Installation of a GEONETCast terminal

Hardware and software setup guide

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1 Introduction

This document shall serve as a systematic guideline to assist during the process of the construction of a GEONETCast receiving terminal. Therefore, it deals with the selection of suitable and obligatory terminal hardware and the installation, connection and configuration of the hardware elements. On the software side, this guide continues with software downloads, installation and configuration in order to gain GEONETCast-data through the constructed terminal. Finally, an insight in the use of the free GIS-software "ILWIS Open" is given with examples to extract information from the received data for further applications.

This guide is based on the reception of EUMETSAT's contribution to GEONETCast called EUMETCast-Europe, which is broadcasted by the EUTELSAT-10A communication satellite and covers regions as shown in Figure 1-1.
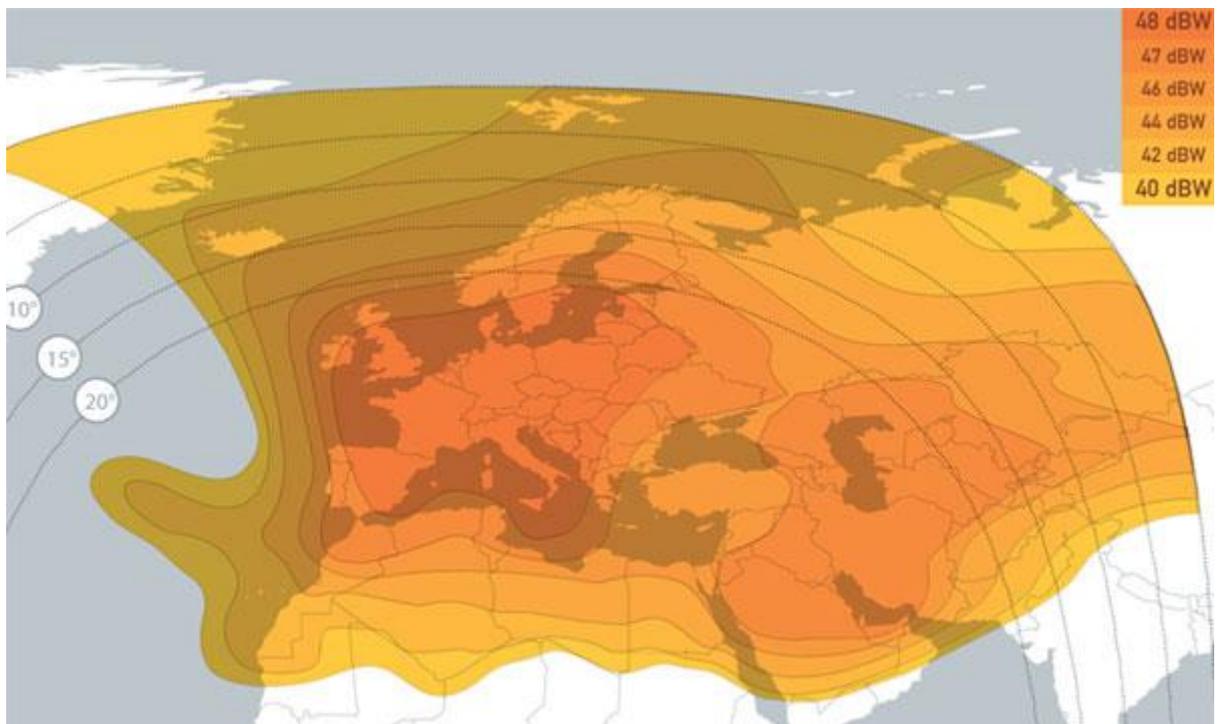
Figure 1-1: EUTELSAT-10A Ku-band EUMETCast footprint (Ku-band)

2 Selection of hardware

As an important beneficial feature of the GEONETCast dissemination service, it allows the installation of a ground receiving station with a low technical and financial effort. Hence, the use of widely available consumer hardware within GEONETCast terminals has been established.

The list of needed hardware components consists of the following basic elements:

- Parabolic dish antenna with LNB
- DVB-S2 receiver
- Desktop-PC (incl. monitor and peripheral devices)
- Cables and mounting elements

This chapter covers the selection of these components based on technical requirements for EUEMTCast reception, gives examples for concrete suitable hardware models and describes their integration and installation in the ground station.

