SATELLAR DIGITAL SYSTEM
PART II: CENTRAL UNIT
USER GUIDE VERSION 1.2

CU

USER GUIDE

WIRELESS WORLD – LOCAL SOLUTION

SATEL®

Contents

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Salo, Finland 2012

Product conformity

2 SATELLAR CU

SATEL Oy hereby declares that SATELLAR Central Unit is in compliance with the essential requirements (electromagnetic compatibility and electrical safety) and other relevant provisions of Directive 1999/5/EC. Therefore the equipment is labelled with the following CE-marking.

CE

DECLARATION of CONFORMITY

In Accordance with

1999/5/EC Directive

of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity

Doc No:	SATEL-DC-RTTE-088
Manufacturer:	SATEL Oy
Address:	POB 142, (Meriniitynkatu 17), 24101 Salo, Finland

Products :

Type	*Model*
SATEL-TA12	**SATELLAR-RU**
SATEL-TA14	**SATELLAR-CU**

As a combined product package the marketing name is either SATELLAR-2DS or SATELLAR-2DSd.

Notified Body Opinion:

according to:	Annex IV of R&TTE Directive
Document No:	148347N
Dated on:	30.6.2010
Issued by:	Nemko / No: 1987

We, the manufacturer of the above mentioned products, hereby declare that these products conform to the essential requirements of the European Union directive 1999/5/EC. This Declaration of Conformity is based on the following documents:

Doc. No	*Type of Product*	*Test Specification*	*Laboratory / Date of Issue*
127761	SATELLAR RU	EN 300 113-2 V1.4.1	NEMKO / Espoo 8.6.2009
127761A	SATELLAR RU	EN 301 489-1 V.1.8.1 & -5 V.1.3.1	NEMKO / Espoo 5.5.2009
127761D	SATELLAR RU	EN 60950-1 2nd Ed (2005)	NEMKO / Espoo 27.8.2009
127761C	SATELLAR CU	EN 301489-1-5 / IEC 61000-6-2 / 61000-6-4	NEMKO / Espoo 5.5.2009
1483478	SATELLAR RU	EN 300113-2 (V1.4.1, 2007-07)	NEMKO / Espoo 20.4.2010

Salo on the 5th of July, 2010.

SATEL OY

Pekka Aura
CEO

LOCAL AREA WIRELESS DATA COMMUNICATIONS • SATEL OY •

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Warranty and safety instructions

Read these safety instructions carefully before using the product:

- The warranty will be void if the product is used in any way that is in contradiction with the instructions given in this manual, or if the housing of the radio modem has been opened or tampered with.
- The devices mentioned in this manual are to be used only according to the instructions described in this manual. Faultless and safe operation of the devices can be guaranteed only if the transport, storage, operation and handling of the device is appropriate. This also applies to the maintenance of the products.
- To prevent damage the Central Unit (referred to in this user guide as CU) must always be switched OFF before connecting or disconnecting the serial connection cable. It should be ascertained that different devices used have the same ground potential. Before connecting any power cables the output voltage of the power supply should be checked.

1. Introduction to the SATELLAR product family

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SATELLAR is a new generation narrow band radio modem that consists of separate units:

- Central unit (CU)
- Radio units 1W and 10W (RU)
- Expansion units (XU)

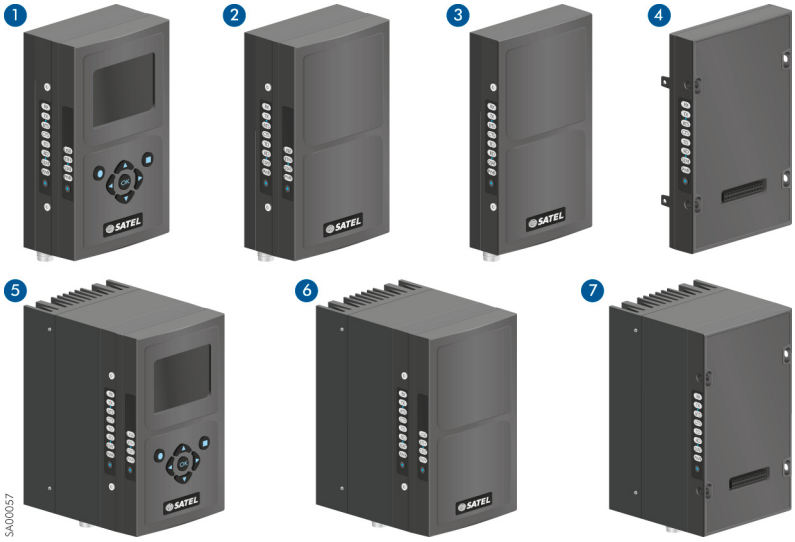

Figure 1.1 SATELLAR product family:

1. SATELLAR-2DSd: Central unit (CU) with display and keypad + radio unit (RU), 1 W
2. SATELLAR-2DS: Central unit (CU) without display and keypad + + radio unit (RU), 1 W
3. SATELLAR-1DS: Radio unit (RU), 1 W
4. Expansion unit (XU) to be added between CU and RU (1W or 10W) when needed
5. SATELLAR-20DS with display:
   Central unit (CU) with display and keypad + radio unit (RU), 10 W
6. SATELLAR-20DS without display:
   Central unit (CU) without display and keypad + radio unit (RU), 10 W
7. SATELLAR-10DS: Radio unit (RU), 10 W

Using SATELLAR the customer builds an own independent radio data communication network. This document presents the specifications and usage of the CU. The properties of other units are described in the extent, which is necessary to read in order to understand the operation of the CU.

Data communication

SATELLAR operates either as a transparent radio link, essentially replacing a wire, for classic RS-232, RS-485 or RS-422 based protocols, or as a wireless router in an IP-based network. Using SATELLAR many network topologies are possible, everything from a point-to-point connection to a nationwide chain with multiple branches.

Range

With SATELLAR the communication range of a point to point link is typically longer than 10 km in urban conditions (some obstacles in the line of sight), and longer than 20 km in ideal line of sight conditions. The range can be further extended using high gain antennas, booster modules and radio repeaters.

Security

Data security is often a concern when using radio communication. In SATELLAR a 128-bit encryption on the air-interface ensures privacy in the radio network.

Display and keypad

The CU is available with or without a display and keypad. The size of the display is 2.4 ", resolution is 320 x 240 pixels, and the amount of colors is 65k. The keypad has seven buttons: left, right, up, and down arrows, OK button, and two software defined buttons.

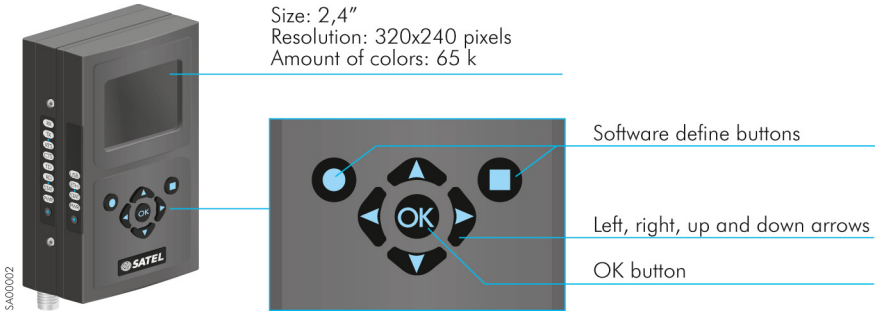

Figure 1.2 Display and keypad

Diagnostics and configuration

Radio modems are often used in applications where reliability and independence are key properties. To support this demand, SATELLAR has built-in diagnostic and remote configuration features.

Local use

The status of the CU can be seen from the LED indicators, which are located on the other narrow side of the unit. More detailed information is available using the graphical user interface with a QVGA display and 7 pushbuttons.

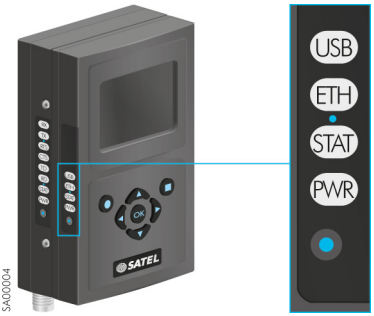

Figure 1.3 The status of the CU can be seen from the LED indicators

Remote use

Once deployed, status monitoring and configuration can be performed using one of the following methods:

1. The SATELLAR CU provides WWW pages for configuration and diagnostic, accessible using IP connectivity (the Ethernet interface of the CU)

2. Using the Windows based SATEL NMS PC software through the serial data interface of the RU, the USB device port of the CU, or TCP/IP port 55555 of the CU. (Check SW availability from SATEL)

SATELLAR can also be accessed over the air by the methods described above.

Flexible and expandable

SATELLAR concept has been designed to be flexible and expandable both in terms of hardware and software functions.

Software

In the RU the modulation method, channel spacing (i.e. air interface data rate), and forward error correction can be selected by changing the modem settings by software. Also the RF output power can be set.

Hardware

Due to the modular mechanical structure of SATELLAR, it is possible to add hardware expansion units. The idea is that this could be done as an update after the initial deployment. At the moment, however, the RU does not support the update. Schedule for this will be informed later.

USB host and device connectors offer a possibility to connect commercially available USB devices like Bluetooth and WLAN modules to the modem or e.g. to show the modem as an external memory device to the PC.

Ruggedized

SATELLAR is constructed of die-cast aluminum to withstand the abuse typical to rough industrial environments. It operates over a wide temperature range and under severe vibration conditions to meet the requirements of vehicular and process industry applications.

1.1 Mounting

2

SATELLAR can be mounted directly on a flat surface or to a DIN rail. When mounting on the flat surface, two-piece mounting clips can be used. The mounting clips are delivered in the basic sales package. DIN-rail mounting is possible either on the backside of the stack of different SATELLAR Units or on the other narrow side of each unit (the latter case so that the LED indicators remain visible for the user). The DIN-rail mounting clips have to be ordered separately.

NOTE!

1. The equipment must be installed in restricted access location due to high touch temperatures of metal enclosure.
2. The screen of coaxial antenna cable must be grounded to protect from over voltages from outdoor antenna.

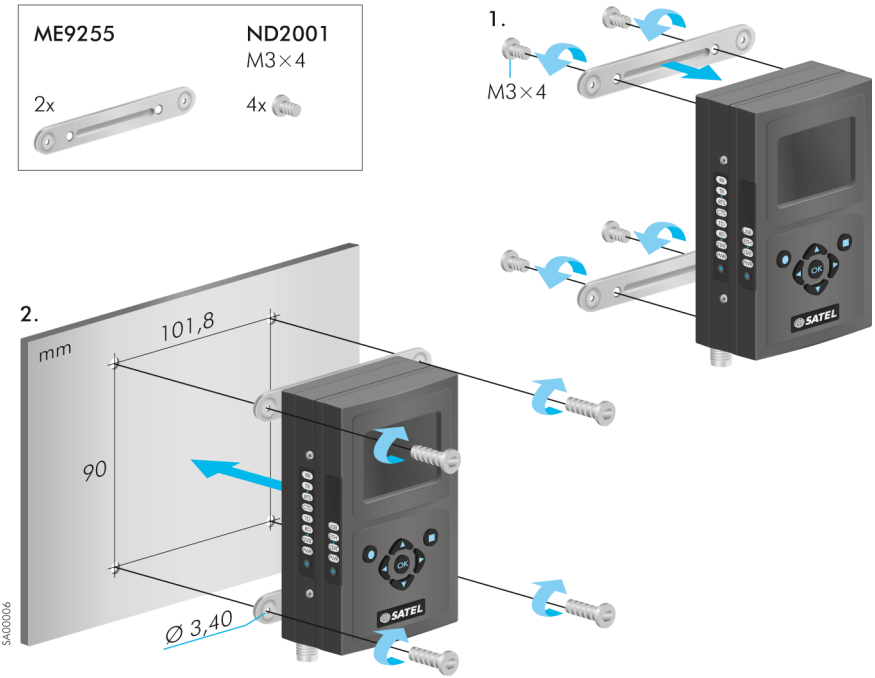

Figure 1.4 SATELLAR-2DS(d), mounting on flat surface with mounting clips (includes in the delivery)

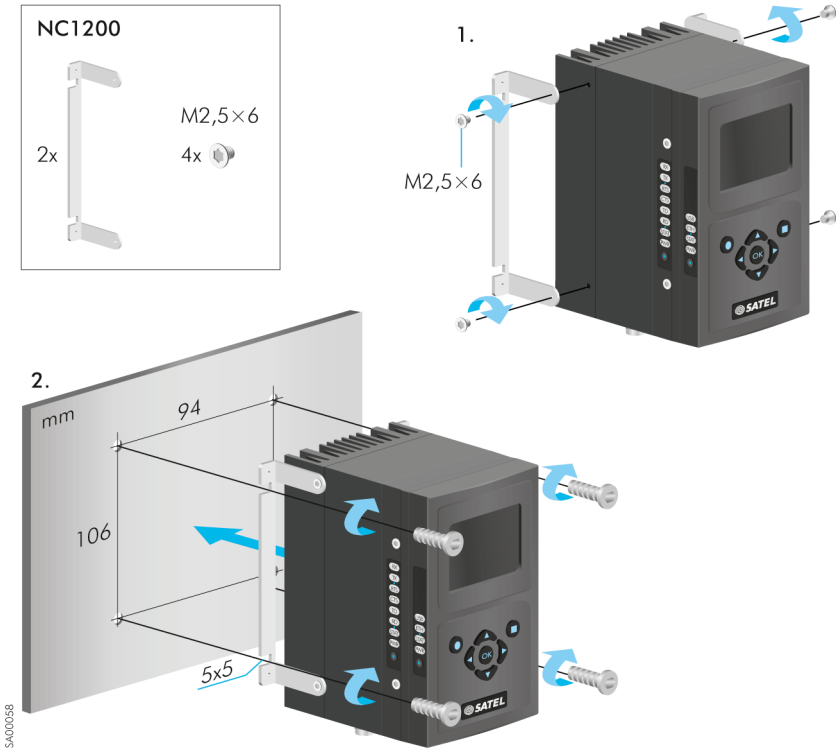

Figure 1.5 SATELLAR-20DS, mounting on flat surface with mounting clips (included in the delivery)

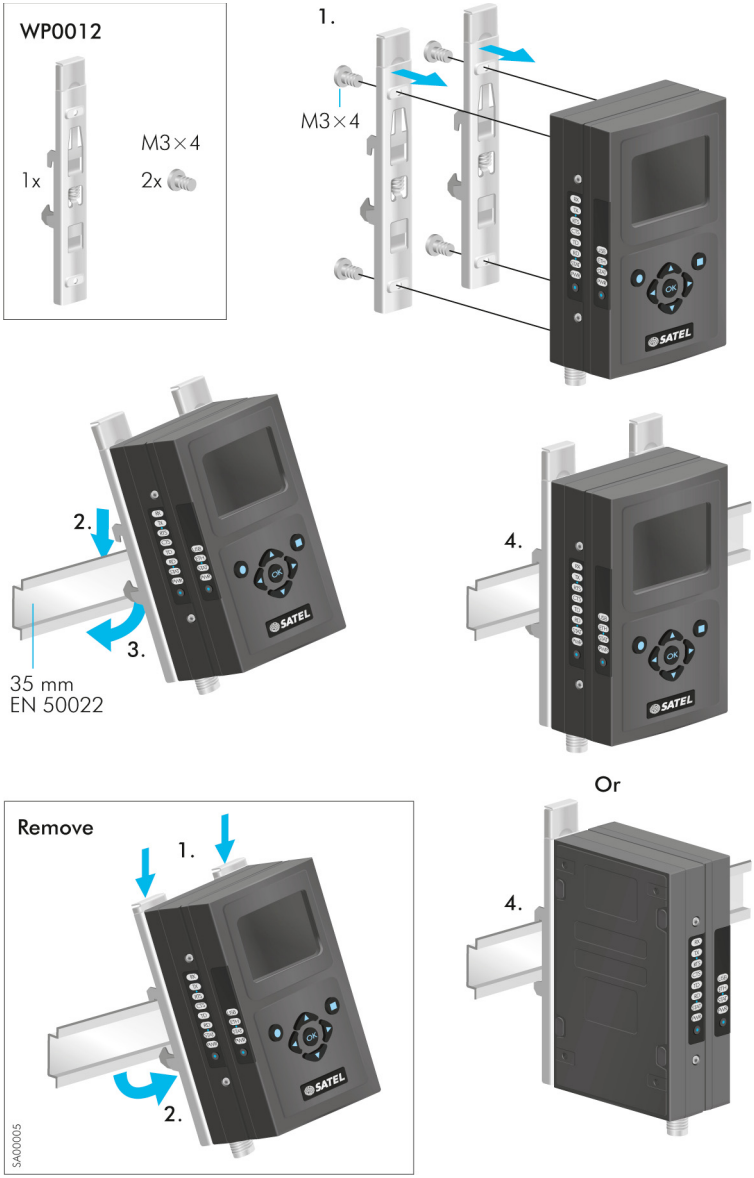

Figure 1.6 SATELLAR-2DS(d), mounting on the DIN-rail with mounting clips (to be ordered separately, one pc / type)

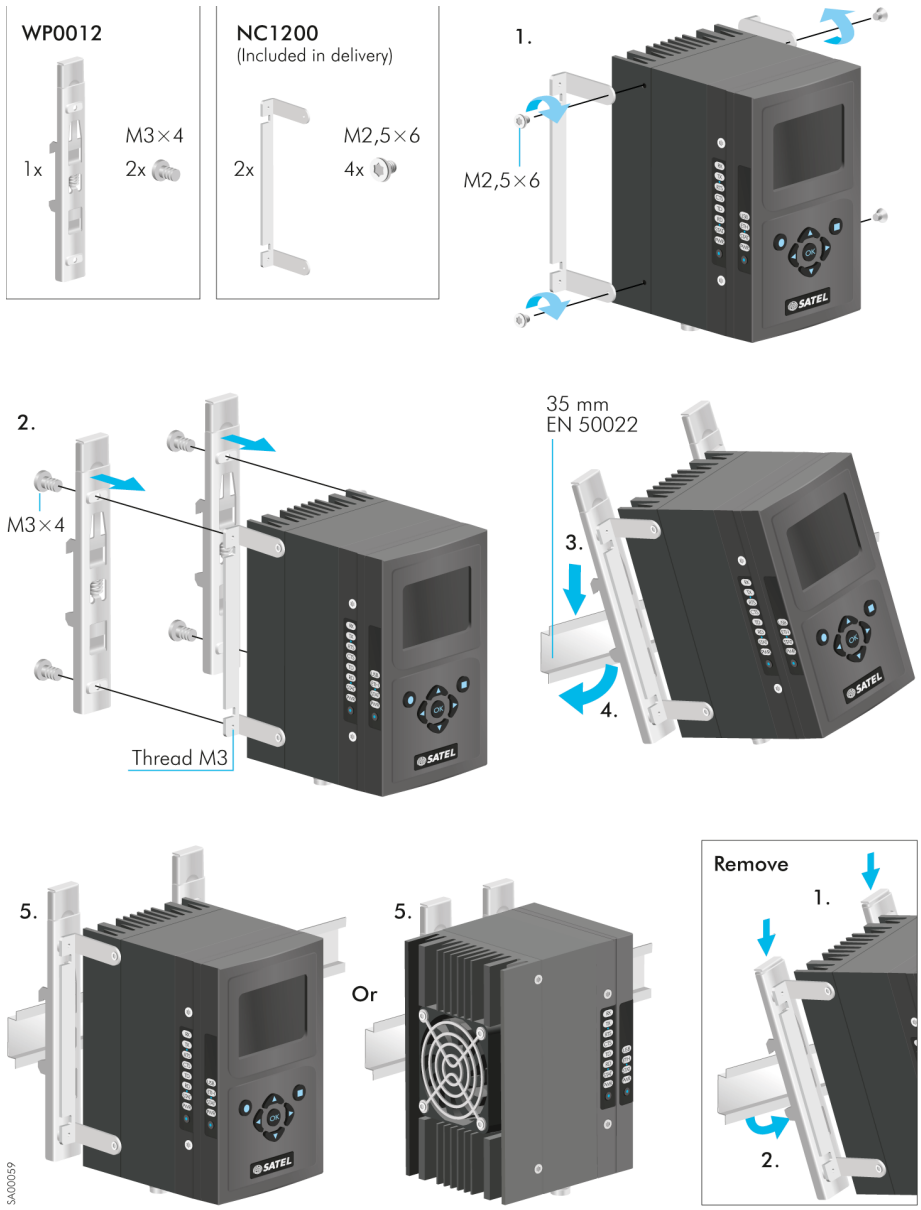

Figure 1.7 SATELLAR-20DS, mounting on the DIN-rail with mounting clips (to be ordered separately, one pc / type)

2. Technical specifications

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Electrical

CPU	ARM 9 @ approx. 200 MHz
RAM	64 MB
ROM	128 MB
Display	2.4 ", 320 x 240 pixel resolution, 65 k colours
Keypad	up, down, left, right, OK (select), and two SW defined keys
Power consumption (no USB device connected)	2.0 W with the display 1.4 W without the display
USB interfaces	USB-host & USB-device USB2.0 high speed
Ethernet interface	10/100 Mbps Ethernet RJ-45 with Auto-MDIX
Start time from power on	For CU/RU combination: 65 s until IP communication works (locally and over the air). 130 s until LCD/GUI works.

