) (SETTINGS > Interfaces > Ethernet > Network interfaces > IP/Subnet > VLAN)

8.3.1.2. Network Interfaces



Network interfaces

```
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00 promiscuity 0 allmulti 0 minmtu 0 maxmtu 0 numtxqueues 1 gso_ma
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet 10.10.10.1/32 scope global lo:dummy
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host proto kernel_lo
       valid_lft forever preferred_lft forever
    RX:  bytes packets errors dropped  missed   mcast
      28566883  182761      0       0       0       0
    TX:  bytes packets errors dropped carrier collsns
      28566883  182761      0       0       0       0
2: ETH5: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group default qlen 1000
    link/ether 00:02:a9:20:1b:da brd ff:ff:ff:ff:ff:ff permaddr 02:1f:29:48:61:00 promiscuity 0 allmulti 0 minmtu 42 maxm
    RX:  bytes packets errors dropped  missed   mcast
             0       0      0       0       0       0
    TX:  bytes packets errors dropped carrier collsns
             0       0      0       0       0       0
3: ETH1: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast master if_bridge state DOWN group default qlen 100
    link/ether 00:02:a9:20:1b:db brd ff:ff:ff:ff:ff:ff permaddr 02:1f:29:48:61:01 promiscuity 3 allmulti 1 minmtu 42 maxm
    bridge_slave state disabled priority 32 cost 100 hairpin off guard off root_block off fastleave off learning on flood
    RX:  bytes packets errors dropped  missed   mcast
             0       0      0       0       0       0
    TX:  bytes packets errors dropped carrier collsns
             0       0      0       0       0       0
4: ETH2: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast master if_bridge state DOWN group default qlen 100
    link/ether 00:02:a9:20:1b:dc brd ff:ff:ff:ff:ff:ff permaddr 02:1f:29:48:61:02 promiscuity 1 allmulti 1 minmtu 42 maxm
    bridge_slave state disabled priority 32 cost 100 hairpin off guard off root_block off fastleave off learning on flood
    RX:  bytes packets errors dropped  missed   mcast
```

Fig. 8.2: DIAGNOSTICS > Information > Interfaces > Ethernet

eth1, eth2, eth3, eth4
Interface of physical Ethernet ports ETH1 – ETH4, BP-L2 interface type

eth0
Interface of physical port SFP (ETH5), BP-L2 interface type

wwan
Bridge interface of the Main cellular module, RI-L3 interface type (SETTINGS > Interface > Cellular > MAIN)

ext
Bridge interface of the EXT cellular module, , RI-L3 interface type (SETTINGS > Interface > Cellular > EXT)

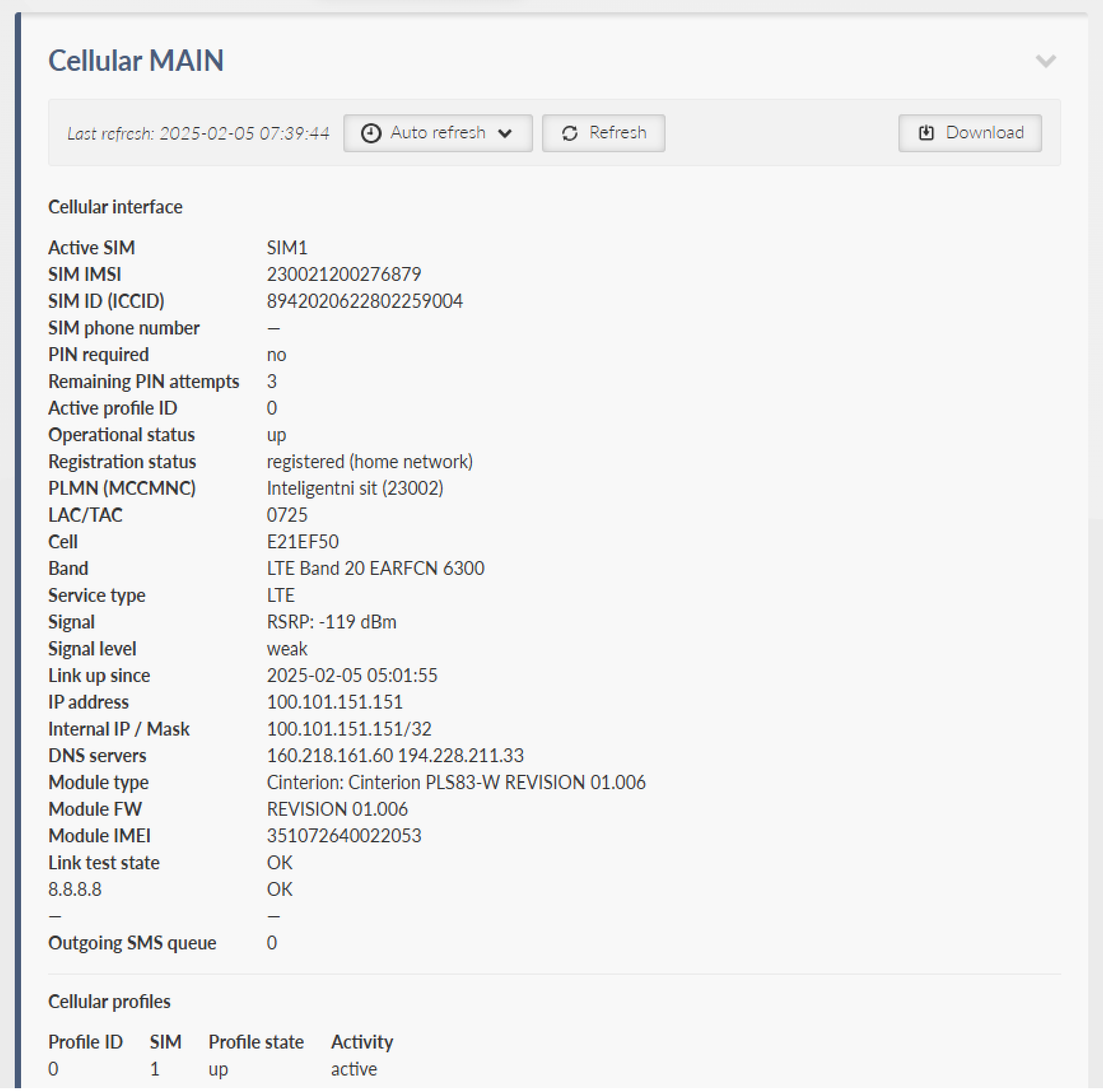
gre_tap<*INDEX*>
GRE L2 tunnel interface, BP-L2 interface type (SETTINGS > VPN > GRE > L2)

gre_tun<*INDEX* >
GRE L3 tunnel interface, RI-L3 interface type (SETTINGS > VPN > GRE > L3)

lo

Loopback interface RI-L3 type of interface – The IP addresses of the loopback (ADVANCED > Interfaces > Loopback).

8.3.1.3. Cellular interfaces



Last refresh: 2025-02-05 07:39:44

Cellular interface

Active SIM	SIM1
SIM IMSI	230021200276879
SIM ID (ICCID)	8942020622802259004
SIM phone number	–
PIN required	no
Remaining PIN attempts	3
Active profile ID	0
Operational status	up
Registration status	registered (home network)
PLMN (MCCMNC)	Inteligentni sit (23002)
LAC/TAC	0725
Cell	E21EF50
Band	LTE Band 20 EARFCN 6300
Service type	LTE
Signal	RSRP: -119 dBm
Signal level	weak
Link up since	2025-02-05 05:01:55
IP address	100.101.151.151
Internal IP / Mask	100.101.151.151/32
DNS servers	160.218.161.60 194.228.211.33
Module type	Cinterion: Cinterion PLS83-W REVISION 01.006
Module FW	REVISION 01.006
Module IMEI	351072640022053
Link test state	OK
8.8.8.8	OK
–	–
Outgoing SMS queue	0

Cellular profiles

Profile ID	SIM	Profile state	Activity
0	1	up	active

Fig. 8.3: DIAGNOSTICS > Information > Interfaces > Cellular

Active SIM

Currently used SIM

SIM IMSI

International Mobile Station Identity of the active SIM

SIM ID (ICCID)
Integrated Circuit Card ID of the active SIM

SIM phone number
SIM phone number, if it is stored in the SIM

PIN required
Whether the SIM you are currently using requires a PIN

Remaining PIN attempts
Remaining number of attempts to enter the PIN into the SIM

Active profile ID
ID of the SIM profile currently in use

Operational status
Connection status

Registration status
Registration status

PLMN (MCCMNC)
Provider name and PLMN of the connected network

LAC/TAC
LAC (2G, 3G) or TAC (4G, LTE Cat. M/NB) of the location to which the module is connected

Cell
ID of the cell

Band
Band used. Not filled in for 2G
Always added ARFCN (2G), UARFCN (3G) or EARFCN (4G, LTE Cat. M/NB) - channel number

Service type
Connected service

Signal
Current signal strength

Signal level
Current signal strength level

Link up since
The timestamp (with UTC) of the connection opening

IP address
IP address assigned to the interface when it is opened (from APN)

Internal IP / Mask
The IP address assigned to the interface when it is opened (internal, from the module)

DNS servers
IP addresses of DNS servers, separated by a space

Module type
Module name and manufacturer

Module FW
Module firmware version

Module IMEI
International Mobile Equipment Identity of the module

Link test state
Link testing status, if enabled

Outgoing SMS queue
SMS queued, waiting to be sent

Cellular profiles
Status of profiles

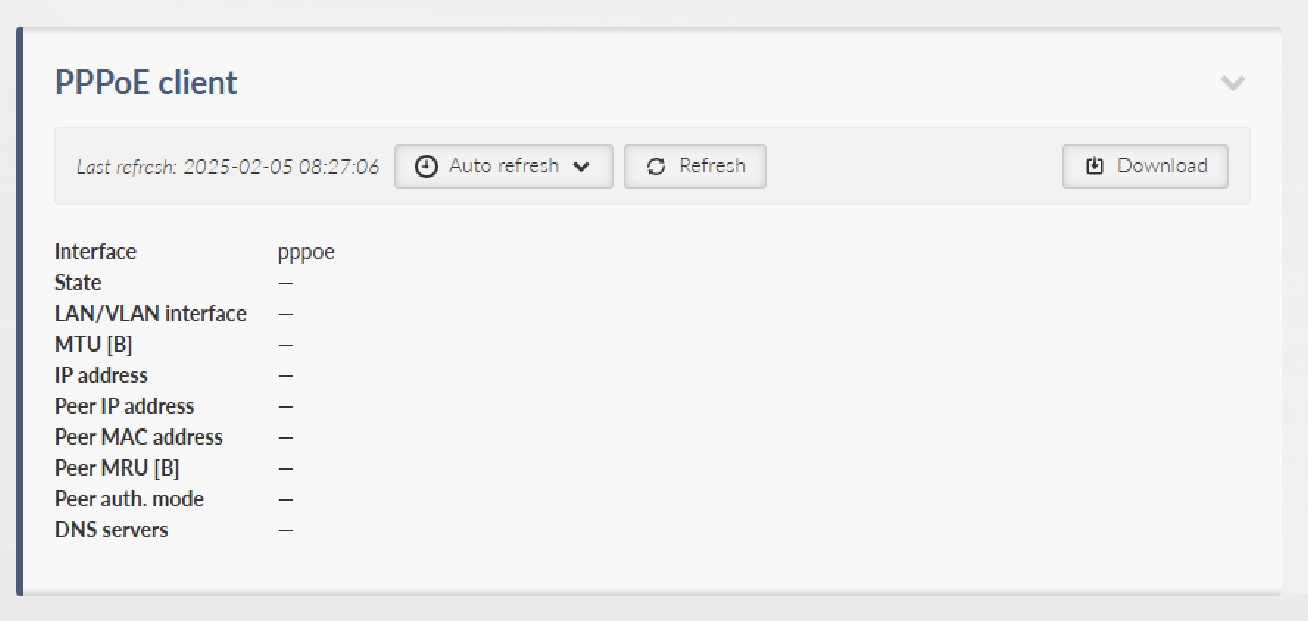
Profile ID
Profile ID in the profile table

SIM
SIM used by the profile

Profile state
Latest profile status

Activity
Whether the profile is currently active

8.3.1.4. PPPoE client



Last refresh: 2025-02-05 08:27:06

Interface	pppoe
State	–
LAN/VLAN interface	–
MTU [B]	–
IP address	–
Peer IP address	–
Peer MAC address	–
Peer MRU [B]	–
Peer auth. mode	–
DNS servers	–

Fig. 8.4: DIAGNOSTICS > Information > Interfaces > PPPoE client

Interface PPPoE interface name

State — Current state of the interface

LAN/VLAN interface — Name of the LAN/VLAN interface on which the PPPoE client is running

MTU [B] — MTU of the LAN/VLAN interface on which the PPPoE client is running

IP address — Assigned IP address

Peer IP address — IP address of the peer (server)

Peer MAC address — MAC address of the peer (server)

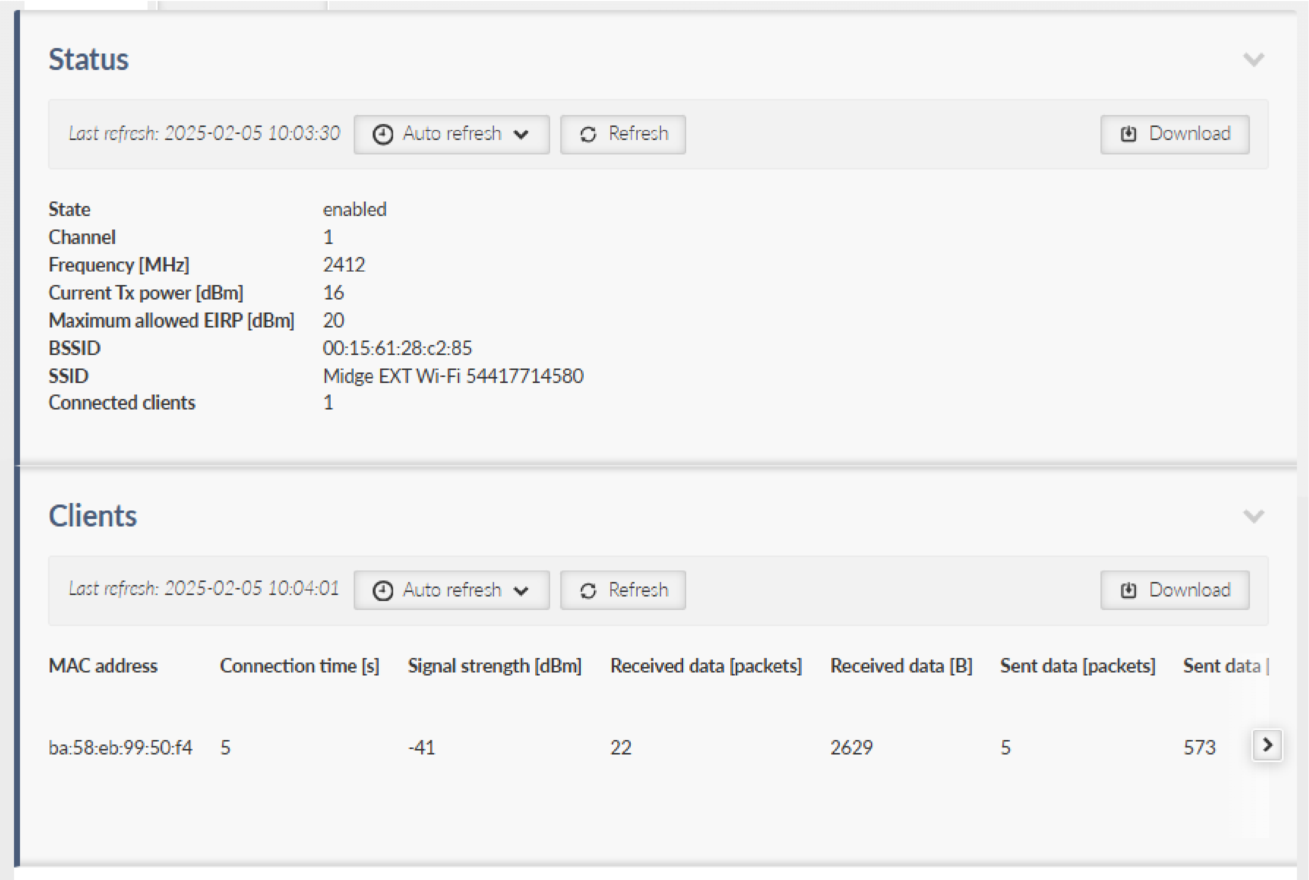
Peer MRU [B] — Maximum Receive Unit (MRU) in bytes requested by the negotiating peer

Peer auth. mode — Authentication protocol requested by the peer

DNS servers — IP addresses of DNS servers, separated by a space

8.3.1.5. Wi-Fi

Provides a detailed info about Wi-Fi Access point and connected Wi-Fi clients.



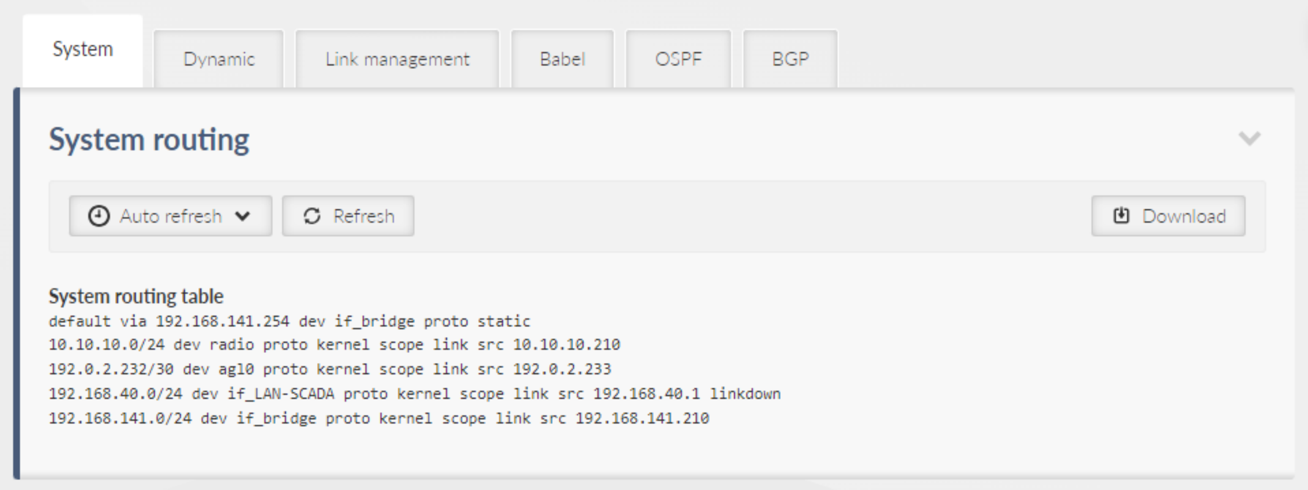
State	enabled
Channel	1
Frequency [MHz]	2412
Current Tx power [dBm]	16
Maximum allowed EIRP [dBm]	20
BSSID	00:15:61:28:c2:85
SSID	Midge EXT Wi-Fi 54417714580
Connected clients	1

MAC address	Connection time [s]	Signal strength [dBm]	Received data [packets]	Received data [B]	Sent data [packets]	Sent data
ba:58:eb:99:50:f4	5	-41	22	2629	5	573

Fig. 8.5: DIAGNOSTICS > Information > Interfaces > Wi-Fi

8.3.2. Routing

Provides information about data extract from section Routing.



System routing table

```
default via 192.168.141.254 dev if_bridge proto static
10.10.10.0/24 dev radio proto kernel scope link src 10.10.10.210
192.0.2.232/30 dev agl0 proto kernel scope link src 192.0.2.233
192.168.40.0/24 dev if_LAN-SCADA proto kernel scope link src 192.168.40.1 linkdown
192.168.141.0/24 dev if_bridge proto kernel scope link src 192.168.141.210
```

Fig. 8.6: DIAGNOSTICS > Information > Routing

This section is divided into following parts:

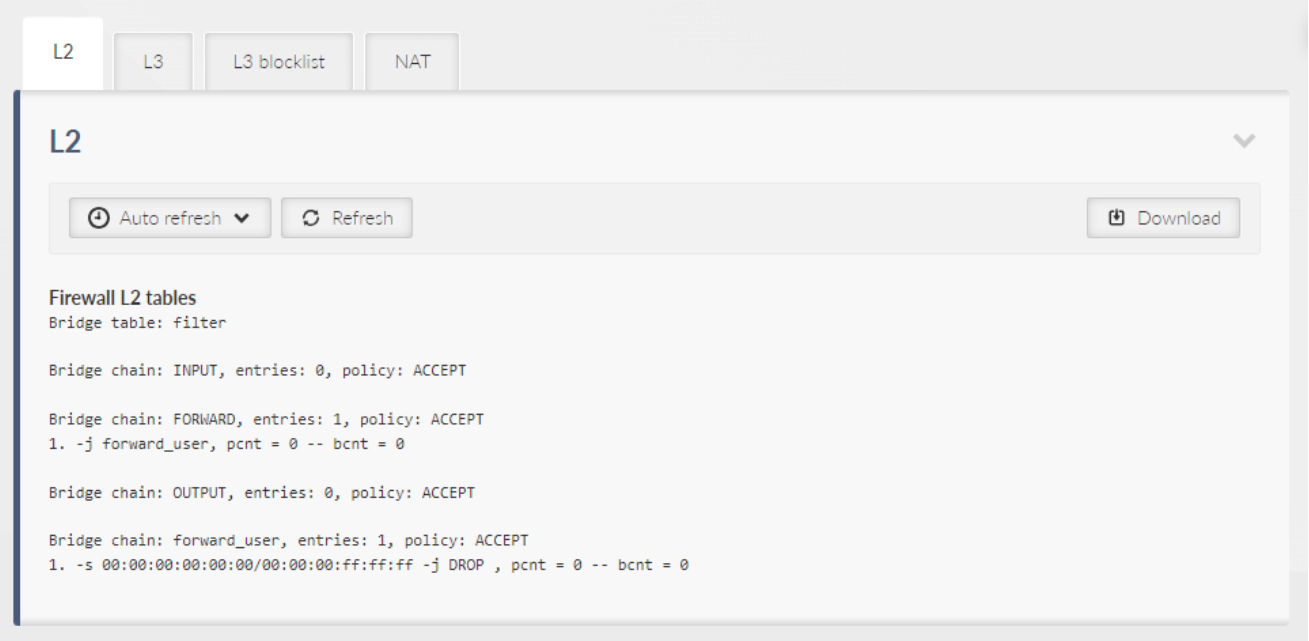
- System - complete data extract of system routing table. Displays data called by linux command “ip route show”.
- Dynamic - complete data extract of internal routing table of dynamic routing service bird master4. Displays data called by linux command “birdcl show route all table master4”.
- Babel - data extract of status of Babel protocol. Displays data called by following linux commands: “birdcl show babel interfaces”, "birdcl show babel neighbors", "birdcl show babel routes", "birdcl show babel entries", "birdcl show route all table babel_ipv4".
- OSPF- data extract of status of OSPF protocol. Displays data called by following linux commands: "birdcl show ospf neighbors", "birdcl show ospf state", "birdcl show ospf interface", "birdcl show route all table ospf_ipv4".
- BGP - data extract of status of all BGP protocol instances. Displays data called by following linux commands: "birdcl show protocol '"bgp*"'", "birdcl show protocol all '"bgp*"'", "birdcl show route all table bgp_ipv4".