2.1 Parabolic antenna

### 2.1.1 Determination of the antenna diameter

The first receiving component is a parabolic dish antenna, as used for satellite television reception. The technical requirement to consider is the dish diameter. The minimum diameter depends on the geographical location of the terminal (in turn depending on the local weather patterns and satellite coverage) and the kind of the dissemination service within EUMETCast (either Basic Service or High Volume Service).

Currently (as at March 2015), only the Basic Service is operational. The High Volume Service is currently operated as a test stream, but shall provide higher data rates (by a factor of about 1,5) than the Basic Service in the future. Because of the higher data rates and a more complex modulation of the data signal, the High Volume Service requires antenna diameters that are by a factor of roughly 1,8 larger than the antennas for the Basic Service reception. [1]

EUMETSAT provides geographical plots showing the signal availability for different antenna diameters (from 0,9m to 4,5m) and for Basic as well as High Volume Service, so the user can select a suitable antenna diameter:

http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_EUMETCAST_E10A_ANTENNA&RevisionSelectionMethod=LatestReleased

The figures below are an excerpt of the plots from this document:
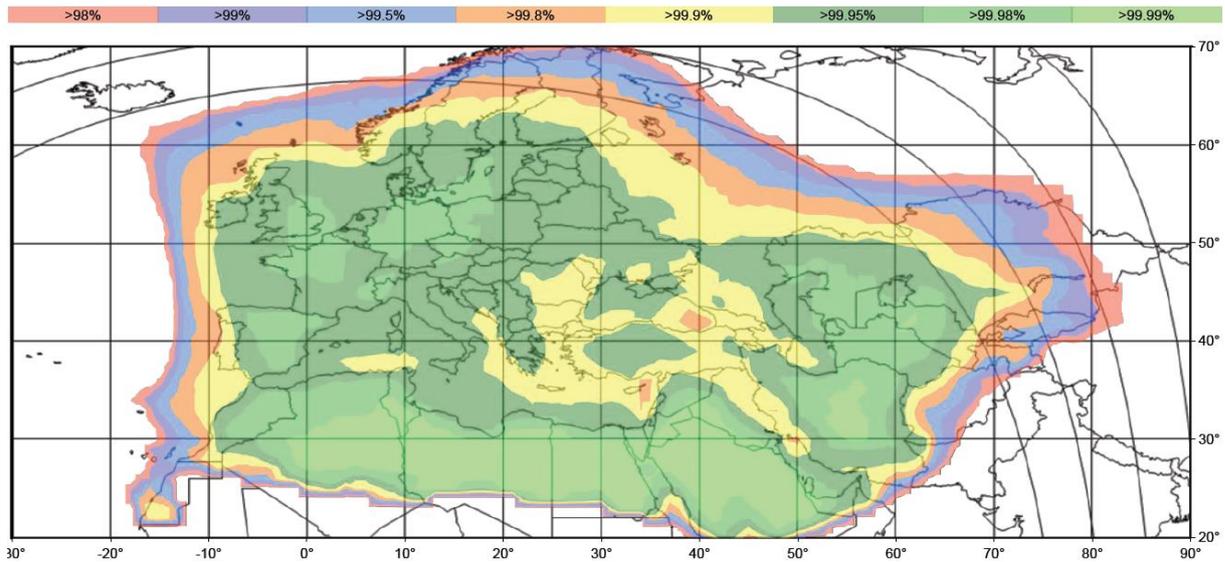
Figure 2-1: EUMETCast Basic Service - 0,9m reception antenna rain fade availability
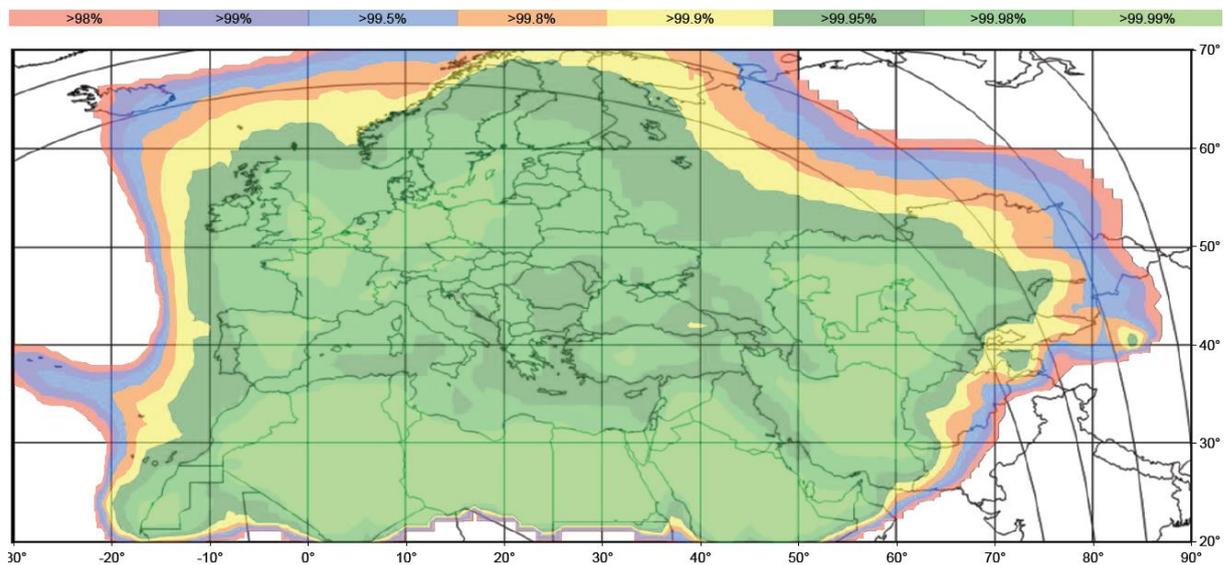
Figure 2-2: EUMETCast Basic Service - 1,2m reception antenna rain fade availability