Mechanical and environmental

Mechanical dimensions	130 x 21.7 x 76.5 mm
Weight	260 g
Temperature ranges	-25 - +55 deg °C, complies with the standards -30 - +75 deg °C, functional -40 - +85 deg °C, storage
Humidity	< 95 % @ 25 deg °C, non-condensing
Vibration	At least 10 – 500 Hz/5g without degradation in data transfer capability
Shock resistivity	Dropping height 1 m, all directions
IP rating	IP 52
Mounting:	DIN rail (side or back), two piece mounting clip, or directly on flat surface

Standards compliance

Emissions	IEC 61600-6-4
Immunity	IEC 61000-6-2
ESD	IEC 61000-4-2 level 4 for external connections EIC 61000-4-2 level 2 for internal unit-to-unit connector
RoHS	2002/95/EC

Table 2.1 SATELLAR Central Unit technical specifications

3. Typical setup

The figure below shows a typical setup when transferring IP data through the CU. When using the RU together with the CU the recommended minimum distance between the antenna and CU is 2 m in order to avoid degradation of the receiver sensitivity due to interference from the CU.

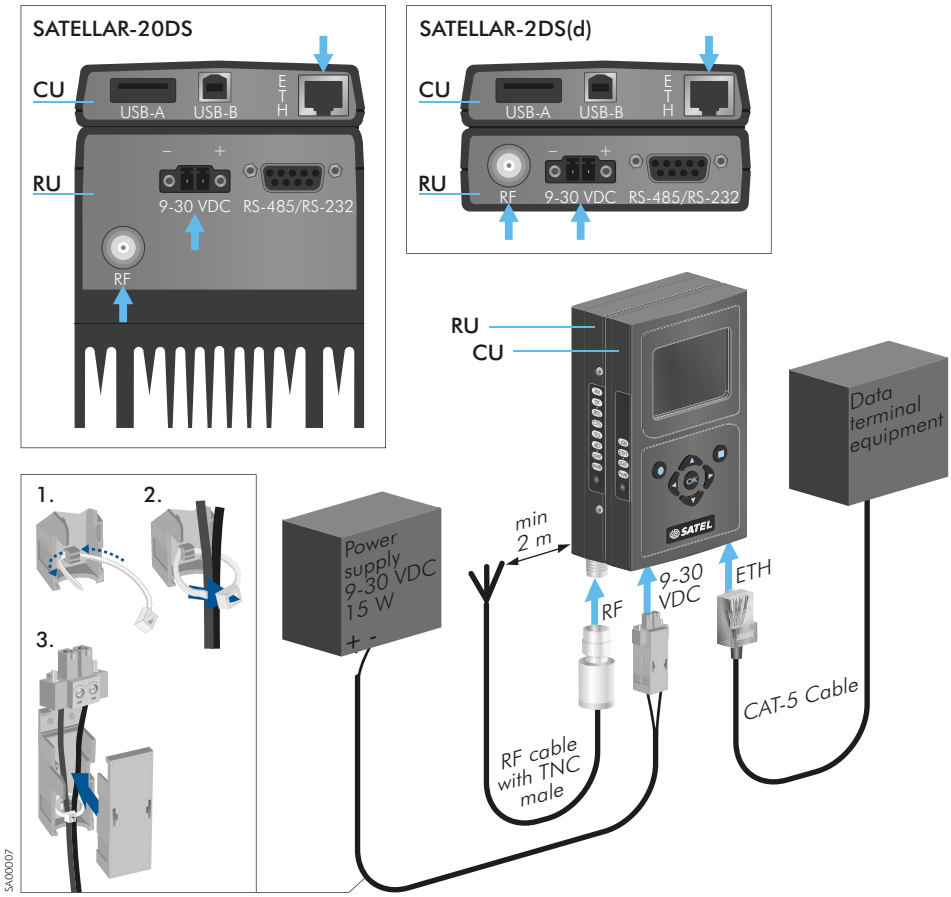

Figure 3.1 Transferring IP data through the CU, cabling

4. Mechanical assembly, modular construction

The expansion unit XU is attached between RU and CU as described in the Figure 4.1.

First remove the CU and RU from each other, see the figure. Take the rubber cover from the unit-to-unit connector of the XU. Modular constraction allows you to connect the expansion unit XU between RU and CU units. Align the tabs of the CU with the mounting holes of the XU and press the units together, and do the same between RU unit and XU+CU units. Finally, tighten the connections with the screws. Now the combination can be mounted either by DIN rail adapters or by a two-piece mounting clip.

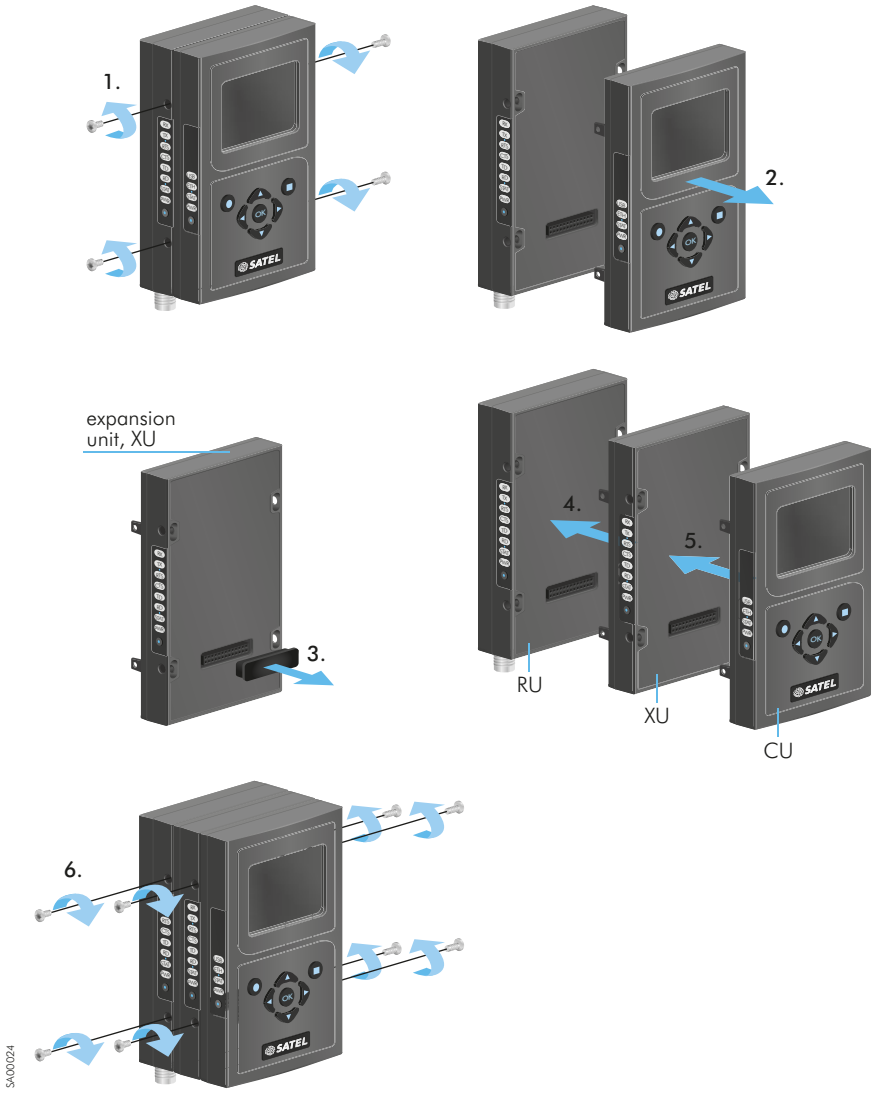

Figure 4.1 Modular construction, mounting of the expansion unit XU

5. Interfaces

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The CU offers three data interfaces: Ethernet, USB host and USB device. LED indicator shows the status of the unit and graphical user interface can be used to check and change device settings and to see the diagnostics data.

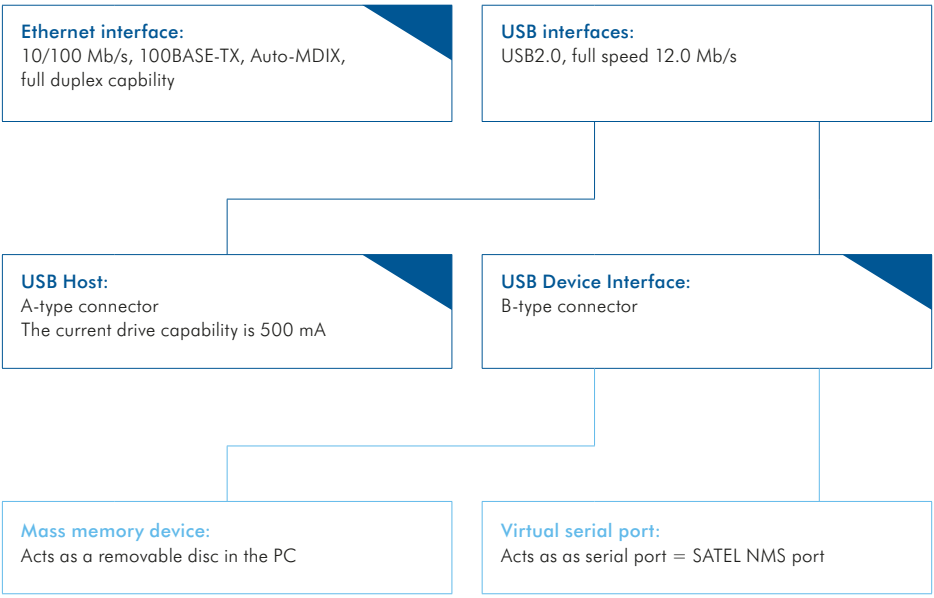

Figure 5.1 Three data interfaces: Ethernet, USB host and USB device

5.1 Ethernet

Ethernet interface is 10/100 Mb/s 100BASE-TX with Auto-MDIX and full-duplex capability.

5.2 USB

The USB interfaces support USB2.0 Full Speed (12.0 Mb/s) data rates. Both USB host and device interfaces are available. For USB host the A type connector is used and for USB device the connector is B type. The current drive capability of the USB host interface is 500 mA. The USB device interface has two modes: Mass memory device and Virtual serial port. The mode can be selected in Modem Settings, General category and in addition by the function button as described in chapter 5.5.

In the Mass memory device -mode a PC can be connected to the USB device interface and SATELLAR acts as a Removable Disc in the PC. The removable disk contains copies of system log files, which can be copied to the PC. Update files can be copied to the removable disk and be used in the Firmware Updater (see chapter 8.3). Any other files copied to the removable disk are removed when the cable is disconnected.

In Virtual serial port -mode, the USB port acts as a serial port. When the USB port is connected to a PC, the virtual serial port device is created in the PC. This virtual port appears to windows as a normal serial port: the only difference is that an actual D9 connector is not used. This allows programs to connect to serial ports in order to access the CU via the USB connection.

Windows PC requires a special driver, available from SATEL. The Virtual Serial port acts as a SATEL NMS port, allowing a program such as SATEL NMS PC to be used to change the settings of SATELLAR.

5.3 Diagnostics, monitoring, changing settings

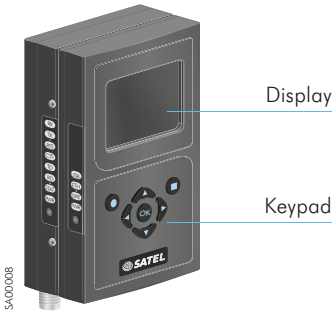

Figure 5.2 Display and keypad

CU equipped with a display and keypad offers an easy way to check or change device settings and see diagnostics information. The same is possible using the Web interface of the CU or SATEL NMS PC SW. Graphical user interface is explained more in chapter 5.6 and the PC SW is described in its own user manual.

5.4 LED indicators

The CU provides four LED indicators that are located on one of the narrow sides of the unit. They are listed and described in the table below.

LED Label	Status	Description
USB	OFF	USB host disabled
	ON	USB host enabled, USB device detected
	Blinking (0.25 s interval)	USB host enabled, no USB device detected
	Blinking (0.50 s interval)	USB device setting override using function button, see chapter 5.5
	Blinking (1.0 s interval)	
ETH	OFF	Ethernet port disabled
	ON	Ethernet port enabled and connected
	Blinking (0.25 s interval)	Ethernet port enabled but not connected or operational
	Blinking (0.50 s interval)	Ethernet port setting override using function button, see chapter 5.5
STAT	ON	Normal operation mode
	Blinking (0.25 s interval)	Device is starting up
PWR	OFF	Device is powered off
	ON	Device is powered on

Table 5.1 LED indicators

NOTE: In normal operation the USB LED indicates the status of the USB host interface. When operating with the function button (chapter 5.5), the USB LED refers to the state changes in the USB device interface.

5.5 Function button

The function button is located below the LED indicators. It is used to control the operation of the USB device and Ethernet interfaces as described below. The CU must be allowed to boot up completely before the button will work.

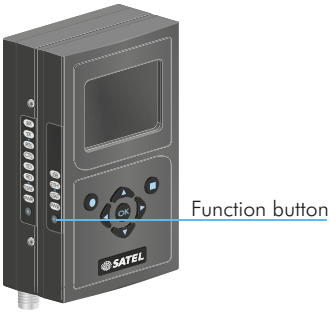

Figure 5.3 Location of the Function button

When the button is pressed for more than a second, all the LEDs turn on indicating the start of the process. The effect depends on how long the button is kept depressed, and is indicated by turning the LEDs off one by one. When the LEDs indicate the desired function, release the button.

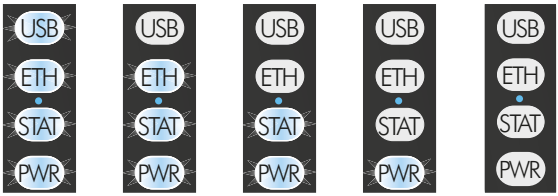

Figure 5.4 LED indications, see the Table 5.2

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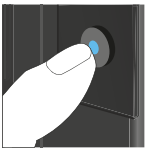
Action	Length of press [seconds]	LED indication	Effect
	1 to 2	All LEDs ON.	The USB device and Ethernet interface settings are reset to states defined by user settings.
	2 to 4	The uppermost LED (USB) is switched off.	The USB device setting is changed so that if the user setting is Mass memory device, the setting changes to Virtual serial port and vice versa. Thereafter the USB LED starts to blink until the setting is reset to the original value. Blinking interval is 0.5 seconds if the new device setting is Virtual serial port and 1.0 seconds if the setting is Mass memory device.
	4 to 6	The next lower LED (ETH) is switched off.	The CU IP address settings are changed. Thereafter the IP address is 192.168.1.1, the net mask is 255.255.255.0, and DHCP is switched to off mode. The ETH LED blinks until the setting is reset to the original value. Blinking interval is 0.5 seconds.
	6 to 8	The next lower LED (STAT) is switched off.	No specific operation defined.
	8 to 10	The fourth LED (PWR) is switched off.	All the LEDs start to blink rapidly until the MCU restarts. SATELLAR CU then reboots.
	> 10	All LEDs ON.	
	> 20	All LEDs turn ON and remain on even if the button is kept down.	The selection process starts from the beginning (11 to 12 seconds counts as 1 to 2 seconds etc.).
			When button is released, the FPGA will reboot the whole CU. This is nearly equivalent to a Power-off reboot.

Table 5.2 Function button operation

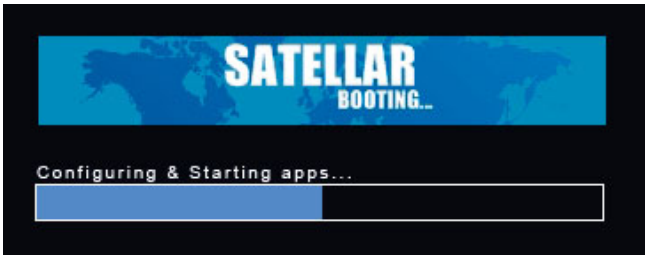
5.6 Graphical user interface

In SATELLAR device equipped with LCD display and keypad, GUI can be used to change settings and access the various applications.

Figure 5.5 Central Unit equipped with LCD display and keypad

5.6.1 Booting screen

This screen is visible while the CU is starting up.



5.6.2 LCD display, information and button menu areas

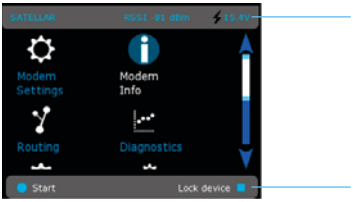


Figure 5.6 Information and button menu areas

Figure 5.7 Red font indicating a value lower than the defined threshold

The top of the screen is the Information area. The following information is available (From left to right).

- Modem name: Default value is "SATELLAR". It can be changed in Modem Settings, General category (see chapter 7.1.2).
- Current date and time, if enabled (see chapter 7.1.6)
- RSSI value: The signal level of the last received message. If no message has been received in the last 5 seconds, the value is set to -128. If the reading is lower than the defined minimum threshold value, this value is shown with red font. The threshold can be set in Modems Settings, General category (see chapter 7.1.2).
- Voltage reading. A numeric value or a voltage bar depending on the setting in Modem Settings, General category (see chapter 7.1.2).

On the bottom of the screen is the button menu area operated by software defined keypad buttons. The left (round) button command is displayed on the left bottom corner of the screen and the right (square) button command on the bottom right corner of the screen.

