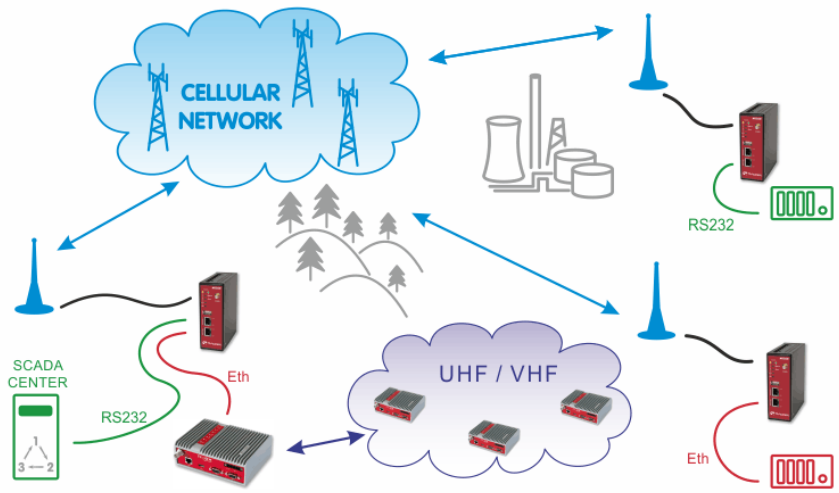
RACOM
RADIO DATA NETWORKS

Application notes



M!DGE/MG102i - Serial SCADA Protocols

version 1.2
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Introduction

In recent years, world of communication is ruled by the Internet Protocol stack and RS232-based interfaces are generally considered obsolete. Typical SCADA device life cycle is nevertheless long enough to guarantee demand for good old serial interfaces for several years from now. Common RS232 to TCP (UDP) converters can help in some cases by creating the required number of transparent peer-to-peer connections from all remote serial ports to the corresponding (physical or virtual) ports in the data center. However such solution requires a special routing arrangement in the center, hence it is not always feasible. A typical SCADA Front End Processor (the central interface of the application to the communication network) uses a proprietary protocol over a single RS232 interface. Each message coming out from the FEP is addressed and should be delivered to the designated remote serial port. Certainly a transparent broadcasting to all remotes could do the job, making the service provider happy (assuming the resulting bills are paid). Obviously the proper solution is to transmit the message to the destination address only.

A SCADA serial protocol typically uses simple 8 or 16 bit addressing. The cellular network address scheme is an IP network, where the range is defined by the service provider (sometimes including individual addresses, even in the case of a private APN). Consequently a mechanism of translation between the SCADA and the IP addresses is required. To make things worse, IP addresses may be assigned to cellular devices dynamically upon each connection.

This chapter describes how to efficiently solve this problem using RACOM made routers.

Two basic situations are described:

a. The M!DGE/MG102i IP addresses are reachable from each other in both directions. This can either mean that you have the private APN with the own IP subnet for your application. Or it can mean that all routers have static public IP addresses. The example in *Chapter 1, SCADA Protocols – private APN* shows the routers' configuration using the private APN with static addresses.

b. The M!DGE/MG102i IP addresses are NOT reachable in both directions – only the center is reachable from the remote side. The center must have a static public IP address. The remote units (slaves in the Master-Slave configuration) can have private and dynamic IP addresses. Utilization of VPN tunnels is required. See the example *Chapter 2, SCADA Protocols – public APN* for more details.

Important

Only one Protocol server can be configured and utilized only on the primary RS232 interface (it is not supported on the COMIO RS232/485 interface). This 2nd COM port can be controlled by Device server or SDK functionality.

1. SCADA Protocols – private APN

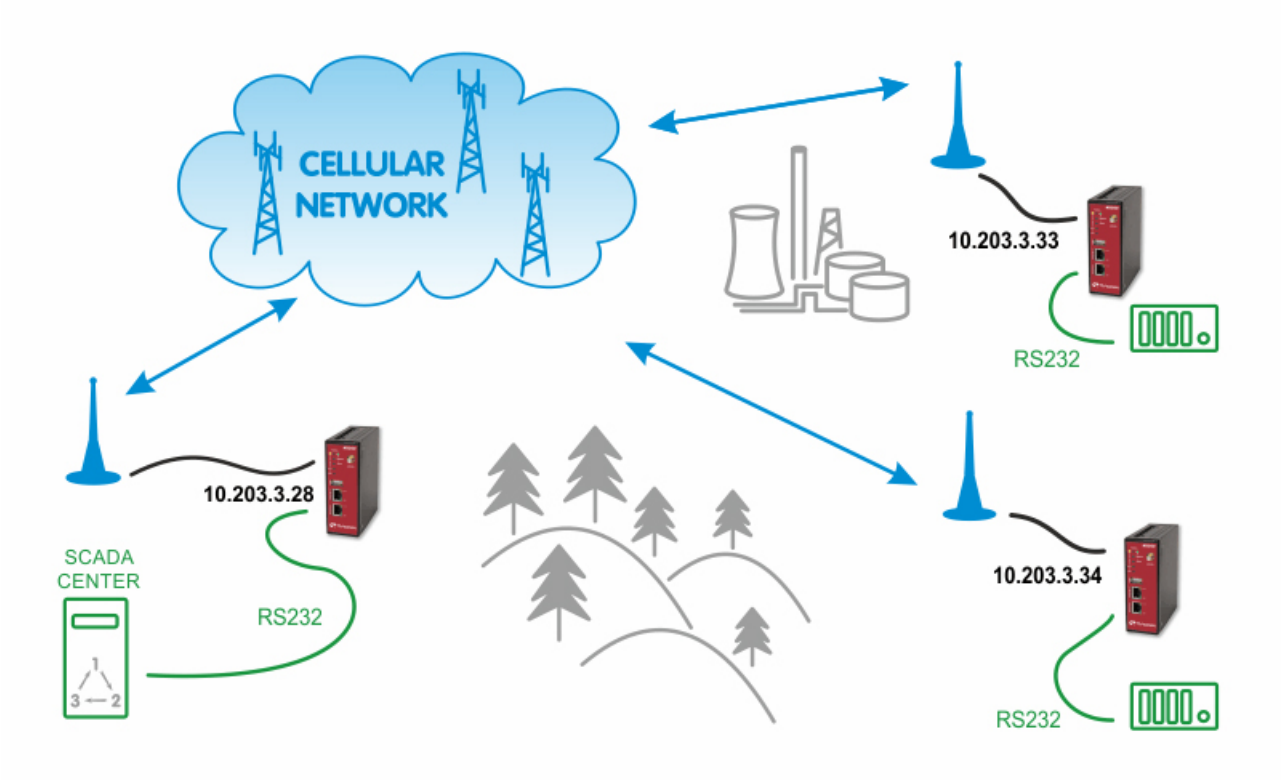

Fig. 1.1: SCADA Solution within Private APN

1.1. APN Configuration

In the INTERFACES – Mobile – Interfaces menu, configure the private APN as defined by your service provider.