The "rain fade availability" states the average availability of the satellite data signal over a year. For example, the availability of 99,90% means an average total data loss of 8,76 hours over a year. EUMETSAT suggests professional users to aim for an availability rate of 99,98% [1].

2.1.2 Requirements for the LNB

The reception of EUMETCast requires a universal LNB (low-noise block) with support for frequencies from 10,7 to 12,75 GHz (Ku-band) and H/V polarisation. An LNB with a low noise figure (below 0,6 dB) is desirable. Most current HD-compatible LNBs offer these specifications.

If the antenna shall provide the data signal for just one single GEONETCast terminal, an LNB with a single cable output (Single-LNB) is sufficient.

2.1.3 Antenna stand/mount

A solid stand of the antenna is important in order to be constantly pointed at the broadcasting satellite and to receive the data signal. Usually, either a ground stand or a wall mount is used depending on the receiving antenna site. Please read about the general requirements to the antenna site in the next chapter prior to a permanent installation of the antenna stand/mount.

For the installation of the antenna on a flat surface (i.e. a flat roof, balcony or front yard), a ground stand can be used. The stand shown in Figure 2-3 below requires four additional flagstones for a stable foundation.

If an accessible wall with a suited orientation in the approximate direction of the satellite is available, a wall mount can be used. The minimal length of the horizontal mount bar depends on the pointing angle of the antenna in relation to the wall plane. It has to allow the alignment of the antenna to the satellite without contact of the antenna dish and the wall surface.

The diameters of the vertical bar and the mount grip hole of the antenna shall fit each other and are usually around 5cm.

Figure 2-3: Ground stand for a satellite dish antenna
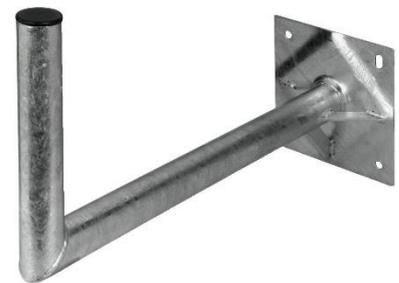
Figure 2-4: Wall mount for a satellite dish antenna

2.2 DVB-S2 receiver

To be able to receive and decode GEONETCast data properly a suitable DVB-S2 receiver is needed. There are strict requirements to receivers as stated by EUMETSAT:

Table 2-1: Generic requirements for the EUMETCast Europe DVB-S2 reception devices