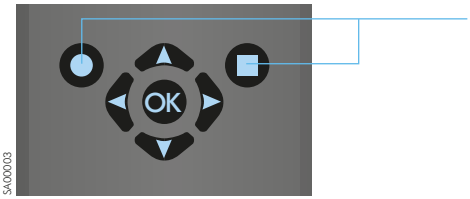
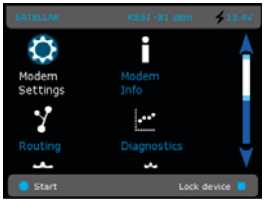
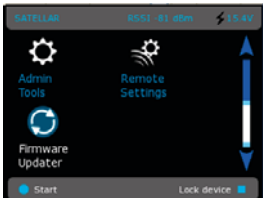


Figure 5.8 Software defined buttons on keypad

5.6.3 Main menu



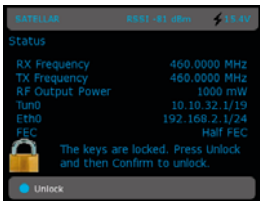


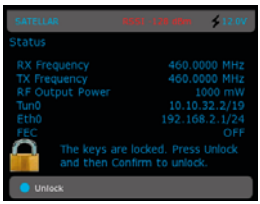
This menu screen contains icons which can be used to start the different applications.

- Modem Settings: See chapter 7.1
- Modem Info: See chapter 7.2
- Routing: See chapter 7.3
- Diagnostics: See chapter 8.1
- Admin Tools: See chapter 8.8
- Remote settings: See chapter 8.4
- Firmware updater: See chapter 8.3

To start an application, use the cursor keys to select the icon and press the round button or OK button.

5.6.4 Status screen





If "Lock Screen" command is given in main menu, or the defined time passes without keyboard input, the screen goes to the status/lock screen mode.

In this screen some basic status values are displayed.

- RX Frequency
- TX Frequency
- RF Output Power
- Tun0 IP Address
- Eth0 IP Address
- Forward Error Correction (FEC) mode

No input is allowed in this screen, except to unlock the screen. To do this, follow the instruction on screen. If PIN code has been enabled, the correct code must be entered to unlock.

2

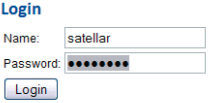
5.6.5 Screen save mode

After a timeout set in Modem Settings, General category (see chapter 7.1.2), the display is turned off. When any button is pressed, the Status screen is displayed and the UI can be unlocked as normal.

5.7 WWW User interface

This interface can be used with a web browser application, such as Mozilla Firefox. The url to access the WWW -page is *http://<modem's IP address>*. By default this is *http://192.168.1.1*. If the current IP address is unknown, it can be forced to 192.168.1.1 by using the function button as explained in chapter 5.5, or using the Graphical user interface, if present. The WWW interface can also be used across the radio link, once routes have been set (see chapter 6). In this case either of the IP addresses defined can be used (both the eth0 and tun0 addresses work).

5.7.1 Login

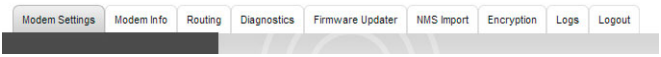


The first screen of the WWW interface is the login screen. The user name is *satellar* and the default password is *Satel123*. (The password can be changed in settings, see chapter 7.1.2)

You can also log in using the name *admin* and default password is *Satel456*. In this case an additional application called Administration is available, see chapter 8.8.

5.7.2 Main menu

The main menu lists all the "applications" available in the WWW interface. An additional Administration tab is available when logged in with user name *admin* as explained in chapter 5.7.1.



5.7.3 Status area

The area immediately below the main menu shows the name of the radio station (settable in the General Settings category, see chapter 7.1.2). Current status information is also available:

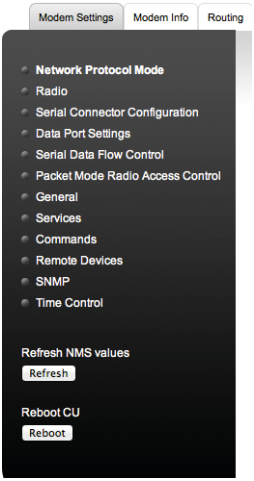
- Voltage
- Received signal strength (RSSI)
- Current system time

More status information may be visible depending on the firmware versions installed.

5.7.4 Categories list

Once a Main menu application (see chapter 5.7.2) is selected, the categories related to that application are listed in the dark grey area on the left. The category labels can be clicked to open the category page, which contain settings and information related to that category. More details about categories can be found beginning from chapter 7.

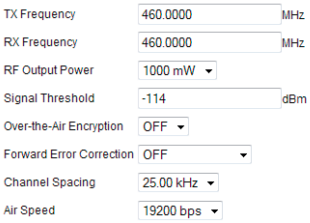
There are also two buttons in the category area.



- Refresh NMS Values – force reload of settings from the RU and CU settings databases into the WWW User Interface.
- Reboot CU – restart the CU.

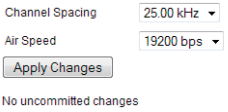
5.7.5 Category page

This area to the right of Categories list shows the contents of the currently selected category. It contains settings or other information.

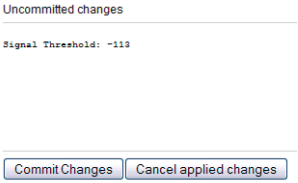


5.7.6 Changing settings

When changing settings in the WWW interface, select first the correct application and category, then change the desired settings found on the category page. Finally click the Apply Changes button.



Some settings are text or numbers which can be changed by typing, while others are drop down lists, allowing you to select from a few choices. Any changes you make are lost if you change the category or application without clicking the Apply Changes -button.



When the Apply Changes button is clicked, all changes on the current page are added to the list of uncommitted changes. You can then navigate to another page and Apply more changes, which are also added to the list. When you have finished making changes, store and take the new settings into use by clicking the Commit Changes button. You can also discard all applied changes by clicking the Cancel applied changes button. In this case all settings are removed from the list of uncommitted changes and all settings of all units remain as they were.

When Commit Changes is clicked, the CU will store settings into the settings database and the Radio Unit, and restart all necessary Linux processes. Therefore the committing process may take a relatively long time, sometimes up to a minute.

NOTE: If the IP Address has been changed, the browser will be automatically redirected to the new address, but in case the network address part of the IP address has changed, you'll need to modify your computer's IP settings so that it is again in the same LAN as the modem to be able to continue using the WWW interface.

5.8 SATEL NMS

SATEL NMS is a Network Management System. Devices that support SATEL NMS can be configured and monitored using external software provided by SATEL. One such program is SATEL NMS PC. Configuration and monitoring can be performed either locally using a cable, or remotely via a radio link.

The SATELLAR Central Unit supports SATEL NMS, and provides the following features.
Connection options:

- Connect via TCP/IP Port 55555
- Connect via USB Device port when the USB port is in Virtual Serial port mode. (See chapters 5.2 and 7.1.2 for details)
- Remote connection via radio network is available when the routing settings are correctly defined.

Most settings available via the User Interfaces of the CU are also accessible using SATEL NMS. For this purpose, the NMSID (Network Management System IDentifier) as well as Sub-Unit number of each setting is listed in this manual. The NMSIDs are also used by the NMS Import application (see chapter 8.5).

Note that the NMS Address of the CU is the same as the RMAC Address of the attached Radio Unit. See the Radio Unit user manual for details.

5.9 SSH

SATELLAR's linux command line can be accessed using the SSH protocol. To do this you need a SSH client, such as putty.exe. The user name is *satellar* and the password is *Satel123*.

6. Data transmission

The CU is used to transfer data over the IP protocol. Multiple IP protocols are supported, such as TCP/IP, UDP and ICMP. A prerequisite for wireless IP transmission is that the RU is configured to packet routing protocol mode as explained in the RU user manual.

6.1 Internet protocol

Each CU has an IP address belonging to the Local Area Network (LAN) to which they are connected via their Ethernet interface. Each CU also has another IP address belonging to a second LAN, the SATELLAR RU LAN. This LAN is formed by the radio protocol. These two interfaces are called eth0 and tun0 according to standard Linux naming conventions. The CU acts as an IP router device, routing IP packets between its Ethernet interface (eth0) and the radio network provided by SATELLAR RUs (tun0).

6.1.1 Example

In the Figure 6.1 shown on the next page is presented a network which has three (3) data terminal equipment devices (DTEs) connected to CU through Ethernet. Each CU is connected to a RU, together forming a SATELLAR-2DSd Radio Station (in this case RU type is: 1 W, with display and keypad). In addition there are two standalone RUs acting as repeater stations. Each of the stations has a unique station address (RMAC) which is a number freely selectable in the range of 1 … 4094. The station addresses are used at the radio protocol level when sending messages through the radio path. (The radio protocol is explained in the RU user manual.)

Each DTE belongs to a LAN on the eth0 interface of a SATELLAR. To be able to communicate with each other, IP routing must be correctly configured in each DTE and each SATELLAR.

How the station addresses are used for routing the data through the radio path, is explained in the RU user manual. This is called Packet Routing. For the network topology seen on Figure 6.1 the Packet Routes routing table looks like the following:

Radio unit	Next hop (neighbor)	Addresses behind (remotes)
A	2	3, 4, 5
B	3	1, 2, 5
C	3	1, 2, 4
D	1	-
	3	4, 5
E	2	1
	4	-
	5	-

Table 6.1 Packet Routes routing table for Figure 6.1

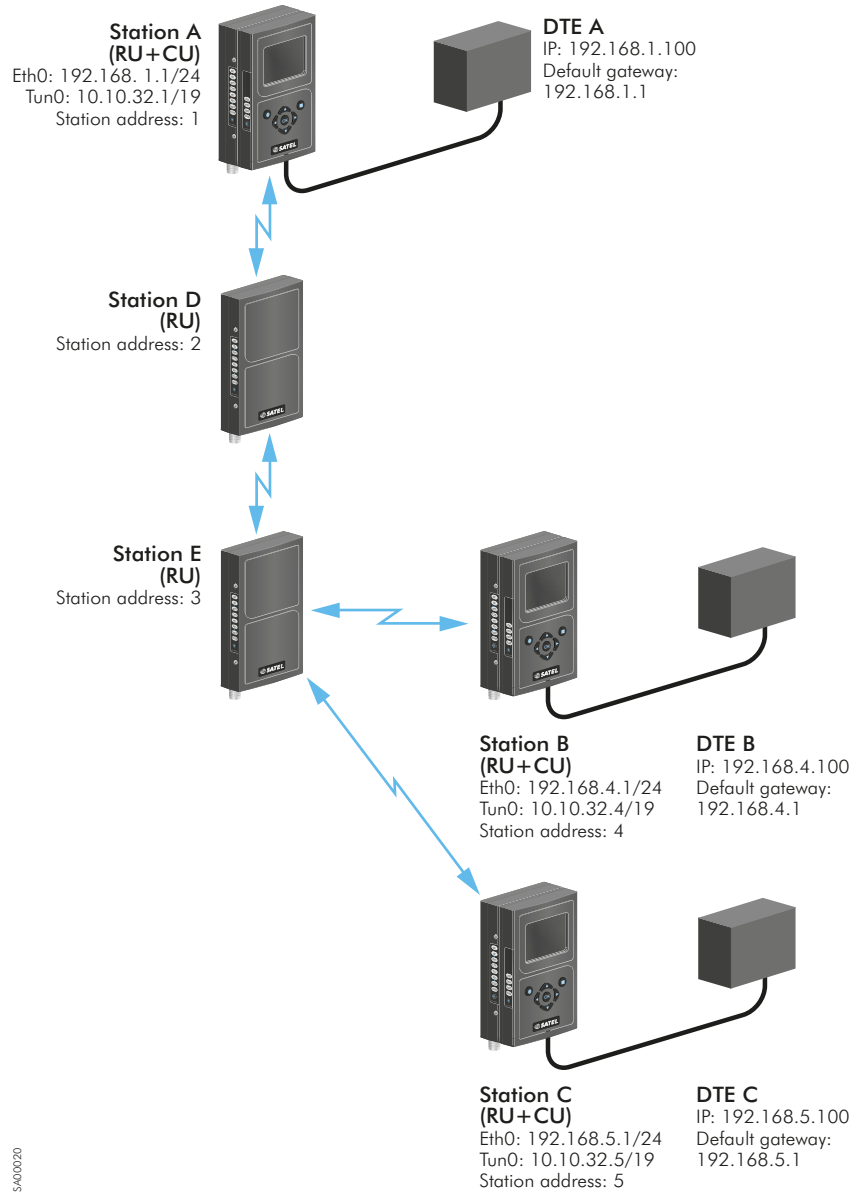


Figure 6.1 Routing example

6.1.2 Forming the tun0 IP address

Whenever the station address (RMAC) of a SATELLAR is changed, the IP address for the tun0 interface is automatically determined: If the station address is X, the tun0 IP address is set to 10.10.32.X, netmask 19.

In case the station address (X) is larger than 254, the tun0 address is of the form 10.10.A.B, where A = 32 + (X / 254), rounded down and B = 1 + (X % 254) [% being the modulus operator]. For example, RMAC 500 translates to tun0 address 10.10.33.247.

In case a subnet with network address 10.10.32.0/19 is already in use in a system, a SATELLAR radio network can be configured to use another tun0 network Base Address. To do this, use the Admin Settings application (see chapter 8.8.2). All modems MUST use the same tun0 Base Address.

6.1.3 Choosing the eth0 IP address

Eth0 IP addresses must be selected according to two rules.

- Each CU's eth0 interface must belong to a different subnet.
- The CU and the corresponding DTE must belong to the same subnet.

Additionally

- It is a good practice to set the CU IP address as 192.168.X.1 where X is the station address (RMAC), if possible.
- The default gateway for the DTE should be the corresponding CU, unless there is another gateway present in the LAN. In this case the routing tables of the gateway must be modified accordingly.

The rules can be clarified with the help of Figure 6.1: Routing example.

The station A has

- Station address (RMAC) 1 → tun0 address is 10.10.32.1
- Eth0 address 192.168.1.1/24 (i.e. subnet mask is 255.255.255.0)
- Therefore DTE A must have an address 192.168.1.X, e.g. 192.168.1.100 and its default gateway must be 192.168.1.1

The station B has

- Station address (RMAC) 4 → tun0 address is 10.10.32.4
- Eth0 address must be chosen so that it belongs to a subnet different from station A, e.g. 192.168.4.1/24
- Therefore DTE B must have an address 192.168.4.X, e.g. 192.168.4.100 and its default gateway must be 192.168.4.1

The station C has

- Station address (RMAC) 5 → tun0 address is 10.10.32.5
- Eth0 address must be chosen so that it belongs to a subnet different from stations A and B, e.g. 192.168.5.1/24
- Therefore DTE C must have an address 192.168.5.X, e.g. 192.168.5.100 and its default gateway must be 192.168.5.1

Stations D and E act only as repeaters without a CU and therefore no local Ethernet connection. So they have no IP addresses – just station addresses.

6.1.4 Setting IP routes

After all the addresses have been set it is still required to define IP routes for each of the CU. Routing data must include the address and net mask of each of the destination subnets (LANs) that need to be reached and the gateway it can be reached through. The gateway address is the tun0 address of the target CU.

For the network in the Figure 6.1 the IP routing tables of each CU equipped station are:

Station	Destination/net mask	Gateway
A	192.168.4.0/24	10.10.32.4
	192.168.5.0/24	10.10.32.5
B	192.168.1.0/24	10.10.32.1
	192.168.5.0/24	10.10.32.5
C	192.168.1.0/24	10.10.32.1
	192.168.4.0/24	10.10.32.4

Table 6.2 IP routing tables for each CU in Figure 6.1

The usage of different addresses and routing tables can be clarified by an example where DTE A wants to send a message to DTE B.

1. The destination IP address, 192.168.4.100, belongs to a subnet different from the source address, 192.168.1.100. The message is therefore routed to the default gateway of DTE A, i.e. to CU of station A.
2. CU of station A recognizes that the destination address belongs to sub network 192.168.4.0 which is reachable through gateway 10.10.32.4. The message is therefore forwarded to tun0 interface which translates the gateway address to the RMAC address, 4 in this case.
3. At this point the packet routing protocol of the RU enters the picture: it reads the destination RMAC address and consults the packet routing table to find out that a message to address 4 must be sent to address 2. (Address of station D).
4. Station A's RU now reserves the radio path using the CSMA/CA algorithm to send the data to station D.
5. Station D receives the data and recognizes that the final destination address is 4. Station D consults its packet routing table and sees that the message to address 4 must be sent to address 3 (station E) and then reserves the radio path to send the message.
6. Station E receives the message and then forwards it to station B (as above) which is the final destination station.
7. The packet routing protocol in station B recognizes that the received data is intended for this station and therefore forwards the data to the CU/tun0 interface.
8. The IP router software component of the CU of station B recognizes that the destination IP address differs from its own IP address but belongs to the same sub network. Therefore it forwards the message to eth0 interface and then the message finally reaches the destination, i.e. DTE B.

6.2 DHCP

The CU supports the DHCP (Dynamic Host Control Protocol) in either Server or Client mode. DHCP can also be set to off, which is the default setting.

In client mode, the CU attempts to contact a DHCP server in the Ethernet subnet to get the eth0 IP address.

In server mode, the CU provides IP addresses to other devices in the Ethernet subnet.
Typically SATELLAR networks are configured with DHCP OFF, because static IP addresses are needed to access remote devices reliably.

7. Settings

The CU has several settings, which affect the operation of the IP routing and other things. The CU can also be used to change the settings of the RU as well as any other units present. There are several interfaces to use when viewing info and changing settings (see chapter 5.6)

The settings are grouped into categories used in the LCD and WWW GUIs. Each setting is also listed with the sub-unit number and NMSID for use with NMS Protocol and NMS Import features. See chapter 5.8 for information about NMSIDs and chapter 8.5 for information about NMS Import.

NOTE: See the settings selection quide at the end of the manual.

7.1 Modem Settings

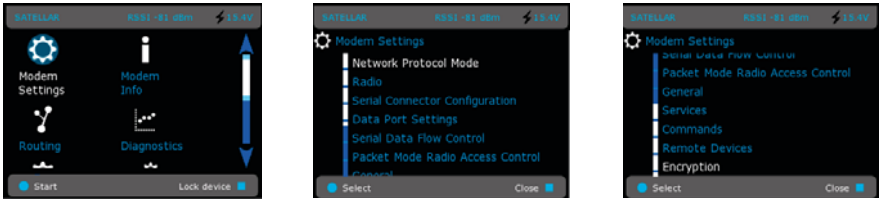


Figure 7.1 Modem Settings by CU: Graphical user interface (GUI/LCD)

7.1.1 Radio Unit Settings categories

For explanation of categories Network Protocol Mode, Radio, Serial Connector Configuration, Data Port Settings, Serial Data Flow Control and Packet Mode Radio Access Control, see the RU user manual chapter 7, subchapters 7.1 through 7.3 respectively.

7.1.2 General

These are general and miscellaneous settings of the radio station and CU.