8.3.3. Firewall

Provides general overview about data extract from sections L2, L3 and NAT.

8.3.3.1. Firewall L2

Displays data called by linux command “iptables -L”.



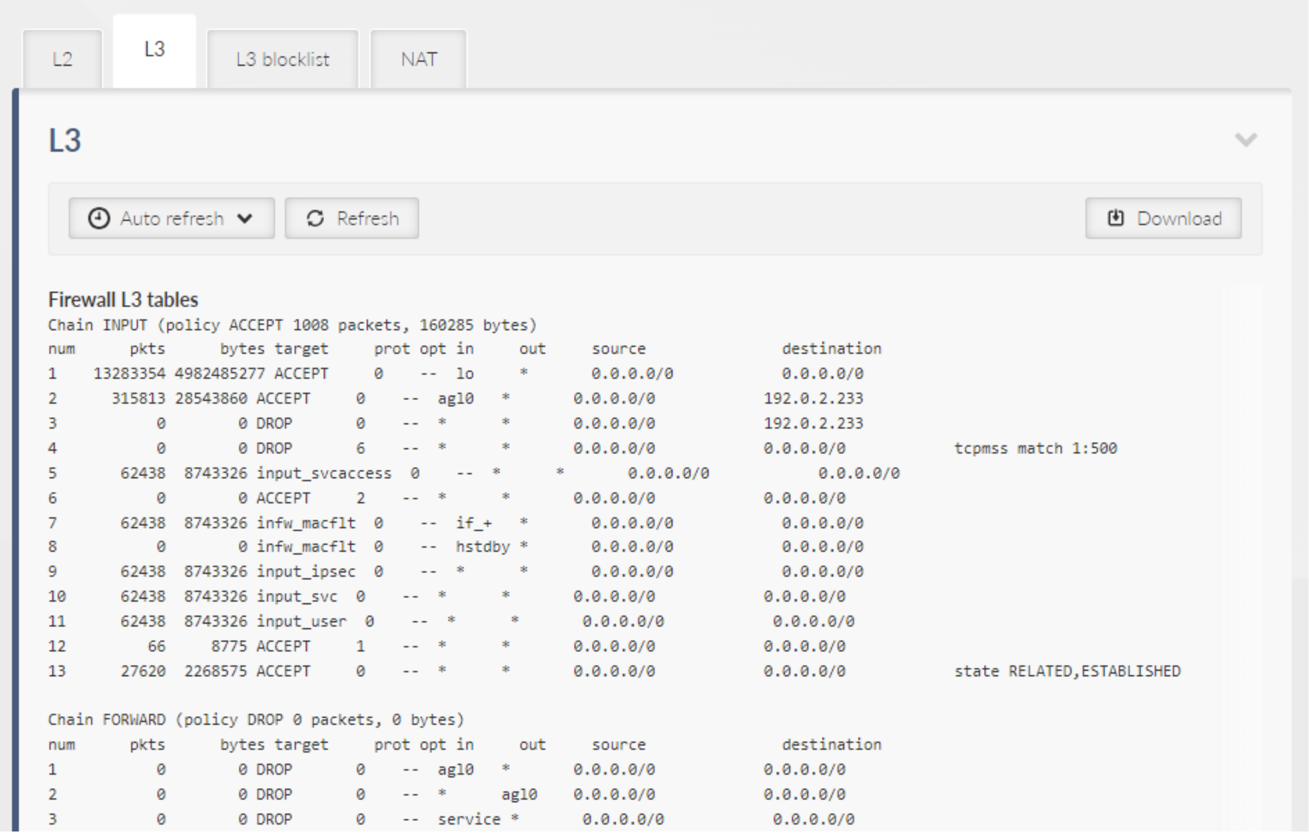
Firewall L2 tables

```
Bridge table: filter

Bridge chain: INPUT, entries: 0, policy: ACCEPT

Bridge chain: FORWARD, entries: 1, policy: ACCEPT
1. -j forward_user, pcnt = 0 -- bcnt = 0

Bridge chain: OUTPUT, entries: 0, policy: ACCEPT

Bridge chain: forward_user, entries: 1, policy: ACCEPT
1. -s 00:00:00:00:00:00/00:00:00:ff:ff:ff -j DROP , pcnt = 0 -- bcnt = 0
```

Fig. 8.7: DIAGNOSTICS > Information > Firewall > L2

8.3.3.2. Firewall L3

Displays data called by following linux commands “iptables -nvL --line-numbers”.



Firewall L3 tables

```
Chain INPUT (policy ACCEPT 1008 packets, 160285 bytes)
num      pkts      bytes target     prot opt in     out     source               destination
1    13283354 4982485277 ACCEPT     0    --  lo     *       0.0.0.0/0            0.0.0.0/0
2      315813 28543860 ACCEPT     0    --  agl0   *       0.0.0.0/0            192.0.2.233
3           0        0 DROP       0    --  *      *       0.0.0.0/0            192.0.2.233
4           0        0 DROP       6    --  *      *       0.0.0.0/0            0.0.0.0/0            tcpmss match 1:500
5       62438  8743326 input_svcaccess  0    --  *      *       0.0.0.0/0            0.0.0.0/0
6           0        0 ACCEPT     2    --  *      *       0.0.0.0/0            0.0.0.0/0
7       62438  8743326 infw_macflt  0    --  if_+   *       0.0.0.0/0            0.0.0.0/0
8           0        0 infw_macflt  0    --  hstdby *       0.0.0.0/0            0.0.0.0/0
9       62438  8743326 input_ipsec  0    --  *      *       0.0.0.0/0            0.0.0.0/0
10      62438  8743326 input_svc  0    --  *      *       0.0.0.0/0            0.0.0.0/0
11      62438  8743326 input_user  0    --  *      *       0.0.0.0/0            0.0.0.0/0
12         66     8775 ACCEPT     1    --  *      *       0.0.0.0/0            0.0.0.0/0
13      27620  2268575 ACCEPT     0    --  *      *       0.0.0.0/0            0.0.0.0/0            state RELATED,ESTABLISHED

Chain FORWARD (policy DROP 0 packets, 0 bytes)
num      pkts      bytes target     prot opt in     out     source               destination
1           0        0 DROP       0    --  agl0   *       0.0.0.0/0            0.0.0.0/0
2           0        0 DROP       0    --  *      agl0    0.0.0.0/0            0.0.0.0/0
3           0        0 DROP       0    --  service *       0.0.0.0/0            0.0.0.0/0
```

Fig. 8.8: DIAGNOSTICS > Information > Firewall > L3

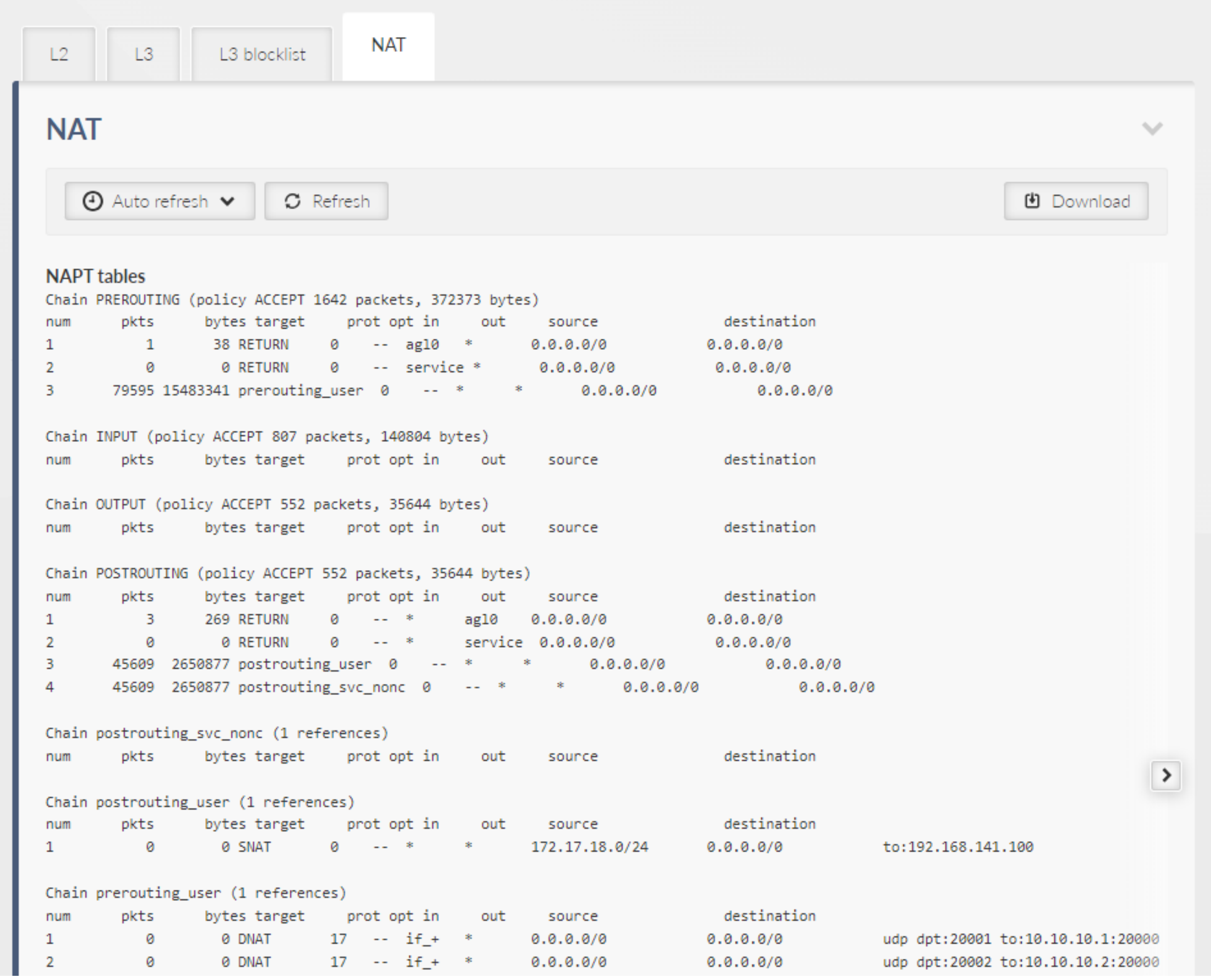
8.3.3.3. Firewall L3 blocklist

Listing of the list of banned addresses. Addresses are added to the list if the Action: “Deny, Add to Blocklist” (adding the source address of the incoming packet to the banned list) is configured in the Firewall L3 - Input rules

8.3.3.4. NAT

Displays data called by following linux commands:

- "iptables -t nat -nvL postrouting_user" – data about SNAT
- "iptables -t nat -nvL prerouting_user" – data about DNAT



NAPT tables

```
Chain PREROUTING (policy ACCEPT 1642 packets, 372373 bytes)
num      pkts      bytes target     prot opt in     out     source               destination
1           1        38 RETURN     0    --  agl0   *       0.0.0.0/0            0.0.0.0/0
2           0         0 RETURN     0    --  service *       0.0.0.0/0            0.0.0.0/0
3       79595 15483341 prerouting_user  0    --  *      *       0.0.0.0/0            0.0.0.0/0

Chain INPUT (policy ACCEPT 807 packets, 140804 bytes)
num      pkts      bytes target     prot opt in     out     source               destination

Chain OUTPUT (policy ACCEPT 552 packets, 35644 bytes)
num      pkts      bytes target     prot opt in     out     source               destination

Chain POSTROUTING (policy ACCEPT 552 packets, 35644 bytes)
num      pkts      bytes target     prot opt in     out     source               destination
1           3       269 RETURN     0    --  *      agl0    0.0.0.0/0            0.0.0.0/0
2           0         0 RETURN     0    --  *      service  0.0.0.0/0            0.0.0.0/0
3       45609  2650877 postrouting_user  0    --  *      *       0.0.0.0/0            0.0.0.0/0
4       45609  2650877 postrouting_svc_nonc  0    --  *      *       0.0.0.0/0            0.0.0.0/0

Chain postrouting_svc_nonc (1 references)
num      pkts      bytes target     prot opt in     out     source               destination

Chain postrouting_user (1 references)
num      pkts      bytes target     prot opt in     out     source               destination
1           0         0 SNAT       0    --  *      *       172.17.18.0/24       0.0.0.0/0            to:192.168.141.100

Chain prerouting_user (1 references)
num      pkts      bytes target     prot opt in     out     source               destination
1           0         0 DNAT       17   --  if_+   *       0.0.0.0/0            0.0.0.0/0            udp dpt:20001 to:10.10.10.1:20000
2           0         0 DNAT       17   --  if_+   *       0.0.0.0/0            0.0.0.0/0            udp dpt:20002 to:10.10.10.2:20000
```

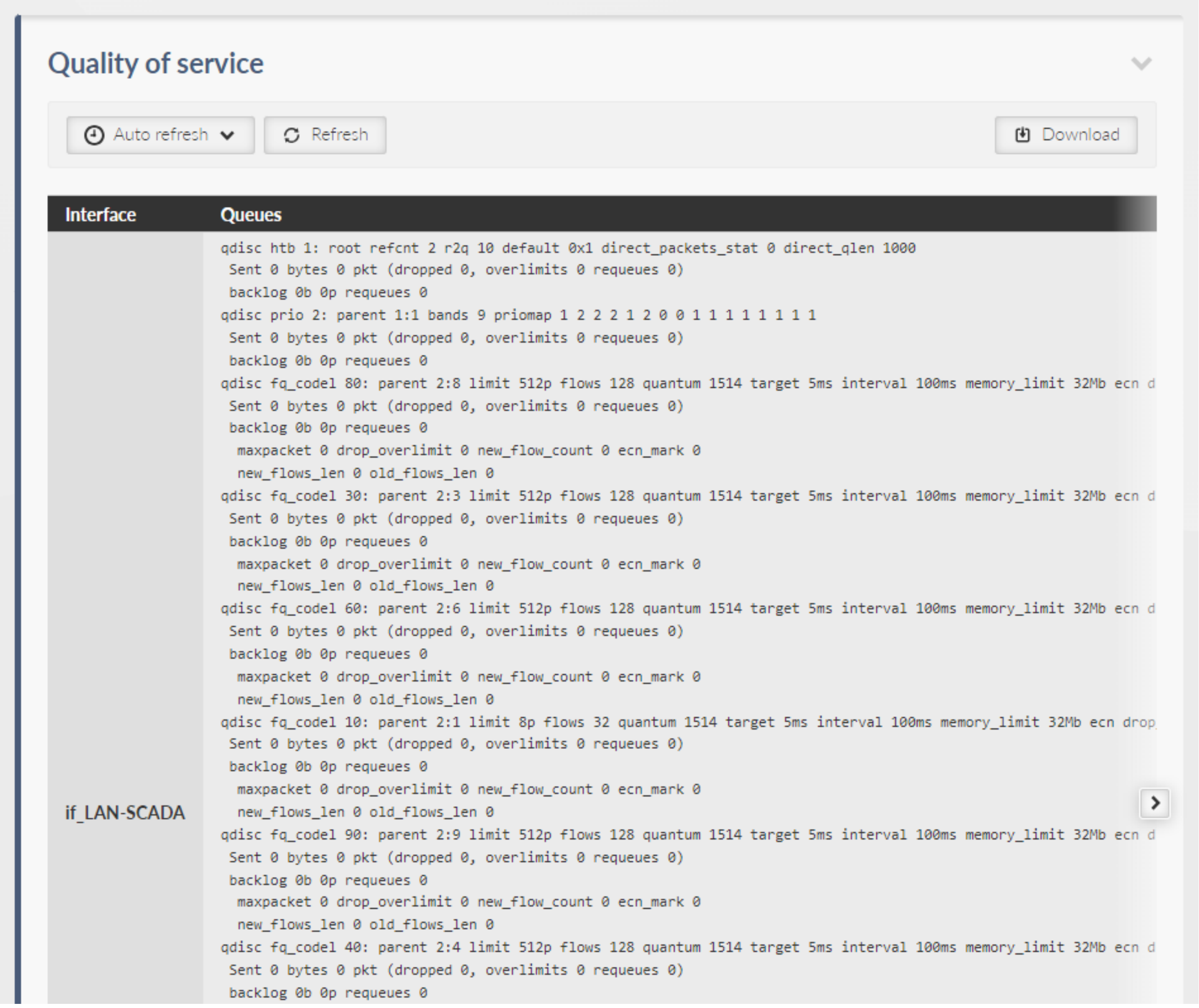
Fig. 8.9: DIAGNOSTICS > Information > Firewall > NAT

8.3.4. Quality of service

Creates a table about object and statistics extract for each given interface. This table contains:

- Name of an interface.

- Status and statistics of front disciplines - displays data called by linux command “tc qdisc show”.
- Status and statistics of classes - displays data called by linux command “tc class show”.
- Status and statistics of filter - displays data called by linux command “tc filter show”.



Interface	Queues
if_LAN-SCADA	see output below

```
qdisc htb 1: root refcnt 2 r2q 10 default 0x1 direct_packets_stat 0 direct_qlen 1000
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
qdisc prio 2: parent 1:1 bands 9 priomap 1 2 2 2 1 2 0 0 1 1 1 1 1 1 1 1
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
qdisc fq_codel 80: parent 2:8 limit 512p flows 128 quantum 1514 target 5ms interval 100ms memory_limit 32Mb ecn d
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
  maxpacket 0 drop_overlimit 0 new_flow_count 0 ecn_mark 0
  new_flows_len 0 old_flows_len 0
qdisc fq_codel 30: parent 2:3 limit 512p flows 128 quantum 1514 target 5ms interval 100ms memory_limit 32Mb ecn d
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
  maxpacket 0 drop_overlimit 0 new_flow_count 0 ecn_mark 0
  new_flows_len 0 old_flows_len 0
qdisc fq_codel 60: parent 2:6 limit 512p flows 128 quantum 1514 target 5ms interval 100ms memory_limit 32Mb ecn d
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
  maxpacket 0 drop_overlimit 0 new_flow_count 0 ecn_mark 0
  new_flows_len 0 old_flows_len 0
qdisc fq_codel 10: parent 2:1 limit 8p flows 32 quantum 1514 target 5ms interval 100ms memory_limit 32Mb ecn drop
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
  maxpacket 0 drop_overlimit 0 new_flow_count 0 ecn_mark 0
  new_flows_len 0 old_flows_len 0
qdisc fq_codel 90: parent 2:9 limit 512p flows 128 quantum 1514 target 5ms interval 100ms memory_limit 32Mb ecn d
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
  maxpacket 0 drop_overlimit 0 new_flow_count 0 ecn_mark 0
  new_flows_len 0 old_flows_len 0
qdisc fq_codel 40: parent 2:4 limit 512p flows 128 quantum 1514 target 5ms interval 100ms memory_limit 32Mb ecn d
 Sent 0 bytes 0 pkt (dropped 0, overlimits 0 requeues 0)
 backlog 0b 0p requeues 0
```

Fig. 8.10: DIAGNOSTICS > Information > Quality of service

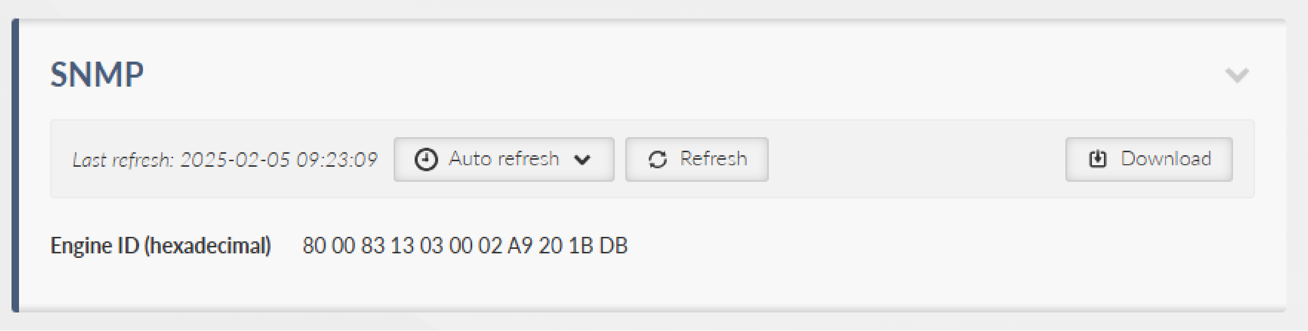
8.3.5. DHCP servers

List of addresses assigned by the DHCP server.

IP address	The assigned IP address of the client
MAC address	MAC address of the client
Lease until	The time when the lease expires

8.3.6. SNMP

Listing the Engine ID value. The Engine ID is used to uniquely identify the station when communicating with the SNMP manager.

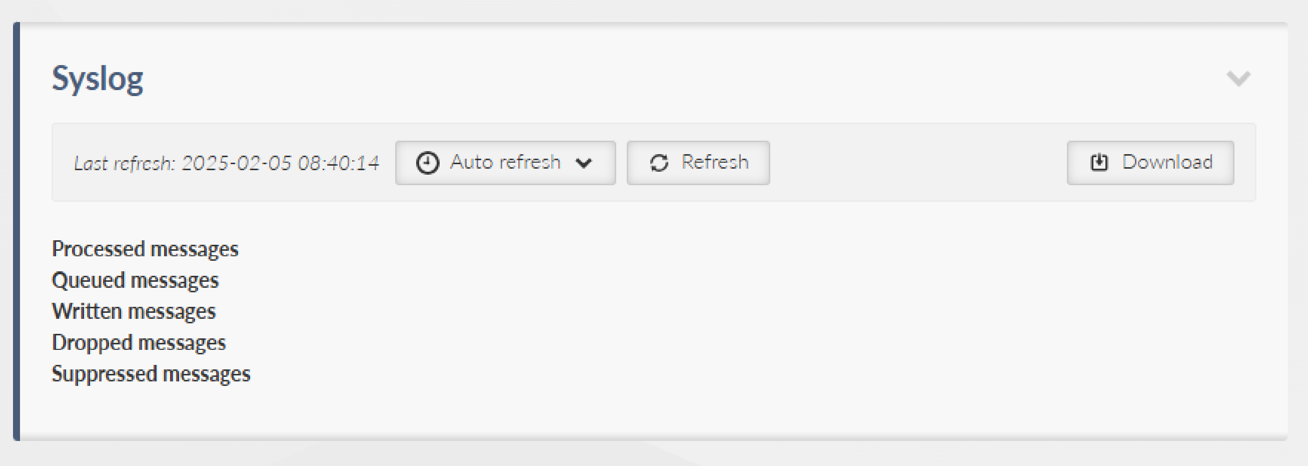

SNMP

Engine ID (hexadecimal) 80 00 83 13 03 00 02 A9 20 1B DB

Fig. 8.11: DIAGNOSTICS > Information > Services > SNMP

8.3.7. Syslog

Listing the message counters to a remote Syslog server.