Parameter	Value
Standard	DVB-S2
Symbol Rate	Up to 33 MSps

Modulation parameters	QPSK, 8PSK and 16APSK including all defined FEC codes for these modulations
Coding parameters	VCM (Variable Coding and Modulation), Multiple Transport Streams, MPE (Multiprotocol Encapsulation), minimum two MPE transport streams using the same ISI (Input Stream Identifier)
Number of PIDs	A minimum of 6 PIDs for the Basic Service and a minimum of 2 PIDs for the High Volume Service. (The total number of PIDs on one transponder will not exceed 8.)
Output bandwidth	A maximum output IP bandwidth of 50Mbit/s for the Basic Service and up to 80Mbit/s for the High Volume Service

To ensure complete functioning of a receiver it is highly advised to use a receiver, which has been tested and approved by EUMETSAT. The corresponding list of receivers (incl. set-up guides) is available online and is constantly being complemented by further suitable models:

http://www.eumetsat.int/website/home/TechnicalBulletins/EUMETCast/DAT_2082113.html

In this document, the use of the DVB-S2 receiver "Ayecka SR1" will be described. It is an approved and well documented device, which also offers support for the High Volume Service.

2.3 Computer hardware

In the following section, a terminal configuration using one single PC will be described. The computer will be used for both, receiving EO data and processing it when needed. This is the most cost-efficient set-up. However, the terminal can be optionally complemented later with a further PC to separate the tasks of receiving and processing with the goal to create a more reliable data reception.

Current middle-class PC hardware is sufficient. Minimum recommended parameters are 6GB of RAM, 1TB hard drive, Intel i3/i5 multicore CPU or equivalent, Ethernet-port, USB-port, graphics-card with HDMI-port and support for multiple screens.

Thereby, the amount of the hard drive storage space highly depends on the selected products and archiving time you want to use. 1TB will not be enough to receive the whole data stream of GEONETCast at once. The EUMETCast Product Navigator at http://navigator.eumetsat.int is a database listing every product in GEONETCast and also contains information about the file-names, reception frequencies and average file size. Use the extended search to find desired products. For example, the Meteosat SEVIRI image data of its 12 spectral channels with a reception frequency of 15 minutes takes up approx. 220GB at an archiving time of 1 month. Also, keep in mind that hard drive space is also occupied by the operating system, software and data processing outputs.

A part of the RAM space will be separated later for the use as a RAM-disk. It will allow the GEONETCast client application (TelliCast) to use this virtual hard drive for buffering incoming data, which is a critical operation requiring high access rates to the memory.

3 Installation and configuration

3.1 Antenna and cabling

The used antenna position has to offer a completely free sight of the antenna to the received satellite-data of EUTELSAT 10A. Any obstacles, like trees, branches and walls can cause reception problems.

To determine the direction at which the antenna will be pointing, the online resource on www.dishpointer.com can be used to calculate the desired angles. Enter your local position in the first text field, press "Go!" and it will be searched using Google Maps and shown in a map below. The green pointer on the map represents your antenna position. You can move the pointer adjust it exactly to your site. Select the satellite, which shall be received ("10E EUTELSAT 10A") from the dropdown-list above the map. The calculated angles are then displayed underneath the map ("Dish Setup Data"). The azimuth is the angle to rotate the dish around its vertical axis starting from the north. Use a compass to find this direction. The elevation is the angle from the horizon upwards. A scale to adjust the elevation-value is located at the antenna mount itself. The LNB skew is an angle by which the LNB should be rotated starting from a vertical position. Looking at the front of the LNB, positive values mean a clockwise rotation and negative skew values result in a counter-clockwise rotation of the LNB.

With this coordinates, you know exactly where the satellite is positioned and therefore where to point the antenna while avoiding obstacles on the sight line. If you find multiple options for the antenna location decide by practical matters where to place it, for example with a short distance to the terminal, a save environment and easy accessibility. The elevation of the antenna is insignificant.

After you have installed and pointed your antenna, further pointing adjustments will be needed at a later point with the actual incoming signal quality in mind. This will be described in this document after the PC and receiver configuration.

Place the LNB in the antenna's retaining bracket at the focus point of the antenna and tilt it according to the LNB skew angle.