Attribute	Explanation	Sub unit	NMSID
Name	Name of the radio station. This is freely selectable by the user, up to a maximum length of 32 characters. The name can be used to identify the radio station. It is shown in the WWW interface and GUI/LCD screen, for example.	0	1.769

Attribute	Explanation	Sub unit	NMSID
PIN Code	Code to unlock the GUI/LCD Screen of the CU (if present).	1	1.3200
Temperature unit	Fahrenheit, Kelvin or Celsius. Used by the Diagnostics graph for modem temperature.	1	1.3201
UI Voltage Critical Level	When the Voltage reading drops to this level, it is displayed in red in the GUI/LCD and WWW interfaces.	1	1.3202
UI RSSI Critical Level	When RSSI drops to this level it is displayed in red.	1	1.3203
UI Voltage Display mode	Select the way to display voltage in the GUI/LCD: either numeric or as a bar	1	1.3204
UI Voltage Bar Min	If display mode is set to Bar, this Voltage level corresponds to the minimum level of the voltage indicator, i.e. no bars.	1	1.3205
UI Voltage Bar Max	If display mode is Bar, this Voltage level corresponds to Maximum bars	1	1.3206
PIN Code Required	If set to Yes, user must enter PIN code to unlock the GUI/LCD and keyboard.	1	1.3224
USB Device Mode	Choose how the CU will act when connected to a PC: Mass memory or Serial port. See also chapter 7.3.	1	1.3225
Display Brightness	A value from 0 to 255, this setting controls the brightness of the LCD screen's backlight.	1	1.3258
Web GUI Password	Set the password of user "satellar". This affects the WWW password and linux command line login password for this user. The password is case-sensitive. Default password is "Satel123".	1	1.3259
GUI Color profile	Choose a color profile for the GUI/LCD. Default is "Black"	1	1.3261
LCD Timeout	The time in seconds without keys pressed before the LCD (if present) of the CU is powered off.	1	1.3275

Table 7.1 Modem settings, General

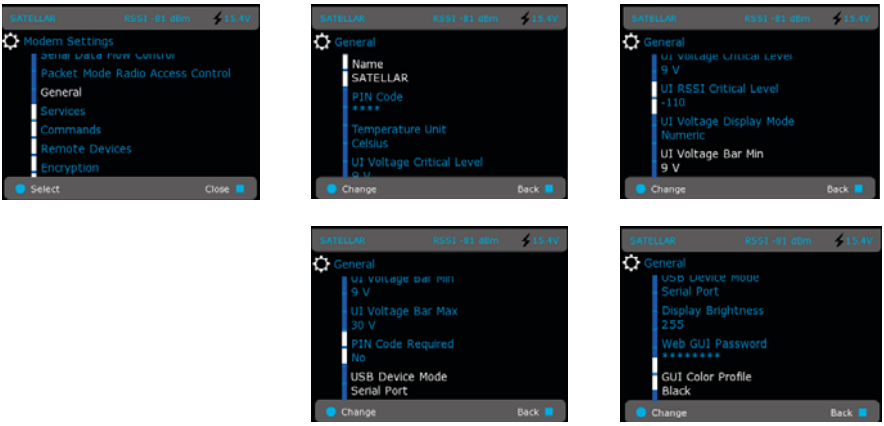


Figure 7.2 Modem Settings, General by CU: Graphical user interface (GUI/LCD)

7.1.3 Services

This category can be used to disable unused features of the CU and fine-tune some operational parameters. Usually these settings should not be modified, as some of the settings disable essential services of the device.

Attribute	Explanation	Sub unit	NMSID
SSHD State	Turn the SSH server ON or OFF	1	1.3230
HTTPD State	Turn the Web server ON or OFF. WARNING: If this is turned off, the WWW interface becomes unavailable. It can be turned back on using the GUI/LCD (if present) or SATEL NMS protocol.	1	1.3231
NMSBluetoothd State	Turn ON or OFF the possibility of giving SATEL NMS commands to the device using a wireless Bluetooth serial connection. A supported USB Bluetooth dongle must be connected to the CU. (List of supported devices available separately)	1	1.3232
NMSTcpsocketd State	Turn ON or OFF the possibility of using SATEL NMS commands over a TCP/IP connection to the device. The default TCP port is 55555.	1	1.3233
NMSLoggerd State	This service is required by the diagnostics features. It monitors diagnostic values and stores them in a database, where they can be viewed using the Diagnostics application. If this service is disabled, the status bar RSSI and Voltage readings are also disabled.	1	1.3234
Linklayer State	This feature is required by IP data transfer. WARNING: IF THIS IS DISABLED, NO IP DATA CAN BE TRANSMITTED TO THE RADIO NETWORK. Diagnostics can still be gathered and settings can still be changed.	1	1.3235
NMSGathererd timeout	Time in milliseconds to wait for NMS messages sent to the RU before giving up. It is usually not necessary to modify this value	1	1.3237
NMSLoggerd Interval	How often the Diagnostic values are updated, in milliseconds.	1	1.3238
NMSLoggerd Timeout	Time in milliseconds to wait for diagnostic NMS messages before giving up. In case a CU is set up to monitor other devices in the network (using the “Modem Settings/Remote Devices” settings category), it may become necessary to increase this value if the network is very large.	1	1.3239
NMSLoggerd Retries	Number of times to retry lost diagnostic NMS messages. This value should be kept low to avoid congestion in heavy traffic situations.	1	1.3240
RU Commslogd State	Set logging of NMS messages between the CU and the RU ON or OFF. The log can be viewed in the “Logs” page of the WWW interface.	1	1.3262
USB Host Control	Set the power control features of the USB host port on or off.	1	1.3269
UI Power Control	When UI Power Control is ON, the GUI/LCD Screen is turned off after the defined timeout (See Modem Settings/General).	1	1.3274

Table 7.2 Modem settings, Services

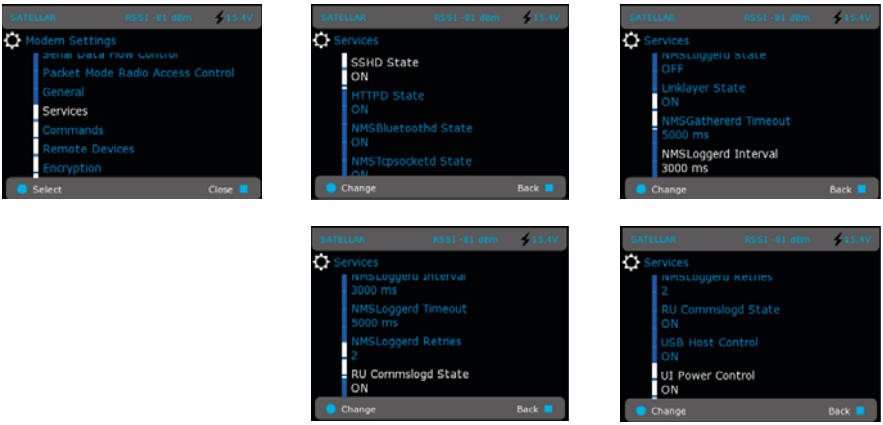


Figure 7.3 Modem Settings, Services by CU: Graphical user interface (GUI/LCD)

7.1.4 Commands

This chapter has commands to reset the unit(s) or restore settings to various states, for example to initialize a device to its original status or reboot device.

Use only one command at the time and do not to save any other settings at the same time.
Also, refresh NMS values after Radio Unit value restore.

To issue a command, select "Reset" or "Reboot", for example. The command is sent when settings are committed, as detailed in chapter 5.7.6.

Command	Explanation	Sub unit	NMSID
Restore Default Factory Settings Radio Unit	The RU's settings, including Frequency, Packet routing tables, RMAC etc. are restored to the state they were in when the unit left the factory.	0	1.3085
Restore Default Factory Settings Central Unit	The CU's settings, including IP, routing etc. are restored to the state they were in when the unit left the factory.	1	1.3085
Reset Radio Unit	Resets the Radio Unit. This command is mostly used by NMS Protocol to discard unsaved changes. It is not usually necessary to use this command when configuring the modem using the WWW or LCD user interfaces.	0	1.3090

Command	Explanation	Sub unit	NMSID
Reset Central Unit	Resets the Central Unit. This command is mostly used by NMS Protocol to discard unsaved changes. It is not usually necessary to use this command when configuring the modem using the WWW or LCD user interfaces. (Note that despite being called the Reset command, the CU is not actually reset. Only unsaved settings are cleared.)	1	1.3090
Reboot Central Unit	Reboot the CU (by resetting the MCU). The reboot lasts approximately one a minute (see technical specification for accurate values)	1	1.3093
Statistical Counters Clear	Clears (resets to zero) all Radio Unit statistical counters.	1	1.3109

Table 7.3 Modem settings, Commands

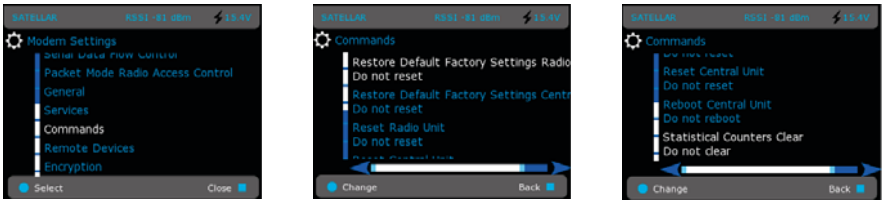


Figure 7.4 Modem Settings, Commands by CU: Graphical user interface (GUI/LCD)

7.1.5 Remote Devices

This controls how the CU diagnostics service (NMSLoggerd) handles remote radio stations. By default, no online remote monitoring is done.

Setting	Explanation	Sub unit	NMSID
Pre-cache All Settings of Device N	(N equals the RMAC address of the radio station). Enable this to have the CU remotely fetch all settings from the remote device. This will cause significant radio traffic. (Not usually recommended)	1	1.3264
Diagnostics Polling of Device N	(N equals the RMAC address of the radio station). Enable this to have the CU monitor the diagnostics values of the remote device. The diagnostics become available in the Diagnostics page. This will cause additional radio traffic which may be significant depending on the size of the network, defined time intervals, timeouts and retries (see chapter 7.1.3) and the number of devices monitored. This setting is not shown, unless at least one Packet Route is defined (see chapter 7.3.1)	1	1.3265

Table 7.4 Modem settings, Remote devices

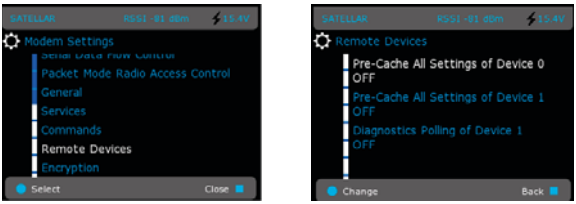


Figure 7.5 Modem Settings, Remote devices by CU: Graphical user interface (GUI/LCD)

7.1.6 Time Control

Control current date and time, time zone and Network Time Protocol (NTP) settings.
Note that SATELLAR does not have battery-backed real time clock hardware, therefore time is not accurately preserved during power off and reboot. Using an external NTP server can help mitigate this.

Time is used mainly for logging purposes and accurate real-time is not essential for the operation of SATELLAR.

Setting	Explanation	Sub unit	NMSID
Time Operation Mode	*No time operation* – default. Other time settings have no effect.	1	1.3282
	Manual time operation. Time and time zone settings are used, NTP settings are not used.		
	NTP Time. Time setting is not used; instead the NTP protocol is used.		
NTP Server Address	Current time is fetched from the defined NTP Server Address. Only works if Time operation mode is set to NTP time.	1	1.3283
NTP Interval	Time is refreshed from the NTP server after the interval defined in this settings has passed. Default is 100 seconds. Please be aware this setting will consume some radio bandwidth if used in remote SATELLARs, therefore very small values are not recommended.	1	1.3284
Time	Current time given in *"YYYY-MM-DD hh:mm:ss"* format. This setting is only taken into use if *Time operation mode* is set to Manual time operation.	1	1.3285
Time Zone	Select time zone. Used in both NTP time and Manual time modes.	1	1.3286

Table 7.5 Modem settings, Time control

7.2 Modem Info

This application contains information about the radio station. These values cannot be changed.

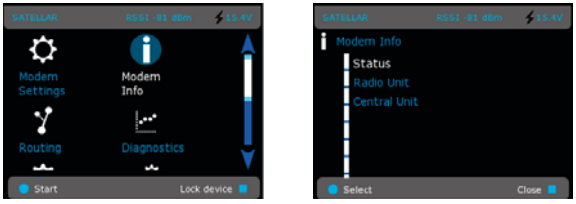


Figure 7.6 Modem Info by CU: Graphical user interface (GUI/LCD)

7.2.1 Status

Information about the current general state of the radio station. The values on this page may be refreshed by pressing the F5 Key, or selecting Refresh from a menu, when viewed via the WWW interface on a standard web browser.

Item	Explanation	Sub unit	NMSID
Temperature	Measured inside the RU radio module. See RU user manual for details.	0	1.32
Voltage	Measured by the RU from the voltage input terminals. Precision of the reading is 0.1 Volts, but actual measurement accuracy may vary, see RU user manual for details.	0	1.33
Bytes From Radio	How much data (including NMS messages) has been received by the RU from radio.	0	1.38
Bytes to Radio	How much data (including NMS messages) has been transmitted by the RU to radio.	0	1.39
Watchdog Error Count RU	Number of resets the RU's Watchdog has performed.	0	1.45
Watchdog Error Count CU	Number of reboots the CU's Watchdog has performed.	1	1.45
Last RSSI	Signal strength of the last received radio message.	0	1.111
Alive Timer	Time in seconds the RU has been running since the last reset.	0	1.113
Transmitted Packet Count	Number of Packet Routing packets transmitted by Radio Unit to the radio since last reset of the RU.	0	1.120
Received Packet Count	Number of Packet Routing packets received by Radio Unit from the radio since last reset of the RU.	0	1.121
Detector Signal To Noise Ratio	Signal to Noise Ratio (SNR) measured by the RU from last received data packet, in decibels (dB).	0	1.122
Ethernet Status	As a result of settings or auto MDI-X negotiation the Ethernet status may change. This item shows the current status. Connected/Not connected, 10 or 100Mb/s, Full or Half duplex.	1	1.3257
Last Boot Reason RU	Reason for the last restart. User command, Watchdog error, Power up etc.	0	9.795
Last Boot Reason CU	Reason for the last restart. User command, Watchdog error, Power up etc.	1	9.795

Table 7.6 Modem info, Status

Figure 7.7 Modem info, Status by CU: Graphical user interface (GUI/LCD)

7.2.2 Radio Unit

This page shows information about the RU. See the Radio Unit User Guide for details.

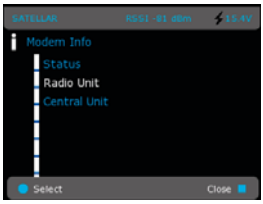


Figure 7.8 Modem info, Radio unit by CU: Graphical user interface (GUI/LCD)

7.2.3 Central Unit

This page shows information about the CU.

2

Item	Explanation	Sub unit	NMSID
FPGA Watchdog Restarts	Count of restarts the hardware watchdog has performed.	1	1.123
FPGA Total Restarts	Total count of restarts the hardware has performed.	1	1.124
Firmware version	The version of the file system of the CU. This information is needed when updating the firmware using Firmware Updater (see chapter 8.3)	1	1.650
Model	Product model name. Normally this is “Satellar CU”	1	1.772
Ethernet MAC Address	The Media Access Control (MAC) address of the built-in Ethernet interface.	1	1.3210
Kernel version	The version of the Linux kernel of the CU. This information is needed when updating the firmware using Firmware Updater (see chapter 8.3). This is the version of SATELLAR kernel build, not the Linux kernel version it is based on.	1	1.3215
Serial Nbr RW	The serial number of the CU, equal to the one printed on the sticker on the device.	1	9.652
Board 1 *	Hardware information about the PCB.	1	various
Interface board *	Hardware information about the interface board (Ethernet and USB connectors).	1	various

* Exact numbers and names of these items depend on the current HW configuration of the device

Table 7.7 Modem info, Central unit

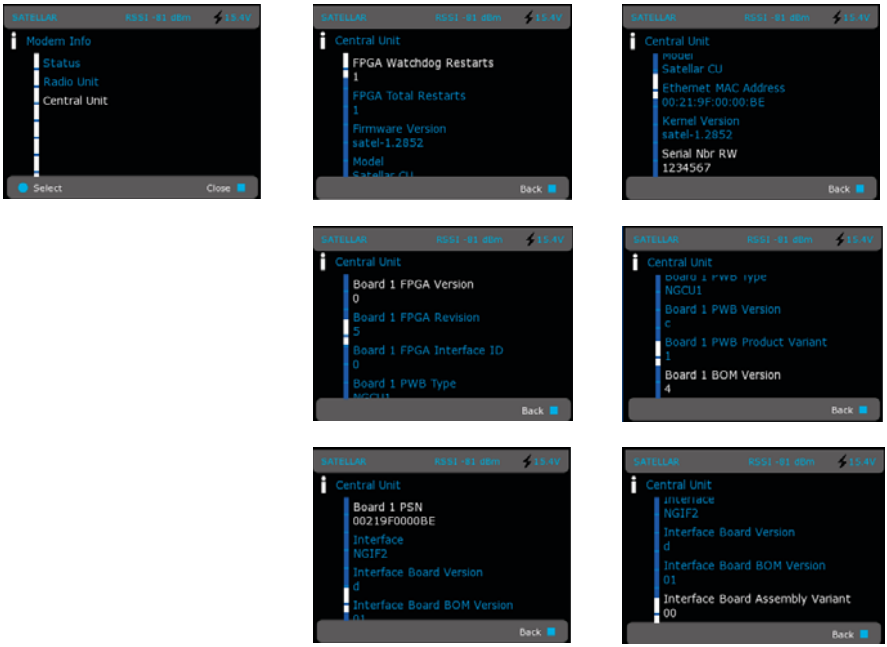


Figure 7.9 Modem info, Central unit by CU: Graphical user interface (GUI/LCD)

7.3 Routing

The routing application allows changing the Packet routing tables, IP settings and routes. This is similar to Modem Settings.

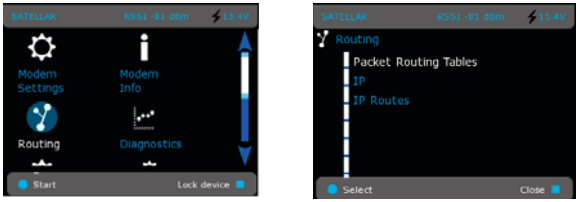


Figure 7.10 Routing by CU: Graphical user interface (GUI/LCD)

7.3.1 Packet Routing Tables

This category controls the packet routing tables of the RU. The interface is a little different on the GUI/LCD and WWW. In both cases you can:

- Add new packet routes
- View current routes
- Delete selected routes
- Add remote stations to a route
- Delete remote stations from a route

See RU user manual for more information about Packet Routing.

Figure 7.11 Packet routing tables by CU: Graphical user interface (GUI/LCD)

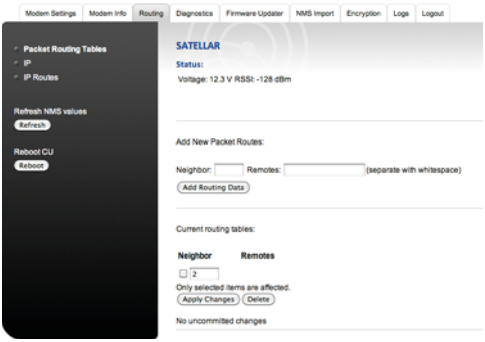


Figure 7.12 Packet routing tables by CU: WWW user interface

7.3.2 IP

This category contains the Internet Protocol settings.

