User's Guide

will'tek

8140 TETRA AirAnalyzer

User's guide
Software version 3.4.4

boosting wireless efficiency

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Ordering information This guide is issued as part of the **8140 TETRA AirAnalyzer**. The ordering number for a published guide is M 292 546. The ordering number for the product is M 860 546.

Table of Contents

List of Figures

About This Guide

Purpose and scope

The purpose of this guide is to help you successfully use the TETRA AirAnalyzer features and capabilities. This guide includes task-based instructions that describe how to configure, use and troubleshoot the TETRA AirAnalyzer. Additionally, this guide provides a description of Willtek's warranty, services, and repair information, including terms and conditions of the licensing agreement.

Assumptions

This guide is intended for novice, intermediate and experienced users who want to use the TETRA AirAnalyzer effectively and efficiently. We are assuming that you have basic computer and mouse/track ball experience and are familiar with basic telecommunication concepts and terminology.

Related information

Use this guide in conjunction with the following information:

8140 TETRA AirAnalyzer: getting started manual, ordering number M 295 099.

Technical assistance

If you need assistance or have questions related to the use of this product, call Willtek's support. You can also contact Willtek by e-mail at customer.support@willtek.com.

Table 1 Technical support contact

Region	Phone number	Fax number
Europe, Middle East, Asia, Africa	+49 (0) 89 996 41 311	+49 (0) 89 996 41 440
Americas	+1 973 386 9696	+1 973 386 9191
China	+86 21 5836 6669	+86 21 5835 5238

Conventions

This guide uses naming conventions and symbols, as described in the following tables.

Table 2 Typographical conventions

Description	Example
User interface actions appear in this **typeface**.	On the Status bar, click **Start**.
Buttons or switches that you press on a unit appear in this **TYPEFACE**.	Press the **ON** switch.
Code and output messages appear in this `typeface`.	`All results okay`
Text you must type exactly as shown appears in this **`typeface`**.	Type: **`a:\set.exe`** in the dialog box.
Variables appear in this **<typeface>**.	Type the new **<hostname>**.
Book references appear in this **typeface**.	Refer to **Newton's Telecom Dictionary**
A vertical bar | means "or": only one option can appear in a single command.	`platform [a|b|e]`
Square brackets [ ] indicate an optional argument.	`login [platform name]`
Slanted brackets < > group required arguments.	<`password`>

Table 3 Keyboard and menu conventions

Description	Example
A plus sign + indicates simultaneous keystrokes.	Press **Ctrl+s**
A comma indicates consecutive keystrokes.	Press **Alt+f,s**
A slanted bracket indicates choosing a submenu from menu.	On the menu bar, click **Start > Program Files**.

Table 4 Symbol conventions

This symbol represents a general hazard.

This symbol represents a risk of electrical shock.

NOTE

This symbol represents a note indicating related information or tip.

Table 5 Safety definitions

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Safety Notes

This chapter provides the safety notes for the TETRA AirAnalyzer. Topics discussed in this chapter include the following:

General conditions of use

Read this product documentation before operation to familiarize yourself with safety markings and instructions.

This product is a Safety Class I instrument (provided with a protective earth terminal). Verify that the product is set to match the available line voltage and that the correct fuse is installed. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set (except for the DC option).

Equipment should be protected from ingress of liquids and precipitation such as rain, snow, etc. When moving the equipment from a cold to a hot environment, it is important to allow the temperature of the equipment to stabilize before it is connected to the supply to avoid condensation forming.

This product is not approved for use in hazardous atmospheres or medical applications. If the equipment is to be used in a safety-related application, e.g. avionics or military applications, the suitability of the product must be assessed and approved for use by a competent person.

Safety warnings

WARNING

The TETRA AirAnalyzer is not designed or tested for usage inside of a moving vehicle (e.g. car, van, airplane, helicopter), so this usage must be avoided. Contempt may cause failures and/or damages in the vehicle system and therefore may lead to disasters!

ELECTRICAL HAZARDS (AC supply voltage)

This equipment conforms with IEC Safety Class 1, i.e. it is provided with a protective grounding lead. To maintain this protection, the supply lead must always be connected to the source of supply via a socket with a grounded contact.

ELECTRICAL HAZARDS (AC supply voltage)

Be aware that the supply filter contains capacitors that may remain charged after the equipment is disconnected from the supply. Although the stored energy is within the approved safety requirements, a slight shock may be felt if the plug pins are touched immediately after removal.

ELECTRICAL HAZARDS

Do not remove covers, no user serviceable parts inside.

Note that there are supply fuses in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

FIRE HAZARD

Make sure that only fuses of the correct rating and type are used for replacement. If an integrally fused plug is used on the supply lead, ensure that the fuse rating is commensurate with the current requirements of this equipment.

TOXIC HAZARDS

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

WARNING

Beryllia (beryllium oxide) may be used in the construction of some of the components of this equipment. This material, when in the form of fine dust or vapor and inhaled into the lungs, can cause a respiratory disease. In its solid form, as used here, it can be handled quite safely although it is prudent to avoid handling conditions which promote dust formation by surface abrasion.

Because of this hazard, you are advised to be very careful in removing and disposing of these components. Do not put them in the general industrial or domestic waste or despatch them by post. They should be separately and securely packed and clearly identified to show the nature of the hazard and then disposed of in a safe manner by an authorized toxic waste contractor.

WARNING

Beryllium copper: Some mechanical components within this instrument may be manufactured from beryllium copper. This is an alloy with a beryllium content of approximately 5%. It represents no risk in normal use. The material should not be machined, welded or subjected to any process where heat is involved. It must be disposed of as "special waste".

It must NOT be disposed of by incineration.

WARNING

Tilt facility: When the instrument is in the tilt position, it is advisable, for stability reasons, not to stack other instruments on top of it.

WARNING

Input overload: The input power at the RF N-type connector should not exceed 0 dBm to guarantee the correct operation of the unit.

The input power level should not exceed 10 dBm to protect the device against damage.

At an input power above 17 dBm a protection circuit with diodes starts to protect the receiver. At any level above 17 dBm these diodes may burn out and the device may get seriously damaged.

WARNING

Static sensitive components: This equipment contains static sensitive components which may be damaged by handling.

Overview

1

This chapter provides a general description of the TETRA AirAnalyzer. Topics discussed in this chapter include the following:

About the TETRA AirAnalyzer

The TETRA Quality of Service is of major concern for network operators and user groups in the public safety and security sector. Willtek's 8140 TETRA AirAnalyzer now helps to discover dead spots and handover problems. It monitors the radio communication and offers users comprehensive post-processing capabilities.

The TETRA AirAnalyzer enables you to test network performance and load to make safety-critical communication as reliable as possible. It records, displays and analyses the complex communication between one or several TETRA mobile stations and a TETRA base station.

The TETRA AirAnalyzer can also be used as a versatile protocol analyzer for the development of TETRA terminals, IOP tests, or monitoring and analysing signalling.

Features and capabilities

- Enables protocol analysis with message sequence charts (MSC) that display in detail the complex flow of communication in the signalling protocol between TETRA radio and base station.
- Optionally provides Quality of Service analyser to chart issues within a radio cell over a given time period, including statistical evaluation.
- Includes voice decoder, allowing users to monitor and record the ongoing voice communication in the network.
- Measures channel and modulation parameters with the TETRA physical data analyser
- Supports GPS-assisted radio coverage measurements
- Features TETRA scanner to survey spectrum utilisation
- Optionally decodes communication under static or dynamic air interface encryption

Options

The following table lists the available options.

Table 1 Options to the 8140 TETRA AirAnalyzer

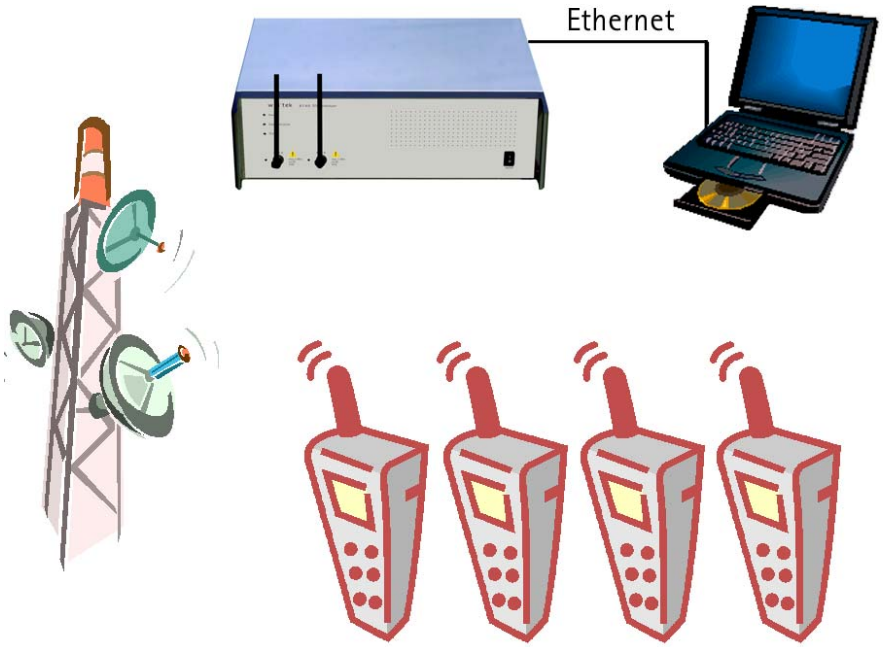
Option	Ordering number
8160 Static Air Interface Encryption	M 860 544
8161 Static/Dynamic Air Interface Encryption	M 860 561
8162 DMO Option	M 860 545
8164 AirAnalyzer Office Software	M 860 547
8165 TETRA QoS Analyzer	M 860 562
8171 DC Power Supply (12 – 18 V)	M 860 541

Table 1 Options to the 8140 TETRA AirAnalyzer (continued)

Option	Ordering number
8172 DC Power Supply (18 – 36 V)	M 860 542
8172 DC Power Supply (36 – 72 V)	M 860 543

System architecture

The following drawing depicts a typical test setup.



Physical description

For information about the physical details of the TETRA AirAnalyzer please refer to the getting started manual that was delivered with the instrument.

Installation

2

This chapter describes how to install the TETRA AirAnalyzer. The topics discussed in this chapter are as follows:

Hardware and software requirements

The following minimum requirements apply to all the PC applications for the 8140 TETRA AirAnalyzer:

- PC with Pentium III processor 866 MHz (or better) and LAN interface (10Base-T)
- Microsoft Windows 2000, XP or Vista
- USB port for dongle
- at least 20 MB of free hard disk space for the application (additional space will be required for the traces)
- 256 MB of RAM
- Microsoft Windows 2000 or Windows XP

The additional minimum requirement for online analyses with LAN recording is a Pentium III processor running at 1500 MHz.

The additional minimum requirement for online analyses with on-air recording is a Pentium D or Intel Core 2 processor.

Standby mode in Windows

It is important that the PC does not enter standby mode while the application is open, running or processing. This may result in an application crash. So please ensure that the standby mode of the operating system or the PC is permanently switched off.

Other PC applications

For the proper operation of the 8140 TETRA AirAnalyzer it is very important to work on a clean Windows system with as few applications running as possible, otherwise these applications could impair the application speed. For this reason, please make sure that there are as few programs in the taskbar and running from Autostart as possible.

Virus scanners, firewalls

Online virus scanners and firewall applications may additionally reduce the data transmission rate in a network. If you work solely with the TETRA AirAnalyzer application to analyze and filter previously traced signaling on a network drive, the file opening and analyzing speed may be noticeably reduced because of online scanning of the network data stream or port scanning.

Software delivered on CD

The PC software coming with the 8140 TETRA AirAnalyzer includes several useful applications:

- AirAnalyzer application
  - Records, analyzes and filters traces (raw, lan, tmw and tmv files)
  - Exports result files (res-files), SNDCP data files (hex) and tetra voice data (tvd files)
- TetraMsc application
  Shows result files as message sequence charts
- QoS application
  View Quality of Service measurements.
- RawFileSplitter application
  Splits extensive raw files into smaller parts
- ConvertSndcpData application
  GUI for text2pcap, converts SNDCP data files into PCAP file format (used in Ethereal, an IP protocol analyzer)
- VoiceDecoder application
  plays and stores TETRA voice data
- AlgorithmDllFramework
  (installed separately with the AlgorithmDllSetup.exe, this is described in Chapter 4, Installing the AlgorithmDll)
  Allows you to program your own decryption DLL
- Acrobat Reader application
  (installed separately using the AcroReader Installer)
  Shows the documentation (pdf files)

Note

Some of these applications may not work on your computer because you do not hold a valid license. Please consult with your Willtek representative for more information.

Installing the software

There are two ways to install the software as administrator:

- Log on to your Windows system as administrator and install the software as described below.
- If you are logged on as a standard user, solely run the setup as administrator by pressing shift and clicking on TetraAirAnalyzerSetup.exe with the right mouse button. Then choose Execute as... and install the software as described below.

If you have installed older versions of the TETRA AirAnalyzer software please uninstall these before you proceed with the installation. If you do not uninstall older versions, problems during operation and later uninstalling procedures may occur.

1 Insert the TETRA AirAnalyzer software CD into the CD drive of your computer.

2 Run the installation program TetraAirAnalyzer_Setup_3.2.x.x.exe from the CD-ROM with administrator rights. A message box will appear indicating that you are about to install the TETRA AirAnalyzer (see Figure 1).

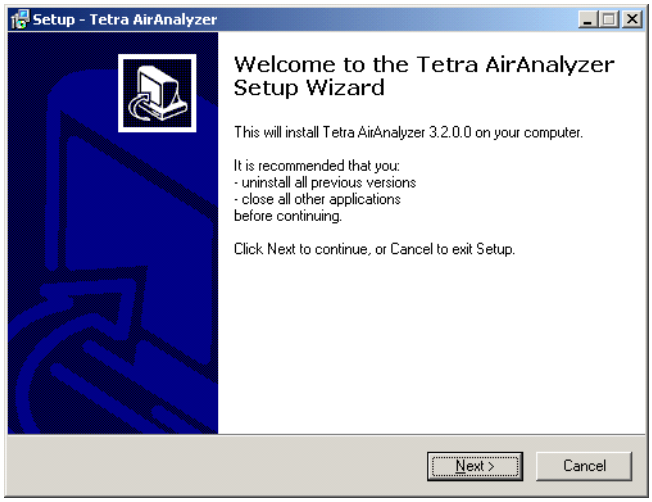


Figure 1 TETRA AirAnalyzer Setup Wizard

3 Click the **Next** button to continue.
The dialog box shown in Figure 2 will be displayed. You will be asked to accept the software license agreement of fjord-e-design GmbH.

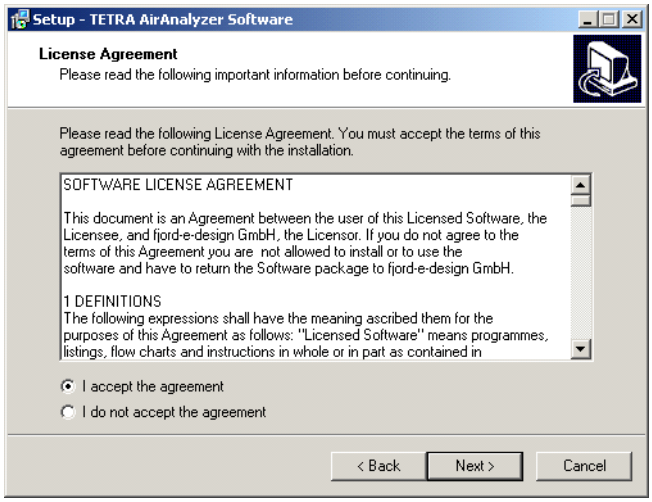


Figure 2 Confirmation of the software license agreement

4 Click the **Next** button to accept the license agreement, or **Cancel** to abort the installation.
If you accept the agreement and click on **Next**, the installation routine will start and the installation information as shown in Figure 3 will be displayed.

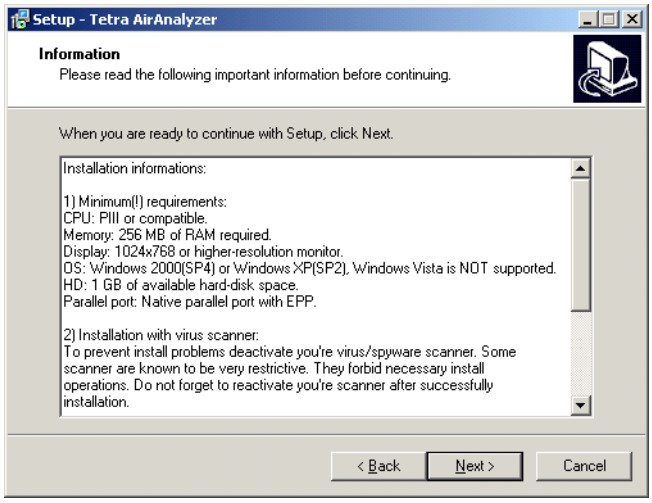


Figure 3 Installation information

5 Read the install information carefully and click the **Next** button.
The installation routine will start and the Select Destination Location dialog box will be displayed as shown in Figure 4.

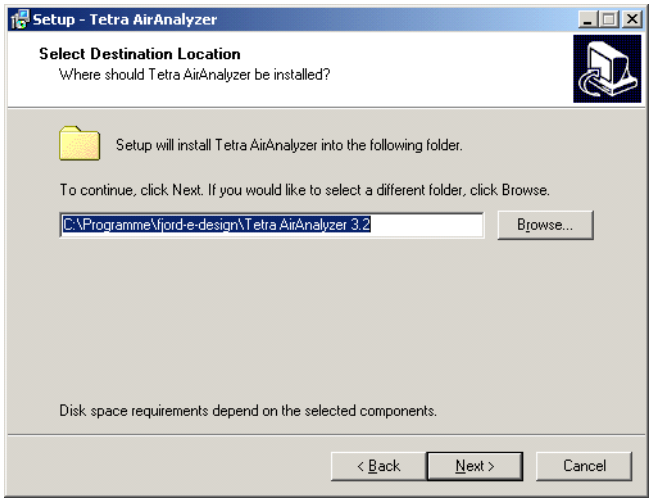


Figure 4 Selecting the installation folder for the software

6 Select a folder to install the application files. (The main application requires about 10 MB of free disk space. Please keep in mind that the data files of the TETRA AirAnalyzer also need some free disk space depending on the monitoring time.)

7 Click **Next** to proceed to the Select Working Directory window.

8 Select a folder where the application software can store traces and data evaluation files, and click **Next**.
The Select Components window appears as shown in Figure 5.

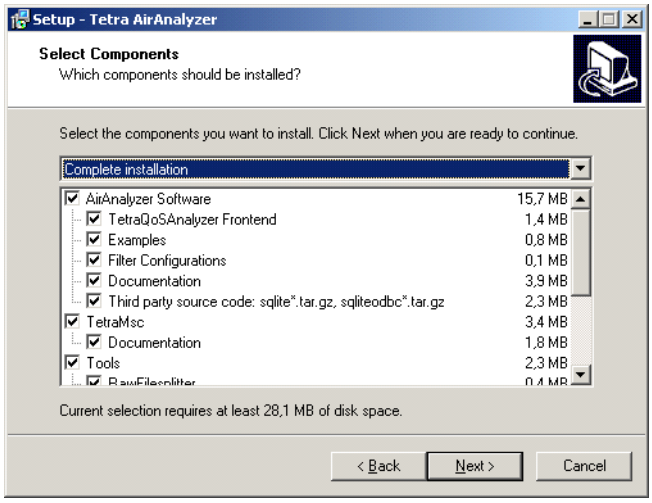


Figure 5 Selecting the AirAnalyzer components for installation

This window displays an overview of the applications and functions to be copied to your hard disk.

- AirAnalyzer Software: Enable this to install the AirAnalyzer software. It is also needed for the E1001 TETRA AirAnalyzer.
  - Examples: These files contain examples you can work with to learn more about the TETRA AirAnalyzer software.
  - Filter Configurations: These files contain predefined filter settings for the AirAnalyzer software.
  - Documentation: The documentation for the AirAnalyzer software.
  - Third party source code: Will install the open source SqLite ODBC-Driver sources.
- TetraMsc: Enable this to install the TetraMsc software.
  - Documentation: The documentation for the TetraMsc software.
- Tools: Various tools as described below.
  - RawFileSplitter: A tool to split large raw files or extract a port out of these files.
  - ConvertSndcpData: A GUI for the text2pcap tool from Ethereal.
  - VoiceDecoder: A tool to decode and play TETRA voice data from file or the AirAnalyzer software
  - Documentation: The documentation for the tools above.

9 Either choose a predefined selection (complete, economical, minimum, tools only) from the pull-down menu, or create your own selection (user defined) by ticking the required functions in the scrollable menu below.

10 Click the **Next** button to proceed to the Select Start Menu Folder window as shown in Figure 6. This window proposes a name for the application group in the Start > Programs folder.

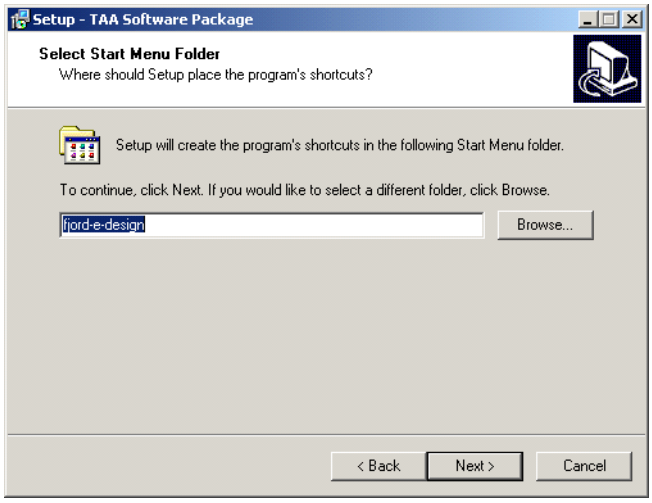


Figure 6 Selecting the start menu folder for the application

11 Accept the name or select a new one by clicking on **Browse**.

12 Click on **Next** to proceed to the next window shown in Figure 7.

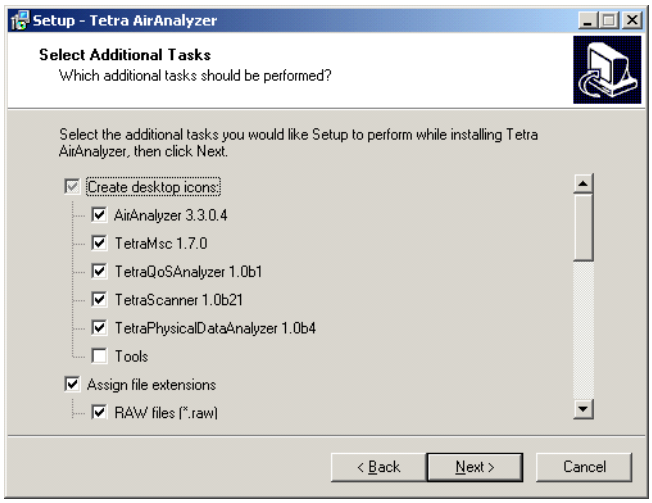


Figure 7 Selecting additional functions to be installed

13 If you want you can choose some of these additional tasks to create shortcuts to the application and/or assign the AirAnalyzer file extensions to the AirAnalyzer software.

14 Click on **Next** to proceed to the next window shown in Figure 8.

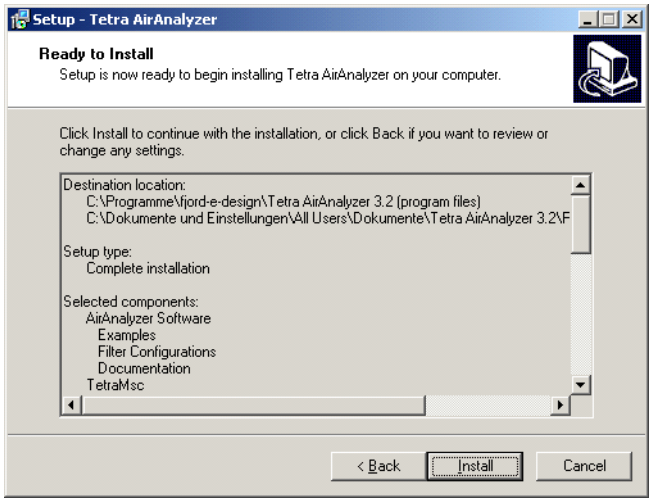


Figure 8 Confirmation of the installation

15 Click the **Next** button to start the copy process.
All program files will be copied to the chosen installation directory and the serial number is registered. The progress of the installation is displayed. Successful completion of the installation will be shown in a new windows (see Figure 9).

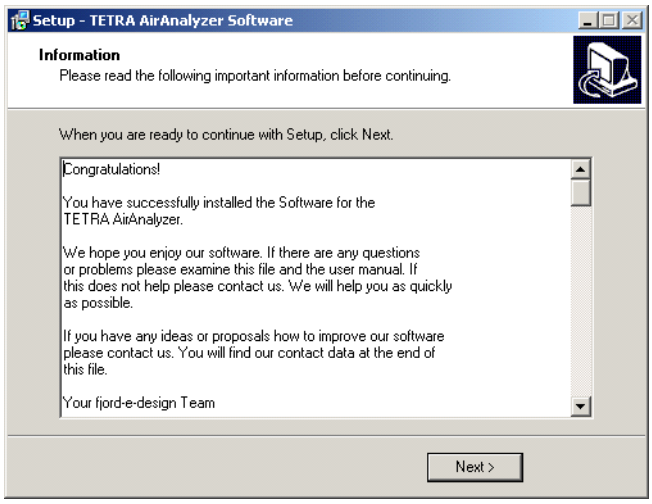


Figure 9 Installation completed

16 Click the **Next** button to proceed to the window shown in Figure 10.

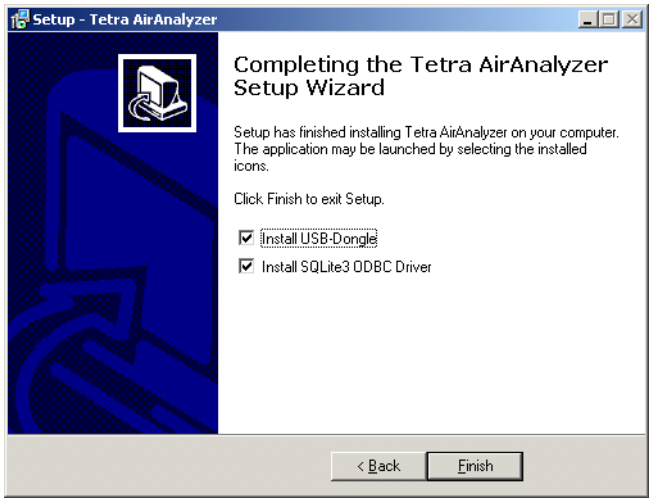


Figure 10 Preparing to install required driver software

17 Keep Install USB Dongle ticked if not already installed. Keep Install SQLite3 ODBC DRiver ticked if you want to use the QoS application.

18 Click **Finish** to install the additional driver software required by the TETRA AirAnalyzer PC software. Completing the installation may require that Windows is re-started.

A new program group entry in the Start > Programs menu named fjord-e-design with the subfolder AirAnalyzer should be available now (see Figure 11). It contains shortcuts to the TETRA AirAnalyzer application, the TetraMsc application and other important programs.

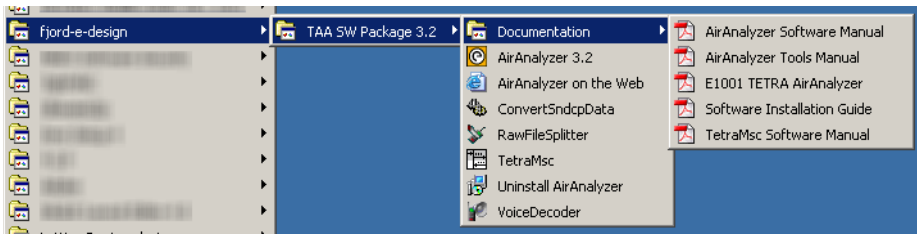


Figure 11 Program folder for the TETRA AirAnalyzer

Repairing an existing installation

If the TETRA AirAnalyzer software has already been installed on the system, the installation program can be started again to repair an existing installation.

Uninstalling the TETRA AirAnalyzer software

To uninstall the PC software for the TETRA AirAnalyzer:

1 Select **Start > Programs > fjord-e-design > Tetra AirAnalyzer 3.2 > Uninstall AirAnalyzer**. (Alternatively, start the uninstaller from the Software Manager in the Windows control panel.
A dialog box as in will appear.

Figure 12 Uninstaller dialog box

2 Click on Yes to uninstall the TETRA AirAnalyzer software and delete all related files.
The Uninstaller will process all changes required and delete all files from the hard disk.

Note

It may be necessary to restart the computer so that the changes take effect, otherwise the process does not finish correctly. The Uninstaller will advise you accordingly.

Installing and using the encryption software

Overview

This section applies if your AirAnalyzer software includes the 8160 Static Air Interface Encryption option or the 8161 Static/Dynamic Air Interface Encryption option. The options require the dongle to be inserted into a USB port of the PC running the AirAnalyzer software.

If your AirAnalyzer software is fitted with any of these options you will find an AlgorithmDllSetup.exe either in the main installation path of the installation CD or attached to an e-mail from Willtek.

A framework for Microsoft Visual C++ is included so that you can create the DLL with the TETRA algorithms. You only have to copy the necessary algorithms received from ETSI-SAGE or a custodian to this file. For security reasons, it is useful to keep the algorithms on an external hardware device. We recommend this relocation since it is possible to copy or decrypt a DLL on a PC. The algorithms are only as safe as the access to this PC.

Installation procedure

1 Start the installation process by calling up AlgorithmDllSetup.exe.
A dialog box pops up, asking to confirm the installation.

2 Click **Yes** to confirm.
The dialog box shown in Figure 13 will be displayed.

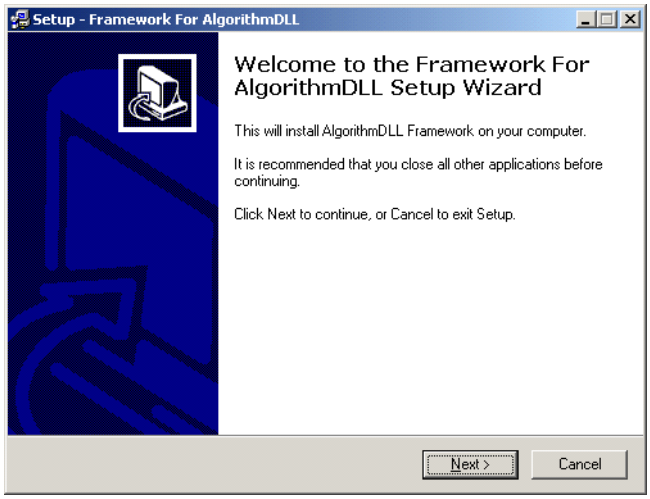


Figure 13 AlgorithmDLL Setup Wizard

3 Click **Next** to continue.
A new dialog box appears, asking for the destination location.

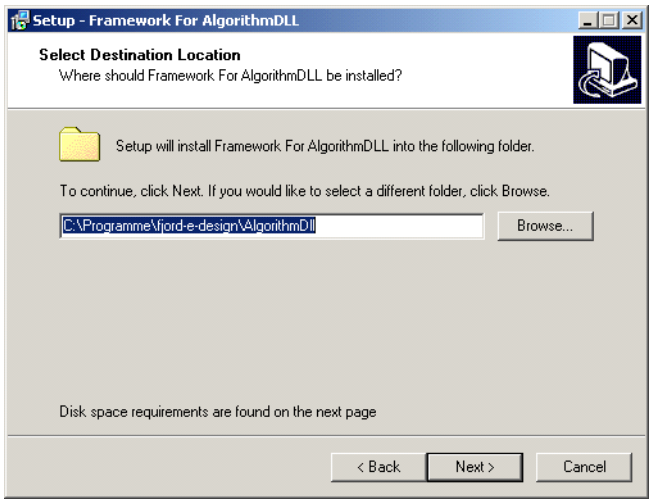


Figure 14 Selecting an installation folder in the AlgorithmDLL setup

4 Leave the folder displayed or choose another one, e.g. on a removable device such as a USB memory stick. If the folder does not exist, the setup wizard will create it. A new subfolder AlgorithmDllFramework will also be created.

5 Click on **Next**.
The Select Components dialog box appears.

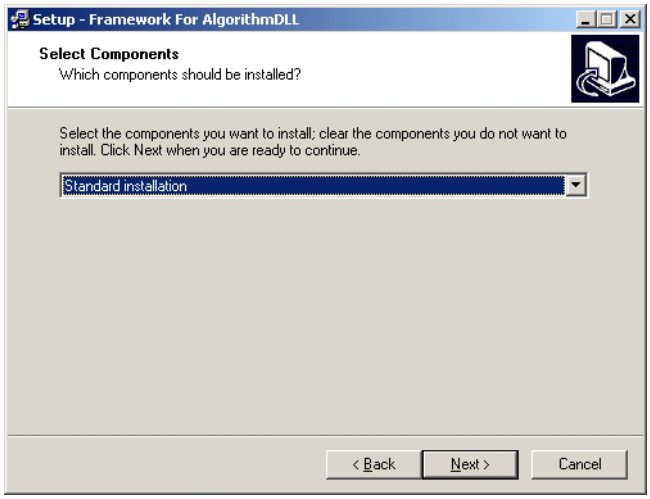


Figure 15 Selecting the installation type

6 Select an installation type and proceed with **Next**.
The Select Start Menu Folder dialog box appears.

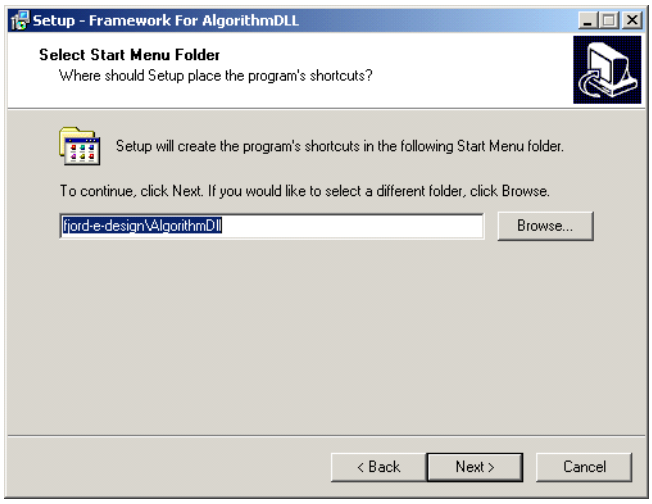


Figure 16 Selecting a start menu folder for the framework

7 Confirm the start menu folder or select a different one. Continue with **Next**.
The Ready to Install dialog box appears.

8 Check the displayed installation parameters. Click **Back** to change the settings. Click **Install** to start the installation.
The program files will be copied to the selected installation folder, into subfolder AlgorithmDllFramework.
When completed, the dialog box in Figure 17 will appear.

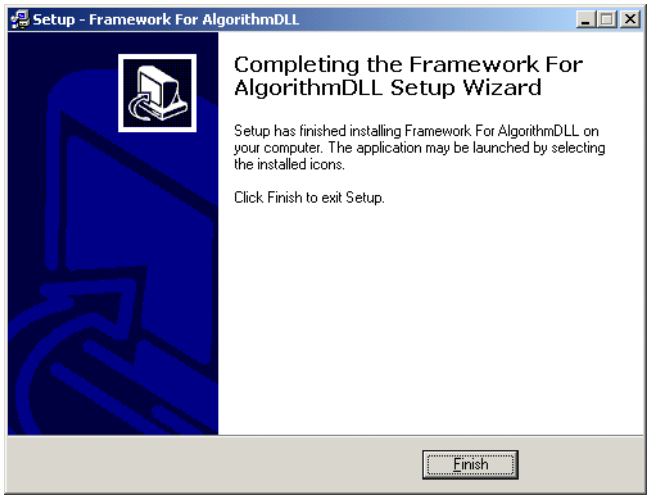


Figure 17 Completing the installation

9 Click on **Finish** to start copying the files.
The files required for creating the algorithm DLL will be copied into the AlgorithmDllFramework folder.
When completed, the AlgorithmDllFramework application can be found in the AirAnalyzer program group accessible under **Start > Programs**.

Defining an encryption method

1 Select **Start > Programs > fjord-e-design > Tetra AirAnalyzer 3.2 > AlgorithmDllFramework**.
The Misoftware to define the encryption algorithm is loaded.

2 In the AlgorithmDll framework, select file AlgorithmFunctions.cpp (see) and follow the descriptions in the file header and body.

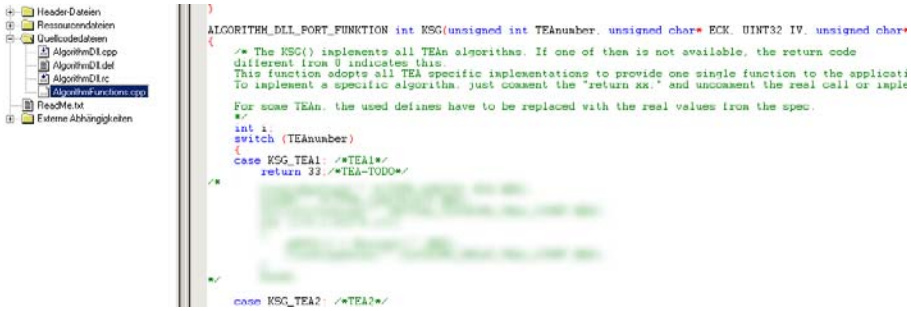


Figure 18 Opening file AlgorithmFunctions.cpp in the framework

3 Follow the descriptions in the file header and body.
If you try to “build” the project at this stage of completion the compiler will display "1 warning" due to missing security algorithms (1 local variable is unreferenced).
In the source code you will be guided completely on how to copy the secret ETSI encryption algorithms to the relevant locations in the file.
The project will create the Algorithm DLL that the AirAnalyzer software needs.

Note

Please contact Willtek Communications if you are interested in a secure solution customized to your organization's requirements.

Getting Started

3

This chapter describes the functionality of the software. Topics discussed in this chapter are as follows:

Using the TETRA AirAnalyzer

Once the TETRA AirAnalyzer and its connections are installed, the instrument is operated from the PC using Windows-based application programs. This chapter shows how to control the TETRA AirAnalyzer from the main application, AirAnalyzer.

Connecting the TETRA AirAnalyzer

The TETRA AirAnalyzer should to be connected to a power source, to the PC and to the RF as described in the Getting Started Manual delivered with the instrument.

Powering the unit

There are two power switches: One is located at the front, turning the AC power on/off; the other one is located at the back and turns the DC power on/off. Turn the corresponding power switch to 1. See chapter "Overview" in the Getting Started manual for the exact positions.

Note

If both AC and DC power are connected to the device and both power switches are turned on (1), the AC power will be used.

After the TETRA AirAnalyzer is turned on, a self test is executed. The LEDs at the front will go through several states. After a second the power-on self test should be completed. Only the power LED should be on, i.e. glowing green. If any other LED is still on, an error occurred during the self test. The device may not work correctly. Please contact Willtek's support (see "Technical assistance" on page xviii).

If the power LED is off, the device is not powered. Check the power cable, the power switch and the corresponding fuses (see chapter "Overview" in the Getting Started manual).

If all the LEDs except the power LED are off after turning on the power, the device is ready for use. To make sure that the TETRA AirAnalyzer is operating according to the specifications, it should run for at least 10 minutes to gain optimal operating temperature.

Immediately after the TETRA AirAnalyzer is turned on you may start the controlling application on the PC.

Setting up the TCP/IP parameters

Setting up the IP address of the 8140

By default the TETRA AirAnalyzer is delivered with a static IP address. This IP address is 192.168.1.200, subnet mask 255.255.255.0 upon delivery. This IP address is also printed next to the network plug at the back of the device.

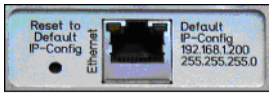


Figure 19 Ethernet connector and default IP address

Resetting the IP address of the 8140

The IP address information can be reset to the factory setting, i.e. to IP address 192.168.1.200, subnet mask 255.255.255.0.

1 Switch on the TETRA AirAnalyzer and wait until it is ready for operation, i.e. the power LED must be on while the other LEDs must be off.

2 Use a thin blunt instrument to carefully press the reset switch in the embedded hole beneath the label "Reset to Default IP-Config" (see Figure 19). Press and hold the button for one second.
This resets the IP address immediately and permanently to the default value.

Changing the IP address of the 8140

The IP address of the 8140 TETRA AirAnalyzer can be set to a static value or to an IP address dynamically obtained from a DHCP server. This can be set up with a web browser on a PC connected to the TETRA AirAnalyzer either over a LAN (using normal LAN cables) or directly (using a cross-connect cable). The IP address of the PC must be in the same subnet as the TETRA AirAnalyzer; see "Changing the IP address of the computer" on page 22.

1 On the PC, start a web browser.

2 Call up the following address: **`http://<IP_ADDRESS>`** where <IP_ADDRESS> is the IP address of the 8140 (192.168.1.200 by default).
The login page of the TETRA AirAnalyzer appears.

3 Log in with the password.
A page with the IP settings is displayed.

4 Change the IP settings as required.

Setting up the IP address of the computer

In order to establish a connection with the 8140 TETRA AirAnalyzer and in addition to the physical network connection it is necessary to use the correct IP settings on the computer. The 8140 and the computer have to be located in the same logical IP network. For the hardware in manufacturing state this means that the computer has to use one of the IP addresses in the range 192.168.1.1 to 192.168.1.199 or 192.168.1.201 to 192.168.1.253; it must differ from the IP address of the 8140 and other devices within the network.

Changing the IP address of the computer

These instructions to change the network settings of the computer apply to Windows XP and Service Pack 2:

1 Click **Start > Control Panel**.
The Control Panel window appears.

2 Double-click **Network Connections**.
The Network Connections applet appears.

3 Select the LAN interface to be used (typically a LAN connection such as Local Area Connection[1]).
The Status window appears.

4 Click on **Properties**.
The Local Area Connection Properties dialog box appears.

5 Select the Internet Protocol (TCP/IP) element and click on **Properties**.
The Internet Protocol (TCP/IP) Properties dialog box appears.

6 Select "Use this IP address" within the Properties dialog. Enter a free IP address (e.g. 192.168.1.150) in the IP Address field, and 255.255.255.0 in the Subnet Mask field. You can also enter the address of a gateway and DNS server if available.

7 Click **OK** to confirm and save the new settings.

Checking the local network connection (optional)

After setting the network connection you can check if the network connection was changed to the correct settings respectively if contact to the TETRA AirAnalyzer has been established. For this example the TETRA AirAnalyzer is used with the default values (see 3.1.1Resetting the 8140 TAA IP address).

1 Start a shell with the command line interpreter by clicking **Start > Run**, typing **`cmd`** and clicking **OK**.
A command shell appears in a new window.

2 Enter the command **`ipconfig`**.
The settings of the available network interfaces are displayed. The defined IP address (192.168.1.150 in the above example) should be displayed.

3 Enter the command **`ping <IP_Address>`** with <IP_Address> set to the IP address of the TETRA AirAnalyzer (default setting: 192.168.1.200) to check if an IP network connection is available between the TETRA AirAnalyzer and the computer.
If the 8140 answers, the settings are correct.

Options for connections using a router or SSH tunnel

In addition to the connection within the local network you can also use a remote connection. This requires a connection of at least 350 kbps (actual) from hardware to software. The direction from software to hardware requires 100 kbps.

1. A name for the LAN interface cannot be given here because the designation differs between computers. If the computer has several cable connections, the name might contain numbers. Laptops often have a wireless network connection in addition to the cable network connection. In addition, there may also be a virtual connection installed (e.g. VMware Network Adapter). If you are unsure which connection to use, contact a person responsible for your IT equipment.

The connection can be established within the network by using a router (e.g. VPN) or by using a SSH tunnel. When using a remote connection you have to observe the following:

- It is not possible to find the hardware using the search dialog. You have to enter the IP address and port of the hardware manually.
- When using a router the correct gateway address of the hardware and the PC has to be used. When using a DHCP server the gateway address has already been transmitted correctly. Otherwise you can set the gateway address of the hardware as described in "Changing the IP address of the 8140" on page 21. Section "Changing the IP address of the computer" on page 22 contains additional information for the PC.

Starting the TETRA AirAnalyzer application

1 Connect the TETRA AirAnalyzer to the PC and power it up as explained above.

2 The TETRA AirAnalyzer software can be called up from **Start > Programs > fjord-e-design** (see Figure 20). It may contain shortcuts (depending on the installed components) to the installed AirAnalyzer applications: AirAnalyzer, TetraMsc, RawFileSplitter, ConvertSndcpData and VoiceDecoder.

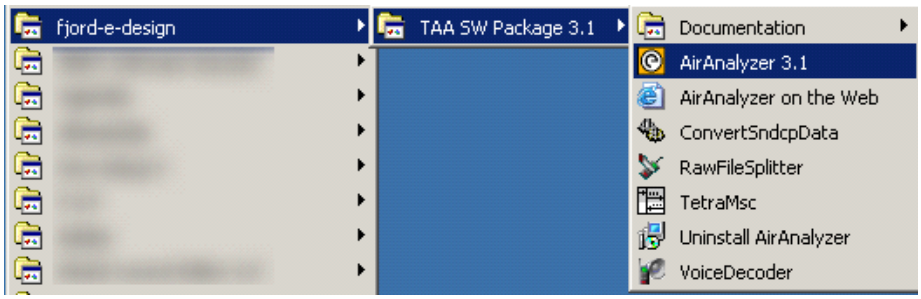


Figure 20 Launching a TETRA AirAnalyzer application

If you chose these items during the installation there will also be desktop icons and icons in the quickstart bar to start the application.

3 Start the TETRA AirAnalyzer application by clicking on one of these shortcuts. If the 8140 TETRA AirAnalyzer is switched on and connected correctly to the PC and the provided user dongle is plugged in, the main window should be displayed after a moment (see Figure 33 on page 35). Otherwise the software will display an error message.
If an error message like Figure 21 is displayed, there are problems with the dongle. Remove the dongle from the USB port and plug it back in. Start the software once again.

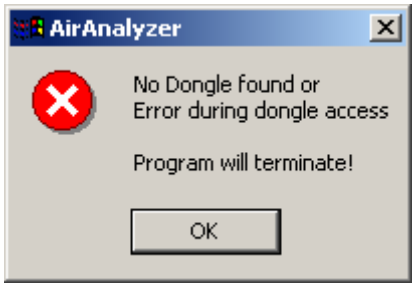


Figure 21 Error message appearing when the dongle is not found

If an error message as in Figure 22 is displayed, the AirAnalyzer version is newer than permitted in the dongle. In that case update the dongle with the dongle update software delivered, or contact Willtek.

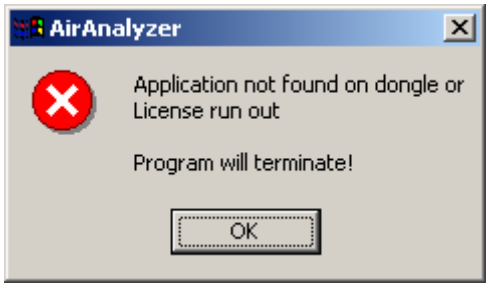


Figure 22 License not available

AirAnalyzer software overview

What it does

The AirAnalyzer software is the MS Windows-based standard software for the TETRA AirAnalyzer. The AirAnalyzer software is designed to record, display and analyze the complex course of the communication between a TETRA mobile unit and a TETRA base station, or another TETRA mobile units in case of DMO. It can monitor and analyze the complete down and uplink of one selectable TETRA carrier including all four time slots in up and downlink.

The software features a multi-document interface, i.e. it is capable of displaying multiple views of one or more raw data file(s), it can also load data through a proprietary interface and different file interfaces.

At first a document window has to be associated with a raw data file, or an input format has to be chosen. When recording a raw data file from the TETRA AirAnalyzer the software associates the file automatically with the active document (window).

The user may also load a specific file (Ian[Proprietary]/raw[TMO/DMO]/TMW/TMV) into the active document. The AirAnalyzer software is now able to analyze the input data (if recorded to or opened from a file) and display the TETRA protocol messages in a readable format. The content of the document is synchronously saved in the result file you were asked to specify before.

Although different documents may be associated with the same raw data file, they all have to use a different result file. Each document window needs a specific result file because several windows would corrupt a common result file.

System overview

The data from the various sources (TETRA AirAnalyzer, proprietary interface, file) is analyzed and evaluated for the following protocols:

- CMCE (CC, SDS), SS (completely, SS actual finished parts)
- MM (completely)
- SNDCP (completely)
- MLE/BLE (completely)
- LLC (completely)
- Upper MAC (completely)
- Lower MAC (completely)
- Physical Layer (completely)
- DMO (optional)

The evaluation is carried out according to TETRA Air Interface, Edition 2 (EN 300 392-2) and for all security functions (EN 300 392-7). Additional TETRA standards (e.g. DMO, SNDCP) are available upon request.

Using various customizable filters, the user can reduce the displayed messages. This will help to focus on the important data, not lose the overview in the quantity of occurring messages. This is especially helpful when searching the communication protocols for faulty messages.

In addition, it is possible to display the filtered messages in the TetraMsc application to visualize the flow of messages on the air interface as message sequence charts. It is also possible to activate the online analysis of the air interface data so that the live data is filtered and displayed according to the current settings.

Features

Saves air interface data

External data input for proprietary and file interface

Measurements for each burst

Analysis of the captured data

Complex filtering of analyzed data (protocol/subscriber)

Online analysis of live data with TetraMsc

Display in the expert text view

Signal flow

The software analyzes the raw data from the TETRA AirAnalyzer or data from various file types, so that the TETRA protocol messages are displayed. The software offers the ability to filter the displayed messages in various ways to keep the focus on the relevant protocol components.

It is possible to activate the online analysis of the data so that the messages of the air or proprietary interface are displayed online.

The raw data from the TETRA AirAnalyzer or a file is sorted according to the layer 1 settings in the filter dialog. A protocol analyzer processes the remaining data. The displayed result is filtered according to the layer 2 and 3 settings in the filter dialog and saved to disk.

Figure 23 shows the signal flow in the application. One raw data file can be used for several documents. Each document may have its individual filter settings.

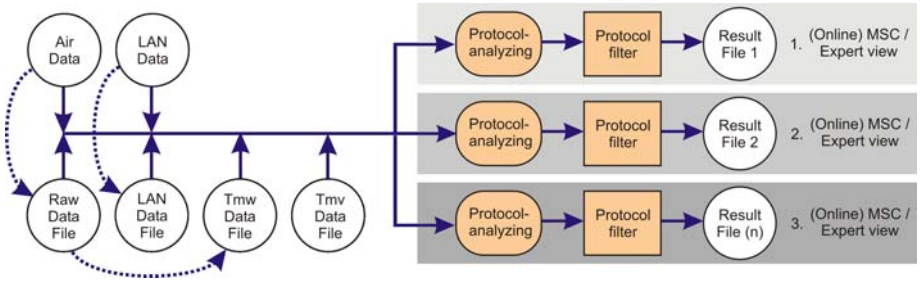


Figure 23 Signal flow in the AirAnalyzer software

The AirAnalyzer application can create a TMW data file that is already channel decoded. You can also use a TMV data file as input file for the analyzing software.

Quick start

With the following steps a TETRA carrier will be scanned for up and downlink. The data is analyzed and filtered for the display. In addition, the scanned messages can be shown in message sequences charts.

The AirAnalyzer software has to be installed and the TETRA AirAnalyzer has to be connected and turned on for recording air interface data (otherwise only proprietary recording is available).

It only takes a few steps to monitor a TETRA signal:

1 Start the AirAnalyzer application.

2 Select a data source in the settings menu (e.g. Record TMO).

3 Click the recording button  .

4 Set the carrier frequency (if you choose Record Proprietary: Set the UDP ports by selecting an entry in the dropdown box in the Settings group. Alternatively,

   a click the Edit button  to enter new values);

b save the new values and click the Ok button.

5 Enable online analysis by checking the Protocol field Protocol.

6 Set the protocol and SSI filters with Protocol and SSI-Filter, or select predefined filters with the dropdown-boxes aside. The default settings provide a reasonable setting for standard signaling measurements.

7 Choose a file name for the raw data file.

8 Press the Start Record button to start recording. After a short while the TETRA MSC will start. All messages according to the filter settings will be displayed online.

9 To stop the recording press .

First recording

Upon a click on the Recording button in the toolbar, the Record dialog appears. This is used to define the required settings for the first recording.

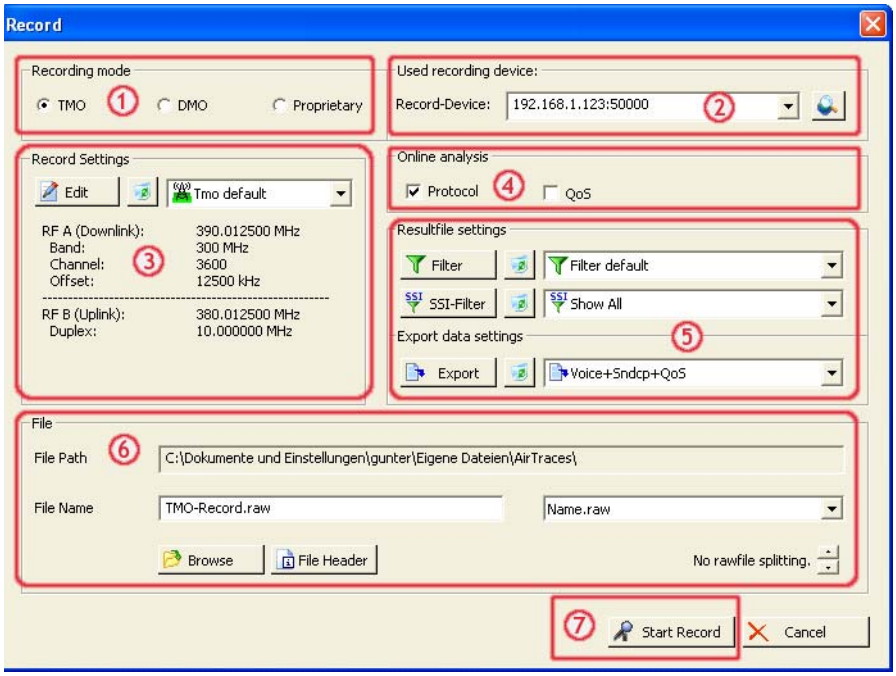


Figure 24 Record dialog

This includes in particular:

- Selecting the AirAnalyzer hardware within the network
- Recording mode for TMO (Trunked Mode Operation) or DMO (Direct Mode Operation)[2]
- Recording frequency
- Filter settings
- Display options (protocol and QoS)

2. DMO recording requires the 8162 DMO Option

– Exporting further data like speech, packet data IP data and GPS data

This example shows how to start a TMO recording. The red marks and numbers in Figure 24 correspond to the possible steps. The choice of hardware and recording frequency and the final start of the recording should be carefully selected; the other steps are optional.