Figure 3-1: Elevation scale markers on the antenna's mount grip
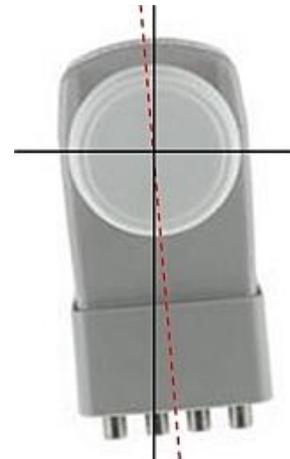
Figure 3-2: Exemplary LNB skew tilt of approx. -10°

Use a coaxial cable with F connectors to connect one end to the LNB output and place the other end near the Ayecka SR1 receiver. The cable length should not exceed 20m to avoid signal loss.

3.2 DVB-S2 receiver

Figure 3-3: Interfaces of DVB-S2 receiver Ayecka SR1 (top: front, bottom: back)

The SR1 uses an Ethernet interface (RJ45) to transmit incoming satellite data traffic to the computer. To access the management user interface of the receiver and to be able to perform an automatic configuration for EUMETCast reception from the EUTELSAT 10A satellite, it is useful to establish a USB-connection of the receiver with the PC.

The device uses a serial UART-interface for the USB connection. Therefore, download and install the driver „CP210x Virtual COM Port" (VCP) by Silicon Labs from the following URL:

https://www.silabs.com/Support%20Documents/Software/CP210x_VCP_Windows.zip

Proceed as follows when connecting the interfaces:

1. Connect the coaxial cable from the LNB output to the "**RF1**" input of the SR1.
2. Connect an Ethernet port of the terminal computer to the "**Traffic**" port of the SR1 using a network cable.
3. Connect a USB port of the terminal computer to the "**Control**" port of the SR1 using a mini-USB cable.
4. Connect the power supply block to the receiver's power interface labelled "**12V 2A**".

The power LED of the SR1 should blink between green and red and finally remain green.

In your Windows OS, go to the "Control Panel" and in the category "Hardware and Sound" open the "Device Manager". Wait a few minutes for the computer system to recognize the device and allocate its drivers. Then, verify that you find "**Silicon Labs CP210x USB Bridge (COM<n>)**" listed in the Device Manager. Right-click and open the "Properties" of the device. Open the "Port Settings" tab and configure the settings as shown below.
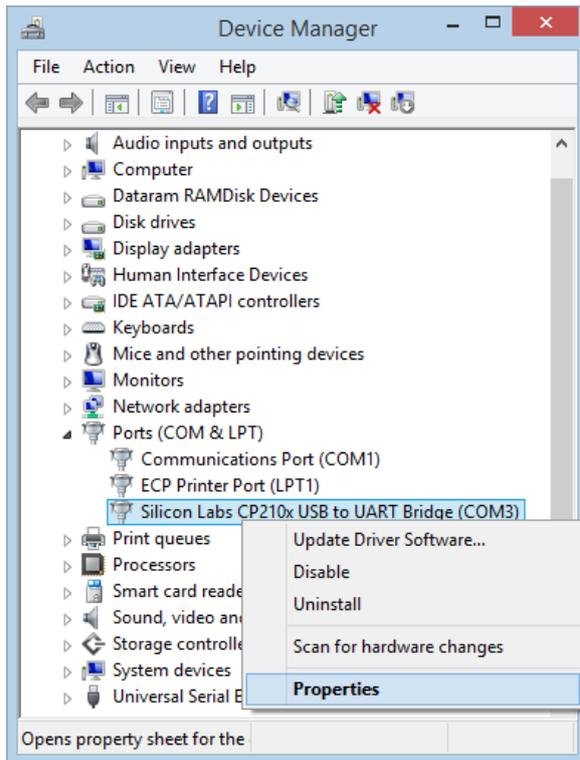
Figure 3-4: Device Manager with recognized COM port device
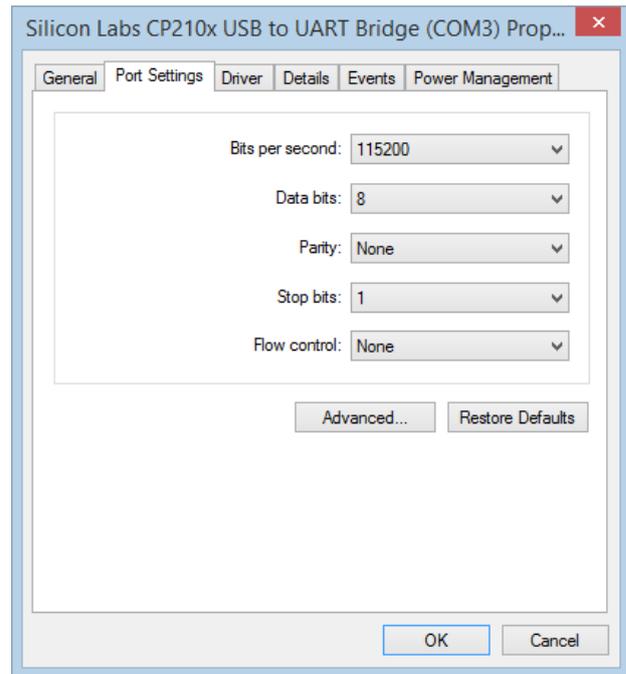
Figure 3-5: Virtual COM port settings