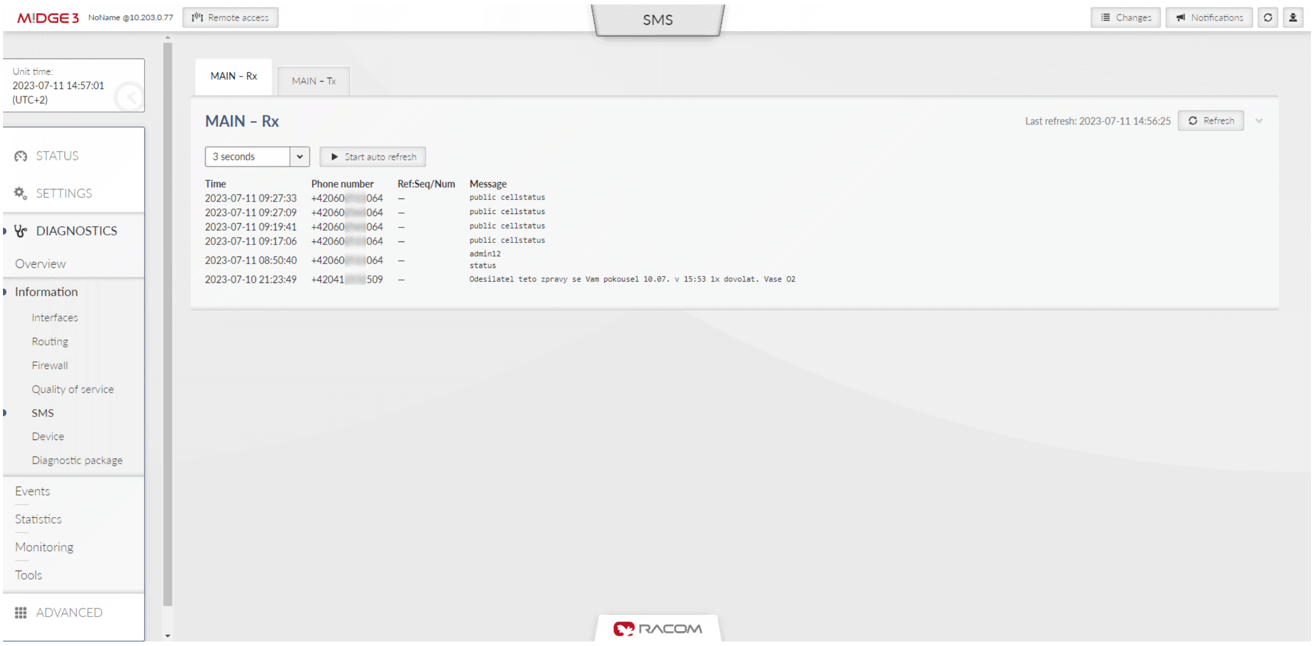

Syslog

Processed messages
Queued messages
Written messages
Dropped messages
Suppressed messages

Fig. 8.12: DIAGNOSTICS > Information > Services > Syslog

8.3.8. SMS

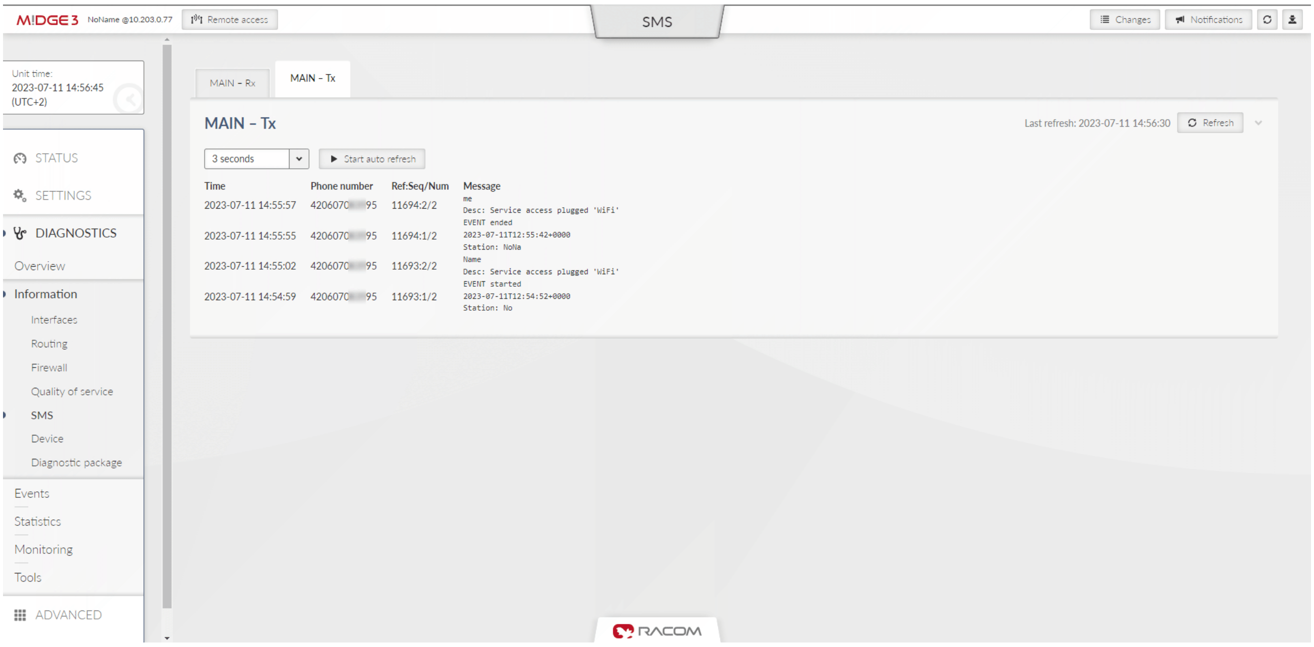
Provides information about sent and received SMS messages.



MAIN – Rx

Time	Phone number	Ref:Seq/Num	Message
2023-07-11 09:27:33	+42060[redacted]064	–	public cellstatus
2023-07-11 09:27:09	+42060[redacted]064	–	public cellstatus
2023-07-11 09:19:41	+42060[redacted]064	–	public cellstatus
2023-07-11 09:17:06	+42060[redacted]064	–	public cellstatus
2023-07-11 08:50:40	+42060[redacted]064	–	admin12 status
2023-07-10 21:23:49	+42041[redacted]509	–	Odesilatel teto zpravy se Vam pokousel 10.07. v 15:53 1x dovolat. Vase O2

Fig. 8.13: DIAGNOSTICS > Information > SMS > MAIN - Rx



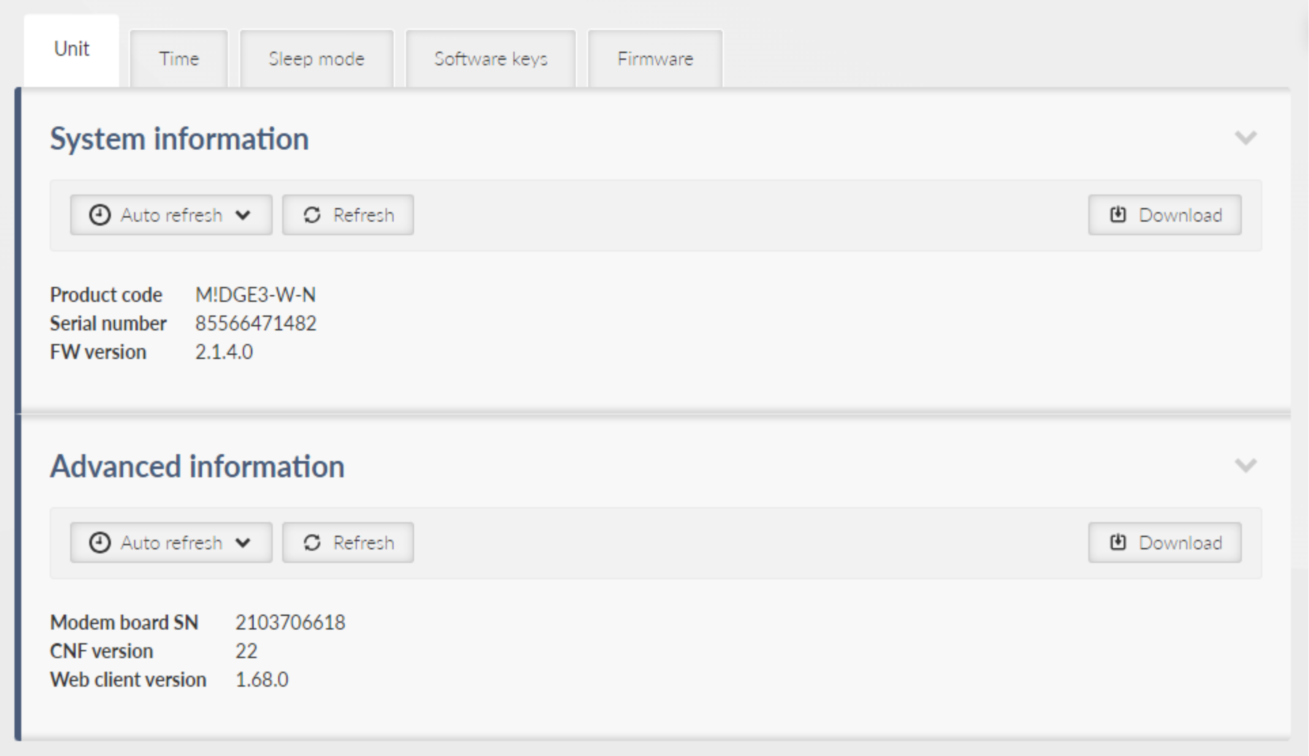
MAIN – Tx

Time	Phone number	Ref:Seq/Num	Message
2023-07-11 14:55:57	4206070[redacted]95	11694:2/2	me
2023-07-11 14:55:55	4206070[redacted]95	11694:1/2	Desc: Service access plugged 'WiFi' EVENT ended 2023-07-11T12:55:42+0000 Station: NoNa
2023-07-11 14:55:02	4206070[redacted]95	11693:2/2	Name
2023-07-11 14:54:59	4206070[redacted]95	11693:1/2	Desc: Service access plugged 'WiFi' EVENT started 2023-07-11T12:54:52+0000 Station: No

Fig. 8.14: DIAGNOSTICS > Information > SMS > MAIN - Tx

8.3.9. Device

Provides general information about the unit (device).



System information

Product code M!DGE3-W-N
Serial number 85566471482
FW version 2.1.4.0

Advanced information

Modem board SN 2103706618
CNF version 22
Web client version 1.68.0

Fig. 8.15: DIAGNOSTICS > Information > Device

8.3.9.1. System information

Basic unit information is provided.

- Product code - Identifies the unit hardware.
- Serial number - Unique unit identification number.
- FW version - Currently installed unit firmware.

8.3.9.2. Advanced information

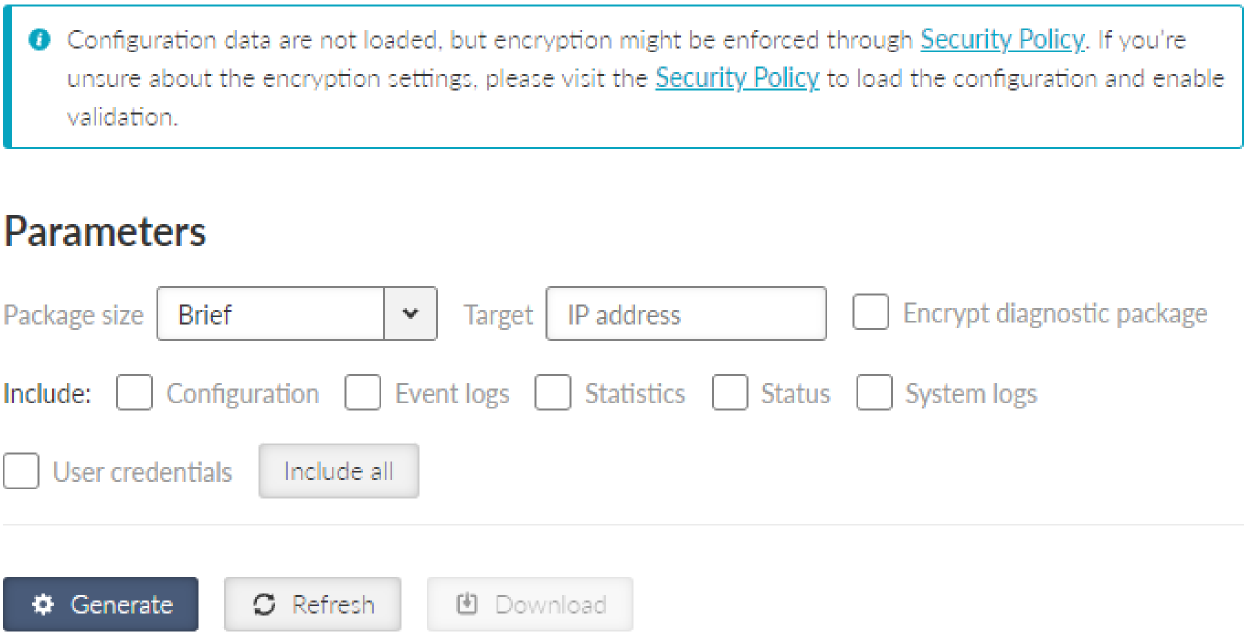
Additional unit information is provided which might be requested for advanced diagnostics. Partial description:

- Modem board SN - Modem boards system number.
- CNF version - Version of the unit configuration.
- Web client version - Version of the current web client.

8.3.10. Diagnostic package

This menu serves for collecting data, either from local or remote station and storing them into a package (file). Diagnostic package serves primarily as a help tool, for RACOM's technical support in case of any potential unit issues. Minimum size of a package is 5kB. Diagnostic package is downloaded already compressed, which saves approx. 1/3 of its original size.

Only one package collecting (applies for both local and remote) at a time is supported.



Configuration data are not loaded, but encryption might be enforced through Security Policy. If you're unsure about the encryption settings, please visit the Security Policy to load the configuration and enable validation.

Parameters

Package size: Brief

Target: IP address

□ Encrypt diagnostic package

Include: □ Configuration □ Event logs □ Statistics □ Status □ System logs

□ User credentials

Fig. 8.16: DIAGNOSTICS > Information > Diagnostic package

Package size
List box {Brief; Detailed}, default = "Brief"
Defines the size of the generated package.

Target
Defines the station, from which is the Diagnostic package being collected.

- Diagnostic package from a local station - this parameter stays empty.
- Diagnostic package from a remote station - destination IPv4 address of the requested station must be used.

Encrypt diagnostic package
Allows generating of the diagnostic package as an encrypted .zip file. The rules for the password complexity are set in the SETTINGS > Security > Policy menu. In the same menu, it is possible to set encryption to always be required.

Note
You cannot use Windows Explorer for extracting the package. You need to use a software that can work with files encrypted with AES-256 algorithm (e.g. WinZip, WinRAR, 7-zip, Total commander).

Include

- Configuration - configuration of the unit is added to the package (json format)
- Event logs - adds a list of events exported to csv
  - Brief: Last 50 events
  - Detailed: Last 500 events

- Statistics - adds list of statistics exported to csv
  - ○ Interval of frames statistics: 30 min
  - ○ Brief: 10 frames
  - ○ Detailed: 24 frames
- Status - lists detailed status of networks devices and services
- System logs - adds last system logs
  - ○ Brief: 100 of current lines from all logs
  - ○ Detailed: whole logs content
- User credentials - adds a list of user accounts

After setting all parameters, click on "Generate" button. By clicking the "Refresh" button update the processing status of the package. Once the package is ready, it can be downloaded by clicking the "Download" button. After its download, the package is deleted from the unit. The package will be deleted even if its download is unsuccessful and if the download is not initiated, the package will be deleted automatically after 24h.

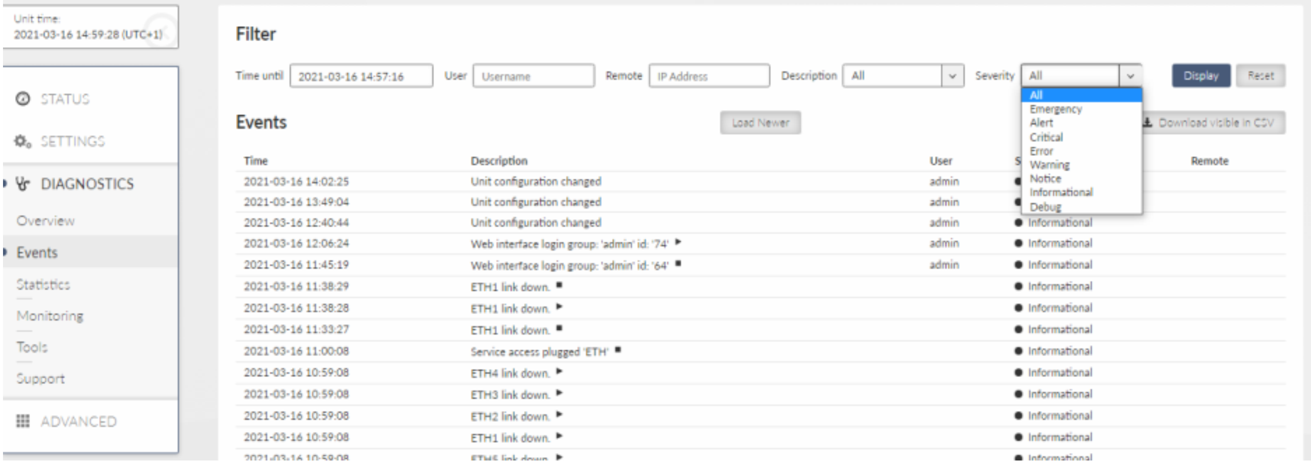
8.4. Events

This menu shows all events which occur within the unit history.

For filtering of events you can use the filtering tool. When no filter rules are used, the last 30 events will be displayed after Display button click.

Older events should be displayed using Load more button click, the events which occur during the viewing of this window can be loaded by using Load newer button.

Alarms are displayed in red color, warnings in orange, notices in black and debugs in gray.



Unit time:
2021-03-16 14:59:28 (UTC+1)

Time until: 2021-03-16 14:57:16 User: Username Remote: IP Address Description: All Severity: All

Time	Description	User	S	Remote
2021-03-16 14:02:25	Unit configuration changed	admin	●	
2021-03-16 13:49:04	Unit configuration changed	admin	●	
2021-03-16 12:40:44	Unit configuration changed	admin	● Informational	
2021-03-16 12:06:24	Web interface login group: 'admin' id: '74' ▸	admin	● Informational	
2021-03-16 11:45:19	Web interface login group: 'admin' id: '64' ■	admin	● Informational	
2021-03-16 11:38:29	ETH1 link down. ■		● Informational	
2021-03-16 11:38:28	ETH1 link down. ▸		● Informational	
2021-03-16 11:33:27	ETH1 link down. ■		● Informational	
2021-03-16 11:00:08	Service access plugged 'ETH' ■		● Informational	
2021-03-16 10:59:08	ETH4 link down. ▸		● Informational	
2021-03-16 10:59:08	ETH3 link down. ▸		● Informational	
2021-03-16 10:59:08	ETH2 link down. ▸		● Informational	
2021-03-16 10:59:08	ETH1 link down. ▸		● Informational	
2021-03-16 10:59:08	ETH5 link down. ▸		● Informational	

It is possible to change severities of individual events in the menu SETTINGS > Device > Events.

Tab. 8.3: Default Events level description

Severity group	Level	Severity	Color code	Description	Action
ALARM	0	Emergency	Red	Faulty unit. HW repair is probably needed.	Replace the unit. Contact Technical support.
	1	Alert	Red	Unit does not work. HW or SW problem.	Check the unit. Consult Technical support.
	2	Critical	Red	Serious error. Communication does not work.	Check the unit immediately.
	3	Error	Red	Error. Communication can work.	Check the unit.
WARNING	4	Warning	Orange	Communication is OK. Self-healing action proceeded.	When often, consult with Technical support.
	5	Notice	Blue	Security important action proceeded or I/O action.	Security check, the I/O status check.
INFO	6	Informational	-	Informational item	Standard behavior
	7	Debug	-	Debug info, if set so.	Debug

8.5. Statistics

M!DGE3 unit permanently monitors various system 'channels'. There are several types of those channels: Physical interfaces (Ethernet ports, serial ports, MAIN, additional module interface (e.g. LTE module) when installed), virtual interfaces (e.g. VLAN interfaces) and HW sensors (CPU temperature, supply voltage, ...). Monitored values are stored in the internal database.

Statistics page provides aggregated statistical data from this internal database. Data can be both displayed and downloaded in CSV format. This file format is suitable to be imported to any 3rd party spreadsheet program for further analysis.

There are two different options how to display statistics data:

Historical

Statistics counters are aggregated over the defined time interval. The interval is defined by two time stamps "From" and "To".

Differential

Statistics counters are aggregated between the counter reset and the current time (the moment when the Display button was pressed). Reset is triggered by a unit reboot or by the Reset statistics button.

Reset statistics button - initiates the Differential statistic counters reset. Such a reset does not affect normal statistic counters - i.e. the Historical statistics are not affected by such a Reset at all.

Length of statistics data

Statistics data are stored in the internal database. There is a fixed memory size allocated for the statistics data - the database is limited by number of records. As a result of this, the length of statistics history - how old records are available - depends on the actual network configuration: The more monitored values, the higher the rate of new recorded values, the shorter the available history.

Some sets of monitored values are constant (Ethernet ports and their counters) or do not rise to a high values (COM ports, Terminal servers and their counters).