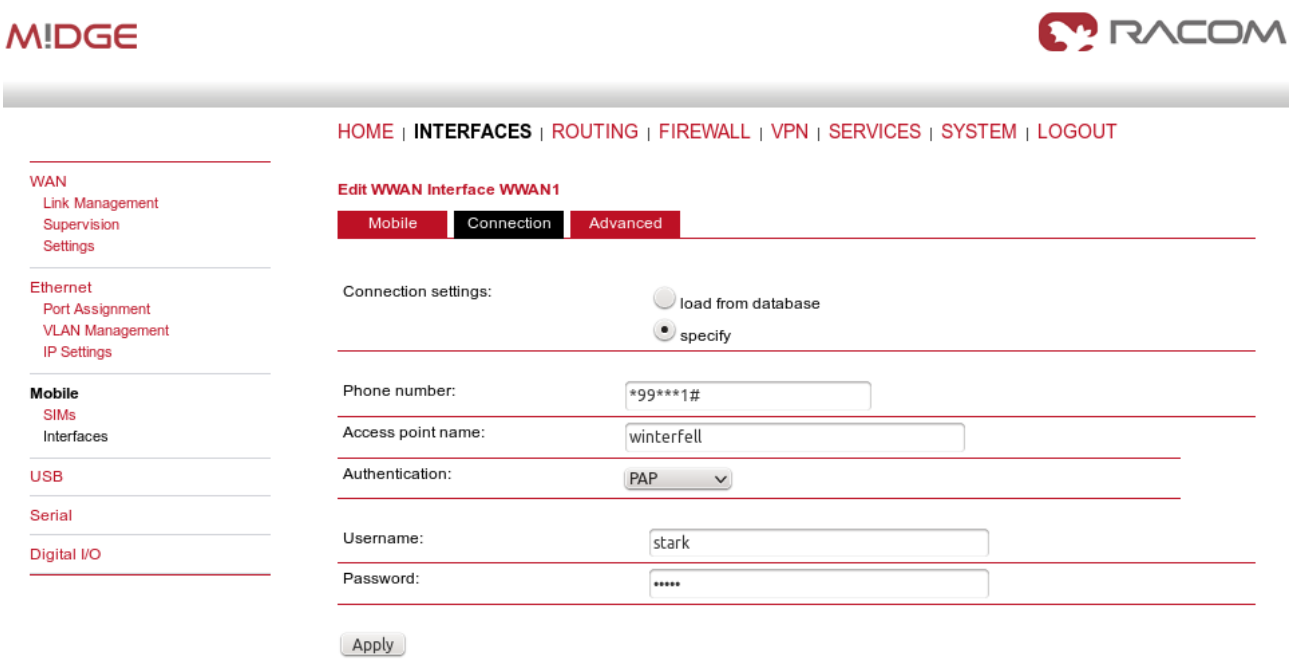

Fig. 1.2: Private APN configuration

Once established, you can check the connection status in the HOME menu.

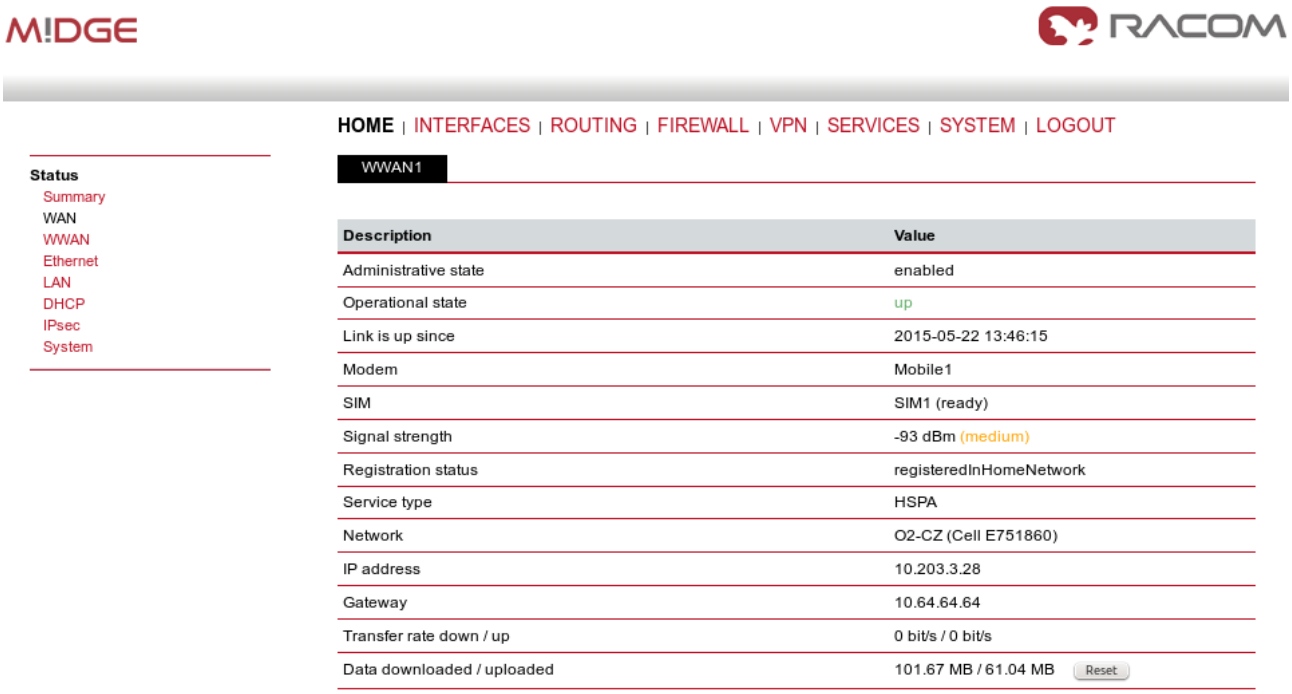

Fig. 1.3: Private APN connection is established

Configure other units with the appropriate credentials. In our example the Master M!DGE obtained the IP address 10.203.3.28 and the remote M!DGE units have 10.203.3.33 and 10.203.3.34.

1.2. SCADA Master Configuration

Our example will explain the Modbus Master-slave configuration with two slave units. On the Master station, select the INTERFACES – Serial menu and set the Protocol server option.