Step (1): Select "TMO" (Trunked Mode Operation) within the area "Recording mode".

Step (2): Select the hardware within the network. If the hardware is not detected automatically you can use the button  to search for it. You can also use the search dialog to see if an AirAnalyzer was detected within the correct IP network; see Figure 25 and Figure 26.

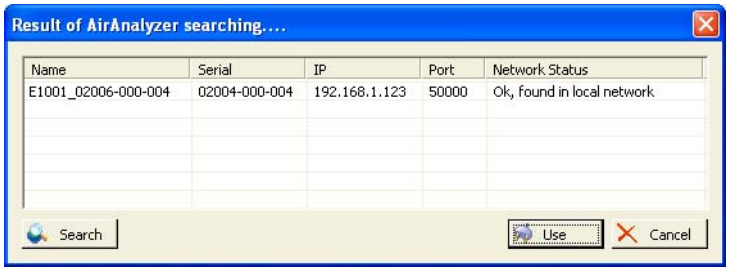


Figure 25 Successful search for 8140 on the LAN

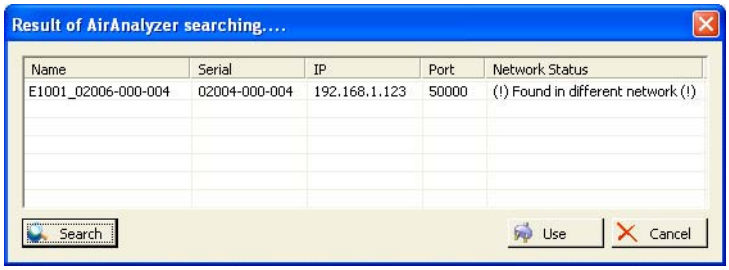


Figure 26 Search for 8140 on the LAN, partially successful

If the hardware was found in a different network (network status: "(!) Found in different network (!)"), the IP information has to be changed on the computer to enable a connection and recording, see section "Setting up the IP address of the computer" on page 21.

You can also enter the IP address directly. This might be necessary if the AirAnalyzer is addressed by using a gateway. Use the following format:
"IP-Address:Port".
Example for IP address 192.168.1.200 on port 50000: "192.168.1.200:50000".

Step (3): Use the frequency to select the TETRA carrier to be observed. Use the Edit button  to set the frequency.

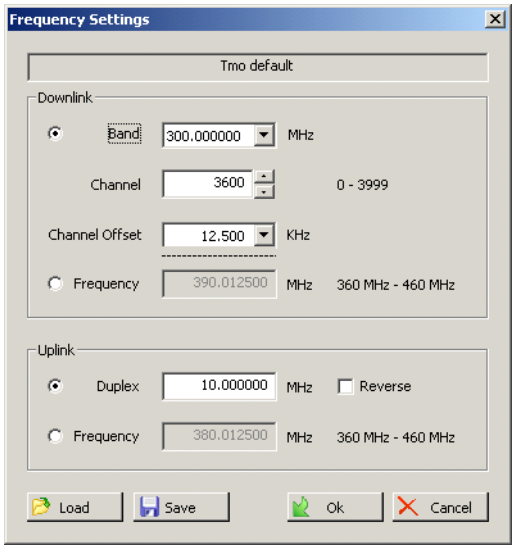
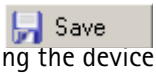
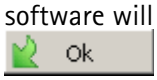


Figure 27 Frequency Settings menu

Enter the downlink frequency (signals from the base) into the upper part of the dialog. You can enter the frequency as band, channel and offset or you can enter the exact value for the frequency. Enter the uplink (signals from the mobile devices) into the lower part. You can enter this frequency as the difference between the duplex or as the exact frequency. You can save the frequency by using the Save button 

and a unique name, so that you do not have to enter it when starting the device again. If you do not save the frequency the software will not remember if after starting again. Use the OK button 

to save the frequency.

Step (4): The Online Analysis section is used to select which values are displayed live during the recording session. The TetraMsc protocol analyzer and optionally the QoS analyzer are available. According to your selection the respective program for the display will start automatically.

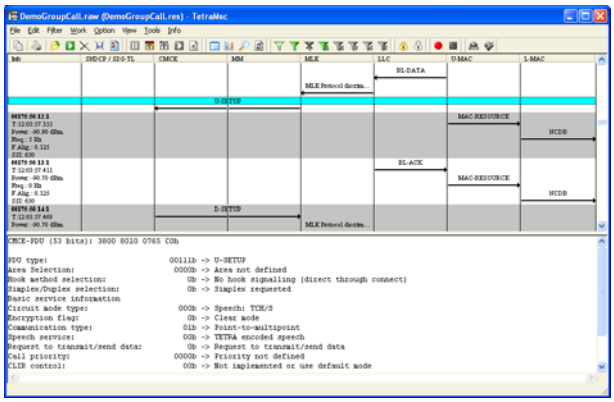


Figure 28 TetraMsc (protocol analyzer)

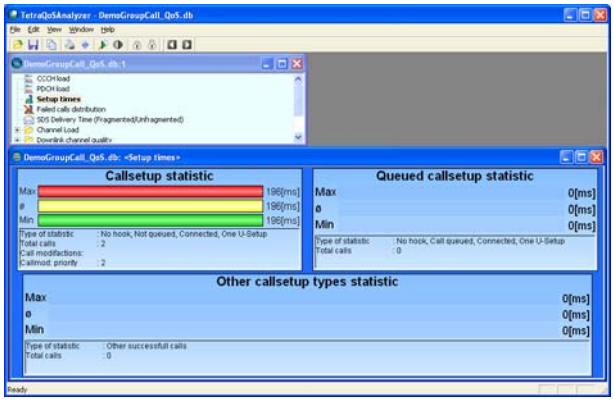


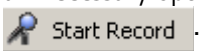
Figure 29 TetraQoSAnalyzer (Quality of Service analyzer)

Step (5): Use the "Resultfile settings" section to define the filters and the export of additional data. Refer to the respective chapter in the manual for additional information. You should use the predefined settings for the first sessions. These settings are the result of long experience and are optimized for approx. 90 percent of all applications.

Step (6): Use the area "File" to set the path for saving the file of the recording session. You also have to enter the name of the file. The extension of the recording file is ".raw". This file contains all data. You can extract other data like speech, QoS, GPS positions, packet data IP packages later. You can select the name format for the file. For example, you can automatically add the current date and time to the file name:

If you select "my_record.raw" as the file name you can also add the date and time: "my_record_2007-08-20_(12_54UTC).raw".

It is possible that exported data have the same name and are saved in the same directory. The only difference is the extension of the file. If you select "my_record.raw" as the main file of the recording the name of the protocol file would be "my_record.res". The name for the speech data would be "my_record.tvd". The name for the QoS database would be "my_record_qos.db".

Step (7): After selecting all necessary options start the recording by clicking on the Start Record button 

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The recording and live data

After starting the recording a TCP connection between the computer and the hardware is established. The hardware is set to the desired recording mode and frequency.

If the online data should be displayed, the display programs (TetraMsc and TetraQoSAnalyzer) are started and set to the online display mode. The AirAnalyzer software opens the Demodulation Info dialog.

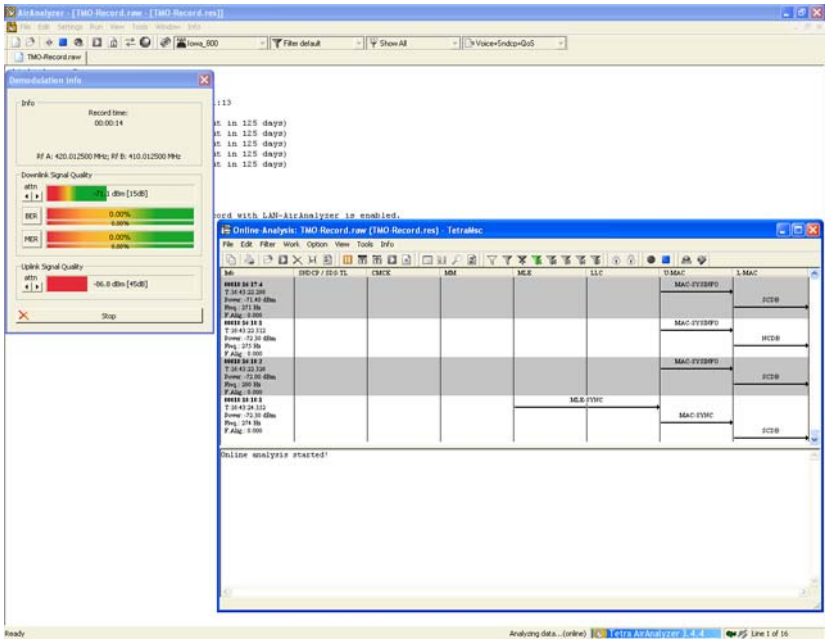
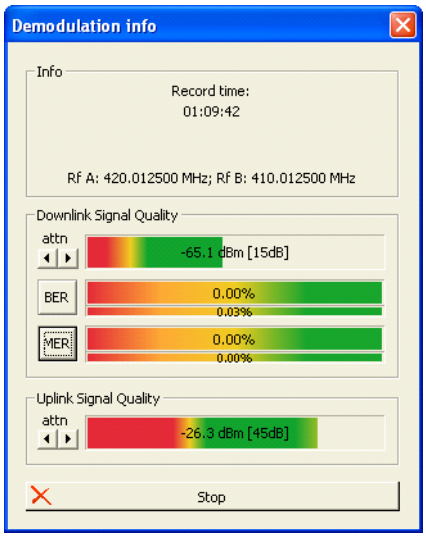


Figure 30 AirAnalyzer recording

The picture shows the AirAnalyzer software in the background. To the right the corresponding dialog "Demodulation info" is displayed. The right bottom area contains the TetraMsc, which displays the protocol.

The Demodulation Info dialog



The Demodulation Info dialog displays the current measurements of the running recording session. The first display of the level control shows the reception level of the downlink. The measured value is displayed in dBm. After that the setting of the AirAnalyzer attenuators is displayed in dB. You can change these settings using the  buttons. The bottom display of the level control is the reception level of the uplink. It operates analogous to the power level bar of the downlink. Below the power level bar for the downlink two additional bars are displayed for the measurement of BER (Bit Error Rate) and MER (Message Error Rate). These bars are split in two parts. The upper part displays the current value. The smaller lower part displays the peak value. It shows the max. error value. You can reset these two peak values by using the  or  button.

The Stop button stops the recording.

The green part of the power level bar displays the optimal area for reception. The lower part displays the sensitivity threshold. The upper part displays the area for overmodulation. The yellow interim part is the area in which the AirAnalyzer hardware has optimum reception. Due to fluctuations of the received field strength it is possible to reach an unfavorable reception range. If this is the case you should select different settings for the attenuators. Experience shows that the tetra modulation is stable in respect to overmodulation. If this is the case, the TETRA AirAnalyzer can demodulate the TETRA messages without problems. However, it is not possible to correctly measure very high values for received field strength. Experience shows that this only occurs under laboratory conditions. In this case we recommend the use of an external attenuator in front of the input of the respective receiving stage of the uplink or downlink of the TETRA AirAnalyzer.

The TetraMsc software

TetraMsc is the display program for the protocol. It can be started manually or automatically when using the online analysis. The protocol is displayed as Message Sequence Charts (MSC).

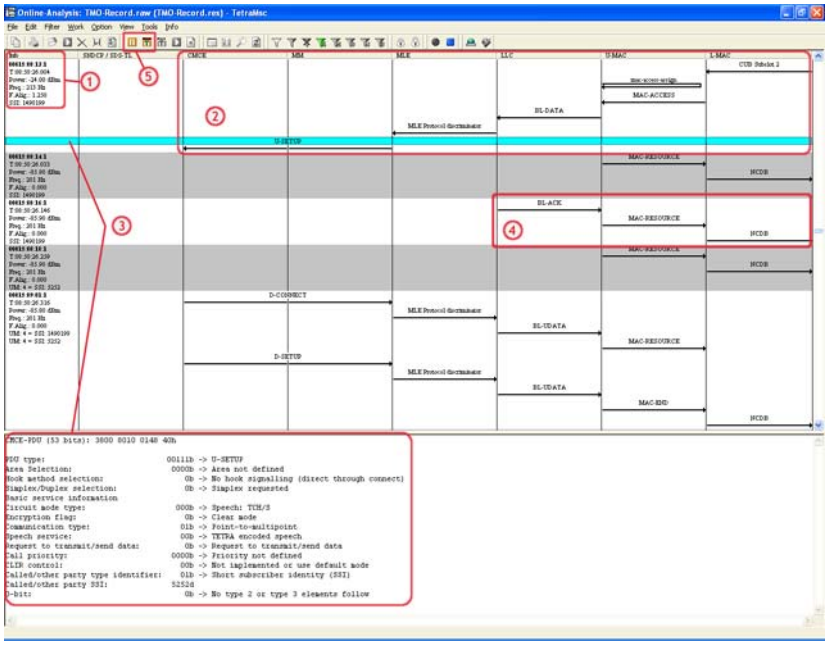


Figure 31 Reading and understanding message sequence charts

(1): The column "Info" on the left contains general information. It contains the frame used for sending, the time in UTC, the received power level of the burst, the symbol offset and the target address(es) of the message(s).

(2): The other columns contain the individual messages of the different layers. It starts with the lowest layer on the right: Lower MAC (as well as the physical layer). The arrow beneath this point 2 points to the left. This means, that this message was sent from the mobile device to the base station. This direction of sending is called uplink. Above the arrow the name of the message of the respective layer is displayed.

(3): You can move the cursor by using the arrow keys on the keyboard or by clicking directly on the message with the mouse. In the bottom part of TetraMsc the individual elements of the messages are displayed as analyzed.

(4): Messages with arrows pointing to the right were sent from the base station to the mobile device. This direction of sending is called downlink. The message "BL-ACK" is displayed in layer LLC. In this case the base station acknowledges the receipt of "BL-DATA" from the message (2) in the LLC layer.

(5): The button "Freeze rendering" is only available during the online analysis. Since new messages are always displayed in real time during the online analysis, it is possible to freeze the display. This gives you enough time to read the messages. If you freeze the display messages are not lost. They will be displayed after disabling the freeze function.

The TetraQoSAnalyzer software

The TetraQoSAnalyzer prepares the information from the protocol statistically and displays these information graphically in lists.

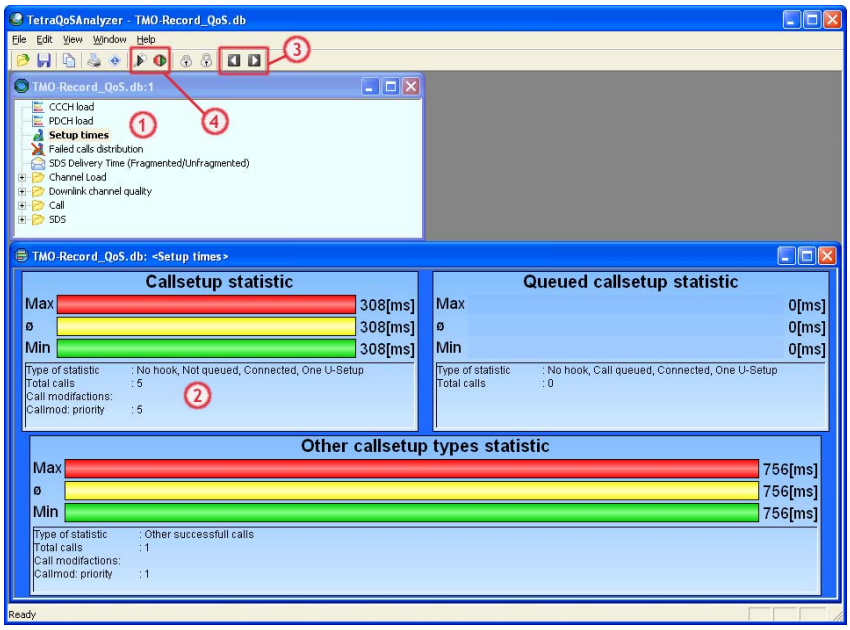


Figure 32 The TetraQoSAnalyzer software

(1): The first window shows the possible measuring methods according to subject. Measuring methods used for a general overview are sorted into the main directory. The other methods are contained within the folders sorted according to subject.

(2): The result of the measurement is displayed in the bottom window.

(3): For some displays of the results over time it is possible to switch between different time frames.

(4): For some measurements the display is changed from online to offline view. When using the online display the current measured value and mean value of the last 32 seconds are displayed. The offline mode displays the total measured value. Since the TetraQoSAnalyzer is not directly connected to the recording software AirAnalyzer, it cannot detect if a recording is still running. You therefore have to set the TetraQoSAnalyzer manually to the offline mode after finishing the recording. The speed for the real time display when using the online display is 4 seconds. This means that the recording software writes data to the database every 4 seconds. The TetraQoSAnalyzer retrieves data from the database approx. every 4 seconds.

Getting acquainted with the AirAnalyzer menus

Main window

The main window contains all open documents.

All adjustments and settings are carried out in the main window. Raw data (LAN/RAW/TMW/TMV) or an already analyzed result file may be loaded into a document (window). The analyzed data of each document can be printed and saved in a result file (*.res). Several documents may be opened at once. The windows can be arranged like all windows in MS Windows.

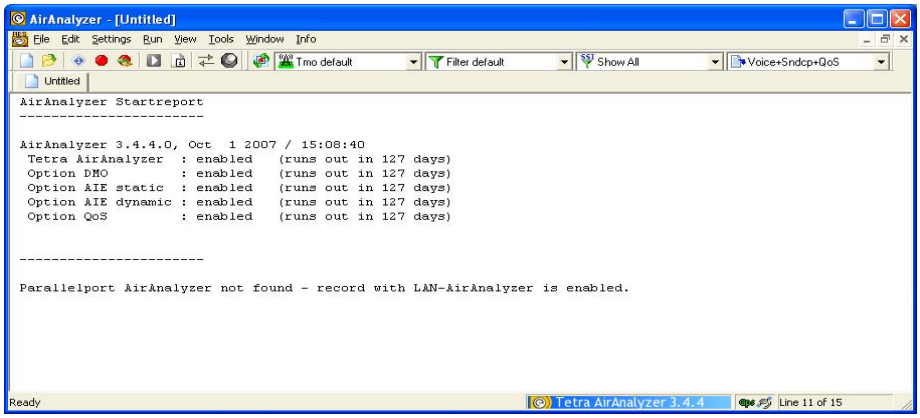


Figure 33 Main window of the AirAnalyzer software

Menu items

File menu

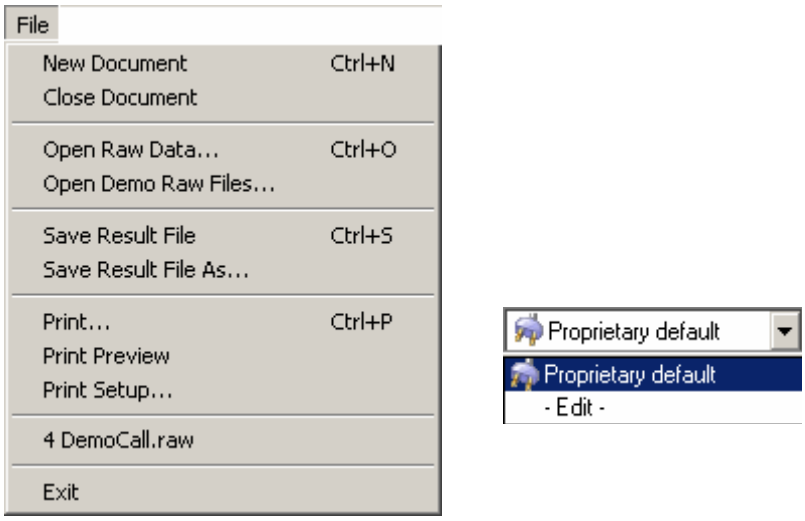


Figure 34 File menu

New Document: Opens a new document for analyzing.

Close Document: Closes the activated document view.

Open Raw Data...: Loads raw data files (LAN/RAW/TMW/TMV) into the active document.

Open Demo Raw Files...: Loads raw data from the All Users directory into the active document.

Save Result File: Saves the analyzed data from the active document view to disk.

Save Result File As...: Saves the analyzed data from the active document view to disk, requires a new path and name.

Print...: Opens the print dialog.

Print Preview...: Shows the printer preview.

Print Setup...: Opens the printer setup dialog.

Recent File List: Opens the selected raw data file to the active document view.

Exit: Closes the AirAnalyzer application.

Edit menu

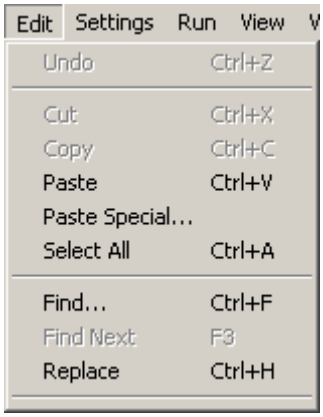


Figure 35 Edit menu

Undo: Undoes the last change to the result file.

Cut: Cuts out the highlighted text of the result file.

Copy: Copies the highlighted text of the result file to the clipboard.

Paste: Inserts the text on the clipboard into the result file.

Paste Special...: Prints the text on the clipboard into the result file, allows some options.

Select All: Highlights the entire text of the result file.

Find...: Allows searching for a string in the result file.

Find Next: Continues the search.

Replace: Exchanges the highlighted text with the text on the clipboard.

Settings menu

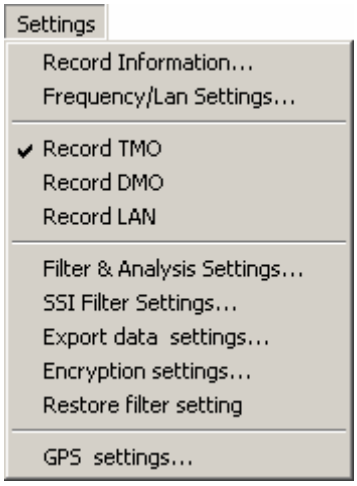


Figure 36 Settings menu

Record Information...: Opens the record information dialog.

Frequency/Proprietary Settings..: Opens the frequency/Proprietary dialog.

Record TMO: If enabled Record Mode is TMO.

Record DMO: If enabled Record Mode is DMO (requires the 8162 DMO Option).

Record Proprietary: If enabled Record Mode is Proprietary.

Filter & Analyzsis Settings...: Opens the filter & analyze settings for the active document.

SSI Filter Settings...: Opens the SSI filter settings for the active document.

Export data settings...: Opens the Export settings for the active document.

Encryption settings...: Opens the dialog box for the encryption key settings.

Restore filter setting: Restores the used filter setting from the result file:

```
Used Filter:      "Filter default" (Encoded: 01:2e2e2e2e0f3a7f7f:f0101000e2f2f0f:7d2f2f073a:2840
```

GPS Settings...: Opens the dialog box for GPS-Receiver settings.

Run menu

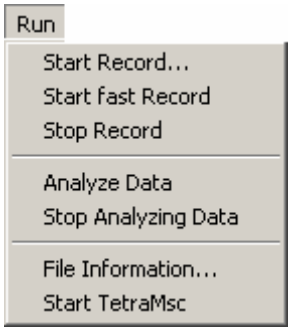


Figure 37 Run menu

Start Record...: Starts the recording process and associates the raw data file with the active document.

Start fast Record: Starts the recording process without the record dialog using the given settings.

Stop Record...: Stops the recording process.

Analyze Data: Starts analyzing the raw data of the active document.

Stop Analyze Data: Stops analyzing the raw data of the active document.

File Information...: Displays the record info dialog for the raw data file of the active document.

Start TetraMsc: Starts the TetraMSC application for the active document.

View menu

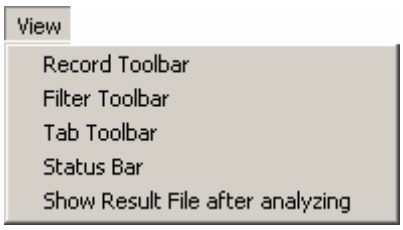
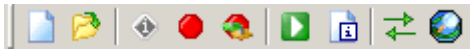
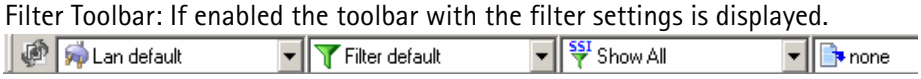


Figure 38 View menu

Record Toolbar: If enabled the main toolbar is displayed.



Filter Toolbar: If enabled the toolbar with the filter settings is displayed.



Tab Toolbar: If enabled the toolbar with the documents is displayed.

Status Bar: If enabled the status bar is displayed.

Show Result File after analyzing: If not enabled the view will not be updated after an analyzing process.

Window menu

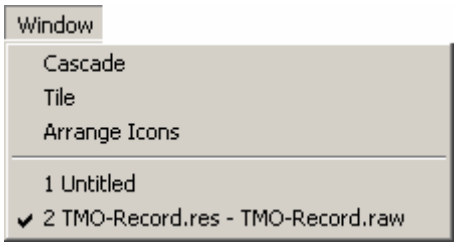


Figure 39 Window menu

Cascade: Cascades the document views.

Tile: Tiles the document views.

Arrange Icons: Arranges minimized document views.

Document view list: In this list of document views you can choose one document which will be displayed on top.

Tools menu

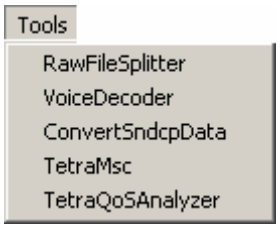


Figure 40 Tools menu

RawFileSplitter: Starts the RawFileSplitter application.

VoiceDecoder: Starts the VoiceDecoder application.

ConvertSndcpData: Starts the ConvertSndcpData application.

TetraMsc: Starts the TetraMsc application.

TetraQoSAnalyzer: Starts the TetraQoSAnalyzer application.

Info menu

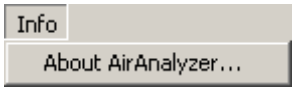


Figure 41 Info menu

About AirAnalyzer...: Opens the About dialog which displays information about the software versions, license information and dongle serial number.

Open config directory: Calls up the Windows Explorer and shows the path of the AirAnalyzer configuration files.

Check online for update: Checks if there is a new version of the AirAnalyzer software package available.

Open documentation: Opens this documentation.

Buttons

opens a new document for analyzing.

loads raw data files (LAN/RAW/TMW/TMV) into the active document.

opens the record information dialog.

/ starts/stops the recording process with the active document.

/ starts/stops the recording process with the active document, but without the record dialog.

/ starts/stops analyzing the raw data of the active document.

displays the record info dialog for the raw data file of the active document.

starts the TetraMsc application for the active document.

starts the TetraQoSAnalyzer application for the active document.

toggle between record types: TMO, DMO and Proprietary.

Document view

The document view displays the analyzed and filtered TETRA protocol components. The data can be saved to and loaded from result files (*.res). Each document has its own unique result file which you have to specify before the first analysis of the raw data file can take place.

If you simply want to work with one window for several successive records, please be sure that the analyzed data is always filtered to the same result file linked to the opened window. If you want the new record analyzed to another result file, please open a new window for each record.

How the decoded data is displayed

The output of the document view is divided into several sections. In the document example in they are additionally used for a better overview of the TETRA protocol components.

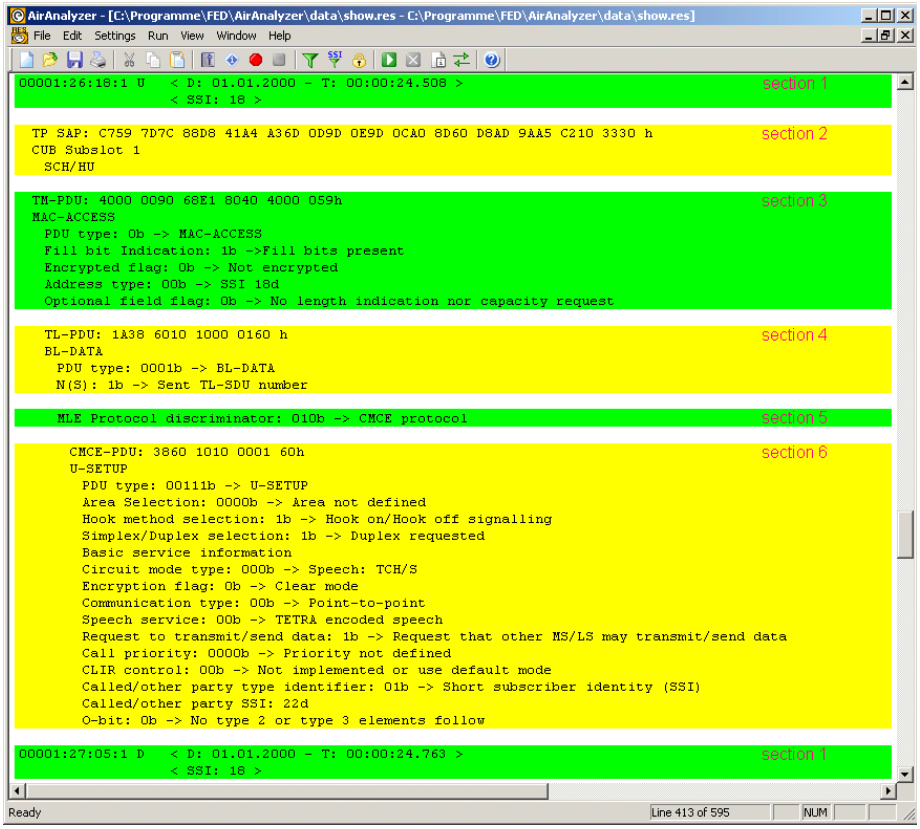


Figure 42 Document view of recorded data

Figure 42 shows an example of an analyzed raw data file. The different sections are highlighted for better understanding and described in Figure 43.

Section 1 contains the timing information for one complete timeslot and always starts within a complete decoded burst. The last line (next section 1) displays the beginning of the next decoded timeslot. Figure 43 explains the coding of the document view in detail.

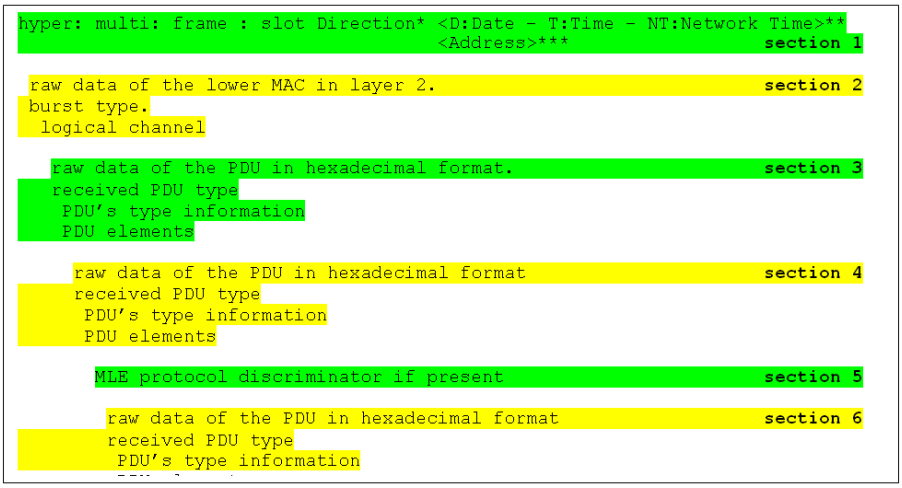


Figure 43 Coding used in the document view

*: D=Downlink, U=Uplink and in DMO Mode CH A = Channel A, CH B = Channel B

**: Display of date, time and network time, can be disabled in general settings

***: Only when address (e.g. SSI, SMI, event label) is found in the message, may be multiple addresses

Note

The raw data of the burst in section 2 is still channel coded.

All the decoded protocol components will be filtered according to the settings in the protocol filter. For more information about the protocol filter see "Protocol filter and analysis settings" on page 49.

Control tags

The result file is a text-based interpretation of the decoded data. Additional control information, called control tags, is placed as text into the result file. You can just ignore these control tags – or use the additional information contained in some of them.

The control tags enhance the MSC display in the TetraMsc. They are indicated in angle brackets. The control tags are used as described below:

<error n> (n is a number) — Changes the message background color in the TetraMsc, normally used to highlight warnings and errors in the trace.

<info_1>, <info_2>, <info_3>, <info_4> and <info_5> — These are used to display text in the leftmost field of the MSC (under the timestamp). They are displayed in their numerical order. <info_1> is used to display the measured power, <info_2> for the measured frequency error and <info_3> for the detected timing error. Currently <info_4> and <info_5> are not used.

< Header present - V1.00 > — A file header V1.00 is found in the analyzed raw file. Due to the fact that there is no information stored in this header version which would be useful to display. The header information always ends with the control tag < End of Header >.

< Header present - V1.01 > — A file header V1.01 is found in the analyzed raw file. The header contents is displayed after this line. The header information always ends with the control tag < End of Header >.

< Header not present > — No file header is found in the analyzed file. Due to the fact that there is no information stored nothing is displayed. The header information always ends with the control tag < End of Header >.

<End of Header > — The header information started with < Header ... > always ends with the control tag < End of Header >.

< SSI: xxx >, < EL: xxx >, < UM: xxx >, < USSI: xxx >, < SMI: xxx > and < P-SSI: xxx > — These control tags contain the address type and address (xxx is used above as a placeholder for the address) used in the message. These addresses are also displayed in the leftmost field of the MSC. An address assign would be displayed as (for example) < UM: xxx = SSI: yyy >.

< GPS: N xx.xxxx; E xx.xxxx > — The control tag contains the GPS position of the AirAnalyzer.

<mobile gps> — The control tag contains the GPS position of a mobile radio. This information is coming from the air interface (i.e. location information protocol LIP or SDS-TL).

< Wrong AddressType: xxx > — This control tag is used when the decoded address type is invalid.

< End of Result-File > — With this line the end of the result file is reached.

< Statistic > — This control tag indicates the start of the statistic output. The statistic contain data about the AACH and decodable and undecodable bursts. It is only present in TMO-Records. The statistic information always ends with the control tag < End of statistic >.

< End of statistic > — With this line the statistic section ends.

GPS settings

The GPS dialog box (see Figure 45) sets up GPS receiver settings for the TETRA AirAnalyzer software. You can open it from the Settings pulldown menu (see Figure 44).

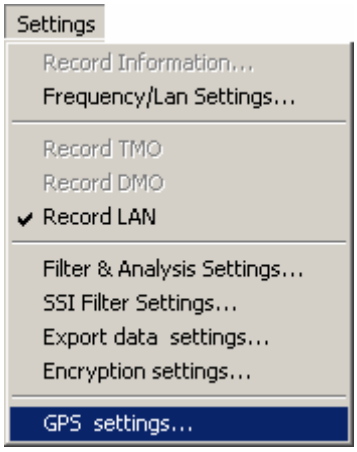


Figure 44 Opening the GPS settings menu

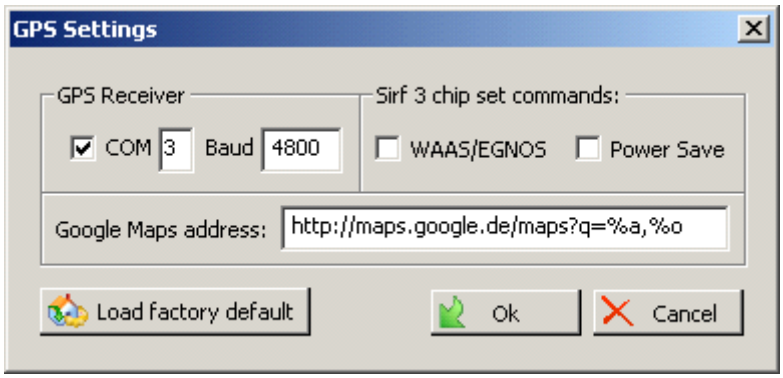


Figure 45 General settings dialog box

Note

If no GPS receiver is connected, the status line will display "No GPS".

GPS receiver

Sets up the COM port and data rate of the GPS receiver. Please note that the COM port will change if you use a different USB port.

Sirf 3 chip set commands

GPS receivers with a Sirf3 chip set provide some spezial features like WAAS/ EGNOS or energy saving mode. Set up the functions you want to use here.

Google maps address

Set up the service address you want to use to display the location information. By default, Google Maps is used. Please note that this service requires an Internet connection.

Record information

The Record File Header dialog defines notes about the next record. This information will be written into the file header of the raw file. The raw-file information will be displayed in the result file.

The same information will be written to all recorded raw files until you change it.

To open the Record Information dialog box select **Settings > Record Information** (see Figure 46) or press the button.

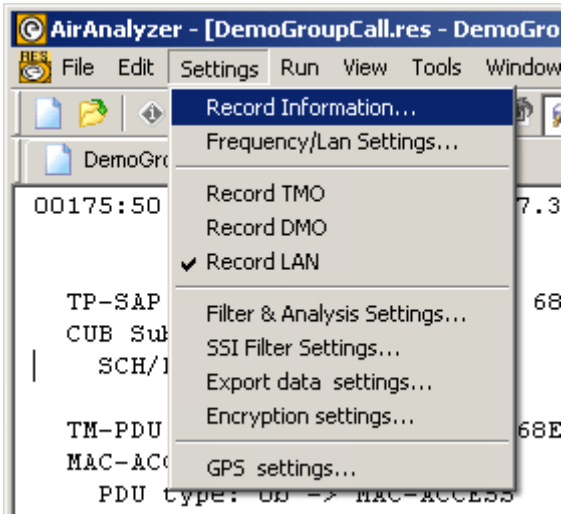


Figure 46 Open the Record File Header dialog

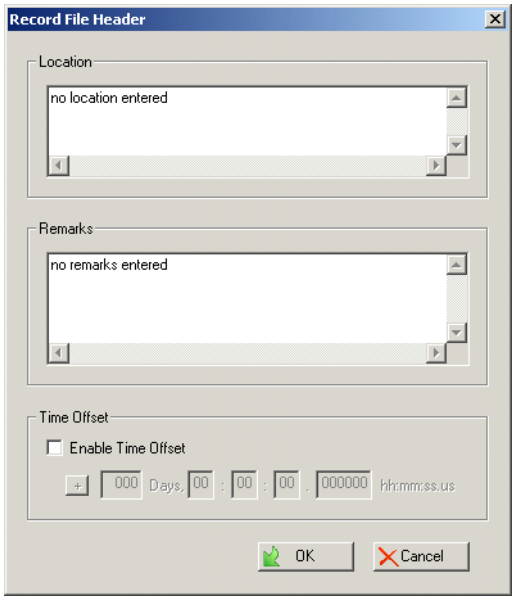


Figure 47 Record File Header dialog

After recording a raw file, these values can be changed using the File Information dialog (see "The raw data format" on page 86).

Time Offset — Enables you to create a time offset. This will affect the time information displayed in the result file. It is used to synchronize the air trace with external traces.

Frequency/Proprietary settings

The Frequency/Proprietary dialog box determines the TETRA AirAnalyzer's monitoring frequency or Proprietary receiving port. Open the dialog box for the Frequency/Proprietary settings in the settings menu or with the Record drop-down box (see Figure 48).

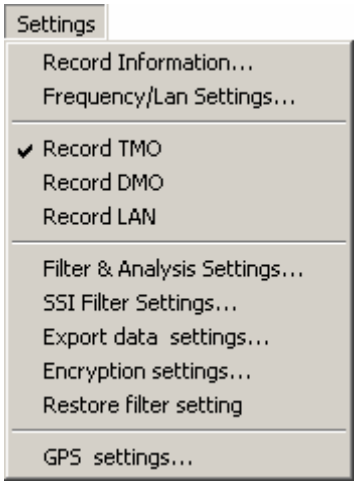


Figure 48 Opening the Frequency/Proprietary settings dialog box

Setting up the frequency

Depending on the record mode (TMO or DMO), the dialog box for the Frequency settings shown in Figure 49 or Figure 50 will be displayed. Both are very similar; in DMO mode the setting for the second frequency (uplink in TMO mode) is not available.

To import settings from an external file, click on **Load**.

To store the setting to a file, click on **Save**. The name of the setting is displayed in the dialog. If you don't save the settings all information will be discarded after closing the AirAnalyzer application.

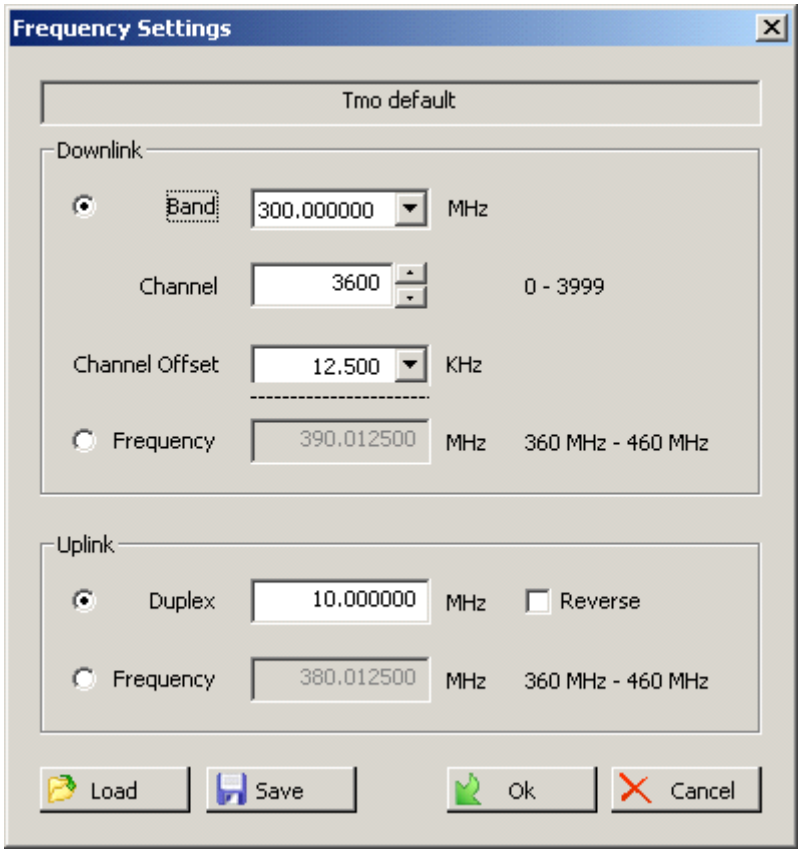


Figure 49 Frequency settings of the AirAnalyzer software in TMO mode

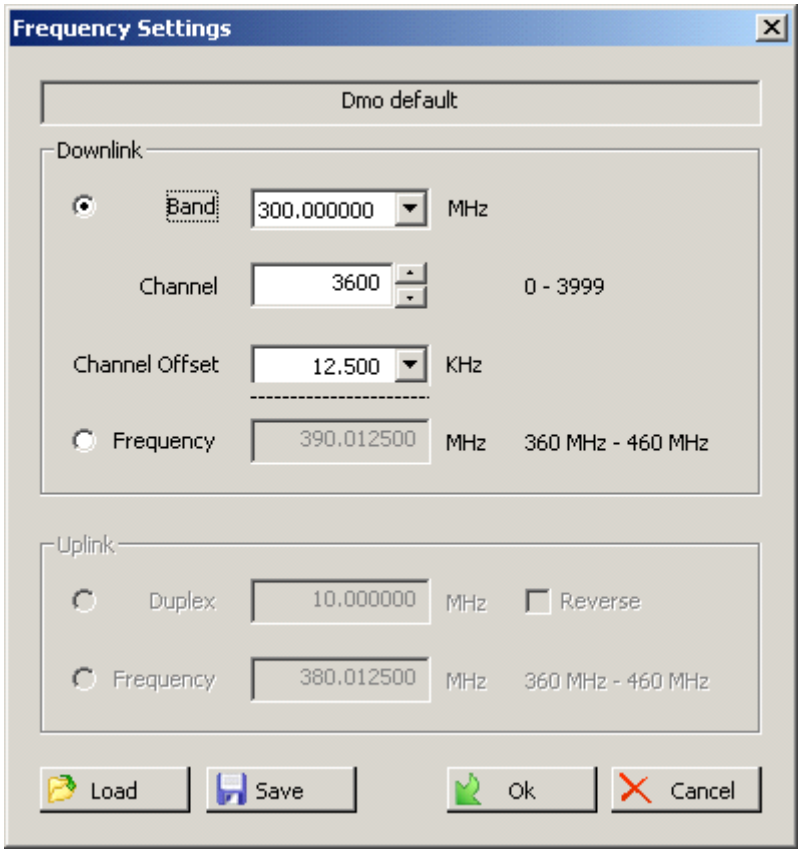


Figure 50 Frequency settings of the AirAnalyzer software in DMO mode

Downlink frequency

There are two different ways of setting up a carrier frequency. The first way describes the carrier frequency as a combination of frequency band, channel number and offset (+12.5 kHz, ±6.25 kHz). The carrier frequency will be calculated automatically.

Alternatively, you can enter the frequency in MHz directly.

TMO uplink freqency

Select the duplex spacing, or enter the uplink frequency directly.

Note

In DMO, the Uplink section is disabled because DMO is operated on a single frequency carrier (no duplex spacing).

Parameters

Band — sets the frequency band of the downlink carrier, in MHz

Channel — sets the frequency channel number

Channel Offset — sets the offset between frequency channels, in kHz

Frequency — sets the (downlink or uplink) frequency directly

Duplex — sets the duplex spacing

Reverse — sets the uplink frequency above the downlink frequency

Proprietary interface settings

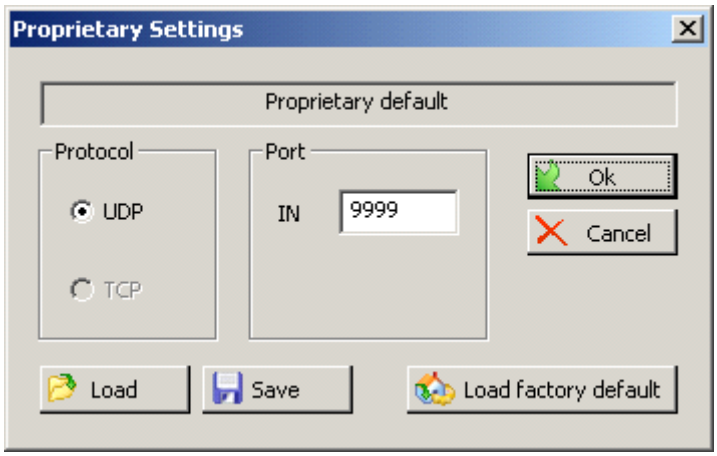


Figure 51 Proprietary settings

To import setting from an external file, click on **Load**.

To store the settings to a file, click **Save**. The name of the settings file is displayed in the dialog. If you don't save the settings all information will be discarded after closing the AirAnalyzer application.

Protocol filter and analysis settings

The protocol filter is a powerful feature. It allows the user to focus on the desired information of the TETRA protocol. The protocol filter can hide slots, frames, PDU and layer information for each layer.

With the protocol filter the user has the ability to hide unnecessary protocol information for a better overview of the relevant data. As opposed to SSI, layer 2 and layer 3 filters, which are used after the analysis process, the layer 1 filter works before this process. Therefore, the bounded up-/downlink, frames and slots of layer 1 will not be analyzed any further, i.e. they are cut out of the analysis.

All filtered components due to SSI, layer 2 and layer 3 filter will not be displayed in the document view, though they are still available for analysis in the logically following layers.

All filter settings can be stored in separate files. The AirAnalyzer software starts with the last selected filter setting.

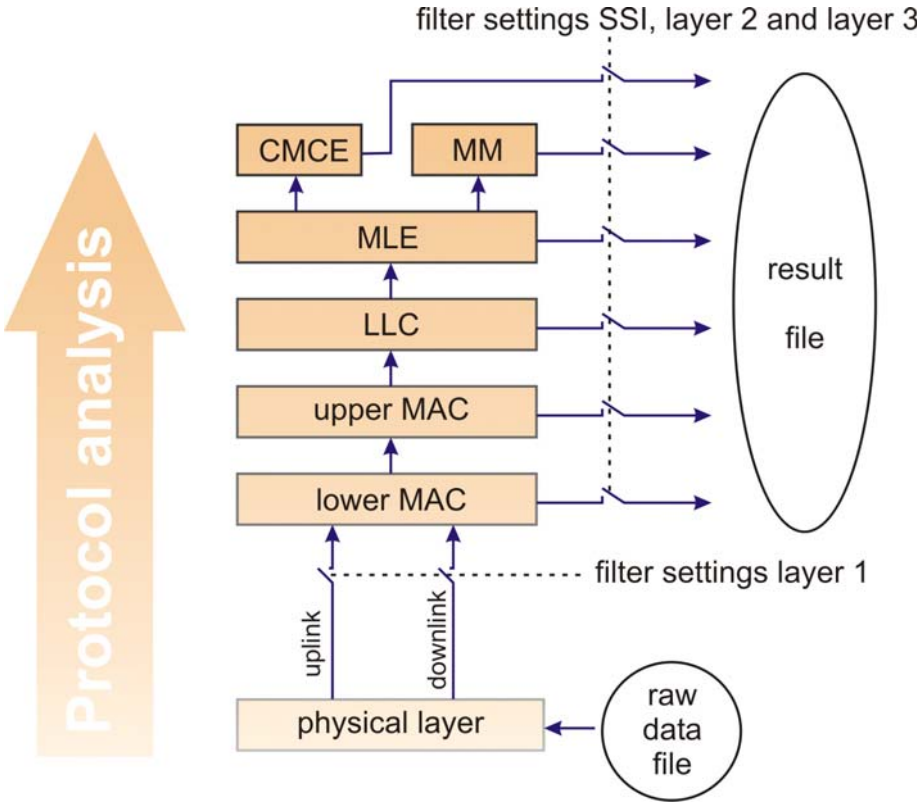


Figure 52 Protocol filter workflow of the AirAnalyzer software

Setting up the filters

Open **Edit > Filter Property**. Alternatively you can use the Filter button in the record dialog. You may also open the dialog via the settings menu.
The dialog box shown in Figure 53 appears.

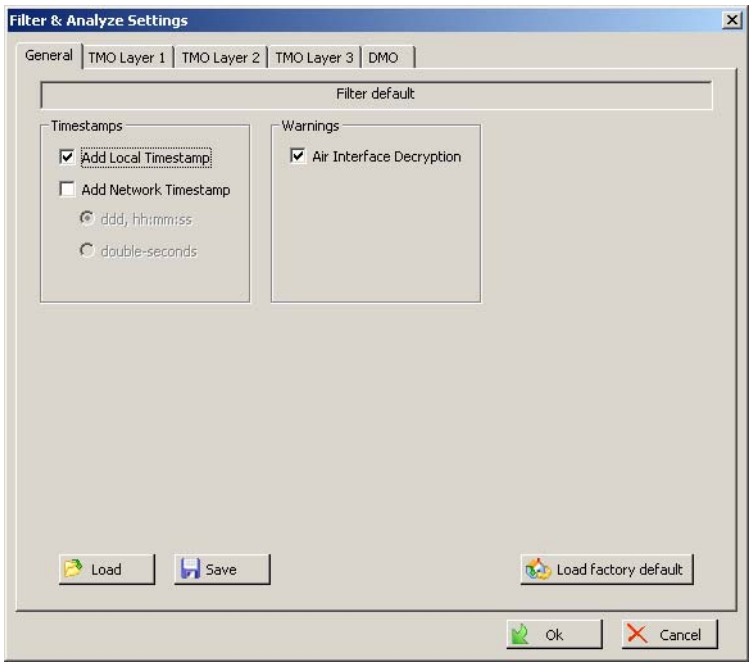
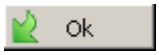


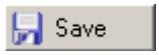
Figure 53 The general filter settings of the AirAnalyzer software

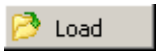
To see the changes in the main window, the raw data has to be re-analyzed by clicking on the Start Analysis button  in the main window.

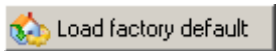
Buttons

 applies the filter and closes the dialog.

 discards all changes.

 saves the settings of all layers to a file.

 loads the settings for all layers from a file.

 loads the factory default settings.

Timestamps

Time stamps add time information for each slot. This information may be valuable when examining the sequence of events and the timing on the higher protocol layers.

Add Local Timestamp: This will display the recorded time of the slot (normally UTC), derived from the PC clock during recording. There is no support on LAN files for this feature. Raw files recorded with an AirAnalyzer software below version 3.0 do not support local timestamps. In this case the AirAnalyzer uses 1 January 2000 as a starting point.

Note

If time offset (see "Record information" on page 44) is used, this time is added to the recorded time in the raw file.

Add Network Timestamp: This will display the latest received network time if available in the D-NWRK-BROADCAST PDU, even if this PDU is filtered. It will not automatically be counted! Choose between the double-second format (as on the air interface) or the calculated Day/Clock version.

Warnings

Enables or disables the warnings of the AIE module.

Note

Only available with Air Interface Encryption Option.

TMO Layer 1

The filter settings for layer 1 (see Figure 54) exclude the unselected protocol components, so that they will not be available for further analysis in the following layers. For a detailed description of each filter setting see the tables below.

DownLink — selects or deselects the entire downlink or just one timeslot or frame.

UpLink — selects or deselects the entire uplink or just one timeslot or frame.

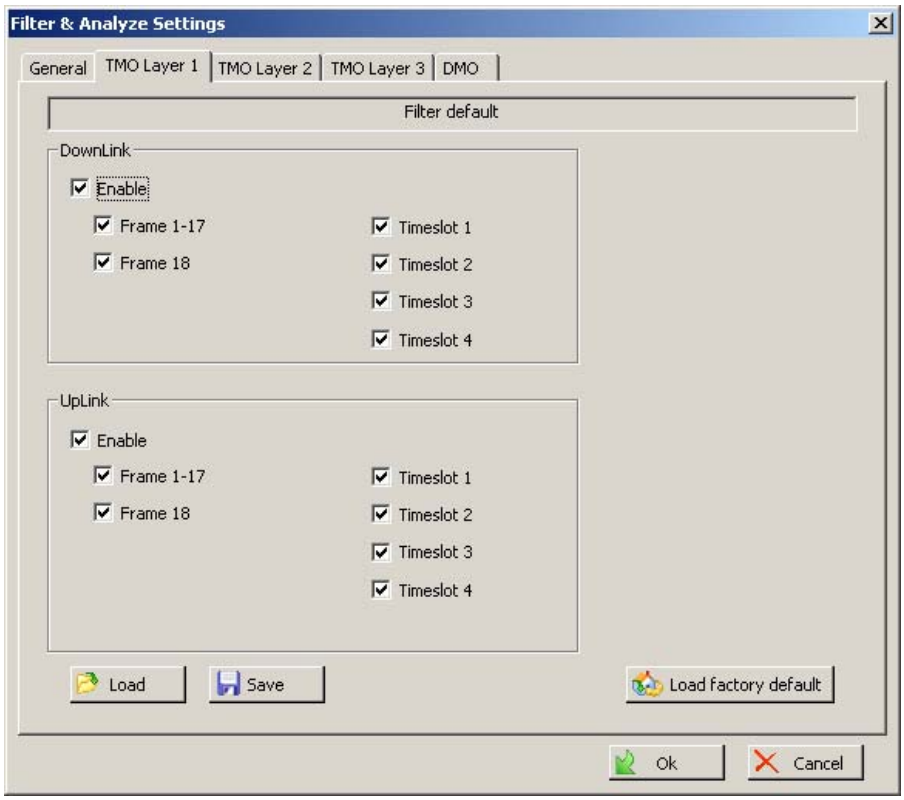


Figure 54 Filter settings for TMO Layer 1

The following tables describe which of the protocol components will be analyzed and displayed if the corresponding box is checked.

