User Manual

MultiAnalyzer

2021-12

English

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Legal Disclosure

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Version 2.9.0 (23/08/2019)

Technical changes reserved.

The Use of Symbols

The following manual includes several symbols to make it easier to follow the instructions.

ⓘ	The information symbol indicates an additional information on the action of the programme or on the handling with the programme.
NOTICE	The NOTICE indicates an important information. Disregarding may cause the programme to not run properly.
➔	The arrow indicates a prerequisite for the following action. If this prerequisite is not given, the programme may can not follow with the given instructions.
✔	The check mark indicates the result of an action.
‘	This symbol indicates an entry in the glossary. The symbol is placed after the corresponding word within the text.

General Information

NOTICE	Modifications on the software, that are going beyond the scope that is presented in this document, are not permitted! Any consequences, that are referable to these modifications, will not be covered by the company.

1 About this Manual

This manual provides an overview of the programme bundle **MultiAnalyzer**. The manual describes the structure of the different programmes and shows the proper use of the programmes.

This manual is addressed to users with or without profound knowledge in radio technology or radio-telephony. As a result of this, in some places this manual contains further information about radio technology and radio-telephony to make it easier to adjust the settings for ones purposes.

More detailed definitions of some terms are available in the glossary.

The manual follows a logical order for a gradual induction. Before start working with the programme bundle, read this manual carefully.

Follow the instructions precisely.

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2 Requirements

PC Requirements	
PC Hardware (Minimum)	Intel® Core™ i3(gen 10), 4GB Memory, 20 GB sufficient free space on hard-drive.
OS	Windows 10 (64 bit, version 1809 or later)
USB-Ports	2.0 (used for chip set device connections)
Ethernet	10/100/1000 Mbit/s (used for measurement device connection)
Supported Recording Devices	
• TCCA TMW • RTL2832 • R&S EM 100 • R&S PR100 • R&S ESMD • AirSpy • MS2710xA • SKY-i7000 • rfe-global (7504, 7510) • Ettus UHD (N210, B210) • Tektronix RSA 306	
Supported Hardware Decryption Devices	
• MASDecryptor	

Further information on the requirements and additional specifications are described in another document.

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3 About the MultiAnalyzer Programme Bundle

The **MultiAnalyzer** is a programme bundle for recording, storing, analysing, and watching protocol data. The bundle includes the following components:

- **MultiAnalyzerLicence**
  This programme is used to check the current licence options and to request a licence, which is needed by the other programme parts.
- **MultiAnalyzerLicenceServer**
  This programme is used to maintain and distribute the pool of carrier licences.
- **MultiAnalyzerLicenceClient**
  This programme is used to update the carrier licences that are provided by **MultiAnalyzerLicenceServer**.
- **MultiAnalyzer**
  This GUI programme is used to start/stop records and to store the protocol data.
- **MultiAnalyzerRecord**
  This command line programme is used to record and to store the protocol data.
- **MultiAnalyzerProto**
  This programme is used to load stored protocol data, to analyse it, and to output the information in a human readable format (text file).
- **MultiAnalyzerMsc**
  This programme is used to graphically present the analysed data in the form of message sequence charts with full access to all protocol elements.
- **MultiAnalyzerQoS**
  This programme is used to graphically present the analysed data in the form of diagrams and statistics.
- **MultiAnalyzerQosServer**
  This programme is used to stream recorded and analysed QoS data to the **MultiAnalyzerQoS** viewer.
- **MultiAnalyzerSplitter**
  The separation programme is used to split recordings into parts or to cut out certain points in time. Additional the reverse joining is possible.
- **MultiAnalyzerSaveRules**
  This programme is used to restrict saving options (e. g. allow only save encrypted).
- **MultiAnalyzerNetworkViewer**
  This programme is used to visualise the data of radio towers and the connection between the radio towers.