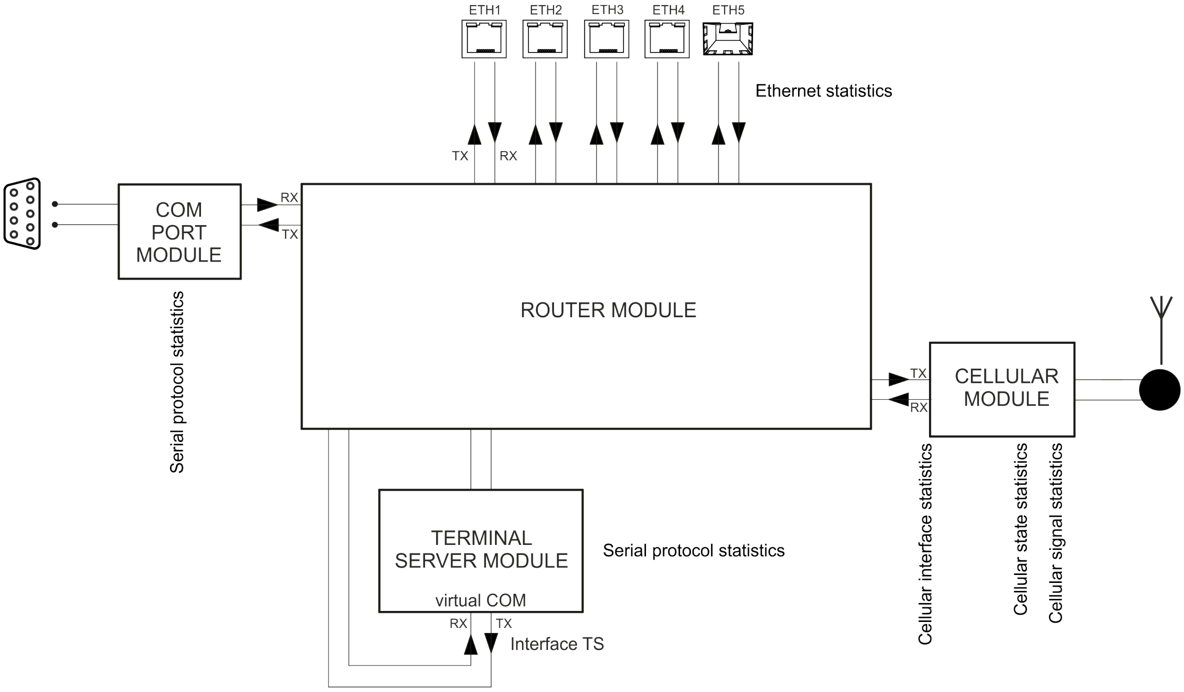


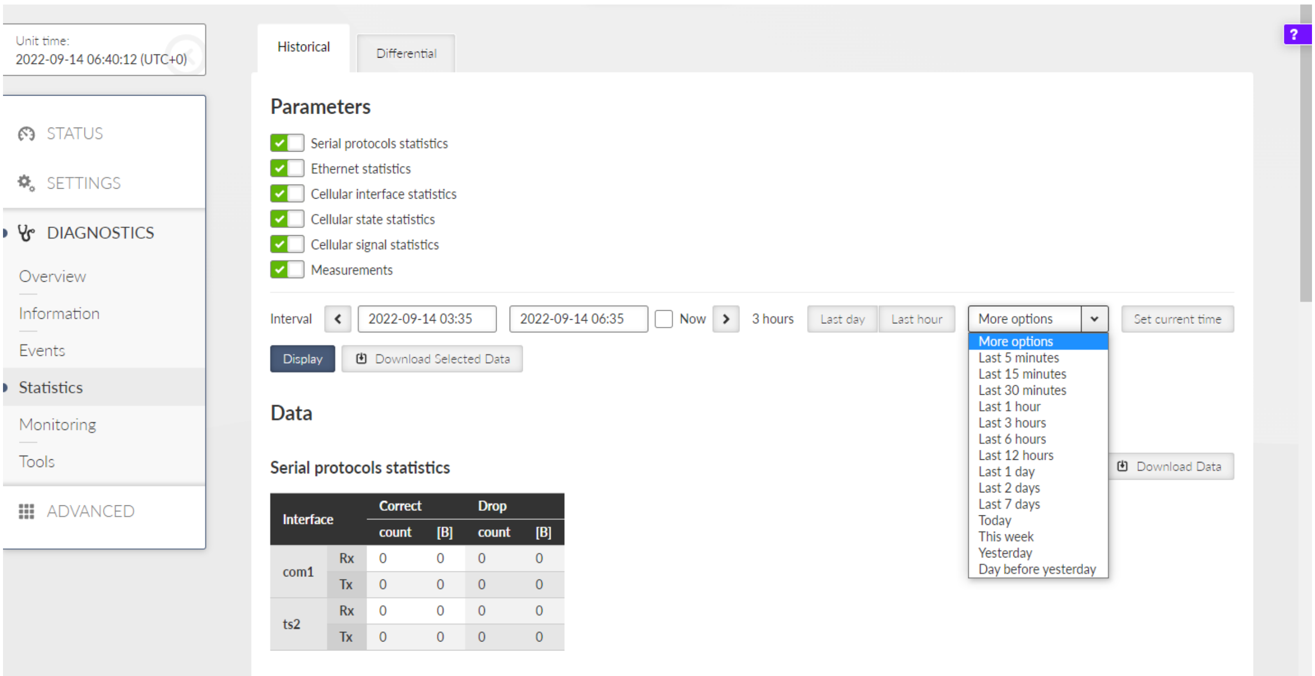
Fig. 8.17: Statistics data in the context of unit interfaces

8.5.1. Parameters

Statistics data are always retrieved as aggregated for a certain time Interval. This Interval can be set by putting specific date and time into "From" and "To" fields, or using buttons “Last day”, “Last hour” or “More options” fast presets (from several minutes to several days). Button “Set Current Time” sets current time to both From and To fields to ease current unit status diagnostics.

There are following sets of statistical data available in the unit:

- Serial protocols statistics
- Ethernet statistics
- Cellular statistic
- Measurements



Parameters

☑ Serial protocols statistics
☑ Ethernet statistics
☑ Cellular interface statistics
☑ Cellular state statistics
☑ Cellular signal statistics
☑ Measurements

Interval 2022-09-14 03:35 2022-09-14 06:35 □ Now 3 hours

Data

Serial protocols statistics

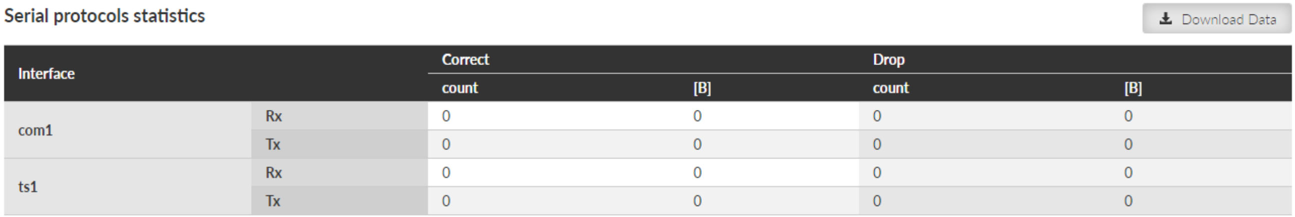
Interface		Correct		Drop	
		count	[B]	count	[B]
com1	Rx	0	0	0	0
	Tx	0	0	0	0
ts2	Rx	0	0	0	0
	Tx	0	0	0	0

“Display” button then shows chosen data below. “Download Selected Data” button generates CSV (UTF-8 encoded) file of all chosen systems’ data and downloads them as files without displaying them. Both "Display" and "Download ..." buttons send a request for the required set of statistics data to the unit. Retrieving and transferring of the data takes some time. Downloading the data is practical when the user needs to process them in a spreadsheet and wants to save some bandwidth. It is also recommended to use spreadsheet editor like Microsoft Excel or Apple Numbers to process statistics on mobile devices due to better user experience provided by the specialized apps.

8.5.2. Serial protocol statistics

Serial protocols statistics provides set of data monitoring the COM port(s) and Terminal server (s). Only enabled interfaces are displayed. The statistics counters are based on packets entering or leaving the COM port or Terminal server module. As a result of this the 'count' values correspond to the Protocol messages (the "Protocol" selected on the specific COM port or Terminal server). If the packet is 'glued' from the several frames, it is evaluated as a single packet. In case of COM port statistics, the summary of 'Correct' and 'Drop' Bytes provides the total amount of Bytes on the physical interface.

Rx direction: from the connected (at the COM or ETH port) external device to the M!DGE3 unit (i.e. from the COM port module or Terminal server module to the Router module). Tx direction: from the M!DGE3 unit to the external device.



Serial protocols statistics

Interface		Correct		Drop	
		count	[B]	count	[B]
com1	Rx	0	0	0	0
	Tx	0	0	0	0
ts1	Rx	0	0	0	0
	Tx	0	0	0	0

Interface – Interface name

Correct (Rx, Tx) – Correctly received / transmitted packets count and amount of data in Bytes. Accepted by the COM port or Terminal server module - based on the selected Protocol processing. Amount of data - for both Correct and Drop counters - is affected by COM port data only (i.e. IP headers of the UDP frames created in the COM port module are NOT counted).

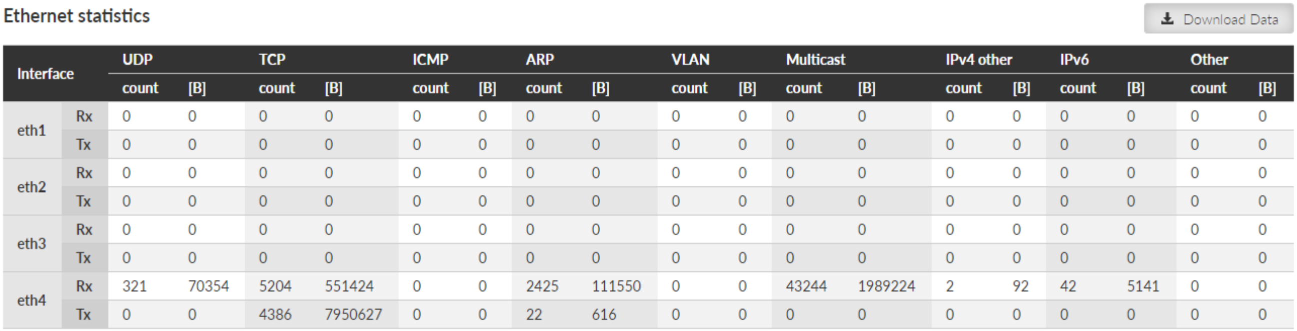
Drop (Rx, Tx) - Dropped received / transmitted packets - reason: corrupted frame, CRC error, wrong protocol message, unsupported protocol message.

8.5.3. Ethernet statistics

Ethernet statistics provides set of data monitoring the physical Ethernet ports. Only enabled interfaces are displayed.

Only correctly received frames are handled. The counters correspond to the specific IP protocol types.

Rx direction: from the physical Ethernet port to the M!DGE3 unit (i.e. to the Router module). Tx direction: from the M!DGE3 unit to the physical Ethernet port.



Ethernet statistics

Interface		UDP		TCP		ICMP		ARP		VLAN		Multicast		IPv4 other		IPv6		Other	
		count	[B]	count	[B]	count	[B]	count	[B]	count	[B]	count	[B]	count	[B]	count	[B]	count	[B]
eth1	Rx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eth2	Rx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eth3	Rx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
eth4	Rx	321	70354	5204	551424	0	0	2425	111550	0	0	43244	1989224	2	92	42	5141	0	0
	Tx	0	0	4386	7950627	0	0	22	616	0	0	0	0	0	0	0	0	0	0

Interface – Interface name.

UDP, TCP, ICMP, ARP, VLAN, Multicast - Packet count and amount of data in Bytes [B] for different protocol types - IPv4 traffic. Amount of data - for all counters - is summed over the whole Layer 2 Ethernet frame (i.e. all IP headers are counted).

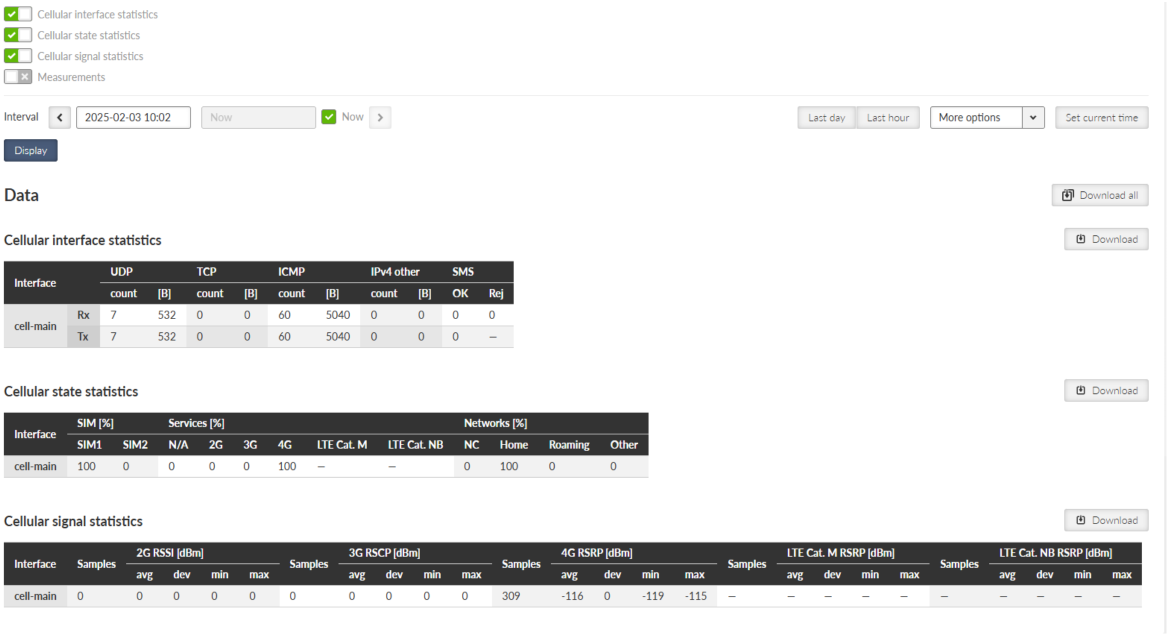
IPv4 other - IPv4 traffic not handled by the previous counters

IPv6 - IPv6 traffic counter

Other - Counter summing up the frames which were not handled by the previous counters - for example MPLS and GOOSE protocols.

8.5.4. Cellular statistics

Cellular statistics are available for main cellular module and eventually for optional extension module if used.



Data

Cellular interface statistics

Interface		UDP		TCP		ICMP		IPv4 other		SMS	
		count	[B]	count	[B]	count	[B]	count	[B]	OK	Rej
cell-main	Rx	7	532	0	0	60	5040	0	0	0	0
	Tx	7	532	0	0	60	5040	0	0	0	–

Cellular state statistics

Interface	SIM [%]		Services [%]						Networks [%]			
	SIM1	SIM2	N/A	2G	3G	4G	LTE Cat. M	LTE Cat. NB	NC	Home	Roaming	Other
cell-main	100	0	0	0	0	100	–	–	0	100	0	0

Cellular signal statistics

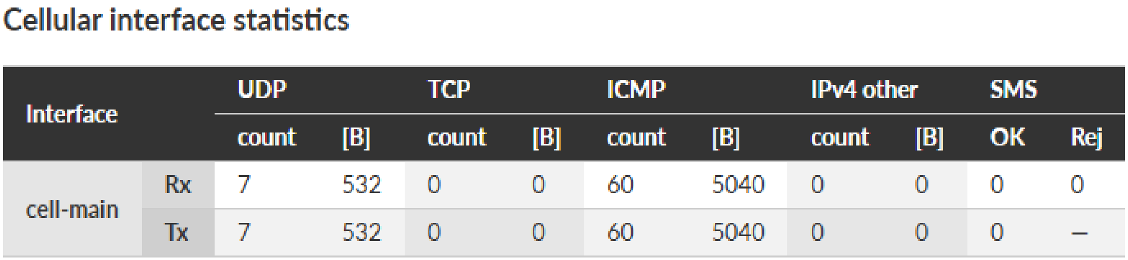
Interface	Samples	2G RSSI [dBm]				Samples	3G RSCP [dBm]				Samples	4G RSRP [dBm]				Samples	LTE Cat. M RSRP [dBm]				Samples	LTE Cat. NB RSRP [dBm]			
		avg	dev	min	max		avg	dev	min	max		avg	dev	min	max		avg	dev	min	max		avg	dev	min	max
cell-main	0	0	0	0	0	0	0	0	0	0	309	-116	0	-119	-115	–	–	–	–	–	–	–	–	–	–

Fig. 8.18: DIAGNOSTICS>Statistics

8.5.4.1. Cellular interface statistics

Cellular interface statistics provides set of data collected from the interface between the Router module (IP routing engine in the unit) and the Cellular module. It corresponds to monitoring Cellular - Interface.

Tx direction: from the Router module to the Cellular module.
Rx direction: from the Cellular module to the Router module.



Cellular interface statistics

Interface		UDP		TCP		ICMP		IPv4 other		SMS	
		count	[B]	count	[B]	count	[B]	count	[B]	OK	Rej
cell-main	Rx	7	532	0	0	60	5040	0	0	0	0
	Tx	7	532	0	0	60	5040	0	0	0	–

Interface

– "cell-main" interface is used for M!DGE3 MAIN cellular module.
– “cell-ext” interface is used for M!DGE3 optional extension cellular module.

UDP, TCP, ICMP

- Packet count and amount of data in Bytes [B] for different protocol types. Amount of data is summed over the whole Layer 2 Ethernet frame (i.e. all IP headers are counted).

IPv4 other

- Packets not handled by the previous counters (e.g. VLAN, services, GRE, IPsec (ESP), ...).

SMS

Rx OK

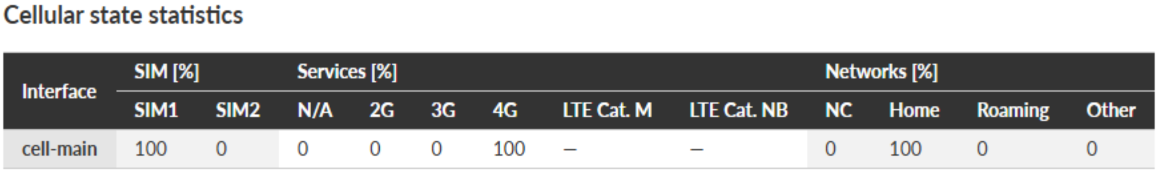
Number of SMS received

SMS with the correct format, passphrase and from the correct number. Invalid commands or wrong parameters are also included here (they are correctly received by the daemon, rejected only in the command execution system).

Rx Rej
Number of rejected incoming SMS
SMS. In case of disabling the reception of command SMS, all received SMS are included here.

Tx OK
Number of SMS sent

8.5.4.2. Cellular state statistics



Cellular state statistics

Interface	SIM [%]		Services [%]						Networks [%]			
	SIM1	SIM2	N/A	2G	3G	4G	LTE Cat. M	LTE Cat. NB	NC	Home	Roaming	Other
cell-main	100	0	0	0	0	100	–	–	0	100	0	0

Interface
– "cell-main" interface is used for M!DGE3 MAIN cellular module.
– “cell-ext” interface is used for M!DGE3 optional extension cellular module.

SIM [%]
– information about using the individual SIM cards during the time displayed in %.

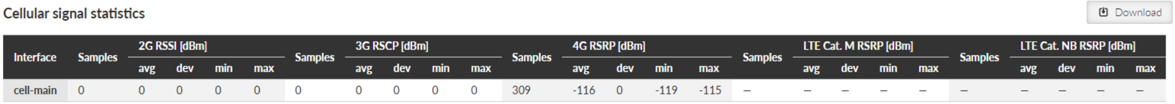
Services [%]
– N/A (not available), 2G (e.g. GPRS, EDGE), 3G (e.g. UMTS), 4G (e.g. LTE), LTE Cat. M, LTE Cat. NB services usage displayed in % of time.

Networks [%]
– NC (not connected), Home (home network), Roaming (roaming network), Other (not matching previous type of networks) displayed in % of time.

Note

Values are rounded to an integer (in %).

8.5.4.3. Cellular signal statistics



Cellular signal statistics

Interface	Samples	2G RSSI [dBm]				Samples	3G RSCP [dBm]				Samples	4G RSRP [dBm]				Samples	LTE Cat. M RSRP [dBm]				Samples	LTE Cat. NB RSRP [dBm]			
		avg	dev	min	max		avg	dev	min	max		avg	dev	min	max		avg	dev	min	max		avg	dev	min	max
cell-main	0	0	0	0	0	0	0	0	0	0	309	-116	0	-119	-115	–	–	–	–	–	–	–	–	–	–

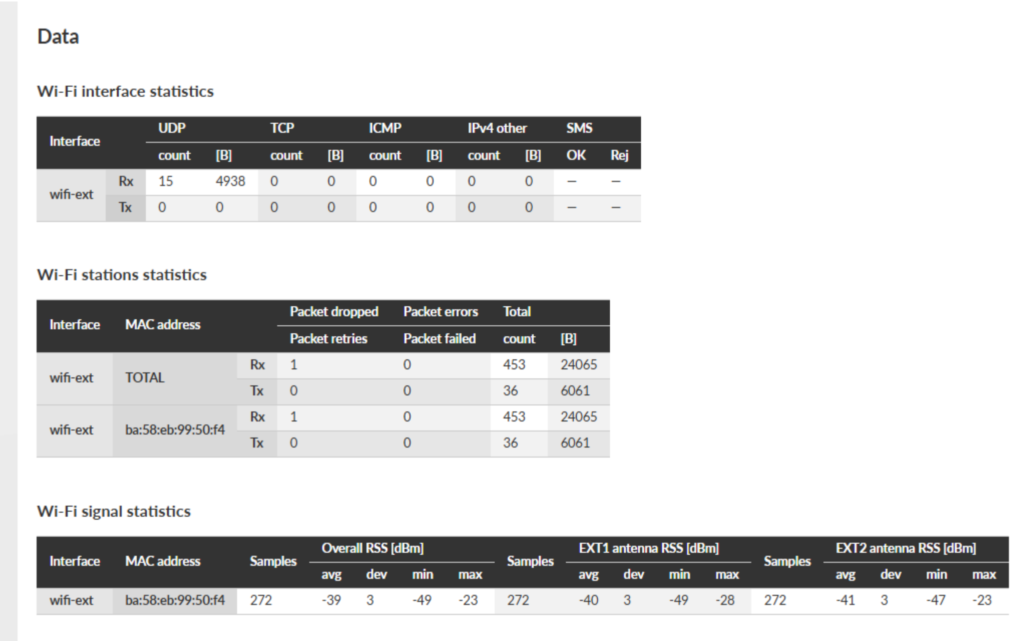
Interface
– "cell-main" interface is used for M!DGE3 MAIN cellular module
– “cell-ext” interface is used for M!DGE3 optional extension cellular module

2G RSSI / 3G RSCP / 4G RSRP/ LTE Cat. M RSRP/ LTE Cat. NB RSRP
Signal levels in dBm

Samples
Number of samples used for the individual statistics

avg / dev / min / max
Average / standard deviation / minimum / maximum value

8.5.5. Wi-Fi statistics



Data

Wi-Fi interface statistics

Interface		UDP		TCP		ICMP		IPv4 other		SMS	
		count	[B]	count	[B]	count	[B]	count	[B]	OK	Rej
wifi-ext	Rx	15	4938	0	0	0	0	0	0	–	–
	Tx	0	0	0	0	0	0	0	0	–	–

Wi-Fi stations statistics

Interface	MAC address		Packet dropped	Packet errors	Total	
			Packet retries	Packet failed	count	[B]
wifi-ext	TOTAL	Rx	1	0	453	24065
		Tx	0	0	36	6061
wifi-ext	ba:58:eb:99:50:f4	Rx	1	0	453	24065
		Tx	0	0	36	6061

Wi-Fi signal statistics

Interface	MAC address	Samples	Overall RSS [dBm]				Samples	EXT1 antenna RSS [dBm]				Samples	EXT2 antenna RSS [dBm]			
			avg	dev	min	max		avg	dev	min	max		avg	dev	min	max
wifi-ext	ba:58:eb:99:50:f4	272	-39	3	-49	-23	272	-40	3	-49	-28	272	-41	3	-47	-23

Wi-Fi interface statistics

Interface
"wifi-ext" interface is used for M!DGE3 optional extension Wi-Fi module

UDP, TCP, ICMP
Packet count and amount of data in Bytes [B] for different protocol types. Amount of data is summed over the whole Layer 2 Ethernet frame (i.e. all IP headers are counted)

IPv4 other
Packets not handled by the previous counters (e.g. VLAN, services, GRE, IPsec (ESP), ...)