Table 2 Downlink filter settings for TMO layer 1

Filter setting	Description
Downlink Enable	The complete downlink information passes the filter
Frame 1–17	All downlink information from frames 1 – 17 passes the filter
Frame 18	All downlink information from frame 17 passes the filter
Timeslot (n)	All downlink information from timeslot (n) passes the filter

Table 3 Uplink filter settings for TMO layer 1

Filter setting	Description
Uplink Enable	The complete uplink information passes the filter
Frame 1–17	All uplink information from frames 1 – 17 passes the filter
Frame 18	All uplink information from frame 17 passes the filter

Table 3 Uplink filter settings for TMO layer 1

Filter setting	Description
Timeslot (n)	All uplink information from timeslot (n) passes the filter

TMO Layer 2

This section describes the filter settings for layer 2 in detail.

The filter settings for layer 2 (see Figure 55) hide the unselected protocol information. These protocol components will still be available for analysis in the layers above layer 2. For a detailed description of each filter setting see the tables below.

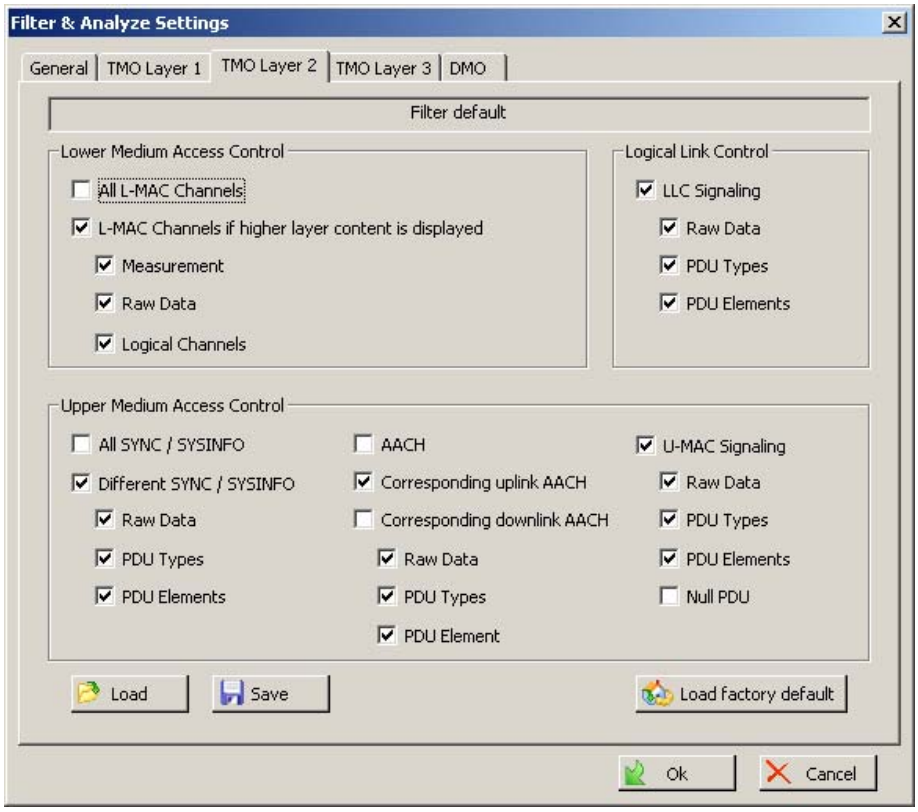


Figure 55 Filter settings for TMO Layer 2

L-MAC — enables or disables the Lo Mac and its raw data, logical channel or measurement data

L-MAC (only if higher layer...) — L-MAC messages will only be displayed if any higher layer message occurs

LLC — enables or disables raw data, PDU types and PDU elements

All Sync/Sysinfo and Different SYNC/Sysinfo — shows all broadcast PDUs or suppresses all equal broadcast PDUs

AACH — can be displayed in the corresponding down or uplink, too

U-MAC Signaling — enables or disables raw data, PDU types and elements for broadcast, signaling and AACH. The Null PDU is switched separately from other PDUs

Table 4 L-MAC filter settings for TMO Layer 2

Filter setting	Description
All L-MAC Channels	Information from the L-MAC sub-layer is enabled for all messages
L-MAC Channels if higher layer content is displayed	Information from the L-MAC sub-layer is enabled for messages where higher layer content is displayed
Measurement	Display of layer 1 measurement values for every time slot analyzed (RSSI, frequency error, timing error)
Raw Data	The unformatted raw data of the L-MAC sub-layer is displayed
Log. channels	Logical channels of the L-MAC sub-layer are displayed

Table 5 Logical Link Control filter settings for TMO Layer 2

Filter setting	Description
LLC Signaling	When checked, displays the complete information of the LLC sub-layer
Raw Data	When checked, displays the unformatted raw data of the LLC sub-layer
PDU Types	When checked, displays the type information about the PDUs of the LLC sub-layer
PDU Elements	When checked, displays the data within the PDU elements of the LLC sub-layer

Table 6 Upper Medium Access Control broadcast filter settings for TMO layer 2

Filter setting	Description
All Sync/Sysinfo	Display of information of the U-MAC sub-layer is enabled for all broadcast messages
Different Sync/Sysinfo	Display of information of the U-MAC sub-layer is enabled only for broadcast messages with different content
Raw Data	Display of the unformatted raw broadcast data of the U-MAC sub-layer
PDU Types	Display of the type information about the broadcast PDUs of the U-MAC sub-layer

Table 6 Upper Medium Access Control broadcast filter settings for TMO layer 2

Filter setting	Description
PDU Elements	Display of the data of the U-MAC broadcast PDU elements

Table 7 Upper Medium Access Control AACH filter settings for TMO Layer 2

Filter setting	Description
AACH	all U-MAC Access Assign PDU information displayed in the corresponding uplink
Corresponding Uplink AACH	all U-MAC Access Assign PDU information displayed in the corresponding uplink
Corresponding Downlink AACH	all U-MAC Access Assign PDU information displayed in the corresponding downlink
Raw Data	the unformatted raw AACH data of the U-MAC sub-layer
PDU Types	the type information about the AACH PDUs of the U-MAC sub-layer
PDU Elements	the data of the U-MAC AACH PDU elements

Table 8 Upper Medium Access Control signaling filter settings for TMO Layer 2

Filter setting	Description
U-MAC Signaling	all U-MAC signaling information
Raw Data	the unformatted raw signaling data of the U-MAC sub-layer
PDU Types	the type information about the signaling PDUs of the U-MAC sub-layer
PDU Elements	the unformatted raw AACH data of the U-MAC sub-layer
PDU Types	the data of the U-MAC broadcast PDU elements
Null PDU	all U-MAC null PDUs

TMO Layer 3

This section describes the filter settings for layer 3 in detail.

The filter settings for layer 3 (see Figure 56) hide the unselected protocol information. These protocol components will still be available for the analysis in the upper layers. For a detailed description of each filter setting see the tables below.

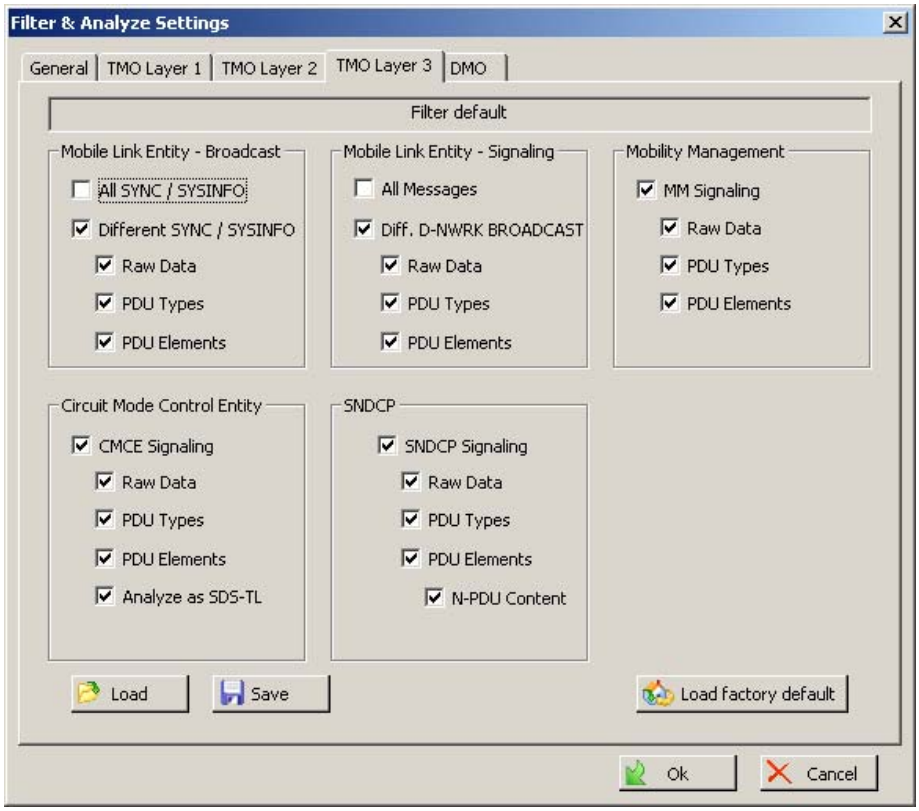


Figure 56 Filter settings for TMO Layer 3

MLE — enables or disables raw data, PDU types and elements for broadcast and signaling

MM — enables or disables raw data, PDU types and PDU elements

CMCE — nables or disables raw data, PDU types and PDU elements

SNDCP — enables or disables raw data, PDU types and PDU elements

Table 9 Mobile Link Entity broadcast filter settings for TMO Layer 3

Filter setting	Description
All SYNC / SYSINFO	information of the MLE sub-layer is enabled for all broadcast messages (i.e. MLE-SYNC PDU, MLE-SYSINFO PDU)
Different SYNC / SYS-INFO	information of the MLE sub-layer is enabled for broadcast messages with different content
Raw Data	the unformatted raw broadcast data of the MLE
PDU Types	the type information of the broadcast PDUs in the MLE
PDU Elements	the data of the MLE broadcast PDU elements

Table 10 Mobile Link Entity signalling filter settings for TMO Layer 3

Filter setting	Description
All Messages	all MLE signaling information
Diff. D-NWRK-BROAD-CAST	all MLE signaling information, and D-NWRK-BROADCAST PDUs only when different
Raw Data	the unformatted raw signaling data of the MLE
PDU Types	the type information of the signaling PDUs in the MLE
PDU Elements	the data of the MLE broadcast PDU elements

Table 11 Mobility Management filter settings for TMO Layer 3

Filter setting	Description
MM	the complete information of the Mobility Management
Raw Data	the unformatted raw data of the Mobility Management
PDU Types	the type information of the Mobility Management PDUs
PDU Elements	the data of the Mobility Management PDU elements

Table 12 Circuit Mode Control Entity filter settings for TMO Layer 3

Filter setting	Description
CMCE	the complete information of the Circuit Mode Control Entity
Raw Data	the unformatted raw data of the CMCE
PDU Types	the type information of the CMCE PDUs
PDU Elements	the data of the CMCE PDU elements
Analyze as SDS-TL	the data of SDS-TL (uncheck this parameter if the SDS contains no SDS-TL data)

Table 13 SNDCP filter settings for TMO Layer 3

Filter setting	Description
SNDCP	the complete information of SNDCP Entity (packet data)
Raw Data	the unformatted raw data of the SNDCP
PDU Types	the type information of the PDUs in the SNDCP

Table 13 SNDCP filter settings for TMO Layer 3

Filter setting	Description
PDU Elements	the data of the PDU elements in the SNDCP
N-PDU Content	higher layer content (IP-data)

DMO This section describes the filter settings for DMO in detail.

Note

DMO is an option to the AirAnalyzer software. Please consult your Willtek sales representative for more information.

The filter settings for DMO (see Figure 57) hide the unselected protocol information. These protocol components will still be available for the analysis in further layers. For a detailed description of each filter setting see the tables below.

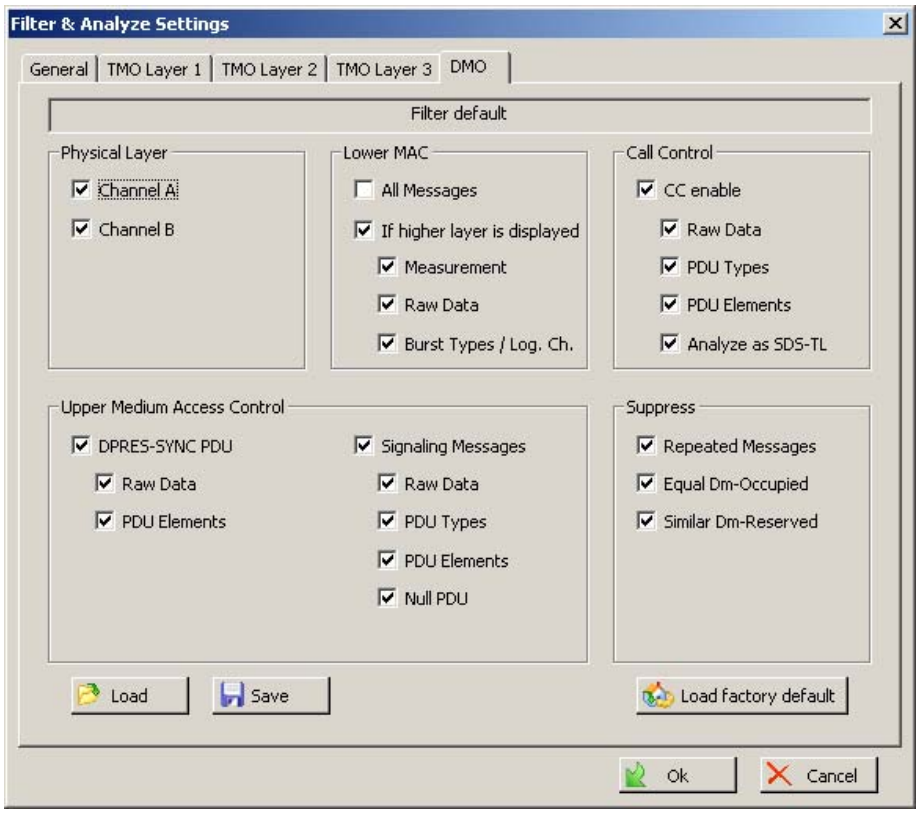


Figure 57 Filter settings for DMO

Physical Layer — enables or disables Messages on Channel A and B

L-MAC — enables or disables the Lo Mac and its raw data, logical channel / burst types or mesurement data. If used L-MAC (with higher Msg.) the L-MAC messages will only be displayed if any higher layer message occurs

CC — enables or disables raw data, PDU and PDU elements

Upper MAC — enables or disables raw data, PDU types and elements for DpresSync and signaling

Supress — enables suppressing of repeated Messages, Equal Dm-Occupied and similar Dm-Reserved

Table 14 Physical Layer filter settings for DMO

Filter setting	Description
Channel A	the complete information of channel A (normal mode and frequency efficient mode)
Channel B	the complete information of channel B

Table 15 Lower MAC filter settings for DMO

Filter setting	Description
L-MAC (all Msg.)	information of the L-MAC sub-layer is enabled for all messages
L-MAC (with higher Msg.)	information of the L-MAC sub-layer is enabled for messages where higher layer content is displayed
Measurement	display of layer 1 measurement values for every analyzed time slot (RSSI, frequency error, timing error)
Raw Data	the unformatted raw data of the L- MAC sub-layer
Burst Types & Log. Ch.	the messages in the logical channels of the L-MAC sub-layer

Table 16 Call Control filter settings for DMO

Filter setting	Description
CC enable	the complete information of the Call Control layer
Raw Data	the unformatted raw data of the CC layer
PDU Types	the type information of the CC PDUs
PDU Elements	the data of the CC PDU elements
Analyze as SDS-TL	the data of SDS-TL, disable this when SDS contain customer specific data

Table 17 Upper MAC Dpres-Sync filter settings for DMO

Filter setting	Description
DPres-Sync	all DPres-Sync information
Raw Data	the unformatted raw data of the DPres-Sync
PDU Elements	the data of the DPres-Sync PDU elements

Table 18 Upper MAC signaling filter settings for DMO

Filter setting	Description
Signaling	all U-MAC signaling information
Raw Data	the unformatted raw signaling data of the U-MAC sub-layer
PDU Types	the type information about the signaling PDUs of the U-MAC sub-layer
PDU Elements	the data of the U-MAC broadcast PDU elements
Null PDU	all U-MAC null PDUs

Table 19 Supress filter settings for DMO

Filter setting	Description
repeated Messages	repeated messages (without Dm-Occupied and Dm-Reserved)
equal Dm-Occupied	equal Dm-Occupied
similar Dm-Reserved	similar Dm-Reserved messages

SSI Filter

The SSI filter is able to filter the analyzed data for specific (G)SSIs, so that only specified mobiles and/or groups will be displayed.

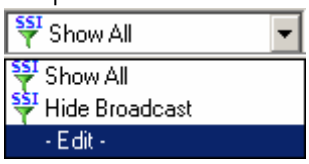
To display the existing SSI numbers of the current trace, analyze it once before opening the SSI filter settings. After pushing the Activate Filter button, the included SSIs of the raw data file will be displayed in the left pane.

Note

After editing the SSI filter settings the raw data has to be analyzed again, so that changes in the document window will take effect.

Setting up the SSI filter

To open the SSi Filter dialog, click on "Edit" in the SSI Filter dialog box.



Alternatively, click the **SSI filter** button in the Record dialog. You may also open the dialog via the Settings menu.

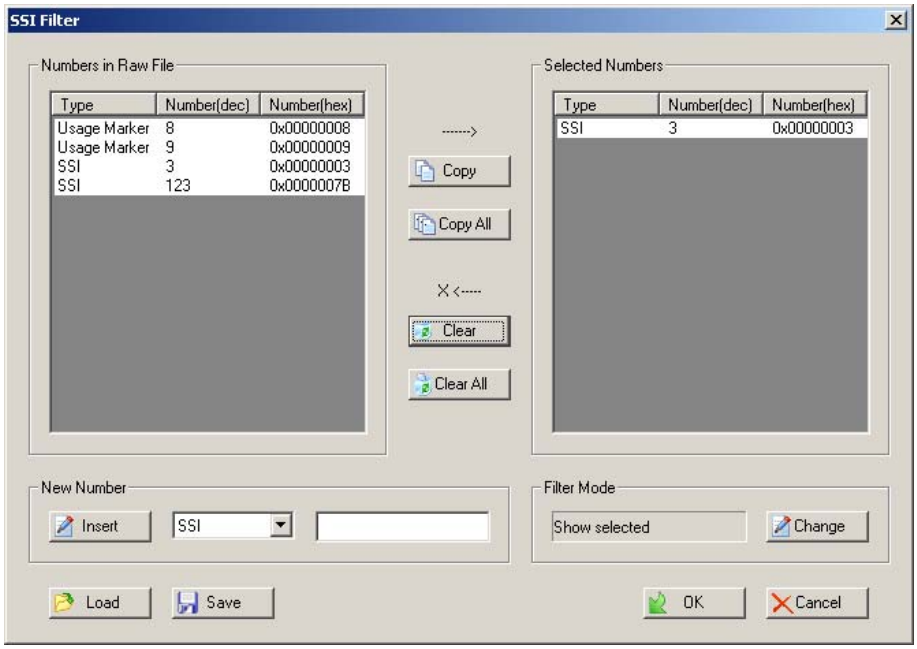


Figure 58 SSI filter of the AirAnalyzer software

To use the SSI filter, the SSI filter has to be activated first. If the raw data file has been analyzed before, the available SSI numbers will be displayed in the left pane. If the raw data file has not been analyzed before, the displayed SSI numbers might be out of date or no numbers might be displayed.

The SSI filter offers three modes: Show selected, Show all and Hide Broadcast SSI. The current mode is displayed in the text field left to the change button.

If the SSI filter is deactivated nothing is filtered. In the Show selected mode, only messages from SSIs in the right pane are displayed.

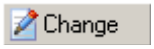
In the special mode Hide Broadcast SSI, only messages to the broadcast SSI are filtered, all other messages are displayed.

You can also enter an SSI number manually in the lower left field of the dialog box.

Additionally, the SSI filter can filter for some other address types: USSI, SMI. They are used in the same way as the SSIs described above. Event Labels are little different: When selected they are displayed until the next assign to an SSI / SMI. After this assign filtering depends on the SSI / SMI it is assigned to, when this SSI / SMI is selected to display, messages with the assigned Event Label will also

be displayed. So usually, it is not necessary to choose an event label in addition to the SSI / SMI. This may only be useful if the assignment is not in the trace (e.g. Event Label is assigned before the recording).

Buttons



toggles between the SSI filter modes.

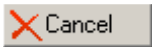
and 

move the SSI identities to the right pane.

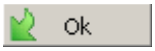
inserts the entered SSI identities to the right pane.

and 

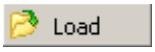
remove the SSI identities from the right pane.



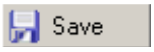
discards all changes.



applies the filter and close the window.



loads an SSI filter list from file.



stores an SSI filter list to file.

To see the changes in the document view, re-analyze the raw data by clicking on  .

If the right pane is empty and the filter is active the document view will not display any messages.

Export settings

The export settings define which additional data from the current recording are exported.

To see the changes the raw data has to be re-analyzed by clicking on the  button in the main window.

Setting up the export settings

In the Filter toolbar, click on **Edit** to open the Export dialog box. Alternatively, click on the Export button in the Reord dialog, or open the dialog via the settings menu.

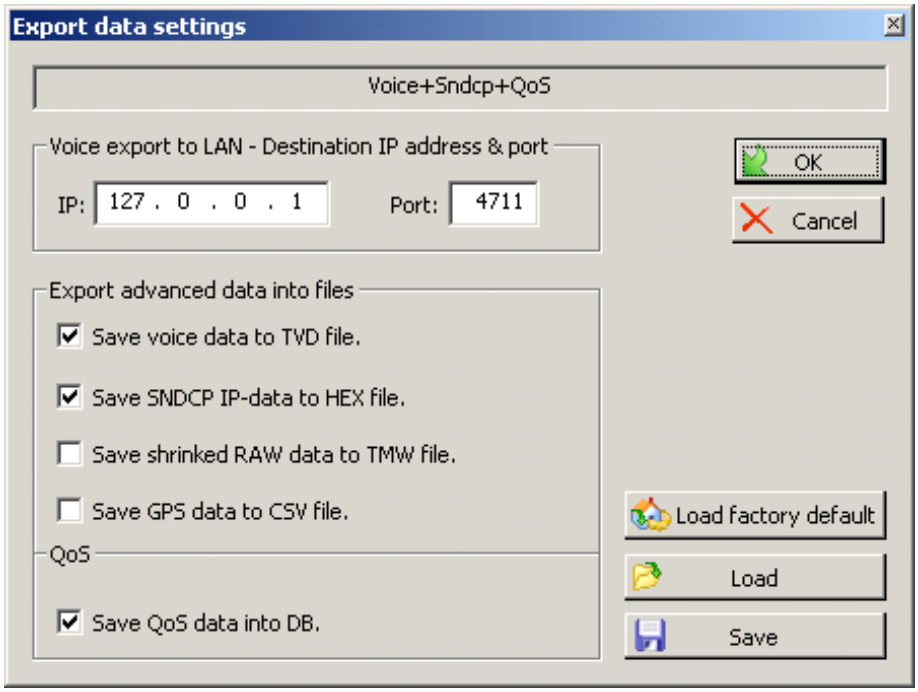


Figure 59 Export Settings dialog

Voice export to Lan — sends voice data to the voice decoder application.

Save voice data to TVD file — generates TVD voice data file.

Save SNDCP IP-data to HEX file — exports packet data files in HEX format.

Save shrinked RAW data to TMW file — creates a TMW file for faster re-decoding.

Save GPS data to CSV file — saves GPS data in a CSV file.

Save QoS data into DB — creates a database file for QoS.

Please note that all the created filenames are derived from the raw data file-name. The files are created in the raw file directory.

Buttons

Cancel — discards all changes.

Ok — apply the filter and close the window.

Load — loads an SSI filter list from file.

Save — stores an SSI filter list to file.

Load factory default — loads the factory default settings.

Record dialog

The Record dialog controls all the important settings for recording and, if enabled, online analysis.

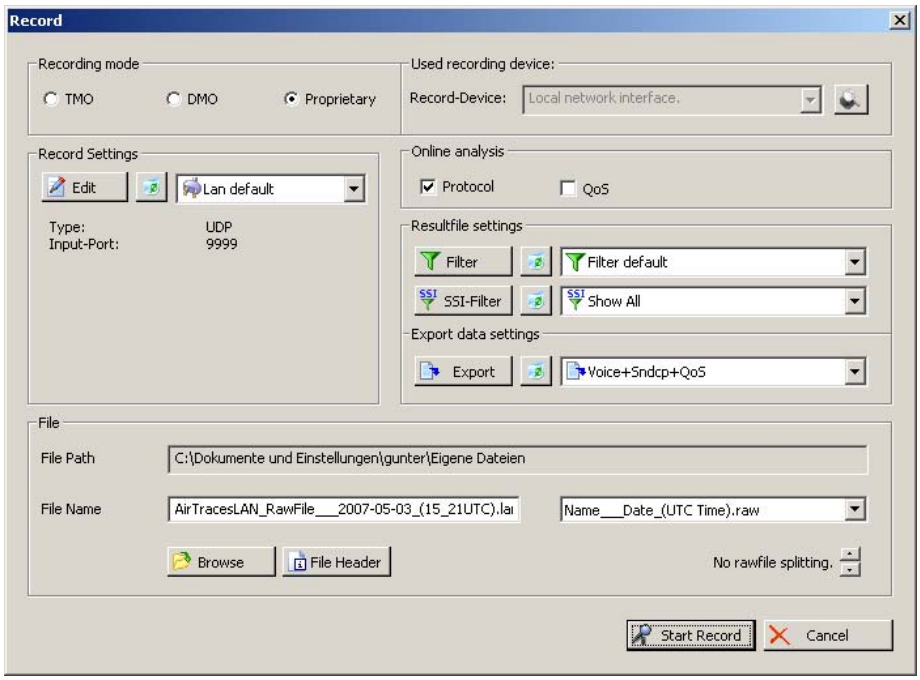


Figure 60 Record dialog

Buttons

Start Record starts the record with the current settings.

Cancel will discard all changes you have made.

deletes the selected setting.

Mode

Choose a record mode (TMO, DMO or Proprietary). This can also be done directly in the settings menu.

Selecting a recording device

The drop-down box

is used to select an AirAnalyzer recording device. It is also possible to insert a IP-address and port number to select a device directly (format "IP-ADDRESS:PORT).

Use button to search for AirAnalyzer devices in the network.

Record settings

Select a previously entered setting or press button Edit to open the Frequency Settings Dialog >Proprietary Settings dialog. The content of the current setting is displayed below the dropdown box.

Online analysis

If protocol online analysis is checked Protocol, the AirAnalyzer will start displaying the decoded messages instantly upon starting the TetraMsc application.

The TetraQoSAnalyzer will be started if QoS is selected. In order to run the online QoS analysis you must enable QoS export. QoS is not available in DMO or proprietary mode.

Result file settings

If protocol online analysis is activated Protocol, you can change the filter Filter or SSIfilter settings SSI-Filter or choose a filter or SSI filter file directly with the dropdown box.

Note

The online analysis will use the current filter settings of the AirAnalyzer application. This may result in an unexpected count of messages per time.

Export data settings

You can change the export file settings with the Export button or choose a setting direct with the dropdown box.

File

In the File Path field the current working directory is displayed. The Browse button changes the working directory. The filename is entered in the field below.

The dropdown field "Time and Date" adds time and date information to the raw file name. There are several formats available (see Figure 34), where "Name" means the file name entered.

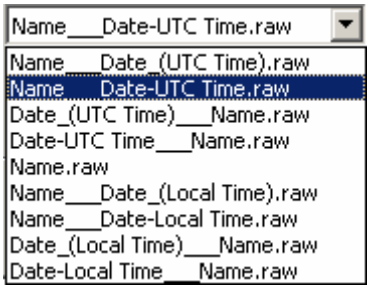


Figure 61 Time and date

File Header

The File Header button opens the Record Information menu. See "Record information" on page 44 for more details.

Split File After

To prevent large raw files the AirAnalyzer software will change the recorded raw file after the entered time. The minimum length is 1 hour and the maximum length is 25 hours.

The new raw file contains the last minute of the previous file (except in record mode Proprietary), the new raw file name will be the old one extended by a number.

Online analysis will automatically restart with the changed file.

About

Figure 62 About dialog

The About dialog shows information about your AirAnalyzer software including the version number, your license name and your dongle number.

The More button displays information about additional software components.

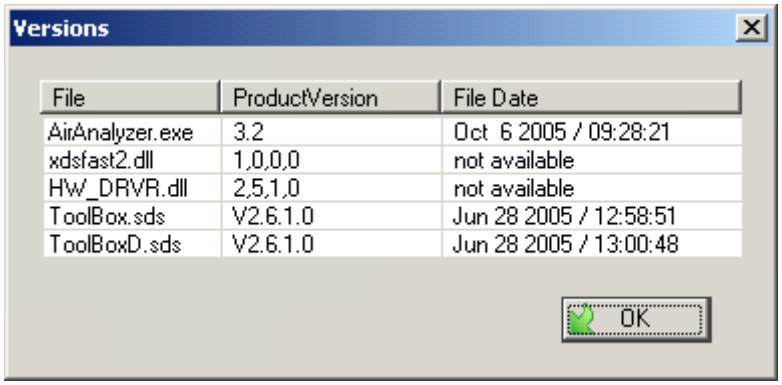


Figure 63 Versions dialog

Working with the AirAnalyzer

Recording

The recording function of the TETRA AirAnalyzer records raw data from the TETRA AirAnalyzer or from the Proprietary interface.

These files can be opened afterwards for further analysis.

1 Click the button to open the record dialog (see "Record dialog" on page 64).

2 Choose one of the following sources for recording data: Air Interface with the 8140 TETRA AirAnalyzer (Record TMO and Record DMO) or Proprietary interface. This can also be done from the settings menu (**Settings > Record TMO/DMO/Proprietary**).

3 Now select a frequency or Proprietary setting (depending on the record mode) in the dropdown box inside the Settings group. Or use the Edit button to enter new settings in the frequency dialog or the Proprietary settings dialog.

4 Enable or disable the Online Analysis. When activated you may change the Filter filter or SSI-Filter SSI-filter settings, or choose a filter or SSI-filter file direct with the dropdown box.

5 Use the Export button to export voice, QoS or packet data information.

6 Now choose a filename and path (or leave the one proposed) and press the Start Record button to start recording.

7 When you have collected enough data, stop recording by clicking the button in the main window. Alternatively, you can use the Stop button within the recording dialog.

Note

If the Online Analysis is activated please note that the TetraMsc application will start automatically and messages are displayed online.

You should be aware that a raw data file is created on the hard disk with a data input speed of about 18 kbyte/s (1 Mbyte/min). This will be the file that is analyzed in the following process.

If you would also like to create a file format that is smaller you should activate the writing process for a TMW file to increase the analyzing speed for future analysis. The raw data file will always be created!

Air Interface

When recording Air Interface data from the 8140 TETRA AirAnalyzer the AirAnalyzer software has to detect the device. Please follow the instructions below.

Initial steps

1 Turn the 8140 TETRA AirAnalyzer on before the AirAnalyzer software is started. Now a self test is executed. After a second the self test for power on should be completed. Only the power LED should be on, i.e. glowing green. If all LEDs, except the power LED, are off after turning on the power, the device is ready for use. To make sure that the TETRA AirAnalyzer is operating according to the specifications, it should run for at least 10 minutes prior to recording to gain optimal operating temperature.

2 Now, start the software on the PC to trace the operation of the TETRA components.

Note

If the TETRA AirAnalyzer is reconnected to the PC (because the parallel port cable was disconnected or the TETRA AirAnalyzer was turned off) the software has to be restarted before a record can be started again. The hardware has to be reinitialized.

Record information

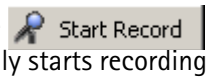
When you record from the 8140 TETRA AirAnalyzer (Record TMO and Record DMO) you can enter additional information for the header of the raw file.

1 Press the  button to open the record information dialog, or select **Settings > Record Information**.

2 In the dialog (see "Record information" on page 44) you can enter information about the location where the trace is recorded and comments about the trace, e.g. what kind of problem you are searching for.

Starting to record

1 Before you start the recording process you have to choose the frequencies. Open the frequency dialog and enter the desired values.

2 In the record dialog, click the 

button.
Before the AirAnalyzer actually starts recording, you will be asked to specify a name and location for the file to save the raw data. You should be aware that a raw data file is created on the hard disk with the data input speed of about 18 kbyte/s (1 Mbyte/min). This will be the file that is analyzed in the following process.

3 If you also would like to create a file format that is smaller you should activate the writing process for a TMW file to increase the analyzing speed for future analysis. The raw data file will always be created!

After pressing the record button the following dialog will appear:

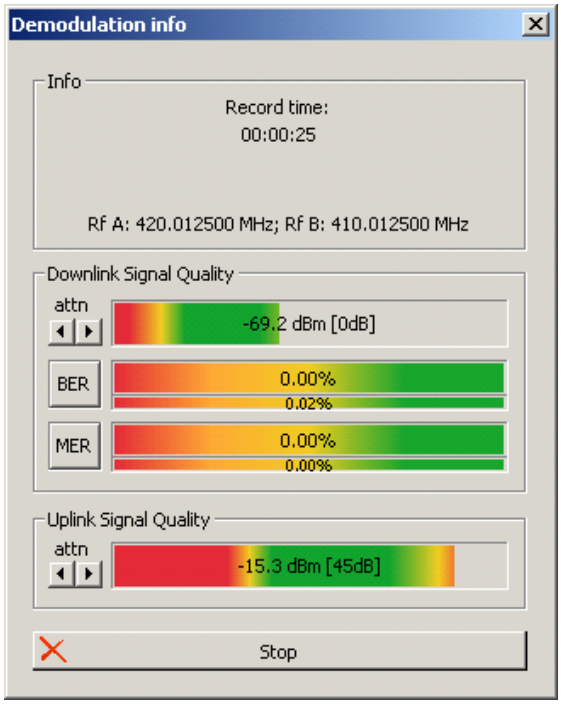


Figure 64 Demodulation info while recording data

During the recording process an animated line will be displayed in the info field. The record time and used frequencies were also displayed.

For optimal results adjust the downlink attenuators (15, 30, 45 dB) so that the RSSI color is green. If the signal level is becoming too high the color will fade from green to yellow/red.

The setting of the uplink attenuation depends on your needs. To monitor mobiles very close to the 8140, use the maximum attenuation of 45 dB. For field measurements the uplink attenuation is usually 0 dB.

Info — displays Information about the monitoring process.

RSSI — displays the signal strength for downlink (left) and uplink (right). When it is depicted in green a signal has been received, yellow means that no signal has been received. If it becomes red on the top you should add additional attenuation. The number in the top part is the currently used attenuation setting.

min.Att. DL — the minimum attenuation in the downlink, the TETRA AirAnalyzer may apply additional attenuation. This protects the receiver against exceeding levels.

Attn. UL — adjusts the attenuation for the receiver to protect against exceeding levels.

Stop — stops the recording.

Proprietary

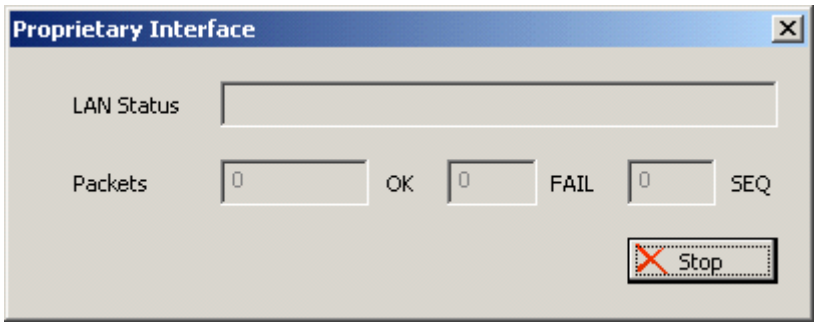


Figure 65 Dialog for the Proprietary record

LAN Status — Displays status information about the Proprietary interface.

Packets — Count the incoming data packages, sorted by OK and FAIL. With SEQ sequence errors are counted.

Stop — Stops the recording.

Opening a file

To open an external file format press the button in the main application window, or select **File > Open Raw Data...**. A window as shown in Figure 66 will open where you can choose the required file format and file.

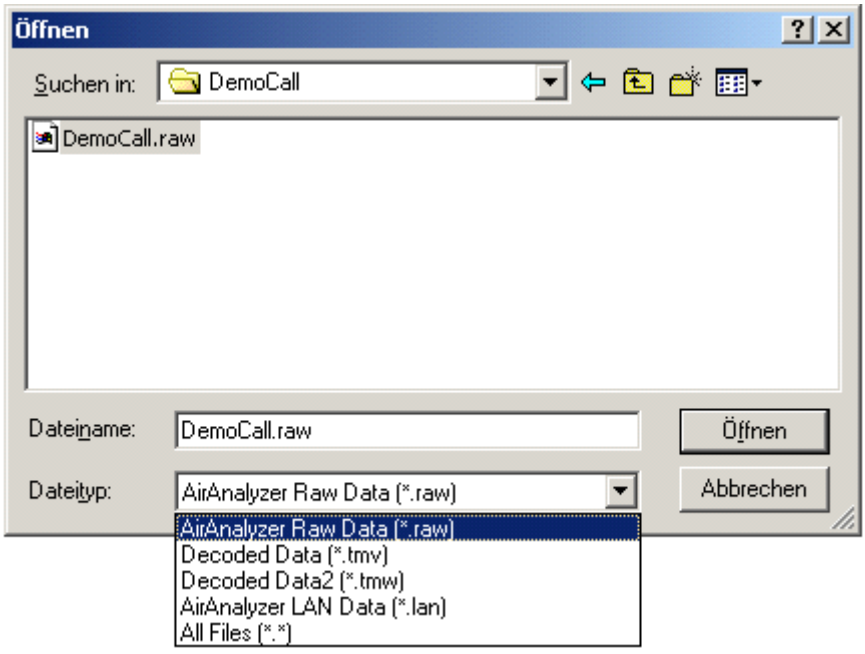


Figure 66 Dialog to open an external file format

Several file formats are available. They are described in more detail in sections "The raw data format" on page 86, "The TMW data format" on page 88 and "The TMV data format" on page 91.

The raw data and Proprietary data format are created automatically during the recording process. They are internal TETRA AirAnalyzer file formats.

There are two ways to create a TMW data file. You can generate this file format on your own (e.g. by converting the output data of your TETRA device, see "The TMW data format" on page 88) or the AirAnalyzer software can generate it while capturing data from the air interface. If you would like to generate it automatically while capturing air interface data, enable this feature. The TMV data format has to be created by the user. This can be generated from the data stream of a base station following the file format description in "The TMV data format" on page 91.

Analysis

The raw data (RAW/TMW/TMV/LAN) has to be analyzed by the application in order to display the transmitted messages in the document view. The analysis is also necessary for the filters to take effect.

Assuming that the raw data is already loaded or recorded (see previous sections), the program can analyze the recorded raw data and display the received TETRA messages with every detail in a readable text format.

Starting the analysis

The  button starts the analyzing process.

Before the process starts, a name for the result file has to be specified for saving the analyzed data. Each document needs its own individual result file. Do not overwrite the result file of an open document, otherwise the information displayed in the TetraMsc application for that document will be incorrect.

At the beginning of the result file the information from the file header (if available) will appear. Some of this information can be edited in the raw file with the file information dialog (see "The raw data format" on page 86).

After the analyzing process has finished, the document should look similar to the text part in Figure 42 on page 41, without the green and yellow blocks.

To stop the analyzing process, click on the  button.

Online analysis

The online analysis is available in all record modes. This could be enabled in the record dialog.

If enabled the recorded data will be analyzed in real time. The result from the analysis process (due to the filter settings) was written to a result file and sent to the TetraMsc. The TetraMsc displays the incoming data.

AIE (Air Interface Encryption)

Quick overview of AIE conditions

The AirAnalyzer software is shipped with an empty AlgorithmDll (container for the ETSI algorithms), which creates an error code at the corresponding position within the trace output for the receipt of a decryption request. See "Installing and using the encryption software" on page 14 on how to create the AlgorithmDll and how to copy the ETSI algorithms.

As the TETRA AirAnalyzer only is a passive listener while tracing the signaling and does not actively intervene in the signaling process (e.g. requesting a re-send, acknowledgement etc.) it is very important to observe certain conditions during the encryption to ensure the successful decryption.

These rules are very important and compelling due to the inherent passiveness of the TETRA AirAnalyzer. If you do not meet these conditions the software may become unstable and this can lead to software crashes.

The following conditions have to be met:

- Ensure a sufficient received field strength from both parties for the entire trace.
- Ensure a small lead time so that the exchange of data for the AIE can be recorded (SYSINFO PDU, other relevant PDUs for encryption).
- Ensure, by means of the Layer 1 Filter Settings, that the downlink is analyzed. Otherwise a successful decryption is not possible.

Decryption of encrypted data

Introduction to air interface encryption

The Air Interface Encryption option allows the analysis of data that were encrypted on the air interface. The actual decryption (exclusive-or operation) is carried out within the UMAC of the system and the control is carried out in MM. The additional components necessary for the decryption in TETRA AirAnalyzer are highlighted in Figure 67. Encrypted messages are decrypted automatically during analysis, if possible.

Additional conditions are required for this process. These conditions are described in detail in "Conditions" on page 73.

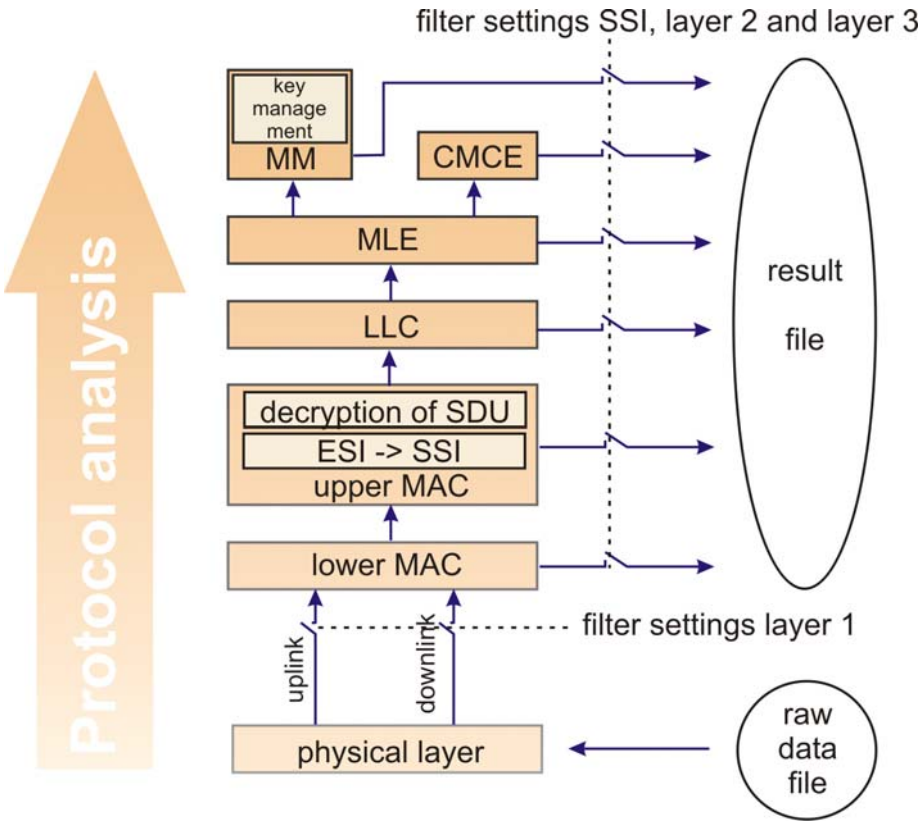


Figure 67 Functionality of Air Interface Encryption

All messages in up and downlink are decrypted. If the decryption of a message was not successful the UMAC does not transmit this message. A corresponding report is sent indicating the reason for canceling the analysis (missing cipher keys, other missing parameters).

The higher protocol stack layers are not able to analyze messages which are not decrypted or incorrectly decrypted. UMAC would interpret these messages incorrectly and therefore they are discarded. Sometimes it is possible to enter missing cipher keys before carrying out another analysis so that another analysis is possible.

If the encryption is turned on an encrypted identity (ESI) is assigned to each MS and to each group. This ESI is derived from the corresponding SSI by using a non-reversible algorithm TA61 and a valid cipher key (SCK for Security Class 2, CCK for Security Class 3).

The additional components for the decryption generate outputs which are recorded in the trace file. They can be switched on or off by using the layer 3 filter settings.

Conditions

The following conditions have to be met to enable the decryption of the Air Interface Encryption:

- The algorithms of the TAA1 (TETRA Authentication Algorithm Set) and the TETRA Encryption Algorithms (TEA1, TEA2, TEA3 or TEA4 or proprietary) have to be protected according to the license conditions (s. TR 101 052 and TR

101 053). They are not shipped with the AirAnalyzer software and are to be made available using a Windows DLL (see "Installing and using the encryption software" on page 14).

- Each MS requires the secret "Authentication Key" K. This key is only known to the BS (resp. to the Authentication Center within the infrastructure) and to the MS.
- Each ISSI and GSSI expected during the analysis has to be specified before so that the corresponding ESI can be built. (TA61 is non-reversible.)
- Some parameters for the encryption are broadcasted by the BS by using the broadcast messages. The receipt of these messages (e.g. MAC SYSINFO PDU) is therefore necessary before the decryption unit is activated.
- Some parameters are processed between MS and BS during an authentication (and/or a registration). These parameters also have to be received by the TETRA AirAnalyzer before the decryption of the messages can be carried out. Some parameters (e.g. DCK) can be entered manually using the dialog for entering values if the necessary information is not contained in the trace.
- The output of the AIE decryption layer should be switched on in the Layer 3 Settings.

Note

If the UMAC receives an encrypted message which can not be decrypted the reason is stated and the message discarded. A further analysis of the discarded message will not be carried out.

Entering the decryption parameters

SSIs

For encrypted signaling an encrypted SSI (called ESI) is used. This ESI is calculated using the original SSI and an algorithm. Since this is non-reversible it is impossible to conclude the SSI from the ESI contained in the trace.

It is only possible to produce the assignment of the ESI to the SSI if all SSIs, which will be part of the trace, are entered using a dialog for entering values before the analysis is carried out. This dialog is displayed by using the lock symbol or the corresponding menu item.

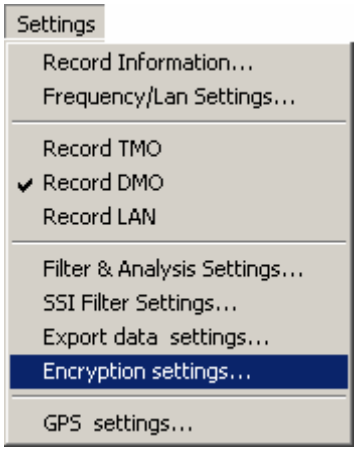


Figure 68 Access to encryption parameters

The dialog is displayed in Figure 44: Dialog to enter the encryption parameters. This mask is used to enter the ISSI and the assigned encryption parameters.

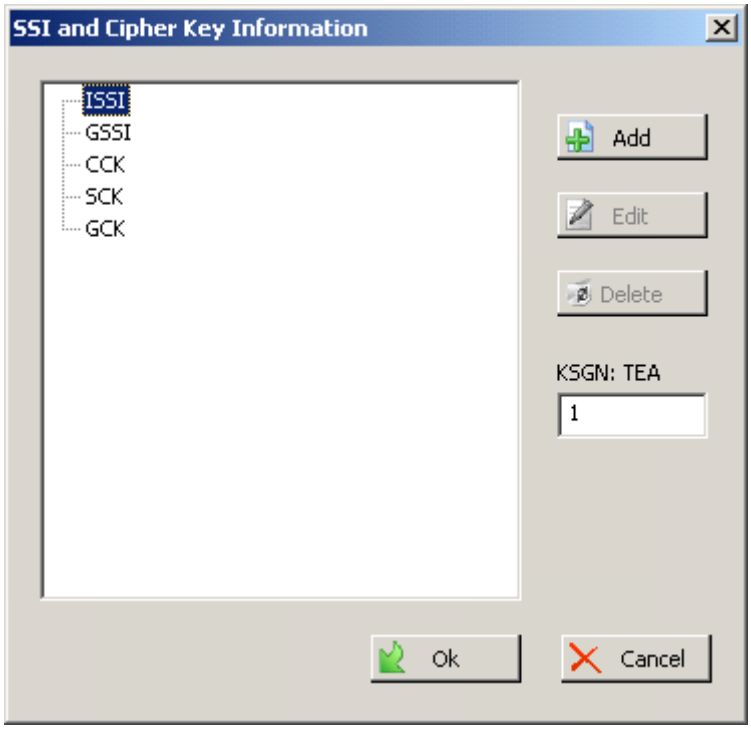


Figure 69 Dialog to enter the encryption parameters

ISSI management

When entering an ISSI it is also necessary to enter the secret key K, so that OTAR signaling to this MS and a DCK encryption (Security Class 3) may be analyzed. For the time being this parameter is not necessary for Security Class 2 since it is only used for OTAR signaling.

If the secret key is to be used there are several methods to derive this key. It is derived from one of the algorithms TB1, TB2, and TB3 from the Authentication Code (AC) and/or the User Authentication Key (UAK). In addition, it is possible to lay down the secret key K within the DLL. In that case the AirAnalyzer software

only transmits the SSI to the DLL and this file is responsible for the correct management of the keys. The AirAnalyzer software has no contact with the keys and a higher security in regard to the keys is guaranteed.

Note

The possibility to lay down the keys K within the AlgorithmDll is available on principle and results in a development effort for the user but also guarantees a higher security level. The highest security level can be implemented by swapping out the keys K to an external hardware module which would only be contacted by the DLL.

The different possibilities for the ISSI management are displayed systematically in "SSI Filter" on page 60. See "Concepts of the AlgorithmDll" on page 79 for a detailed description of the configuration and conception options for the AlgorithmDll.

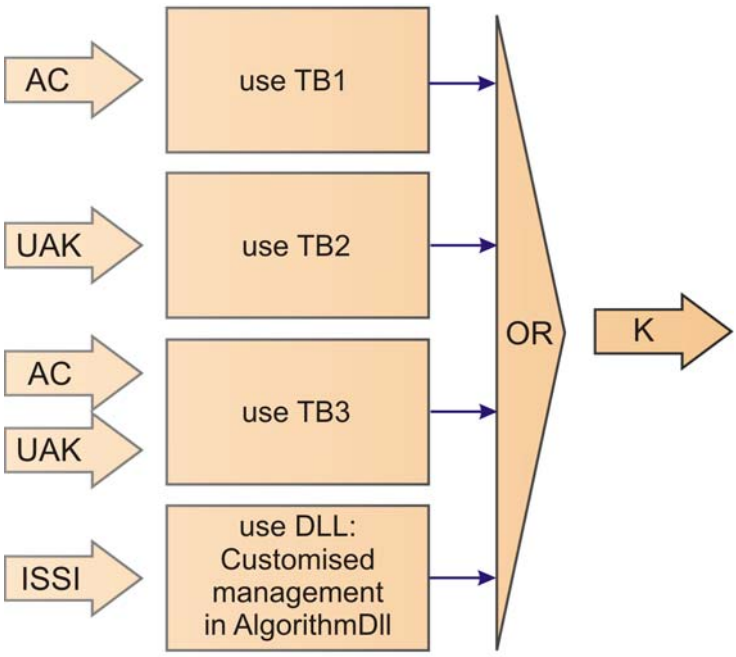


Figure 70 Ciphering key K generation

It is possible to enter a DCK for each ISSI. This is necessary if the MS is not contained in the analysis file of the authentication process since the DCK is determined during the authentication. Systems use Security Class 3.

GSSI management

When entering GSSIs it is also possible to enter an assigned (associated) GCKN. This is necessary if a GCK encryption is used.

Keys and other parameters

The keys to be used are also entered using the dialog for entering the SSI (see "SSIs" on page 74). If new keys are exchanged via OTAR-PDUs during the analysis the AirAnalyzer will automatically update the data. These new keys are not written to this dialog after the analysis, so that the same trace may be analyzed again using the same start conditions.

SCK management

A SCK is necessary for systems with Security Class 2 for creating the ESI. Therefore, it should be entered into the input mask.

CCK management

Systems with Security Class 3 use the CCK for creating the ESI. The CCK has to be entered if it does not result from the analysis. This may be the case during a clear-text (new) registration of an MS if this requires the CCK at the same time.

GCK management

If a GCK encryption is used it is possible to enter the GCKs to be used via the input mask.

Layer 3 settings

Activate the output of messages of the decryption layer in the Layer 3 settings. This is recommended in order to find indications of missing encryption parameters faster.

Processes, which can not be decrypted, are described in detail within the scope of the messages and outputs and each action of the decryption layer is recorded. This trace may be compared to the expected reaction of the DUTs (Device under test: MS or BS).

Limits of decryption

It is possible that errors occur during the analysis as soon as encrypted signaling is processed. The problems result from the fact, that the AirAnalyzer software has to synchronize to an BS (similar to an MS) in order to receive all necessary (encryption) parameters. These circumstances are described in details in this chapter.

- The analysis does not display any messages above the UMAC:
  The UMAC is responsible for the decryption. If it is not possible to carry out the decryption without errors, the processing of the message in UMAC is interrupted.
  If the notification of the Air Interface Encryption is enabled within the Layer 3 Settings a corresponding message is displayed within the UMAC trace stating the reason for the cancelation of the analysis.
- The UMAC reports, that certain information is missing for the decryption:
  Make sure that a correct AlgorithmDll is used containing the necessary algorithms (see Software Installation Guide.pdf).
  Furthermore, some information is necessary to synchronize the TETRA AirAnalyzer with the BS: Some parameters relevant for the decryption are transmitted by the BS in SYSINFO PDU. If this element has not been received a correct decryption is not possible.
  It is recommended to allow for a lead time before the scenarios to be analyzed are recorded. Depending on the BS this lead time should be between 15 and 30 sec.
- Error message "AIE: ESI: Unknown Instance":
  The SSI for the ESI to be decoded is not known. You have to enter all SSIs for which an analysis is to be carried out into the dialog. (see "SSIs" on page 74).