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4 Getting Started

The **MultiAnalyzer**, **MultiAnalyzerQoS**, **MultiAnalyzerQosServer**, **MultiAnalyzerRecord**, **MultiAnalyzerProto**, **MultiAnalyzerMsc** and **MultiAnalyzerNetworkViewer** need a valid licence.

The licence is provided as a hardware dongle, or as a licence file. The licence can be managed with the programme **MultiAnalyzerLicence** (see chapter 4.1 Requesting the Licence File) and with the programme bundle **CarrierManager** (see chapter 4.3 CarrierManager).

The **MultiAnalzyerLicence** is used to read and view the current licence (dongle, or licence file) or to request the licence file “MultiAnalyzer.lic”. The **CarrierManager** includes the **MultiAnalzyerLicenceServer** and the **MultiAnalzyerLicenceClient** that are used to maintain and distribute the pool of carrier licences and to update these licences.

If a dongle, is available, plug the dongle, into the computer and ensure that the red LED of the dongle, is switched on. If no light is on, check the dongle, driver installation.

If a “MultiAnalyzer.lic” licence file was provided by the *femvenner GmbH*, copy the file into the programme folder (see Chapter 4.1 Requesting the Licence File, step 6.).

If no licence file was provided by the *femvenner GmbH*, follow the next chapter to request a licence using the programme **MultiAnalyzerLicence**.

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4.1 Requesting the Licence File

If no licence is present, then it is necessary to request a licence file using the programme **MultiAnalyzerLicence**.

To request a licence file with **MultiAnalyzerLicence**, follow the next steps.

➔ **MultiAnalyzerLicence** is running.