SMS

Rx OK
Number of SMS received
SMS with the correct format, passphrase and from the correct number. Invalid commands or wrong parameters are also included here (they are correctly received by the daemon, rejected only in the command execution system)

Rx Rej
Number of rejected incoming SMS
SMS. In case of disabling the reception of command SMS, all received SMS are included here

Tx OK
Number of SMS sent

Wi-Fi stations statistics

Interface
“wifi-ext” interface is used for M!DGE3 optional extension Wi-Fi module

MAC address
Statistics available for the ext interface and connected stations (by MAC address)

Packet dropped Rx
Number of packets dropped without specifying the reason

Packet errors Rx
Number of packets with FCS error

Total count Rx
Total number of packets received

Total bytes Rx
Total size of received data in bytes

Packet retries Tx
Number of repeatedly sent packets

Packet failed Tx
Number of packets sent unsuccessfully

Total count Tx
Total number of packets sent

Total bytes Tx
Total size of sent data in bytes

Wi-Fi signal statistics

MAC address
Statistics available for the ext interface and connected stations (by MAC address)

Overall RSS
Signal levels in dBm

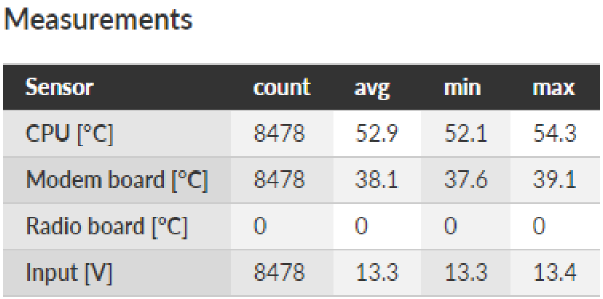
avg / dev / min / max
Average / standard deviation / minimum / maximum value

Samples
Number of samples used for the individual statistics

EXT1 antenna RSS
Signal strength at EXT1 antenna in dBm

EXT2 antenna RSS
Signal strength at EXT2 antenna in dBm

8.5.6. Measurements



Measurements

Sensor	count	avg	min	max
CPU [°C]	8478	52.9	52.1	54.3
Modem board [°C]	8478	38.1	37.6	39.1
Radio board [°C]	0	0	0	0
Input [V]	8478	13.3	13.3	13.4

Sensor
Measured values on M!DGE3.

count
Number of times that the sensor measured given value (counter).

avg / min / max
Average / minimum / maximum value.

8.6. Monitoring

Monitoring is an advanced on-line diagnostic tool, which enables a detailed analysis of communication over any of the M!DGE3 router interfaces. In addition to all the physical interfaces (MAIN, EXT, ETHs, COMs, TSs), some internal interfaces between software modules can be monitored when such advanced diagnostics is needed.

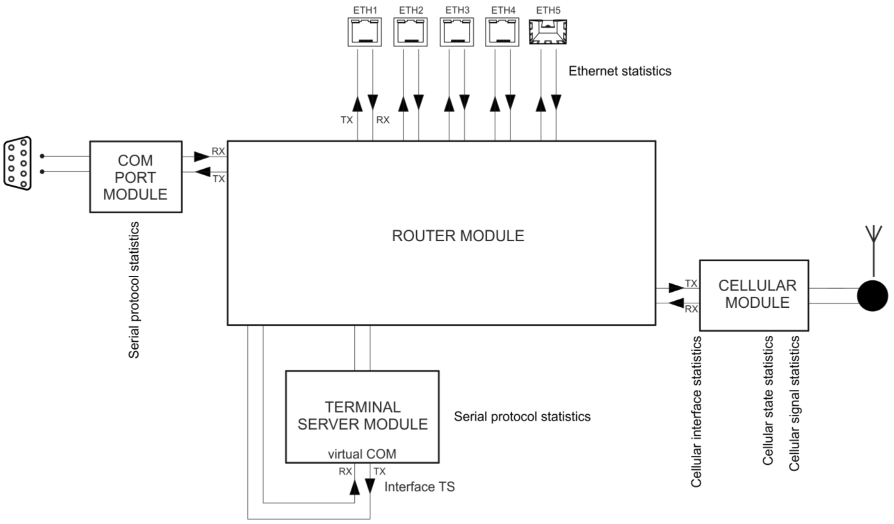
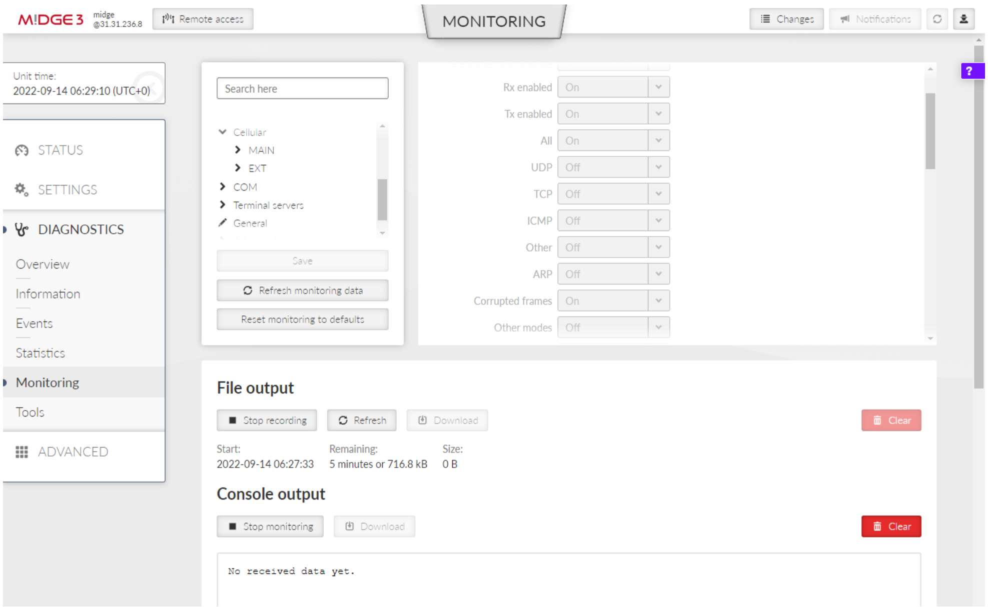


Fig. 8.19: Interfaces in the context of unit monitoring

Monitoring consists of two independent processes: settings of the monitored items and outputs. Please note that even if both of the outputs are switched off and some interfaces are set to On, the monitoring is still running in the background.

The monitoring screen has two main parts - Settings and Output



Unit time:
2022-09-14 06:29:10 (UTC+0)

Rx enabled: On
Tx enabled: On
All: On
UDP: Off
TCP: Off
ICMP: Off
Other: Off
ARP: Off
Corrupted frames: On
Other modes: Off

Start: 2022-09-14 06:27:33
Remaining: 5 minutes or 716.8 kB
Size: 0 B

```
No received data yet.
```

8.6.1. Settings

Save button - saves the new settings of the monitoring parameters.

Refresh monitoring data button - refreshes the settings menu according to the statistics status saved in the unit. The difference between the displayed and saved status can occur for example when the status is changed in different browser tab.

8.6.1.1. Overview

All status (On/Off) of individual interfaces are displayed on this place for quick overview on monitoring settings.

8.6.1.2. Interfaces

This section allows detailed settings of particular monitoring parameters for all interfaces.

Common parameters for several interfaces:

Rx enabled, Tx enabled

List box {On; Off}, default = "On"

A packet is considered a Tx one when it comes out from the respective software module (e.g. Terminal Server) and vice versa. When an external interface (e.g. Interface COM) is monitored, the Tx also means packets being transmitted from the M!DGE3 over the respective interface (Rx means "received"). Understanding the directions over the internal interfaces may not be that straightforward, please see *Fig. 8.19, “Interfaces in the context of unit monitoring”* above for clarification.

All

List box {On; Off}, default = "On"

Monitoring output can also be limited by IP protocol type. Select Off to be able to enable/disable specific protocol output individually - see next parameter(s).

UDP / TCP / ICMP / Other / ARP

List box {On; Off}, default = "Off"
Monitoring output of specific IP protocol limitation.

Offset [B]

Default = 0
Number of bytes from the beginning of packet/frame, which will not be displayed - the monitoring output is truncated by 'Offset' bytes at the beginning of the message.

Length [B]

Default = 32
Number of bytes to be displayed from each packet/frame.
Example: Offset=2, Length=4 means, that bytes from the 3rd byte to the 6th (inclusive) will be displayed:

Data (HEX):	01AB **3798 A285** 93CD 6B96
Monitoring output:	3798 A285

Bandwidth

List box {LOW; NORMAL; HIGH; UNLIMITED}, default = "NORMAL"
Monitoring bandwidth limit to prevent overload of management link between client PC and the M!DGE3 unit. LOW (up to ~300 kb/s), NORMAL (up to ~800 kb/s), HIGH (up to ~2 Mb/s), UNLIMITED (up to ~8 Mb/s)

Source port (from) / Source port (to)

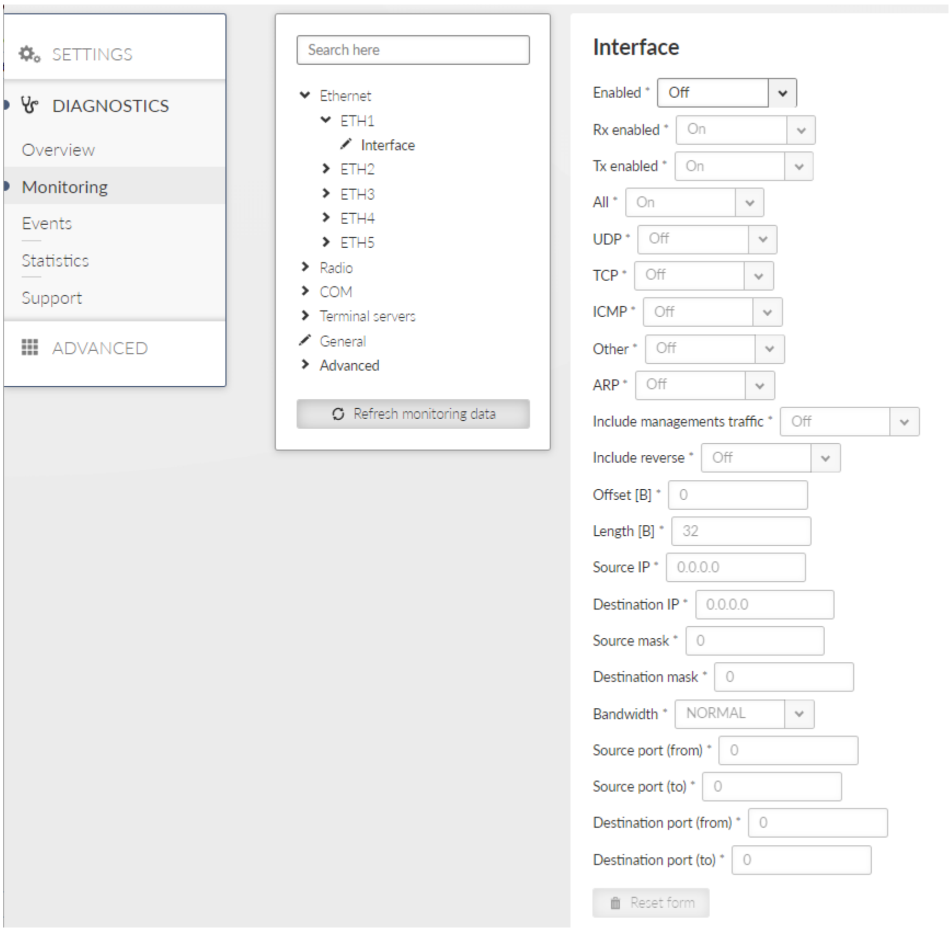
TCP/UDP source port to be enabled/disabled in the monitoring output. Use these parameters to specify the source range of ports <from - to>.

Destination port (from) / Destination port (to)

TCP/UDP destination port to be enabled/disabled in the monitoring output. Use these parameters to specify the destination range of ports <from - to>.

Dropped frames

List box {On; Off}, default = "Off"
When On, monitoring shows frames which are dropped (e.g. CRC is not valid, buffer overflow, ...).



Interface

Enabled * Off
Rx enabled * On
Tx enabled * On
All * On
UDP * Off
TCP * Off
ICMP * Off
Other * Off
ARP * Off
Include managements traffic * Off
Include reverse * Off
Offset [B] * 0
Length [B] * 32
Source IP * 0.0.0.0
Destination IP * 0.0.0.0
Source mask * 0
Destination mask * 0
Bandwidth * NORMAL
Source port (from) * 0
Source port (to) * 0
Destination port (from) * 0
Destination port (to) * 0

ETH interfaces

Include management traffic

List box {On; Off}, default = "Off"
Enable/disable management packets monitoring output.

Include ETH headers

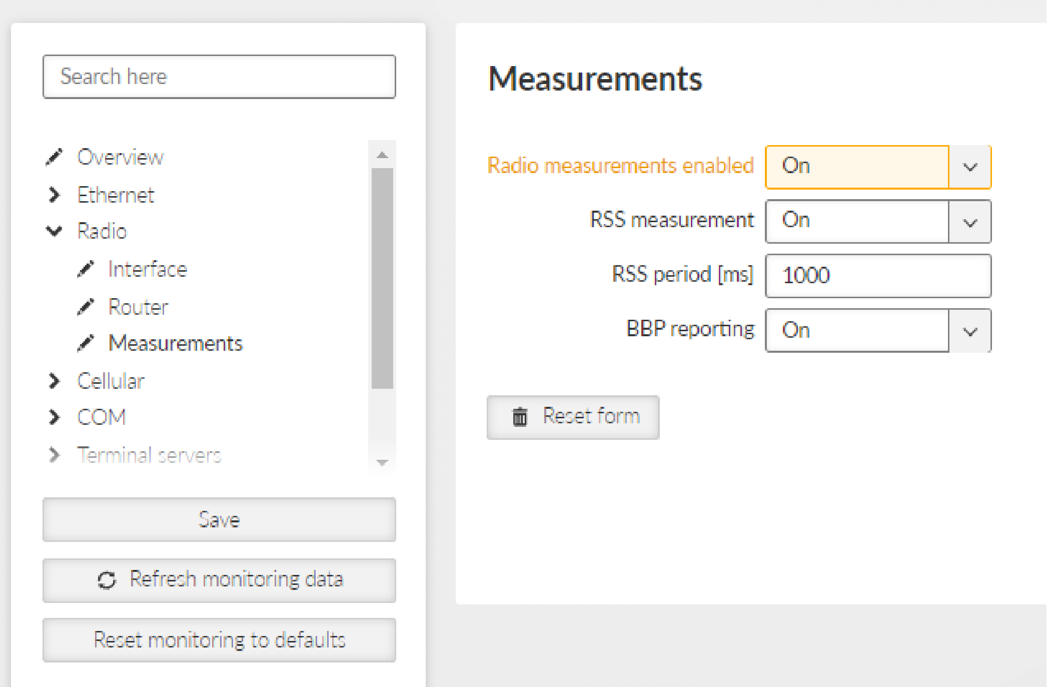
List box {On; Off}, default = "Off"
Displays (enable) / omits (disable) L2 headers in the monitoring output.

Include reverse

List box {On; Off}, default = "Off"
Enable/disable reverse traffic (e.g. TCP reply to a request) monitoring.

Source IP / mask, Destination IP / mask

Monitoring output can also be limited to a specific address range - Source and Destination IP address and mask can be used to define the required range.



Measurements

Radio measurements enabled: On

RSS measurement: On

RSS period [ms]: 1000

BBP reporting: On

Fig. 8.20: Diagnostics > Monitoring > Radio > Measurements

Monitoring now includes additional parameters such as modulation type, FEC code, RF power, and temperature for TX, as well as modulation type, FEC code, frequency offset, and pre-packet RSS for RX.

Monitors regular measurements of radio channel and HW variables.

Individual measurements can be switched on and off, or the measurement period can be modified.

The signal strength is measured at the receiver at the set interval, regardless of any ongoing activity—even during transmission.

The BBP reporting function is included, providing the measured integrated power level across the entire bandwidth.

Cellular interfaces

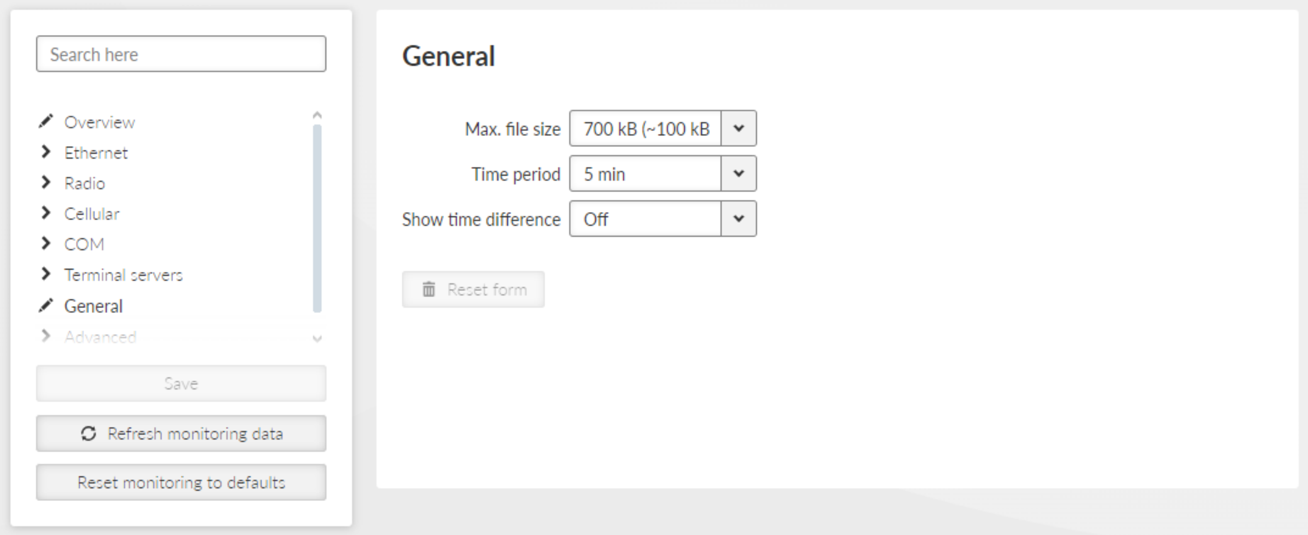
Cinterion PLS83-W cellular module is connected to L3 layer, thus captured frames do not contain L2 header(s). For consistency reasons are following values added to the frame:

- SRC mac: 0x0 0x0 0x0 0x0 0x0 0x0
- Dst mac: 0x0 0x0 0x0 0x0 0x0 0x0
- Ethertype: 0x0800

Cellular interface MAIN enabled (MAIN)
List box {On; Off}, default = "Off"

Cellular interface EXT enabled (EXT)
List box {On; Off}, default = "Off"

8.6.1.3. General



General

Max. file size: 700 kB (~100 kB

Time period: 5 min

Show time difference: Off

Fig. 8.21: DIAGNOSTICS > Monitoring

The settings of output parameters for file output – **Max. file size** and **Time period**, the first parameter matched closes the monitoring file. File is saved in compressed way, so the uncompressed and approximate compressed size is displayed in the list box.

Max. file size
List box {7 kB (~1 kB); 70 kB (~10 kB); 358 kB (~50 kB); 700 kB (~100 kB); 3 MB (~500 kB); 7 MB (~1 MB); max (~2 MB)}, default = "700 kB (~100 kB)"

Time period
List box {1 min; 2 min; 5 min; 10 min; 20 min; 30 min; 1 hour; 3 hours; 24 hours; Off}, default = "5 min"

Show time difference
List box {On; Off}, default = "Off"
When On, the time difference between subsequent packets is displayed in the monitoring output.

8.6.2. File output

Record button – starts recording to the file. Triggers a process, which is set by parameters in the chapter above (*Section 8.6.1.3, “General”*).

Stop recording button – stops recording to the file. The recording will be stopped immediately regardless of the size and time of recording. When the Record button is pressed for the second time the previously recorded data will be cleared.

Refresh button – refreshes the information about time remaining and size of the recorded data (in uncompressed way).

Download button – downloads file to a connected computer. The default name contains of the Unit name, date and time of the begin and day and time of the end of the monitoring. Before downloading you have to stop recording.

Clear button – allows to clear the monitoring data stored in the unit – both downloaded or not downloaded.