3.2.1 EUMETCast satellite reception configuration

If your receiver did not come preconfigured and has to be configured for the EUMETCast DVB-S2 reception from EUTELSAT-10A, an automatic configuration tool "SR1CFG" of EUMETSAT can be used:

ftp://ftp.eumetsat.int/pub/OPS/out/user/EUMETCast_Support/EUMETCast_Licence_cd/Windows/DVB_devices/SR1/SR1_Configuration_Files/

Download the file named "SR1CFG_DVBS2_ACTIVE_CONNECTED_MNGT-MLCST-ON_HVS-DSBLD" and unpack the archive. The included text-file "sr1cfg.cfg" contains the configuration set.

Proceed as follows to perform the automatic configuration:

1. Make sure the connections of the SR1 are established as stated above in 3.2.
2. Unplug the power cable and plug it in again.
3. Wait for the power LED to become and stay green.
4. Run the executable file "SR1CFG.exe" to start the configuration utility and follow the on-screen instructions.

Notes:

- For the configuration utility, it is required that the ".NET-Framework" is installed. With Windows 7 and later versions of Windows, it comes preinstalled by default. If it is missing on your system, download and install the latest version from: http://www.microsoft.com/net/downloads

- If the automatic configuration is taking too long (more than 5 minutes), stop SR1CFG unplug the receiver from power, plug it back and run "SR1CFG.exe" again.
- The applied automatic configuration may sometimes differ from the expected configuration due to communication issues.

## 3.2.2 Access to the receiver UI with PuTTY

To name a few features of the UI of the receiver, it allows to check and edit its satellite-configuration, IP-settings of the Ethernet-ports and to monitor signal parameters.

Download the open source console application "PuTTY" from http://www.putty.org/ and open the program.

On the left part of the "PuTTY Configuration" window, select the Category "Terminal" and change the settings as shown in Figure 3-6. Afterwards, select the Category "Session" and fill in the text-area "Serial line" with the COM-port name according to your settings in the device manager (Figure 3-4). Change the other settings to comply with Figure 3-7. Finally, enter "SR1" to the text-area under "Saved Sessions" and click "Save" to save the settings-profile in PuTTY.
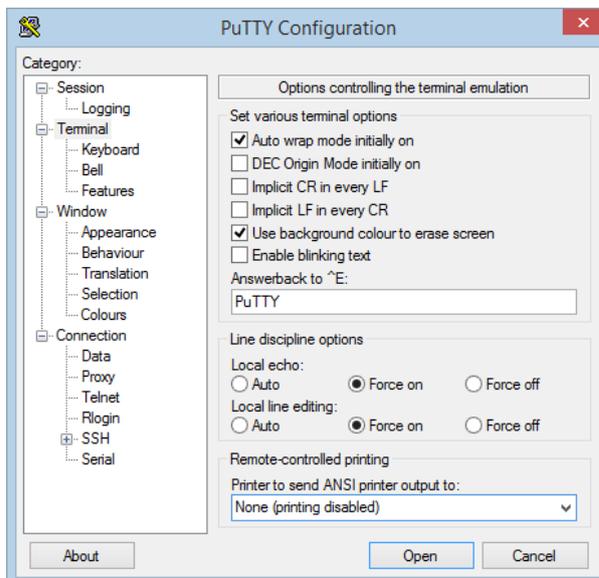
Figure 3-6: PuTTY configuration, "Terminal"
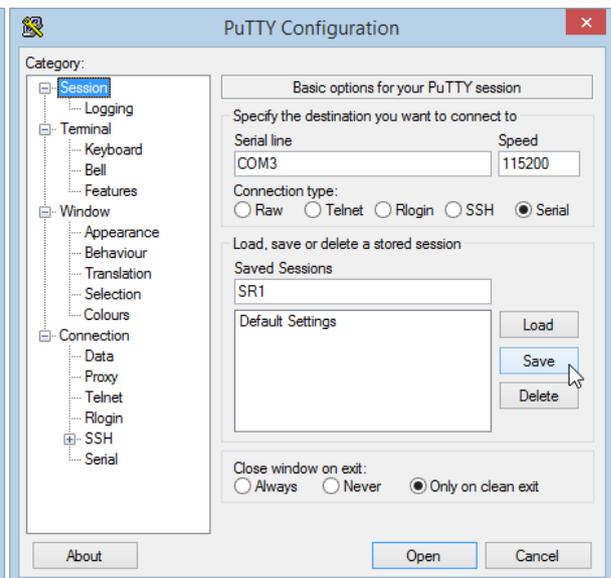
Figure 3-7: PuTTY configuration, "Session"