- Error message "AIE: ... Please abort analysis":
  An unexpected change of the entered parameters occurred. The analysis should be canceled. It is possible to continue the decryption but the data is not reliable. Furthermore, crashes of the AirAnalyzer software may occur since faulty values for decrypted length values might lead to memory access violation.
- Software does not decrypt correctly
  The TEA algorithm to be used is transmitted during the registration of an MS. It is therefore necessary to receive this registration process (clear-text). You can also enter the value into the corresponding input mask.

Synchronization of the parties

Encryption is only possible if both parties, BS and MS, are always synchronized regarding their keys. This is ensured by the corresponding PDUs (CK-CHANGE DEMAND and others). If such a message is successfully received the MS sends a receipt in Layer 2 containing the appropriate acknowledgement. If the BS does not receive this message after a specified time "t" the message is sent again.

During this signaling process the TETRA AirAnalyzer is only a passive listener. If the TETRA AirAnalyzer does not receive some of these signaling messages it will lose the synchronization for the decryption without realizing it. The basis for a decryption without errors of the following signaling is not available anymore. Therefore, it is important to ensure that the received field strength is sufficient.

Missing keys

If some keys are not determined by means of OTAR processes the user should enter these values using the input mask.

The keys can be taken from another trace of this signaling (usually from BS messages). After that another analysis is possible.

As long as some keys are unknown the messages secured by this key are highlighted accordingly within the output trace so that it is easy to add the necessary keys later.

Missing time synchronization

The information about the current hyperframe is displayed by the BS in SYSINFO PDU. As long as this element is not decoded the decrypting cannot take place since the complete IV time data (hyperframe, multiframe, frame, slot, direction) including hyperframe number (only from SYSINFO PDU) is necessary for this process. Encrypted messages received before the evaluation of the SYSINFO PDU can therefore not be decrypted.

The recording should be started with a short lead time so that the hyperframe number is recorded before the relevant encrypted messages. This guarantees the time synchronization.

Missing downlink messages

For a fast analysis it is possible to deactivate some or all downlink messages in the TETRA AirAnalyzer Software. However, the downlink messages necessary for the AIE are not displayed anymore and they are also not processed within the protocol stack. They do not reach the PROC_AIE. The decryption is bound to fail resp. lead to wrong results.

The filter for the downlink messages shall not be used so that all downlink messages can be analyzed and the decryption of the AIE can be carried out.

AlgorithmDll

Function of the AlgorithmDLL

The AlgorithmDll is used to capsule the secret TETRA algorithms. It contains one or several encryption algorithms (Key Stream Generator, KSG: TEA1, TEA2, TEA3, TEA4 and/or proprietary algorithms). Furthermore, the authentication algorithms are implemented (TA11, TA12, TA21, TA22, TA32, TA41, TA52, TA61, TA71, TA82, TA92, TB1, TB2, TB3, TB4, TB5, and TB7).

For additional security it is possible to include the individual ISSI-K pairs in a separate hardware (resp. DLL).

The DLL has to be protected according to the SAGE regulations (see also literature 1 to literature 7). As Willtek cannot protect this DLL from being copied on a PC based system (possibly with a LAN connection) it is not possible to deliver the complete DLL.

Note

Please contact Willtek Communications if you are interested in a customized, secure solution for your enterprise.

Concepts of the AlgorithmDll

As already outlined in "ISSI management" on page 75, it is also possible to store the keys K (or a link to other locations) in AlgorithmDll (apart from swapping in the ETSI TETRA encryption algorithms) while using it.

This means an additional programing effort for the user for creating/editing the available DLL, but it also guarantees additional security for the keys K.

Additional security is also possible if the keys K do not reside on the computer but are only called via the DLL from an external storage module (e.g. an ASIC). These possibilities of using the AlgorithmDll are explained below.

Algorithms within the DLL (standard)

As described in section "Installing and using the encryption software" on page 14, you can create the standard version of the DLL with the algorithms included. The key values for the calculation of K are entered separately using the interface for the application. This method is illustrated by the top three blocks in Figure 71 on page 80.

The application transmits the message to be decrypted and one or both partial keys (AC/UAK) to the AlgorithmDll stating the algorithms to be used. The key K necessary for the decryption is calculated within the AlgorithmDll. The AlgorithmDll returns the decrypted message to the application. The drawback of this method is, that the partial keys AC/UAK are contained in the application memory and it is not possible to prevent outsiders to gain access to these parameters (which determine the secret key K).

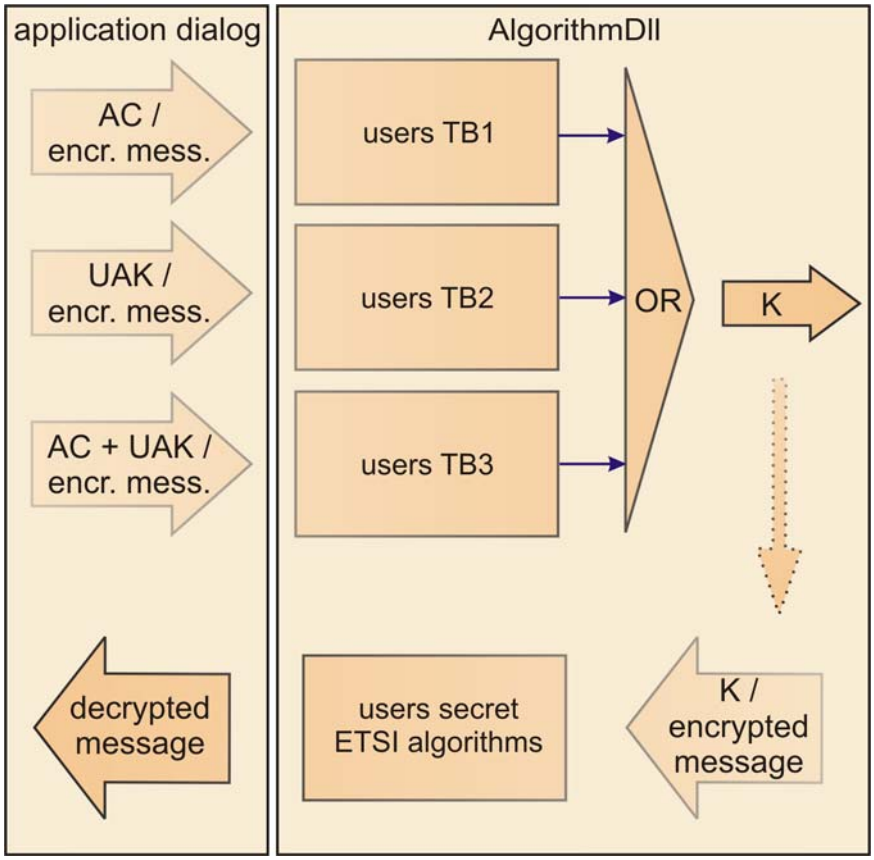


Figure 71 Deriving and storing K without DLL hiding

Algorithms and Ks In/Via the DLL

If the keys K are called via the AlgorithmDll there are several possibilities for the programing of the DLL to store the keys K (as well as the algorithms) to a 'save' location to protect them as much as possible from unauthorized access. The highest security level is possible if the algorithms and Ks are not stored in the AlgorithmDll but on an external/transportable storage medium to which only the AlgorithmDll has access (in this case the AlgorithmDll only has routing and security functions). The concept of the highest security level is illustrated in Figure 72.

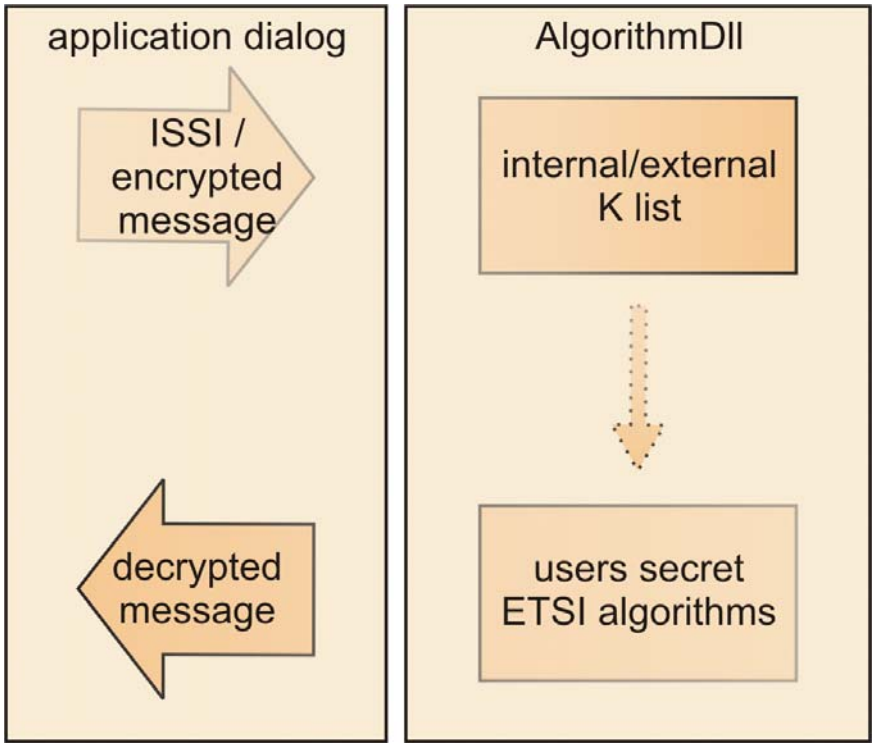


Figure 72 Secure use of K and algorithms with AlgorithmDll

Note

The final implementation of the different AlgorithmDll concepts cannot be included in Willtek's standard offering because for security reasons, the company does not have access to the secret ETSI algorithms and ISSI-K pairs of the user.

Willtek Communications will gladly carry out this implementation under secure conditions in form of separate orders.

External data input formats

Proprietary interface format

In order to create the correct input data stream for the UDP proprietary interface you should program a module that realizes the descriptions of this chapter.

The proprietary interface transmission works by sending UDP packets to the AirAnalyzer software. Each packet contains one message:

- LLC SDUs including an additional text for the lower layers MSC display (see "Text and SDU signaling message" on page 82) or
- ETSI TETRA TMV interface data (see "TMV signaling message" on page 84).

Note

Please make sure that for each analyzing process only one message type (LLC SDU or TMV data) is sent.

Table 20 Proprietary interface format

Type	Element	Description
Byte	Start flag	0x21
UINT16	Message length	Complete message block length. Start with following element, end flag is excluded.
	Message block	See descriptions below
Byte	End flag	0x0D End flag

Note

The data arrangement of the proprietary interface format is big endian, i.e. 0x01A0 is a value of 416 decimal.

The transmission of the UDP data packets is carried out according to a simple protocol, just send data to the configured UDP-Port. All Proprietary messages will be stored in a lan file.

Text and SDU signaling message

This type of message block contains a message header, a text field for generation of a starting information for the MSC arrow in the TetraMsc application and an SDU of a specific TETRA layer. It will be stored in a LAN file by the TETRA AirAnalyzer.

This message can be used to analyze and display PDUs above the Upper Mac. The optional text block displays proprietary messages for the TetraMsc.

Table 21 LLC SDU signaling block

No.	Type	Element	Description
1	Byte	Message type	0xDD (text and SDU signaling message)

Table 21 LLC SDU signaling block (continued)

No.	Type	Element	Description
2	UINT16	Sequence number	Message number
3	Byte	Direction:	1 – Downlink 2 – Uplink
4	UINT32	Current time 1	Time format is chosen in bit 3 in "Extended Information Flag" (Element no. 5) 0 – Old default format: Current time in ms (0 at begin of a day) 1 – Second format: Current time in seconds beginning at 01.01.2000 00:00:00.
5	Byte	Extended Information Flag [formerly: Reserved('0')]	Bit description: (LSB = Bit 1) 1..2: Reserved (0) 3: The time format used in element no. 4 and 12. 4..7: Reserved (0)
6	Byte	Slot number	
7	Byte	Frame number	
8	Byte	Multiframe number	
9	UINT16	Hyperframe number	
10	Byte	Address type	1: SSI 2: Event Label 3: USSI 4: SMI 5: SSI + Event Label 6: SSI + Usage Marker 7: SMI + Event Label
11	UINT32	Address	Subscriber identity
12	UINT16	Current time 2 / Reserved	Bit Description: (LSB = Bit 1) 1..10: when bit 4 is set in Extended Information Flag (Element no. 4) milliseconds or reserved if not set. 11..16: Reserved.
13	UINT16	Text length	

Table 21 LLC SDU signaling block (continued)

No.	Type	Element	Description
14	N bytes	Text characters	Note: The first line will be used as message type in MSC, the line has to be terminated with '\n'
15	Byte	SDU destination layer	0: No destination, the SDU length shall be set to zero 2 : LLC Note: all other values are reserved for future enhancements
16	UINT16	SDU length	In bits (i.e. 16 bits = 2 bytes)
17	N bytes	SDU data	

In order to display your proprietary messages with the TetraMsc application you have to edit the file MsgTypes in the BIN folder of the application (e.g.: C:\Program files\FED\AirAnalyzer\bin). Please refer toTetraMsc chapter for information on the format of this file.

TMV signaling message

This message block contains TMV data that will be stored in a lan file. This data input results in a display that will be equal to the display of an air interface trace.

Table 22 The TMV signaling block

No.	Type	Element	Description
1	Byte	Message type	0xDE (TMV signaling message)
2	UINT16	Sequence number	Message number
3	UINT16	Cell-ID	
4	Byte	Carrier-ID	
5	Byte	Direction	1 – Downlink with PDU association 2 – Uplink with PDU association 17 – Downlink, SDU already decrypted 18 – Uplink, SDU already decrypted
6	UINT32	Current time 1	Time format is chosen in bit 1 in "Current time 2" (element no. 7) 0 – Old default format: Current time in ms (0 at begin of a day) 1 – Second format: Current time in seconds beginning at 01.01.2000 00:00:00.

Table 22 The TMV signaling block (continued)

No.	Type	Element	Description
7	Byte	Current time 2 [formerly: Reserved ('0')]	Bit description: (LSB = bit 1) 1 – The used time format in element no. 6, 7 (bits 2-8) and 23 (bits 5-8). 2 – Milliseconds in 10 ms steps (values 0-99 mean 0 ms - 990 ms)
8	Byte	Slot number	
9	Byte	Frame number	
10	Byte	Multiframe number	
11	UINT16	Hyperframe number	
12	UINT16	Text length	
13	N bytes	Text characters	Note: The first line will be used as message type in the MSC, the line is terminated with '\n'
14	INT16	RSSI 1	used for CUB1, NUB, NDB and SCDB1/ 10 dBm, i.e. "-10" is equivalent to "–1 dBm"
15	INT16	RSSI 2	only used for CUB2 1/10 dBm, i.e. "-10" is equivalent to "–1 dBm"
16	UINT16	Phase error 1 (in 1/100°)	used for CUB1, NUB, NDB and SCDB
17	UINT16	Phase error 2 (in 1/100°)	only used for CUB2
18	INT16	Timing error 1 in 1/8 symbol	used for CUB1, NUB, NDB and SCDB
19	INT16	Timing error 2 in 1/8 symbol	only used for CUB2
20	UINT16	AACH/ Reserved	Downlink: Access Assign Channel (packed from MSB to bit 2) Uplink: Reserved ('0')

Table 22 The TMV signaling block (continued)

No.	Type	Element	Description
	Byte	Channel	0 – No Burst 1 – BSCH + BLCH 2 – BSCH + SCH/HD resp. BNCH 3 – SCH/HD + SCH/HD resp. BNCH 4 – SCH/HD + BLCH 5 – SCH/F 6 – SCH/HU first sub slot 7 – SCH/HU second sub slot 8 – STCH + STCH 9 – STCH + TCH/S 10 – STCH + TCH/2.4 11 – STCH + TCH/4.8 12 – STCH + TCH/7.2 13 – TCH/S 14 – TCH/2.4 15 – TCH/4.8 16 – TCH/7.2 17 – SCH/HU + SCH/HU
	Byte	CRC and Current time 3	('1' means CRC OK and '0' means CRC failure) bit 1 – CRC flag of a full slot resp. the first half slot bit 2 – CRC flag of the second half slot bit 3 – CRC flag for AACH bits 5—8 – Current time 3: Absentee 0—9 ms (if bit 1 set in element no. 7)
	Byte	Channel data	If only one channel is included all bytes will be used. If two channels are included the first channel uses the first 27 bytes and the second channel the last 27 bytes. (Packed and filled up with '0'; the MSB of the first datum is equivalent with the first bit of the PDU)

File formats

The raw data format

The raw data format is the format the TETRA AirAnalyzer creates while capturing data from the air interface. It contains the symbols of the air interface. Channel decoding has still to be carried out during the analyzing process.

This file format has a storage capacity of about 18 kbyte/s (ca. 1 Mbyte/min).

You will always be able to open each captured raw data to re-analyze it if you previously saved it to disk.

When you open a raw file the file header is read by the software. The contents of this header is written in front of the result file, but you can also view (and edit some items) in the file information dialog (see Figure 73). Open this dialog with the button or by selecting **Run > File Information**.

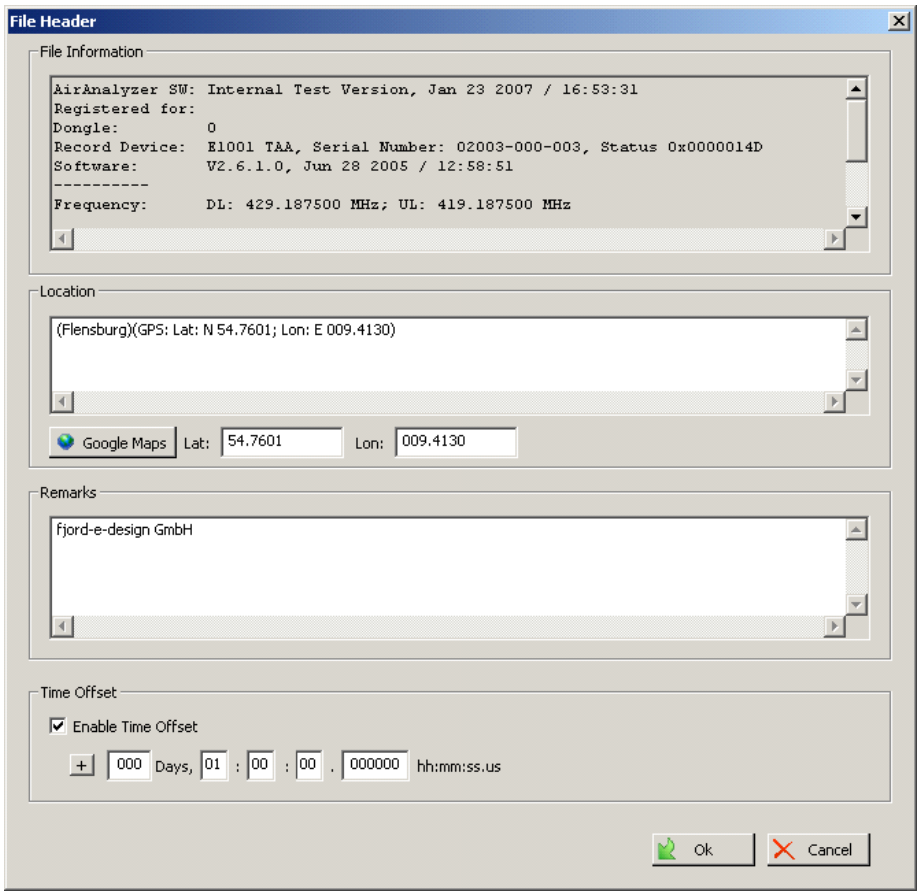


Figure 73 File Information dialog

Use the Google Maps button to view the position data of the TETRA AirAnalyzer (start point of recording). This function needs a GPS receiver.

The RES format

The RES format is an internal AirAnalyzer data format that is used to display the analyzed messages in text view and in the TetraMsc application. This format is text based and for that reason does not need to be published. You will always be able to create a new RES file with the AirAnalyzer software if you analyze a RAW/TMW/TMV data file.

The HEX format

The hex format is an ASCII hexdump of the SNDCP data. This line orientated format starts each line with the date (10/11/05), time (08:11:05.231) and position (000000) in the file (in hex digits, minimum three digits), followed by a varying count of bytes, each individually displayed (in hex digits) and surrounded with a space (00 e0 1e a7 05 6f 00 10). Text dump at the and of each line is allowed.

Here is an example of such a dump:

```
10/11/05 08:11:05.231 000000 00 e0 1e a7 05 6f 00 10 ........

10/11/05 08:11:05.287 000000 5a a0 b9 12 08 00 46 00 ........

10/11/05 08:11:05.316 000000 03 68 00 00 00 00 0a 2e ........

10/11/05 08:11:05.412 000000 ee 33 0f 19 08 7f 0f 19 ........
```

The TVD format

The TVD file format is an internal AirAnalyzer data format that contains the voice data found during the analysis. This file can be read by the VoiceDecoder software. This software can play back the voice data.

The TMW data format

You can create data following this format on your own or have it created by the TETRA AirAnalyzer Software.

The TMW data format contains the same information as the raw data format but the information is already channel decoded. This saves a lot of disk space and increases the analyzing speed considerably because the channel decoding does not have to be executed for each analyzing process.

The TMW data format has a storage capacity of about 12 kbyte/s (ca. 720 kbyte/min). Time slots with no data in it will not be saved which may decrease the size of the file.

A description of the file format is available in Table 23. The data format for the used variables is big endian.

Table 23 The TMW data file format

Byte	Type	Description
1..2	UINT16	Cell ID
3	UINT8	Carrier ID
4	UINT8	Direction: 1 – Downlink with PDU association 2 – Uplink with PDU association 17 – Downlink, SDU already decrypted 18 – Uplink, SDU already decrypted 33 – DMO: Channel A 34 – DMO: Channel B 49 – DMO: Channel A, SDU already decrypted 50 – DMO: Channel B, SDU already decrypted
5..8	UINT32	Bit 3 in "Extended Information Flag" (Element no. 5) 0 – Old default format: Current time in ms (0 at begin of a day) 1 – Second format: Current time in seconds beginning at 01.01.2000 00:00:00.

Table 23 The TMW data file format

Byte	Type	Description
9	UINT8	Extended Information Flag: [formerly: Reserved ('0')] (LSB = Bit 1) Bit 1 – Hyperframe unknown (true if Hyperframe Number contains no valid data) Bit 2 – Power type (true when "Power 1&2" values contain no dBm value but RSSI) Bit 3 – The used time format in element no. 4. Bits 4-8 – Reserved (false)
10	UINT8	Slot number
11	UINT8	Frame number
12	UINT8	Multiframe number
13..14	UINT16	Hyperframe number or reserved ('0') (depends on Extended Information flag)
15..16	INT16	Power 1 used for CUB1, NUB, NDB, SCDB and DMO-Bursts: 1/10 dBm, i.e. "-10" is equivalent to "-1dBm" or RSSI (Dependants on Extended Information Flag)
17..18	INT16	Power 2 only used for CUB2: 1/10 dBm, i.e. "-10" is equivalent to "-1dBm" or RSSI (Dependants on Extended Information Flag) DMO: Reserved ('0')
19..20	UINT16	Phase error 1 (in 1/100°) used for CUB1, NUB, NDB and SCDB
21..22	UINT16	Phase error 2 (in 1/100°) only used for CUB2
23..24	INT16	Timing error 1 in 1/8 Symbol used for CUB1, NUB, NDB and SCDB
25..26	INT16	Timing error 2 in 1/8 symbol only used for CUB2
27..28	UINT16	Downlink: Access Assign Channel (packed from MSB to bit 2) Uplink/DMO: Reserved ('0')

Table 23 The TMW data file format

Byte	Type	Description
29	UINT8	Channel 0 – No burst 1 – BSCH + BLCH 2 – BSCH + SCH/HD resp. BNCH 3 – SCH/HD + SCH/HD resp. BNCH 4 – SCH/HD + BLCH 5 – SCH/F 6 – SCH/HU first sub slot 7 – SCH/HU second sub slot 8 – STCH + STCH 9 – STCH + TCH/S 10 – STCH + TCH/2.4 11 – STCH + TCH/4.8 12 – STCH + TCH/7.2 13 – TCH/S 14 – TCH/2.4 15 – TCH/4.8 16 – TCH/7.2 17 – SCH/HU + SCH/HU 18 – 31 – Reserved 32 – DMO: No burst 33 – Reserved 34 – SCH/S + SCH/H 35 – Reserved 36 – Reserved 37 – DMO: SCH/F 38 – Reserved 39 – Reserved 40 – DMO: STCH + STCH 41 – DMO: STCH + TCH/S 42 – DMO: STCH + TCH/2.4 43 – DMO: STCH + TCH/4.8 44 – DMO: STCH + TCH/7.2 45 – DMO: TCH/S 46 – DMO: TCH/2.4 47 – DMO: TCH/4.8 48 – DMO: TCH/7.2 49 – 255 – Reserved
30	UINT8	CRC (LSB = Bit 1) Bit 1: CRC flag of a full slot resp. the first half slot Bit 2: CRC-flag of the second half slot Bit 3: CRC flag for AACH (only for TMO downlink bursts)

Table 23 The TMW data file format

Byte	Type	Description
31...84	UINT8	Channel data – if only one channel is included all bytes will be used. – if two channels are included the first channel uses the first 27 bytes and the second channel the last 27 bytes. (packed and filled up with '0'; the MSB of the first datum is equivalent with the first bit of the PDU)

The TMV data format

The TMV data format is a file format that enables you to simply input TETRA data streams into the AirAnalyzer software. This file format is not created by the software because this functionality is covered more completely by the TMW data format.

The TMV data format has a storage capacity of about 9,2 kbyte/s (ca. 550 kbyte/min). Not existing time slots will not be saved which may decrease the size of the file.

A description of the file format is available in Table 24. The data format for the used variables is big endian.

Table 24 The TMV data file format

Byte	Type	Description
1	Byte	Direction 1 – Downlink 2 – Uplink if Direction equals 0, primitive ends here.
2	Byte	Slot number
3	Byte	Frame number
4	Byte	Multiframe number
5..6	Short	Hyperframe number
7..8	Short	Downlink: Access Assign Channel (packed data MSB to Bit 2) Uplink: 0

Table 24 The TMV data file format

Byte	Type	Description
9	Byte	Channel 0 - No Burst 1 - BSCH + BLCH 2 - BSCH + SCH/HD 3 - SCH/HD + SCH/HD 4 - SCH/HD + BLCH 5 - SCH/F 6 - SCH/HU (1. subslot) 7 - SCH/HU (2. subslot) 8 - STCH + STCH 9 - STCH + TCH/S 10 - STCH + TCH/24 11 - STCH + TCH/48 12 - STCH + TCH/72 13 - TCH/S 14 - TCH/24 15 - TCH/48 16 -TCH/72 Note: TCH Data will currently not displayed
10	Byte	Downlink CRC: 0 Uplink CRC: B1 - Full slot / first sub slot channel CRC B2 - Second sub slot channel CRC (1 -> CRC OK; 0 -> CRC Failure)
11...64	Byte	Channel data if one channel included: all bytes will be used if two channel included: first channel in the first 27 bytes and the second channel in the last 27 bytes. Note: acked data filled with '0'; MSB from Byte 11 is the first bit of the PDU

Reference documents

[1] TETRA Air Interface Specification EN 300 392-2 (March 2001)

[2] TETRA Security Specification EN 300 392-7 (February 2001)

[3] TR 101 052; Version 1.1.1; 1997-06; Security Algorithms Group of Experts (SAGE); Rules for the management of the TETRA standard authentication and key management set TAA1

[4] TR 101 053-1; Version 1.1.1; 1997-06; Security Algorithms Group of Experts (SAGE); Rules for the management of the TETRA standard encryption algorithms; Part 1: TEA1

[5] TR 101 053-2 Version 1.1.1; 1997-06; Security Algorithms Group of Experts (SAGE); Rules for the management of the TETRA standard encryption algorithms; Part 2: TEA2

[6] TR 101 053-3; Version 1.1.1; 1999-08; Security Algorithms Group of Experts (SAGE); Rules for the management of the TETRA standard encryption algorithms; Part 3: TEA3

[7] TR 101 053-4; Version 1.1.1; 1999-08; Security Algorithms Group of Experts (SAGE); Rules for the management of the TETRA standard encryption algorithms; Part 4: TEA4

AirAnalyzer Tools

4

This chapter describes additional software tools that come with the TETRA AirAnalyzer. Topics described in this chapter are as follows:

Installation

The software tools can be installed during the installation of the AirAnalyzer software as described in section "Installing the software" on page 7. To install them, please enable the Tools checkbox as shown in Figure 74. Some or all tools can be selected for installation.

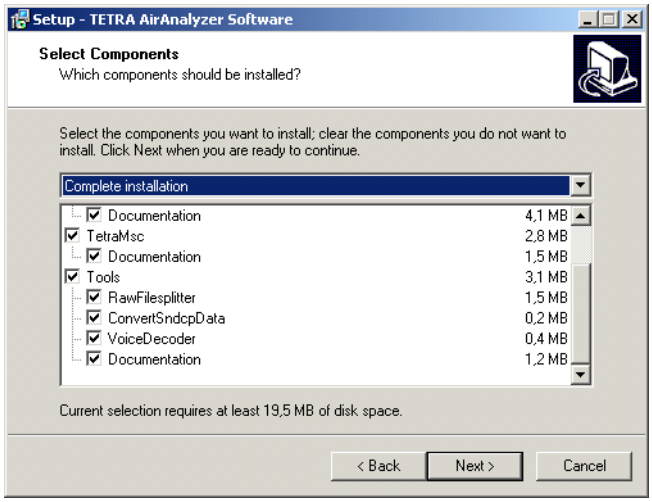


Figure 74 The Tools components in the Installer

Starting a software tool

There are several ways of starting an AirAnalyzer software tool: It can be started by using the start menu (Figure 75), by selecting the Tools menu from the AirAnalyzer software (Figure 76) or by selecting an icon on the desktop (if created during installation, Figure 77). The figures show how RawFileSplitter can be started in different ways. For starting another tool, the same principles apply.

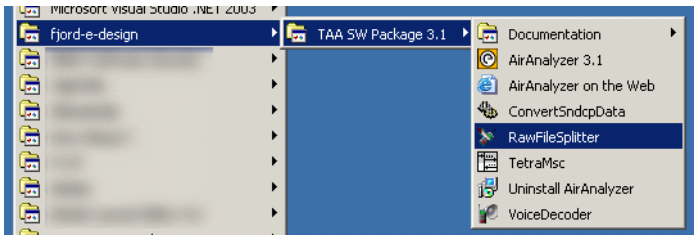


Figure 75 Start of tools using the program folder

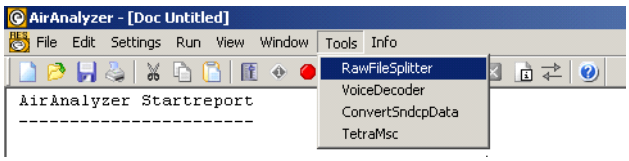


Figure 76 Start of tools from within AirAnalyzer

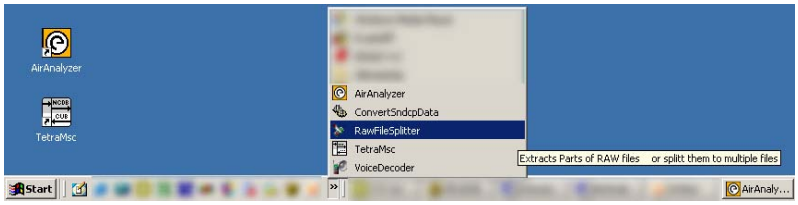


Figure 77 Starting the tools from the Quick Launch Bar

Handling huge traces with RawFileSplitter

Using RawFileSplitter

RawFileSplitter is a tool to split huge raw files into smaller parts. Two ways are available to do this: Either a part can be extracted by entering a start and a stop time, or the whole raw file can be split into multiple equally-sized smaller files.

Figure 5 shows the main dialog of the RawFileSplitter.

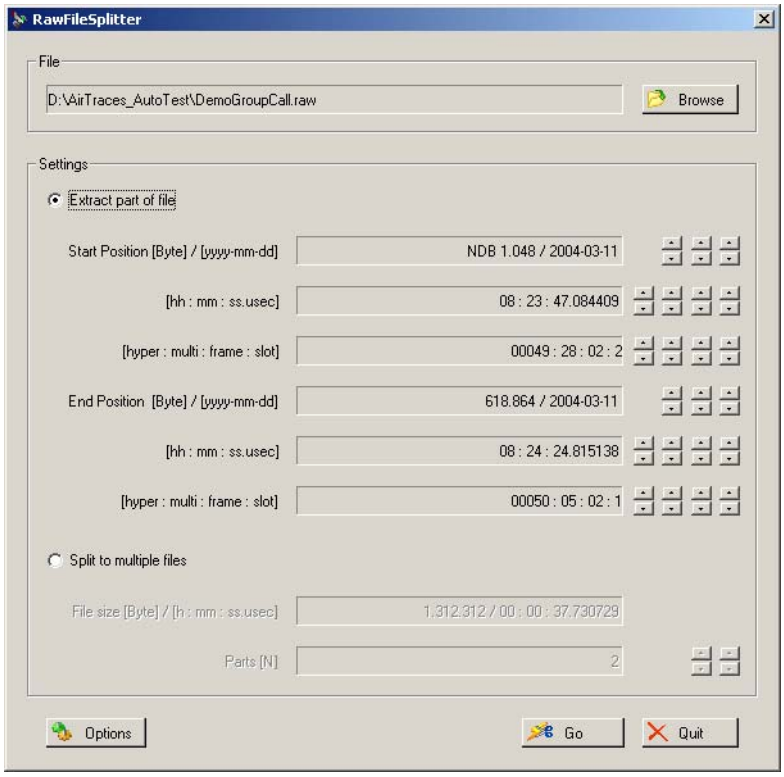


Figure 78 Main menu of RawFileSplitter

1 Click the **Browse** button and select a source raw file.
The file name will be transferred to the File section.

2 Select the mode of operation (either user-defined start and stop time, or equally-sized parts) by activating the respective radio button (**Extract part of file** or **Split into multiple files**).

3 Enter the respective parameters.
   - If you selected "Extract part of file", enter the start and stop time for the part to extract.
   - If you selected "Split into multiple files", enter how many files you want the raw file to be split into.
   - Click on the Options button to specify options as explained below.

4 Press the **Go** button to start the extracting or splitting process. During operation a progress bar is shown in the File section.

Extracting part of the file

In this mode of operation, the starting and ending position must be specified using the buttons. The text "NDB" indicates that the selected starting position contains a Normal Downlink Burst. As the AirAnalyzer software needs a synchronisation timeslot before any data can be displayed, a starting position with "SB" should be selected. That timeslot includes a Synchronization Downlink Burst.

Splitting into multiple files

In this mode of operation, the size and the number of output files can be specified by using the buttons.

Note: The last file created might become shorter than the other files.

Selecting options

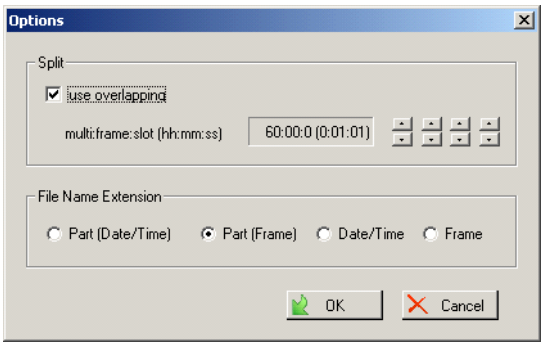


Figure 79 Options dialog in the RawFileSplitter

Split section

The Split section only applies if “Split into multiple files” has been selected.

If **use overlapping** is enabled, the specified number of bursts will be duplicated and appear in both parts after splitting. This may be useful as some signaling message might otherwise be split into two different output files.

Use the buttons to modify the overlap time.

Example: The source consists of 100 blocks. Splitting into 10 smaller equal-sized files is requested. An overlapping of 2 is enabled. Then the first file will consist of block 1 to 10, the second file will consist of block 9 to 20, the third file will consist of block 18 to 30 and so on. The original blocks 9 and 10 can be found in the first and the second output file. If some interesting signalling is happening in block 9 to 11, it can be totally found in the second output file. Without having enabled the overlapping function, the signalling in block 9 to 11 would be split into the first (block 9 and 10) and the second output file (block 11).

This option should always be enabled because the AirAnalyzer software needs a sync burst before it is able to analyze any data. So the beginning of each output file will be unusable until a sync burst is decoded.

File Name Extension section

The output file names will be derived from the source file name. To make the different output files unique, an identifier (appendix) will be added to the source file name.

Four types of appendix are available:

Part (Date/Time): In "Split into multiple files" operation, the appendix will be a sequential part number followed by the starting/ending date and time of the current output file. In "Extract part of file" operation, the appendix will be the starting/ending date and time of the current output file (without a part number as there is only one part extracted).

Part (Frame): In Split into multiple files operation, the appendix will be a sequential part number followed by the starting/ending frame number of the current output file. In Extract part of file operation, the appendix will be the starting/ending frame number of the current output file (without a part number as there is only one part extracted).

Date/Time: The appendix will be the starting/ending date and time of the current output file.

Frame: The appendix will be the starting/ending frame number of the current output file.

ConvertSndcpData – Analyzing SNDCP and IP data with WireShark

Introduction

WireShark is a free (GPL) and powerful protocol analyzer. It can be used to analyze any sort of IP data. The latest version of WireShark can be found at http://www.wireshark.org/.

So WireShark is an appropriate tool to analyze the IP data contained in the SNDCP service of TETRA. The AirAnalyzer software has built-in support to generate files that can directly be opened using WireShark.

The AirAnalyzer software displays SNDCP data as a hex-dump in the result file. Additionally, an export of this hex data is possible during analysis.

To enable this export option, the SNDCP Data to File must be selected in the Filter settings of the AirAnalyzer software. A text file (*.hex) containing all the IP packets will be written each time an analysis is performed.

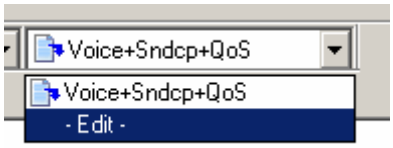


Figure 80 Edit menu

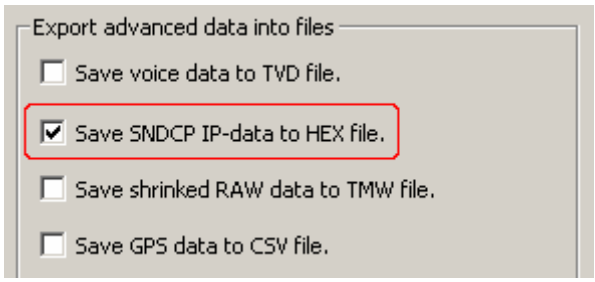


Figure 81 SNDCP data export option in the AirAnalyzer

As WireShark uses a proprietary format (*.pcap), a command line based tool named text2pcap, provided with the WireShark distribution, is used to convert the hex trace to pcap format. Usage is simplified with ConvertSndcpData, a graphical user interface for WireShark.

Starting ConvertSndcpData

ConvertSndcpData can be called directly from the Tools menu of AirAnalyzer. The current file name (with .hex extension) will be transferred automatically.

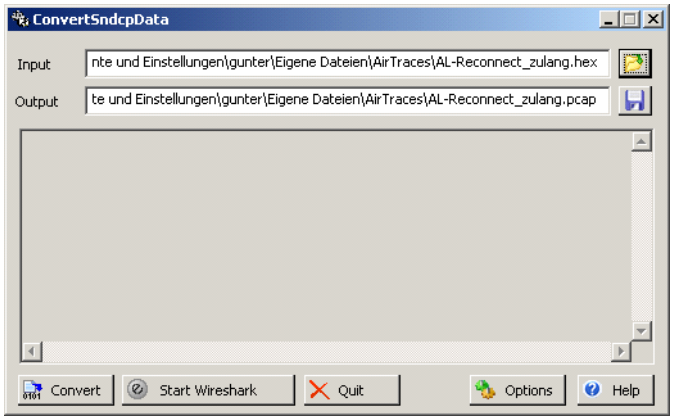


Figure 82 Start menu of ConvertSndcpData

Converting the trace to a WireShark-compatible format

Click the **Convert** button to start the text2pcap command. The output of text2pcap will be displayed in the view.

Starting WireShark

Click the **Start WireShark** button to start the WireShark software. WireShark will open the current pcap file. The conversion will be started automatically if not yet done in the previous step.

Parameters

There are several parameters and options that impact the functionality of the conversion. Most of them are initialized to useful default values.

Input file

The most recent input file name is copied from the AirAnalyzer software. Another file can be specified if needed.

Output file

Another file name and/or path can be chosen for the converted pcap file.

Options

Press the **Options** button to open the Options dialog of ConvertSndcpData.

The ConvertSndcpData tool tries to auto-detect the correct path and command line parameters for the WireShark application and the text2pcap application. Changes should only be performed if needed.

The original settings can be restored using the **Load factory default** button.

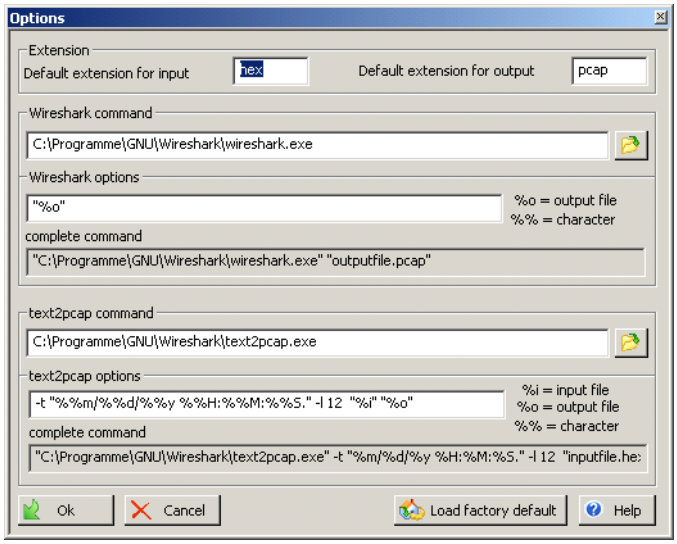


Figure 83 Options dialog in the ConvertSndcpData

WireShark command The complete path and options for calling the WireShark application is specified here.

Text2pcap command The command line including the complete path and options for calling the text2pcap application is specified here. For the text2pcap options please refer to the text2pcap manual at http://www.wireshark.org/docs/.

Example

This example shows a typical SNDCP data transmission. TetraMsc shows the LLC segmentation on advanced link and the resulting SNDCP data as hex dump. To identify the corresponding SNDCP data in WireShark use the timestamp (e.g. T:14:13:17.075).

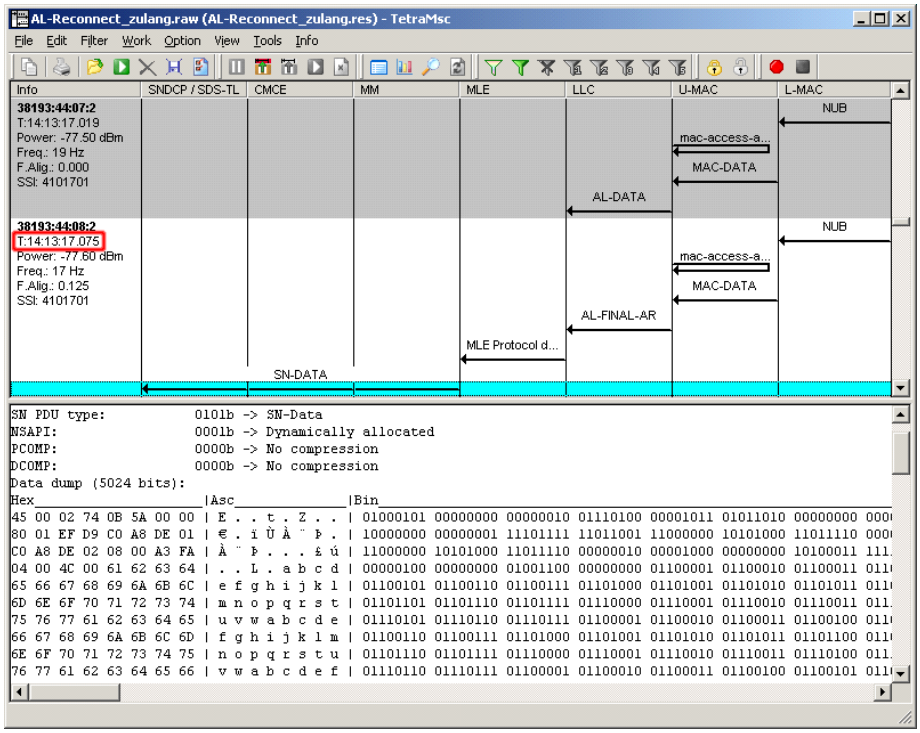


Figure 84 SNDCP example

The following steps are needed to view data with WireShark:

1 The SNDCP dump data must be exported to a hex file (see Figure 81).

2 The hex file must be converted with ConvertSndcpData into pcap format (see "Starting ConvertSndcpData", "Converting the trace to a WireShark-compatible format" on page 102).

3 Ensure you view the time in WireShark by selecting **View > Time Display Format > Time of Day**.

4 The contained IP data can now be analyzed.

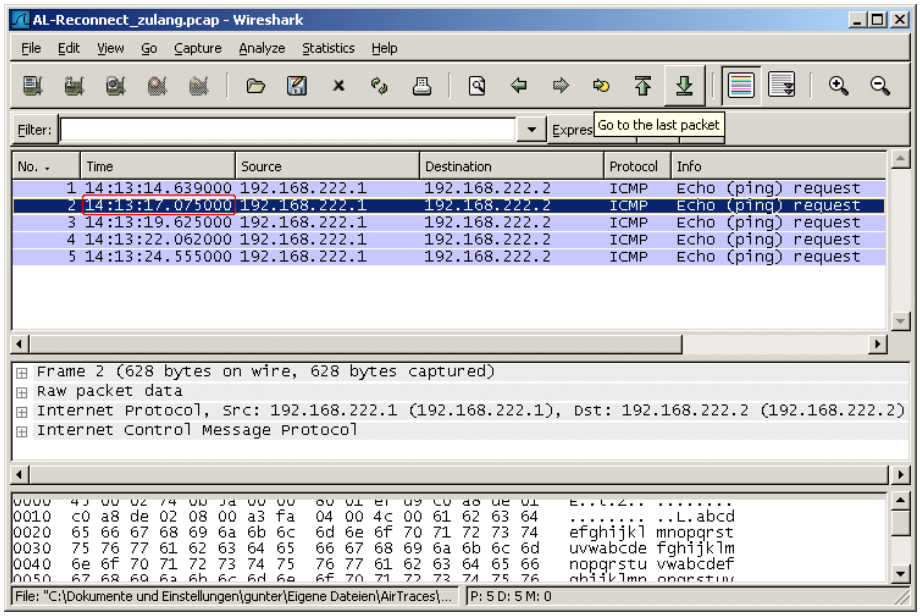


Figure 85 WireShark

The timestamp (14:13:17.075000) corresponds to the timestamp in the result file.

For more information about WireShark please refer to the WireShark documentation. The manual is available in the WireShark installation directory or at http://www.wireshark.org/docs/.

VoiceDecoder – listening to TETRA voice online and offline

When capturing an air trace, some traffic data might be included, i.e. TCH/S. Such traffic data can be decoded using the TETRA ACELP codec.

VoiceDecoder is a tool to convert TETRA coded speech to wave files (*.wav) and it also enables direct playback of received voice data. VoiceDecoder can either convert TVD files that have been generated by the AirAnalyzer software (offline mode), or it can convert a UDP input stream received from the AirAnalyzer software (online mode). The second case enables listening to a voice stream while capturing it in real time.

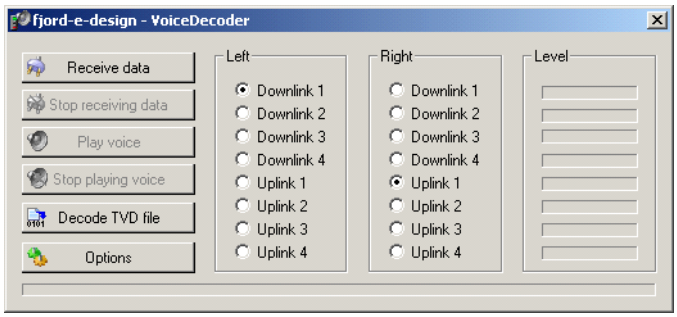


Figure 86 VoiceDecoder menu

Decoding voice data offline

Offline voice decoding needs a TVD file as input. The AirAnalyzer application will generate such a file during offline protocol analysis if the voice export option is enabled, see Figure 88.

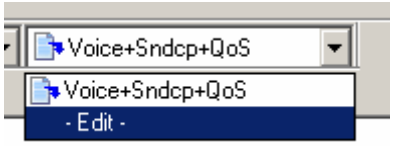


Figure 87 Edit menu item

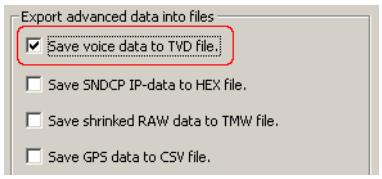


Figure 88 Offline voice export option in the AirAnalyzer

To decode a TVD file in offline mode, click **Decode TVD file**. The TVD file must be specified. The voice data from this file will be exported to eight wave files, one file per link and slot. The filenames for these files are derived from the TVD file name by adding <link><slot number> and changing the file name extension to WAV.

A progress bar will indicate the progress of conversion for longer TVD files.

Online voice decoding

The online voice decoding needs a UDP stream containing TETRA voice data. The AirAnalyzer application will generate such a UDP stream during online protocol analysis if the voice export option is enabled, see Figure 18: Online voice export option.

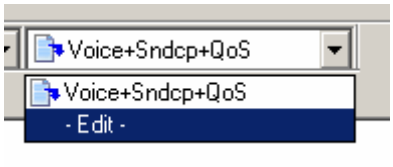


Figure 89 Edit menu for online voice decoding

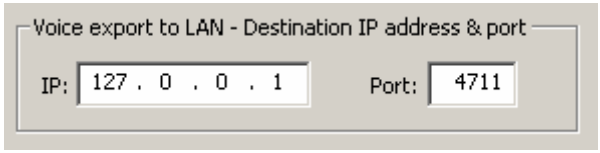


Figure 90 Online voice export option in the AirAnalyzer

The online mode is started by clicking **Receive data**. The voice stream received via UDP will be saved to a TVD file. Therefore a filename needs to be entered.

When receiving a voice stream on one or more TETRA timeslots, the corresponding level meter on the right part of the VoiceDecoder will indicate the level of that stream.

To listen to that stream, just select the timeslot using the radio buttons next to the Timeslot name. One timeslot can be assigned to the left speaker output, and another one can be assigned to the right speaker output. And the online playback functionality must be activated by clicking **Play voice**.

Stop the voice playback by clicking **Stop playing voice**.

Stop reception of a UDP stream by clicking **Stop receiving data**.

Note

A soundcard must be installed correctly in your system to provide audio playback.

Options

To use the online voice decoding mode, a shared UDP port must be specified in both the AirAnalyzer application and the VoiceDecoder application. In VoiceDecoder, the UDP port can be specified by clicking **Options**.

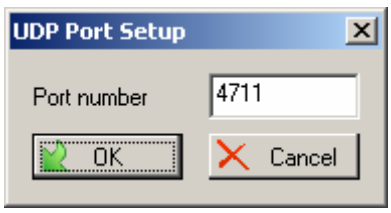


Figure 91 UDP port option in VoiceDecoder

The same port must be specified in the settings of the AirAnalyzer software, see Figure 92. The local host IP address (127.0.0.1) is useful if VoiceDecoder is started on the same computer as AirAnalyzer.

Figure 92 UDP port selection in AirAnalyzer

TetraScanner

5

This chapter provides task-based instructions for using the TetraScanner features of the TETRA AirAnalyzer. Topics discussed in this chapter are as follows:

Finding TETRA signals

Introduction

In order to operate TetraScanner correctly and to be able to interpret the results it is important to know some basics about the different TETRA signals as well as when and how they are broadcast. This chapter explains these basics. It is also important to know how TetraScanner works in order to be able to find a TETRA signal and to identify this as a TETRA signal. This know-how then enables you to further optimize the scanning process according to your individual requirements.

TETRA signals

There are three different types of TETRA signals: TMO continuous transmissions, TMO discontinuous transmissions and DMO transmissions. The structure of the individual bursts and the behavior when sending are different. TetraScanner is able to find these different signals. Due to the different sending properties different requirements have to be met for searching and finding these signals. See section "How TETRA signals are broadcast" on page 112 for additional information.

Table 25 TETRA signals

Type	Downlink	Uplink
TMO continuous transmissions	Data bursts or broadcast bursts are transmitted continuously to all slots within the downlink. At this time all TMO systems work according to this principle.	Data bursts are only broadcast when a call or data transfer is in progress.
TMO disontinuous transmissions	If no data bursts are transmitted only individual broadcast bursts are transmitted within certain time frames.	Data is only broadcast when a call or data transfer is in progress.
DMO transmissions	Data bursts are only transmitted to Slot 1 and broadcast bursts every 6 frames to Slot 3 if a call is in progress. Gateway, repeater or managed DMO instances transmit broadcast bursts within certain time frames.	Nothing is broadcast except the possibility of a random access signal.

Burst types

TETRA TMO employs two different burst types within the downlink: sync burst and normal burst. Sync bursts contain a BSCH as well as additional logical channels. The BSCH usually contains system information as well as parameters to decode the remaining logical TETRA channels. The sync burst contains a longer

training sequence in order to allow for a better synchronization in time. Only after the sync burst has been successfully decoded is it possible to use the information from the other logical channels. The BNCH (Broadcast Network Channel), AACH (Access Assign Channel) and TCH (Traffic Channel) are especially important for the analysis by TetraScanner. Either the normal burst or the sync burst (no TCH available) can contain these logical channels.

How to find TETRA signals

In order to be able to find a TETRA signal within a certain frequency range there are certain clues to go by:

The power is higher than the background noise.

The first characteristic is the received field strength. Depending on the signal type of the TETRA carrier, power is always present (continuous TMO operation) or data is only sent at certain times (discontinuous TMO operation or DMO). If additional carriers are used at one location to extend the traffic load you have to take into consideration that these can be activated as required and do not send continuously.

The demodulated data stream contains TETRA training sequences.