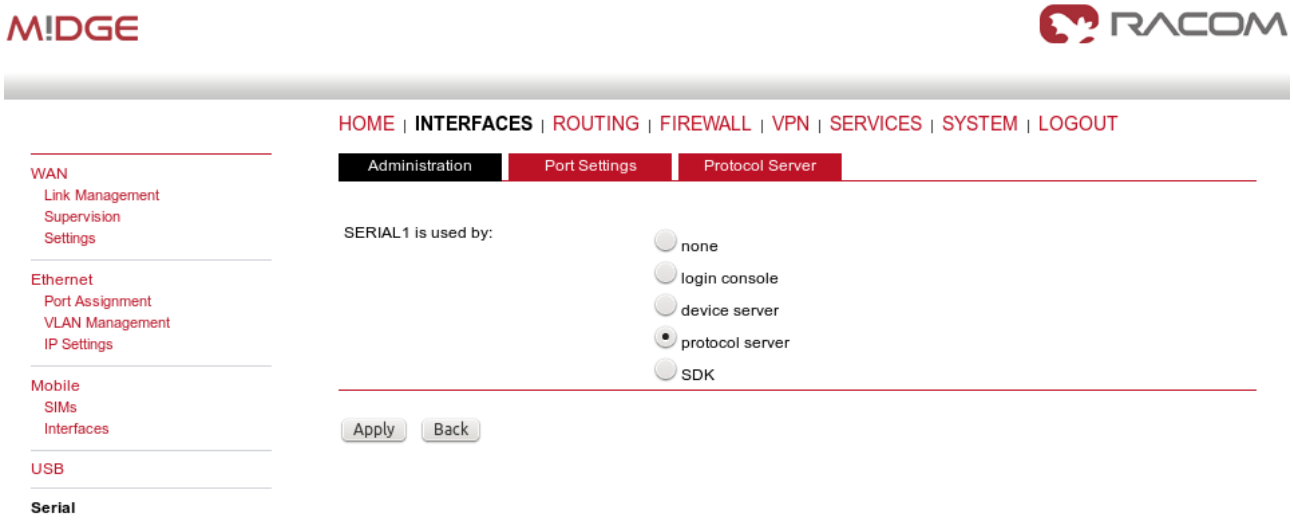

Fig. 1.4: Master Protocol server configuration

Configure the correct RS232 parameters such as baud rate, stop bits, …

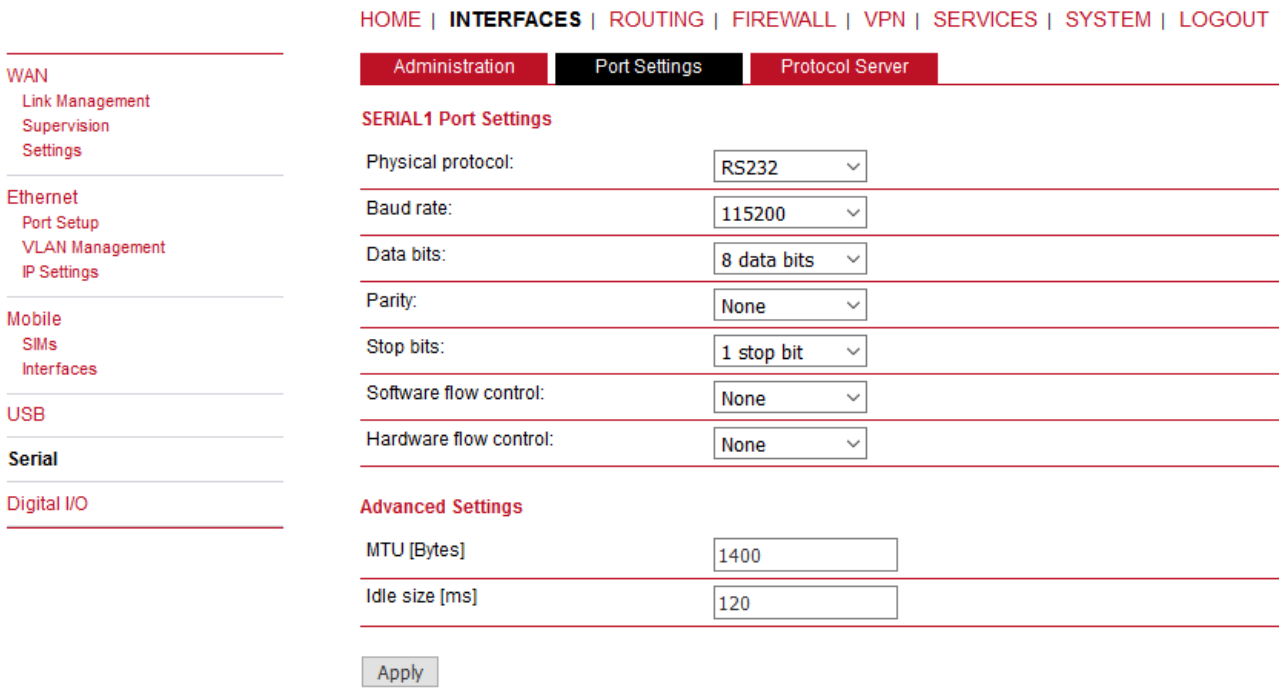

Fig. 1.5: Port Settings

Set the MTU to default 1400 Bytes and Idle to 120 ms. *See the manual*[1] for details. Go to the Protocol server menu and configure the Master parameters. Focus on the correct Address translation. You can

[1] https://www.racom.eu/eng/products/m/midge1/web_conf.html#protocols

either use mask or table for this purpose. If in doubts, open the Help window via the button located on top right corner. This Help explains the whole Protocol server functionality.

In the example below, the Master translates addresses A and B (hex) into IP addresses (and vice versa) 10.203.3.33, resp. 10.203.3.34. Using the port 8882 is mandatory if the remote device is connected via M!DGE RS232 interface.