After you have configured the connection settings, select the saved session "SR1" and click "Open". In the opened console, type "0" (zero) and confirm with the enter-key to access the UI:

```
================================================================================
SR1c Serial No. 111700 30AAC Run Time: 2:38:47
Software Version 1.05b255 Hardware Version 2.00 Firmware Version 2.02b922

RX1: Active, Locked
 EUMETCast DVB-S2 1513.000 MHz, DVB-S2 8PSK 3/5, 32.994 Msps, ACM, 10.2 dB

RX2: Not Active, Not Locked
 Profile 1 1100.000 MHz, Auto


================================================================================


1. Configuration
2. Status
3. Network
4. System
5. Statistics
6. ACM Client
```

Navigate by typing in the number or letter of the interested category/setting. Use the number zero to navigate back.

At a later point for further terminal PC configuration, it is important to know the IP-parameters of the receiver. Enter the "3. Network" menu of the receiver and note the "Management IP Address" and "LAN IP Address". Below, you will find the default SR1 network configuration set by the automatic configuration utility from 3.2.1. These settings should be equal to yours:

```
Network
=======


1. Management IP Address        192.168.10.99
2. Management IP Mask           255.255.255.0
3. Management Ethernet Address  CC-F6-7A-04-CA-BA
4. Management IP Multicast      Off
5. Management DSCP              0
6. Management VLAN ID           0
7. Management Default Gateway   0.0.0.0
8. Management DHCP Client        Off            (for a fixed IP address)
9. Management Port State        Enabled

A. LAN IP Address               192.168.10.102
B. LAN IP Mask                  255.255.255.0
C. LAN Ethernet Address         CC-F6-7A-04-CA-B9
D. LAN IP Multicast             On
E. Router IP Address            192.168.10.101
F. LAN DHCP Client              Off
G. ARP Management

H. Air IP Address               192.168.1.161
I. Air Ethernet Address         CC-F6-7A-04-CA-B8
J. Isolate Networks             Connected      (for management access through "Traffic" port)
```

3.2.3 Verify lock and reception signal quality

Return to the main menu and verify the RX channel has locked as shown below.

```
================================================================================
SR1c Serial No. 111700 30AAC Run Time: 2:39:47
Software Version 1.05b255 Hardware Version 2.00 Firmware Version 2.02b922


RX1: Active, Locked
 EUMETCast DVB-S2 1513.000 MHz, Dummy PLframe, 32.994 Msps, ACM, 10.2 dB


================================================================================
```

To view the signal quality parameters, go to "2. Status", "1. RX Channel 1":

```
RX Status 1, Configuration 2
============================
1. Tuner Status                    Locked
2. Demodulator Status              Locked
3. Transport Status                Locked
4. Demodulator Frequency Offset    -10556 KHz
5. Demodulator Es/N0               10.3 dB
6. Signal Input Level              -35.0 dBm
7. Demodulator BER                 0.00 e-7
8. Bad Frame Count                 10908
9. Bad Packet Count                35511
A. Demodulator Link Margin         4.4 dB
B. Modulation Order and Code Rate  DVB-S2 8PSK 3/5
C. Link Adaptation                 ACM
D. Pilots                          On
E. Frame Type                      Normal
F. Roll Off                        20%
G. FPGA                            Loaded
```

You can also view reception quality of the DVB data stream at the submenu "5. Statistics", „1. Show RX1 Transport Statistics".