The next step is searching within the demodulated data for TETRA signals, that is training sequences (TS). In comparison to non-TETRA signals it should be possible to find training sequences in a certain order and with few bit errors within a TETRA signal. Due to the length of the training sequence the reliability of this information is limited. This is further complicated if the signal is discontinuous.

The signal can be decoded.

In order to be able to correctly identify the TETRA signal, TetraScanner has to be able to decode the bursts. The sync burst types have to be used first. Compared to other burst types all sync bursts are coded using a defined scrambling sequence. The sync burst contains the necessary information for decoding all other burst types.

How TetraScanner works

The search for TETRA signals in carried out in user definable steps. You can define a different search strategy according to the expected TETRA signal. TetraScanner will carry out the steps described in section "How to find TETRA signals". Parameters are available for the described steps to control the success of the search.

You can also skip individual search steps. This is useful if the result of the search cannot be used to find TETRA signals. For example, it is not useful to search for power and training sequence if you are using a gateway, repeater or managed DMO instance to find the broadcast data of a TMO disontinuous transmission or DMO transmission. Measurable power or training sequence would only be available if there happens to be a call in progress. In this case you should try to decode the broadcast over a longer period of time.

Searching for power

When searching for power the mean value for received power is determined for a definable period of time within the 25 kHz frequency allocation scheme. Every 14.16 milliseconds (time of one slot) a power value is determined and the mean value is calculated using the predefined period of time. If this mean value exceeds a definable power value, the search for a training sequence is carried out.

Searching for training sequences

The second step searches for training sequences within a definable number of slots. You can use the condition for a premature disconnection (timeout) as an additional criterion. This timeout determines the time period between the detected training sequences before further training sequences should occur. Example: The search for training sequences is carried out for 72 slots (one multi-frame). When using TMO continuous transmission the search should find 72 training sequences. If more time than the defined time passes between two training sequences, the scanning of the 72 slots is interrupted. Finally, the detected training sequences are evaluated. The number and mean bit error rate are important for this step. If both values are within the defined values, the signal is classified as a potential TETRA signal (scan candidate).

Decoding bursts

During the decoding a search for sync bursts is carried out over a predefined period of time. It is only possible to decode a sync burst if the CRC error check was carried out successfully. By using the information from this sync burst it is possible to decode additional logical TETRA channels. If the BSCH (Broadcast Synchronization Channel, contained within the sync burst) is successfully decoded: the carrier is clearly identified as a TETRA signal. After this a search for the BNCH (Broadcast Network Channel) has to be carried out to complete the channel information.

How TETRA signals are broadcast

TMO continuous transmissions

In the downlink (DL), bursts are broadcast in frame 1-18 for all slots. These TETRA carriers are secure and comparatively easy to identify. By evenly broadcasting across all slots, a mean value for the field strength with little variance results. The search for the training sequences is carried out under optimum conditions. Possible aberrations incorrectly received are neglectable due to the multitude of received training sequence. At least once every multi-frame (1.02 seconds) a sync burst is broadcast. The search within a frequency range for this TETRA signal is therefore secure and fast.

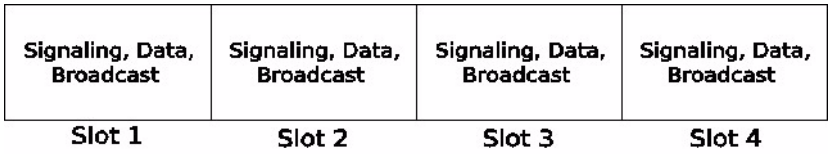


Figure 93 TMO continuous frame

TMO disontinuous transmissions

If no call is in progress and no data are transmitted it is very difficult to detect the TETRA signal, since broadcast data are only sent in long intervals. Since the field strength can only be measured when data is transmitted and since there is no transmission over many slots, the search for this carrier is very difficult. The TS measurement does not yield a meaningful result. We therefore recommend to set the time for the measurement to at least 4.08 s. If the carrier to be detected is already known, we recommend to use the DeepScan function.

DMO transmissions

DMO signals are only broadcast continuously and are easy to find when a call is in progress. The broadcast data transmitted by a gateway, repeater or managed DMO instance sometimes are sent over large time periods. It is therefore only possible to identify DMO channels if a call is in progress.

During a call in progress bursts are only broadcast to slot 1 and, in addition, data every 6 frames in slot 3. The measurement of the field strength results in the effective mean value of one frame, the peak values of the individual bursts show higher values. During an active call 21 training sequences are sent per multi-frame (=72 bursts). The threshold for the received training sequence should be low. Since it is possible to find a training sequence within the noise in the slots not used for sending, the allowed bit error rate has to be raised.

By scanning for broadcast data it is possible to clearly identify the DMO carrier. The scanning process has to be carried out over at least 6 frames (=24 bursts). If no call is in progress but a gateway, repeater or managed DMO instance is available, it is possible to scan the channel over a certain period of time using the DeepScan function (see "DeepScan" on page 139). This will also clearly identify the broadcast data from the gateway, repeater or managed DMO instances.

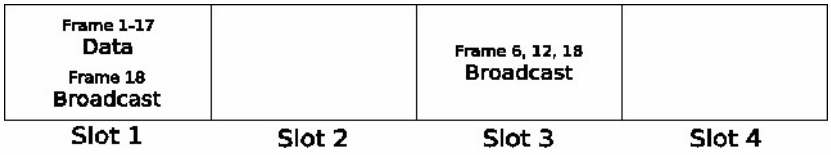


Figure 94 DMO frame during an active call

Getting started with TetraScanner

After starting TetraScanner, the Options window is displayed. You first have to select the 8140 to be used.

There are two different search options available. You can either search for TETRA carriers using a frequency band or you can use a channel list with predefined channels.

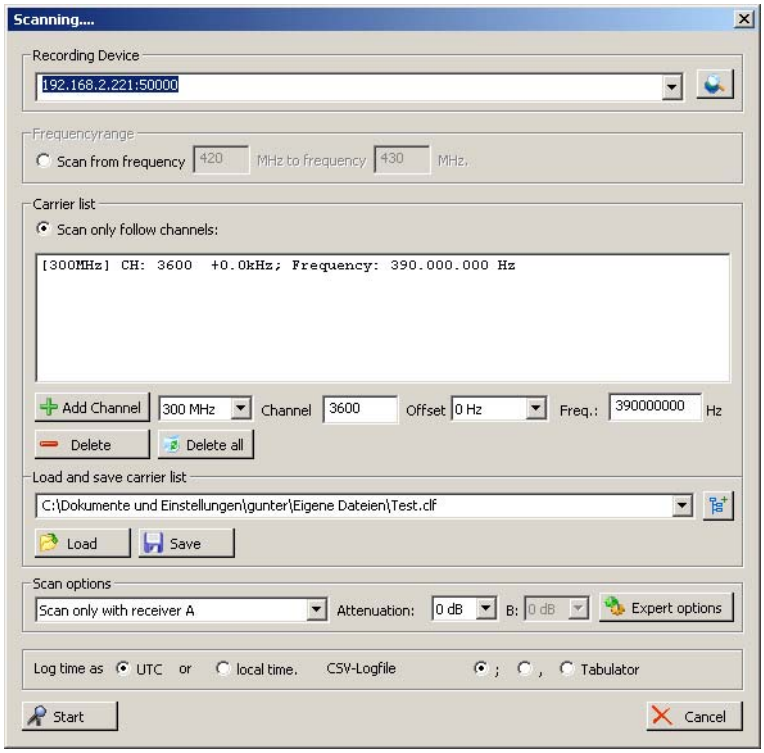


Figure 95 Options dialog

Scanning a frequency range

When scanning a frequency range you have to define the start and end frequency in the Options dialog. Use integer MHz values for this. The 25 kHz allocation scheme is scanned using the predefined frequency range. See "Action buttons" on page 116 for additional information on scanning. The setting for the frequency offset is carried out automatically by the 8140.

Scanning a channel list

Instead of a frequency range you can also use a list with channels. You can define the list manually. You can also save, load and edit this list. The lists can also be created from scans of the frequency range.

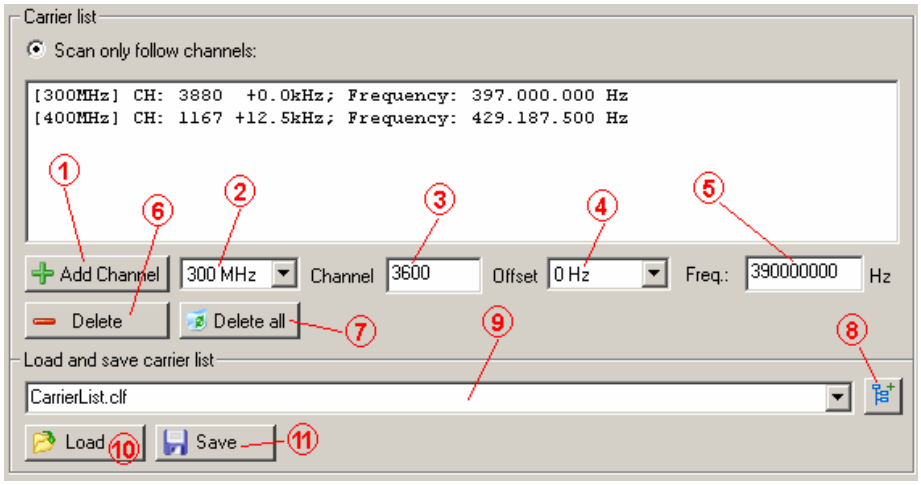


Figure 96 Channel list

Use button "Add channel" (1) to add a channel to the list. Use the fields (2) to (5) to define the channel.

Use button "Delete" (6) to remove one or several selected entries. Use the button "Delete all" (7) to remove the entire list.

Use button (8) within a file dialog to select the path or file name. Field (9) contains the file name.

Use button "Load" (10) to load the file selected in field (9). Older entries are not deleted when loading. The new entries from the file are attached to the bottom.

Use button "Save" (11) to save the list to the file shown in field (9).

Scanning options

The scanning options define the hard and software. First you select the receiver for the scanning process. The inputs on the hardware are labeled "RF-IN-A" and "RF-IN-B". In addition you can use attenuators. Use button "Expert options" to define the settings for the power measurement, training sequence measurement and for the broadcast search (see "Expert options" on page 116 and "Finding TETRA signals" on page 110).

Figure 97 Scanning options

Logfile settings

TetraScanner can create logfiles when the monitor or DeepScan options are used. You can set the timeframe to be used. You can either use UTC (Coordinated Universal Time) or the defined local time zone. You can only change this setting at the start. It is not possible to change the setting later. Monitoring data are exported to a CSV file. You can select the format for the CSV file by using the

option "CSV-Logfile separator". This setting is also only possible at the start. You can import these CSV files by using Excel or OpenOffice. We recommend the separator ";" when using Excel.

Action buttons

Click on **Scan** to save all settings. The defined frequency range or the selected carrier are immediately scanned.

Click on **Use** to save the settings without being asked to confirm. The frequency scan is, however, not started automatically. (The Use button is not available at the start; it is available only if the options dialog is used after starting, e.g. to change settings.) See "Menus" on page 129 for more information.

Expert options

Click on **Expert options** (see "Scanning options" on page 115) to define the search for TETRA signals. "Finding TETRA signals" on page 110 explains these options.

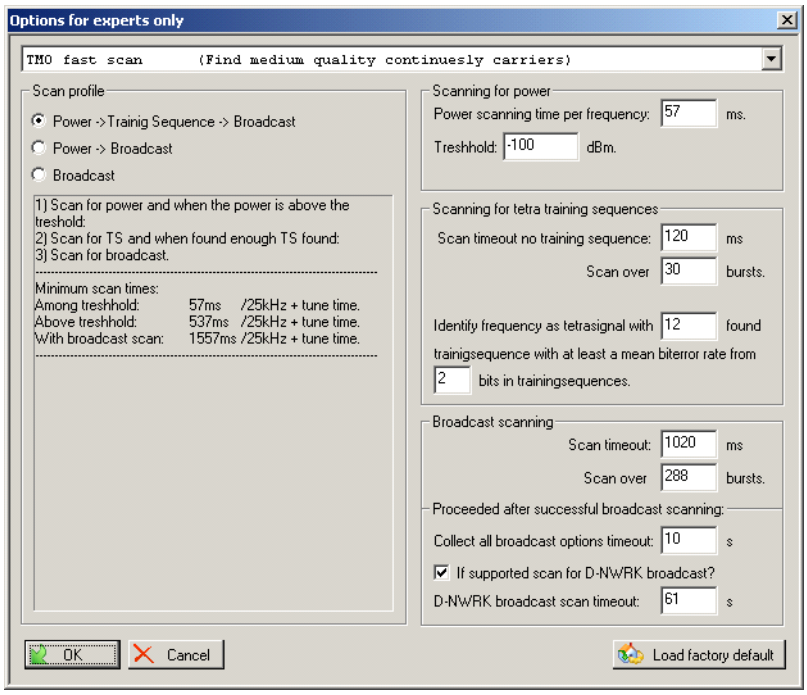


Figure 98 Expert options

Predefined profiles

In order to make it easier to define parameters, different scan profiles are available. It is easy to use these profiles for the different search strategies. You can always select one by using the upper dropdown box. The predefined profiles shown in are available.

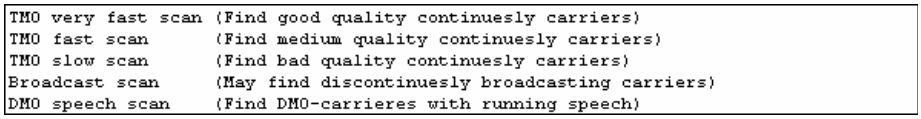


Figure 99 Scan profiles

The name of the profile is displayed on the left. This describes the object of the search and the speed. Additional information on which carrier types can be detected are displayed within the brackets.

Dividing the parameters and calculating the time for measurement

The details for the individual scan options are summarized within the groups "Scan profile", "Scanning for power", "Scanning for tetra training sequences" and "Broadcast scanning". The "Scan profile" group defines the steps for the scan. The other groups contain the options for the individual steps. The text field contains additional information on the defined values. This also contains the minimum scan time per 25 kHz. Please note that each change of frequency in respect to the carrier and offset results in additional tune time for the receivers. Since this time varies only the measuring times are calculated. The times for the individual measurement steps are also added up. Example: The first step searches for power and therefore the first point contains the time used for this step. If the power exceeds the defined threshold, step two is carried out (e.g. searching for the training sequence). The time displayed for step two contains the entire measurement time for step one (searching for power) in addition to step two (searching for TS). If there is a step three (the broadcast search) after searching for the training sequence, the time displayed beneath the broadcast search is the sum of the time for the power search, training sequence search and broadcast search. You can use this for an approx. evaluation of the measurement time for a frequency range. The measurement time depends on the search depth for each carrier as well as the necessary steps and their measurement times.

"Scan profile" group

Power -> Training Sequence -> Broadcast

Three steps determine if a TETRA signal is available. The first step is the search for power. Only if the power exceeds the predefined threshold this frequency is checked further.

The second step is used to search the frequencies exceeding the threshold value for training sequences. The 8140 also determines the frequency offset used (-6250 Hz, 0 Hz, +6250 Hz and 12500 Hz). The four results are then evaluated. The results within the predefined values are checked further.

The third and last step uses the detected offset to scan the carrier for broadcasts.

This profile can be used to quickly search large frequency ranges for (continuous) TMO channels.

Power -> Broadcast

Two steps determine if a TETRA signal is available. The first criterium is the received field strength. Only if this exceeds the predefined threshold value this frequency is checked further.

The second step is used to search the frequencies exceeding the treshold value for broadcasts. The scanning is carried out four times. The 8140 also determines the frequency offset used (-6250 Hz, 0 Hz, +6250 Hz and 12500 Hz).

This profile can be used to reliably detect (continuous) TMO channels. If the field strength lies just above the background noise this method also detects carriers with bad reception quality. You can even detect TMO discontinuous transmissions and DMO transmissions if a call is in progress during the scanning. But the scan process takes longer, since the scanning for training sequences is normally much faster than the scanning for broadcasts.

Broadcast

All frequencies are scanned for receivable broadcasts. The 8140 also determines the frequency offset used (-6250 Hz, 0 Hz, +6250 Hz and 12500 Hz).

This method is very slow. However, if you use a long scanning time you can also find TMO discontinuous transmissions or DMO TETRA carriers with gateway, repeater or managed-DMO instances if no call is in progress.

"Scanning for power" group

You can define how long the scan for power should take per frequency. A mean value is calculated over the period of time. When searching for TMO continuous transmissions you can use a low value (up to approx. 14 ms). This can shorten the scanning time considerably. When searching for DMO transmissions the value has to be at least one frame (>= 57 ms). The threshold determines, if the search should be carried out further for the frequency.

"Scanning for TETRA training sequences" group

You can define how the search for training sequences should be carried out. TetraScanner searches for the defined time (scan timeout no training sequence) for a training sequence. If no training sequence could be detected during this time, the scanning process is canceled. However, TetraScanner searches for the defined number of bursts (Scan over n bursts) at the most. In order to decide if this could be a potential TETRA signal, the defined number of detected training sequence has to be reached or exceeded. The quality of the training sequence has to be equal to or lower than the definable mean bit error rate (bit error rate within the training sequence).

"Broadcast scanning" group

The search for the sync burst is carried out for the defined period of time and the defined bursts at the most. If the scan is successful it has to continue since not all broadcast information are necessarily sent in one message. They are usually sent in a row (alternating). If all information could be collected before the defined time out, the scan process is canceled. The scan can also be carried out for a D-NWRK-Broadcast if the base broadcasts this signal. Using the received data TetraScanner automatically detects if the scan for the D-NWRK-Broadcast has to continue. If this is not the case, the scan process is canceled. Since the D-NWRK-Broadcast is rarely broadcast the scan has to be carried out over a longer period of time. Not all information are necessarily contained in one message. As soon as TetraScanner detects that the D-NWRK-Broadcast is repeated, the scan process is canceled.

TetraScanner windows

Overview after a frequency range scan

After a frequency range scan TetraScanner looks as follows. A window for power to show the power in relation to the frequency. A window "Carrier list" to show detected TETRA carriers. A text window to show additional information. A (still) deactivated window for monitor data. The titles of the individual windows show additional information. If a scanning job is being carried out, this job will be displayed in the title of the power window. The title of the text window shows to which carrier the information belongs.

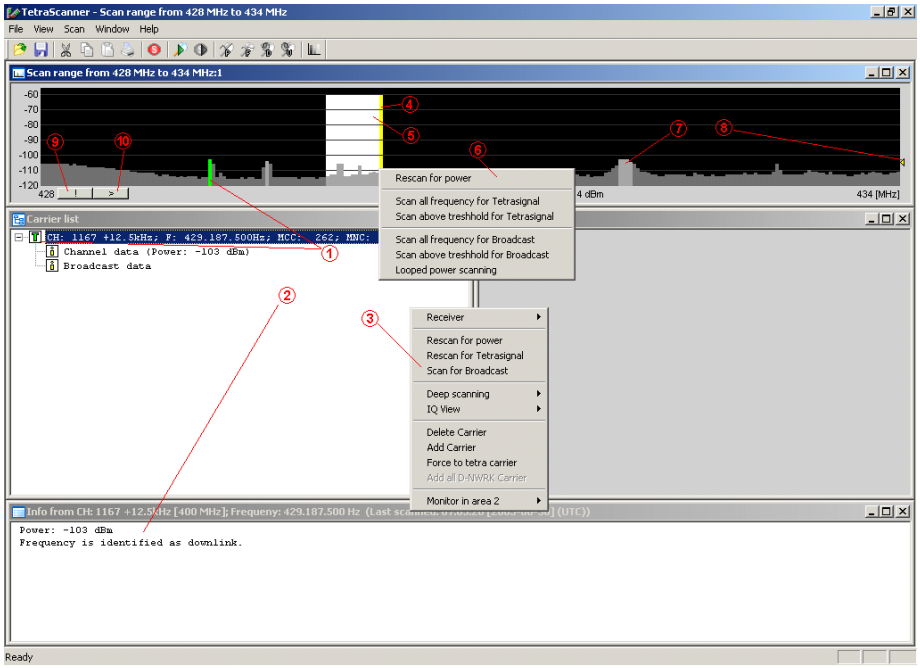


Figure 100 Scanning a frequency range

(1) Detected TETRA carriers are depicted using different colors within the power window. A TMO downlink carrier is green, a TMO uplink carrier is yellow and a DMO carrier is dark yellow.

The "Carrier list" window shows them using a special icon for detected carriers. This icon can be expanded to show a list. The main entry for each carrier consists of the channel data Channel (CH) + Offset; Frequency (F) and, if the broadcast could be decoded, the MobileCountryCode (MCC), Mobile Network Code (MNC) and Base Color Code (BCC).

Each detected carrier may contain additional items with data:

- Channel data with the measurement results of the search for training sequence and broadcast.
- Broadcast data with all decoded broadcast data.
- D-NWRK Broadcast with all received D-NWRK broadcast data.

(2) The text window shows error messages, warnings and information for selected objects. The title contains the reference for the displayed text.

(3) When you click on a selected carrier using the right mouse button a popup menu is displayed. You can use this for additional options.

(4) You can select the individual frequencies within the power window by using the cursor (yellow horizontal bar).

(5) You can select a frequency range (white).

(6) You can click on a frequency or selected area with the right mouse button to display a popup menu. This menu contains additional options. (See "Context menu" on page 123).

(7) The determined power values are either depicted dark gray or light gray. Power values depicted dark gray fall short of the definable threshold (8) and value depicted light gray exceed the threshold.

(8) The arrow points to the defined value for the threshold. You can grab and move the arrow at any time. When you drop the arrow you define a new threshold. All values exceeding this threshold are depicted light gray and are scanned for TETRA signals again.

(9) The power window offers two views: Power in relation to frequency and a list of all channels detected or added manually. You can use the **!** button to toggle the two views.

(10) Use the **>** button to show additional menus for controlling the power window (see "Understanding and operating the Power window" on page 122).

Overview after scanning a list

After scanning a list TetraScanner looks as follows. The power window shows the individual list entries with their power value. The "Carrier list" window shows the entries of the list. The text window shows additional information. The titles of the individual windows show additional information. If a scanning job is being carried out, this job will be displayed in the title of the power window. The title of the text window shows to which carrier the information belongs.

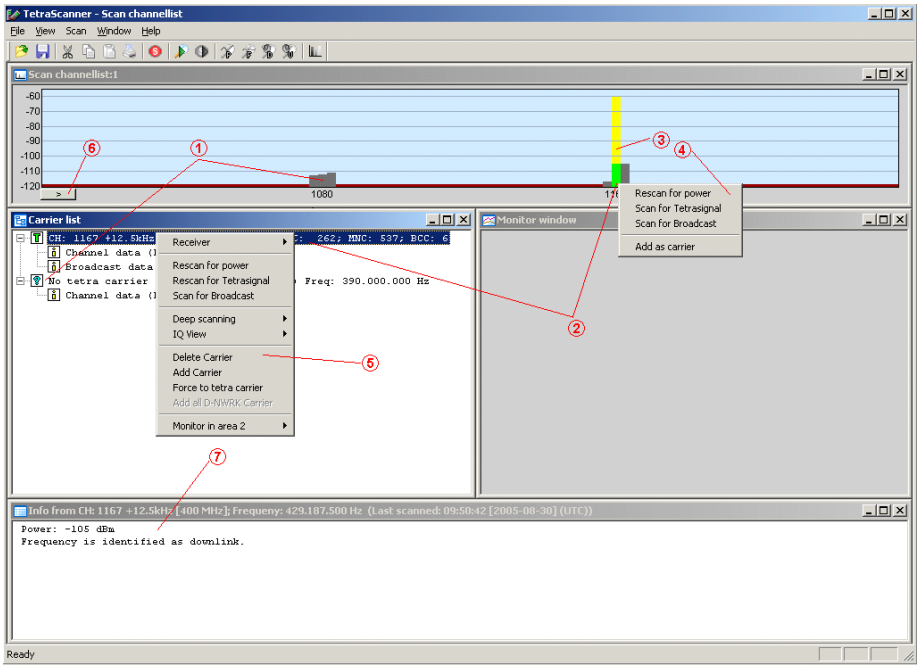


Figure 101 Scanning based on a frequency channel list

(1) Entries are shown in the power window and as expandable lists in the "Carrier list" window. If no TETRA carrier was detected the carrier is depicted gray.

(2) A TMO downlink carrier is green, a TMO uplink carrier is yellow and a DMO carrier is dark yellow.

(3) You can select the individual frequencies within the power window by using the cursor (yellow horizontal bar). The carrier is shown in the middle and the frequencies to the right and left of the carrier.

(4) You can click on a frequency or selected area with the right mouse button to display a popup menu (see "Context menu" on page 123).

(5) You can click on a selected carrier with the right mouse button to display a popup menu.

(6) Use the **>** button to show additional menus for controlling the power window (see "Understanding and operating the Power window" on page 122).

(7) The text window shows error messages, warnings and information for selected objects. The title contains the reference for the displayed text.

Understanding and operating the Power window

The power window allows two different view settings: frequency or carrier. The frequency view shows the power in relation to the frequency. The carrier view only shows the carriers contained in the carrier list and their power values. You can toggle the view by using the **!** button.

View of the frequency range

After scanning a frequency range the power window shows a multitude of data and options for additional scans. To the left and right of the bottom row the frequency range is depicted (380 – 435 [MHz]). The received power in dBm (–120 to –60) is shown on the left.

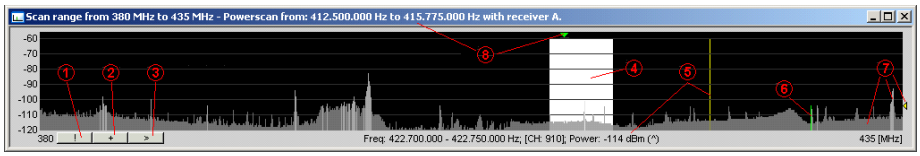


Figure 102 Power window showing a frequency range

(1) Use the **!** button to switch to the carrier view (see "Carrier view" on page 124).

(2) If a large frequency range was scanned the window cannot contain all measured values. Several measurement values are summarized in order to provide a complete overview of the scanned area. You can enable the zoom option by using the **+** button. The window shows one value for each measurement value. You can scroll the entire range of measurement. Use the **–** button to switch back to the overview.

(3) You can use the **>** button to open additional menus (see "Additional menus" on page 123).

(4) Selected areas are highlighted. (See "Context menu" on page 123).

(5) The cursor is depicted as a horizontal yellow bar. The most important data beneath the cursor are shown in the bottom row. The example (Figure 102) shows a large frequency range. Several measurement values are summarized. The text explains the range of the combined measurement values (e.g. "Freq: 422.700.000 – 422.750.000 Hz") and the peak (^) power value of the measurement (e.g. "Power: –114 dBm"). If the summarized range contains a TETRA carrier, this TETRA carrier has a higher priority in respect to the display. If only one measurement value is available at the position of the cursor, only this measurement value is depicted. See section "Context menu" on page 123 for additional information.

(6) Detected TETRA carriers are highlighted using colors. A TMO downlink carrier is green, a TMO uplink carrier is yellow and a DMO carrier is dark yellow.

(7) Power values are either depicted dark gray (if their value falls short of the defined threshold) or light gray (if the value exceed the threshold). The defined threshold is depicted by the yellow arrow on the right. You can grab and move this arrow. When defining a new treshold all frequencies which are equal to or

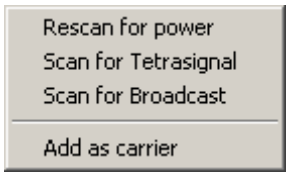
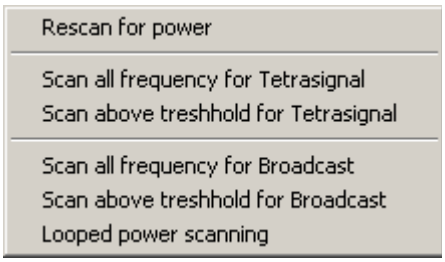
exceed the new value are scanned for TETRA carriers immediately. The threshold value also defines which frequencies TetraScanner searches more closely for TETRA carriers.

(8) If TetraScanner is busy with a scan job, the green arrow shows the frequency being processed. The title shows the job being processed. The example (Figure 102) shows a power scan for the selected range (4).

Context menu

You can display a context popup menu by clicking with the right mouse button. The available options either refer to the frequency to which the cursor points or to a selected range.

Table 26 Popup menus

Single frequency	Frequency range
	
Rescan for Power: Scans the selected frequency for power.	Rescan for Power: Scans the selected frequency range for power.
Scan for Tetrasignal: Scans the selected frequency for TS.	Scan all frequencies for Tetrasignal: Scans all frequencies within the selected range for TS.
	Scan above threshold for Tetrasignal: Scans all frequencies within the selected range and exceeding the threshold for TS.
Scan for Broadcast: Scans the frequency for broadcast data.	Scan all frequencies for Broadcast: Scans all frequencies within the selected range for broadcasts.
Add as carrier: Adds the frequency to the list of carriers.	Scan above threshold for Broadcast: Scans all frequencies within the selected range and exceeding the threshold value for broadcasts.
	Looped power scanning: Scans the selected range repeatedly. You can stop the scan process by using the Stop button. You can scan as many ranges as you like.

Additional menus

The **>** button described in section "View of the frequency range" on page 122 shows an additional menu within the power window.

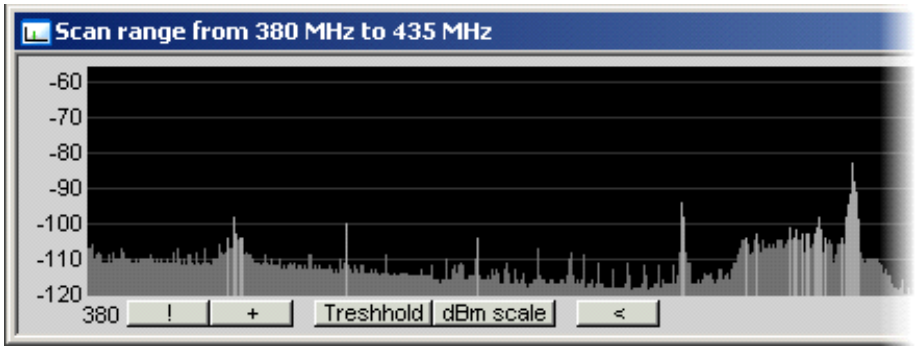


Figure 103 Frequency range scan, extended menu

Click **Threshold** to manually set the threshold.

Click **dBm scale** to set the displayed dBm range.

Click on **<** to hide the menu again.

Carrier view

The main difference compared to the view of the frequency range is the following: only channels contained within the carrier list are displayed. Identical features therefore contain a reference to previous sections.

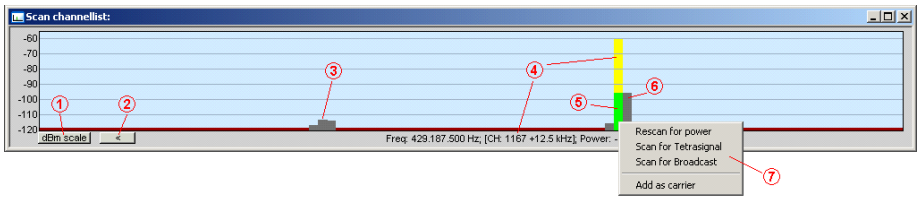


Figure 104 Power window with carrier view

(1) See description in section "Additional menus" on page 123.

(2) See description in in section "Additional menus" on page 123.

(3) If an entry within the list is not a TETRA carrier as shown in the example, only the power is depicted in gray.

(4) You can select individual entries with the cursor, which is displayed as a yellow line. The bottom row contains the information for the entry.

(5) Entries detected as TETRA signals are depicted using colors. A TMO downlink carrier is green, a TMO uplink carrier is yellow and a DMO carrier is dark yellow.

(6) To the left and right of each entry the performance of the neighboring channel is depicted.

(7) See description in section "Context menu" on page 123.

Understanding and operating the "Carrier list" window

The "Carrier list" window shows all detected downlink TETRA carriers from a scan over a frequency range and/or all entries within a list.

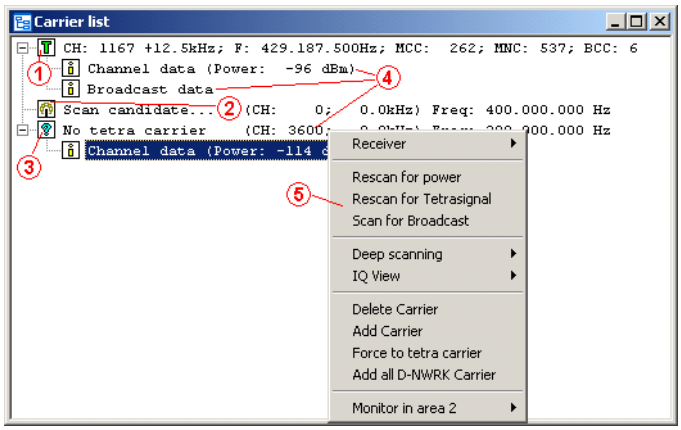


Figure 105 "Carrier list" window

(1) Detected TETRA carriers are highlighted with the T symbol. Behind the symbol, the main data are shown.

Table 27 Information about TETRA carriers

Type	Text: Channel + Offset;	Frequency	Broadcast
TMO	CH: Channel + Offset;	F: Frequency Hz;	MCC: MCC; MNC: MNC; BCC: BCC
DMO	DM MS-MS: DM REP. : DM GATE.: DM RP/GT:	Channel + Offset;	F: Frequency Hz;	MCC: MCC; MNC: MNC

(2) Entries in the list that have not been scanned yet (), are shown as "Scan candidate". When carrying out a scan of a frequency range all entries exceeding the threshold are added automatically. If, however, it turns out after the scan process that this is not a TETRA carrier, these automatically added entries are removed.

(3) Entries not added automatically by the scan process for a frequency range but which are part of a list or which have been added manually, are labeled "No TETRA carrier" () after an unsuccessful scanning process.

(4) The measurement results of the individual entries are depicted as subitems:

- Channel data: Shows power values, TS measurement data and tries of broadcast scans.
- Broadcast data: If received, shows the decoded broadcast.

– D-NWRK Broadcast: I received, shows the decoded D-NWRK broadcast.

(5) You can click on a selected carrier with the right mouse button to display a popup menu which offers additional options.

"Carrier" context menu

You can display a popup context menu by clicking with the right mouse button. The available options refer to the carrier selected for the popup menu.

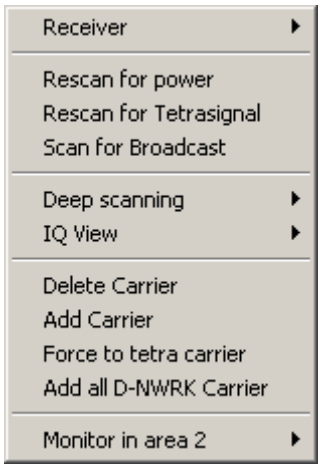


Figure 106 "Carrier list" context menu

Receiver: Not used at the moment.

Rescan for Power: Carries out a power measurement for the selected entry.

Rescan for Tetrasignal: Scans the selected entry for Training-Sequences.

Scan for Broadcast: Scans the selected channel for broadcast data.

Deep scanning: Starts a DeepScan measurement (see "DeepScan" on page 139).

IQ View: Not used at the moment, reserved for later use.

Delete Carrier: Deletes the entry from the list.

Add Carrier: Opens a dialog in which you can create a new entry manually.

Figure 107 "Add channel" dialog from the "Carrier list" context menu

Force to tetra Carrier: You can define the carrier type and network data. When receiving broadcast data the predefined data are overwritten.

Figure 108 "Force tetra carrier" dialog from the "Carrier list" context menu

This method is used to decode TETRA carriers while monitoring them without having to wait to receive a SYNC PDU. This might be useful if you want to travel a route. At the start it is not possible to receive all carriers and their broadcast data. When travelling the route only this carrier lies within the reception range. Since the broadcast might be rarely transmitted and by periodically scanning when monitoring it is possible, that no broadcast data are received using this method. It is therefore not possible to decode the carrier. You will see an increase in power, however, the carrier is not recognized as a TETRA carrier. When you supply the network data you do not depend on receiving the SYNC PDU.

Add all D-NWRK Carrier: If D-NWRK broadcast data were received, it is possible to add the submitted neighboring carriers to the carrier list.

Monitor in area 2: If TetraScanner is operated in monitor mode you can use the second monitor window to add or remove any measurement values from any channels.

Menus and toolbar

Toolbar

The toolbar contains general features which do not refer to frequency and list entries. Unavailable features are depicted gray according to their state.

Figure 109 TetraScanner toolbar

Loads a carrier list. If the carrier window already contains a carrier, the entries are added.

Saves the current carrier list.

Cuts text from the text window.

Copies text to the text window.

Copies text from the text window to the clipboard.

Prints text and graphics.

Stops all measurement jobs immediately.

Starts the monitoring. This button is only available if the carrier list contains entries. See "0 Search for Country/Network:Search for MCC and MNC within the database." for additional information.

Stops only the monitoring. This features is only available during the monitoring process. See "0 Search for Country/Network:Search for MCC and MNC within the database.

Shows all power values over time in the second monitor window. This features is only available during the monitoring process. See "0 Search for Country/Network:Search for MCC and MNC within the database".

Shows all frequency errors over time in the second monitor window. This features is only available during the monitoring process. See "0 Search for Country/Network:Search for MCC and MNC within the database".

Shows the DL traffic over time in the second monitor window. This features is only available during the monitoring process. See "0 Search for Country/Network:Search for MCC and MNC within the database".

Shows the UL traffic over time in the second monitor window. This features is only available during the monitoring process. See "0 Search for Country/Network:Search for MCC and MNC within the database".

Shows the AACH statistics. This features is only available during the DeepScan measurement. See "DeepScan" on page 139.

Menus

File

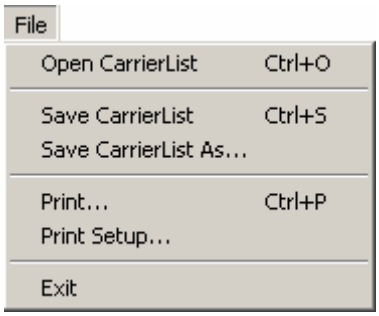


Figure 110 File menu

- Open CarrierList: Loads entries from an available list. If entries are already available within the window "Carrier list", the entries are added.
- Save CarrierList: Saves the current list shown in the window "Carrier list".
- Save CarrierList As...: Saves the current list using a different name.
- Print: Prints text and graphics.
- Print Setup: Settings for the printer.
- Exit: Closes TetraScanner.

View

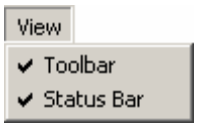


Figure 111 View menu

- Toolbar: Displays or hides the toolbar. ("Menus and toolbar" on page 128).
- Statusbar: Displays or hides the statusbar.

Options

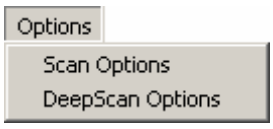


Figure 112 Options menu

- Scan Options: Opens the scan dialog (see "Getting started with TetraScanner" on page 114).
- DeepScan Options: Opens the DeepScan dialog (see "DeepScan options" on page 139).

Carrier

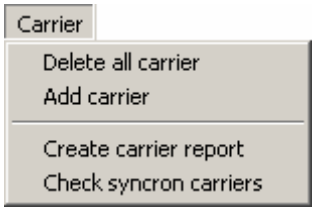


Figure 113 Carrier menu

- Delete all carriers: Removes all carriers from the list.
- Add carrier: Adds an entry to the carrier list.
- Create carrier report: Saves all carriers including the broadcast information to a text file.

Scan

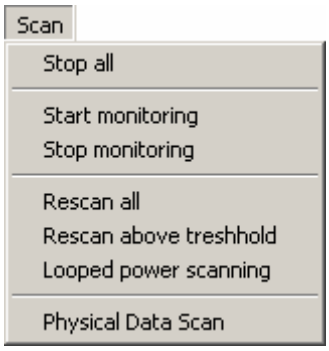


Figure 114 Scan menu

- Stop all: Stops all scan jobs immediately.
- Start monitoring: Starts monitoring the carrier list.
- Stop monitoring: Stops monitoring the carrier list.
- Rescan all: Rescans the frequency range or all entries within the carrier list.
- Rescan above threshold: Scans all frequencies exceeding the threshold.
- Looped power scanning: Scans the complete frequency range repeatedly.
- Physical Data Scan: Not used at the moment, reserved for later use.

Window

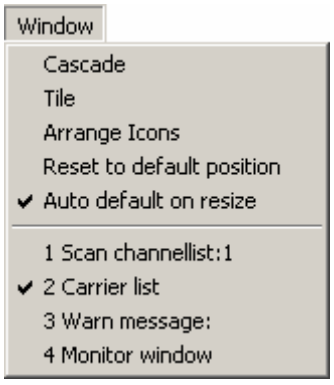


Figure 115 Window menu

- Cascade, Tile, Arrange Icons, Reset to default position: Rearranges the windows.
- Auto default on Resize: Customizes the frame windows to the new size if the main window is changed.

Tools

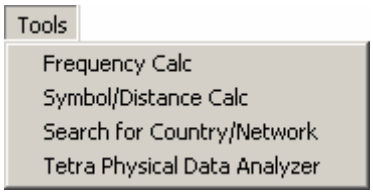


Figure 116 Tools menu

- Frequency Calc: Tool to convert frequencies to carrier numbers and vice versa.
- Symbol/Distance Calc: Not used at the moment, reserved for later use.
- Search for Country/Network: Search for MCC and MNC within the database.
- TETRA Physical Analyzer: Reserved for future versions.

Monitoring

By using monitoring you can monitor several TETRA carriers almost at the same time. Each selected carrier is monitored for a short time and the result is evaluated. After that the next carrier is monitored.

One receiver is able to monitor about 3 carriers per second. The time for each carrier depends on the tune time of the receiver and the reception of 8 slots. The tune time for the receiver takes up most of the time. The tune time is not a set time since this process may vary with each frequency change.

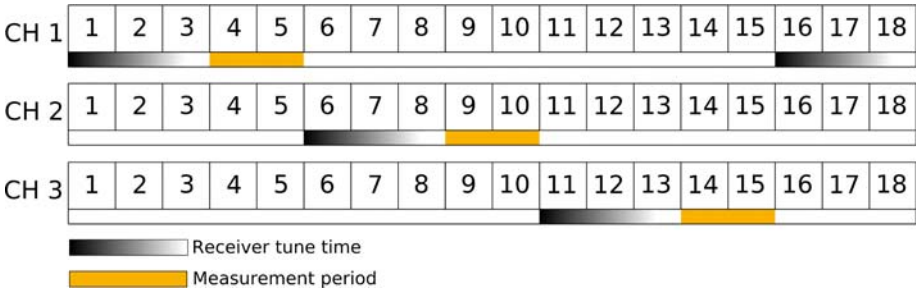


Figure 117 Timeline for monitoring

What data are collected during monitoring?

The following measurement results are available:

- Received field strength
- Frequency offset (only if bursts can be decoded)
- For TMO: Downlink-Traffic (only if AACH can be decoded)
- For TMO: Uplink-Traffic (only if AACH can be decoded)
- For DMO: If traffic was received in channel A.
- For DMO: If traffic was received in channel B.

The data are saved temporarily. At the same time the data are displayed over time and in real time within the monitor window.

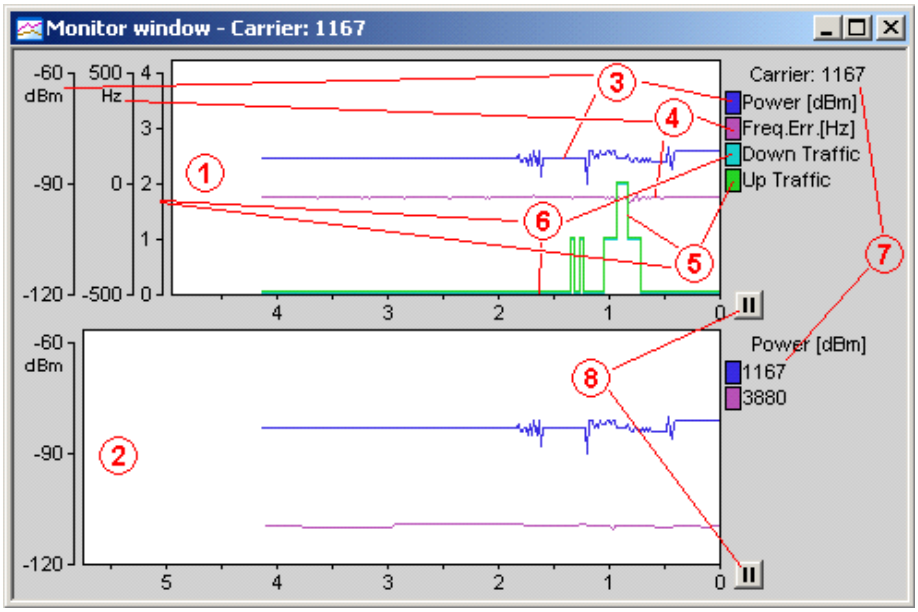


Figure 118 Display of the monitoring data over time

(1) Monitor window one:

This monitor window shows all received data of the selected channel. You can select the channel within the carrier window or within the power window.

(2) Monitor window two:

This displays an overview of the type of measurement (power, frequency offset, DL traffic, UL traffic) for all carriers within the carrier list. Figure 118 shows the power of both channels 1167 and 3880. You can use the buttons on the toolbar to toggle the view of the types. You can add individual curves or remove them by using the popup menu (right mouse button).

(3) Received field strength of channel 1167

On the left the "dBm" scale is depicted, on the right the curve of the field strength is shown in blue.

(4) Frequency offset of channel 1167

On the left the "Hz" scale is depicted. On the right the curve of the frequency offset is shown in color.

(5) Uplink traffic of channel 1167

On the left the "Used timeslots" scale is shown. On the right the curve of the uplink traffic is shown in color.

(6) Downlink traffic of channel 1167

On the left the "Used timeslots" scale is shown. On the right the curve of the downlink traffic is shown in color.

(7) Depiction of channel 1167

Window one shows all data of channel 1167. Window two shows all values of one measurement type compared to the other channels from the carrier list.

(8) Pause buttons for both monitor windows

You can use the pause buttons to freeze and unfreeze the view.

Tip: Show or hide curves.

You can show or hide the respective curve by double clicking on one of the colored boxes.

Starting the monitoring

In the toolbar, click on to start the monitoring. All channels contained within the window "Carrier list" are monitored (see "Understanding and operating the "Carrier list" window" on page 125). You can add as many channels as you like during the monitoring process. They will automatically be monitored, too. You can also delete channels at any time. In this case the monitoring for that channel is canceled immediately. If there are no additional channels in the "Carrier list" window the monitoring process is automatically canceled.

Stopping the monitoring

Click to stop the monitoring. You can also click button (Stop all actions), which stops all scan actions carried out by the scanner. On stopping the monitoring, TetraScanner will ask if you want to save the monitoring data or delete them.

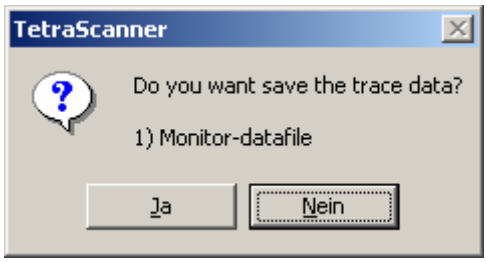


Figure 119 Optionally saving the monitoring data

If you decide to save the data you can add additional information (user, place, comment etc.) to the data file. You also have to select a name and path for saving the file.

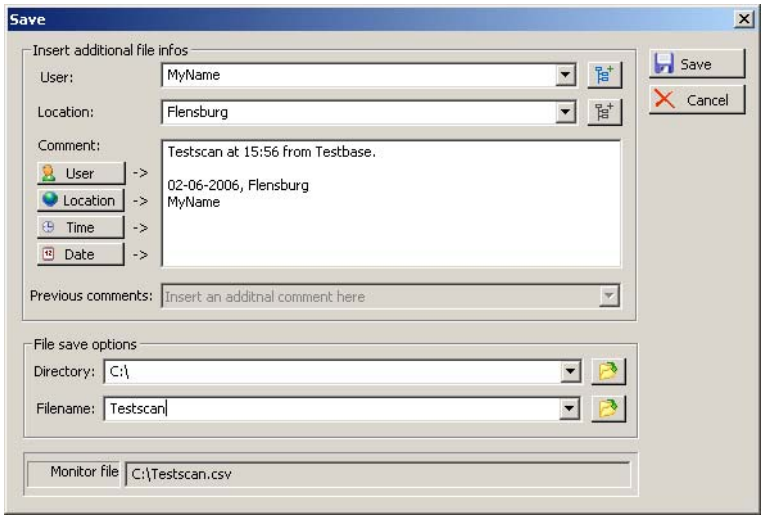


Figure 120 Saving the monitoring data

The CSV file format

Files are saved using the CSV format. However, since there is no obligatory standard TetraScanner can save files using different versions. You can select commas (,), semicolon (;) or tabs as separators. You have to select the format at the beginning. You cannot change the format later (see Figure 97 on page 115). If you want to use Excel you should use the version with semicolon. OpenOffice works with all versions.

The individual data of the fields are enclosed in quotation marks.

Line breaks within the files are kept as line breaks. They will not be replaced by "\n".

A quotation mark (") within the data will be replaced by two quotation marks (""). It will not be replaced by (\") or (&quote).

An inverted comma (') [not the quotation mark (")] will not be changed.

Example:

"Data 1";"Data 2";"Data 3";

"Data 4 with ""quotation marks"" and

line break";"Data 5";"Data 6";

The example above shows two lines with three columns containing the following data:

Data 1	Data 2	Data 3
Data 4 with "quotation marks" and line break	Data 5	Data 6

Data elements of the CSV files

The CSV file shows the following structure:

1 The header containing general information.

2 The start time.

3 Names of the individual measurement columns.

4 The measurement values.

5 Names of the individual measurement columns.

6 The end time.

Header

User	Entered data, see Figure 120.
Location	Entered data, see Figure 120.
Comment	Entered data, see Figure 120.

Version	Version of TetraScanner.

Start time

Start	Time [Date] (time zone)

Names of measurement columns

Time (time zone)	Power (Channel)	Freq. Error (Channel)	DL Traf-fic (Channel)	UL Traf-fic (Channel)	Receiver (Channel)

Measurement values

HH:MM:SS	Value in dBm	Value in Hz	How many slots were busy with traffic	How many slots were busy with traffic	Which receiver was used for scanning. Receiver A = 1, Receiver B = 2
...	...	...	...	...	...
HH:MM:SS	Value in dBm	Value in Hz	How many slots were busy with traffic	How many slots were busy with traffic	Which receiver was used for scanning. Receiver A = 1, Receiver B = 2

Names of measurement columns

Time (time zone)	Power (Channel)	Freq. Error (Channel)	DL Traffic (Channel)	UL Traffic (Channel)	Receiver (Channel)

End time

End	Time [Date] (time zone)

Example:

The following CSV file was recorded:

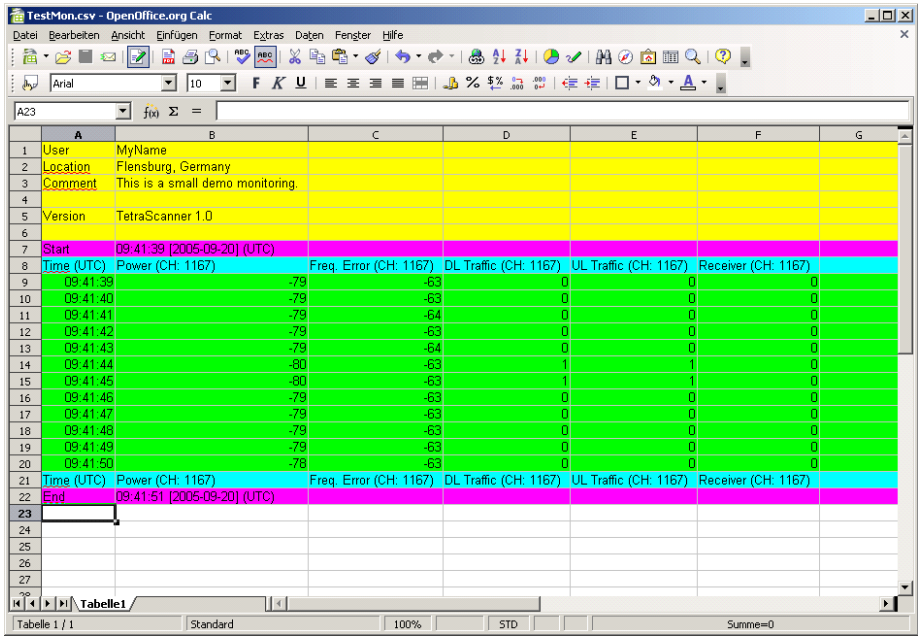
```
"User";"MyName";
"Location";"Flensburg, Germany";
"Comment";"This is a small demo monitoring.";

"Version";"TetraScanner 1.0";

"Start";"09:41:39 [2005-09-20] (UTC)";
"Time (UTC)";"Power (CH: 1167)";"Freq. Error (CH: 1167)";"DL Traffic (CH: 1167)";"UL Traffic (CH: 1167)";"Receiver (CH: 1167)";
"09:41:39";"-79";"-63";"0";"0";"0";
"09:41:40";"-79";"-63";"0";"0";"0";
"09:41:41";"-79";"-64";"0";"0";"0";
"09:41:42";"-79";"-63";"0";"0";"0";
"09:41:43";"-79";"-64";"0";"0";"0";
"09:41:44";"-80";"-63";"1";"1";"0";
"09:41:45";"-80";"-63";"1";"1";"0";
"09:41:46";"-79";"-63";"0";"0";"0";
```

```
"09:41:47";"-79";"-63";"0";"0";"0";
"09:41:48";"-79";"-63";"0";"0";"0";
"09:41:49";"-79";"-63";"0";"0";"0";
"09:41:50";"-78";"-63";"0";"0";"0";
"Time (UTC)";"Power (CH: 1167)";"Freq. Error (CH: 1167)";"DL Traffic (CH:
1167)";"UL Traffic (CH: 1167)";"Receiver (CH: 1167)";
"End";"09:41:51 [2005-09-20] (UTC)";
```

The screenshot below shows the CSV file viewed in OpenOffice.