1. Choose the network adapter from the tab page ‘Licence file’ (see 1).

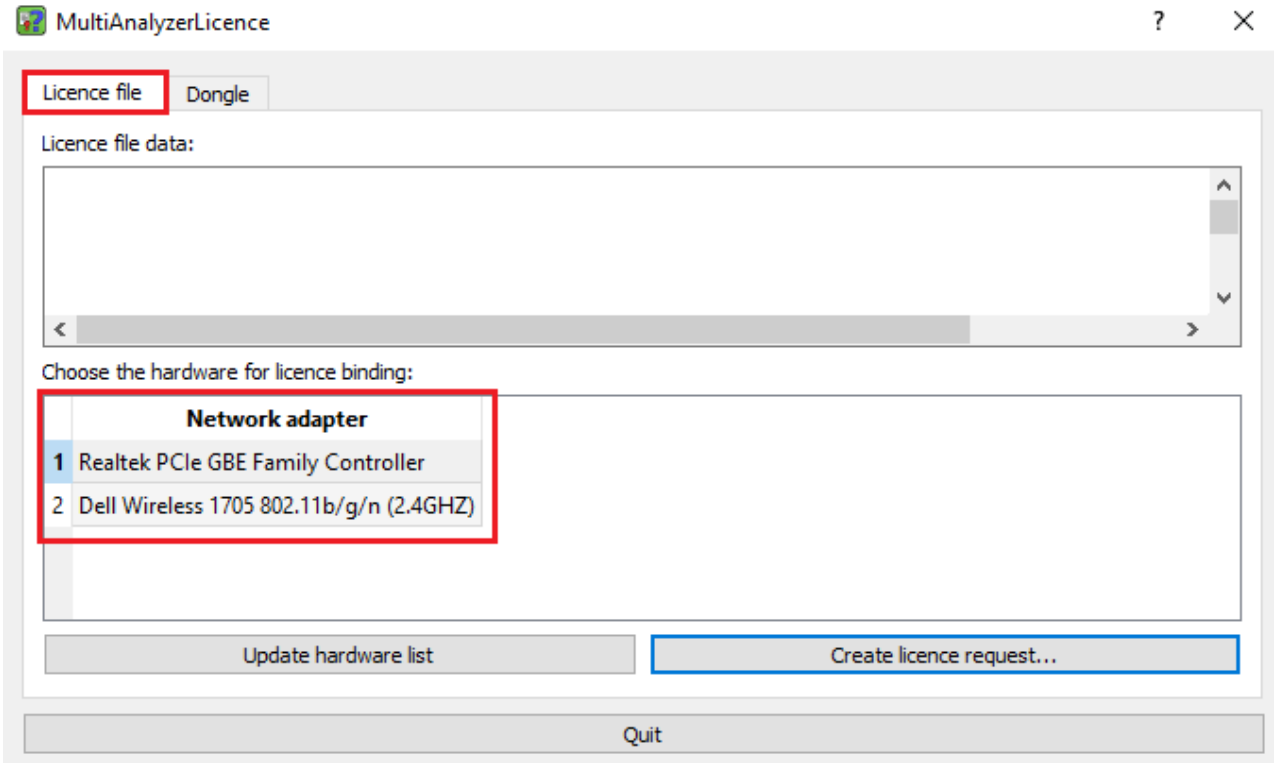

Illustration 1 MultiAnalyzer Licence: Choosing Network Adapter

ⓘ The licence is bound to a network adapter. If the network adapter is an onboard-hardware, the licence is fixed to this hardware. If a removable hardware is used (e. g. USB WiFi Adapter), the licence can be used more dynamical. This removable hardware has to be plugged into the computer all the time while the programmes are running.

2. Click on the button [Create licence request…] (see 2).

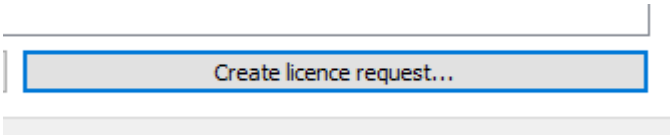

Illustration 2 MultiAnalyzerLicence: Button Create Licence Request

✔ A form opens (see 3).

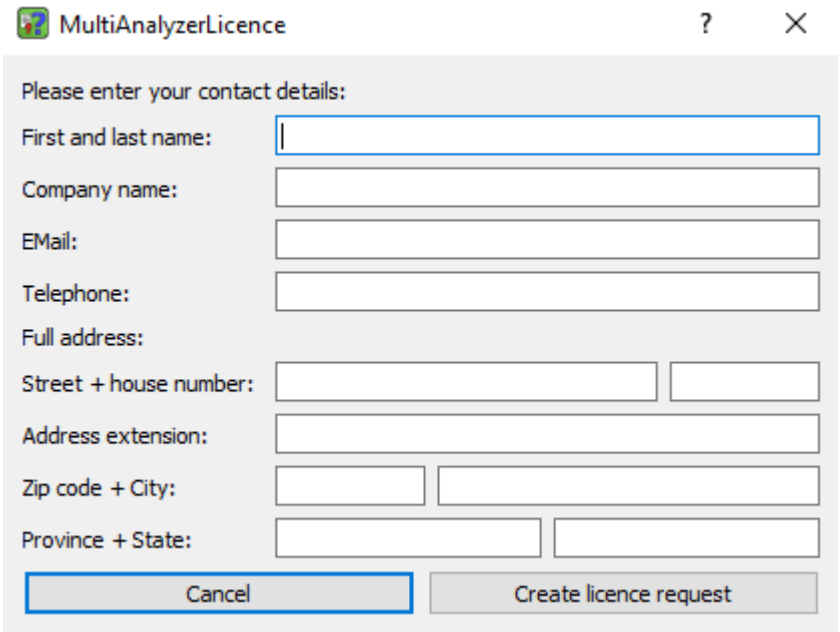

Illustration 3 MultiAnalyzerLicence: Request Licence File Form

3. To create a licence request, fill in the information and click on the button [Create licence request] (see 4).

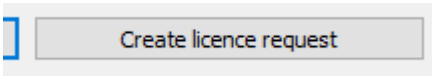

Illustration 4 MultiAnalyzerLicence: Button Create Licence Request Form

✔ The save dialogue opens to set the storage path of the request file (see 5).