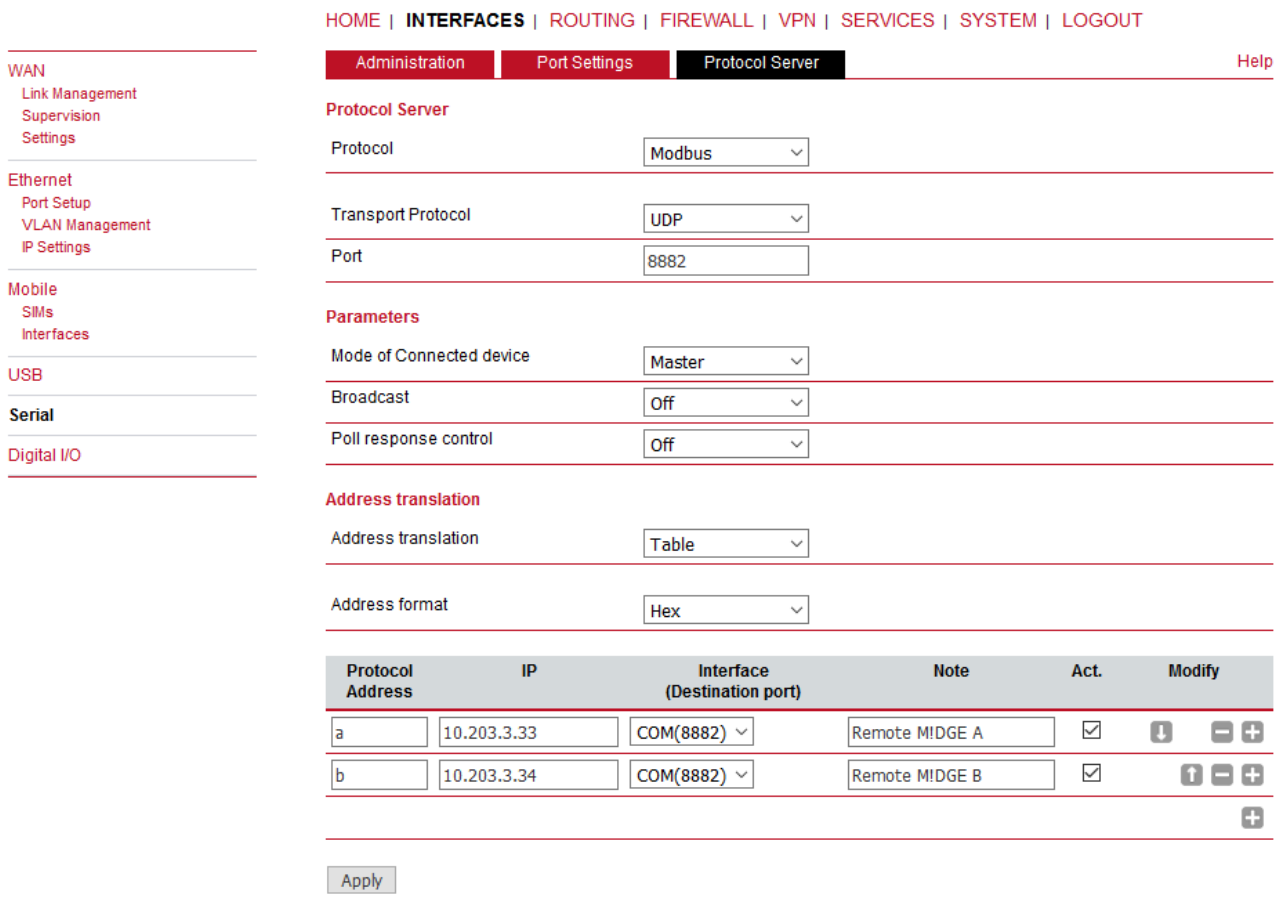

Fig. 1.6: Modbus Master configuration

1.3. SCADA Slave Configuration

The Slave configuration is very straightforward. You set the Modbus Mode to “slave” and Slave destination to "Last received".

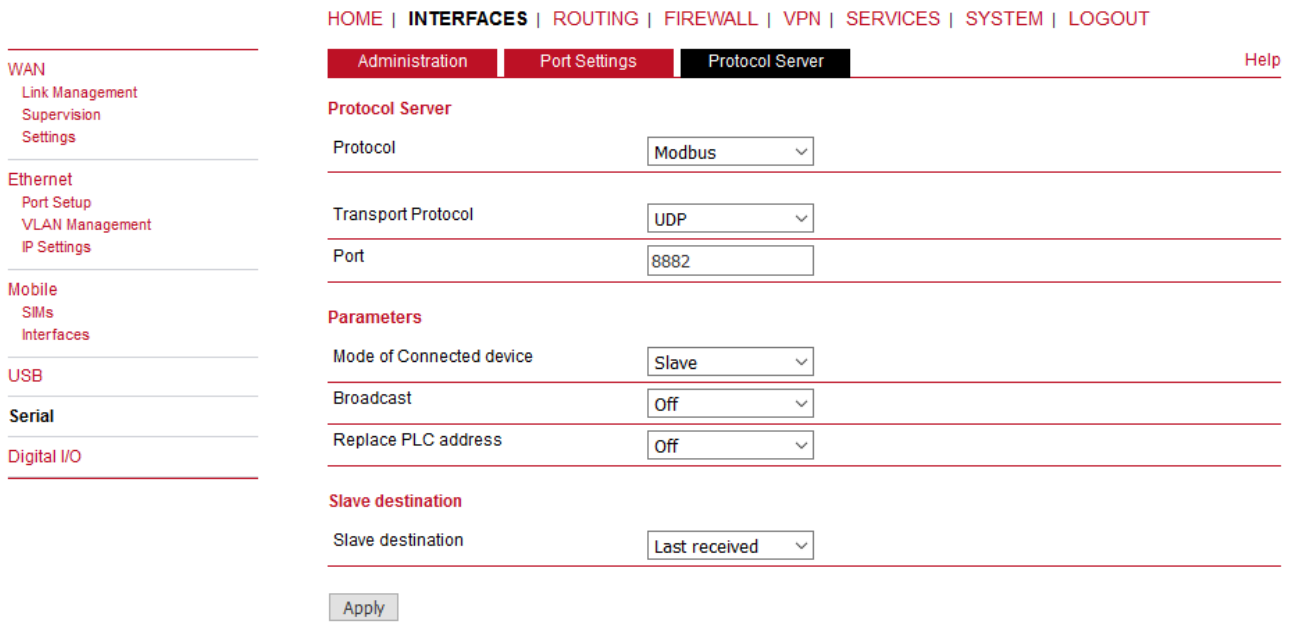

Fig. 1.7: Modbus Slave configuration

Important

"Protocol server" daemon listens only on LAN1 IP address. This is fixed and cannot be changed currently (FW 4.4.40.101 and older). Port Forwarding is required to be set in M!DGE units in a way that received data are forwarded to LAN1 IP on UDP port 8882. Received interface can be the WWAN IP, OpenVPN TUN interface etc.