Setting	Explanation	Sub unit	NMSID
IP Address 0 and 1	One of these is the Tun0 address. This cannot be directly modified. The Eth0 address can be modified.	1	1.3208
QoS set	The functionality controlled by this setting is not finished in the current firmware version. Please ignore it for the time being.	1	1.3227
DHCP State	OFF, Client or Server. Default is OFF. See chapter 6.2 for details.	1	1.3229

Setting	Explanation	Sub unit	NMSID
Ethernet Speed	Auto, 10 Mbps or 100 Mbps. Some Ethernet devices will not work correctly if speed is set to Auto. In this case select the correct speed using this setting.	1	1.3255
Automatic IP State	OFF or ON. Default is OFF. If set to ON, the eth0 address is set to 172.20.X.1/14, where X equals the RMAC address. In this case, the eth0 IP address cannot be modified until Automatic IP State is set to OFF.	1	1.3263
Ethernet Current IP Address	Show the current eth0 address. If the address has been overridden by the function button as detailed in chapter 5.5, this value is 192.168.1.1, even if the setting on this same page has been set to another value.	1	1.3270
Ethernet Current Ethernet mask	As above, shows the actual netmask in use at this time.	1	1.3271
Ethernet Duplex	Settable to FULL or HALF. Some Ethernet devices require this to be set to Half.	1	1.3276
IP Queue Max Time Length	The IP router of the CU buffers the IP packets going to the radio interface. This setting controls how long individual packets are kept in the buffer before being deleted. See below for more information.*	1	1.3280
IP Queue Max Packets	This setting controls the maximum number of packets in the outgoing IP packet buffer.*	1	1.3281

* IP Queue handling: When the radio channel is experiencing heavy traffic, IP packets cannot always be sent immediately. They are placed in a queue waiting for the radio channel to become free. (See RU user manual for more information). Note that the radio queue should not be set to too large values, because the TCP/IP protocol will resend IP packets if it has not received a response in time. Too long IP queue will in this case just cause more duplicate packets to be sent, to no useful effect. Also some real-time or near-real-time applications, typically those using the UDP protocol, require packets to be at most a few seconds old, therefore buffering them for tens of seconds is not useful.

Table 7.8 Routing, Internet protocol settings

Figure 7.13 Routing, IP by CU: Graphical user interface (GUI/LCD)

7.3.3 IP Routes

This category allows adding, modifying and removing IP routes. For examples of typical routes, see chapter 6.1.

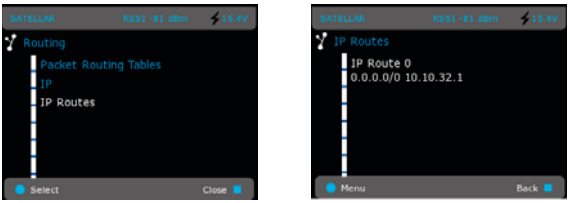


Figure 7.14 Routing, IP Routes by CU: Graphical user interface (GUI/LCD)

A short introduction to IP routing

The SATELLAR IP radio network consists of Local Area Networks (LANs) and routers (the SATELLAR CUs). One of the LANs is the radio network, reached through the tun0 interface of each SATELLAR. This LAN is common to all SATELLARs. The other LANs are the Ethernet LANs (reached through the eth0 interface).

A router's defined task is to route IP packets between LANs. To do this, the router needs routing tables which tell it how to reach any other network. Therefore each router must have defined routes to all the LANs.

The task of defining routes is made easier by the concept of default route, also known as default gateway. All IP packets are sent to the default gateway, unless there is a specific route telling otherwise. All IP routes consist of two pieces of information.

- The target *network address* (including netmask)
- The target *gateway address*.

Together these two tell the router that an *IP packet belonging to a certain network (i.e. LAN or subnet) must be sent to a certain gateway*. For example a route defined as 192.168.2.0/24 10.10.32.2, tells that all IP packets which have a destination address that falls under the 192.168.2.0/24 network address (for example 192.168.2.7) must be sent to the gateway 10.10.32.2.

Note that there must also be a return route defined in the other end router back to the original LAN. (Sometimes a default route is enough for this). Typically SATELLARs at remote sites will act as the default gateway for the Ethernet LAN they are connected to.

Consider the network in the Figure 7.15. There are four Ethernet LANs (1 through 4), connected by SATELLAR radios (R1 through R4). The radios are connected by a fifth LAN, the radio LAN. LAN 1 is also connected to the internet via a gateway (router, ADSL etc.).

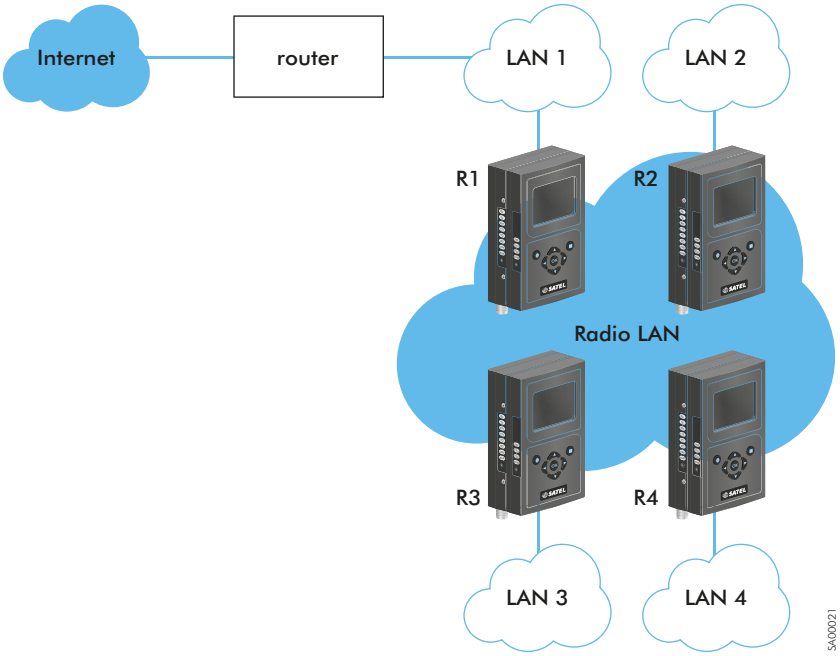


Figure 7.15 IP routing

Before designing the IP routes, we must define the desired connectivity. To keep the amount of routes smaller, we decide that LANs 2, 3 and 4 do not need to have access to each other, because our central station is in LAN 1 and it will receive status messages from sensors connected to the other LANs. The sensors do not need to communicate with each other. LAN 1 must however have access to the internet, so it can be reached from off-site for remote monitoring.

Router	Default gateway	Other routes
router	WAN/internet	LAN 2 via R1
		LAN 3 via R1
		LAN 4 via R1
R1	router	LAN 2 via R2
		LAN 3 via R3
		LAN 4 via R4
R2	R1	none
R3	R1	none
R4	R1	none

Table 7.9 Interface routes, see Figure 7.15

(Note that interface routes are omitted for simplicity, as they are automatically added)

The next step is to decide the actual IP address and netmask for each LAN. You also decide which device will be the default gateway of each LAN.

LAN name	network IP address	Netmask	Default gateway
LAN 1	192.168.1.0	24	router
LAN 2	192.168.2.0	24	R2
LAN 3	192.168.3.0	24	R3
LAN 4	192.168.4.0	24	R4
Radio LAN (Automatic)	10.10.32.0	19	R1

Table 7.10 IP address and net mask, see Figure 7.15

Please remember that the Radio LAN (tun0) addresses of each modem are automatically set based on the RMAC addresses (see chapter 6.1.2). If we assume that each RMAC of radios R1…R4 is the same as their number, we get the following IP addresses for the modems:

Device	RMAC address	tun0 IP address	eth0 IP address (suggestion)
router	-	-	192.168.1.1
R1	1	10.10.32.1	192.168.1.2
R2	2	10.10.32.2	192.168.2.1
R3	3	10.10.32.3	192.168.3.1
R4	4	10.10.32.4	192.168.4.1

Table 7.11 IP address, see Figure 7.15

Now we can define the routing tables with actual addresses:

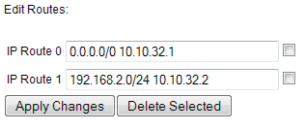
Device	Target network	gateway	notes
router	0.0.0.0/0	<WAN IP address or interface>	Default route is to internet
	192.168.2.0/24	192.168.1.2	LAN 2 via R1
	192.168.3.0/24	192.168.1.2	LAN 3 via R1
	192.168.4.0/24	192.168.1.2	LAN 4 via R1
R1	0.0.0.0/0	192.168.1.1	Default route is via the router to internet
	192.168.2.0/24	10.10.32.2	LAN 2
	192.168.3.0/24	10.10.32.3	LAN 3
	192.168.4.0/24	10.10.32.4	LAN 4
R2	0.0.0.0/0	10.10.32.1	Default route is via the radio network to R1
R3	0.0.0.0/0	10.10.32.1	Default route is via the radio network to R1
R4	0.0.0.0/0	10.10.32.1	Default route is via the radio network to R1
<other devices in the LANs>	0.0.0.0/0	<default gateway of the LAN as defined above>	We omit the details, but in principle each device in LANs 2, 3 and 4 will set the SATELLAR as their default gateway. Devices in LAN 1 use router as their default gateway.

Table 7.12 Routing tables with actual address, see Figure 7.15

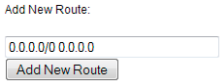
To insert these routing tables to the SATELLAR CUs, use the Routing Application, IP Routes category. Note that you also need to change the routing in your other routers to gain full connectivity. In case of demonstrating and testing, the "router" is usually your PC.

Adding routing tables to SATELLAR

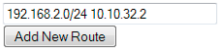
To add a new route, insert the route in the text area and click on the Add New Route button.



For example, to add a route to LAN 192.168.2.0/24 via the radio address 10.10.32.2, insert this:



To edit existing routes, use the Edit routes area:



- To delete a route, mark the checkbox and click on the Delete Selected button
- To change a route, change the text and click on the Apply Changes button.

If you have entered an invalid route, SATELLAR will print a red error text and the invalid route is not added. Finally, remember to click on the *Commit Changes* button, or *Cancel* applied changes if you made a mistake.

7.4 Serial IP

2

Serial IP is a feature where data coming from serial port is converted to IP packets and set to designated IP address. Correspondingly the received IP packets are converted and forwarded to serial interface. Serial IP configuration handling is divided into two sections for two interfaces:

- RS-232 connection in the radio unit (RU) and
- USB-Serial dongle attached to USB-A port of the central unit (CU).

7.4.1 Serial IP RS-232 / USB-A

This section includes configurations related to both RS-232 and USB-A interface connection / serial IP functionality.

Attribute	Explanation	Sub unit	NMSID
Serial IP Mode	Server – Used typically in cases where the data transfer is initiated by some remote host. Uses both sending and receiving functionality.	1	3287
	Client – Used typically in cases where most of data that is sent is originated from the serial port of this device. This can be e.g. some on-demand service where data is sent whenever there is something to be sent. Uses both sending and receiving functionality.		
	Send Only - In this mode device is able only to send data to from serial port to defined IP address and port i.e. not able to receive any sending.		
	Receive Only – In this mode device is able to only receive data to defined IP listening port and forward it to serial port .		
Port Rate	Rate of serial port – from 1200 to 460800 bps. Default is 19200.	1	3288
Port Data Bits	Serial Port Data Bits - 7 or 8.	1	3289
Port Parity	Serial Port Parity - No Parity, Odd, Even.	1	3290
Port Stop Bits	Serial Port Stop Bits – 1 bit or 2 bits.	1	3291
Protocol	TCP, UDP, Telnet or Bulk Mode. Must be coherent in network.	1	3292
Listening Port	IP Port for listening incoming messages. *	1	3293
Sending Port	IP Port for sending outgoing messages. **	1	3294
Sender Target Address	IP address for sending outgoing messages. **	1	3295
Sender Retry Count	Count for how many times messages are attempted to resent in TCP protocol if send does not succeed. ***	1	3296
Sender Retry Interval	The gap time between resending attempts (in TCP mode) in milliseconds. ***	1	3297

Attribute	Explanation	Sub unit	NMSID
UDP Listener Port Timeout	Timeout for releasing the listener of one connection in UDP mode in seconds. This means that if there is no data received in defined time, connection is closed. New connection can be established at any time again. ****	1	3298
Remote Control Port Mode	Defines whether the RFC 2217 configuration possibility set on or off, default being off.	1	3299
Remote Control Port Rate	Port rate of remote control connection. Default is 115200.	1	3300
Remote Control Port	IP port of configuration.	1	3301

* Parameter is effective when message listening is on (Server, Client, Receive Only).
** Parameter is effective when message sending is on (Server, Client, Send Only).
*** Parameter is effective when message sending is on (Server, Client, Send Only) with TCP protocol.
**** Parameter is effective when message listening is on (Server, Client, Receive Only) with UDP protocol.

Table 7.13 The configurations related to both RS-232 and USB-A interface connection / serial IP functionality

NOTE: The SATELLAR device can act as a both "client" and "server" in some cases. When e.g. two SATELLAR devices are configured to send data from serial port to each other and they are also configured to forward the received data to serial port, the both devices are acting in two modes. In such cases, "server" -mode is a good solution.

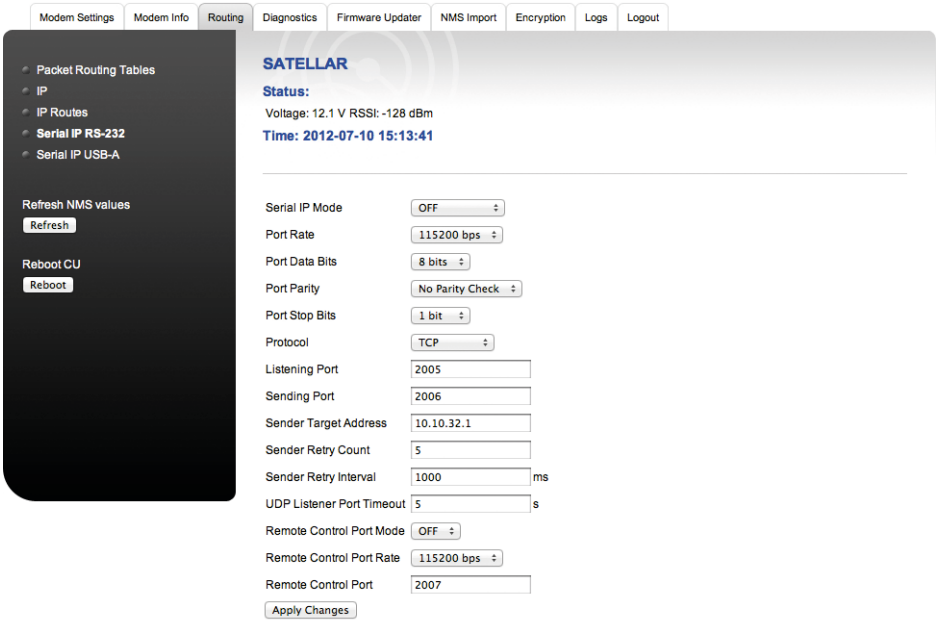


Figure 7.16 Configuration of Serial IP RS-232 via WWW-interface

7.4.2 Examples

7.4.2.1 Point-to-point

2

Example "Point-to-point" presents the basic feature and usage of configuration parameters.

Two user devices DTE A and B are connected to SATELLARs via serial port connection and the SATELLARs are configured to have a radio connection.

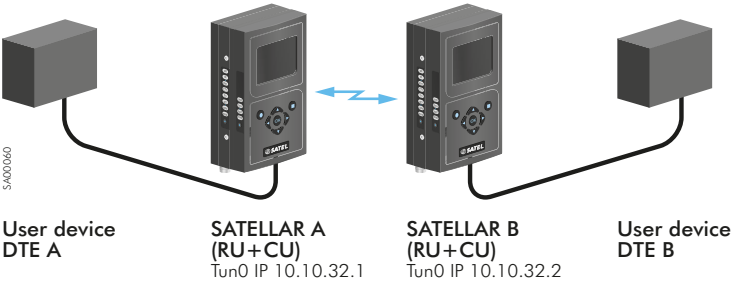


Figure 7.17 Point to point -example

SATELLAR A is having Tun0 IP 10.10.32.1 and SATELLAR B Tun0 IP 10.10.32.2 (can be obtained from screen saver or from Routing – IP category). They are configured to listen messages from serial port, to send them to target address and port, and also to listen dedicated IP port and to forward messages to serial port. First, the serial port in both SATELLARs must be configured to match the User devices DTE A and DTE B configuration. After that, the SATELLAR devices are able to send and to listen each other messages.

Parameter	SATELLAR A	SATELLAR B
Mode	Server	Server
Protocol	TCP	TCP
Listening Port	2005	2006
Sending Port	2006	2005
Sender Target Address	10.10.32.2	10.10.32.1

Table 7.14 Configuration of SATELLAR a and B devices in Point to point- example

The basic idea is to cross-configure SATELLAR devices to communicate with each other. Protocol can be also UDP as long as it is same in both ends.

7.4.2.2TCP Server

SATELLAR is configured to listen to the defined IP Port number and forward it to the serial port (IP to Serial-conversion).

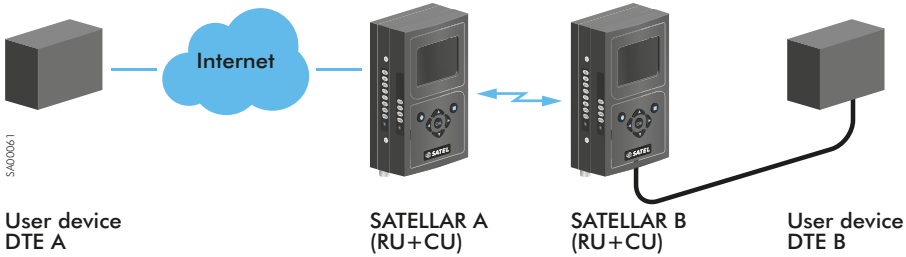


Figure 7.18 TCP Server, conversion from IP to serial port

DTE A
Ethernet IP Address 19.21.68.10
IP Route 192.168.2.0/24 via 19.21.68.20
Application able to send messages to dedicated address and port configured to send to 192.168.2.10 port 2006

SATELLAR A
Ethernet IP Address 19.21.68.20
RMAC 1 i.e. Tun0 10.10.32.1
Packet Route to 2
IP Route 192.168.2.0/24 via 10.10.32.2

SATELLAR B
Ethernet IP Address 192.168.2.10
RMAC 2 i.e. Tun0 10.10.32.2
Packet Route to 1
IP Route 19.21.68.0/24 via 10.10.32.1
Serial IP configuration as above
Serial port configuration in line with User device DTE B

DTE B
Serial port configuration in line with SATELLAR B

2

User Device DTE A has an Ethernet IP address 19.21.68.10. SATELLAR B has two IP addresses Tun0 10.10.32.2 and Eth0 192.168.2.10 which both can be used depending on the routing configuration in User device DTE A. Ethernet address is used in this example.

SATELLAR A do not have any Serial IP connection and it is configured to have radio connection with SATELLAR B. User device DTE A must be set to route messages to SATELLAR B via SATELLAR A. In this case SATELLAR A has an IP 19.21.68.20, User device DTE A must have a route 192.168.2.0/24 via 19.21.68.20 and must also have an application able to send messages to dedicated address and port, in this case to port 2006 at 192.168.2.10.

Parameter	SATELLAR B
Mode	Server
Protocol	TCP
Listening Port	2006

Table 7.15 Serial port conficuration of SATELLAR B

Sending parameters are not necessary, since TCP is capable of sending replies back when connection has been opened.

7.4.2.3TCP Client

In TCP client case whenever data comes from the serial port, the data is buffered and sent to target address. This can be e.g. some on-demand service sending some e.g. log data whenever there is something to send. Setup is similar to server case.