	A	B	C	D	E	F	G
1	User	MyName					
2	Location	Flensburg, Germany					
3	Comment	This is a small demo monitoring.					
4							
5	Version	TetraScanner 1.0					
6							
7	Start	09:41:39 [2005-09-20] (UTC)					
8	Time (UTC)	Power (CH: 1167)	Freq. Error (CH: 1167)	DL Traffic (CH: 1167)	UL Traffic (CH: 1167)	Receiver (CH: 1167)	
9	09:41:39	-79	-63	0	0	0	
10	09:41:40	-79	-63	0	0	0	
11	09:41:41	-79	-64	0	0	0	
12	09:41:42	-79	-63	0	0	0	
13	09:41:43	-79	-64	0	0	0	
14	09:41:44	-80	-63	1	1	0	
15	09:41:45	-80	-63	1	1	0	
16	09:41:46	-79	-63	0	0	0	
17	09:41:47	-79	-63	0	0	0	
18	09:41:48	-79	-63	0	0	0	
19	09:41:49	-79	-63	0	0	0	
20	09:41:50	-78	-63	0	0	0	
21	Time (UTC)	Power (CH: 1167)	Freq. Error (CH: 1167)	DL Traffic (CH: 1167)	UL Traffic (CH: 1167)	Receiver (CH: 1167)	
22	End	09:41:51 [2005-09-20] (UTC)					
23							
24							
25							
26							
27							

Figure 121 CSV file in OpenOffice

DeepScan

When you use DeepScan only one carrier per receiver is monitored (in comparison to monitoring). However, it is monitored continuously without interruptions. This results in detailed information and additional display options:

- Complete AACH monitoring for all slots.
  All slots are received and AACH is decoded and evaluated. Different basic states of AACH are displayed: UMc,UMt, UMa, UMx.
- Monitoring and collecting all broadcast data.
  In DeepScan mode, all parameter available are collected.
- Display of changes with timeline.
  - Changes of the AACH are displayed in relation to slot.
  - Changes of the broadcast elements are displayed.
  - Additional events like reception interruptions are displayed.

A CSV file is created the same as when using the monitoring option (see "Data elements of the CSV files" on page 136). Furthermore two additional text files are created. The first one contains a timeline view of the events which occurred. The second text file contains detailed information about the event.

DeepScan options

You can display the following menu by clicking on **Options > DeepScan Options**.

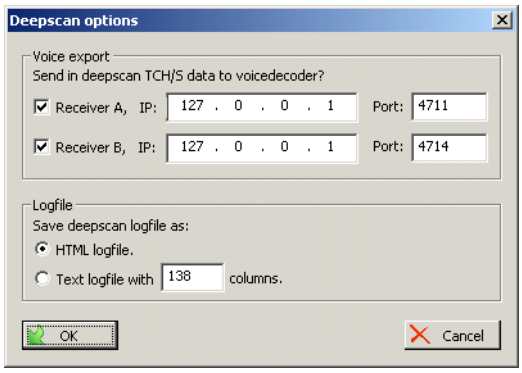


Figure 122 DeepScan options

Voice export

You can record calls by using the tool "VoiceDecoder". Depending on which receiver DeepScan is carried out you can send the speech data by using UDP.

Logfile

The recorded DeepScan events can be saved using two formats: Either as text or as HTML.

When you select the text format you have to define the desired number of columns. If you select many columns the display of the events might be confusing.

It is easy to display logs in HTML by using a browser. The events are linked to detailed text descriptions and vice versa. The display is based on the window of the online view.

Starting DeepScan

You can start DeepScan from the "Carrier list" window. Select the carrier and display the context menu (right mouse button). Select the option "Deep scanning".

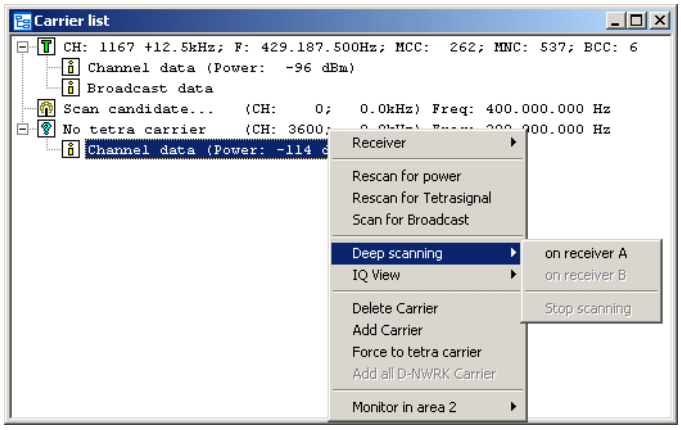


Figure 123 Starting DeepScan

After starting DeepScan, the icon in the list changes from  to  to display the DeepScan mode. The same as when monitoring the monitor window is activated (see "Starting the monitoring" on page 134). When monitoring the measurement values like received field strength, frequency offset and usage of the traffic channels are displayed over time. In addition, the event window is displayed. The detected changes are shown as a list.

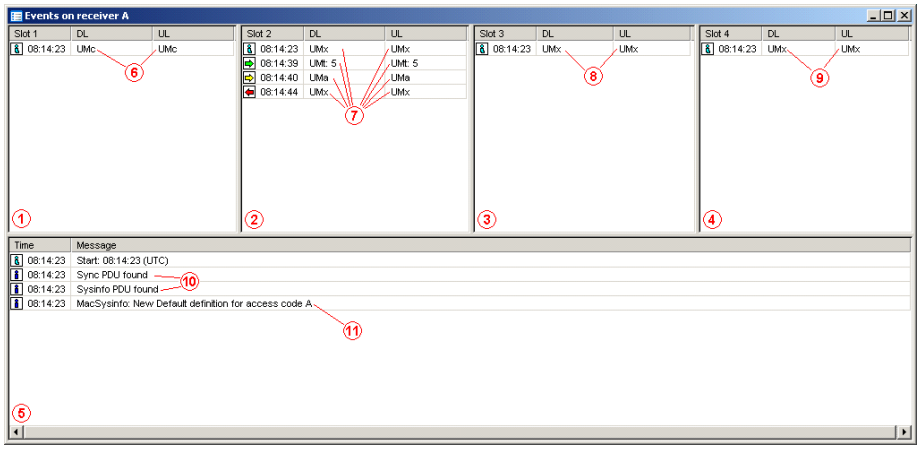


Figure 124 Event window

1) Displays information regarding the Timeslot 1.

2) Displays information regarding the Timeslot 2.

3) Displays information regarding the Timeslot 3.

4) Displays information regarding the Timeslot 4.

5) Displays general information not specific to a timeslot.

6) Displays that the DL and UL are used for Comon-Control(UMc).

7) Displays the timeline for a call:

- At 08:14:23 the scanning of Slot 2 started. It was Unallocted(UMx) in DL and UL.
- At 08:14:39 a call (UMt) was set up with Usage-Marker 5.
- At 08:14:40 the channel switched to Assigned(UMa). The PTT was released.
- At 08:14:44 the call was terminated and the channel switched to Unallocted(UMx).

8) Displays that DL and UL are Unallocted(UMx).

9) Displays that DL and UL are Unallocted(UMx).

10) Broadcast information were decoded.

11) Previously unknown broadcast information were found.

Stopping DeepScan

DeepScan is terminated within the window "Carrier list" by using the context menu (right mouse button) and clicking "Deep scanning" > "Stop scanning". You can also click to stop all scanning processes of the scanner.

On stopping, TetraScanner will ask you if you want to save the data.

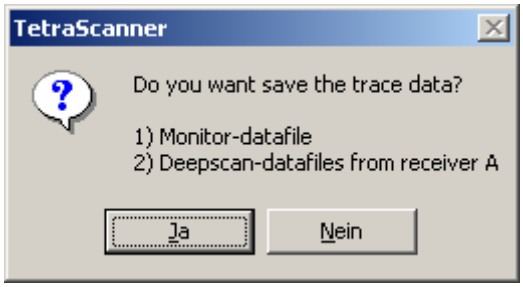


Figure 125 Saving DeepScan data

A CSV file is saved the same as when using the monitoring option (see "Stopping the monitoring" on page 134). After that you have to define the name for the text logfiles. These text logfiles contain the information displayed in the event window.

The DeepScan Logfiles

The logfiles are available depending on the file format selected by using the DeepScan options (see "DeepScan options" on page 139): HTML or plain text.

Text logfiles

You can create two text logfiles when using DeepScan: the event logfile and the detailed text logfile.

Event text logfile

The event logfile records events at the time they occur. All events displayed within the event window during DeepScan are written into the event logfile at the same time. All timeslots and messages not relating to timeslots are summarized and saved as a list. This list contains 5 columns. The first column contains a time stamp followed by time slot 1, time slot 2, time slot 3 and time slot 4. The events related to timeslots are shown within the respective column. Events not related to timeslots are depicted across all timeslot columns. The additional text regarding the individual events is saved to the detailed text logfile. In order to find these each text receives a unique identifier.

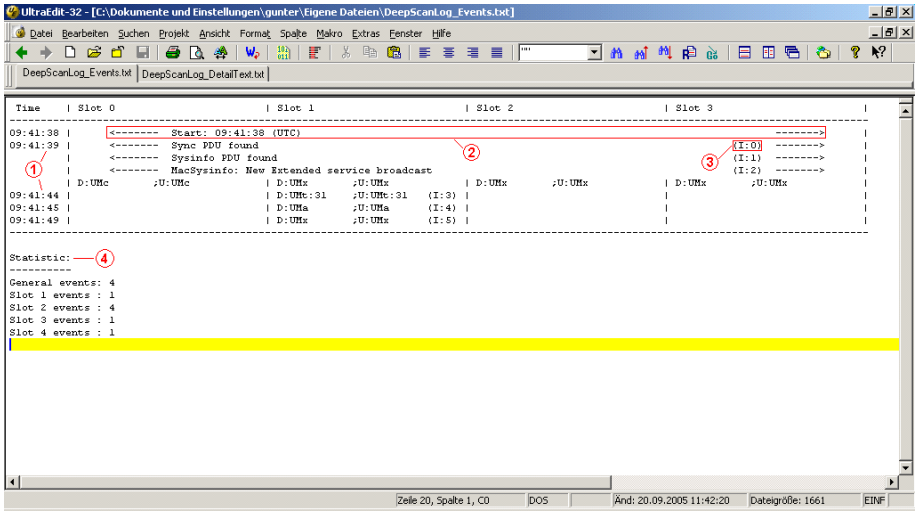


Figure 126 Event logfile

1) The time at which the event occurred. If several events occurred at the same time, this time is entered for the first event. For additional events, which occurred at the same time, the field remains empty.

2) A message not related to timeslots. It is displayed across all timeslot columns.

3) The number for the additional text within the DetailText-Logfile.

4) An overview of how many events occurred during which timeslot.

Detailed text logfile

The detailed text logfile contains the additional information for individual events. Example: If broadcast information were found, the event saved to the event logfile shows that these information were found. This event received an identifier, e.g. (I: 10). The corresponding text, the completely decoded broadcast, is saved using the same number (I:10) to the detailed text logfile. By using this identifier you can look up detailed information. In addition to this text the logfile also contains the identifier, time stamp and if it is a general message or a timeslot message. The individual messages are separated using "----".

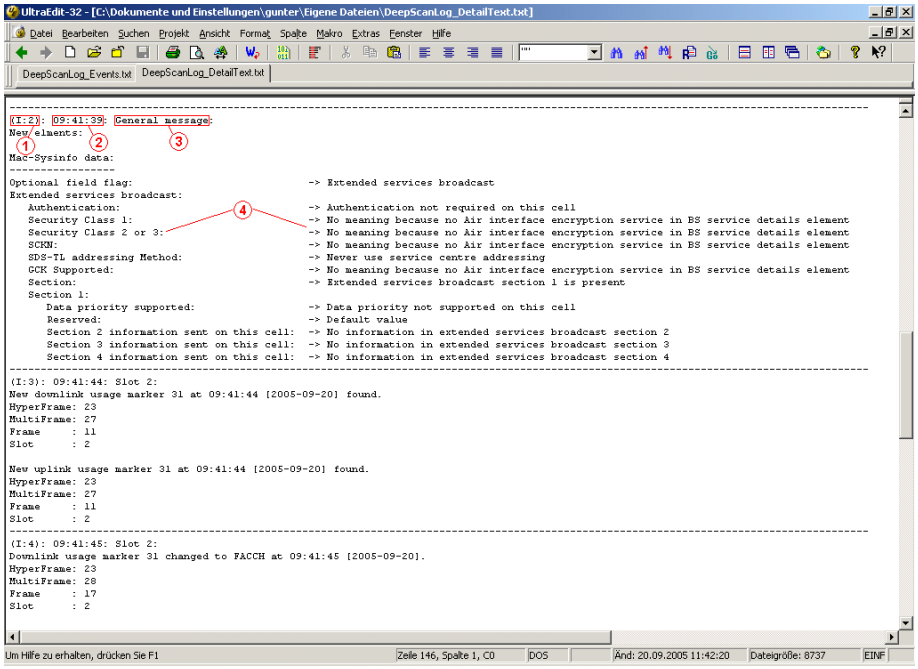


Figure 127 Detailed logfile

1) The identifier for the text.

2) The time stamp of the event.

3) Properties of the event (related to the timeslot or not).

4) Field for Information.

HTML logfiles

Three files are created: event logfile, detailed logfile and index file. The event logfile records events at the time when they occur and is saved using the HTML format. The detailed logfile contains the additional information for individual events (also in HTML). The index file combines both files and shows these in IFrames. You can use this index file to easily display linked files. We therefore recommend opening these files using a browser.

TetraMsc

6

This chapter provides task-based instructions for using the TETRA AirAnalyzer features. Topics discussed in this chapter are as follows:

Installation

The software tools can be installed during the installation of the AirAnalyzer software as described in section "Installing the software" on page 7. To install them, please enable the TetraMsc checkbox as shown in Figure 128. Some or all tools can be selected for installation.

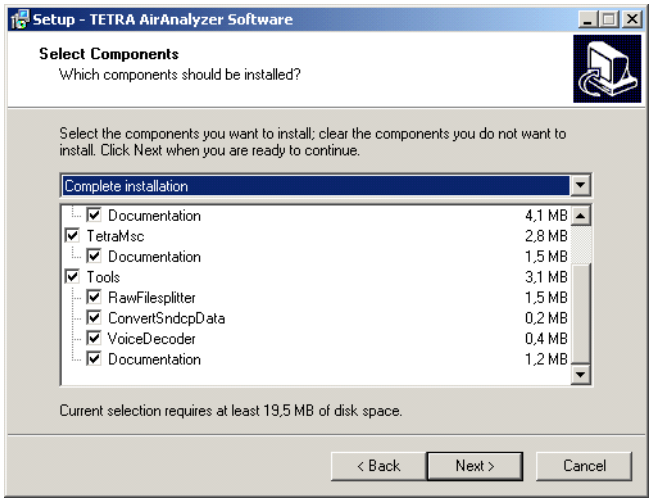


Figure 128 The TetraMsc components in the Installer

Starting a software tool

There are several ways of starting TetraMsc: It can be started by using the start menu (Figure 129), by selecting the Tools menu from the AirAnalyzer software (Figure 130) or by selecting an icon on the desktop (if created during installation, Figure 131). The figures show how TetraMsc can be started in different ways.

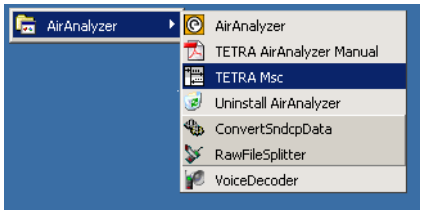


Figure 129 Start of TetraMsc using the program folder

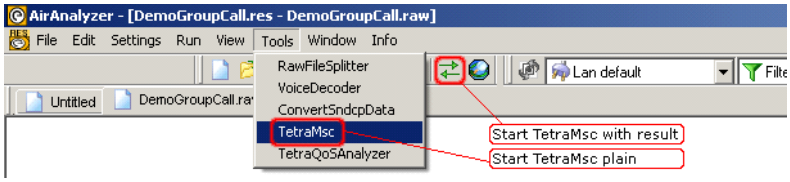


Figure 130 Start of TetraMsc from within AirAnalyzer

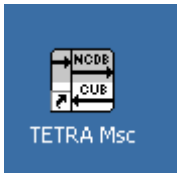


Figure 131 Starting TetraMsc from the Windows desktop

Features

TetraMsc offers the following features:

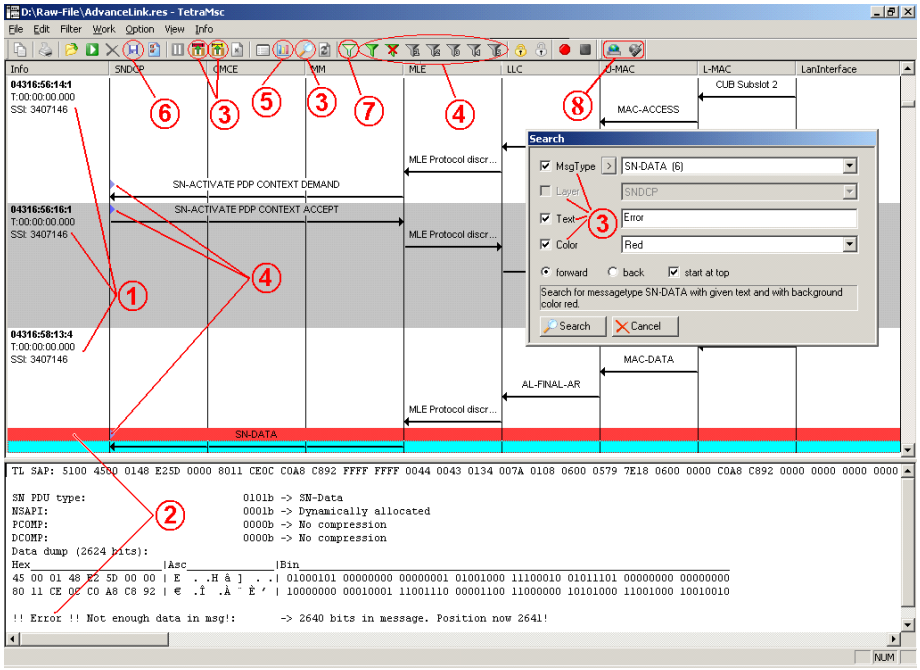


Figure 132 TetraMsc features

(1) Displays the analysis graphically and in chronological order.

(2) Displays errors and warnings in different colors.

(3) Extensive search options.

(4) Blacklist and whitelist filters.

(5) Statistic functions.

(6) Exports the message sequence chart.

(7) Control color highlighting.

(8) Shows the GPS position (AirAnalyzer and mobile radio).

The main window

The TetraMsc application graphically displays the analyzed TETRA protocol messages in a message sequence chart (MSC). It provides an overview of the messages in a time related manner, providing a better overview for the complete communication process.

It also includes the ability to export the MSC to an ASCII formatted text file.

Click the button to start the TetraMsc application.
A window as in is displayed.

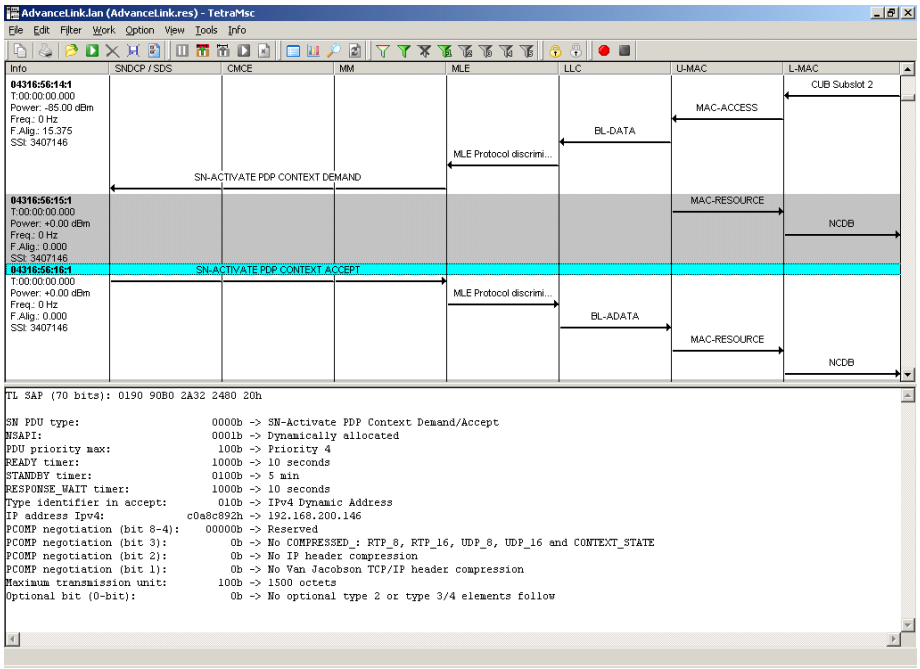


Figure 133 The message sequence chart application

Quick reference of buttons

Click ...

to choose a result file.

to start (or continue) to render the message sequence chart from the chosen result file.

to stop rendering or to stop the online analysis.

to set up the export options.

to set up the view options.

to pause the rendering process.

to jump to the last red message.

to jump to the last yellow message.

to delete all messages and to free up memory.

to show the header information.

to show statistics of the PDUs in the lower pane of the window.

to search for specific messages and strings.

to reset the column size in view.

to change the color highlighting.

to show the filter browser.


to choose one of the filters.

to lock TetraMsc (no more commands from AirAnalyzer will be executed).

to unlock TetraMsc (commands from AirAnalyzer will be executed).

to start a record remotely.

to stop a record remotely.

to view the recorded GPS position of the AirAnalyzer.

to view the GPS position of the mobile radio.

The message sequence charts in detail

Basics

The arrows display the communication flow of a single PDU through the different layers of the TETRA protocol. A single arrow represents detailed information for each involved layer. A right-pointing arrow displays the uplink data (MS → BS) and a left-pointing arrow displays the downlink data (MS ← BS). The data is transported from the layer with the arrow to the layer to which the arrow is pointing. For better clarity messages are displayed with an alternating background color (gray/white).

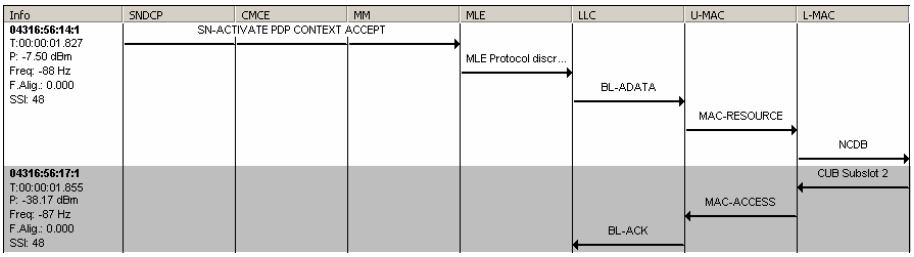


Figure 134 The message sequence chart in detail

In the left column, the Info column, the first line displays information about the current frame and slot in the following format:

hyper frame:multi frame:frame:slot

The next line displays the record time of the message, this time is normaly given in UTC. Then some additional receiving information like power, frequency error and phase error is displayed. The last line is the SSI from the sending or receiving mobile.

In addition the application can count the number of messages and displays the current message number and the line number where to find the displayed time slot in the corresponding result file.

All of these elements in Info field, accept the frame information, can be controlled in the View Options settings (see "View options" on page 156).

The remaining columns on the right side of the window correspond to each existing functional TETRA block. Above each arrow the current PDU type is displayed. If the arrow is selected, all data (PDU type, elements) of the current layer is displayed in the lower pane of the window. This information is the same as in the document view of the AirAnalyzer application.

Colored messages

If an error occurs the TetraMsc can display the corresponding sub-message in a different background color.

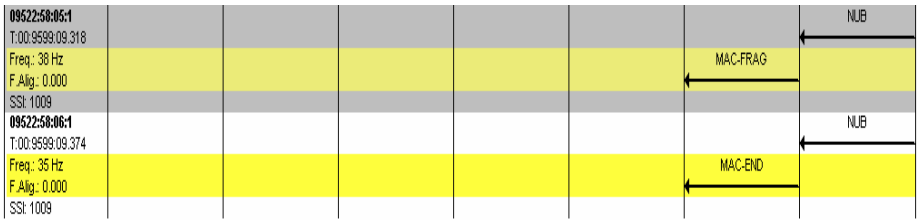


Figure 135 Fragmentation not started

Figure 135 shows a fragmentation failure. All the MAC-FRAGs and the MAC-END are yellow colored. In this case the start of the fragmentation with the first fragment was not received. AirAnalyzer will therefore not analyze the corrupt data.

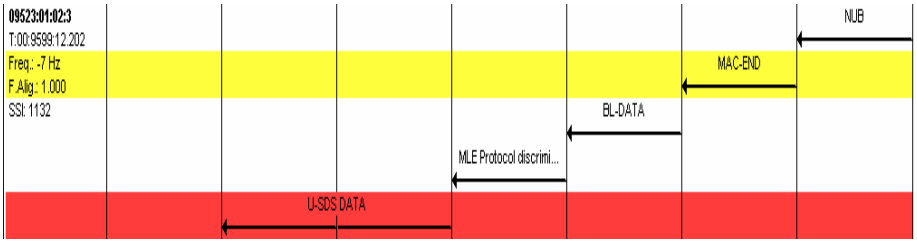


Figure 136 Fragment not received

If a fragmentation was started and one or more MAC-FRAGs are not received, the MAC-END will be colored yellow, too (see Figure 136). In the corresponding text to the MAC-END all slots which were not received will be listed. The example shows that the U-SDS DATA message is colored red. If no FCS is included AirAnalyzer cannot verify the received data and will try to analyze the data. If one or more fragments are missing the data is corrupt. In this example the message "message to short" is displayed and the U-SDS DATA is colored red.

Controlling the colored messages

Click the button or the **Color highlighting** menu entry to change the coloring of messages.

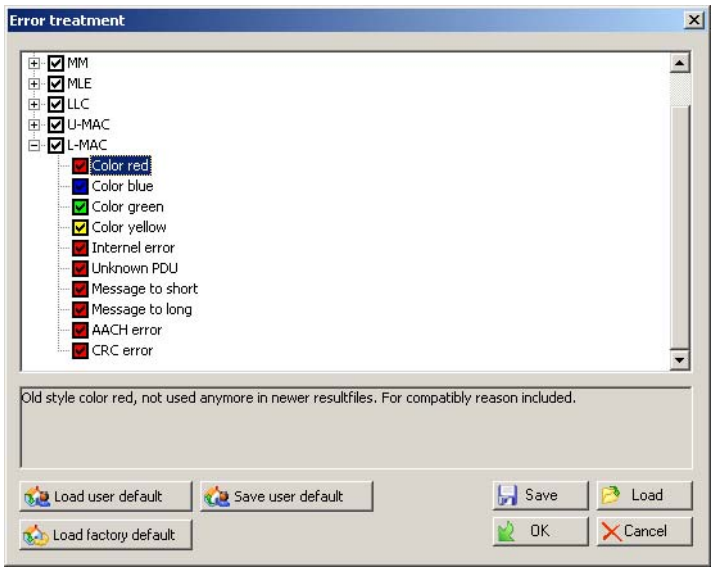


Figure 137 Changing the message colors

The known errors or warnings are ordered in layers. You can enable or disable viewing an error or warning, or the hole layer, with the checkboxes. The background color of the checkboxes shows the color used for the error. You can switch the color with a double click. With a right click you can edit the description.

During startup the TetraMsc loads a default color filter setting.

- Click **Save user default** to save your settings as this default.
- Click **Load user default** to load this setting.
- Click **Load factory default** to load the factory default.
- Click **Load** or **Save**, respectively, to load and save individual settings.
- Click **OK** to apply all changes immediately.

Examples of how to change message highlighting

Using the context menu

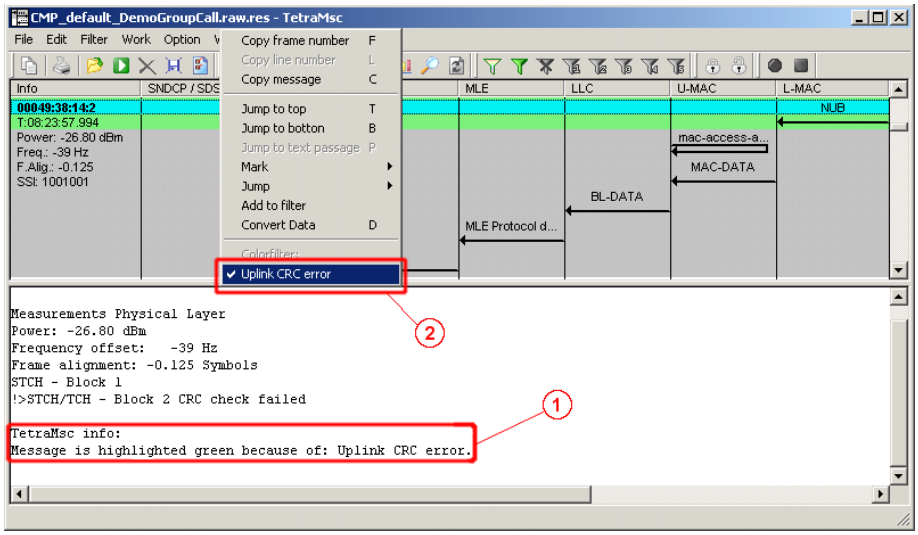


Figure 138 Setting the message highlighting in a context menu

The highlighting of messages (e.g. "Uplink CRC error" (1)) can be switch on or off by using the context menu. A click on the right-hand mouse button opens the context menu (see Figure 138). In the Color filter section, all errors for the chosen message are listed (2). Click on the error type to toggle the highlighted view.

Using the Color Filter dialog

In the example in Figure 139, a couple of messages are displayed with colors because an "Uplink CRC error" occured (1). Theses messages belong to the Lower Medium Access Control (L-MAC) (2). TetraMsc marks the beginning of the line where the error ("Uplink CRC error") occurs with "!>" (3).

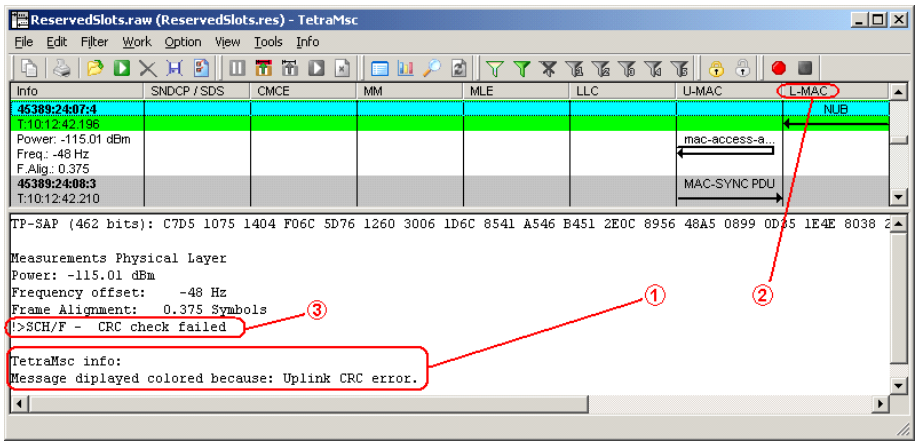


Figure 139 Example of a colored message

In order to change the colors,

1 Click the color filter button from the toolbar.
The Error Treatment menu appears, see Figure 140.

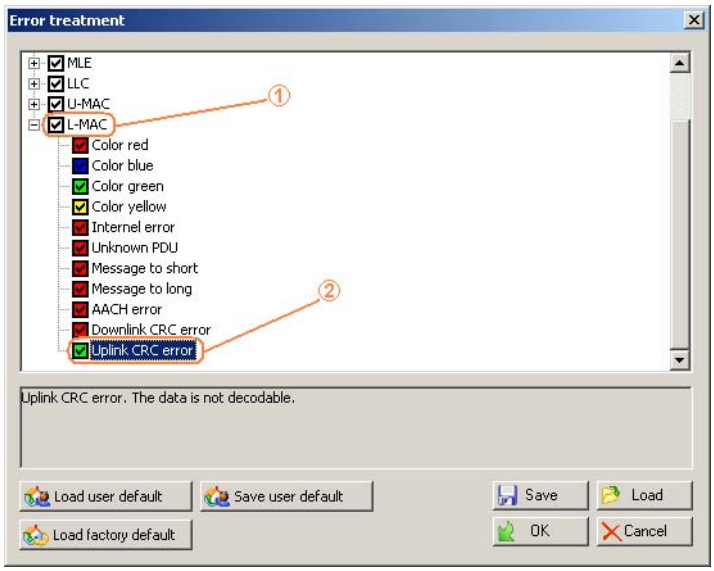


Figure 140 L-MAC color filters

2 Extend the list for Layer "L-MAC" (1) in the dialog.

3 Look for "Uplink CRC error" (2).

4 To disable this highlighted message click on the checkbox.

5 A double-click on the "Uplink CRC error" text will change the color. A right-hand click allows you to edit the text.

6 To use this setting as a default, click **Save user default**. TetraMsc will use these setting at the next startup.

Rendering the messages

After a result file is specified, the TetraMsc application can analyze the TETRA protocol information and render a MSC graphic.

The button starts the rendering process. While the software processes the result file the following buttons are available. An online analysis will be started remotely from the AirAnalyzer software.

Click on ...

to pause the rendering process. This is useful for the online analysis if you would like to read the output in your own time.

to pause the rendering process and jump to the last error.

to continue the rendering process.

to delete all messages and to free up memory.

By setting a breakpoint the dialog box shown in Figure 141 will be displayed.

- Enter the interval at which a break should occur, or 0 for no breakpoint.
- To display a continuous block of messages, specify the first and last message of the block in the “Show from” fields.

Menu entries in the "Work" section:

- "Next five": processes the next 5 messages.
- "Next 25": processes the next 25 messages.
- "Jump to a Msg": processes up to a specific message. See Figure 142.
- "New breakpoints": specifies breakpoints for the rendering process. See Figure 141.

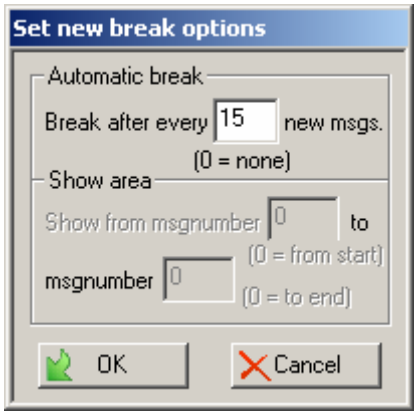


Figure 141 Setting break options for the rendering process

Automatic break after: processes the specified number of messages.

Show area: the number of the first (start) and last (end) message to be displayed.

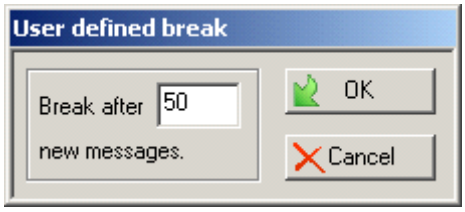


Figure 142 User defined break after message

User defined break: processes the next X new messages.

View options

The view options specify how the info column will look. Click on to open the dialog box shown in Figure 143.

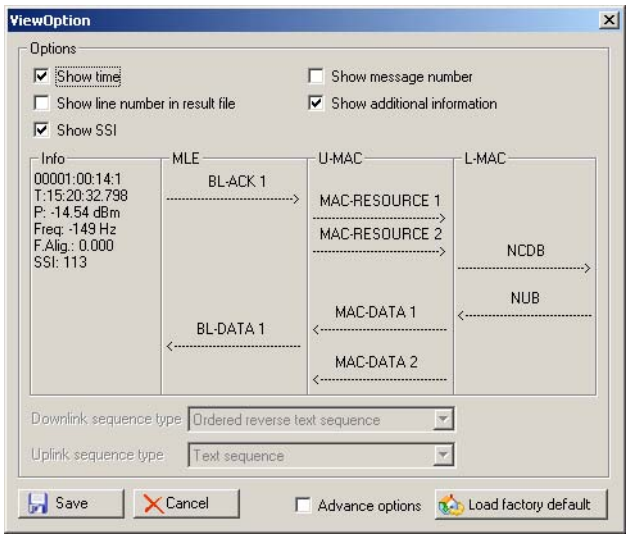


Figure 143 View options for the message sequence charts application

The example in the dialog box shows in detail what the options will do. Some of the information depends on the AirAnalyzer settings.

Note

The changes will take effect after the next rendering.

Show Time — Shows the record time; has to be enabled in the AirAnalyzer general settings.

Show line number in result file — The start line number of the message.

Show SSI — Shows the address.

Show message number — Numbers all messages.

Show additional information — Shows information like power, frequency error and phase error.

Advance options — Enable to choose the Down/Up-link sequence type.

Downlink sequence type — The sequence to display the downlink messages.

Uplink sequence type — The sequence to display the uplink messages.

Click on **Save** to accept the new settings.

Click on **Cancel** to discard all changes.

Click on **Load factory default** to restore the settings at installation.

Export option

The TetraMsc application can export the graphical MSC to an ASCII formatted text file. Click on  to open the dialog box shown in Figure 144.

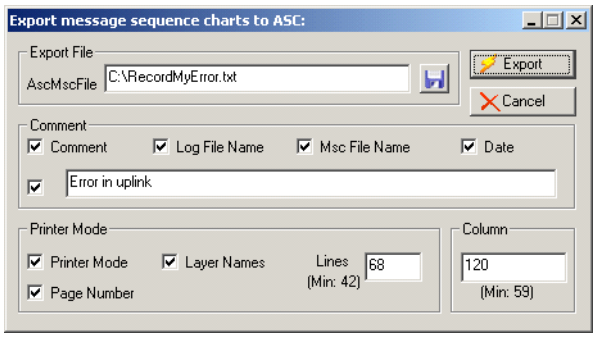


Figure 144 Exporting message sequence charts to an ASCII file

Export File section

This section specifies the name and location for the ASCII coded MSC text file. The  button opens a standard Open File dialog.

ASCII MSC file — file name and location for the ASCII coded MSC.

Comment section

The export file can be set up to contain these comments.

Comment — A comment will be saved to the export file containing the following fields.

Log file name — The name of the result file.

MSC file name — The name of the export file.

Date — The date of the rendering.

User — A user specific comment.

Printer Mode section

The Printer mode settings adjust the document size for printing.

Printer mode — Formats the output size so that it can be printed.

Layer names — Shows the layer names at the beginning of each page.

Lines — Indicates the number of lines that will fit on a page.

Column — Indicates the numbers of columns that will fit on a page.

Page number — Shows the page number at the beginning of each page.

Click **Export** to have TetraMsc export the MSC to the ASCII coded text file.

Click **Cancel** to discard all changes and return to the main window.

Statistic evaluation

Upon a click on the button, TetraMsc displays a statistic in the lower pane of the window. It shows how often each message of the TETRA protocol occurs. If messages have errors these error with the viewed color will be listed. In addition to the TetraMsc message statistic, the statistic from the AirAnalyzer will be shown as well.

Message statistic:

MsgTypes	count
AL-ACK	4
AL-DATA	5
AL-FINAL-AR	4
AL-SETUP	2
UNITDATA DOWNLINK	16 <- declared as not viewable

Figure 145 Example of count of messages statistic

Warnings and errors:

- CMCE -

Color	Number	Short discription
Red	4	Message too short
Red	2	Message too long
Yellow	66	Value out of range

Figure 146 Example of messages with error statistic

AirAnalyzer statistic:

Downlink Type	All	Slot 1	Slot 2	Slot 3	Slot 4
SYNC	83 (->100%)	20 (->100%)	21 (->100%)	21 (->100%)	21 (->100%)
SYNC block 1 err	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
SYNC block 2 err	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
SYNC AACH err	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
SYNC undecodable	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Figure 147 Example of L-MAC AirAnalyzer statistic

Search feature

The button opens the Search dialog shown in Figure 21. The TetraMsc application can search depending on message type, layer, color, error and text content.

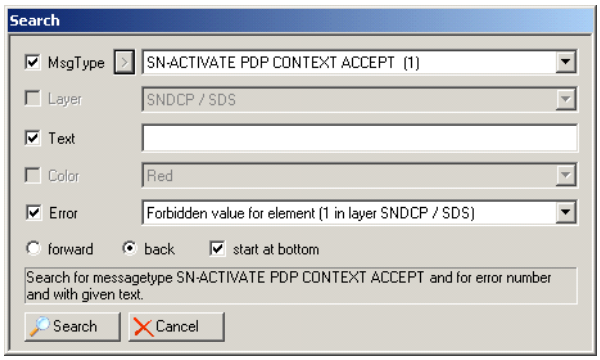


Figure 148 Finding a specific message or content

Message type: Select which message type to search for. You will see the count of messages in brackets.

> — Choose the message beneath the cursor.

Layer — Choose which layer to search for.

Text — Choose which text to search for.

Color — Choose the background color.

Error — Choose an error in message.

Choose the search direction with a click on **forward** or **back**.

Select the starting point with a click on **start at top** or **start at bottom**.

Jump to frame

The shortcut **Ctrl+G** opens the Jump to frame dialog shown in Figure 149. You can jump to an exactly given frame or jump for example from slot one to next slot one.

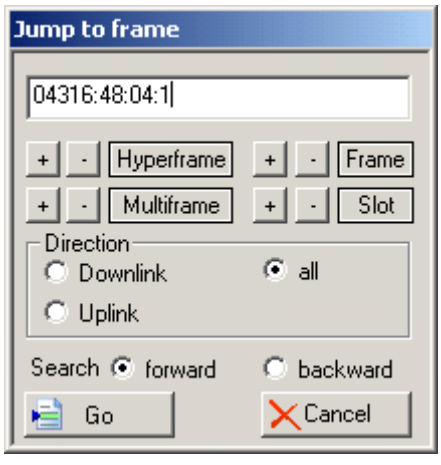


Figure 149 Jumping to a specific frame or slot

+ or - — Increase or decrease value.

Hyper/Multi/Frame/Slot — Toggles between "any" and the current cursor value.

Direction — Jump to the selected frame in the chosen direction only.

Search forward or backward — If not an exact frame is given you can search for the next or last applying frame.

If you do not enter an exact frame and a direction, you can search with the **F4** and **Shift+F4** keys to the next frame or previous frame.

Jump to Time **Ctrl+T** opens the "Jump to Time" dialog shown in Figure 150.

Note

This search feature can be used only if Show Time is enabled in the View options (see "View options" on page 156).

You do not have to give an exact time. The entry will always be modified to the nearest message.

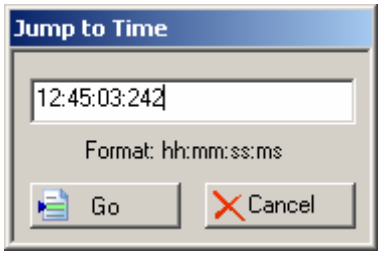


Figure 150 Jumping to a specific time

The time format is: hour:minute:second:millisecond.

Shorter formats like hour:minute or hour:minute:second are also acceptable. The missing values will be filled with zero.

Understanding and using the filter feature

The filter from the TetraMsc is different and complements the filter functions of the AirAnalyzer. While the AirAnalyzer filters depend on layers, the TetraMsc filters depend on messages. With this filter you can remove unwanted messages or display chosen messages.

A complete message consists of several different sub-messages. The background is colored (see Figure 151): Filter example, gray or white for each part of a complete message.

A filter is a list of free composed sub-messages. A filter searches if a message includes one or more sub-message that correspond to a message on the filter list. This includes the entire message and not only the found sub-message so that the entire message will be filtered.

There are two filter strategies. The blacklist filter and the whitelist filter. The blacklist filter removes a complete message with all his sub-messages if one or several filter conditions are met. The behaviour of the whitelist filter is opposite. Only the messages where at least one of the filter conditions is met are displayed.

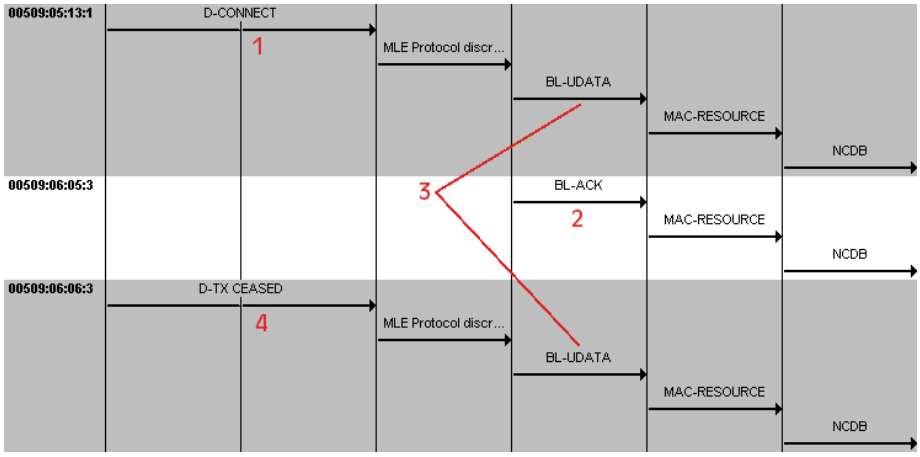


Figure 151 Filter examples

For clarification of the follow examples it is assumed that only one sub-message is in the filter list:

Message 1 (D-CONNECT) is in a blacklist filter:

The complete first message from sub-message D-CONNECT up to NCDB would not be announced. Because one criteria of the blacklist filter filter list is met and the entire message is removed. All other messages 2 (BL-ACK) and 4 (D-TX CEASED) and their sub-messages will be announced.

Message 1 (D-CONNECT) is in a whitelist filter.

Messages 2 (BL-ACK) und 4 (D-TX CEASED) would not be shown. Because none of the sub-news is a D-CONNECT. Only message 1 (D-CONNECT) would be announced up to its NCDB (entire message).

Message 2 (BL-ACK) is in a blacklist filter:

Only the two gray messages 1 (D-CONNECT) and 4 (D-TX CEASED) would be shown since both messages do not have any sub-message BL-ACK.

Message 3 (BL-UDATA) is in a blacklist filter:

Only the white message 2 (BL-ACK) would be announced. Since the other two do not have any sub-message BL-UDATA.

Message 3 (BL-UDATA) is in a whitelist filter:

Only the white message 2 (BL-ACK) would not be shown. Because none of its sub- messages is a BL-UDATA.

The filter browser

Button opens the filter browser. With the filter browser you can create or change the filter lists. During the online analysis the filter browser cannot be opened. You can use the filter browser only if you pause the rendering process (click to pause).

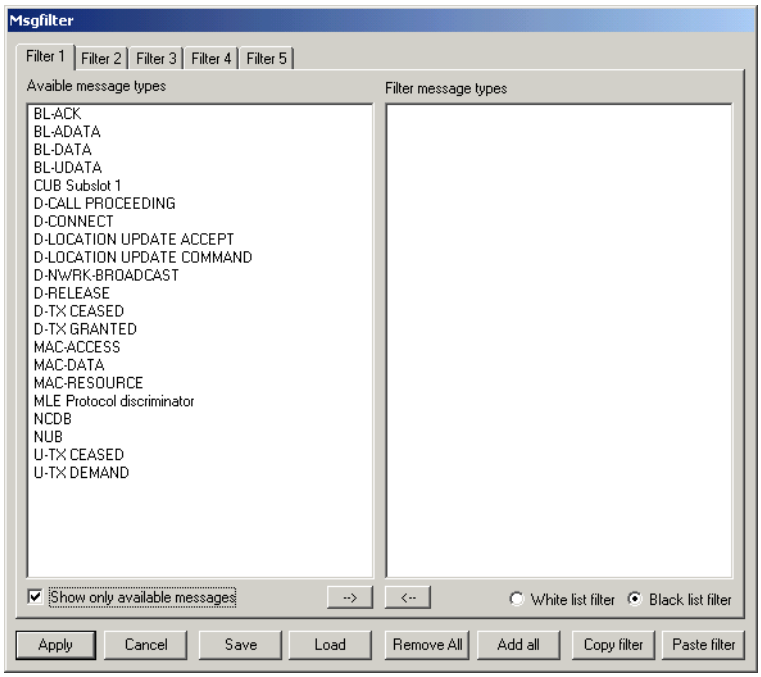


Figure 152 Message filter browser

1 Select a filter to define or modify by selecting one of the tabs (Filter 1 through Filter 5).
The left-hand list shows the available message types; check the "Show only available messages" field to include only those messages in the list that occur in the actual trace. Or uncheck the field if you want TetraMsc to show all the message types possible.

2 Select message types that should be filtered, and click --> to enter them into the "Filter message types" list on the right-hand side. (Select message types in the right-hand list and click <-- to remove them from the filter message type list.)

3 For each message type on the right-hand side, select the message type and click on either **Whitelist filter** or **Blacklist filter** to specify if the message type should occur or not.

4 Click on **Apply** or **Save** to confirm the changes to all the filters.

Click on **Cancel** to discard all changes and returns to the main window.

Click on **Load** to load and display the filter settings that were last saved.

Click on **Remove All** to delete all messages from the filter message type list.

Click on **Add All** to move all messages available to the filter.

Click on **Copy filter** to copy a complete filter.

Click on **Paste filter** to add previously copied filter message types to the current filter.

Adding and removing a message without the filter browser

Click on a message type with the right-hand mouse button to open its context menu. Select **Add** for the dialog shown in Figure 153:

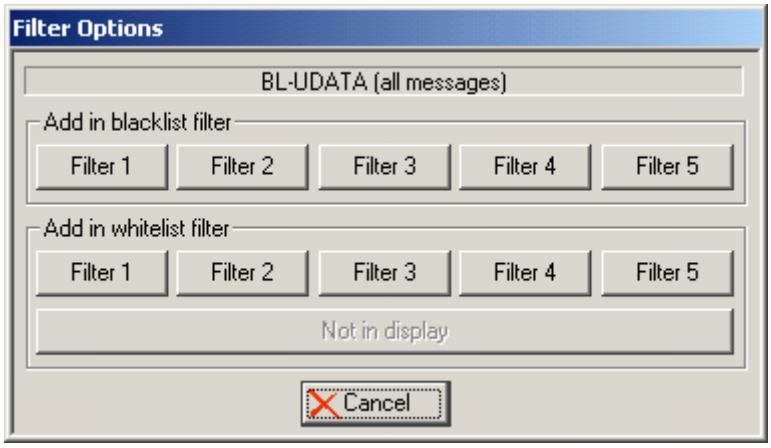


Figure 153 Adding a message to a filter

Click on the appropriate button (Filter 1 through Filter 5) to add the message type to a blacklist or whitelist filter. (Filters already containing the message type in their blacklist or whitelist are grayed out.)

If the message is contained in a whitelist filter it can be removed without using the filter browser by clicking the **Remove** button. If this was the last message the view will be switched to normal view.

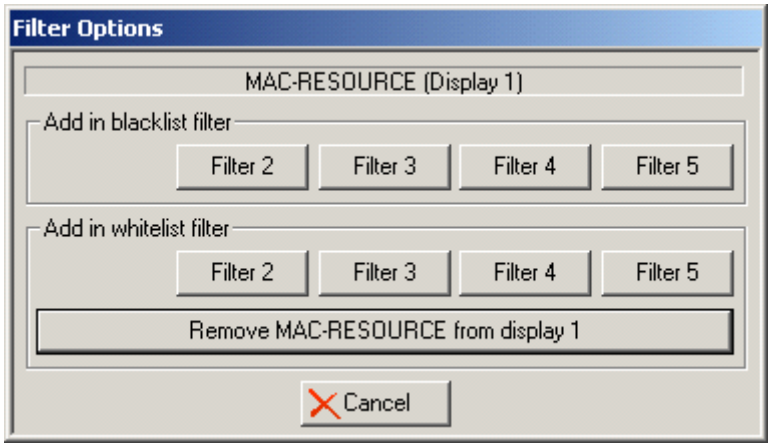


Figure 154 Removing a message from a whitelist filter

Using the filters

With the buttons in the toolbar the respective filter is selected. You can change the filters on the fly during the online analysis. With the button you can return to the normal view.

Connection to AirAnalyzer

TETRA AirAnalyzer is able to control TetraMsc remotely. After starting TetraMsc, TetraMsc tries to connect to the TETRA AirAnalyzer on the local host. If the connection is successfully established and TetraMsc rendered a file or did an online analysis the button or is enabled. With these two buttons you can allow or restrict the execution of commands from the TETRA AirAnalyzer. For example: you have completed a trace with the online analysis. After you stopped the online analysis you would like to keep the trace in the TetraMsc. You can now lock the TetraMsc. If you start a new online analysis the TETRA AirAnalyzer starts a new TetraMsc because the old one rejected the command to start an online analysis.

The Connection Manager

Connection Manager is a tool to check and control the connection to the TETRA AirAnalyzer. Using this connection the TETRA AirAnalyzer can control the TetraMsc and send online data.

Click **Info > Connection Manager** to start the Connection Manager.

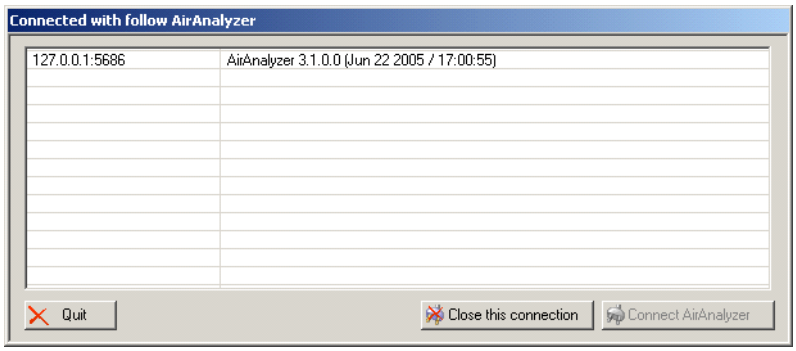


Figure 155 Connection Manager

If a connection is established the connection data and the TETRA AirAnalyzer info will be shown. The first column contains the IP address and the port number of the TETRA AirAnalyzer. The second column shows the TETRA AirAnalyzer version. Only one connection to one AirAnalyzer is possible at the same time.

Click on **Quit** to close the Connection Manager and return to the main window.

Click on **Close this connection** to terminate a connection.

Select a TETRA AirAnalyzer and click on **Connect AirAnalyzer** to connect manually to the TETRA AirAnalyzer.

Manually adding a connection

Click on **Connect to...** to manually connect to an AirAnalyzer. A new window as shown in will appear.

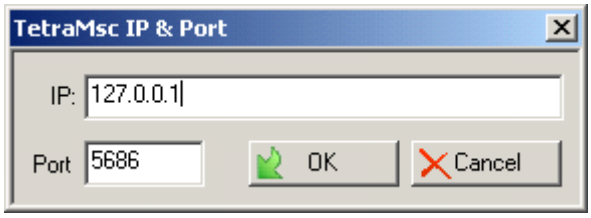


Figure 156 Connecting manually

Enter the IP address and the port number of the TETRA AirAnalyzer. Please note that an old established connection will be closed automatically before a new one will be established.

The receive port

This is the receive port of TetraMsc. The AirAnalyzer application will send the data and commands to this port.