8.6.3. Console output

Monitor / Stop monitoring button

Download button – downloads the content of the console output as a file

Clear button - clears Console output screen

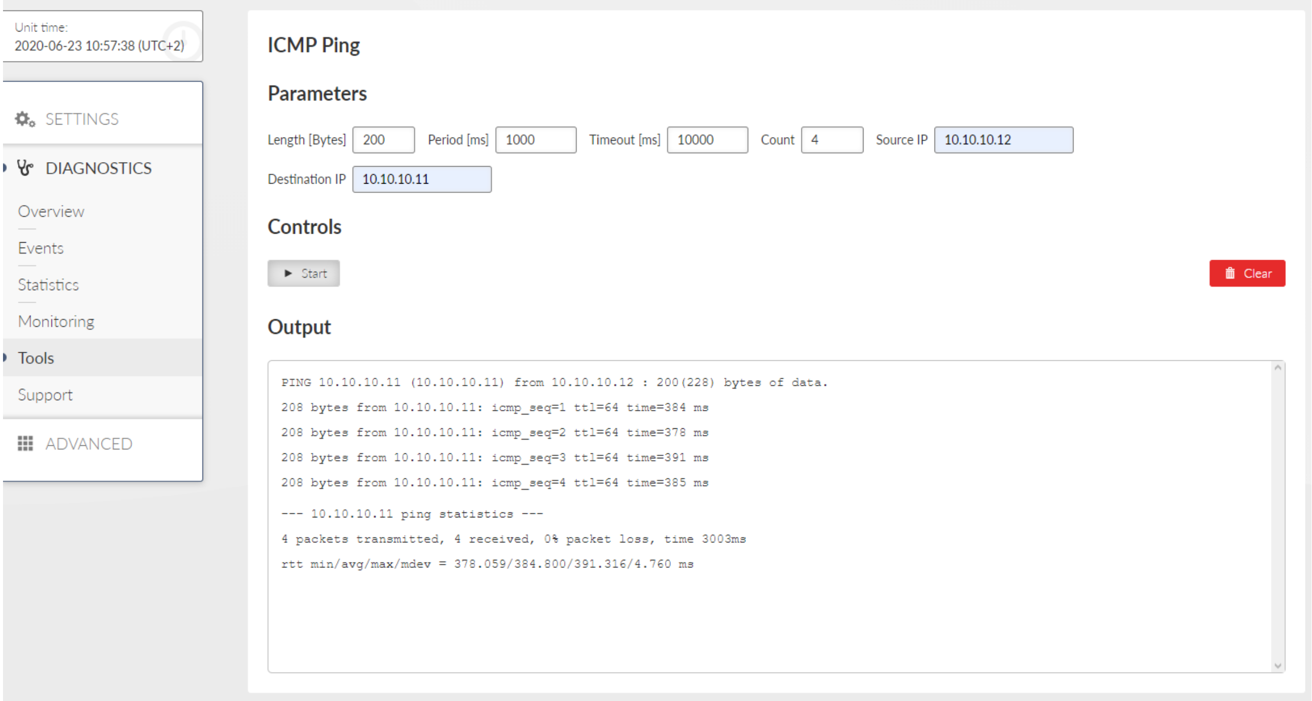
Note

If the amount of monitored data exceeds the limit (2.7 kB for remote monitoring and 32 kB for local monitoring) for one time period (approx. 1 s), some data will not be displayed in the console output. A note about the omited data will be inserted to the console output to the position of the non-displayed data.

8.7. Tools

Set of diagnostic tools

8.7.1. ICMP ping



Length [Bytes] 200 Period [ms] 1000 Timeout [ms] 10000 Count 4 Source IP 10.10.10.12

Destination IP 10.10.10.11

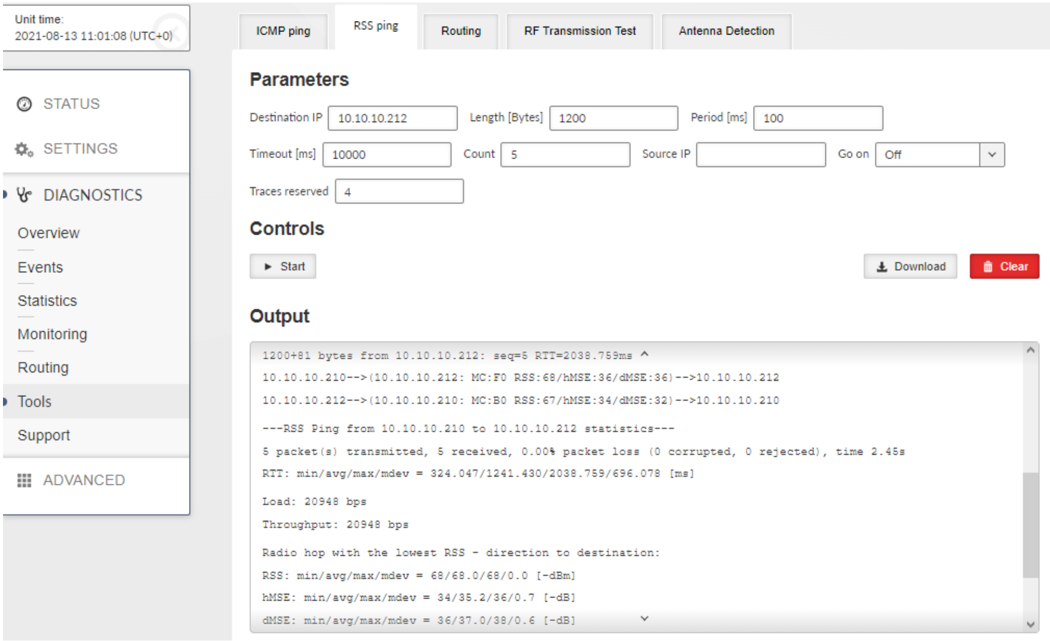
```
PING 10.10.10.11 (10.10.10.11) from 10.10.10.12 : 200(228) bytes of data.
208 bytes from 10.10.10.11: icmp_seq=1 ttl=64 time=384 ms
208 bytes from 10.10.10.11: icmp_seq=2 ttl=64 time=378 ms
208 bytes from 10.10.10.11: icmp_seq=3 ttl=64 time=391 ms
208 bytes from 10.10.10.11: icmp_seq=4 ttl=64 time=385 ms

--- 10.10.10.11 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 378.059/384.800/391.316/4.760 ms
```

All parameters used by standard ICMP ping are available. Start / Stop button starts / stops pinging.

8.7.2. RSS ping

RSS ping can be used for monitoring of the radio channel in case of hybrid networks (RipEX2 / M!DGE3 combination). In such networks, RSS ping comes through the whole network, but information about the RSS/MSE is evaluated only for radio hops.

RSS ping is a diagnostic tool for the radio performance measurement (Radio Signal Strength and modulation Mean Squared Error) of the individual radio hops within a RipEX2 network. Hybrid networks are supported. Output format of different type (other than radio) of hops is similar to ICMP ping.



Parameters

Destination IP 10.10.10.212 Length [Bytes] 1200 Period [ms] 100
Timeout [ms] 10000 Count 5 Source IP Go on Off
Traces reserved 4

Controls

Output

```
1200+81 bytes from 10.10.10.212: seq=5 RTT=2038.759ms
10.10.10.210-->(10.10.10.212: MC:F0 RSS:68/hMSE:36/dMSE:36)-->10.10.10.212
10.10.10.212-->(10.10.10.210: MC:B0 RSS:67/hMSE:34/dMSE:32)-->10.10.10.210

---RSS Ping from 10.10.10.210 to 10.10.10.212 statistics---
5 packet(s) transmitted, 5 received, 0.00% packet loss (0 corrupted, 0 rejected), time 2.45s
RTT: min/avg/max/mdev = 324.047/1241.430/2038.759/696.078 [ms]

Load: 20948 bps
Throughput: 20948 bps

Radio hop with the lowest RSS - direction to destination:
RSS: min/avg/max/mdev = 68/68.0/68/0.0 [-dBm]
hMSE: min/avg/max/mdev = 34/35.2/36/0.7 [-dB]
dMSE: min/avg/max/mdev = 36/37.0/38/0.6 [-dB]
```

Destination IP

Destination IP address. This address must belong to a RipEX2 unit as the RSS ping can be initiated only between two RipEX2 units.

Length [B]

Number {8 – 1500}, default = 10

The length of data used by RSS ping. In case the length of RSS ping packet is longer than the length of **Radio interface MTU**, the first RSS ping packet will be lost and will cause decreasing of the packet length to the value matching to the current radio MTU. Random data are used as a payload.

Period [ms]

Number {100 – 3 600 000}, default = 1000

Period of sending RSS ping packets

When the period is set to a shorter number than the actual RTT, collisions might appear (depends on the selected Radio protocol). In order to reach the shortest possible period enable the **Go on** mode.

Timeout [ms]

Number {100 – 3 600 000}, default = 10000

Response timeout

Count

Number {1 – 10000}, default = 5

Number of RSS pings to be send

Source IP

The local IP address of M!DGE3 unit originating RSS ping. Blank field (equal to 0.0.0.0 address) is used to assign the source address automatically - address is assigned automatically according to the routing rules.

Go on

List box {On; Off}, default = “Off”

Go on mode. When Enabled, RSS pings are sent immediately after receiving the RSS ping reply (Period parameter is ignored).

Traces reserved

The RSS ping also contains data about the route (RSS, MSE), this parameter allows to set number of radio hops within the network to be measured. Radio hop is measured in both directions, so the number has to be higher than number of hops in route multiplied by 2 (for example: link consisting of 2 radio hops needs 5 traces to be reserved).

Output:

- **MC** – Encodes Modulation and Coding – see transcription table:

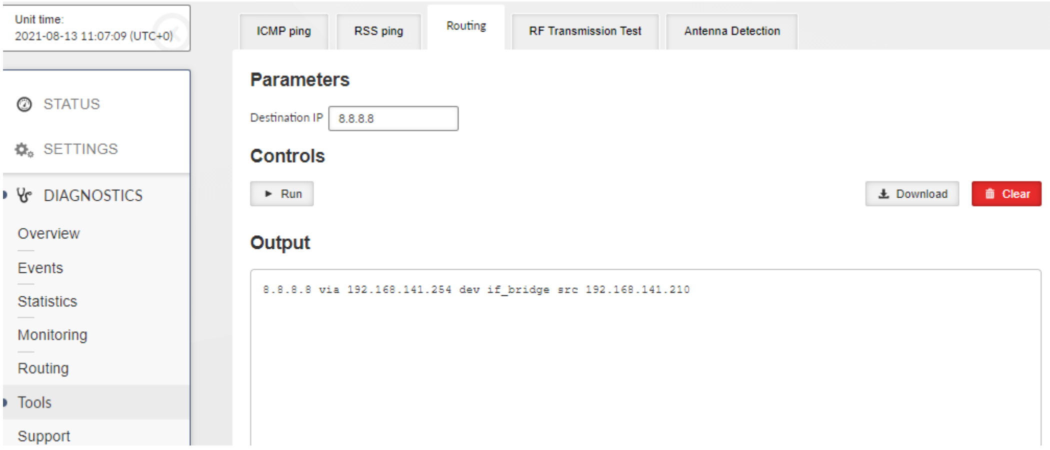
Tab. 8.4: Translation table for Modulation rates and FEC

	Modulation	FEC
00	2CPFSK	FEC off
01		FEC 3/4
10	4CPFSK	FEC off
11		FEC 3/4
80	DPSK	FEC off
81		FEC 3/4
90	pi/4 DQPSK	FEC off
91		FEC 3/4
A0	D8PSK	FEC off
A1		FEC 3/4
B0	16DEQAM	FEC off
B1		FEC 3/4
C0	64QAM	FEC off
C1		FEC 3/4
D0		FEC 5/6
D1		FEC 2/3
E0	256QAM	FEC off
E1		FEC 3/4
F0		FEC 5/6
F1		FEC 2/3

- **RSS** – Radio Signal Strength [dBm] - measured within the header reception
- **hMSE** – Phy header modulation Mean Squared Error [dB] - measured within the header reception
- **dMSE** – Data modulation Mean Squared Error [dB] - measured within the frame data part reception

8.7.3. Routing

Routing tool provides the next hop routing information of the given IP address.



Destination IP: 8.8.8.8

```
8.8.8.8 via 192.168.141.254 dev if_bridge src 192.168.141.210
```

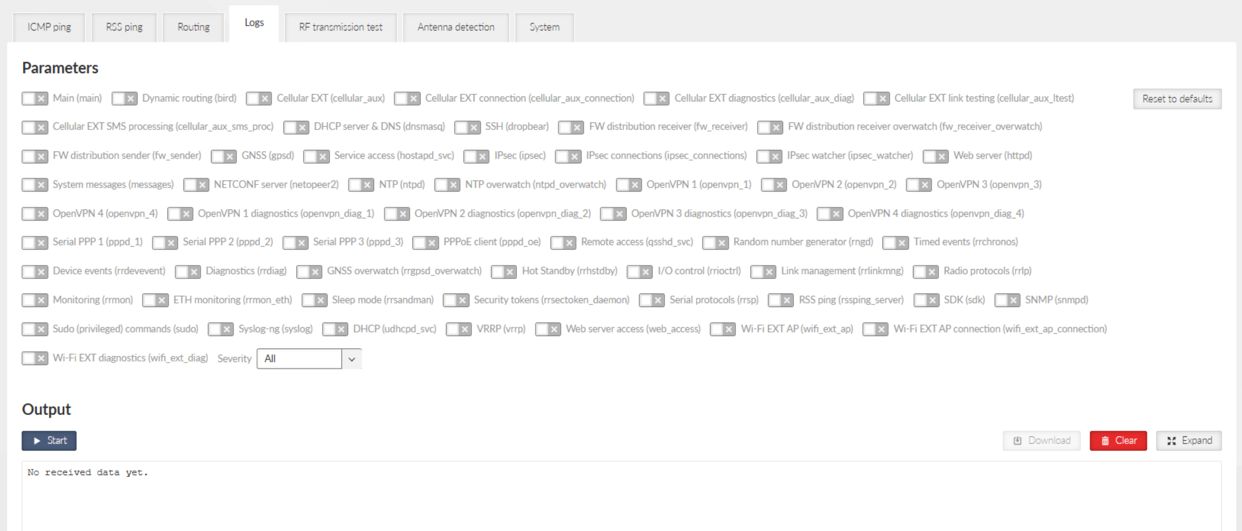
Destination IP
The examined IP address.

Output
Output section provides the following details:

- Examined address (example: 8.8.8.8)
- Next hop (gateway) address (example: via 192.168.141.254)
- Next hop interface (example: dev if_bridge)
- Outgoing packet Source address (example: src 192.18.141.210)

8.7.4. Logs

This tool provides a real-time display of process logs for active device operations. These logs are designed for live station diagnostics and do not offer historical data retrieval. For retrospective analysis, please utilize an alternative method, such as the *Diagnostic package*.



Parameters

☒ Main (main) ☒ Dynamic routing (bird) ☒ Cellular EXT (cellular_aux) ☒ Cellular EXT connection (cellular_aux_connection) ☒ Cellular EXT diagnostics (cellular_aux_diag) ☒ Cellular EXT link testing (cellular_aux_ltest)

☒ Cellular EXT SMS processing (cellular_aux_sms_proc) ☒ DHCP server & DNS (dnsmasq) ☒ SSH (dropbear) ☒ FW distribution receiver (fw_receiver) ☒ FW distribution receiver overwatch (fw_receiver_overwatch)

☒ FW distribution sender (fw_sender) ☒ GNSS (gpsd) ☒ Service access (hostapd_svc) ☒ IPsec (ipsec) ☒ IPsec connections (ipsec_connections) ☒ IPsec watcher (ipsec_watcher) ☒ Web server (httpd)

☒ System messages (messages) ☒ NETCONF server (netopeer2) ☒ NTP (ntpd) ☒ NTP overwatch (ntpd_overwatch) ☒ OpenVPN 1 (openvpn_1) ☒ OpenVPN 2 (openvpn_2) ☒ OpenVPN 3 (openvpn_3)

☒ OpenVPN 4 (openvpn_4) ☒ OpenVPN 1 diagnostics (openvpn_diag_1) ☒ OpenVPN 2 diagnostics (openvpn_diag_2) ☒ OpenVPN 3 diagnostics (openvpn_diag_3) ☒ OpenVPN 4 diagnostics (openvpn_diag_4)

☒ Serial PPP 1 (pppd_1) ☒ Serial PPP 2 (pppd_2) ☒ Serial PPP 3 (pppd_3) ☒ PPPoE client (pppd_oe) ☒ Remote access (qsshd_svc) ☒ Random number generator (rngd) ☒ Timed events (rrchronos)

☒ Device events (rrdevevent) ☒ Diagnostics (rrdiag) ☒ GNSS overwatch (rrgpsd_overwatch) ☒ Hot Standby (rrhstdby) ☒ I/O control (rrioctrl) ☒ Link management (rrlinkmng) ☒ Radio protocols (rrlp)

☒ Monitoring (rrmon) ☒ ETH monitoring (rrmon_eth) ☒ Sleep mode (rrsandman) ☒ Security tokens (rrsectoken_daemon) ☒ Serial protocols (rrsp) ☒ RSS ping (rssping_server) ☒ SDK (sdk) ☒ SNMP (snmpd)

☒ Sudo (privileged) commands (sudo) ☒ Syslog-ng (syslog) ☒ DHCP (udhcpd_svc) ☒ VRRP (vrrp) ☒ Web server access (web_access) ☒ Wi-Fi EXT AP (wifi_ext_ap) ☒ Wi-Fi EXT AP connection (wifi_ext_ap_connection)

☒ Wi-Fi EXT diagnostics (wifi_ext_diag) Severity All

Output

```
No received data yet.
```

Fig. 8.22: DIAGNOSTICS > Tools > Logs

The core functionalities of this tool include:

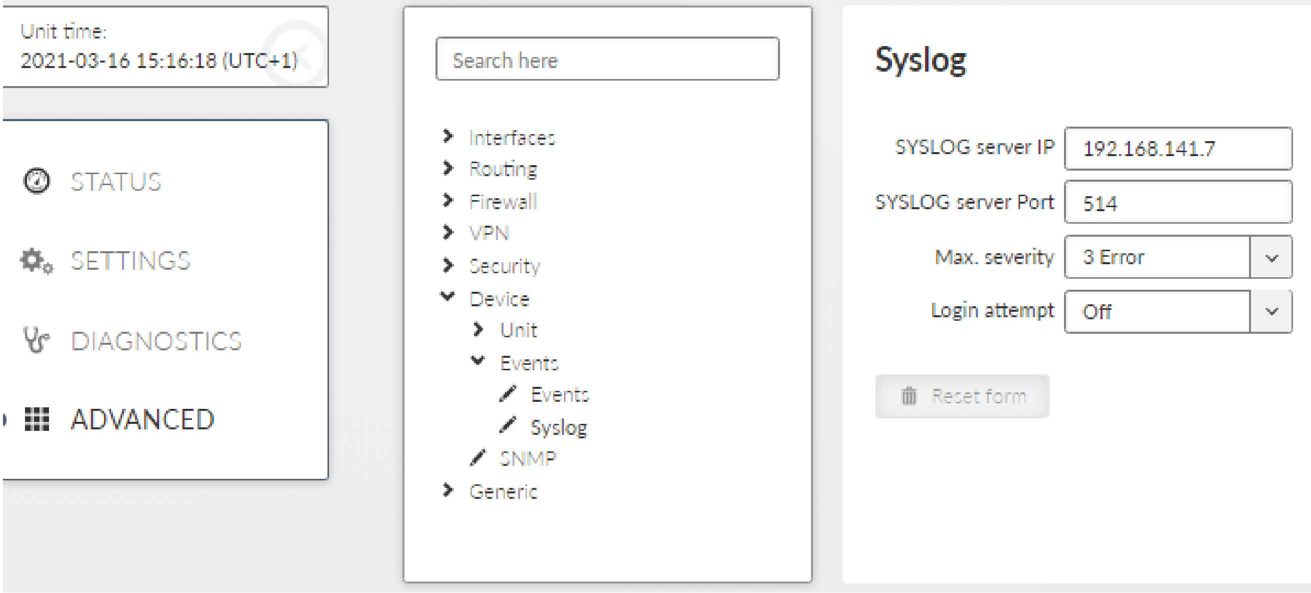
- Real-time record display.
- Support for multiple independent instances (up to 10).
- Consolidated display of records from any number of processes within a single instance.
- Record filtering based on specified severity levels.
- Record length limitation to 1024 characters, with truncation of longer entries.

8.7.5. System

Reboot button

Performs unit cold restart (power cycle equivalent).

8.8. Syslog



SYSLOG server IP: 192.168.141.7
SYSLOG server Port: 514
Max. severity: 3 Error
Login attempt: Off

SYSLOG server IP

IP address of the remote Syslog server to which logs will be sent with severity higher than severity set in the Max. severity

SYSLOG server Port

Port used by the Syslog server

Max. severity

List box {Off; 0 Emergency; 1 Alert; 2 Critical; 3 Error}, default= ”Off”
Off - switches off the SYSLOG functionality
Only the events with set severity (and higher) will be sent to the Syslog server. Severities for individual Events can be set in *Section 7.6.3, “Events”*.

Login attempt

List box {Off; Web}, default = "Off"
Switches whether login attempts (both successful and unsuccessful) will be sent to the SYSLOG server.