For more information including further configuration scenarios, a guide on SR1 software upgrades, and possible issues, you can refer to the "Ayecka SR1 DVB Receiver EUMETCast Setup Guide" by EUMETSAT:

http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_DVB_SR1_GUIDE&RevisionSelectionMethod=LatestReleased

3.2.4 Fine-tuning the antenna pointing direction

Pointing the antenna using a compass for setting the azimuth and the mount scale for the elevation as described in 3.1 usually is not precise enough for a satisfying reception quality.

With the configured SR1 outputting information on the actual signal quality as described in 3.2.3, it is necessary to further adjust the antenna pointing to optimise the signal quality.

There is an application by Ayecka, which outputs these quality parameters from the SR1's management UI on a graphical console. Download "Sr1Control.jar" from the following link:

https://github.com/AYECKa/SR1Control

It connects to the management IP (192.168.99) of the SR1 to gain the data. If you have followed the aforementioned instructions (network settings from 3.2.2; connected SR1 "Traffic" port), the application will be able to connect to the receiver.

An installation of the "Java Runtime Environment" is required to run this application.
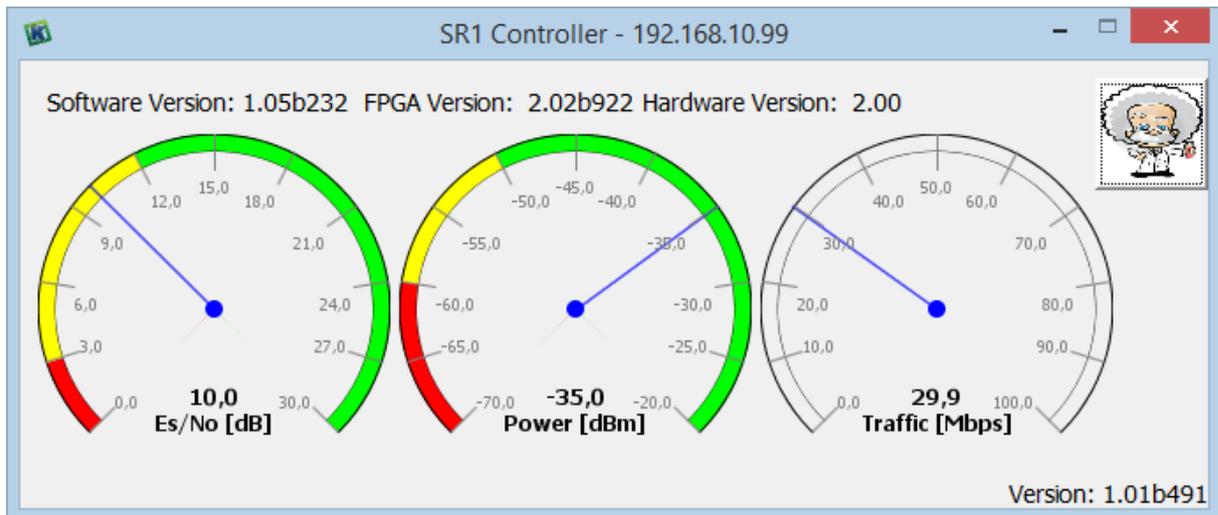
Figure 3-8: "SR1 Controller" application GUI

While monitoring the signal quality parameters ("Es/No" and "Power"), adjust the antenna direction by little amounts to optimise the output. For this task, usually two persons are necessary.

3.3 Terminal computer

3.3.1 Installation of a RAM-Disk

The DVB-S2 signal stream does not carry information in a consecutive form, but provides small data packets, which are mixed fractions of different final EO product files. Therefore, buffering of the incoming data stream is necessary.

Especially when receiving higher data-rates, the access-rate to the buffer database becomes crucial. This leads to a requirement to the used computer memory, which on its part has to allow decent reading/writing speeds. In case of insufficient memory speed, data loss can occur.

There are programs available to separate and create a virtual hard drive on the RAM (operating memory) of the terminal computer, which is the fastest available storage. In this chapter, the installation and configuration of a RAM-Disk using the application "RAMDisk" by Dataram will be described.

Download the latest version of RAMDisk from the following URL. This software is freeware for personal use.