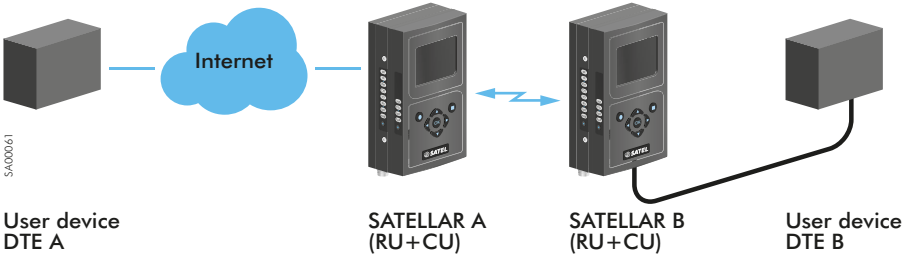


Figure 7.19 TCP Client

DTE A: IP address 19.21.68.10
SATELLAR A: IP address 19.21.68.20
SATELLAR B: IP address 192.168.2.10..

User Device DTE A has IP address: 19.21.68.10, SATELLAR A: 19.21.68.20 and SATELLAR B: 192.168.2.10. SATELLARs are configured to have the radio connection and IP routes are configured so that devices are able to communicate with each other i.e. route from User device DTE A to SATELLAR B via SATELLAR A and from SATELLAR B to User device DTE A via SATELLAR A.

User device DTE A must now have an application that opens port listening to messages coming from SATELLAR B. SATELLAR A does not have any Serial IP configuration. SATELLAR B has following serial port configuration, where it is assumed that User Device DTE A has port 2005 open:

Parameter	SATELLAR B
Mode	Client
Protocol	TCP
Sending Port	2005
Sender Target Address	19.21.68.10

Table 7.16 Serial port conficuration of SATELLAR B

7.4.2.4Multipoint-to-point

Multipoint-to-point case can be presented as an extended case of TCP Client.

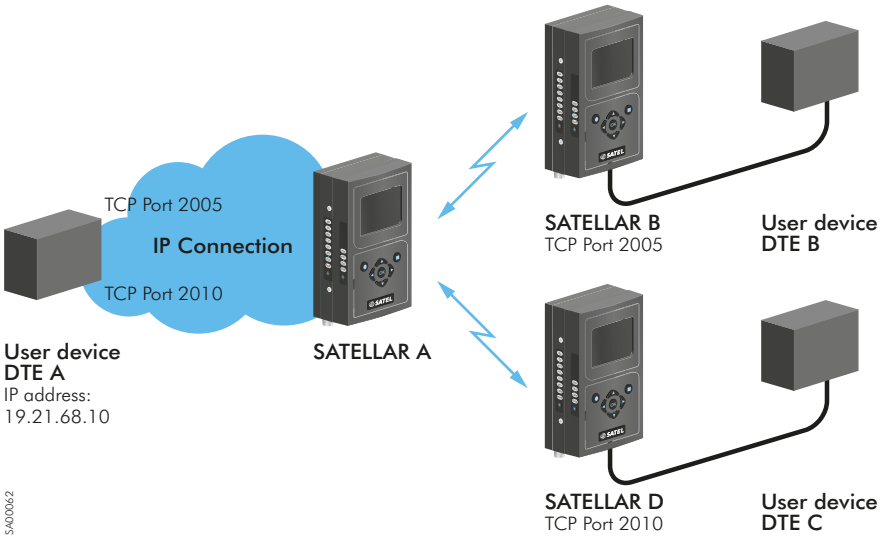


Figure 7.20 Multipoint-to-point -example

In this example the User device DTE A is capable of simultaneously listening to several ports. Both SATELLAR B and SATELLAR C are configured to send messages to User device DTE A, but to different ports. Following configuration is set to SATELLAR B and SATELLAR D, when User device DTE A has IP address 19.21.68.10:

Parameter	SATELLAR B	SATELLAR C
Mode	Client	Client
Protocol	TCP	TCP
Sending Port	2005	2010
Sender Target Address	19.21.68.10	19.21.68.10

Table 7.17 The configuration of SATELLAR B and SATELLAR C

One option for this kind of tasking is serial port virtualizing that can be done e.g. with HW VSP application: **http://www.hw-group.com/products/hw_vsp/index_en.html**

The application creates virtual serial ports which are actually IP addresses and ports i.e. user defines IP address and port combination which then creates a (virtual) serial port to system. By this way different applications can use these connections as serial ports although they are actually IP connections.

7.4.2.5UDP

UDP mode can be used similar to TCP modes with some extension.

When using UDP in Server mode and some replies are needed to send, also the target needs to be set. This concerns also the Client mode and listening of replies.

Parameter	SATELLAR B
Mode	Server
Protocol	UDP
Listening Port	2006
Sending Port	2005
Sender Target Address	19.21.68.10

Table 7.18 The conficuration of SATELLAR B

More detailed protocol explanation is in section 7.4.3.

7.4.2.6 Send or receive only

These features are limited versions of presented features. The example is similar to point-to-point.

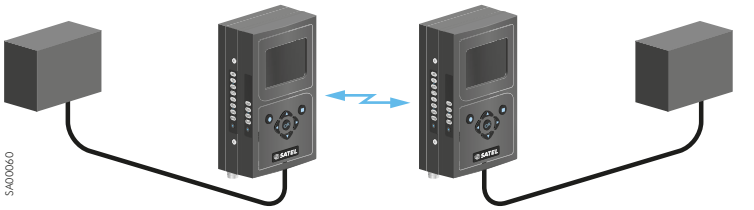


Figure 7.21 Send or receive only -example

SATELLAR A is having Tun0 IP 10.10.32.1 and SATELLAR B Tun0 IP 10.10.32.2. SATELLAR A is configured to send to SATELLAR B and SATELLAR B is configured to listening defined port.

Parameter	SATELLAR A	SATELLAR B
Mode	Send only	Receive only
Protocol	UDP	UDP
Listening Port	Irrelevant in this mode	2006
Sending Port	2006	Irrelevant in this mode
Sender Target Address	10.10.32.2	Irrelevant in this mode

Table 7.19 The conficuration of SATELLAR A and SATELLAR B

The User device DTE A can only send and the User device DTE B can only listen the messages.

7.4.3 UDP and TCP protocols

Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) are both based on Internet Protocol (IP) suite. They are used for relaying datagrams - also known as network packets – from the source host to the destination host solely based on the addresses. Packets are structured by Open Systems Interconnection (OSI) model layer principles. OSI model structures packets to different layers and TCP and UDP packets can quite simply be presented with these layers:

- Data link layer: Physical addresses i.e. source and destination MAC addresses
- Internet layer: IPv4 / IPv6 addresses and related header
- Transport Layer: TCP, UDP or similar protocol data (ports etc.) and related header
- Application Layer: Actual user data

Following tables present the structure of data. Data link layer data comes first and in the end there is frame footer. Between the frame data and footer is IP packet data. In IP packet internet layer data is first, then the transport layer i.e. protocol related data and finally actual user data.

Data Link layer

Frame header (8 bytes)	Frame data (14 bytes)	IP + UDP packet (below)	Frame footer i.e. CRC (4 bytes)

IP Packet

bits	0-3	4-7	8-13	14-15	16-18	19-31
0	Version	Internet Header Length	Differentiated Services Code Point	Explicit Congestion Notification	Total Length	
32	Identification				Flags	Fragment Offset
64	Time To Live		Protocol		Header Checksum	
96	Source Address					
128	Destination Address					
160+	Data (UDP Packet)					

UDP Packet

bits	0-7	8 – 15	16 – 23	24 – 31
0	Source Port		Destination Port	
32	Length		Checksum	
64+	Data (actual user data)			

Thus IP + UDP Packet headers are altogether 28 bytes. TCP packet is alike the UDP with some more information in TCP section such as sequence number. TCP header is thus larger (20 bytes) than UDP (8 bytes).

The difference between the protocols is the administration of packets and how the received packets are supposed to be handled. UDP is a not connection based simple transmission model without implicit handshaking dialogues for providing reliability, ordering, or data integrity. Thus, datagrams may arrive out of order, appear duplicated, or go missing without notice. UDP assumes that error checking and correction is either not necessary or performed in the application, avoiding the overhead of such processing at the network interface level. TCP on the other hand is connection based protocol which provides error checking, ordering and general reliability.

Time-sensitive applications often use UDP because dropping packets is preferable to waiting for delayed packets. Also as described above, the size of headers - i.e. packet overhead - is smaller with UDP which may make difference when the size of actual data is always small. Examples of applications using UDP are DHCP, DNS and voice and video applications. On the other hand, if error correction facilities, ordering and general reliability is needed, an application may use the TCP. Examples of using TCP are HTTP, FTP, SMTP and SSH.

7.4.4 Notes

There are some noticeable issues, which are related to serial IP functionality.

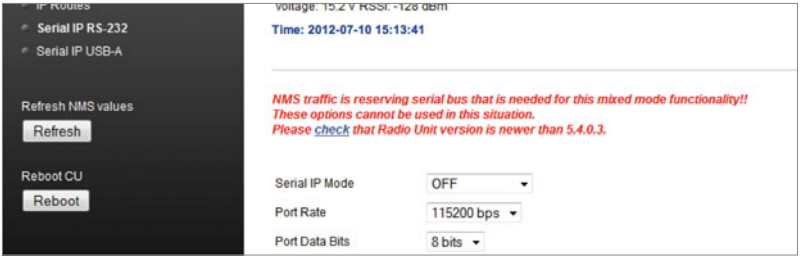
7.4.4.1 USB Serial dongle connection

Availability of USB serial connection is informed with different notes. When USB serial dongle is connected, the following text is shown in the screen: USB serial dongle connected.

If not connected, then note about interface being not available is shown.

7.4.4.2RS-232 port availability

In some occasions RS-232 is reserved and cannot be used for Serial IP functionality. Following text is displayed in such occasions.



7.4.4.3Incompatible parameter combinations

There are some parameter combination cases that can make the connection ends incompatible

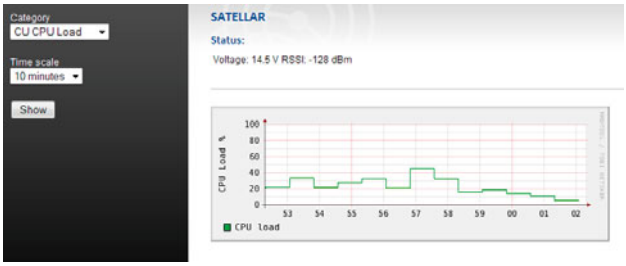
- Different protocols: It must be verified that both connection ends have the same protocol. When one connection end uses TCP and other UDP, connection cannot work.
- Compatible modes: If both ends have either send only or receive only mode on, connection does not work as assumed. On the other hand, when using send only on one end and receive only on other end, it must be verified that send only is in the end intended to send data.
- Ports and addresses: Ports and addresses must match in the setup. I.e. the sending target address and port must match with IP address of listener and the port that is opened for listening.

8. Applications

This chapter explains the additional applications available in the CU.

8.1 Diagnostics

This application is used to view graphs of measured diagnostics.



The following Diagnostics graphs are available:

Diagnostic	Explanation
CU RAM Usage	Memory used by all running processes and kernel in the CU.
CU CPU Load	Shows the percentage of CU CPU (MCU) processing power used.
NMS Timeouts	Local RU NMS message timeouts. Values higher than 0 indicate the RU is busy with data traffic and unable to answer all settings or diagnostics NMS messages sent by the CU.
RSSI	Signal strength of all received radio messages.
Temperature	As measured at the RU RF Power Amplifier. See RU User Manual for accuracy and other information.
Voltage	As measured at the RU power in connector. See RU User Manual for accuracy and other information.

Table 8.1 Diagnostics

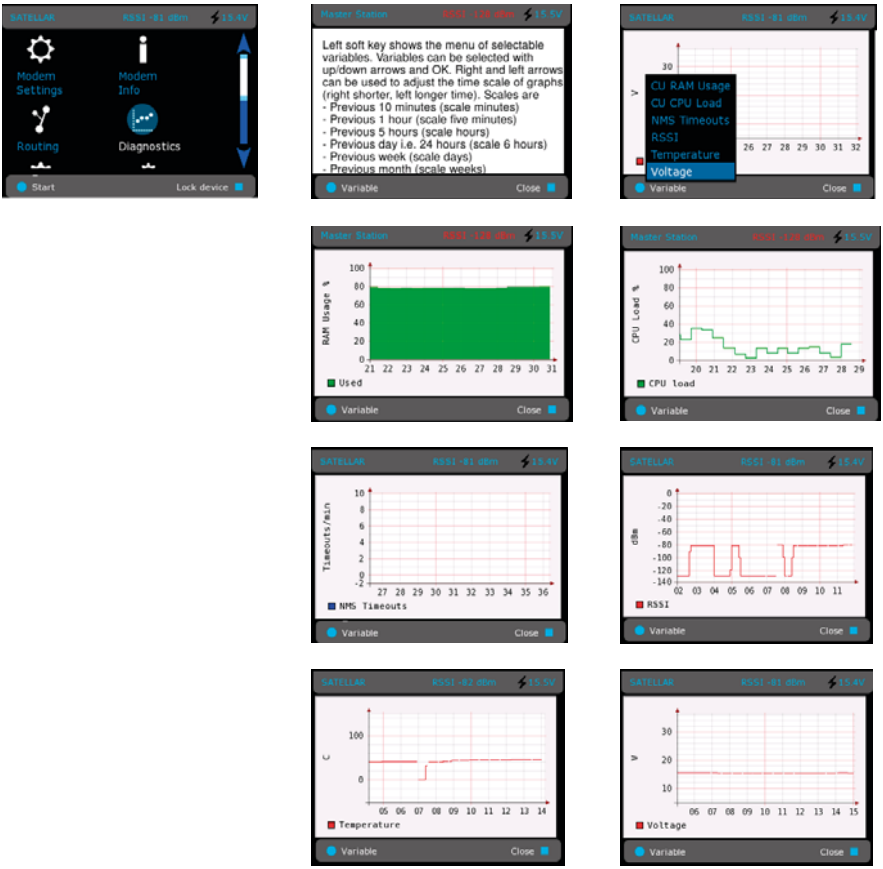


Figure 8.1 Diagnostics by CU: Graphical user interface (GUI/LCD)

8.2 Simple Network Management Protocol (SNMP)

An "Internet-standard protocol for managing devices on IP networks." It is used mostly in network management systems to monitor network-attached devices for conditions that warrant administrative attention. SNMP is simply a protocol for collecting and organizing information. SNMP itself does not define which information (which variables) a managed system should offer. Rather, SNMP uses an extensible design, where the available information is defined by management information bases .

In typical SNMP uses, one or more administrative computers, called managers, have the task of monitoring or managing devices on a network. Each managed system executes, at all times, a software component called an agent which reports information via SNMP to the manager.

Essentially, SNMP agents expose management data on the managed systems as variables. The protocol also permits active management tasks, such as modifying and applying a new configuration through remote modification of these variables.

An SNMP-managed network consists of three key components:

- Managed device
- Agent — software which runs on managed devices
- Network management system (NMS) — software which runs on the manager

Typical radio modem or system monitoring can be RSSI-values, Voltage or Temperature. Setting type configuration consists of IP- or radio parameters.

Status of SNMP application is set similarly to other CU applications i.e. in Services category.

Attribute	Explanation	Sub unit	NMSID
SNMPD State	Status of SNMP application is named as SNMPD state. Options are ON and OFF, OFF being the default.	1	3266

Table 8.2 The settings of SNMP status

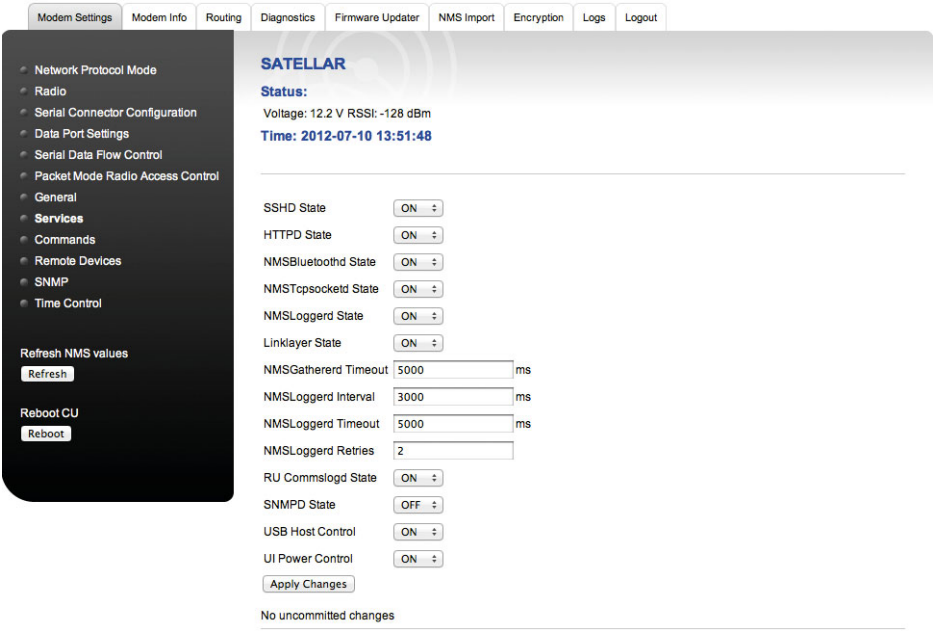


Figure 8.2 Services settings view

8.2.1 SNMP category

SNMP category includes the settings related to SNMP usage.

Attribute	Explanation	Sub unit	NMSID
SNMP RO Community	Read-only community phrase i.e. word that for reading values via SNMP. In other words, when reading something with SNMP this phrase must be used as a community word. Maximum length is 255 characters. Default RO Community phrase is 'public'	1	3241
SNMP RW Community	Read-write community phrase i.e. word that for writing values via SNMP. When writing something with SNMP this phrase must be used as a community word. RW community word can be used for reading also. Maximum length is 255 characters. Default RW Community phrase is 'private'.	1	3242
SNMP RW Community IP	Read-write community IP defines the network space i.e. scope of IPs that can use read-write options. E.g. 192.168.1.0 means IPs from 192.168.1.0 to 192.168.1.1.255. Default is 0.0.0.0 i.e. all IPs are allowed.	1	3243
SNMP Notification IP	IP where the notifications are being sent when such are available.	1	3244

Table 8.3 The settings of SNMP category

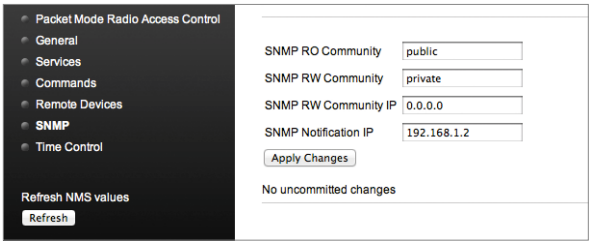


Figure 8.3 SNMP settings view

8.2.2 MIB

MIB i.e. Management Information Base is a file that is used along the SNMP to define the set of parameters that are available with SNMP. MIBs include hierarchical name space including individual parameters that called as OIDs - Object Identifiers. SATELLAR has its own MIB but it needs two SATEL generic MIBs to be able to work with typical SNMP application hierarchy mechanisms. These MIBs are available at www.SATEL.com/downloads.
Available parameters are basically the same as in GUIs and also defined similar way also (read-write or read-only). Parameters can be seen by browsing them with graphical SNMP applications after importing MIBs or e.g. with snmptranslate tool with following command.
snmptranslate -Tp -IR satel
Basic structure of MIB is following

- satelSATELLARNMS
  - satelSATELLARNMSInfo
    - satelSATELLARNMSInfoRU
    - satelSATELLARNMSInfoCU
  - satelSATELLARNMSSettings
    - satelSATELLARNMSSettingsRU
    - satelSATELLARNMSSettingsCU
  - satelSATELLARNMSRouting
  - satelSATELLARNMSCancelCommit

These follow the idea of GUIs so that NMSInfo includes same parameters as Modem Info category, NMSSettings include same parameters as Modem Settings and NMSRouting same parameters as Routing category.