9. Technical parameters

Electrical	**M!DGE3**	**M!DGE3e**
Primary power	10 to 50 VDC, negative GND	
Rx	4.8 W / 24 V, *see details*	
Tx	7.8 W / 24 V, *see details*	
Sleep mode	0.01 W	
Interfaces		
SIM slots	2× Micro SIM + 1× eSIM[1]	2× Micro SIM
Ethernet	10/100/1000 Base-T, Auto MDX, 4× RJ45 bridged or routed	10/100/1000 Base-T, 2× RJ45 Auto MDX, bridged or routed
SFP	10/100/1000Base-T or 1× SFP 1000Base-SX or 1000Base-LX	No SFP
Serial	1× RS232/RS485 SW configurable Terminals 2× RS232 (mPCIe expansion 1× RJ45 board [3]) 600 b/s – 1 Mb/s	1× RS232/RS485 or 2× Terminals RS232[2] SW configurable 600 b/s – 1 Mb/s
USB	USB 3.0/Host A	
Inputs/Outputs	1× HW alarm input, 1× HW alarm output, 1× Sleep input - Power connector RJ45	
	2× DI, 2× DO, 1× difDI (when mPCIe-COMS is not used)	No
Antenna	2× SMA female – receiver diversity (2×2 MIMO)	
Optional Expansions	1× mPCIe: Cellular module ('W' or 'M' or 'O') or 2× RS232 or GPS or Wi-Fi	No
1) eSIM for 5G only		
2) only for 'R' Order Code		
3) not available for 'R' Order Code		

Cellular interface	
5G[2)]	
Available on motherboard M!DGE3	
Frequency bands for extension module 'Q' Cellular	5G Rel.17 n1, n2, n3, n5, n7, n8, n12, n13, n14, n18, n20, n25, n26, n28, n29(SDL), n30, n38, n40, n41, n48, n53, n66, n67(SDL), n70, n71, n75(SDL), n76(SDL), n77, n78, n79, n91, n92, n93 ,n94
	4G Cat 20 Band 1 (2100 MHz), Band 2 (1900 MHz), Band 25 (1900 MHz), Band 3 (1800 MHz), Band 4 (1700/2100 MHz), Band 66 (1700/2100 MHz), Band 26 (850 MHz), Band 5 (850 MHz), Band 18 (850 MHz), Band 19 (850 MHz), Band 7 (2600 MHz), Band 8 (900 MHz), Band 12 (700 MHz), Band 17 (700 MHz), Band 13 (700 MHz), Band 14 (700 MHz), Band 20 (800 MHz), Band 28 (700 MHz), Band 29 (700 MHz), Band 30 (2300 MHz), Band 32 (1500 MHz), Band 34 (2010-2025 MHz), Band 38 (2600 MHz), Band 39 (1900 MHz), Band 40 (2300 MHz), Band 41 (2500 MHz), Band 42 (3500 MHz), Band 43 (3700 MHz), Band 46 (5200 MHz), Band 48 (3600 MHz), Band 67 (700 MHz), Band 68 (700 MHz), Band 70 (1700/2000 MHz), Band 71 (600 MHz)
	3G HSPA+ Rel 8 Band 1 (2100 MHz), Band 2 (1900 MHz), Band 4 (1700/2100 MHz), Band 5 (850 MHz), Band 8 (900 MHz)
	Cinterion MV32-W-A FCC ID QIPMV32-W-A
Specification for module 'Q' Cellular	4× SMA Antenna
	5G NR 3GPP Release 16 FR1 (Sub 6G) Data throughput (max. @ 5G FR1 NSA) DL 3.6 Gb/s , UL 0.55 Gb/s Data throughput (max. @ 5G FR1 SA) DL 2.8 Gb/s , UL 0.45 Gb/s DL 4×4 MIMO / UL 2×2 MIMO
	4G LTE 3GPP Release 15 Long Term Evolution (LTE) UE Cat 19 (DL 2 Gb/s, UL 210 Mb/s) 7× DL CA, 2× UL CA (Intra-band), 5× DL CA+ 4 × 4 MIMO (Up to UE Cat 20)
	3G UMTS/HSDPA/HSUPA 3GPP Release 8 DC-HSPA+ – DL Cat 24 (42 Mb/s) / UL Cat 6 (11 Mb/s) HSUPA – UL 11 Mb/s
4G	
Available on motherboard M!DGE3, M!DGE3e[2)] or mPCIe extension board	

Frequency bands for extension module 'W' Cellular	4G LTE (also 5G NSA) Band 1 (2100 MHz), Band 2 (1900 MHz), Band 3 (1800 MHz), Band 4 (2100 MHz), Band 5 (850 MHz), Band 7 (2600 MHz), Band 8 (900 MHz), Band 12 (700 MHz), Band 13 (700 MHz)**, Band 18 (850 MHz), Band 19 (850 MHz), Band 20 (800 MHz), Band 26 (850 MHz), Band 28 (700 MHz), Band 38 (2600 MHz), Band 40 (2300 MHz), Band 41 (2500 MHz), Band 66 (2100 MHz) ** a sensitivity issue will occur in GNSS when transmitting in band 13	
	3G UMTS/HSDPA/HSUPA Band 1 (2100 MHz), Band 2 (1900 MHz), Band 3 (1800 MHz), Band 4 (2100 MHz), Band 5 (850 MHz), Band 6 (850 MHz), Band 8 (900 MHz), Band 19 (850 MHz)	
	2G GSM/GPRS/EDGE GSM 850 MHz, E-GSM 900 MHz, DCS 1800 MHz,PCS 1900 MHz	
	Cinterion PLS83-W	FCC ID QIPPLS83-W TAC 35107264
Specification for module 'W' Cellular	ANT1, ANT2 - space diversity	2× SMA Antenna
	4G LTE (also 5G NSA) 3GPP Release 10 Long Term Evolution (LTE) Evolved Uni. Terrestrial Radio Access (E-UTRA) Frequency Division Duplex (FDD) DL Multi-Input Multi-Output (MIMO) 2×2	
	3G UMTS/HSDPA/HSUPA 3GPP Release 7 Dual-Cell HS Packet Access (DC-HSPA+) UMTS Terrestrial Radio Access (UTRA) Frequency Division Duplex (FDD) DL Rx diversity	
	2G GSM/GPRS/EDGE 3GPP Release 4 Enhanced Data rate GSM Evolution (EDGE) GSM EGPRS Radio Access (GERA) Time Division Multiple Access (TDMA) DL Advanced Rx Performance Phase 1	
	Data rates up to 150 Mb/s downlink / 50 Mb/s uplink	
LTE Cat M1/NB1/NB2		
Available on motherboard M!DGE3, M!DGE3e[2)] or mPCIe extension board		
Frequency bands for extension module 'M' Cellular	LTE Cat M1: Band 1 (2100 MHz), Band 3 (1800 MHz), Band 8 (900 MHz), Band 20 (800 MHz), Band 28 (700 MHz), Band 31 (450 MHz), Band 72 (450 MHz)	
	LTE Cat NB1/2: Band 1 (2100 MHz), Band 3 (1800 MHz), Band 8 (900 MHz), Band 20 (800 MHz), Band 28 (700 MHz), Band 31 (450 MHz), Band 72 (450 MHz)	
	Cinterion TX62-W-C	

Frequency bands for extension module 'O' Cellular	LTE Cat M1: Band 1 (2100 MHz), Band 2 (1900 MHz), Band 3 (1800 MHz), Band 4 (AWS-1), Band 5 (850 MHz), Band 8 (900 MHz), Band 12 (700 MHz), Band 13 (700 MHz), Band 18 (800 MHz), Band 19 (800 MHz), Band 20 (800 MHz), Band 25 (1900 MHz), Band 26 (800 MHz), Band 27 (800 MHz), Band 28 (700 MHz), Band 66 (AWS-3), Band 85 (700 MHz)	
	LTE Cat NB1/2: Band 1 (2100 MHz), Band 2 (1900 MHz), Band 3 (1800 MHz), Band 4 (AWS-1), Band 5 (850 MHz), Band 8 (900 MHz), Band 12 (700 MHz), Band 13 (700 MHz), Band 18 (800 MHz), Band 19 (800 MHz), Band 20 (800 MHz), Band 25 (1900 MHz), Band 26 (800 MHz), Band 28 (700 MHz), Band 66 (AWS-3), Band 71 (600 MHz), Band 85 (700 MHz)	
	Cinterion TX62-W-B	FCC QIPTX62-W-B
Frequency bands for extension module 'R' Cellular	LTE Cat M1: Band 1 (2100 MHz), Band 3 (1800 MHz), Band 5 (850 MHz), Band 8 (900 MHz), Band 20 (800 MHz), Band 28 (700 MHz), Band 31 (450 MHz), Band 72 (450 MHz), Band 87 (410 MHz), Band 88 (410 MHz)	
	Telit ME310G1-W2	LatAm
Specification for extension module 'M' and 'O' Cellular	ANT1	1× SMA Antenna
	LTE Cat M1 - DL: max. 300 kb/s, UL: max. 1.1 Mb/s LTE Cat NB 1 - DL: max. 27 kb/s, UL: max. 63 kb/s LTE Cat NB 2 - DL: max. 124 kb/s, UL: max. 158 kb/s	
	3GPP Release 14	
	Half Duplex - Frequency Division Duplex (HD-FDD)	
Specification for extension cellular module 'R'	ANT1	1× SMA Antenna
	LTE Cat M1 - DL: 588 kb/s, UL: max. 1 Mb/s LTE Cat NB 1 - DL: max. 27 kb/s, UL: max. 63 kb/s LTE Cat NB 2 - DL: max. 120 kb/s, UL: max. 160 kb/s	
	3GPP Release 14	
	Half Duplex - Frequency Division Duplex (HD-FDD)	
	Only 1.8 V simcard are supported.	
2) Pending		

Indication LEDs	
LED panel	5× tri-color status LEDs (SYS, WAN, EXT, VPN, COM)
ETH	4× RJ45 (Link and Activity LEDs), 1× SFP (Status LED)
Environmental	
IP Code (Ingress Protection)	IP40, for indoor use only
MTBF (Mean Time Between Failure)	> 100 years
Service life of system	>= 15 years
Operating temperature	−40 to +70 °C (−40 to +158 °F)
Operating humidity	5 to 95 % non-condensing
Storage	−40 to +85 °C (−40 to +185 °F) / 5 to 95 % non-condensing
Mechanical	
Casing	Metal
Dimensions	H×W×D: 132×43×110 mm (5.20×1.69×4.33 in)
Weight	0.50 kg (1.1 lbs)
Mounting	DIN rail, optionally: flat-bracket or corner-bracket
SW	
User protocols on COM	DNP3, DF1, IEC101, Modbus RTU, PR2000, RDS, Siemens 3964(R), COMLI, SAIA S-bus, Mars-A, PPP, UNI, Async Link
User protocols on Ethernet	Modbus TCP, IEC104, DNP3 TCP, Comli TCP, Terminal server…
Serial to IP convertors	DNP3 / DNP3 TCP, Modbus RTU / Modbus TCP
Routing	Static, Dynamic - Babel, OSPF, BGP, Link management
QoS	8 levels on all interfaces
Security	
Management	HTTPS (Web Interface or Application Programming Interface)
Role-based access control (RBAC)	4 levels (Guest, Tech, SecTech, Admin)
WiFi management access (optional)	WPA2-PSK secured
VPN	IPsec, OpenVPN, GRE
VLAN	IEEE 802.1Q (tagging)
AAA protocol	RADIUS
Firewall	Layer 2 - MAC, Layer 3 - IP, Layer 4 - TCP/UDP
FW	Digitally signed
HW tamper	Case opening evidence (N/A for M!DGE3e)

Diagnostic and Management	
Link testing	ICMP ping
Status information	User interfaces
Statistics	Historical and differential statistics for Rx / Tx Packets on all user interfaces (e.g. ETH 1-5, COM 1-3, TS 1-5)
Statistics history	Several weeks
Event log	Events filtered by time, severity, user, remote IP address and type of event
SNMP	SNMPv1, SNMPv2c, SNMPv3 Trap / Inform notifications generation as per settings
NTP	Client / Server
Monitoring	Real time analysis of all interfaces (e.g. ETH 1-5 , COM 1-3, TS 1-5) and internal interfaces between software modules, *see details*

Standards	
CE, FCC	*RED, RoHS, WEEE*
Spectrum	ETSI EN 301 511 V12.5.1 ETSI EN 301 908-01 V13.1.1 ETSI EN 301 908-02 V11.1.2 ETSI EN 301 908-13 V13.1.1 ETSI EN 303 413 V1.1.1
EMC (electromagnetic compatibility)	ETSI EN 301 489-1 V2.2.3 ETSI EN 301 489-5 V3.2.1 ETSI EN 301 489-19 V2.1.0 ETSI EN 301 489-52 V1.1.0
Product safety	EN 62368-1:2014 + A11:2017
RF health safety	EN 62311:2008
Electric power substations environment	IEEE 1613:2009 IEEE 1613.1:2013 EN 61850-3:2014
Environmental	EN 61850-3: 2014
Vibration & shock	EN 60068-2-6:2008 ETS 300 019-2-3:1994, Class 3.4 EN 61850-3:2014
Seismic qualification	EN 60068-2-27:2010
IP rating	EN 60529:1993 + A1:2001 + A2:2014

Optional interfaces	
Extension module 'G' GPS (GNSS)	Active antenna 3.3 VDC SMA female (EXT1 on bottom)
	72-channel u-blox M8 engine GPS/QZSS L1 C/A, GLONASS L10F, BeiDou B1I, Galileo E1B/C, SBAS L1 C/A: WAAS, EGNOS, MSAS, GAGAN
Extension module 'C' COM ports	COM2: RS232 - 5 pin (RxD, TxD, GND, RTS, CTS) 600 b/s to 2 Mb/s COM3: RS232 -3 pin (RxD, TxD, GND) 2.4 kb/s to 921.6 kb/s RJ45 (DI/DO on front panel)
Extension module 'W', 'M', 'O', 'R' Cellular	see *Cellular interface*
Extension module 'F' Wi-Fi	IEEE 802.11a/b/g/n/ac 2x2 MIMO 20 MHz / 40 MHz for 2.4 GHz 20 MHz / 40 MHz / 80 MHz for 5 GHz WPA/WPA2 PSK WPA3-SAE AES/TKIP hardware encryption Output power up to 16 dBm EmWicon WMX6218 - FCC ID 2A3G3-WMX6218

List of connected cables			
Input / Output	**Specified length for EN 61850-3**	**Shielded / Nonshielded**	**Recommended cable type**
DC power supply 10 – 50 V	As needed	N	V03VH-H 2×0,5
GPIO (Sleep Input, HW Alarm Input, HW Alarm Output)	As needed	S	LiYCY 6×0,14
Antenna connection	As needed	S	Coaxial
COM (RS232/485)	As needed, typically up to 15 m (RS232) or up to 400 m (RS485)	S	LiYCY 4×0,14
EXT1	As needed (for cellular) Max. 2 m (GPS antenna)	S	Coaxial
EXT2	As needed (for cellular) Max. 2 m (time pulse output)	S	Coaxial
ETH (4 ports)	As needed, typically up to 100 m	S	STP CAT 5e
Optical Ethernet	As needed, typically up to 2 km	N/A	Optical fibre
USB	Max. 2 m	S	USB3
DI / DO	As needed	S	STP CAT 5e

Rx Power consumption @24Vdc	
Rx	4.8 W
LTE Tx	+3.0 W
+Ethernet	+0.1 W @ 10BaseT +0.12 W @ 100BaseT +0.5 W @ 1000BaseT per Eth interface with connected equipment
+1st COM	+0.2 W
+GNSS	+0.15 W
+2nd COM	+0.1 W
+2nd LTE	Rx +0.3, Tx +3.0 W
+SFP module typ.	+1.0 W
+	+3.0 W Max.

10. Safety, regulations, warranty

10.1. Safety instructions

The M!DGE3 Wireless Router must be used in compliance with any and all applicable international and national laws and in compliance with any special restrictions regulating the utilization of the communication module in prescribed applications and environments.

To prevent possible injury to health and damage to appliances and to ensure that all the relevant provisions have been complied with, use only the original accessories. Unauthorized modifications or utilization of accessories that have not been approved may result in the termination of the validity of the guarantee.

The M!DGE3 cellular routers must not be opened. Only the replacement of the SIM card is permitted.

Voltage at all connectors of the communication module is limited to SELV (Safety Extra Low Voltage) and must not be exceeded.

For use with certified (CSA or equivalent) power supply, which must have a limited and SELV circuit output. The M!DGE3 is designed for indoor use only. Do not expose the communication module to extreme ambient conditions. Protect the communication module against dust, moisture and high temperature.

We remind the users of the duty to observe the restrictions concerning the utilization of radio devices at petrol stations, in chemical plants or in the course of blasting works in which explosives are used. Switch off the communication module when traveling by plane.

When using the communication module in close proximity of personal medical devices, such as cardiac pacemakers or hearing aids, you must proceed with heightened caution.

If it is in the proximity of TV to prevent possible injury to health sets, radio receivers and personal computers, M!DGE3 Wireless Router may cause interference.

It is recommended that you should create an approximate copy or backup of all the important settings that are stored in the memory of the device.

You must not work at the antenna installation during a lightning.

Always keep a distance bigger than 40 cm from the antenna in order to keep your exposure to electromagnetic fields below the legal limits. This distance applies to Lambda/4 and Lambda/2 antennas. Larger distances apply for antennas with higher gain.

Adhere to the instructions documented in this user’s manual.

10.2. High temperature

If the M!DGE3 is operated in an environment where the ambient temperature exceeds 55 °C, the M!DGE3 must be installed within a restricted access location to prevent human contact with the enclosure heatsink.

10.3. Battery disposal

Battery Disposal - This product may contain a battery (e.g. CRC1225, 3V, 48 mAh). Batteries must be disposed of properly, and may not be disposed of as unsorted municipal waste. Batteries are marked with a symbol, which may include lettering to indicate cadmium (Cd), lead (Pb), or mercury (Hg). For proper recycling, return the battery to your supplier or to a designated collection point.

10.4. Instructions for Safe Operation of Equipment

Please read these safety instructions carefully before using the product:

- The radio equipment can only be operated on frequencies stipulated by the body authorized by the radio operation administration in the respective country and cannot exceed the maximum permitted output power. RACOM is not responsible for products used in an unauthorized way.
- Equipment mentioned in this User manual may only be used in accordance with instructions contained in this manual. Error-free and safe operation of this equipment is only guaranteed if this equipment is transported, stored, operated and controlled in the proper manner. The same applies to equipment maintenance.
- In order to prevent damage to the cellular router and other terminal equipment the supply must always be disconnected upon connecting or disconnecting the cable to the cellular router data interface. It is necessary to ensure that connected equipment has been grounded to the same potential.
- Only undermentioned manufacturer is entitled to repair any devices.

10.5. SW license

Conditions of use of this product software abide by the license mentioned below. The program spread by this license has been freed with the purpose to be useful, but without any specific guarantee. The author or another company or person is not responsible for secondary, accidental or related damages resulting from application of this product under any circumstances.

RACOM Open Software License

Version 1.0, November 2009

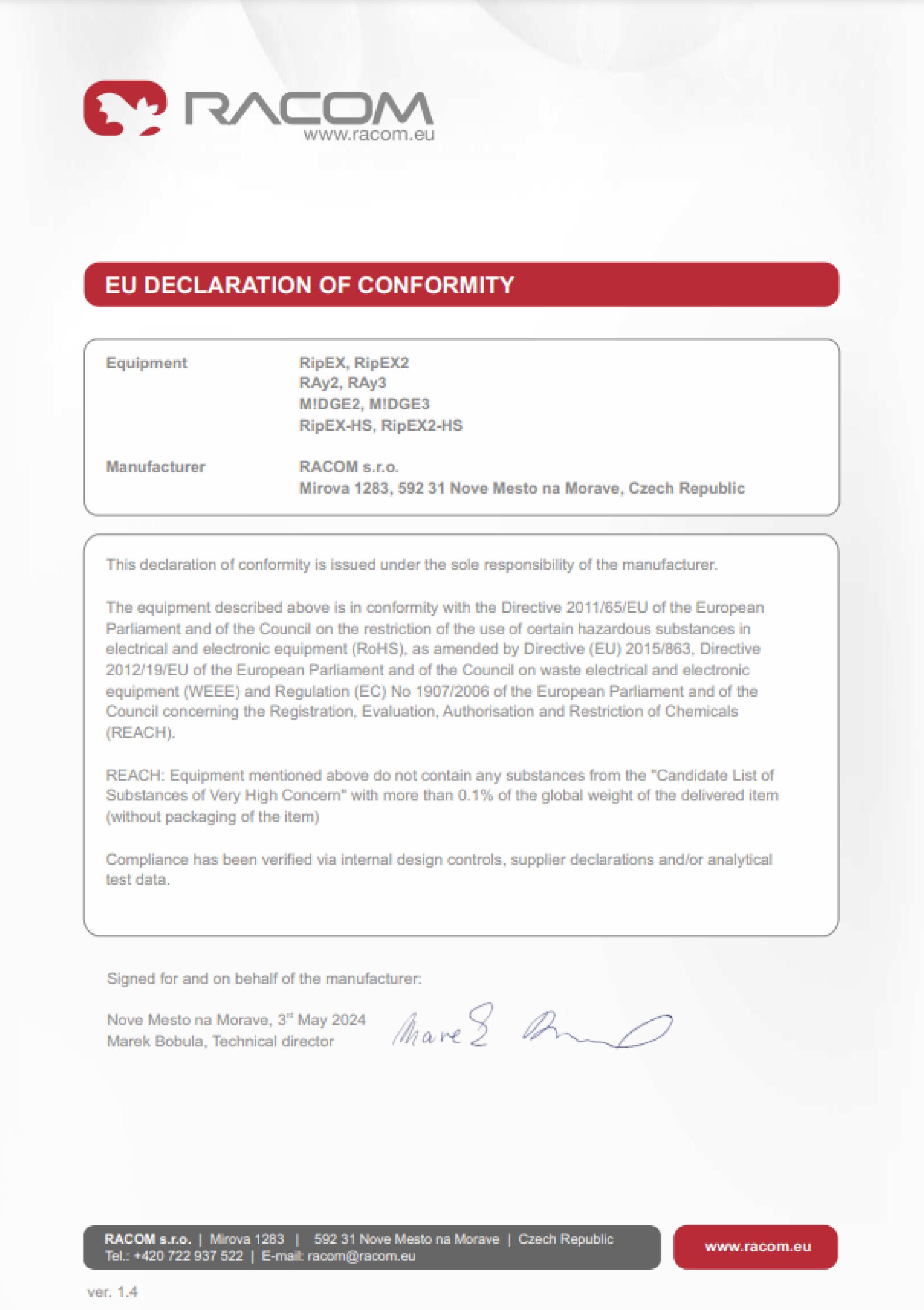
Copyright (c) 2001, RACOM s.r.o., Mírová 1283, Nové Město na Moravě, 592 31

Everyone can copy and spread word-for-word copies of this license, but any change is not permitted.

The program (binary version) is available for free on the contacts listed on https://www.racom.eu. This product contains open source or another software originating from third parties subject to GNU General Public License (GPL), GNU Library / Lesser General Public License (LGPL) and / or further author licenses, declarations of responsibility exclusion and notifications. Exact terms of GPL, LGPL and some further licenses is mentioned in source code packets (typically the files COPYING or LICENSE). You can obtain applicable machine-readable copies of source code of this software under GPL or LGPL licenses on contacts listed on https://www.racom.eu. This product also includes software developed by the University of California, Berkeley and its contributors.

10.6. EU Compliance

10.6.1. RoHS, WEEE and WFD



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EU DECLARATION OF CONFORMITY

Equipment	RipEX, RipEX2 RAy2, RAy3 M!DGE2, M!DGE3 RipEX-HS, RipEX2-HS
Manufacturer	RACOM s.r.o. Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The equipment described above is in conformity with the Directive 2011/65/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), as amended by Directive (EU) 2015/863, Directive 2012/19/EU of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE) and Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

REACH: Equipment mentioned above do not contain any substances from the "Candidate List of Substances of Very High Concern" with more than 0.1% of the global weight of the delivered item (without packaging of the item)

Compliance has been verified via internal design controls, supplier declarations and/or analytical test data.