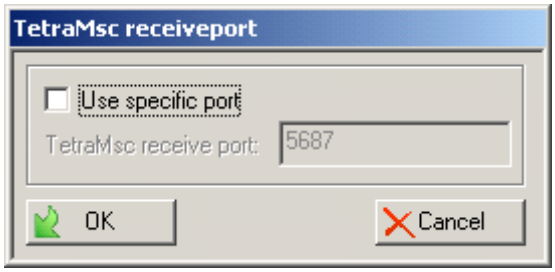


Figure 157 Receive port

TetraMsc uses a default port number of 5687 unless a different one is specified. Check the "Use specific port" box to activate the input field for the TetraMsc receive port and enter a new port number.

If you are using AirAnalyzer and TetraMsc on the same local machine, the TetraMsc receive port and the AirAnalyzer server port have to be different. It is a good idea to increment the AirAnalyzer server port by one to get the TetraMsc receive port value.

Remote control

When a TetraMsc is connected to the TETRA AirAnalyzer you can command the TETRA AirAnalyzer remotely to start a recording (button). You can also stop a running recording if you have started it (button).

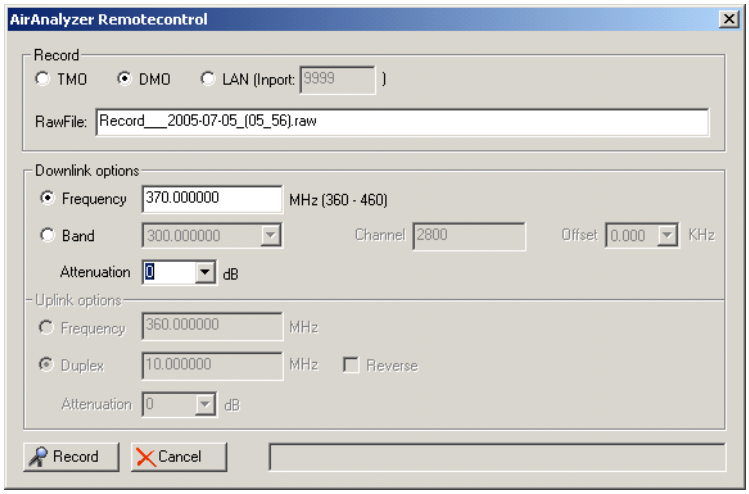


Figure 158 Remote control

Like the real AirAnalyzer you have to adjust some option for recording. In the group "Record" you can choose witch type of recording you want to start. When you choose "LAN" you have to give the UDP input port. You can only give the rawfile name. For security reasons, the path is chosen by the AirAnalyzer. You can easily generate a name by clicking **Generate Name**. The format is:

- TMO: `Name___YYYY:MM:DD_hh.mm.raw`
- DMO: `Name___YYYY:MM:DD_hh.mm.raw`
- LAN: `Name___YYYY:MM:DD_hh.mm.lan`

When you want to record "TMO" or "DMO", the group "Downlink options" is enabled. You can enter the frequency directly or as "Band", "Channel" and "Offset".

The intensity difference is set with the "Attenuation" for receiver A.

If you record "TMO", the group "Uplink options" is enabled. You can enter the frequency directly or as "Duplex" spacing from the downlink frequency.

The intensity difference is set with the "Attenuation" for receiver B.

Shortcuts

Keys

Table 28 Description of the key shortcuts for TetraMsc

Key	Function
↑	Move the selection up.
↓	Move the selection down.
Page ↑, ←	Move the selection up by one page.
Page ↓, →	Move the selection down by one page.
T, Pos1	Move the selection to the beginning of the MSC.
B, End	Move the selection to the end of the MSC.
P	Jump to related text passage of the selection in the TETRA AirAnalyzer application.
F2	Mark the starting position for time counting.
SHIFT + F2	Mark the end position for time counting, the result is displayed in the lower frame.
SHIFT + 1..5	Remember current selection position.
1..5	Jump to remembered position.
TAB	Toggle formatted text output.
F	Copy frame number of the actual selection to the clipboard.
L	Copy line number of the actual message to the clipboard.
C	Copy actual message as ASCII export to the clipboard.
R	Copy (n) message to the clipboard. A dialog box will be displayed asking for the number of frames (n) and the number of rows for the ASCII coded text format.
Alt+M	View Mobile GPS position in browser.
Alt+P	View AirAnalyzer GPS position in browser.

Mouse

Table 29 Description of the mouse buttons for TetraMsc

Mouse	Function
Left button	Select the message.
Right button	Open a pop-up menu with options:

Table 29 Description of the mouse buttons for TetraMsc (continued)

Mouse	Function	
	Copy frame number	Copy frame number of the actual selection to the clipboard.
	Copy line number	Copy line number of the actual message to the clipboard.
	Copy message	Copy actual message as ASCII export to the clipboard.
	Jump to top	Move the cursor to the beginning of the MSC.
	Jump to bottom	Move the cursor to the end of the MSC.
	Jump to text passage	Jump to related text passage of the selection in the TETRA AirAnalyzer application.
	Mark	Remember current selection position.
	Jump	Jump to remembered position.
	Add to filter	Add message to filter (see "Adding and removing a message without the filter browser" on page 163).
	AirAnalyzer Position	View AirAnalyzer GPS position in browser
	Mobile Position	View Mobile GPS position in browser
Mouse wheel		Scroll page up / down.

Error messages

Table 30 Description of the error messages for the TetraMsc

Error message	Problem	Solution
Warning! Unknown or no StartMarker!	The result file is not valid.	Specify a result file. Check if the version and the result file type are compatible.
Warning! Internal error during rendering!	The data in the result file has the wrong format.	If you send your own message through the lan-interface you have to make sure that you have not more than 20 sub-messages. The sub-message name has to be shorter than 60 chars. Or contact Willtek Communications and keep the result file ready for faster debugging.
Error! Could not open "MessageType.xml" file.	MessageType.xml could not be opened.	Copy the original MessageType.xml file to the same directory as TetraMsc.exe or reinstall the software.
File format error in "MsgTypes.xml" file!	There is an error in the specified line of the "MsgTypes.xml" file.	See 9.5 The File Format of the File MsgTypes.xml (Version 1.1)
Could not open *.res!	The result file might not be valid.	Choose a valid result file or create a new one using the correct AirAnalyzer version.
Error while reading *.res-File!	The result file might be corrupted.	Create a new result file with AirAnalyzer.
Problem while writing exported MscFile to disk! – or – Could not create or write the export MscFile!	The disk might be full or the old file with the same name is write protected or currently used by another application.	Free some disk space, check the rights or close the file.

Table 30 Description of the error messages for the TetraMsc (continued)

Error message	Problem	Solution
Memory or Buffer error!	There might not be enough memory.	If you send your own message through the lan-interface you have to make sure that you have not more than 64 kB text info for one sub-message and that no single line exceeds 1024 characters. Check if TetraMsc knows all sub-messages, see "The file format of TMO/DMO/LAN_MessageTypes.xml version 1.0" on page 177.
Sorry, no dongle found!	No dongle was found.	Install a dongle.
Sorry, no AirAnalyzer is connected!	TetraMsc is trying to start the online analysis, but no connection to AirAnalyzer is established.	Check the connection, see "The Connection Manager" on page 165. Or contact Willtek Communications and keep the result file for faster debugging. Or Contact fjord-e-design GmbH and keep the result file for faster debugging.
Internal error!	Program error.	Contact fjord-e-design GmbH and keep the result file for faster debugging.

File formats

TetraMsc is a universal display program for message sequence charts. You can easily extend TetraMsc with youre own messages. One source for these messages is the LAN interface. Using this data the AirAnalyzer creates the result file which is read by TetraMsc.

The RES format

The RES format is an internal TETRA AirAnalyzer data format that is used to display the analyzed messages in text view and in the TetraMsc application. This format is text based. You will always be able to create a new RES file with the AirAnalyzer software if you analyze a RAW/LAN//TMW/TMV data file.

Some tricks for LAN traces or proprietary filter

TetraMsc uses some special keywords. These keywords affect the view directly. The first kind of keyword will color the background of the corresponding message. The second kind of keyword will add some additional information to the info column. The third kind will add an address to the info column.

AirAnalyzer uses some of these keywords by default. But you can use these keywords, too. During a LAN trace you can use these keywords in your text messages. The second way to use these keyword is to change a saved result file. You can change it using a normal text editor, for example using the search and replace function. The second way to change the result file is to write a text filter, for example with AWK (http://www.gnu.org/software/gawk/gawk.html).

Table 31 Keywords

Key word	Funktion	AirAnalyzer usage	Note
<color red>	Change the background color to red	Not used anymore	1
<color yellow>	Change the background color to yellow	Not used anymore	1
<color green>	Change the background color to green	Not used anymore	1
<color blue>	Change the background color to blue	Not used anymore	1
<Error 'number'>	Message will be marked coloured	An error or warning has occured	1
<info_1>	Add the following text to the info column	Power information	2
<info_2>	Add the following text to the info column	Frequency error	2

Table 31 Keywords (continued)

Key word	Funktion	AirAnalyzer usage	Note
<info_3>	Add the following text to the info column	Timing error	2
<info_4>	Add the following text to the info column		2
<info_5>	Add the following text to the info column		2
< SSI xxx >	Add an address to the info column	Used to add an address	3
< EL xxx >	Add an address to the info column	Used to add an address	3
< USSI xxx >	Add an address to the info column	Used to add an address	3
< SMI xxx >	Add an address to the info column	Used to add an address	3
< UM xxx >	Add an address to the info column	Used to add an address	3
< P-SSI xxx >	Add an address to the info column	Used to add an address	3
< GPS : xxx ; xxx >	Add AirAnalyzer GPS position	Used to add the AirAnalyzer position	
<mobile gps>	Add mobile GPS position.	Used to add mobile position	

Note 1: The sphere of a keyword is one sub-message. When different keywords occur in one sub message only the last one will be used.

Note 2: Will add the following text in the line of the info column. If the same keyword is used twice or several times only the text of the last one will be used. Can be suppressed with the Show additional information option, see "View options" on page 156.

Note 3: Will add an address to the info column. Up to eight different addresses are supported for one message. Can be suppressed with the "Show SSI" option, see "View options" on page 156.

Old MessageTypes file

With version 1.3 of TetraMsc, the file MessageTypes is not used anymore. It is replaced by the files MsgTypes.xml, TMO_MessageTypes.xml and DMO_MessageTypes.xml. The file format for these files is slim XML. The file MsgTypes.xml includes the reconnaissance data of the different result file types (*.res). At the moment there are three types: the TMO result file, the DMO result

file and the TMO/LAN result file. The individual data (MessageTypes) of these result file types is contained in the corresponding files TMO_MessageTypes.xml, DMO_MessageTypes.xml and LAN_MessageTypes.xml. The file MsgTypes.xml points to these three files.

Some info on the XML format used

For all files the file format is "slim" XML version 1.0. The coding has to be ISO 8859-1. Special characters (i.e: <,>,",...) have to be replaced with entities. The following types of entities are supported: &#xHEX;, &#DEZ; and named entities (").

How can I find out in which path the XML-Files are stored?

Select **Info > Path infos**.
You will get some output like in this example:

```
Path and File Infos:
--------------------

User settings path     : "C:\Dokumente und Einstellungen\gunter\Anwendungsdaten\fjord-e-design\Tetra AirAnalyzer 3.2\TetraMsc\"
Applikation work path  : "C:\Programme\fjord-e-design\Tetra AirAnalyzer 3.2\bin\"
Last file              : "C:\Dokumente und Einstellungen\gunter\Eigene Dateien\Download\test what is wrong2___2004-03-29-15-27.res
```

The "User settings path" is the path you are searching for.

File format of the MsgTypes.xml file (version 1.1)

The file MsgTypes.xml includes the data TetraMsc uses to distinguish the different result file types. The result file types can be distinguished by the file identifier. This indicates that the first lines of the result file are analyzed and a special keyword, the file identifier, is searched for. If no keyword is found the defined default file type is used. These keywords and the reference to the corresponding data file are stored in the file MsgTypes.xml. The data file contains the known message types for the chosen result file type. Another entry defines the default filter file name. TetraMsc automatically loads the corresponding filter to every result file type.

xml

Table 32 <xml>

Tag	xml	
usage	Mandatory in first line	
argument	name	version
	usage	mandatory
	argument	"1.0" (mandatory)
argument	name	encoding
	usage	mandatory
	argument	"iso-8859-1" (mandatory)
comment	Define an XML file	
example	<?xml version="1.0" encoding="iso-8859-1"?>	

file

Table 33 <file>

tag	file	
usage	Mandatory in second line	
argument	name	name
	usage	mandatory
	argument	"TETRA-MSC-FILETYPES" (mandatory)
argument	name	version
	usage	mandatory
	argument	"1.1" (mandatory)
comment	XML-file is type "TETRA-MSC-FILETYPES"	
example	<file name="TETRA-MSC-FILETYPES" version="1.1">	

Tags of <file> entry

Table 34 <entry>

tag	entry		
usage	Mandatory for the default result file type.		
argument	name	default	
	usage	mandatory	
	argument	yes	This is the default result file type.
		no	Not the default result file type.
comment	Starts a result file type		
example	<entry default="yes"> and <entry default="no"> (short: <entry>)		

Tags of <entry> fileid

Table 35 <fileid>

tag	fileid
usage	Mandatory in entry tag
comment	The keyword to recognize the file type. Please observe that the keyword is case sensitive.
example	<fileid>TMO-Resultfile</fileid>

msgtypefile

Table 36 <msgtypefile>

tag	msgtypefile
usage	Mandatory in entry tag
comment	The reference to the data file with the message types. Path details are not allowed. It is always searched for the file in the current work path.
example	<msgtypefile>TMO_MessageTypes.xml</msgtypefile>

defaultfilter

Table 37 <defaultfilter>

tag	defaultfilter
usage	Mandatory in entry tag
comment	The reference to the default filter file. Path details are not allowed. It is always searched for the file in the current work path.
example	<defaultfilter>TMO_default.tfc</defaultfilter>

colorfilter

Table 38 < colorfilter>

tag	defaultfilter
usage	Mandatory in entry tag
comment	The reference to the default colour filter file. Path details are not allowed. It is always searched for the file in the current work path.
example	< colorfilter>TMO_default.cflt</ colorfilter>

Example

```
<?xml version="1.0" encoding="iso-8859-1"?>
<file name="TETRA-MSC-FILETYPES" version="1.1">
     <tetramsc>
          <entry default="yes">
               <fileid>TMO-Resultfile</fileid>
               <msgtypefile>TMO_MessageTypes.xml</msgtypefile>
               <defaultfilter>TMO_default.tfc</defaultfilter>
               <colorfilter>TMO_default.cflt</colorfilter>
          </entry>
          <entry>
               <fileid>DMO-Resultfile</fileid>
               <msgtypefile>DMO_MessageTypes.xml</msgtypefile>
               <defaultfilter>DMO_default.tfc</defaultfilter>
               <colorfilter>DMO_default.cflt</colorfilter>
          </entry>
     </tetramsc>
```

```
</file>
```

The file format of TMO/ DMO/ LAN_MessageTypes.xml version 1.0

These files store the known messages (D-CONNECT, MAC-ACCESS...). Every result file type has its own message type file.

xml

Table 39 <xml>

Tag	xml	
usage	Mandatory in first line	
argument	Name	Version
	usage	mandatory
	argument	"1.0" (mandatory)
argument	name	encoding
	usage	mandatory
	argument	"iso-8859-1" (mandatory)
comment	Define an XML file	
example	<?xml version="1.0" encoding="iso-8859-1"?>	

file

Table 40 <file>

tag	file	
usage	Mandatory in second line	
argument	name	name
	usage	mandatory
	argument	"MSG-TYPES-NAMES" (mandatory)
argument	name	version
	usage	mandatory
	argument	"1.1" (mandatory)
comment	XML-file is type "TETRA-MSC-FILETYPES"	
example	<file name=" MSG-TYPES-NAMES " version="1.0">	

Tags of <file> **messagestypes**

Table 41 <messagestypes>

tag	**messagestypes**
usage	Mandatory
comment	Starts the data field.
example	<messagestypes>

Tags of <messagestypes> **layer**

Table 42 <layer>

tag	**layer**
usage	Mandatory
comment	Starts the layer data block. The position of the layer data block has to be at the beginning of the messag-estypes data block. Only one layer data blocks are allowed.
example	<layer>

msg

Table 43 <msg>

tag	**msg**
usage	Mandatory
comment	A single message block starts. Ensure that you have a valid layer data block before the first message block.
example	<msg>

Tags of <layer> **layername**

Table 44 <layername>

tag	**layername**
usage	Mandatory
comment	Up to 20 layer names, but at least two. Keep the order, it begins with the lowest layer and climbs.
example	<layername>L-MAC</layername>

Tags of <msg> Msgname

Table 45 <msgname>

tag	msgname	
usage	Mandatory	
argument	name	largerlayer
	usage	mandatory
	argument	Layer number
argument	name	lowerlayer
	usage	mandatory
	argument	Layer number
comment	The single message itself. Every message consists of two layer numbers and the message name. The argument larger-layer contains the numerically bigger layer number, the smaller number is defined in lowerlayer. Every one of these layer numbers is assigned to a layer from the definition block of the single layer. For the first layer the number is zero (<layername>L Mac</layername>) and the number is increased with every next layer. In addition, there is one firmly built-in layer for the physical layer, this has the value -1. It corresponds graphically to the right edge. TetraMsc draws an arrow from and to the corresponding layer number. The direction of the arrow is not defined in this file but in the result file. So numbers do not influence the direction. Of course, the layer numbers have to be in the range of given layers (count begins at zero). The same values are allowed. An arrow is then drawn from and to the given layer. The value "-2" is an other special layer number. In case the larger or lowerlayer is "-2", TetraMsc will suppress these messages.	
example	<msgname largerlayer="5" lowerlayer="3">D-ALERT</msg-name>	

Example

```
<?xml version="1.0" encoding="iso-8859-1"?>
<file name="MSG-TYPES-NAMES" version="1.0">
     <messagestypes>
          <layer>
               <layername>L-MAC</layername>
               <layername>U-MAC</layername>
               <layername>LLC</layername>
               <layername>MLE</layername>
               <layername>MM</layername>
               <layername>CMCE</layername>
          </layer>
          <msg>
               <msgname largerlayer="0" lowerlayer="-1">NUB</
                msgname>
          </msg>
```

```
            <msg>
                 <msgname largerlayer="5" lowerlayer="3">D-
                  ALERT</msgname>
            </msg>
            <msg>
                 <msgname largerlayer="5" lowerlayer="2">SUP-
                  PRESSED</msgname>
            </msg>
       </messagestypes>
</file>
```

QoS Analyzer

7

This chapter describes the QoS Analyzer option to the TETRA AirAnalyzer. Topics described in this chapter are as follows:

Scope

This section applies if your AirAnalyzer software includes the 8165 TETRA QoS Analyzer option. The option requires the dongle to be plugged into a USB port of the PC running the AirAnalyzer software.

Installation

The QoS Analyzer software can be installed during the installation of the AirAnalyzer software as described in section "Installing the software" on page 7. To install it, please enable the TETRA QoS Analyzer Frontend checkbox as shown in Figure 159.

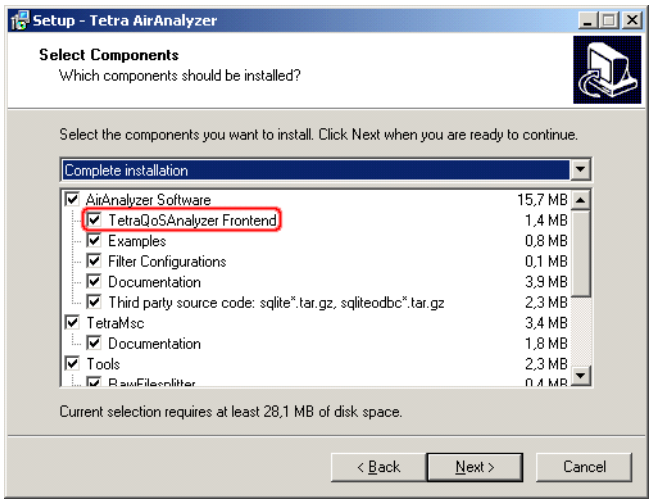


Figure 159 The TETRA QoS Analyzer component in the Installer

Starting TETRA QoS Analyzer

There are several ways of starting an AirAnalyzer software tool: It can be started by using the start menu (Figure 160), by selecting the Tools menu from the AirAnalyzer software (Figure 161) or by selecting an icon on the desktop (if created during installation).

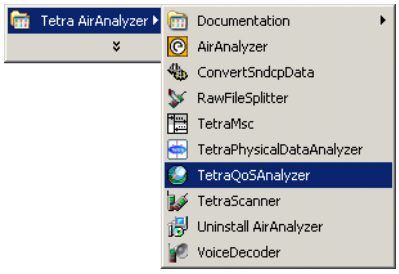


Figure 160 Start of TETRA QoS Analyzer using the program folder

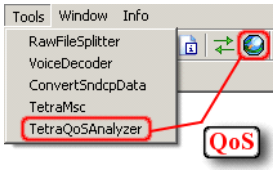


Figure 161 Start of TETRA QoS Analyzer from within AirAnalyzer

TETRA QoS Analyzer

Parallel to recording the TETRA AirAnalyzer writes TETRA protocol information into an SQLite database. This database contains all relevant events necessary for evaluating the quality of service (QoS). The TETRA QoS Analyzer is used to display the data.

By default SQLite is used as a database. According to the desired action the TETRA QoS Analyzer retrieves these data from the SQL database. According to the desired action the information is displayed by using optimized filter functions. The filtered data are processed for viewing by using a basic script. After that they are written to a separate window.

The TETRA QoS Analyzer can be used during the online analysis as well as offline when performing the evaluation in your office. The individual views may differ according to this mode.

Selecting a database

Use the button within the AirAnalyzer software to open the TETRA QoS Analyzer with the database of the current *raw file. You can also open the database manually within the TETRA QoS Analyzer.

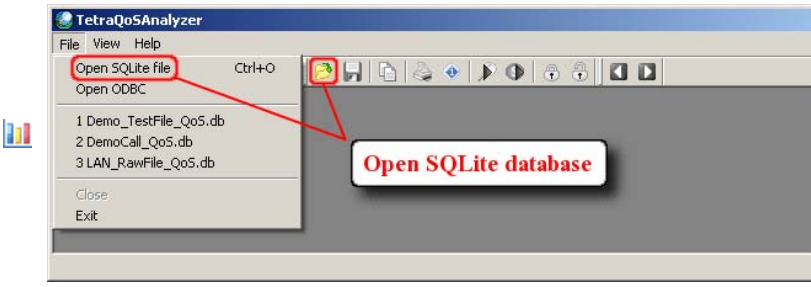


Figure 162 Opening a database

Measuring options

When opening the database the following window with the available measuring options is displayed.

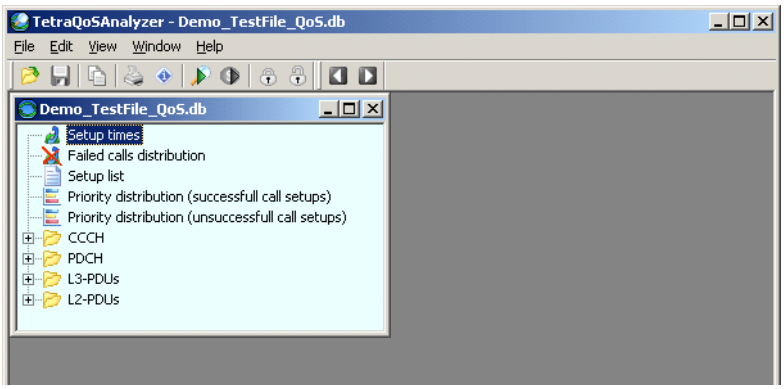


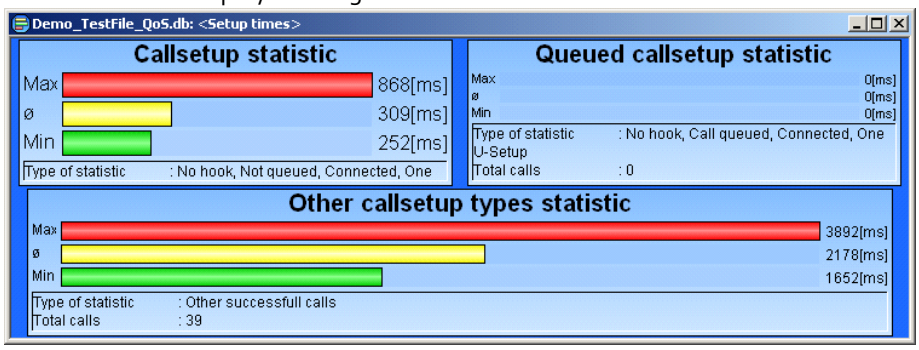
Figure 163 Window with measuring options

The individual measuring options ( ) are displayed directly or sorted into group folders ( ). The icon either shows the view type or the measurement of a certain type (call setup etc.). By double clicking on a measuring option or using the return key you run it or open/close the folder.

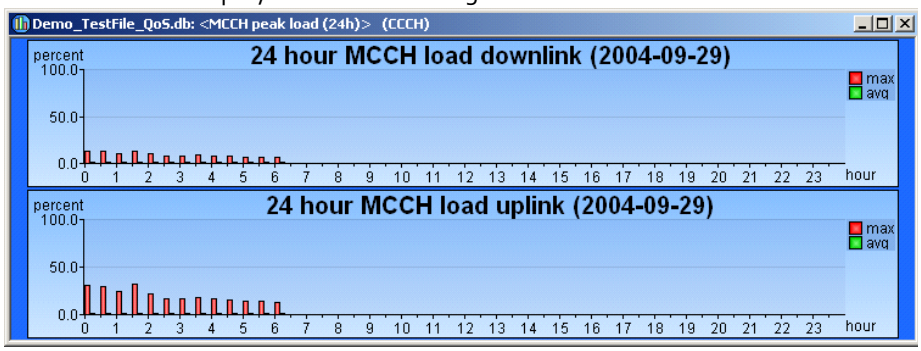
Measuring options and view types

Three view types are used:

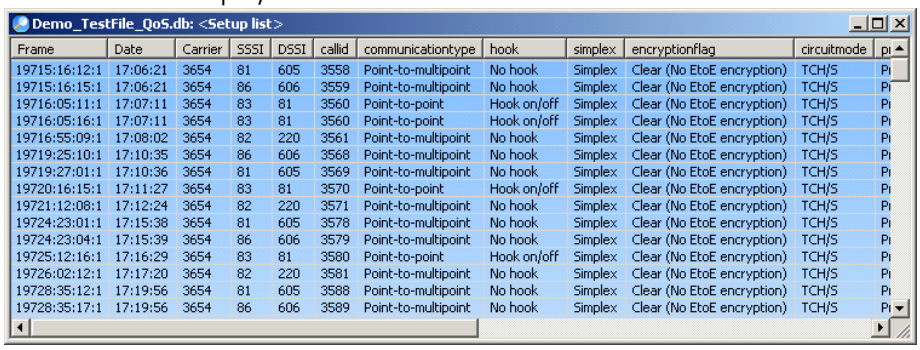
– The result is displayed using horizontal bars.



– The result is displayed over time using vertical bars.



– The result is displayed as a list.



The window used to display the measuring options not only contains the description as text but also an icon. This icon either represents the type of view or the measurement itself. Individual measurements can be sorted into the group folders.

The following icons describe the type of view:

The result is displayed using horizontal bars.

The result is displayed using vertical bars.

The result is displayed as a list.

These icons describe a measuring group (the type of view may vary):

Describes the measurement for call setup.

Describes the measurement for unsuccessful call setup.

Describes the measurement for call clearing.

Describes the measurement for SDS (Short Data Service).

Additional view types for measurement results

The display of the measurement results can be further influenced.

- By viewing them online.
- By limiting the results to a certain time frame.

The TETRA QoS Analyzer can display the results offline or online (near real time). There are special measuring options which are optimized for the online display. They will show additional information when viewed using the online mode.

Example 1: Online/offline display of the same measuring option

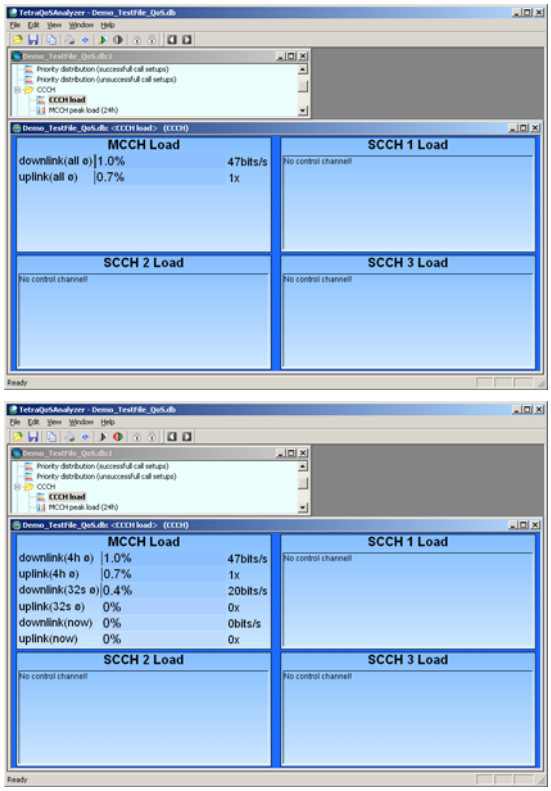


Figure 164 Example: Online/offline view

The figure on the top shows the mean values of the entire measurement period using the offline mode. The figure on the bottom shows the mean value of the last 4 hours (4h), the mean value for the last 32 seconds (32s) and the current value (now). Use the toolbar and the buttons  to switch from the offline to the online mode and back (see "Offline and online mode" on page 189).

Example 2: (View limited to a time range)

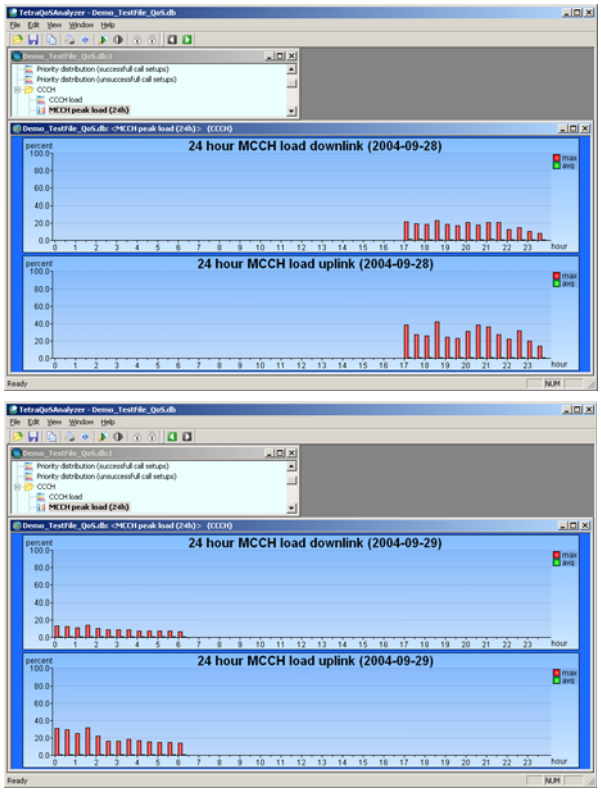
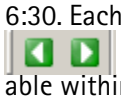


Figure 165 Example: Time range view

The pictures show a measurement within a certain time frame: it was started on Sept. 28, 2004 between 17:00 and 17:30 and was stopped between 6:00 and 6:30. Each view contains one day from 00:00:00 until 23:59:59. You can use the  buttons on the toolbar to select the day. These buttons are only available within the offline mode. When using the online mode only the current day is displayed.

The possible measurements are described in "QoS measurements" on page 194.

Printing, saving and copying measurement results

You can export measurement results. The following methods are available:

Save to a file.

Copy to the clipboard.

Print.

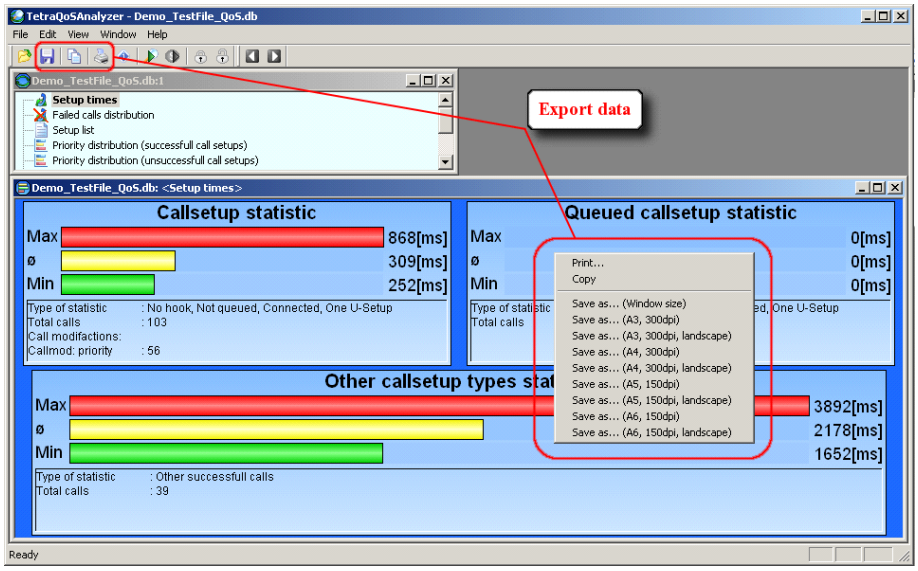


Figure 166 Exporting data

You can select these options on the toolbar or by clicking with the right mouse button in the result window to display a popup menu.

Saving

You can save measurement results by using the button on the toolbar or by using the popup menu in the window (clicking with the right mouse button).

Depending on the type of display used for the measurement results (bar graph or list) the data are saved either as picture or CSV file (Comma Separated Value).

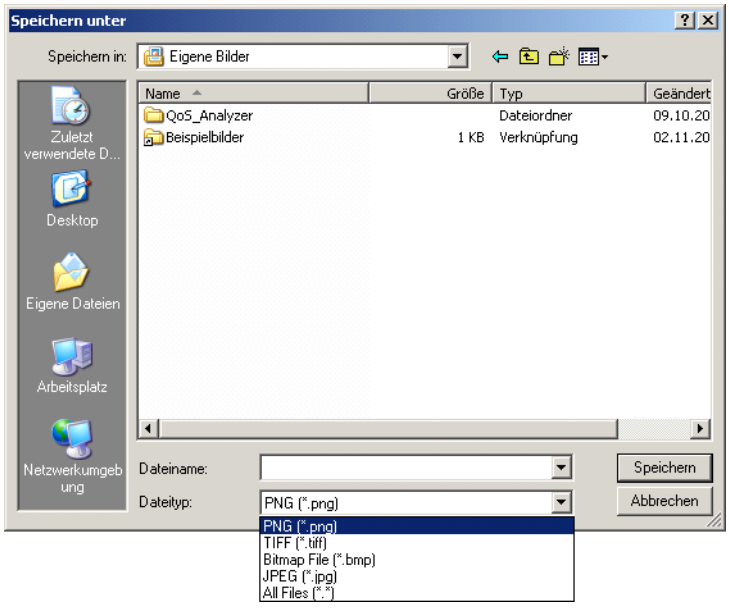


Figure 167 Saving data

The pictures are exported according to the size of the window. You can select the file type in the dialog for saving files.

You can open, edit and print the CSV file in spreadsheet programs like Excel or OpenOffice.

The picture files are saved with a white background to make it easier to insert them into publications.

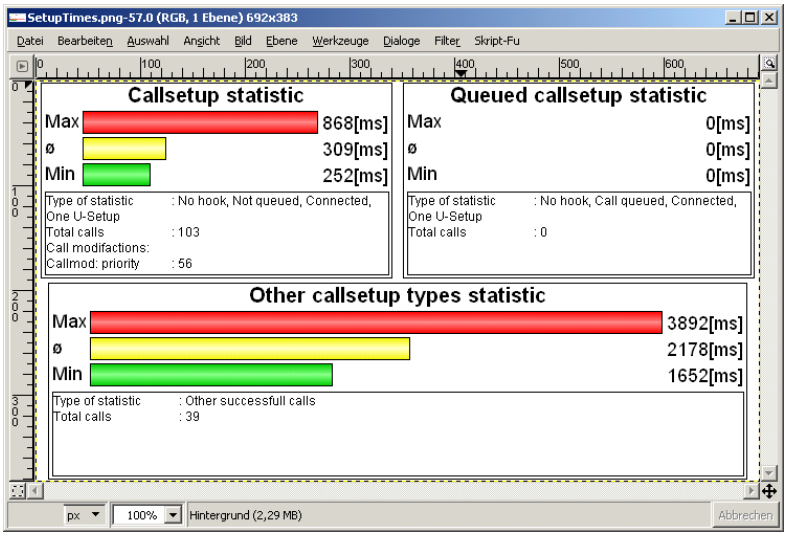


Figure 168 Saved picture

Copying

You can copy measurement results to the clipboard by using the button on the toolbar or by using the popup menu in the window (clicking with the right mouse button).

Similar to saving, the data are processed as a picture or CSV file. The difference is, that the data are copied to the clipboard without requiring confirmation.

Printing

You can print measurement results by using the button on the toolbar or by using the popup menu in the window (clicking with the right mouse button).

Offline and online mode

The TETRA QoS Analyzer can be operated in two modes. First the offline mode. This mode is used when a measurement is completed and the data have to processed. The second one is the online mode. The mode displays the just recorded data in near real time. This mode corresponds to the online view of TetraMsc. The AirAnalzer writes a data set to the database approx. every 4 seconds (exactly every 4 multi frames). When using the online mode the TETRA QoS Analyzer retrieves new data from the database every 4 seconds, processes the data and displays them. In addition the online view offers optimized measuring options (see "Additional view types for measurement results" on page 186). You can extract already added older raw files by simply analyzing them in AirAnalyzer after version 3.4 with the option "QoS export" activated. You can process/edit these data by using the offline mode.

You can switch between the offline and online mode by using the buttons on the toolbar.

The toolbar

The toolbar contains frequently used features.

Figure 169 TETRA QoS Analyzer Toolbar

Table 46 Toolbar icons

Icon	Short description	Section in manual
	Opens a SQLite database.	"Selecting a database" on page 184
	Saves the measurement results.	"Saving" on page 188
	Copies the measurement results to the clipboard.	"Copying" on page 189
	Prints the measurement results.	"Printing" on page 189
	Opens the dialog "About".	Shows information about the TetraQoSAnalyzer, ODBC driver and the database used.
	Switches TetraQoSAnalyzer to the online mode.	"Offline and online mode" on page 189
	Closes the online mode.	"Offline and online mode" on page 189
	Not used in this software version.	
	Not used in this software version.	
	Going back one unit of time when using the view with a timeline. (24 hours, 1 hour etc.)	"Additional view types for measurement results" on page 186
	Going forward one unit of time when using the view with a timeline. (24 hours, 1 hour etc.)	"Additional view types for measurement results" on page 186

Menus

File

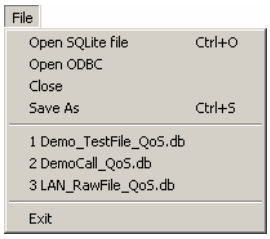


Table 47 File menu

Menu	Short description	Section in this user's guide
Open SQLite file	Opens a database with the SQLite file format.	"Selecting a database" on page 184
Open ODBC	Opens a database with a different ODBC driver.	"Selecting a database" on page 184
Close	Closes the current document.	
Save As	Saves the measurement results.	"Saving" on page 188
Recent files (....)	Shows the recently opened files.	"Selecting a database" on page 184
Exit	Closes the TETRA QoS Analyzer.	

Edit

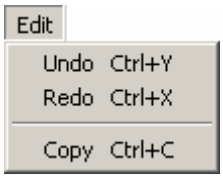


Table 48 Edit menu

Menu	Short description	Section in user's guide
Undo	Executes the last action.	
Redo	Executes the previous action.	
Copy	Copies the measurement result to the clipboard.	"Copying" on page 189

View

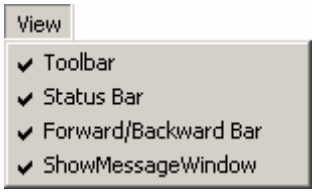


Table 49 View menu

Menu	Short description	Section in this user's guide
Toolbar	Displays or hides the main toolbar.	"The toolbar" on page 190
Status bar	Displays or hides the status bar.	
Forward/Backward bar	Displays or hides the forward/backward buttons.	"The toolbar" on page 190
ShowMessageWindow	Displays or hides the window containing error messages.	"Possible problems with measurements" on page 194

Window

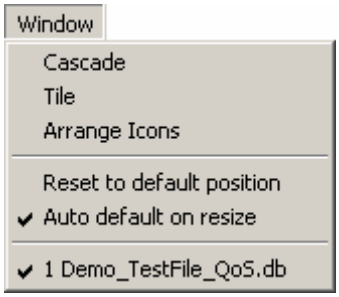


Table 50 Window menu

Menu	Short description
Cascade	Re-arranges the windows.
Tile	Re-arranges the windows.
Arrange Icons	Re-arranges the windows.
Reset to default position	Re-arranges the windows in a predefined position.
Auto default on resize	Arranges the windows in a predefined position when the size is changed.
(Name of window)	Displays or hides individual windows.

Help

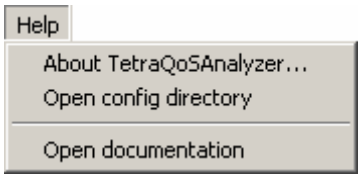


Table 51 Help menu

Menu	Short description
About TetraQoSAnalyzer...	Shows information about the TETRA QoS Analyzer, ODBC driver and the used database.
Open config directory	Opens the directory containing the configuration files by using Windows explorer.
Open documentation	Opens this documentation.

QoS measurements

This chapter describes the individual measurements, which requirements are necessary for measurements, how the results are collected and which additional options are available for each measurement (online view or view with timeline).

Possible problems with measurements

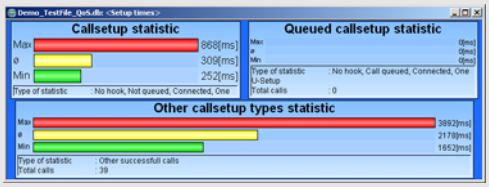
Systematic measurement errors: Some measurements require not only the error free receipt of the downlink but also the complete reception of the uplink. If the reception of the uplink cannot be ensured, these partial measurements cannot be evaluated and are ignored. We therefore recommend the selection of a location resp. to create the required conditions for the measurement to ensure the reception of the uplink.

Errors within the TETRA QoS Analyzer: If, in spite of careful checks, a problem occurs with the TETRA QoS Analyzer, the errors are displayed in a window. Examples for this are errors when reading out the database. The error display can be toggled by using the menu item "ShowMessageWindow". If an error occurs please send the database and a description to us.

Measurements for call setup

Setup times

Table 52 Setup time measurement

Name	Description
Name:	Setup Times
Description:	This measurement deals with the times for call setups. It calculates the time it takes from the first attempt of the mobile device to setup the call to the successful setup of the call.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 **Callsetup statistics:** This displays the times for the call setup for group calls. Calls, which are forwarded to a waiting queue, are not taken into consideration. **Queued callsetup statistics:** How long did it take for a call in the queue to be completed. **Other callsetup types statistics:** This statistics contains all other call types. It mainly refers to calls with "hook signalling" (ringing). That is, a human intervention (taking the call) is necessary before the call can be achieved. In addition, calls which had to send several call setup requests are evaluated. These occur if the infrastructure was not able to receive the first request or ignored it.

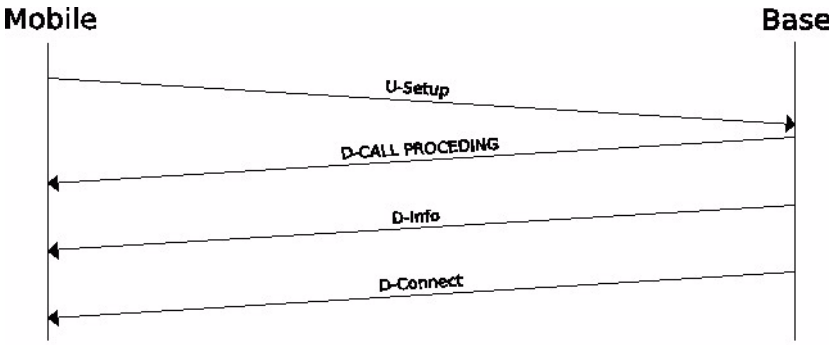
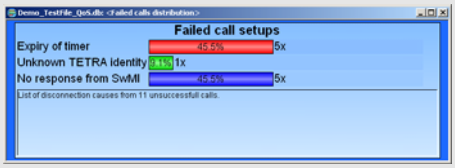


Figure 170 Setup time MSC

The times for call setup are determined from U-Setup to D-Connect. It is possible, that call modification or call queued are detected and included in the statistics. The offset between uplink and downlink is also taken into consideration when calculating the time. Calls, for which the U-Setup or D-Connect are missing, are ignored. Failed calls are evaluated in a different measurement.

Failed call distribution

Table 53 Failed call distribution measurement

Name	Description
Name:	Failed call distribution
Description:	This measurement deals with unsuccessful call setups. The reasons for the unsuccessful call set-ups are collected in this statistics.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 The reasons for the failed call are displayed in numbers and percent.

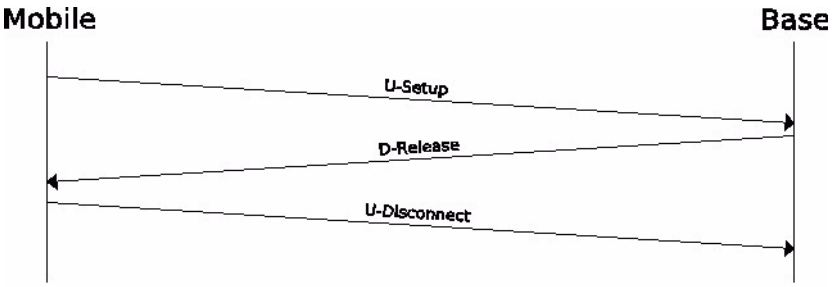
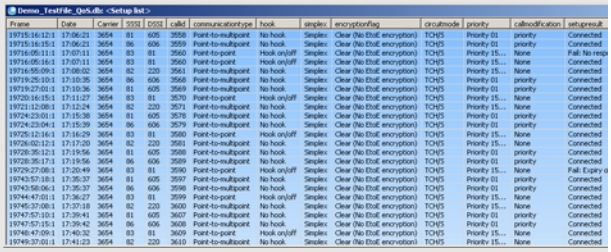


Figure 171 Setup failed MSC

Reasons for failed calls are determined by using D-Release or U-Disconnect. The call setup had to start with U-Setup. Possible repetitions of D-Release or U-Disconnect are filtered out.

Setup list

Table 54 Setup list

Name	Description
Name:	Call Setup list
Description:	Lists all successful calls and unsuccessful calls.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all specific data for the call setup as well as the result of the setup.

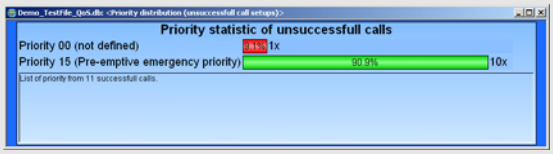
Priority distribution (successful call setup)

Table 55 Priority distribution (successful call setup)

Name	Description
Name:	Call Priority distribution (successful call setup)
Description:	Displays the distribution of the priorities of the successful call setups.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 The call priorities are displayed in numbers and percent.
Comment:	Determining the call priorities is derived from the same messages of the setup process.

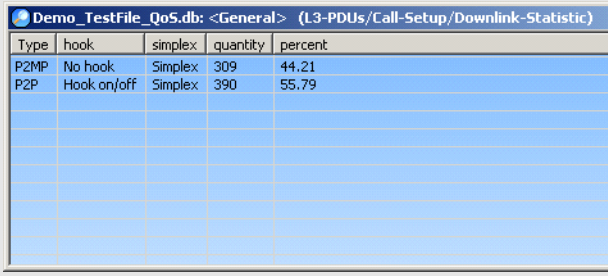
Priority distribution (unsuccessful call setup)

Table 56 Priority distribution (unsuccessful call setup)

Name	Description
Name:	Call Priority distribution (successful call setup)
Description:	Displays the distribution of the priorities of the unsuccessful call setups.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 The call priorities are displayed in numbers and percent.
Comment:	Determining the call priorities is derived from the same messages of the setup process.

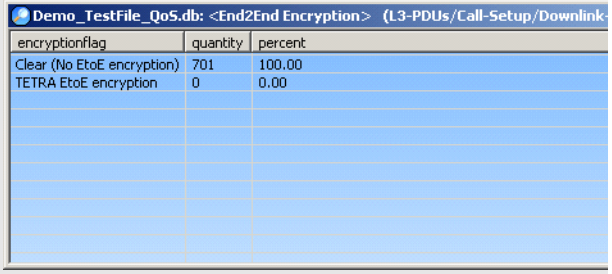
General (L3 PDUs in the downlink)

Table 57 General (L3 PDUs in the downlink)

Name	Description
Name:	Call/L3-PDUs/Downlink Statistics General
Description:	Displays the number of P2P and P2MP calls of the L3 D-Setup. Repetitions are suppressed.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the call type.
Comment:	The basic data in the database are used for a simple statistical evaluation.

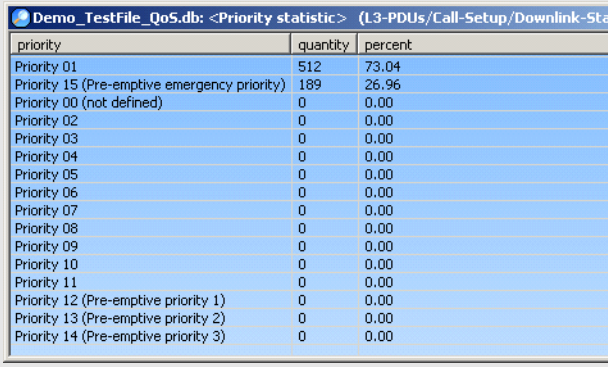
End2End encryption (L3 PDUs in the downlink)

Table 58 End2End encryption (L3 PDUs in the downlink)

Name	Description
Name:	Call/L3-PDUs/Downlink Statistics End2End Encryption
Description:	Displays the number of End2End encrypted and free L3 D-Setups. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the number of End2End encrypted and free L3 D-Setups.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Priority statistics (L3 PDUs in the downlink)

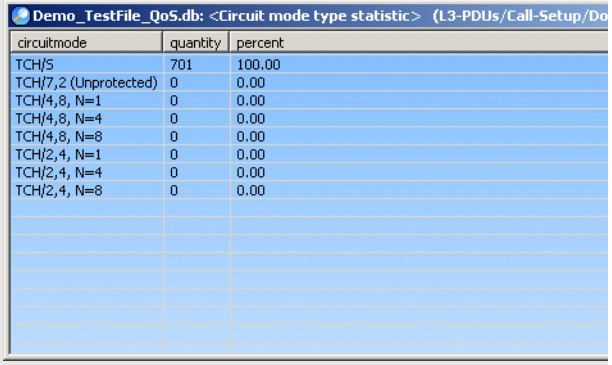
Table 59 Priority statistics (L3 PDUs in the downlink)

Name	Description
Name:	Call/L3-PDUs/Downlink Statistics Priority statistics
Description:	Displays the priorities of the L3 D-Setups. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the priorities of the L3 D-Setups.
Comment:	The basic data in the database are used for a simple statistical evaluation.

priority	quantity	percent
Priority 01	512	73.04
Priority 15 (Pre-emptive emergency priority)	189	26.96
Priority 00 (not defined)	0	0.00
Priority 02	0	0.00
Priority 03	0	0.00
Priority 04	0	0.00
Priority 05	0	0.00
Priority 06	0	0.00
Priority 07	0	0.00
Priority 08	0	0.00
Priority 09	0	0.00
Priority 10	0	0.00
Priority 11	0	0.00
Priority 12 (Pre-emptive priority 1)	0	0.00
Priority 13 (Pre-emptive priority 2)	0	0.00
Priority 14 (Pre-emptive priority 3)	0	0.00

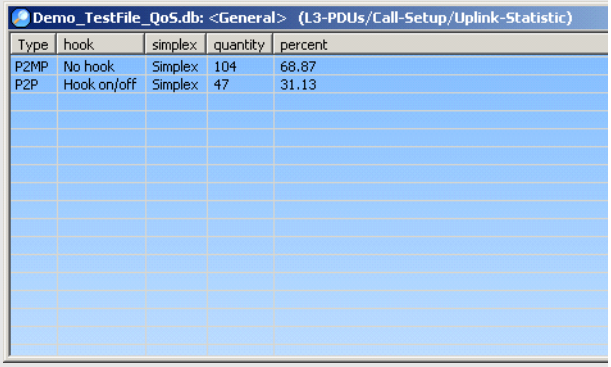
Circuit mode type statistics (L3 PDUs in the downlink)

Table 60 Circuit mode type statistics (L3 PDUs in the downlink)

Name	Description
Name:	Call/L3-PDUs/Downlink Statistics Circuit mode type statistics
Description:	Displays the circuit mode types of the L3 D-Setups. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the circuit mode types of the L3 D-Setups.
Comment:	The basic data in the database are used for a simple statistical evaluation.

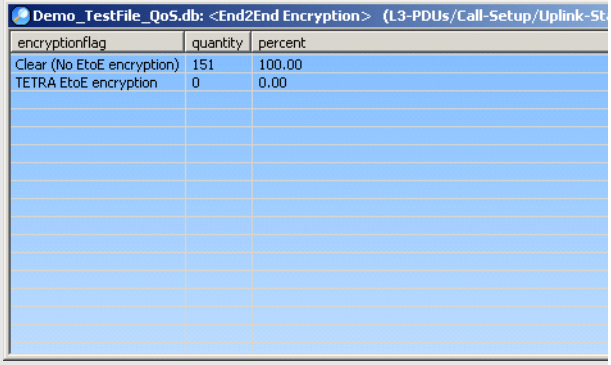
General (L3 PDUs in the uplink)

Table 61 General (L3 PDUs in the uplink)

Name	Description
Name:	Call/L3-PDUs/Uplink Statistics General
Description:	Displays the number of P2P and P2MP calls of the L3 U-Setup. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the call type.
Comment:	The basic data in the database are used for a simple statistical evaluation.