CancelCommit is an individual parameter and is used for making the saving functional analog to GUIs. When setting some parameter, user stores them into temporary storage in Satellar same way as they are applied in web GUI. To store the values permanently and make them effective, CancelCommit is set to value 1. To cancel settings that are not yet stored and to clear the temporary storage, CancelCommit is set to 0.

8.2.2.1Applications, examples

NET-SNMP – Console based application for various SNMP usages.

Dude – a simple Windows-GUI application.

Spiceworks – a browser-based application.

8.3 Firmware updating

The currently installed firmware version numbers are available in the Modem Info Application, RU and CU categories.

There are three different ways to do the firmware updating:

- to use the firmware updater application in CU by the LCD GUI or in the WWW interface
- to use the USB Stick during boot CU update method
- to use the firmware update over-the-air

8.3.1 Firmware updater application

The Firmware updater application can be used to update the firmware of the RU or the CU. This application is available in the WWW interface and the LCD GUI, but the operation is slightly different. When updating the firmware using Firmware Updater, previous settings are NOT lost, unless the release notes for the new firmware specify differently.

Figure 8.4 Firmware updater by CU: Graphical user interface (GUI/LCD)

8.3.1.1 Choosing the right update file

First you must determine which firmware you are updating. It is possible to update either the RU or the CU firmware.

The RU firmware update file is named "satellar-ru.x.y.z.w.update", where "x.y.z.w" is the version number of the new firmware. Simply choose the update file, which has the version number you wish to update to.

The CU firmware update file is named "satellar_xxxxyyyy.update" where xxxx is the old firmware version number and yyyy is the new firmware version number. When updating the CU firmware using Firmware Updater, it is necessary to know the current filesystem version number, so that the correct update file can be chosen. For example, if you need to install a new firmware version satel-2863, and your current filesystem version number is satel-2775, you need an update file named "satellar_27752863.update". The current firmware version can be seen in Modem Info, CU category.

The CU firmware update file consists of two different files, the kernel image and the filesystem. Due to the relatively large size of the full filesystem image (typically 11 MB), the update includes only the changed parts of the image, so the update file size is kept to a minimum. This is called an incremental, or patch, update.

The following table illustrates the different possibilities.

Update file	Example of update file name	Images contained in the update file	Typical size, approximately	Update method
RU update file	satellar_rmu-5.3.0.2.update	RU firmware image.	300 kB	Firmware Updater
CU update file	satellar_27752863.update (typical total size: 4.3 MB)	CU kernel image.	2.4 MB	Firmware Updater
		CU file system incremental upgrade patch.	1.9 MB	

Table 8.4 Choosing the update file

8.3.1.2 Uploading the update file

When you have the correct update file on your computer, open SATELLAR WWW GUI, and go to the Firmware Updater application. Then click on the Browse… button and then locate the file using the window that opens. Then click on Send to transfer the file to SATELLAR CU.

Note that this step is NOT yet the actual update; it is just a file transfer.

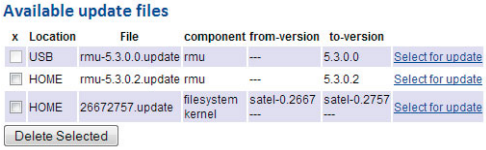
Alternatively, the update file can be placed on an USB memory stick. In the latter case, the file will become visible in the list of Available update files when the memory stick is inserted into SATELLAR's USB port and the web page is reloaded. Allow a few seconds after inserting the stick before reloading the page.

8.3.1.3 Starting the firmware update process

After a file has been uploaded or a USB memory stick containing the file has been inserted, it appears on the list of available update files.

The following image shows that three update files are available:

- A RU update file, eg. version 5.3.0.0, on the USB memory stick
- Another RU update file, eg. version 5.3.0.2, uploaded to the CU
- A CU update file, containing a filesystem patch eg. from version 2667 to 2757 and a kernel image, uploaded to the CU.



When the file is available, click "Select for update" to start the update process using that file (see chapter 8.3.1.4).

Unneeded files can be deleted from the CU by checking the checkbox in the "x" column and clicking "Delete Selected".

8.3.1.4 The firmware update process

The update process is time-consuming, but in case the update is interrupted by a power failure etc, the process can be resumed. The process can also be cancelled at any time.

First the devices to be updated must be selected. Normally choose only device 0 (local device).

Click the Start transfer -button, and you will get this message:

The progress of update is indicated by a progress bar, which is automatically refreshed with 5-second intervals. The transfer may be cancelled at any time by clicking on "Cancel transfer", and no harm will be done to the target unit.

When transfer has finished, the RU is restarted and is ready to use.

When updating a CU, it will also be automatically restarted. The restart will take longer than usual; because part of the update process takes place during the booting process. The progress of the update can be seen on the LCD screen. In case no screen is available, the STAT LED blinks while booting and updating is in progress.

The CU firmware update can last up to 10 minutes. Do NOT turn off, restart or reboot the CU during this time. IF the CU is restarted or turned off, the firmware update process fails and the previous firmware version remains in use.

After restart has completed, please check the Firmware versions from Modem Info, RU and CU categories (see chapters 8.5 and 8.4) to see that the Firmware versions have been updated to the new version.

8.3.2 USB Stick during boot CU update method

This method is completely different from the Firmware Updater application. The files used are not .update files; instead they are RAW kernel and/or file system images. The files are placed on a USB Memory Stick and renamed according to the table below. The USB stick is then inserted, and then SATELLAR is rebooted. The update is done automatically during the device boot.

The progress of the update process is displayed on the LCD screen. In case the CU is not equipped with a LCD screen, you can follow the process by the STAT LED. While the STAT LED is blinking, the update is underway.

Image updated	Files needed	File name example	Rename file name to	Approximate duration of update
kernel[1)]	kernel image	satel-0.2757_uImage	uImage	5 minutes
	signature file	satel-0.2757_uImage.sig	uImage.sig	
filesystem[2)]	filesystem image	satel-0.2757_rootfs.jffs2	rootfs.jffs2	10 minutes or more
	signature file	satel-0.2757_rootfs.jffs2.sig	rootfs.jffs2.sig	

Table 8.5 Update process

[1)] Note about kernel update using this method: After the device has booted, it must be restarted again to actually start using the new kernel.

[2)] Note about filesystem update using this method: This method removes all files AND settings, including IP settings, stored in the CU. RU settings such as Frequency are not affected. (CU settings can be identified by the sub-unit number "1"). The advantage of this method is that the previous file system version number is not needed; you can update any filesystem version over any other.

8.3.3 Firmware update over-the-air

This chapter explains how the firmware of devices in an installed, running network consisting of SATELLAR 2DS(d) and 20DS devices in Packet routing / TCP/IP mode can be remotely updated.

Both SATELLAR CU and RU firmware can be updated using this method. The method has the following steps:

- Preparation
- Transfer of files
- Update process
- Confirmation

The time taken is dependent on the relatively slow (compared to the size of the update packets) transfer speed over radio. While comparatively slow, the time may still be less than doing the updates by hand, i.e. going to the site physically and doing an USB-memory-stick update. This depends fully on the size and geography of the installed network.

8.3.3.1Preparation steps

Before starting the firmware update, make sure the following preconditions are fulfilled.

Step 1. Plan the time needed for the update process

You should plan your update process so you know the downtime of the data system beforehand and can proceed with less uncertainty.

Table 1 lists the time needed for some examples. All times are calculated without any other traffic in the radio network. (I.e. data transfer has been stopped)

Air speed	Update file size	Transfer time	Total update time per device (approximate)
38.4 kbps	4.5 MBytes	28 minutes (measured)	50 minutes
38.4 kbps	3.5 MBytes	24 minutes (approximate)	45 minutes
19.2 kbps	4.5 MBytes	45 minutes (approximate)	1 hour 10 minutes
19.2 kbps	300 kB	5 minutes (approximate)	15 minutes

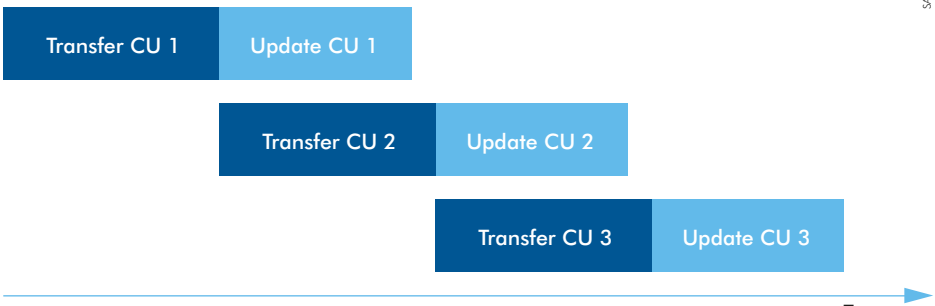
Table 8.6 Update file transmit time examples

Notes about the time needed:

Transmit time is the critical factor. Total time includes data transfer, delays such as using the WWW interface manually, which can be speeded up with a little practice, and the time taken by the CU to actually install the update, a process which is done separately from file transfer. Actually, you can stagger the process by starting the update process in one modem while the update file is being transferred to the next modem. This “staggering” method can save time. Alternatively, transfer all files first (one after the other), then update all modems at once.

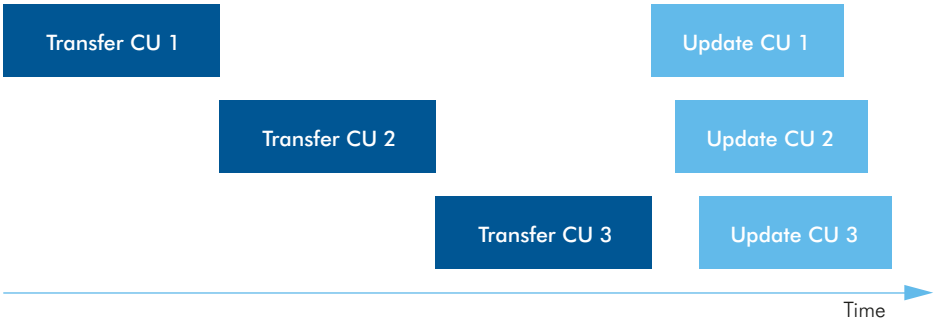
Do not start multiple uploads at the same time, as this will cause slower transfer speeds and potentially cause some transfers to fail. (It could be worth trying for overnight transfers, though)

Staggering:



SA00063

Alternative:



Step 2. Make sure there is a connection to all SATELLAR 2DS(d) and 20DS devices

You need a working TCP/IP connection to all modems. This can be confirmed by opening the WWW setup interface of each remote SATELLAR device by writing the IP address of the device in the address bar of your web browser.

The update is done via the WWW interface of each modem. The HTTP protocol used to control the update and transfer the files is running in the SATELLAR radio network. For this reason the update cannot be done if the Protocol Mode setting in your network is not set to "Packet Routing" or IP connections to all devices do not work for some other reason. You can use either the "radio IP addresses" or the "Ethernet IP addresses" of the Central Units for ping tests and WWW interface access.

If you are using a PC which is connected to other LANs or the Internet at the same time as you are connected to the SATELLAR network, you need to add a temporary IP route to your PC configuration for the purpose of connecting to the SATELLAR network. Assuming your local SATELLAR unit connected via Ethernet has IP 192.168.1.1 and your PC is 192.168.1.2 and this connection is working, you can then use this command in windows to add the temporary route:

First, start cmd.exe using administrator privileges. Then enter the following command:

```
c:\> route add 10.10.32.0 mask 255.255.255.0 192.168.1.1
```

Now you can access all SATELLARs by using their radio IP address, such as 10.10.32.2, 10.10.32.3 etc.

A simpler way is to disconnect the PC from all other networks and set your local SATELLAR unit as the default gateway. This way you don't need to use the ROUTE command.

Step 3. Organize your modems into browser tabs

This is a very useful feature in modern web browsers. If you put each SATELLAR unit's web interface into a separate web browser tab, it is easy to go through the update process. This is also helpful if using the staggering method to save time.

Step 4. Identify the current firmware versions

It is possible that your modems have different firmware versions. When the CU firmware is updated it is important to know what the current version number is. Go to "Modem info, CU" menu (See chapter 7.2.3) in the WWW interface of each of the modems and look at file system version (NMSID 1.650).

For RU firmware, the current version is not important.
If you have different CU firmware versions, it can be helpful to record the version on a piece of paper or excel sheet for easy reference while updating or you could check the version every time using the WWW modem info page.

If you transfer the wrong file to the CU you have just lost 25 minutes or more time, because the wrong update file cannot be used to upgrade the firmware!

Step 5. Gather the needed update files

See CU User Manual chapter 8.2.1 for help identifying the correct files. Make a note which files go into which modems, if your network has different versions currently installed.

Step 6. Stop all other data traffic

To speed up the file transfer and reduce the risk of transfer errors, it is recommended to stop all other traffic from your radio network while updating.

8.3.3.2 Transferring the files

Actual transfer of the .update file is done exactly as detailed in the chapter 8.2.2. Note that while the file is uploaded, there is no progress indication, other than what is provided by your web browser. Typically uploads are not tracked by web browsers, while downloads have very good progress indicators. Please be patient, and wait at least twice as long as the time mentioned in chapter 8.3.3.1 before giving up.

When one upload is complete, this screen appears:

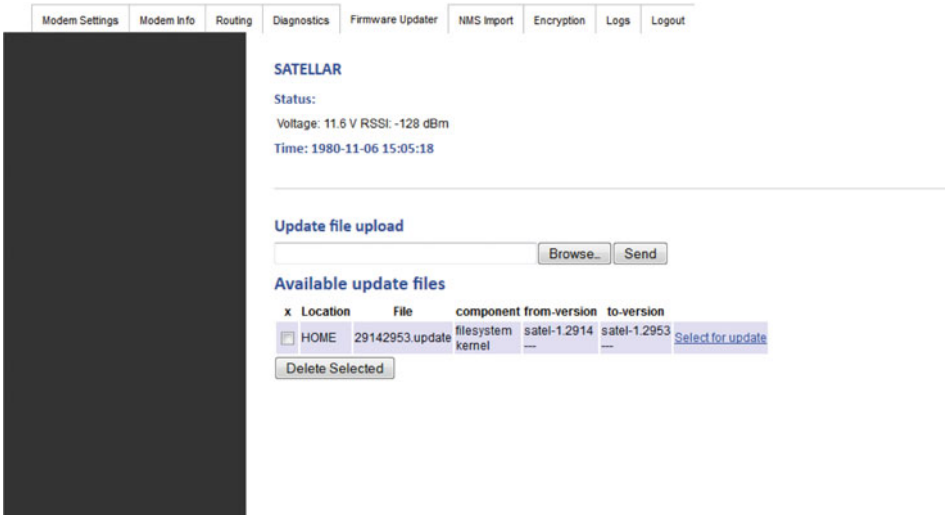


Figure 8.5 Update file transfer complete

Now you can start the update process as indicated in next chapter, and then start file upload for the next modem.

8.3.3.3 Updating

To start each firmware update, just click on the "Select for update" link text (see Figure 1) as explained in the user manual chapter 8.3.1.3, and follow instructions in chapter 8.3.1.4.
Note especially:

- Select only the target device '0'
- Update is done in two stages, "transfer" and "reboot".
  - Transfer is quick, a minute at most (Do not confuse this with file transfer)
  - Reboot, which can take more than 10 minutes for the CU. (The actual update is done at this stage)

While the firmware is being updated (about 10 minutes for CU firmware), little or no data is being sent or received, so this time can be used for transferring another update file to another modem.

8.3.3.4 Confirming the update

After 10 minutes or so, the web interface should reload automatically. You can also refresh the page manually using your browser (hit F5). Note that the modem is unresponsive while the reboot process in underway.

When the web interface is responding again, go to "Modem Info" and confirm the version number from either the "CU" or "RU" category as appropriate. You should do this step at once for all modems (by going through the browser tabs in order) as the last step of the update process. If any modem does NOT display the new version number, you should:

- Refresh the web page (press F5)
- if still old version, reboot the updated device (RU or CU)
- if still old version, retry the update (select for update, also double-check the from version is correct)
- if still old version, confirm the original .update file is valid and re-transmit, effectively doing the whole process again for the affected modem(s).

When all modems are running the new firmware versions, re-start your data traffic.
Updates do not normally change any settings, but if they do, there should be a mention of this in the release notes.

8.4 Remote settings

This application is only available in the LCD GUI. It is used to change settings of a remote SATELLAR, over the air. (The same functionality can be achieved in the WWW interface by contacting the WWW server in the target SATELLAR directly, by using its IP number. Remember that both tun0 and eth0 IP numbers can be used.)

Figure 8.6 Remote settings by CU: Graphical user interface (GUI/LCD)

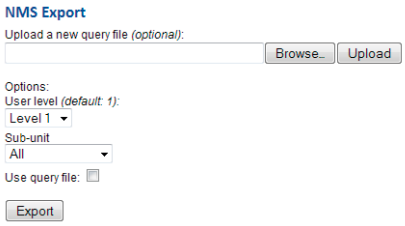
8.5 NMS Import

This application is available in the WWW interface only. It allows to export and import settings as text files. For example you can export all modem settings into a file and save it to your computer as a backup. You can also edit this file and send it back to the modem, or to another modem. The modified file could contain only one or a few settings, not all settings originally found in the file are needed. This can be used to change the same few settings to multiple modems relatively quickly. (By creating a file with just the settings to be changed, and importing it to all the modems).

8.5.1 Exporting settings from modem

When exporting settings, SATELLAR CU creates a file which contains the settings. The file can then be saved on a computer and kept as a backup, or edited using a text editor and sent back to the modem. The following procedure can be used to export all user settings from a radio station (both CU and RU).

1. Go to the NMS Import Application of WWW GUI. The page looks like this:



2. Ignore the query file, User level and sub-unit selections for now. Just click on the Export button. SATELLAR now generates the export file.
3. The new export file appears at the top of the page, under Available import files:

4. Click on “satellar_export.nmst” to download the export file to your computer.

8.5.2 NMS Export advanced features

These optional features are available:

Option	Effect

Query file	If you wish to export only some specific settings, create a text file containing only the NMSIDs, one per row, and use it as the query file. Click Browse to select the file and Upload to send it to the modem.
	
	Example query file contents:
	`1.398`
	`1.33`
	`1.80`

Use query file	Mark this checkbox to use the query file that was uploaded. The resulting export file will only contain the values of the NMSIDs that were specified in the query file.
User level	Level 1 is the normal level. Sometimes SATEL technical support may request you to export level 5 or 9 settings in case the information is needed to solve a problem. Level 5 or 9 settings cannot be changed.
Sub-unit	Choose All to export both RU and CU settings. Sub-unit 0 exports only RU settings and sub-unit 1 exports only CU settings.

Table 8.7 NMS Export advanced features

8.5.3 The export/import file contents

The export file is a text file in UNIX format. This means that the windows default text editor 'notepad.exe', does not correctly split the text into lines, instead all text appears on one long line. The file should not be edited with an editor which does not support Unix-style text. We recommend using a better text editor, such as 'Notepad++' which is freely available on the net.

The file contains a list of NMSIDs, followed by the '=' character and the value assigned to that NMSID. There are also comment rows, which usually give the name of the following NMSID and possibly the list of valid values.