Signed for and on behalf of the manufacturer:

Nove Mesto na Morave, 3rd May 2024
Marek Bobula, Technical director

RACOM s.r.o. | Mirova 1283 | 592 31 Nove Mesto na Morave | Czech Republic
Tel.: +420 722 937 522 | E-mail: racom@racom.eu

www.racom.eu

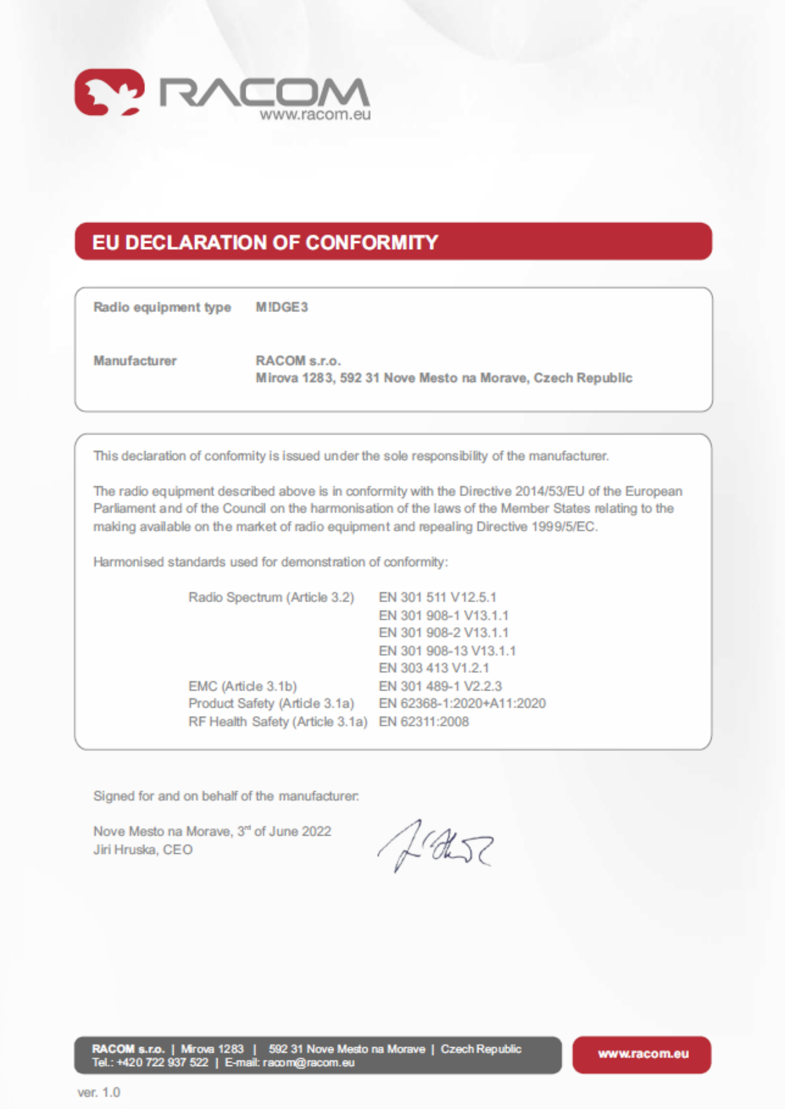
ver. 1.4

Fig. 10.1: EU Declaration of Conformity RoHS, WEEE

Waste Framework Directive Statement

According to the Directive 2008/98/EC on waste amended by Directive (EU) 2015/1127 and Directive (EU) 2018/851 (Waste Framework Directive) we hereby state that our products doesn't contain substances of very high concern (SVHC) listed on European chemical agency (ECHA) SCIP database candidate list in concentrations above 0.1 % w/w.

10.6.2. EU Declaration of Conformity RED



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www.racom.eu

EU DECLARATION OF CONFORMITY

Radio equipment type	**M!DGE3**
Manufacturer	**RACOM s.r.o.** **Mirova 1283, 592 31 Nove Mesto na Morave, Czech Republic**

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The radio equipment described above is in conformity with the Directive 2014/53/EU of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

Harmonised standards used for demonstration of conformity:

Radio Spectrum (Article 3.2)	EN 301 511 V12.5.1 EN 301 908-1 V13.1.1 EN 301 908-2 V13.1.1 EN 301 908-13 V13.1.1 EN 303 413 V1.2.1
EMC (Article 3.1b)	EN 301 489-1 V2.2.3
Product Safety (Article 3.1a)	EN 62368-1:2020+A11:2020
RF Health Safety (Article 3.1a)	EN 62311:2008

Signed for and on behalf of the manufacturer:

Nove Mesto na Morave, 3rd of June 2022
Jiri Hruska, CEO

RACOM s.r.o. | Mirova 1283 | 592 31 Nove Mesto na Morave | Czech Republic
Tel.: +420 722 937 522 | E-mail: racom@racom.eu

www.racom.eu

ver. 1.0

Fig. 10.2: EU Declaration of Conformity RED

10.6.3. Simplified EU declaration of conformity

BG
С настоящото RACOM s.r.o. декларира, че този тип радиосъоръжение M!DGE3 е в съответствие с Директива 2014/53/ЕС.

ES
Por la presente, RACOM s.r.o. declara que el tipo de equipo radioeléctrico M!DGE3 es conforme con la Directiva 2014/53/UE.

CS
Tímto RACOM s.r.o. prohlašuje, že typ rádiového zařízení M!DGE3 je v souladu se směrnicí 2014/53/EU.

DA
Hermed erklærer RACOM s.r.o., at radioudstyrstypen M!DGE3 er i overensstemmelse med direktiv 2014/53/EU.

DE
Hiermit erklärt RACOM s.r.o., dass der Funkanlagentyp M!DGE3 der Richtlinie 2014/53/EU entspricht.

ET
Käesolevaga deklareerib RACOM s.r.o., et käesolev raadioseadme tüüp M!DGE3 vastab direktiivi 2014/53/EL nõuetele.

EL
Με την παρούσα ο/η RACOM s.r.o., δηλώνει ότι ο ραδιοεξοπλισμός M!DGE3 πληροί την οδηγία 2014/53/ΕΕ.

EN
Hereby, RACOM s.r.o. declares that the radio equipment type M!DGE3 is in compliance with Directive 2014/53/EU.

FR
Le soussigné, RACOM s.r.o., déclare que l'équipement radioélectrique du type M!DGE3 est conforme à la directive 2014/53/UE.

HR
RACOM s.r.o. ovime izjavljuje da je radijska oprema tipa M!DGE3 u skladu s Direktivom 2014/53/EU.

IT
Il fabbricante, RACOM s.r.o., dichiara che il tipo di apparecchiatura radio M!DGE3 è conforme alla direttiva 2014/53/UE.

LV
Ar šo RACOM s.r.o. deklarē, ka radioiekārta M!DGE3 atbilst Direktīvai 2014/53/ES.

LT
Aš, RACOM s.r.o., patvirtinu, kad radijo įrenginių tipas M!DGE3 atitinka Direktyvą 2014/53/ES.

HU
RACOM s.r.o. igazolja, hogy a M!DGE3 típusú rádióberendezés megfelel a 2014/53/EU irányelvnek.

MT
B'dan, RACOM s.r.o., niddikjara li dan it-tip ta' tagħmir tar-radju M!DGE3 huwa konformi mad-Direttiva 2014/53/UE.

NL
Hierbij verklaar ik, RACOM s.r.o., dat het type radioapparatuur M!DGE3 conform is met Richtlijn 2014/53/EU.

PL
RACOM s.r.o. niniejszym oświadcza, że typ urządzenia radiowego M!DGE3 jest zgodny z dyrektywą 2014/53/UE.

PT

O(a) abaixo assinado(a) RACOM s.r.o. declara que o presente tipo de equipamento de rádio M!DGE3 está em conformidade com a Diretiva 2014/53/UE.

RO
Prin prezenta, RACOM s.r.o. declară că tipul de echipamente radio M!DGE3 este în conformitate cu Directiva 2014/53/UE.

SK
RACOM s.r.o. týmto vyhlasuje, že rádiové zariadenie typu M!DGE3 je v súlade so smernicou 2014/53/EÚ.

SL
RACOM s.r.o. potrjuje, da je tip radijske opreme M!DGE3 skladen z Direktivo 2014/53/EU.

FI
RACOM s.r.o. vakuuttaa, että radiolaitetyyppi M!DGE3 on direktiivin 2014/53/EU mukainen.

SV
Härmed försäkrar RACOM s.r.o. att denna typ av radioutrustning M!DGE3 överensstämmer med direktiv 2014/53/EU.

10.7. Compliance FEDERAL COMMUNICATIONS COMMISSION AND INNOVATION, SCIENCE AND ECONOMIC DEVELOPMENT CANADA

M!DGE3 fulfils FCC - Title 47 CFR Part 15 and ICES-003, Issue 7.

Module	Contains FCC ID	Contains IC
W	QIPPLS83-W	7830A-PLS83W
Q*	QIPMV32-W-A	7830A-MV32W-A
M	---	---
O	QIPTX62-W-B	7830A-TX62WB

*pending

10.8. Warranty

RACOM-supplied parts or equipment ("equipment") is covered by warranty for inherently faulty parts and workmanship for a warranty period as stated in the delivery documentation from the date of dispatch to the customer. The warranty does not cover custom modifications to software. During the warranty period RACOM shall, on its option, fit, repair or replace ("service") faulty equipment, always provided that malfunction has occurred during normal use, not due to improper use, whether deliberate or accidental, such as attempted repair or modification by any unauthorised person; nor due to the action of abnormal or extreme environmental conditions such as overvoltage, liquid immersion or lightning strike.

Any equipment subject to repair under warranty must be returned by prepaid freight to RACOM direct. The serviced equipment shall be returned by RACOM to the customer by prepaid freight. If circumstances do not permit the equipment to be returned to RACOM, then the customer is liable and agrees to reimburse RACOM for expenses incurred by RACOM during servicing the equipment on site. When equipment does not qualify for servicing under warranty, RACOM shall charge the customer and be reimbursed for costs incurred for parts and labour at prevailing rates.

This warranty agreement represents the full extent of the warranty cover provided by RACOM to the customer, as an agreement freely entered into by both parties.

RACOM warrants the equipment to function as described, without guaranteeing it as befitting customer intent or purpose. Under no circumstances shall RACOM's liability extend beyond the above, nor shall RACOM, its principals, servants or agents be liable for any consequential loss or damage caused directly or indirectly through the use, misuse, function or malfunction of the equipment, always subject to such statutory protection as may explicitly and unavoidably apply hereto.

10.9. M!DGE3 maintenance

Action	Period	Note
Visual check – Antenna: Draining hole on dipole must be downward pointing There should be no damaged elements on the antenna Angle of elevation of antenna Azimuth (angle of horizontal deviation) in accordance with design	Quarterly	
Visual check – Coaxial Cable: Mechanical damage Solar degradation Entire cable correctly mounted to surface Connectors tightened to function optimally Self-vulcanizing tape used for all connections requiring insulation PSV & RF measurements	Annually	
Visual check – Cabinet: Mechanical damage Damage resulting in lower categorization for cabinet coverage Bushings for running cables	Annually	
Visual check – Electricity Supply: Insulation damage Connection to terminals	Annually	
Visual check – Accumulator: Capacity in accordance with customer requirements Condition of the accumulator	Annually	
Functionality check – power source: Overcharging Accumulator damage	Annually	
Full utilization of provided protective coverings	Annually	
Remove any items which are not part of the installation	Annually	
Fix and secure makeshift installations correctly	Annually	
Check grounding connections	As required	
Check lightning arrester : connectors must be tightened	As required	
Check data connectors connected including securing screws	Annually	
Evaluate the signal strength values of the cellular connection as a preventive measure against the failure of the connection.	Monthly	*Section 8.5.4.3, “Cellular signal statistics”*
Check activity logs to detect abnormalities in data transmissions	Monthly	*Section 8.5.4.2, “Cellular state statistics”*

Action	Period	Note
Check if internal temperature alarm has been triggered	Monthly	*Section 8.4, “Events”* *Section 8.2.1, “Measurements”*
Check that firmware is latest stable version – upgrading FW recommended when new features required	As required	*Firmware M!DGE3*[1]

If you are unsure on any of the above, please contact RACOM technical support.

[1] https://www.racom.eu/eng/products/cellular-router-midge.html#dnl_fwr3

Appendix A. Security Hardening Procedure

RipEX2/M!DGE3 are wireless cellular IP-enabled telecommunication devices providing a 24/7 reliable service for wireless data transfer in mission-critical applications like Industrial control systems (ICS) and Supervisory Control And Data Acquisition (SCADA) systems.

This appendix contains several steps that can be considered when deploying wireless telecommunications infrastructures.

A.1. Password and accounting

Use strong password for an **“Admin” Role** (full access)

- SETTINGS > Security > Local authentication > User accounts

Configure a **strong password** for all users. Consider changing the “Password complexity rules” feature

- SETTINGS > Security > Local authentication > Settings
- Using complex passwords is your first line of defense in protecting your device. Consider periodic updates
- The recommended length is at least 8-10 characters including A-z, 0-9 and special characters (@?* etc.)

Role-based access control (RBAC) enables you to assign privileges and access rights to administrative/read-only users through role assignment. You create user accounts (**local authentication** or remote **RADIUS**) and assign them roles via which they can access RipEX2/M!DGE3 GUI or API.

- There are four different levels of user access privileges – they are bound with four different user access roles:
  Guest
  Technician
  Security technician
  Administrator
- *Note*: You may export Local authentication users and import them to other units in your network. You do not need to create them separately in each device
  The file consists of hashed/salted passwords, i.e. not readable and non backwards deductible

Web inactivity timeout

- When the user account is not active for some time, the user will be automatically logged-out. The inactivity timeout of the account is set for 1 day by default. It is possible to change in the range of 5 minutes up-to 2 days
- ADVANCED > Generic > UserAccess > Web inactivity timeout
- *Note:* A mechanism against brute-force attacks is implemented. When the wrong combination of the Account / Password is entered, you have to wait a while for the following attempt. The time is growing with every wrong attempt.

A.2. Physical access

Restrict physical access to the device to only authorized personnel.

Disable physical ports which are not used
Ethernet ports

- SETTINGS > Interfaces > Ethernet > Ports

Serial ports

- SETTINGS > Interfaces > COM

USB port
- for USB/ETH and USB/WiFi management access
- SETTINGS > Device > Unit > Service USB

Cellular ports (if any)
- SETTINGS > Interfaces > Cellular > MAIN/EXT

Wi-Fi (if any)
- SETTINGS > Interfaces > Wi-Fi

Tamper detection
RipEX2 and M!DGE3 units are equipped by case opening detection. The behaviour in case of this event shall be set in menu SETTINGS > Device > Events > Tamper.

A.3. Encrypt data on Radio network (RipEX2)

Encrypting your wireless radio data prevents anyone who might be able to access your network from viewing it. Radio traffic can be encrypted via AES-256-CCM (passphrase or key), or utilizing IPsec/OpenVPN secure VPN options (but these are not bandwidth-optimized options for a Radio channel).

Radio AES256
For the encryption is possible to set primary and secondary Passphrase or Key. This option allows to change credentials in the whole network without service outage.
The radio traffic encryption has an additional option AES-256-CCM + KEX, which enables periodical key replacement.
- SETTINGS > Interfaces > Radio > Encryption

VPN
- SETTINGS > VPN > IPsec
- SETTINGS > VPN > OpenVPN

A.4. Encrypt data on cellular network

Cellular networks are in control of operators and public APNs are connected to the public Internet. Any data sent or received by RipEX2 (EXT) or M!DGE3 (MAIN, EXT) can be captured by experienced hackers. If such data are not encrypted, sensitive data can be read by these hackers and misused.

It is highly recommended to **encrypt all sensitive data** via supported VPN options - **IPsec or OpenVPN**.

Note: Private APNs resemble private Radio networks. Such APNs are restricted from the Internet by the operator's firewalls and should be more secure. Nevertheless, it is still recommended to encrypt your sensitive data.

Note: Routing LAN2LAN (end2end) data through the operator’s APN/network is blocked by their firewalls and tunnelling or port-forwarding are the only ways to pass end2end data successfully.

A.5. Disable Remote access or configure it securely

Remote access is used to configure and manage remote units via bandwidth-friendly volumes of transmitted data. You must login to the local unit via username and password. There is no need to provide any other credentials to access other units remotely via Remote access. The security is based on QSSH protocol (TCP port 8889) and a private key. Enable only the interfaces you will use for Remote access:

- ADVANCED > Interfaces > Ethernet > Network interface - Default value is Off
- ADVANCED > Interfaces > Radio > Radio interface - Default value is On

- ADVANCED > Interfaces > Cellular > Cellular MAIN / EXT - Default value is Off
- ADVANCED > Interfaces > Wi-Fi EXT - Default value is Off

Or switch it off fully:

- SETTINGS > Security > Management access > Remote access

Hints for set in a secure way for enabled interfaces:

User generated Remote access key

The private key is the same for ALL manufactured units. It is highly recommended to generate such a key in one unit and distribute it to all others within your network. No other unit with default key (or other user key) can access your units via Remote access.

- SETTINGS > Security > Credentials
  - ○ to generate/download/upload the key
- SETTINGS > Security > Management access > Remote access
  - ○ to set “user” key for Remote access
  - ○ to define the user key ID

A.6. Exchange of certificates

It is recommended to change certificates for certificates trusted by the M!DGE3 user.

The default certificates are part of installation of all units, so the replacement for your own certificates will increase the security of all processes and services (e.g. web access, radio encryption), which use certificates (see SETTINGS > Security > Credentials).

It is also possible to generate certificates with parameters required by the user application (see parameters in SETTINGS > Security > Credentials > Settings).

A.7. Services

Enable only **services** utilized on the device and disable all other services

Disable unused **SSH**

- ADVANCED > Security > Management access > Administration website > Enable SSH → Off

Disable SNMPv2c, if SNMP is required, **use SNMPv3**

- SETTINGS > Services > SNMP
- or use “SNMPv3”
  - ○ security level: AuthPriv
  - ○ Use secure Authentication and Encryption algorithms
  - ○ Set strong passphrases

Change default **HTTPs** port

- SETTINGS (or ADVANCED) > Security > Management access > Administration website > HTTPS port

Disable **HTTP** access

- SETTINGS (or ADVANCED) > Security > Management access > Administration website > Enable HTTP → Off

Disable **SMS** or adjust allowed phone numbers

- SETTINGS > Services > SMS
  - ○ Set strong SMS passphrase

WiFi

- Only available if USB/WiFi adapter for management access is used (plugged)
- Enable WPA2-PSK with strong password to ensure WiFi security
  - ○ SETTINGS > Security > Management access > Service USB > Wi-Fi > Security, Passphrase
- If not used, the feature can be disabled completely within the same menu

A.8. Firewall

Protect the unit via **Firewall** settings

- SETTINGS > Firewall > L2 / L3 / NAT
- Especially important if RipEX2/M!DGE3 has a public IP address!

Limit access to RipEX2/M!DGE3 GUI

- Only allow **authorized IPv4 addresses** to access your network. Each piece of hardware connected to a network has an assigned IPv4 address. You can restrict access to your network by filtering these IPv4 addresses within the L3 firewall.
- Local access can be restricted by filtering MAC addresses via L2 firewall (blacklist, whitelist).
- SETTINGS > Firewall > L2 / L3

A.9. HTTPS certificate

Since FW 2.1.0.0 and its feature Credentials, you can generate or upload your own certificates and keys, including **HTTPs**.

- SETTINGS > Security > Credentials
- SETTINGS > Security > Local authentication > Settings

A.10. Configuration files

Configuration files are stored as **unencrypted JSON files** or encrypted zip files. It is possible to set that only encrypted files will be allowed and the rules for the password can be set as well.

- SETTINGS > Security > Policy

You can download configuration files from the complete network smoothly via NetSPIDER tool.

Note: Each user can only download a configuration file which includes configuration parameters available for a particular user level role.

A.11. Firmware

Keep the **firmware up-to-date**.

The latest FW can be downloaded from the RACOM website:

RipEX2 FW: *https://www.racom.eu/eng/products/radio-modem-ripex.html#dnl_fwr2*

M!DGE3 FW: *https://www.racom.eu/eng/products/cellular-router-midge.html#dnl_fwr3*

Note

Standard FW versions are available quarterly, release notes with changes are available on the same web page.

Utilize **direct Upload and Activation** for locally connected RipEX2/M!DGE3 devices.

- SETTINGS > Device > Firmware > Local

Utilize **USB flash drive** - for FW upgrade via USB disk - this service is on by default, it can be disabled.

- SETTINGS > Device > Firmware > USB

Utilize **Firmware distribution** for RipEX2 networks in a bandwidth optimized way.

- FW distribution uses the authentication key during the process - the key is the same in all manufactured units - you can generate and use your own.
- SETTINGS > Services > Firmware distribution
- SETTINGS > Device > Firmware > Distributed
- ADVANCED > Device > Firmware distr. - receiver

Utilize **NetSPIDER** to speed the FW distribution process in the whole network.

Revision History

Revision
This manual was prepared to cover a specific version of firmware code. Accordingly, some screens and features may differ from the actual unit you are working with. While every reasonable effort has been made to ensure the accuracy of this publication, product improvements may also result in minor differences between the manual and the product shipped to you.

Revision 1.0 2022-09-12
First issue

Revision 1.01 2022-11-16
General improvements

Revision 1.01 2022-12-16
Section Sleep mode added

Revision 1.02 2023-02-24
Minor improvements of chapter SETTINGS

Revision 1.03 2023-05-11
Minor improvements of chapter SETTINGS

Revision 1.04 2023-07-28
Section *Credentials* added
Section *Link management* added

Revision 1.05 2023-10-23
Section OpenVPN added
Appendix Security Hardening Procedure added

Revision 1.06 2023-12-15
New features for FW 2.1.2.0 version added

Revision 1.07 2024-03-05
New features for FW 2.1.6.0 version added

Revision 1.08 2024-06-05
New features for FW 2.1.7.0 version added

Revision 1.09 2024-08-29
New features for FW 2.2.0.0 version added

Revision 1.10 2024-10-07
Extension of the PPP protocol to include Tetra

Revision 1.11 2024-11-28
New features for FW 2.2.1.0 version added

Revision 1.12 2025-02-25
Section *Wi-Fi* added
Section *Logs* added

Revision 1.13 2025-05-29

IPsec transport mode added
L3 firewall improvements added
End of Russian language support