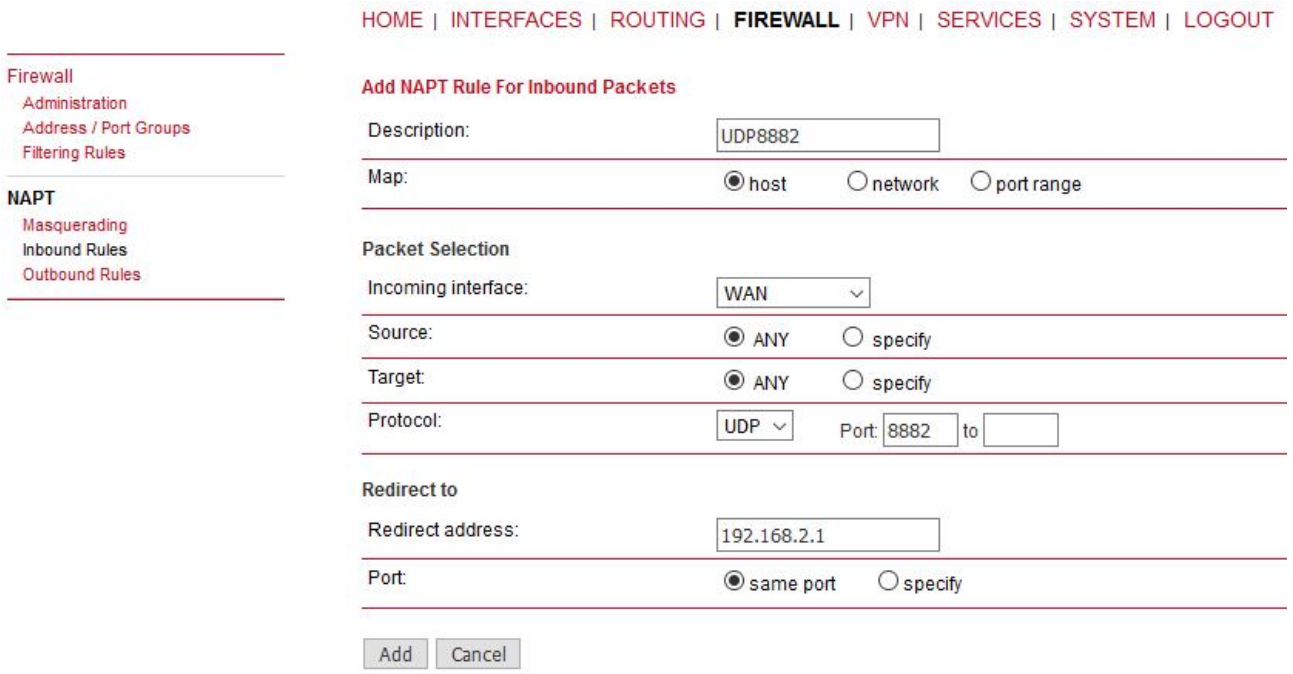

Fig. 1.8: M!DGE Port forwarding rule – Protocol server (LAN1 IP is 192.168.2.1/24)

1.4. Troubleshooting

In case that you encounter any issue, you can read the **Protocol Server Help** which is reachable from the right top corner of the page. Sending the issue description to our technical support at *<support@racom.eu>* is possible. Please try to include the following information:

- The **issue description** (together with topology, required technology, …)
- Please increase the **debug level of rrsp2 daemon** first (SYSTEM – Troubleshooting – System Debugging – Debug Levels – set rrsp2 to “4”). When applied, try to run your application and then download the Tech Support package (can be downloaded from the SYSTEM – Troubleshooting – Tech Support menu).

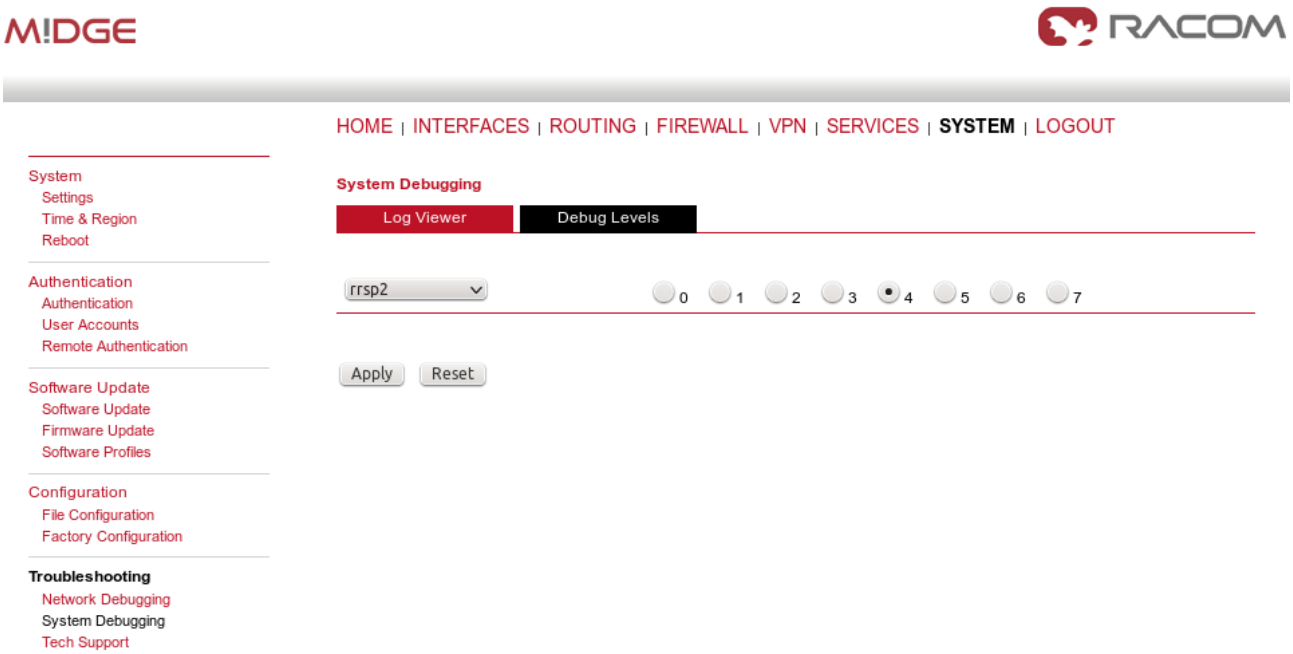

Fig. 1.9: Debug level of rrsp2 daemon

- You can also include the **WWAN interface monitoring** output: SYSTEM – Troubleshooting – Network debugging - tcpdump – Set interface to “wwan1” and check all the “Exclude” boxes. Click start, run your application and after a while, stop the tcpdump again and download the file.