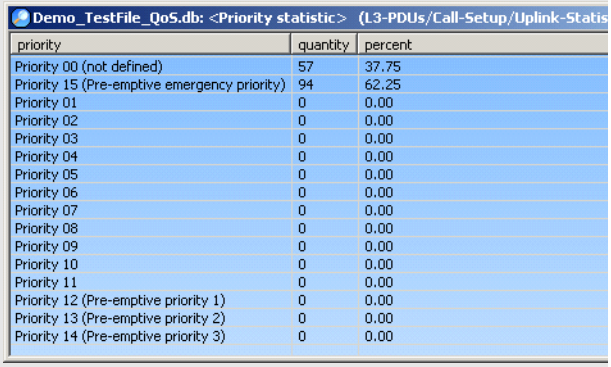
End2End encryption (L3 PDUs in the uplink)

Table 62 End-to-end encryption (L3 PDUs in the uplink)

Name	Description
Name:	Call/L3-PDUs/Uplink Statistics End2End Encryption
Description:	Displays the number of End2End encrypted and free L3 U-Setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the number of End2End encrypted and free L3 U-Setups.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Priority statistics (L3 PDUs in the uplink)

Table 63 Priority statistics (L3 PDUs in the uplink)

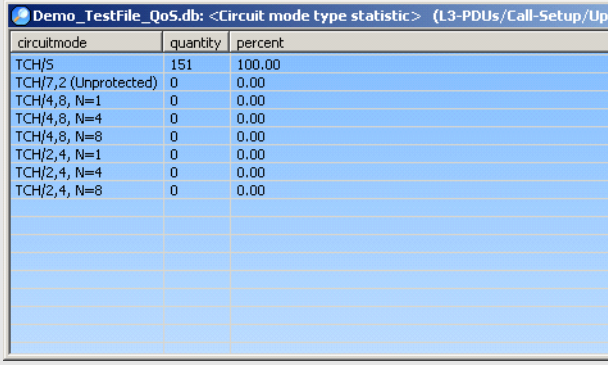
Name	Description
Name:	Call/L3-PDUs/Uplink Statistics Priority statistics
Description:	Displays the priorities of the L3 U-Setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the priorities of the L3 U-Setups.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Demo_TestFile_QoS.db: <Priority statistic> (L3-PDUs/Call-Setup/Uplink-Statis

priority	quantity	percent
Priority 00 (not defined)	57	37.75
Priority 15 (Pre-emptive emergency priority)	94	62.25
Priority 01	0	0.00
Priority 02	0	0.00
Priority 03	0	0.00
Priority 04	0	0.00
Priority 05	0	0.00
Priority 06	0	0.00
Priority 07	0	0.00
Priority 08	0	0.00
Priority 09	0	0.00
Priority 10	0	0.00
Priority 11	0	0.00
Priority 12 (Pre-emptive priority 1)	0	0.00
Priority 13 (Pre-emptive priority 2)	0	0.00
Priority 14 (Pre-emptive priority 3)	0	0.00

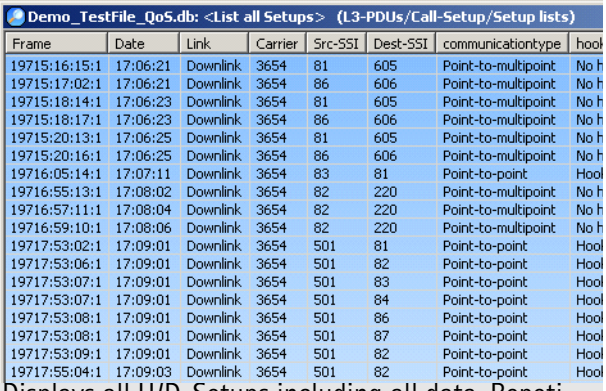
Circuit mode type statistics (L3 PDUs in the uplink)

Table 64 Circuit mode type statistics (L3 PDUs in the uplink)

Name	Description
Name:	Call/L3-PDUs/Uplink Statistics Circuit mode type statistics
Description:	Displays the circuit mode types of the L3 U-Set-ups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the circuit mode types of the L3 U-Set-ups.
Comment:	The basic data in the database are used for a simple statistical evaluation.

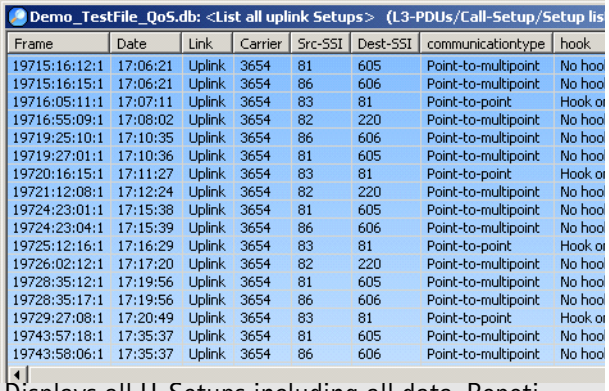
List all setups (L3 PDUs setup lists)

Table 65 List all setups (L3 PDUs setup lists)

Name	Description
Name:	Call/L3-PDUs/Setup lists List all setups
Description:	Displays all U/D-Setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all U/D-Setups including all data. Repetitions (e.g. downlink P2MP setup) are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

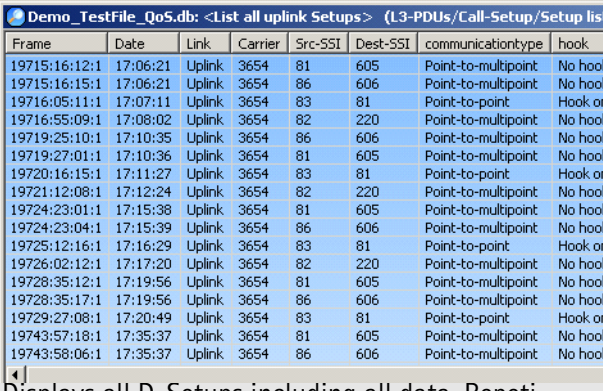
List all uplink setups (L3 PDUs setup lists)

Table 66 List all uplink setups (L3 PDUs setup lists)

Name	Description
Name:	Call/L3-PDUs/Setup lists List all uplink setups
Description:	Displays all U-Setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all U-Setups including all data. Repetitions (e.g. Random-Access) are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

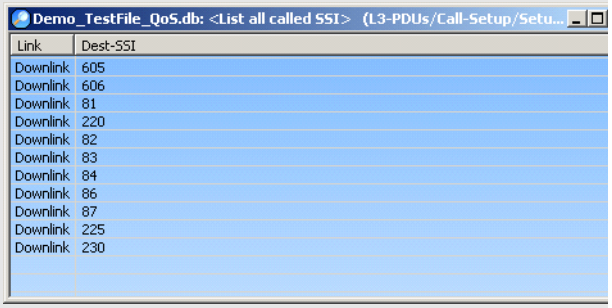
List all downlink setups (L3 PDUs setup lists)

Table 67 List all downlink setups (L3 PDUs setup lists)

Name	Description
Name:	Call/L3-PDUs/Setup lists List all downlink setups
Description:	Displays all D-Setups. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all D-Setups including all data. Repetitions (e.g. downlink P2MP setup) are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

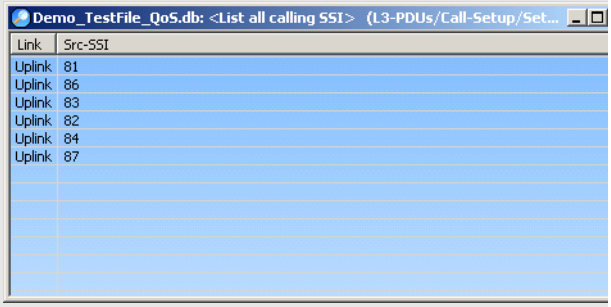
List all called SSI (L3 PDUs setup lists)

Table 68 List all downlink setups (L3 PDUs setup lists)

Name	Description
Name:	Call/L3-PDUs/Setup lists List all called SSI
Description:	List all called SSI
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all mobile SSIs called by using D-Setup.
Comment:	The basic data in the database are used for a simple statistical evaluation.

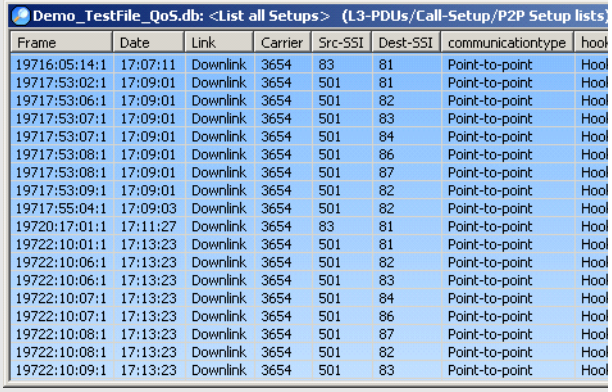
List all calling SSI (L3 PDUs setup lists)

Table 69 List all calling setups (L3 PDUs setup lists)

Name	Description
Name:	Call/L3-PDUs/Setup lists List all calling SSI
Description:	Lists all mobile SSIs which used a U-Setup for sending.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all mobile SSIs which used a U-Setup for calling.
Comment:	The basic data in the database are used for a simple statistical evaluation.

List all setups (L3 PDUs P2P setup lists)

Table 70 List all setups (L3 PDUs P2P setup lists)

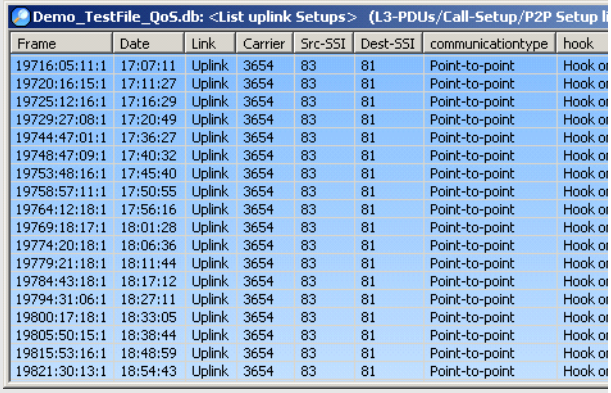
Name	Description
Name:	Call/L3-PDUs/P2P Setup lists List all setups
Description:	Displays all U/D-P2P setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all U/D-P2P setups including all data. Repetitions (e.g. Random-Access) are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Demo_TestFile_QoS.db: <List all Setups> (L3-PDUs/Call-Setup/P2P Setup lists)

Frame	Date	Link	Carrier	Src-SSI	Dest-SSI	communicationtype	hook
19716:05:14:1	17:07:11	Downlink	3654	83	81	Point-to-point	Hook
19717:53:02:1	17:09:01	Downlink	3654	501	81	Point-to-point	Hook
19717:53:06:1	17:09:01	Downlink	3654	501	82	Point-to-point	Hook
19717:53:07:1	17:09:01	Downlink	3654	501	83	Point-to-point	Hook
19717:53:07:1	17:09:01	Downlink	3654	501	84	Point-to-point	Hook
19717:53:08:1	17:09:01	Downlink	3654	501	86	Point-to-point	Hook
19717:53:08:1	17:09:01	Downlink	3654	501	87	Point-to-point	Hook
19717:53:09:1	17:09:01	Downlink	3654	501	82	Point-to-point	Hook
19717:55:04:1	17:09:03	Downlink	3654	501	82	Point-to-point	Hook
19720:17:01:1	17:11:27	Downlink	3654	83	81	Point-to-point	Hook
19722:10:01:1	17:13:23	Downlink	3654	501	81	Point-to-point	Hook
19722:10:06:1	17:13:23	Downlink	3654	501	82	Point-to-point	Hook
19722:10:06:1	17:13:23	Downlink	3654	501	83	Point-to-point	Hook
19722:10:07:1	17:13:23	Downlink	3654	501	84	Point-to-point	Hook
19722:10:07:1	17:13:23	Downlink	3654	501	86	Point-to-point	Hook
19722:10:08:1	17:13:23	Downlink	3654	501	87	Point-to-point	Hook
19722:10:08:1	17:13:23	Downlink	3654	501	82	Point-to-point	Hook
19722:10:09:1	17:13:23	Downlink	3654	501	83	Point-to-point	Hook

List all uplink setups (L3 PDUs P2P setup lists)

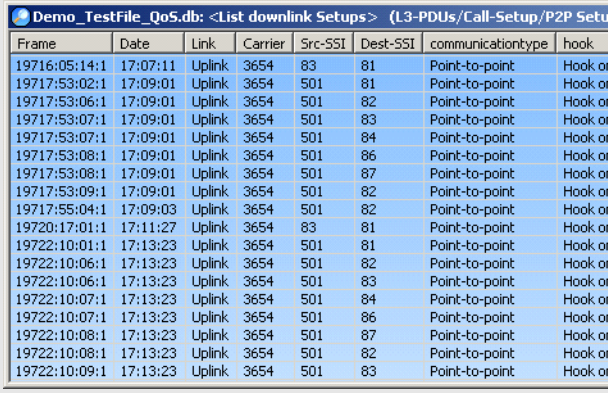
Table 71 List all uplink setups (L3 PDUs P2P setup lists)

Name	Description
Name:	Call/L3-PDUs/P2P Setup lists List all uplink setups
Description:	Displays all U-P2P Setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all U-P2P setups including all data. Repetitions are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Frame	Date	Link	Carrier	Src-SSI	Dest-SSI	communicationtype	hook
19716:05:11:1	17:07:11	Uplink	3654	83	81	Point-to-point	Hook o
19720:16:15:1	17:11:27	Uplink	3654	83	81	Point-to-point	Hook o
19725:12:16:1	17:16:29	Uplink	3654	83	81	Point-to-point	Hook o
19729:27:08:1	17:20:49	Uplink	3654	83	81	Point-to-point	Hook o
19744:47:01:1	17:36:27	Uplink	3654	83	81	Point-to-point	Hook o
19748:47:09:1	17:40:32	Uplink	3654	83	81	Point-to-point	Hook o
19753:48:16:1	17:45:40	Uplink	3654	83	81	Point-to-point	Hook o
19758:57:11:1	17:50:55	Uplink	3654	83	81	Point-to-point	Hook o
19764:12:18:1	17:56:16	Uplink	3654	83	81	Point-to-point	Hook o
19769:18:17:1	18:01:28	Uplink	3654	83	81	Point-to-point	Hook o
19774:20:18:1	18:06:36	Uplink	3654	83	81	Point-to-point	Hook o
19779:21:18:1	18:11:44	Uplink	3654	83	81	Point-to-point	Hook o
19784:43:18:1	18:17:12	Uplink	3654	83	81	Point-to-point	Hook o
19794:31:06:1	18:27:11	Uplink	3654	83	81	Point-to-point	Hook o
19800:17:18:1	18:33:05	Uplink	3654	83	81	Point-to-point	Hook o
19805:50:15:1	18:38:44	Uplink	3654	83	81	Point-to-point	Hook o
19815:53:16:1	18:48:59	Uplink	3654	83	81	Point-to-point	Hook o
19821:30:13:1	18:54:43	Uplink	3654	83	81	Point-to-point	Hook o

List all downlink setups (L3 PDUs P2P setup lists)

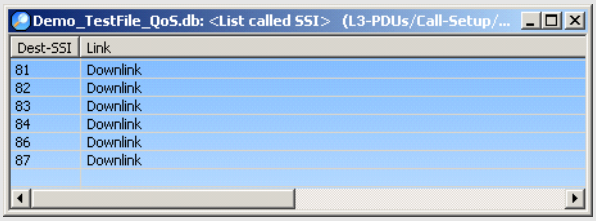
Table 72 List all downlink setups (L3 PDUs P2P setup lists)

Name	Description
Name:	Call/L3-PDUs/P2P Setup lists List all downlink setups
Description:	Displays all D-P2P Setups. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all D-P2P setups including all data. Repetitions are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Frame	Date	Link	Carrier	Src-SSI	Dest-SSI	communicationtype	hook
19716:05:14:1	17:07:11	Uplink	3654	83	81	Point-to-point	Hook o
19717:53:02:1	17:09:01	Uplink	3654	501	81	Point-to-point	Hook o
19717:53:06:1	17:09:01	Uplink	3654	501	82	Point-to-point	Hook o
19717:53:07:1	17:09:01	Uplink	3654	501	83	Point-to-point	Hook o
19717:53:07:1	17:09:01	Uplink	3654	501	84	Point-to-point	Hook o
19717:53:08:1	17:09:01	Uplink	3654	501	86	Point-to-point	Hook o
19717:53:08:1	17:09:01	Uplink	3654	501	87	Point-to-point	Hook o
19717:53:09:1	17:09:01	Uplink	3654	501	82	Point-to-point	Hook o
19717:55:04:1	17:09:03	Uplink	3654	501	82	Point-to-point	Hook o
19720:17:01:1	17:11:27	Uplink	3654	83	81	Point-to-point	Hook o
19722:10:01:1	17:13:23	Uplink	3654	501	81	Point-to-point	Hook o
19722:10:06:1	17:13:23	Uplink	3654	501	82	Point-to-point	Hook o
19722:10:06:1	17:13:23	Uplink	3654	501	83	Point-to-point	Hook o
19722:10:07:1	17:13:23	Uplink	3654	501	84	Point-to-point	Hook o
19722:10:07:1	17:13:23	Uplink	3654	501	86	Point-to-point	Hook o
19722:10:08:1	17:13:23	Uplink	3654	501	87	Point-to-point	Hook o
19722:10:08:1	17:13:23	Uplink	3654	501	82	Point-to-point	Hook o
19722:10:09:1	17:13:23	Uplink	3654	501	83	Point-to-point	Hook o

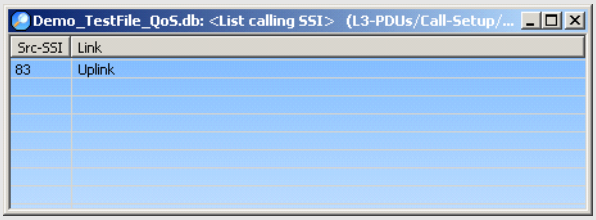
List all called SSI (L3-PDUs P2P Setup lists)

Table 73 List all called SSI (L3-PDUs P2P Setup lists)

Name	Description
Name:	Call/L3-PDUs/P2P Setup lists List all called SSI
Description:	Lists all mobile SSIs called by using P2P D-Setup.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all mobile SSIs called by using P2P D-Setup.
Comment:	The basic data in the database are used for a simple statistical evaluation.

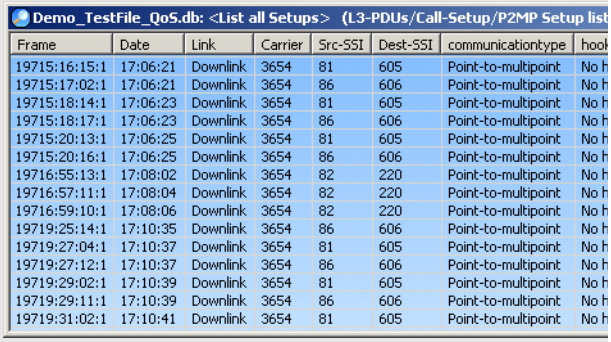
List all calling SSI (L3-PDUs P2P setup lists)

Table 74 List all callingSSI (L3-PDUs P2P setup lists)

Name	Description
Name:	Call/L3-PDUs/P2P Setup lists List all calling SSI
Description:	Lists all mobile SSIs which used a P2MP U-Setup for calling.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all mobile SSIs which used a P2MP U-Setup for calling.
Comment:	The basic data in the database are used for a simple statistical evaluation.

List all setups (L3 PDUs P2MP setup lists)

Table 75 List all setups (L3 PDUs P2MP setup lists)

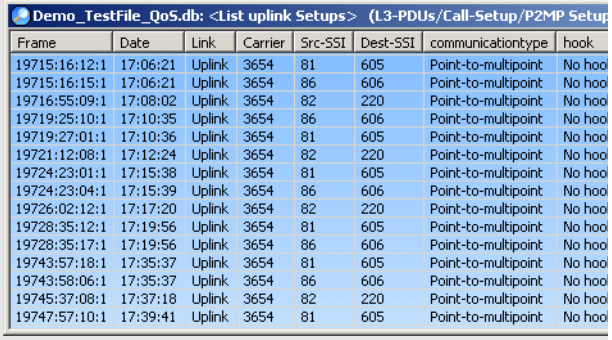
Name	Description
Name:	Call/L3-PDUs/P2MP Setup lists List all setups
Description:	Displays all U/D-P2MP setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all U/D-P2MP setups including all data. Repetitions are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Demo_TestFile_QoS.db: <List all Setups> (L3-PDUs/Call-Setup/P2MP Setup list

Frame	Date	Link	Carrier	Src-SSI	Dest-SSI	communicationtype	hook
19715:16:15:1	17:06:21	Downlink	3654	81	605	Point-to-multipoint	No h
19715:17:02:1	17:06:21	Downlink	3654	86	606	Point-to-multipoint	No h
19715:18:14:1	17:06:23	Downlink	3654	81	605	Point-to-multipoint	No h
19715:18:17:1	17:06:23	Downlink	3654	86	606	Point-to-multipoint	No h
19715:20:13:1	17:06:25	Downlink	3654	81	605	Point-to-multipoint	No h
19715:20:16:1	17:06:25	Downlink	3654	86	606	Point-to-multipoint	No h
19716:55:13:1	17:08:02	Downlink	3654	82	220	Point-to-multipoint	No h
19716:57:11:1	17:08:04	Downlink	3654	82	220	Point-to-multipoint	No h
19716:59:10:1	17:08:06	Downlink	3654	82	220	Point-to-multipoint	No h
19719:25:14:1	17:10:35	Downlink	3654	86	606	Point-to-multipoint	No h
19719:27:04:1	17:10:37	Downlink	3654	81	605	Point-to-multipoint	No h
19719:27:12:1	17:10:37	Downlink	3654	86	606	Point-to-multipoint	No h
19719:29:02:1	17:10:39	Downlink	3654	81	605	Point-to-multipoint	No h
19719:29:11:1	17:10:39	Downlink	3654	86	606	Point-to-multipoint	No h
19719:31:02:1	17:10:41	Downlink	3654	81	605	Point-to-multipoint	No h

List all uplink setups (L3 PDUs P2MP setup lists)

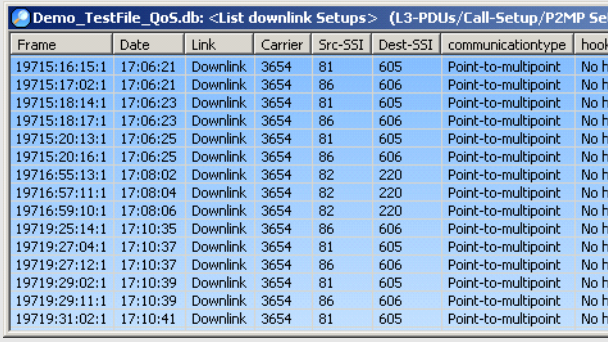
Table 76 List all uplink setups (L3 PDUs P2MP setup lists)

Name	Description
Name:	Call/L3-PDUs/P2MP Setup lists List all uplink setups
Description:	Displays all U-P2MP setups. Repetitions are ignored.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all U-P2MP setups including all data. Repetitions (e.g. random access) are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Frame	Date	Link	Carrier	Src-SSI	Dest-SSI	communicationtype	hook
19715:16:12:1	17:06:21	Uplink	3654	81	605	Point-to-multipoint	No hoo
19715:16:15:1	17:06:21	Uplink	3654	86	606	Point-to-multipoint	No hoo
19716:55:09:1	17:08:02	Uplink	3654	82	220	Point-to-multipoint	No hoo
19719:25:10:1	17:10:35	Uplink	3654	86	606	Point-to-multipoint	No hoo
19719:27:01:1	17:10:36	Uplink	3654	81	605	Point-to-multipoint	No hoo
19721:12:08:1	17:12:24	Uplink	3654	82	220	Point-to-multipoint	No hoo
19724:23:01:1	17:15:38	Uplink	3654	81	605	Point-to-multipoint	No hoo
19724:23:04:1	17:15:39	Uplink	3654	86	606	Point-to-multipoint	No hoo
19726:02:12:1	17:17:20	Uplink	3654	82	220	Point-to-multipoint	No hoo
19728:35:12:1	17:19:56	Uplink	3654	81	605	Point-to-multipoint	No hoo
19728:35:17:1	17:19:56	Uplink	3654	86	606	Point-to-multipoint	No hoo
19743:57:18:1	17:35:37	Uplink	3654	81	605	Point-to-multipoint	No hoo
19743:58:06:1	17:35:37	Uplink	3654	86	606	Point-to-multipoint	No hoo
19745:37:08:1	17:37:18	Uplink	3654	82	220	Point-to-multipoint	No hoo
19747:57:10:1	17:39:41	Uplink	3654	81	605	Point-to-multipoint	No hoo

List all downlink setups (L3 PDUs P2MP setup lists)

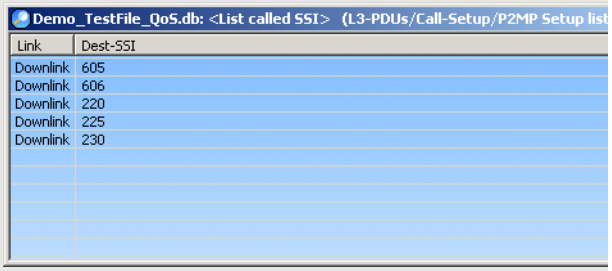
Table 77 List all downlink setups (L3 PDUs P2MP setup lists)

Name	Description
Name:	Call/L3-PDUs/P2MP Setup lists List all downlink setups
Description:	Displays all D-P2MP setups. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays all D-P2MP setups including all data. Repetitions are filtered out.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Frame	Date	Link	Carrier	Src-SSI	Dest-SSI	communicationtype	hook
19715:16:15:1	17:06:21	Downlink	3654	81	605	Point-to-multipoint	No h
19715:17:02:1	17:06:21	Downlink	3654	86	606	Point-to-multipoint	No h
19715:18:14:1	17:06:23	Downlink	3654	81	605	Point-to-multipoint	No h
19715:18:17:1	17:06:23	Downlink	3654	86	606	Point-to-multipoint	No h
19715:20:13:1	17:06:25	Downlink	3654	81	605	Point-to-multipoint	No h
19715:20:16:1	17:06:25	Downlink	3654	86	606	Point-to-multipoint	No h
19716:55:13:1	17:08:02	Downlink	3654	82	220	Point-to-multipoint	No h
19716:57:11:1	17:08:04	Downlink	3654	82	220	Point-to-multipoint	No h
19716:59:10:1	17:08:06	Downlink	3654	82	220	Point-to-multipoint	No h
19719:25:14:1	17:10:35	Downlink	3654	86	606	Point-to-multipoint	No h
19719:27:04:1	17:10:37	Downlink	3654	81	605	Point-to-multipoint	No h
19719:27:12:1	17:10:37	Downlink	3654	86	606	Point-to-multipoint	No h
19719:29:02:1	17:10:39	Downlink	3654	81	605	Point-to-multipoint	No h
19719:29:11:1	17:10:39	Downlink	3654	86	606	Point-to-multipoint	No h
19719:31:02:1	17:10:41	Downlink	3654	81	605	Point-to-multipoint	No h

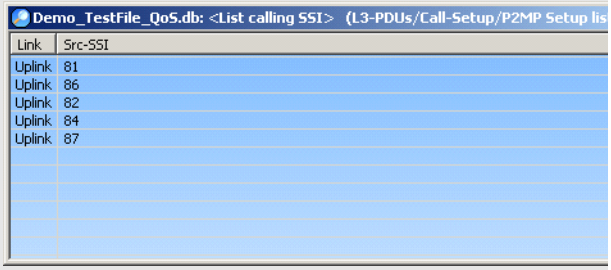
List all called SSI (L3 PDUs P2MP setup lists)

Table 78 List all called SSI (L3 PDUs P2MP setup lists)

Name	Description
Name:	Call/L3-PDUs/P2MP Setup lists List all called SSI
Description:	Lists all mobile SSIs called by using P2MP D-Setup.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all mobile SSIs called by using P2MP D-Setup.
Comment:	The basic data in the database are used for a simple statistical evaluation.

List all calling SSI (L3 PDUs P2MP setup lists)

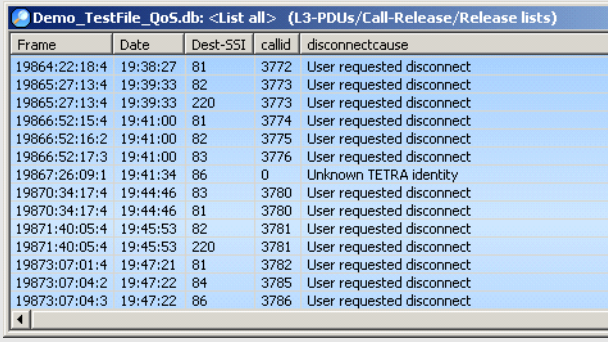
Table 79 List all calling SSI (L3 PDUs P2MP setup lists)

Name	Description
Name:	Call/L3-PDUs/P2MP Setup lists List all calling SSI
Description:	Lists all mobile SSIs which used a P2MP U-Setup for calling.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all mobile SSIs which used a P2MP U-Setup for calling.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Call release

List all (L3 PDUs release lists)

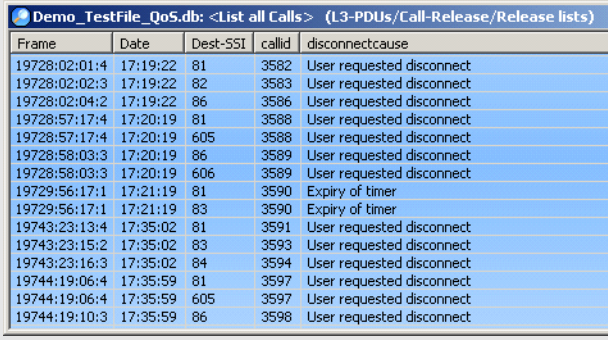
Table 80 List all (L3 PDUs release lists)

Name	Description
Name:	Call/Call-Release/Release lists List all
Description:	Lists all D-Release including "disconnect cause". Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all D-Release with Disconnect reason.
Comment:	The basic data in the database are used for a simple statistical evaluation.

Frame	Date	Dest-SSI	callid	disconnectcause
19864:22:18:4	19:38:27	81	3772	User requested disconnect
19865:27:13:4	19:39:33	82	3773	User requested disconnect
19865:27:13:4	19:39:33	220	3773	User requested disconnect
19866:52:15:4	19:41:00	81	3774	User requested disconnect
19866:52:16:2	19:41:00	82	3775	User requested disconnect
19866:52:17:3	19:41:00	83	3776	User requested disconnect
19867:26:09:1	19:41:34	86	0	Unknown TETRA identity
19870:34:17:4	19:44:46	83	3780	User requested disconnect
19870:34:17:4	19:44:46	81	3780	User requested disconnect
19871:40:05:4	19:45:53	82	3781	User requested disconnect
19871:40:05:4	19:45:53	220	3781	User requested disconnect
19873:07:01:4	19:47:21	81	3782	User requested disconnect
19873:07:04:2	19:47:22	84	3785	User requested disconnect
19873:07:04:3	19:47:22	86	3786	User requested disconnect

List all calls (L3 PDUs release lists)

Table 81 List all calls (L3 PDUs release lists)

Name	Description
Name:	Call/Call-Release/Release lists List all calls
Description:	Lists all D-Release with "Disconnect cause" which do not contain a "dummy call identifier". Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Lists all D-Release with "Disconnect cause" which do not contain a "dummy call identifier".
Comment:	The basic data in the database are used for a simple statistical evaluation.

Demo_TestFile_QoS.db: <List all Calls> (L3-PDUs/Call-Release/Release lists)

Frame	Date	Dest-SSI	callid	disconnectcause
19728:02:01:4	17:19:22	81	3582	User requested disconnect
19728:02:02:3	17:19:22	82	3583	User requested disconnect
19728:02:04:2	17:19:22	86	3586	User requested disconnect
19728:57:17:4	17:20:19	81	3588	User requested disconnect
19728:57:17:4	17:20:19	605	3588	User requested disconnect
19728:58:03:3	17:20:19	86	3589	User requested disconnect
19728:58:03:3	17:20:19	606	3589	User requested disconnect
19729:56:17:1	17:21:19	81	3590	Expiry of timer
19729:56:17:1	17:21:19	83	3590	Expiry of timer
19743:23:13:4	17:35:02	81	3591	User requested disconnect
19743:23:15:2	17:35:02	83	3593	User requested disconnect
19743:23:16:3	17:35:02	84	3594	User requested disconnect
19744:19:06:4	17:35:59	81	3597	User requested disconnect
19744:19:06:4	17:35:59	605	3597	User requested disconnect
19744:19:10:3	17:35:59	86	3598	User requested disconnect

Disconnect cause statistics (L3 PDUs release lists)

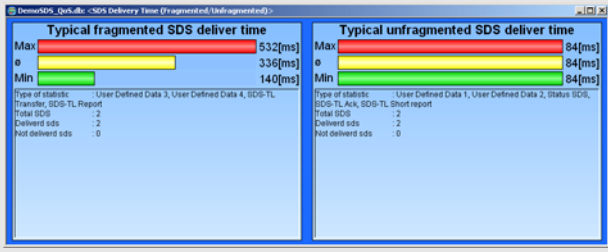
Table 82 Disconnect cause statistics (L3 PDUs release lists)

Name	Description
Name:	Call/Call-Release/Release lists Disconnect cause statistics
Description:	Creates statistics of all disconnections with a D-Release. Repetitions are ignored.
Uplink reception required?	No
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	Demo_TestFile_QoS.db: <Disconnect cause statistic> (L3-PDUs/Call-Release/9 disconnectcause | quantity | percent User requested disconnect | 420 | 94.17 Expiry of timer | 23 | 5.16 Unknown TETRA identity | 1 | 0.22 SwMI requested disconnection | 2 | 0.45 Cause not defined or unknown | 0 | 0.00 Called party busy | 0 | 0.00 Called party not reachable | 0 | 0.00 Called party does not support encryption | 0 | 0.00 Congestion in infrastructure | 0 | 0.00 Not allowed traffic case | 0 | 0.00 Incompatible traffic case | 0 | 0.00 Requested service not available | 0 | 0.00 Pre-emptive use of resource | 0 | 0.00 Invalid call identifier | 0 | 0.00 Call rejected by the called party | 0 | 0.00 Creates statistics of all disconnections with a D-Release.
Comment:	The basic data in the database are used for a simple statistical evaluation.

SDS

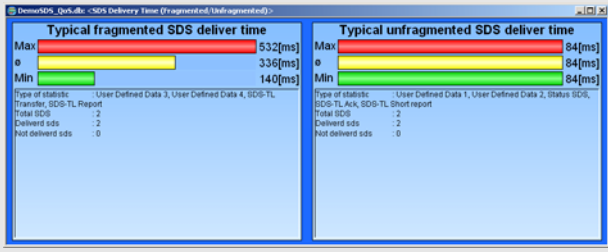
SDS delivery time (fragmented/ unfragmented)

Table 83 SDS delivery time (fragmented/unfragmented)

Name	Description
Name:	SDS delivery time (fragmented/unfragmented)
Description:	Creates statistics containing the delivery time of all SDS sent by mobile devices and delivered by the SwMi.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Creates statistics containing the time of all delivered SDS.

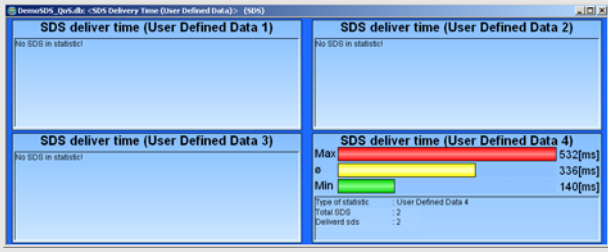
SDS delivery time (SDS-TL)

Table 84 SDS delivery time (SDS-TL)

Name	Description
Name:	SDS SDS delivery time (SDS-TL)
Description:	Creates statistics containing the delivery time of all SDS-TL sent by mobile devices and delivered by the SwMi.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Creates statistics containing the time of all delivered SDS-TL.

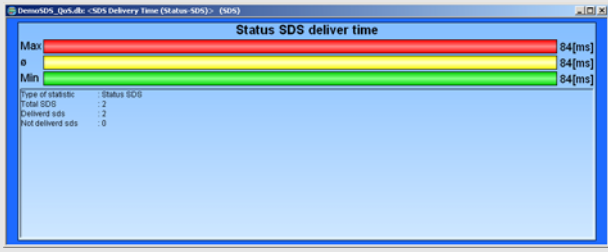
SDS delivery time (User Defined Data)

Table 85 SDS delivery time (User Defined Data)

Name	Description
Name:	SDS SDS delivery time (User Defined Data)
Description:	Creates statistics containing the delivery time of all SDS-User Defined Data sent by mobile devices and delivered by the SwMi.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Creates statistics containing the time of all delivered SDS-User Defined Data.

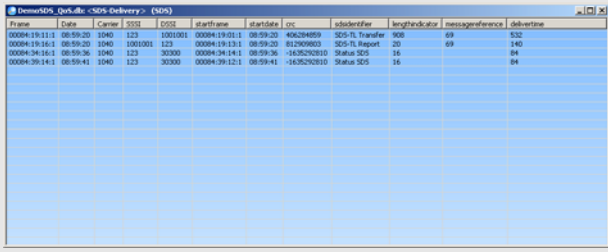
SDS delivery time (Status SDS)

Table 86 SDS delivery time (Status SDS)

Name	Description
Name:	SDS SDS delivery time (Status SDS)
Description:	Creates statistics containing the delivery time of all Status SDS sent by mobile devices and delivered by the SwMi.
Uplink reception required?	Yes
Online view?	Yes
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Creates statistics containing the time of all delivered Status SDS.

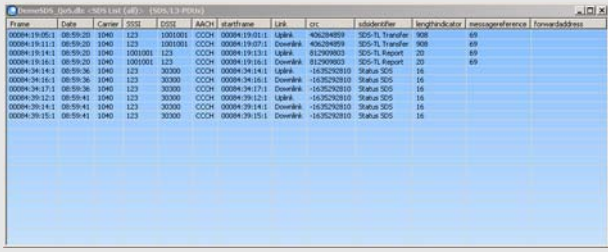
SDS delivery

Table 87 SDS delivery

Name	Description
Name:	SDS SDS delivery
Description:	Displays a list of all SDS sent from mobile devices.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays a list of all SDS sent from mobile devices.

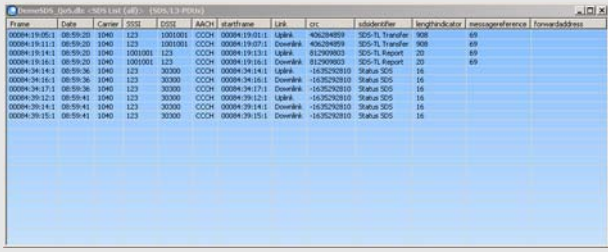
SDS list (all)

Table 88 SDS list (all)

Name	Description
Name:	SDS/L3-PDUs SDS list (all)
Description:	Displays a list of SDS PDUs.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays a list of SDS PDUs sent in the uplink and downlink.

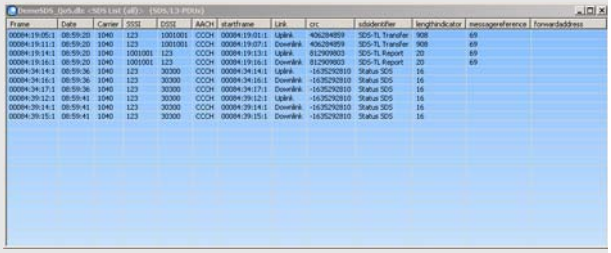
SDS list (uplink)

Table 89 SDS list (uplink)

Name	Description
Name:	SDS/L3-PDUs SDS list (uplink)
Description:	Displays a list of SDS PDUs sent within the uplink.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays a list of SDS PDUs sent in the uplink.

SDS list (downlink)

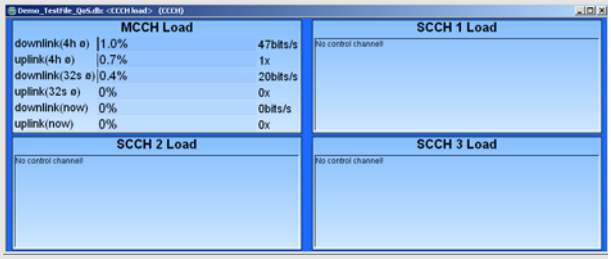
Table 90 SDS list (downlink)

Name	Description
Name:	SDS/L3-PDUs SDS list (downlink)
Description:	Displays a list of SDS PDUs sent within the downlink.
Uplink reception required?	Yes
Online view?	No
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays a list of SDS PDUs sent within the downlink.

CCCH

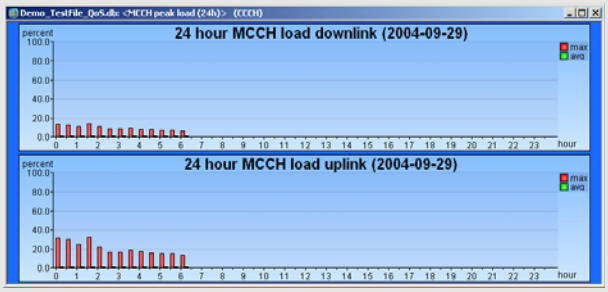
CCCH load

Table 91 CCCH load

Name	Description
Name:	CCCH load
Description:	Displays the load of the control channels (MCCH, SCCH1-3).
Uplink reception required?	No
Online view?	Yes, especially optimized for the online view.
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the load of the control channels (MCCH, SCCH1-3). The view for the online mode shows the mean value of the last 4 hours (4h), the mean value for the last 32 seconds (32s) and the current value (now).
Comment:	The view for the offline mode shows only the mean values of the entire measurement period.

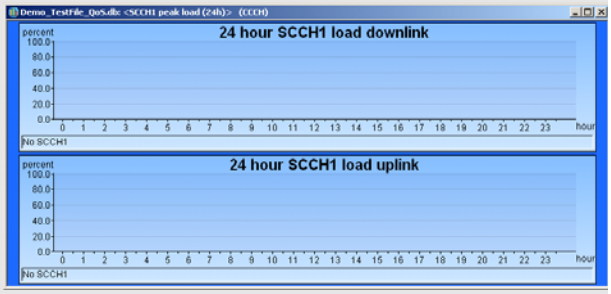
MCCH peak load (24h)

Table 92 MCCH peak load (24h)

Name	Description
Name:	Channel Load MCCH peak load (24h)
Description:	Displays the load of the MCCH over a certain time period (24h).
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 24 hours.
View:	 Displays the load of the MCCH over a certain time period (24h). Within the time frames of 30 minutes the maximum value (red) and the mean value (green) are displayed.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the current day is displayed.

SCCH1-3 peak load (24h)

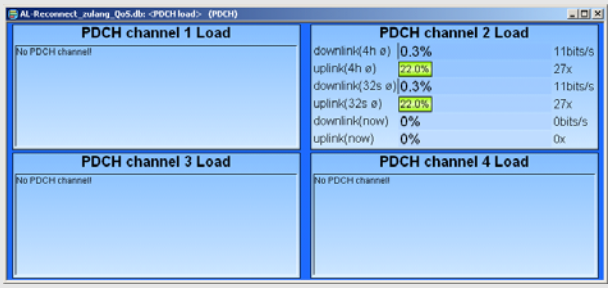
Table 93 SCCH1-3 peak load (24h)

Name	Description
Name:	Channel Load SCCH1-3 peak load (24h)
Description:	Displays the load of SCCH1-3 over a certain time period (24h).
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 24 hours.
View:	 Displays the load of SCCH1-3 over a certain time period (24h). Within the time frames of 30 minutes the maximum value (red) and the mean value (green) are displayed.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the current day is displayed.

PDCH

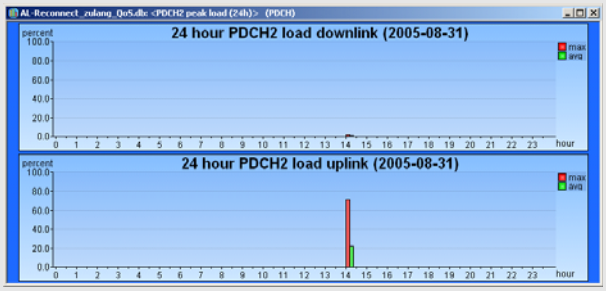
PDCH load

Table 94 PDCH load

Name	Description
Name:	PDCH load
Description:	Displays the load of the PDCH channels (PDCH1-4).
Uplink reception required?	No
Online view?	Yes, especially optimized for the online view
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated.
View:	 Displays the load of the PDCH channels (PDCH1-4). The view for the online mode shows the mean value of the last 4 hours (4h), the mean value for the last 32 seconds (32s) and the current value (now).
Comment:	The view for the offline mode only shows the mean values of the entire measurement period. Not available for encrypted connections.

PDCH1-4 peak load (24h)

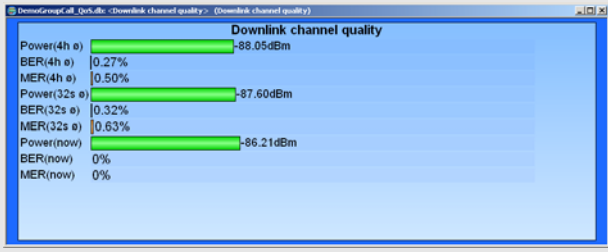
Table 95 PDCH1-4 peak load (24h)

Name	Description
Name:	Channel Load/PDCH PDCH1-4 peak load (24h)
Description:	Displays the load of PDCH1-4 over a certain time period (24h).
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 24 hours
View:	 Displays the load of PDCH1-4 over a certain time period (24h). Within the time frames of 30 minutes the maximum value (red) and the mean value (green) are displayed.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the current day is displayed. The PDCH measurement does not work with encryption.

Downlink Channel Quality

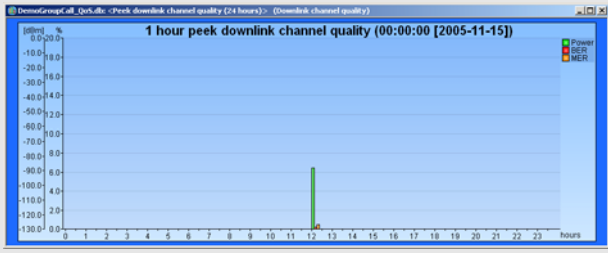
Downlink channel quality

Table 96 Downlink channel quality

Name	Description
Name:	Downlink channel quality Downlink channel quality
Description:	Displays the quality of the downlink channel. Three measurement values are collected: – Received field strength – Bit error rate – Message erasure rate
Uplink reception required?	No
Online view?	Yes, especially optimized for the online view
Timeline view?	No, all measurement data recorded during the time of the measurement are evaluated
View:	 Displays the quality of the downlink channel.
Comment:	The view for the offline mode shows only the mean values of the entire measurement period.

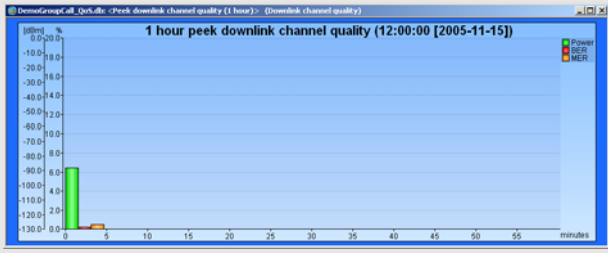
Downlink channel quality (24 hours)

Table 97 Downlink channel quality (24 hours)

Name	Description
Name:	Downlink channel quality Downlink channel quality (24 hours)
Description:	Displays the quality of the downlink channel. Three measurement values are collected: – Received field strength – Bit error rate – Message erasure rate
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 24 hours
View:	 Displays the signal quality over time (24h) in steps of 30 minutes.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the current day is displayed.

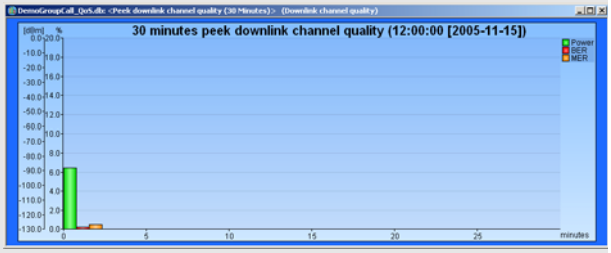
Downlink channel quality (1 hour)

Table 98 Downlink channel quality (1 hour)

Name	Description
Name:	Downlink channel quality Downlink channel quality (1 hour)
Description:	Displays the quality of the downlink channel. Three measurement values are collected: – Received field strength – Bit error rate – Message erasure rate
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 1 hour
View:	 Displays the signal quality over time (1 hour) in steps of 5 minutes.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the current hour is displayed.

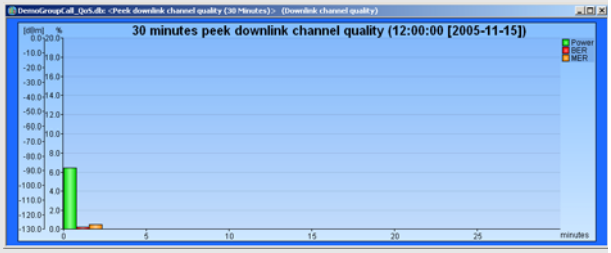
Downlink channel quality (30 minutes)

Table 99 Downlink channel quality (30 minutes)

Name	Description
Name:	Downlink channel quality Downlink channel quality (30 minutes)
Description:	Displays the quality of the downlink channel. Three measurement values are collected: – Received field strength – Bit error rate – Message erasure rate
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 30 minutes
View:	 Displays the signal quality over time (30 minutes) in steps of 5 minutes.
Comment:	The displayed period of time can be selected in offline mode using the buttons. When using the online mode only the last 30 minutes are displayed.

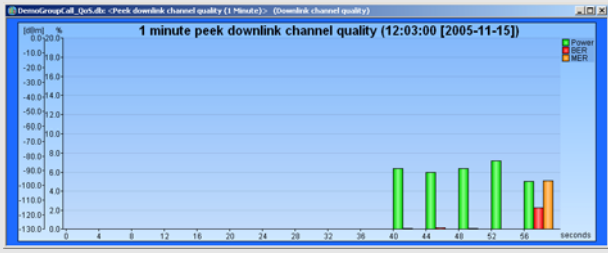
Downlink channel quality (5 minutes)

Table 100 Downlink channel quality (5 minutes)

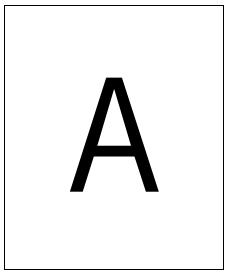
Name	Description
Name:	Downlink channel quality Downlink channel quality (5 minutes)
Description:	Displays the quality of the downlink channel. Three measurement values are collected: – Received field strength – Bit error rate – Message erasure rate
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 5 minutes
View:	 Displays the signal quality over time (5 minutes) in steps of 1 minute.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the last 5 minutes are displayed.

Downlink channel quality (1 minute)

Table 101 Downlink channel quality (1 minute)

Name	Description
Name:	Downlink channel quality Downlink channel quality (1 minute)
Description:	Displays the quality of the downlink channel. Three measurement values are collected: – Received field strength – Bit error rate – Message erasure rate
Uplink reception required?	No
Online view?	Yes
Timeline view?	Yes, the display always shows 1 minute
View:	 Displays the signal quality over time (1 minute) in steps of 4 seconds.
Comment:	The displayed period of time can be selected in offline mode using the  buttons. When using the online mode only the last minute is displayed.

Abbreviations



This appendix contains a list of abbreviations used throughout this manual.

AACH — Associated Control Channel

BNCH — Broadcast Network Channel

BSCH — Broadcast Synchronization Channel

CMCE — Circuit Mode Control Entity

LLC — Logical Link Control

Lo Mac — Lower Medium Access Control

MLE — Mobile Link Entity

MM — Mobility Management

MSC — Message Sequence Chart

PDU — Packet Data Unit

Raw data — Normally the physically received data of all four down and uplink slots from one TETRA carrier (*.raw). This may also be TMW or TMV data.

RSSI — Receive Signal Strength Indication

SAP — Service Access Point

SCDB — Synchronous Downlink Burst

SCH — Signaling Channel

SNDCP — Sub Network Dependent Convergence Protocol

SSI — Short Subscriber Identity

TETRA — Terrestrial Trunked Radio

TT — TETRA Test

Warranty and Repair

B

This chapter describes the customer services available through Willtek. Topics discussed in this chapter include the following:

Warranty information

Willtek warrants that all of its products conform to Willtek's published specifications and are free from defects in materials and workmanship for a period of one year from the date of delivery to the original buyer, when used under normal operating conditions and within the service conditions for which they were designed. This warranty is not transferable and does not apply to used or demonstration products.

In case of a warranty claim, Willtek's obligation shall be limited to repairing, or at its option, replacing without charge, any assembly or component (except batteries) which in Willtek's sole opinion proves to be defective within the scope of the warranty. In the event Willtek is not able to modify, repair or replace nonconforming defective parts or components to a condition as warranted within a reasonable time after receipt thereof, the buyer shall receive credit in the amount of the original invoiced price of the product.

It is the buyer's responsibility to notify Willtek in writing of the defect or nonconformity within the warranty period and to return the affected product to Willtek's factory, designated service provider, or authorized service center within thirty (30) days after discovery of such defect or nonconformity. The buyer shall prepay shipping charges and insurance for products returned to Willtek or its designated service provider for warranty service. Willtek or its designated service provider shall pay costs for return of products to the buyer.

Willtek's obligation and the customer's sole remedy under this hardware warranty is limited to the repair or replacement, at Willtek's option, of the defective product. Willtek shall have no obligation to remedy any such defect if it can be shown: (a) that the product was altered, repaired, or reworked by any party other than Willtek without Willtek's written consent; (b) that such defects were the result of customer's improper storage, mishandling, abuse, or misuse of the product; (c) that such defects were the result of customer's use of the product in conjunction with equipment electronically or mechanically incompatible or of an inferior quality; or (d) that the defect was the result of damage by fire, explosion, power failure, or any act of nature.

The warranty described above is the buyer's sole and exclusive remedy and no other warranty, whether written or oral, expressed or implied by statute or course of dealing shall apply. Willtek specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. No statement, representation, agreement, or understanding, oral or written, made by an agent, distributor, or employee of Willtek, which is not contained in the foregoing warranty will be binding upon Willtek, unless made in writing and executed by an authorized representative of Willtek. Under no circumstances shall Willtek be liable for any direct, indirect, special, incidental, or consequential damages, expenses, or losses, including loss of profits, based on contract, tort, or any other legal theory.

Equipment return instructions

Please contact your local service center for Willtek products via telephone or web site for return or reference authorization to accompany your equipment. For each piece of equipment returned for repair, attach a tag that includes the following information:

- Owner's name, address, and telephone number.
- Serial number, product type, and model.
- Warranty status. (If you are unsure of the warranty status of your instrument, include a copy of the invoice or delivery note.)
- Detailed description of the problem or service requested.
- Name and telephone number of the person to contact regarding questions about the repair.
- Return authorization (RA) number or reference number.

If possible, return the equipment using the original shipping container and material. Additional Willtek shipping containers are available from Willtek on request. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. Willtek is not liable for any damage that may occur during shipping. The customer should clearly mark the Willtek-issued RA or reference number on the outside of the package and ship it prepaid and insured to Willtek.

End-User License Agreement

C

This appendix describes the conditions for using the software.

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