Example 1:

```
#Address (RMAC)
0:1.398=1
```

The first row is a comment, identified by the '#' character. Everything on comment rows is ignored when importing. This comment tells us that the next NMSID is the address.

The next row begins with a zero, followed by a colon character ':'. The zero indicates the sub-unit is the RU (1 would be CU). Next number is the NMSID, which is '1.398'. After the equal sign '=' is the value, which is 1. The address of the RU is therefore set to 1.

Example 2:

```
#Protocol Mode
#0 = Basic-RX Priority, 1 = Basic-TX Priority, 2 = Basic-Repeater, 6 = Packet Routing
0:1.409=6
```

The two comment rows tell that this is the Protocol Mode setting, and valid choices are 0, 1, 2, or 6. The comment explains what each number means. The actual NMSID row again shows that sub-unit is 0 (RU), the NMSID is '1.409' and the current value is '6'.

8.5.4 Managing export files

You can use export files as backup to store the settings of devices in your network, so in case you need to replace the hardware, you can just import the saved settings to the new hardware. In this case it is useful to name the export files to the name of the radio station, for example.

Remember that the file extension must remain as .nmst, otherwise you are free to rename the file. Avoid using special characters in the name.

Another way to use export/import files is to create a file containing all the settings, which are common to all modems in your network. Some such settings are RX and TX frequencies (0:1.256 and 0:1.257), bandwidth, airspeed, encryption keys, network ID, TUN Base Address (1:1.3212) etc. These settings must be the same in each modem for the network to work. If you put all these settings in a single file, you can easily import it to all modems, saving time and avoiding errors caused by inputting all the settings by hand.

Another use related to the above is to copy some settings from one modem to another. In this case you should carefully edit the file after exporting, removing any settings you do not wish to modify in the target device. For example you might want to create a copy of a modem you have already configured, except for the Address and IP settings, which should remain as they are. In this case remove the relevant rows from the file before importing it to the target modem.
Always be careful of typing errors when editing the file. If any errors appear in the file, the whole import process fails (see next paragraph).

NMS Commands, such as Save User settings, Restore User settings and Reset should NOT be used in an import file.

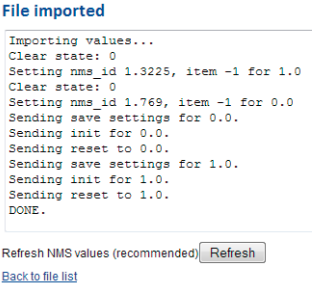
8.5.5 Importing settings to a modem

To send an import file to the modem follow this procedure:

1. Click the Browse... button under the NMS Import file upload heading, select your file in the window that opens, and finally click the Send button.

2. The file will appear under the Available import files heading. Click on the "Use file" link to import the settings.

3. The importing process result is shown in a text box.



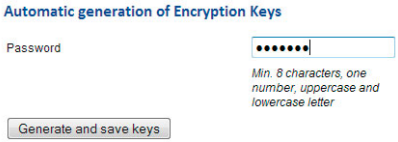
4. In case of any errors, the process stops and an error message is displayed. The error message will tell which NMS ID caused the error. For example, an error message such as this: "ERROR: Value set of 1.769/-1 for 0.0 failed" means that the NMS ID with the problem was 1.769, and the subunit was 0 (the first number in 0.0 or 1.0 is the subunit). If an error happens, NO values are saved. Fix the error and try again.

After an import, the Refresh button should be used, to fully synchronize the actual settings and those displayed by the WWW GUI.

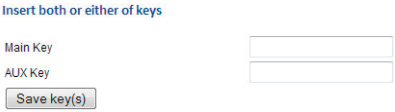
8.6 Encryption

The Encryption Application is used to set the encryption keys of the radio protocol of the RU. See the RU User Manual for information about encryption.

You have two choices to input encryption keys. The easiest way is to use a password, and SATELLAR then automatically generates encryption keys from the password. Type your password in the "Password" text field. The web page will show an indicator about how strong the password is. Then click the Generate and save keys button. The same password will always generate the same keys.



The other way to insert encryption keys is to manually insert them. This option is for power users who wish to generate keys themselves.



You can insert either one or both keys at the same time. The key that is left empty is not saved.

Note that as a security measure, the encryption keys or passwords in the device cannot be read back, but you can see a CRC checksum in Modem Info->RU, which can be used to verify if modems have the same keys inserted.

8.7 Logs

Logs are available on the WWW interface only. These can be used to debug problems. If you contact SATEL representative with a problem report, it may be a good idea to include copies of the logs in your report, or SATEL may request you to provide copies.

- Kernel Messages: Linux kernel messages
- System Messages: Linux system messages
- Service Messages: Messages of the SATELLAR Services
- RU NMS Log: internal NMS traffic between the RU and the CU

8.8 Administration

This application contains settings which are not usually needed and have a high possibility of rendering the modem inoperable if they are set into incorrect values.

To access the Administration application in the LCD GUI, select the Admin Tools icon and press Start. This application requires a PIN code.

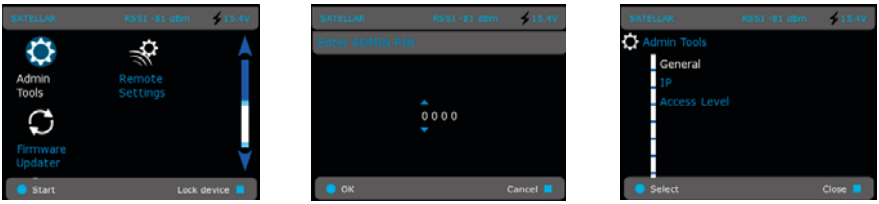


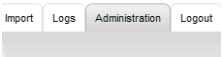
Figure 8.7 Admin tools / Access to Administration applications by CU: Graphical user interface (GUI/LCD)

LCD GUI default pin code	0000

To access Administration application in the WWW User Interface, you need to log out and log in using the admin password.

WWW username	admin
WWW default password	Satel456

After login, the WWW interface has an additional “Administration” tab.



The following setting categories are available in the Administration application.

8.8.1 General

Item	Explanation	Sub unit	NMSID
Boot Counter RU	This value indicates the number of reboots for the RU.	0	1.119
Error Report RU	The currently active error codes. If an internal error caused the unit(s) to reboot, these values will show what caused the error. In case of problems, please send a screen capture of this page to SATEL technical support.	0	1.797
Error Report CU		1	1.797
ADMIN PIN Code	Allows changing the admin pin code.	1	1.3245
Web GUI Admin Password	Allows changing the WWW interface admin password.	1	1.3260

Table 8.8 Admin tools, General

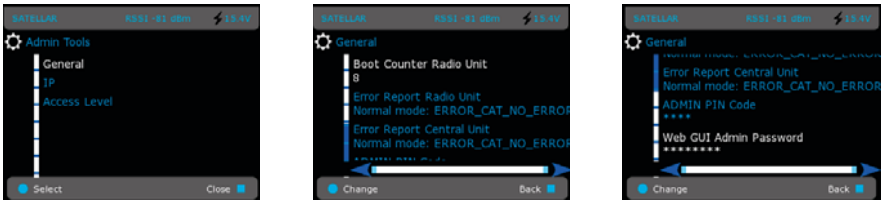


Figure 8.8 Admin tools, General by CU: Graphical user interface (GUI/LCD)

8.8.2 IP

Item	Explanation	Sub unit	NMSID
TUN Base Address	This can be used to change the IP Network address of the radio network. It must be the same in all modems of a network. Only change this if your system already uses the 10.10.32.0/19 network. The default is 10.10.32.0/19. For more information, see chapter 6.1.2.	1	1.3212

Table 8.9 Admin tools, IP

Figure 8.9 Admin tools, IP by CU: Graphical user interface (GUI/LCD)

9. Type designation

2

The labels of the CU are located on the on the back of the CU.

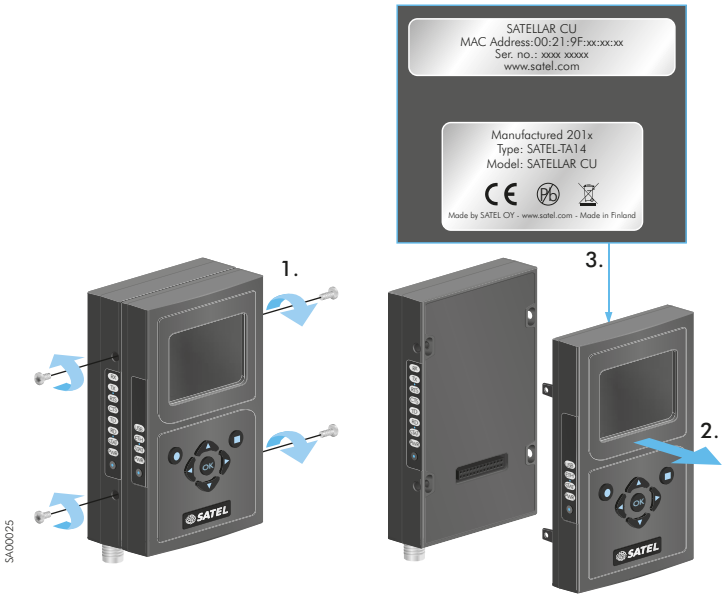


Figure 9.1 Location of the labels in CU

CU	-	1	U21	00
XX		a	bcd	ef

Field	Description
XX	Type designator of the unit, in this case CU
a	Feature designator 1: 200 MHz CPU, 128 MB flash memory, 64 MB RAM
bcd	Variant designator U21: display and keys N21: no display, no keys
ef	Interface board designator 00: USB host and device, Ethernet

Table 9.1 The type designation

10. Troubleshooting

10.1 Error codes

If the MCU detects an error in operation, it indicates the error state by LEDs in the following way:

At first all the LEDs are switched on for one second. Thereafter all the LEDs are switched off for one second and then an error code is shown for three seconds. This sequence is repeated for approximately one minute or until the MCU is restarted. In some cases the error causes the unit to restart automatically.

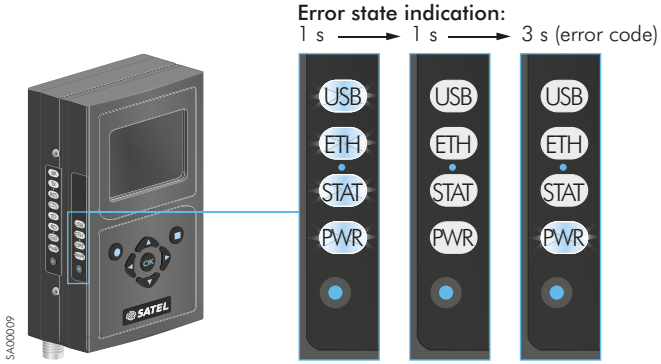


Figure 10.1 Error state and error code indicated by LEDs

For displaying the error codes the four LEDs indicates a binary number, USB LED is the first (MSB) and PWR LED the last (LSB). LED switched on means bit '1'. The error codes are the following:

	Binary	Error code	Description
	0001	1	USB over current
	0010	2	USB under voltage
	0011	3	Ethernet interface problem
	0100…1111	4…15	Reserved for future needs
	0000	0	Not used

Table 10.1 Error codes

11. SATEL open source statements

11.1 LGPL and GPL software

This SATEL product contains open source software (OSS), licensed under LGPLv2, GPLv2, GPLv3 and other licenses.

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11.2 Written offer for LGPL and GPL source code

Where such specific license terms entitle you to the source code of such software, SATEL will provide upon written request via email and/or traditional paper mail the applicable LGPL and GPL source code files via CD-ROM for a nominal fee to cover shipping and media charges as allowed under those respective licenses.

Contact SATEL Technical support for more details: Please visit http://www.satel.com.

12. Settings selection guide

2

12.1 Modem Settings

Menu	Submenu	Value (* = default)
Network Protocol Mode	NetID	Satel NG * (max 8 characters)
	Address (RMAC)	0001 * (1 - 4093)
	Protocol Mode	Basic-RX Priority
		Basic-TX Priority
		Basic-Repeater
		Packet Routing *
Radio	TX Frequency	460.000000 MHz (Depends on hardware configuration)
	RX Frequency	460.000000 MHz (Depends on hardware configuration)
	RF Output Power	100 mW
		200 mW
		300 mW
		400 mW
		500 mW
		600 mW
		700 mW
		800 mW
		900 mW
		1000 mW *
	Signal Threshold	-114 dBm *
	Over.the-Air Encryption	OFF * / ON
	Forward Error Correction	OFF, Half FEC, Two-thirds FEC
	Channel Spacing	12.50, 25.00 kHz *
	Air Speed	9600, 19200 *, 28800, 38400 bps
		with 25kHz Channel Spacing
		4800, 9600, 19200, 28800 bps
		with 12.50 kHz Channel Spacing
Serial Connector Configuration	Radio Unit Port Assignment	NONE
		MCU UARTS TO SATBUS *
		DATA UART TO RADIO D9 RD/TD
		DATA UART TO RADIO D9 RD/TD - NMS TO D9 DTR/DSR
		DATA UART TO RADIO D9 RD/TD - NMS TO D9 RTS/CTS
		DATA UART TO RADIO D9 RD/TD - NMS TO SATBUS
		MCU UARTS TO SATBUS CAN
	DTE Port Physical Communication Mode	RS232 (In models RU-xxxx00)
		RS422, RS485, FD-RS485 (In models RU-xxxx01)

Menu	Submenu	Value (* = default)
Data Port Settings	Rate	1200, 2400, 4800, 9600, 19200 *, 38400, 57600 BPS
	Data Bits	7, 8 bits *
	Parity	No Parity Check *, Even, Odd
	Stop Bits	1 bit *, 2 bits
Serial Data Flow Control	TX Delay	0 * (0 - 65535)
	CRC	OFF / ON *
	Handshaking CTS Line	Clear To Send, TX buffer state *, RSSI Treshold, Always ON
	Handshaking RTS Line	Ignored *, Flow control, Reception control
	Handshaking CD Line	RSSI treshold *, Data on channel, Always ON
	Pause Length	3 bytes * (3 - 255)
	Maximum Number of Accepted Errors	0 * (0 - 255)
Packet Mode Radio Access Control	Network Topology	Point-to-point *, Repeater, Fast mode
	Retransmissions	OFF / ON *
	Back Off Counter	8 * (4 - 63)
General	Name	SATELLAR * (1 - 30 characters)
	PIN Code	0000 * (4 numbers: 0000-9999)
	Temperature Unit	Celsius *, Fahrenheit, Kelvin
	UI Voltage Critical Level	9 V * (9 - 30 V)
	UI RSSI Critical Level	-110 dBm * (-100 - -118 dBm)
	UI Voltage Display Mode	Numeric * / Bar
	UI Voltage Bar Min	9 * (9 - 30 V)
	UI Voltage Bar Max	30 * (9 - 30 V)
	PIN Code Required	No * / Yes
	USB Device Mode	Serial Port * / Mass Memory
	Display Brightness	255 * (0 - 255)
	Web GUI Password	Satel123 * (8 characters)
	GUI Color Profile	Blue / Black *
	LCD Timeout	2560 s * (1 - 65535 s)
Services	SSHD State	OFF / ON *
	HTTPD State	OFF / ON *
	NMSBluetoothd State	OFF / ON *
	NMSTcpsocketd State	OFF / ON *
	NMSLoggerd State	OFF / ON *
	Linklayer State	OFF / ON *
	NMSGathererd Timeout	5000 ms * (1000 - 65535 ms)
	NMSLoggerd Interval	3000 ms * (1000 - 65535 ms)
	NMSLoggerd Timeout	5000 ms * (1000 - 65535 ms)
	NMSLoggerd Retries	2 * (0 - 10)
	RU Commslogd State	OFF / ON *
	SNMPD State	OFF / ON
	USB Host Control	OFF / ON *
	UI Power Control	OFF / ON *

Menu	Submenu	Value (* = default)
Commands	Restore Default Factory Settings Radio Unit	Do not reset / Reset
	Restore Default Factory Settings Central Unit	Do not reset / Reset
	Reset Radio Unit	Do not reset / Reset
	Reset Central Unit	Do not reset / Reset
	Reboot Central Unit	Do not reboot / Reboot
	Statistical Counters Clear	Do not clear / Clear
Remote Devices	Pre-Cache All Settings of Device	OFF * / ON
SNMP	SNMP RO Community	public
	SNMP RW Community	private
	SNMP RW Community IP	0.0.0.0
	SNMP Notification IP	192.168.1.2
Time Control	Time Operation Mode	No time operation *, Manual time operation, NTP time
	NTP Server Address	192.168.1.1 *
	NTP Interval	100 s *
	Time	1980-02-01 00:00:00 * (format YYYY-MM-DD hh:mm:ss)
	Time Zone	Greenwhich Mean Time *
		Central European Time (GMT+1)
		East European Time (GMT+2)
		Moscow Time (GMT+3)
		Iran Standard Time (GMT+3:30)
		Iran Daylight Saving Time (GMT+4:30)
		Mauritius Time (GMT+4)
		Afganistan Time (GMT+4:30)
		Pakistan Time (GMT+5)
		Indian Standard Time (GMT+5:30)
		Nepal Time(GMT+5:45)
		Bhutan Time(GMT+6)
		Myanmar Time (GMT+6:30)
		Bangladesh Standard Time(GMT+7)
		China Standard Time(GMT+8)
		Apo Island Time (GMT+8:15)
		Australian Central Western Standard Time (GMT+8:45)
		Japan Standard Time (GMT+9)
		Australian Central Standard Time(GMT+9:30)
		Australian Eastern Standard Time (GMT+10)
		Australian Central Daylight Time (GMT+10:30)
		Vanuatu Time (GMT+11)
		New Zealand Standard Time (GMT+12)
		New Zealand Daylight Time (GMT+13)
		Chatham Island Standard Time (GMT+12:45)

Menu	Submenu	Value (* = default)
		Chatham Island Daylight Time (GMT+13:45)
		Line Island Time (GMT+14)
		Baker Island Time (GMT-12)
		Samoa Standard Time (GMT-11)
		Hawaiian Standard Time (GMT-10)
		Marquesas Island Time (GMT-9:30)
		Alaska Standard Time (GMT-9)
		Pacific Standard Time (GMT-8)
		Mountain Standard Time (GMT-7)
		Central Standard Time (GMT-6)
		Eastern Standard Time (GMT-5)
		Venezuela Standard Time (GMT-4:30)
		Atlantic Standard Time (GMT-4)
		Atlantic Daylight Time (GMT-3)
		Newfoundland Standard Time (GMT-3:30)
		Newfoundland Daylight Time (GMT-2:30)
		Brazilian Standard Time (GMT-3)
		Brazilian Eastern Standard Time (GMT-2)

12.2 Routing

Menu	Submenu	Value (* = default)
Packet Routing Tables	see chapter 7.3.1	
IP	IP Address (eth0)	192.168.2.1/24 *
	QoS Set	ignored
	DHCP State	OFF * / ON
	Ethernet Speed	Auto *, 10 Mbps, 100 Mbps
	Automatic IP State	OFF * / ON
	Ethernet Duplex	Full * / Half
	IP Queue Max Time Length	15000 ms * (1 - 65535 ms)
	IP Queue Max Packets	30 * (1 - 65535)
IP Routes	see chapter 7.3.3	

12.3 Administration

2

Menu	Submenu	Value (* = default)
General	ADMIN PIN Code	0000 * (0000 - 9999)
	Web GUI Admin Password	Satel456 * (8 characters)
IP	TUN Base Address	10.10.32.0/19 *

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