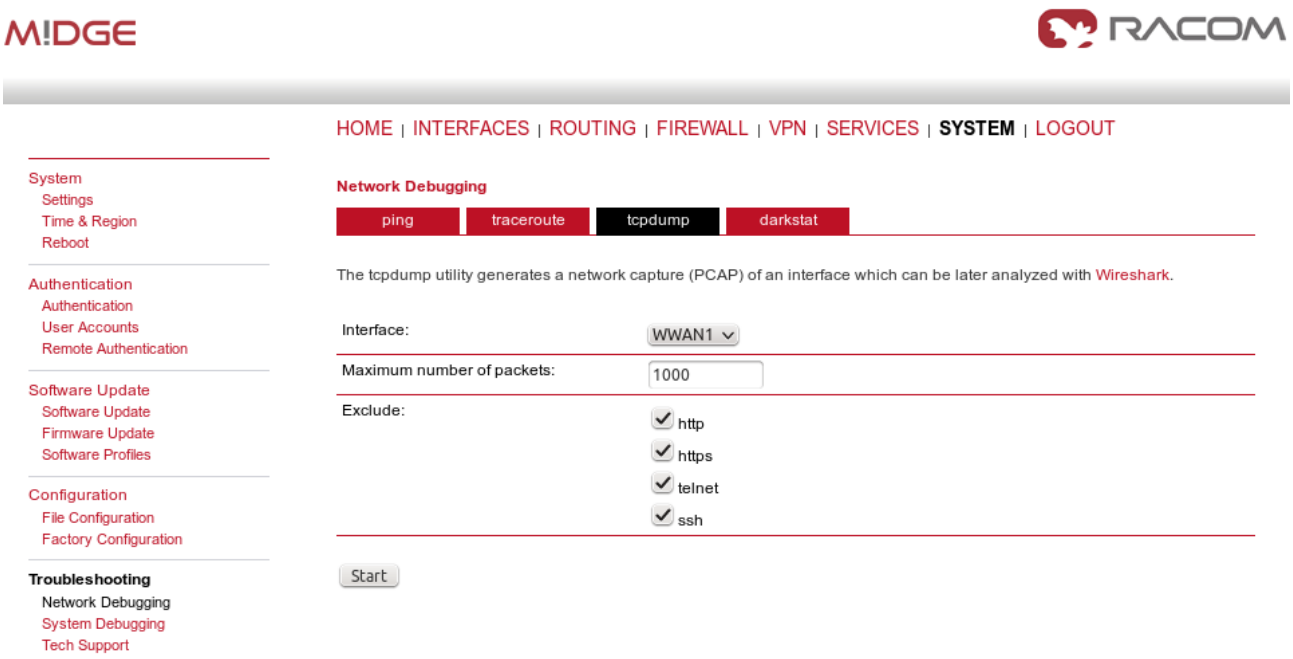

Fig. 1.10: Tcpdump via Web interface

Note

It is not possible to monitor the serial interface in M!DGE/MG102i.

2. SCADA Protocols – public APN

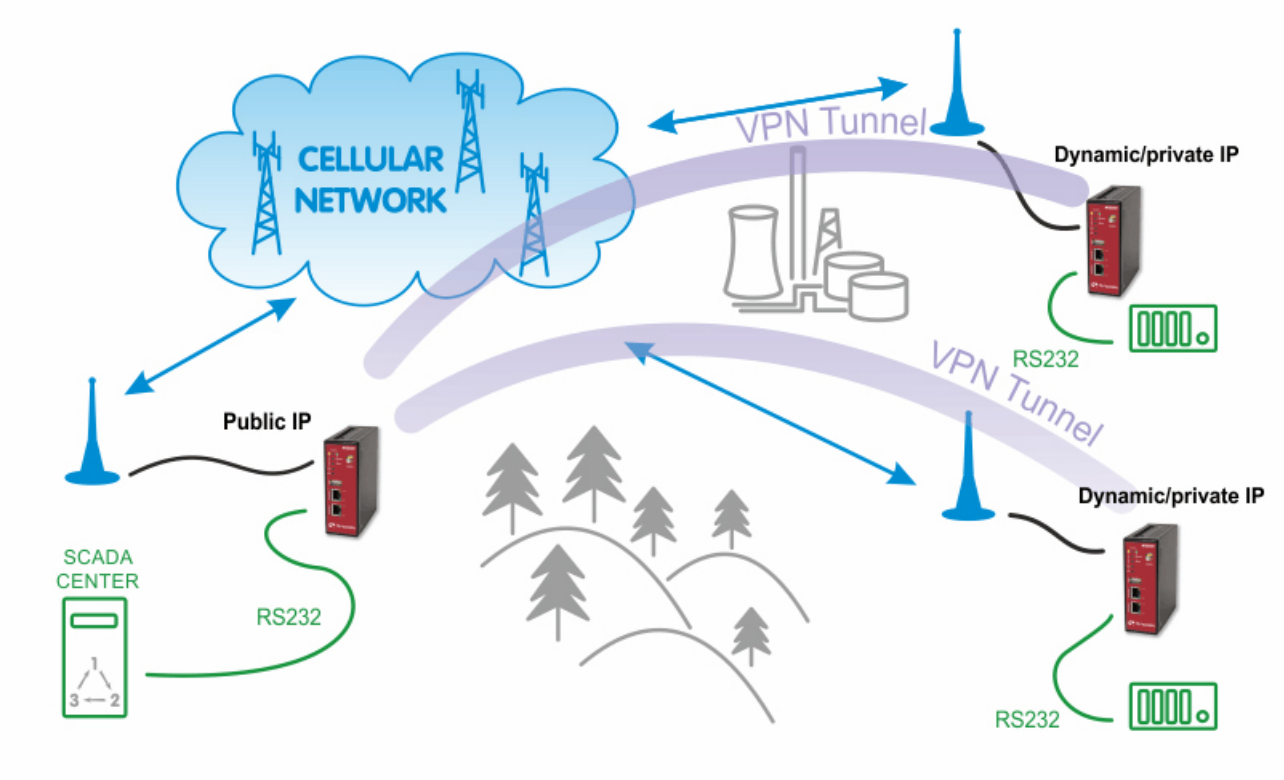

Fig. 2.1: Public APN SCADA configuration

2.1. APN Configuration

With the public APN, you need to have a public and static IP address in the center. In our example, we configure the APN to be “internet.open.s” so we obtain the required IP address.

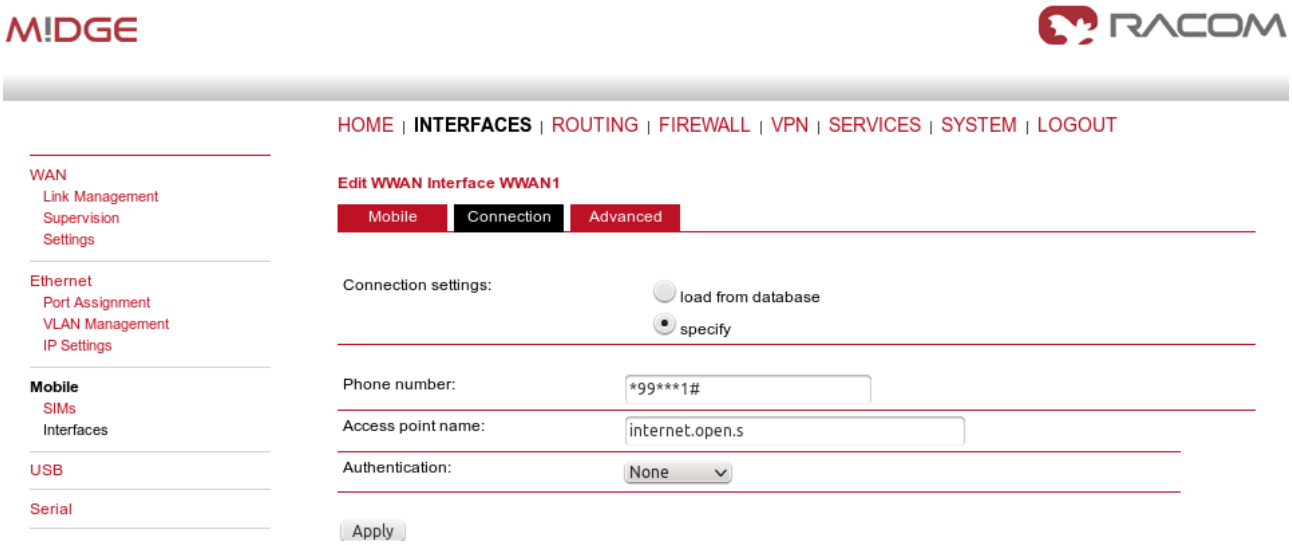

Fig. 2.2: Public APN configuration (static, public IP address)

The remote stations can be configured with the most basic APN, e.g. “internet” to obtain the private and dynamic IP address. In the next section, we will configure the VPN tunnel which is necessary for this kind of connection. Without the tunnel, the serial communication will be blocked within the cellular network.

In this example, we configure the OpenVPN tunnel in the routed mode. See *Open VPN*[1] for configuration details. The only difference is that we do not need to configure any VPN connected networks on any M!DGE unit, we just use the fixed tunnel addresses for serial data communication.

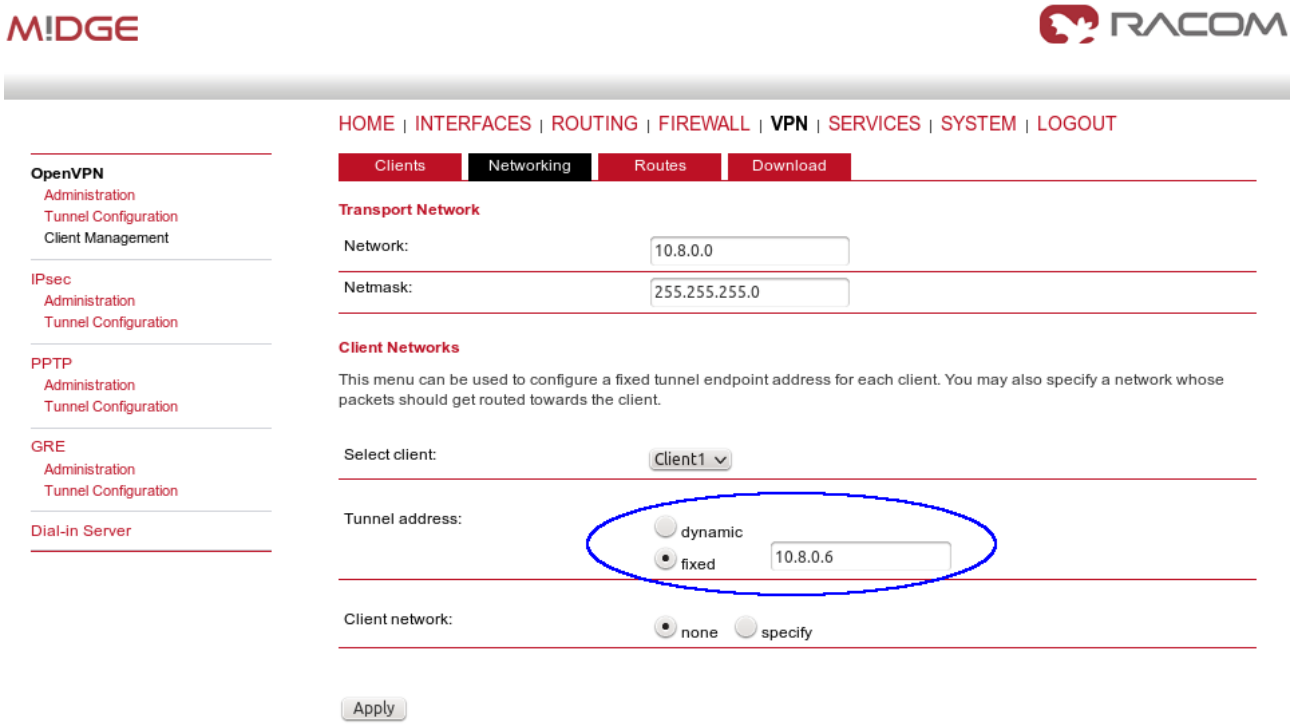

Fig. 2.3: Fixed OpenVPN tunnel address for clients

The clients can be then configured just via the Expert files downloaded from the Master M!DGE. The first client will obtain 10.8.0.6 tunnel address and the second client 10.8.0.10.

[1] https://www.racom.eu/eng/products/m/midge/app/vpn/OpenVPN.html

2.2. SCADA Master Configuration

The configuration is the same as explained with the *Private APN* , but replace the IP addresses.

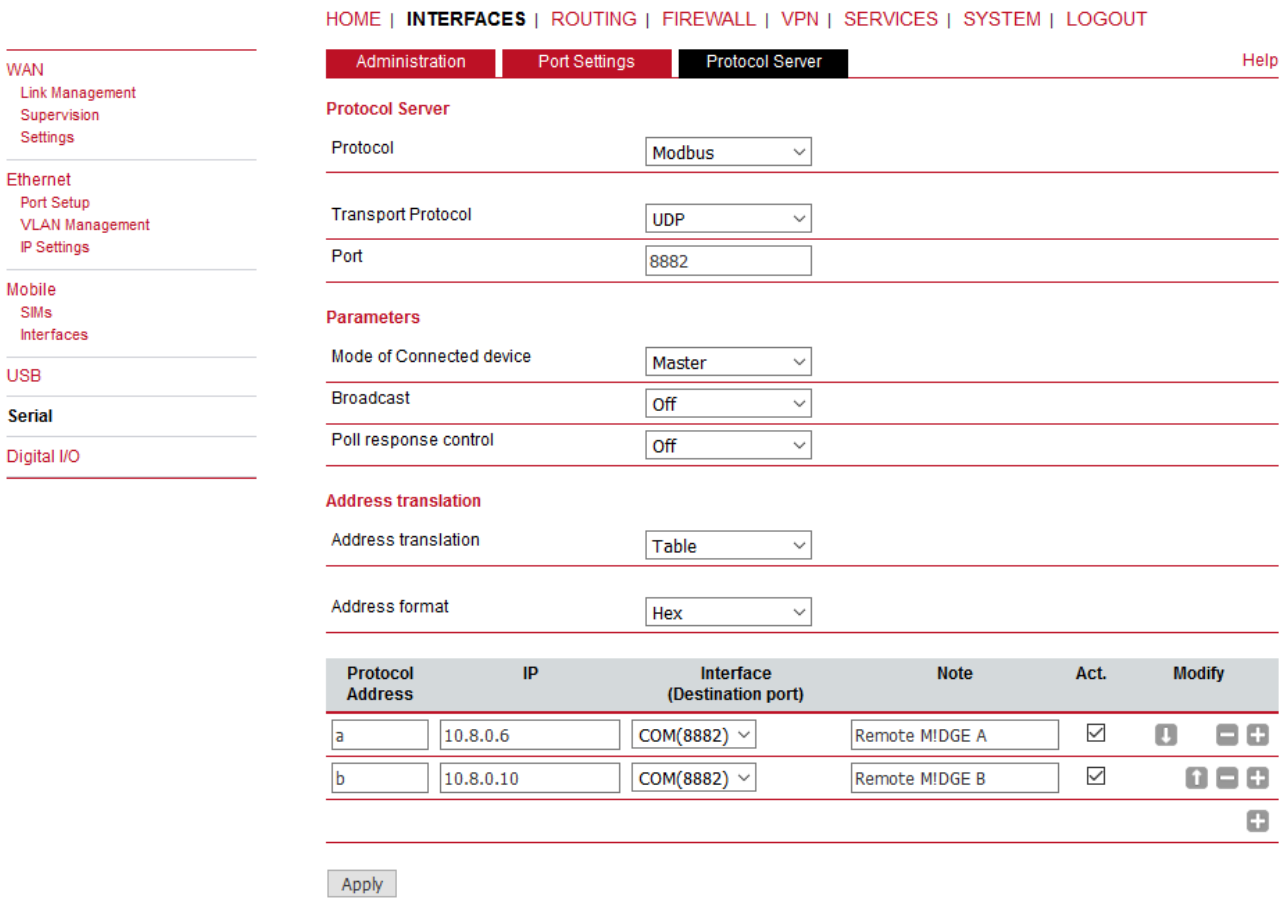

Fig. 2.4: Master Protocol server configuration (public APN)

Do not forget to set Poll response control to "Off", because the VPN changes the IP addresses from WAN to VPN addresses and thus, the protocol mechanism would discard incoming packets.

2.3. SCADA Slave Configuration

The Slave must be connected via the OpenVPN tunnel to the Master and its Protocol server must be configured to the Modbus – Slave mode.

Important

“Protocol server” daemon listens only on LAN1 IP address. This is fixed and cannot be changed currently (FW 4.4.40.101 and older). Port Forwarding is required to be set in M!DGE units in a way that received data are forwarded to LAN1 IP on UDP port 8882. Received interface can be the WWAN IP, OpenVPN TUN interface etc.
While using OpenVPN, you can either utilize LANtoLAN communication and use LAN1 IP addresss with no Port forwarding, or port forward the received data as explained.

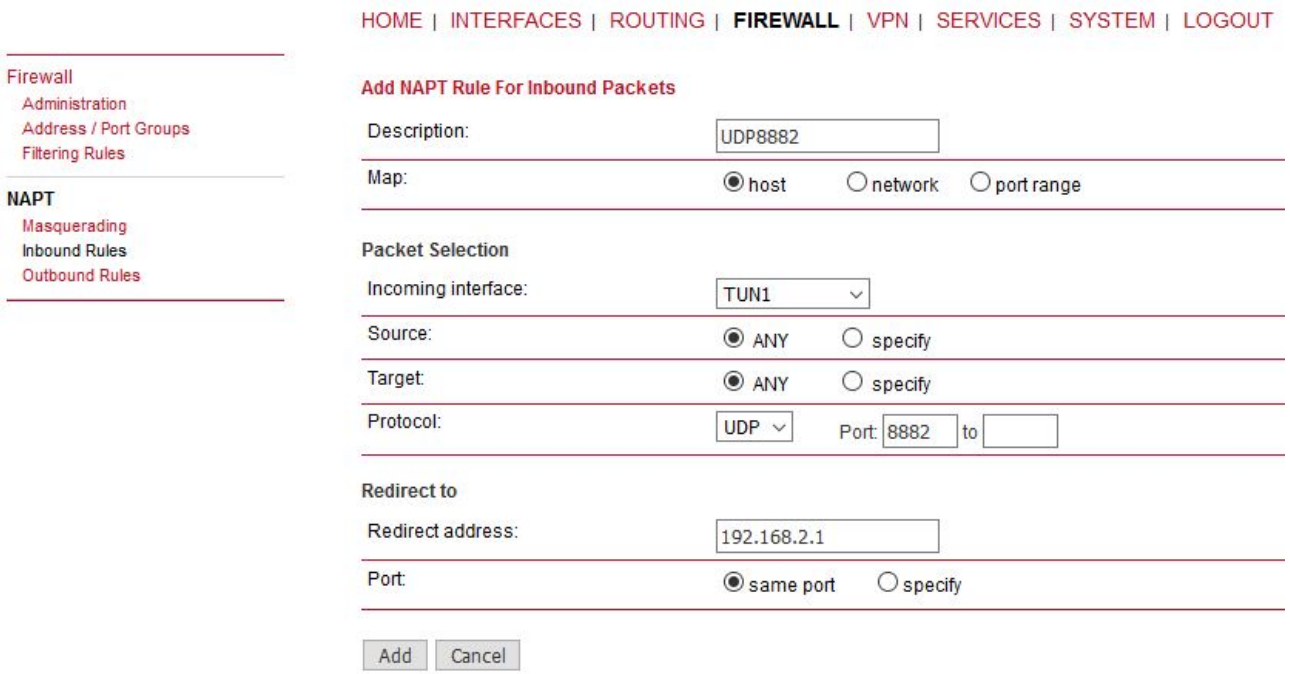

Fig. 2.5: M!DGE Port forwarding rule – Protocol server (LAN1 IP is 192.168.2.1/24)

2.4. Troubleshooting

The troubleshooting is the same as explained in the *Section 1.4, “Troubleshooting”*.

Note

If your server is using TCP connection, configure the Device server instead of Protocol server and set the Mode to “TCP Raw” with the appropriate TCP port.

Revision History

Revision 1.0 2017-12-07
First issue

Revision 1.1 2018-02-27
Termination of M!DGE UMTS routers manufacturing

Revision 1.2 2020-04-28
Protocol server listening on LAN1 IP only