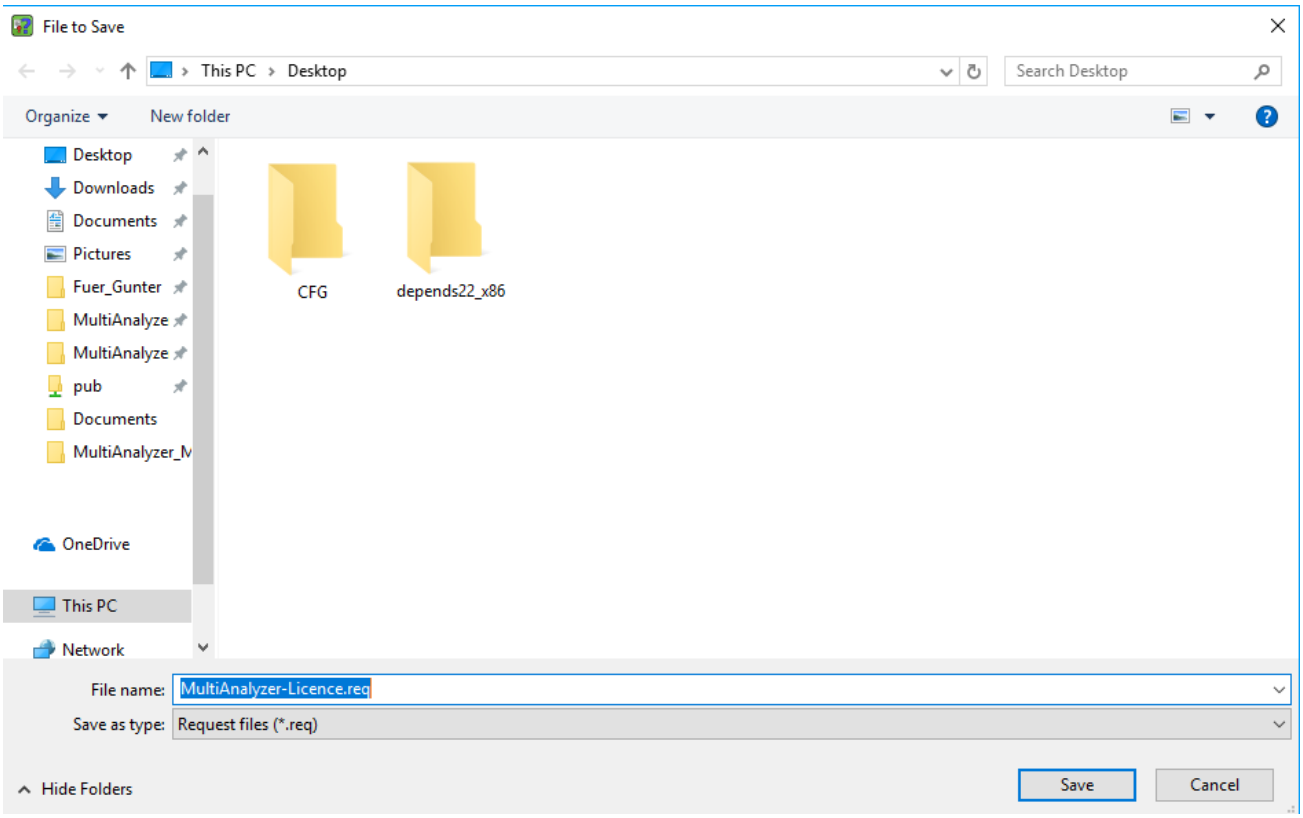

Illustration 5 MultiAnalyzerLicence: Save Dialogue

4. To save the request file, choose the storage path and click on the button [Save].

   ⓘ This is not the licence file itself it is just a request for a file.

5. Send the saved request file to the *femvenner GmbH (malicense@femvenner.de)*.

   ⓘ The *femvenner GmbH* generates the licence file and sends back the licence file.

6. Copy the received licence file “MultiAnalyzer.lic” into the programme folder (see 6).

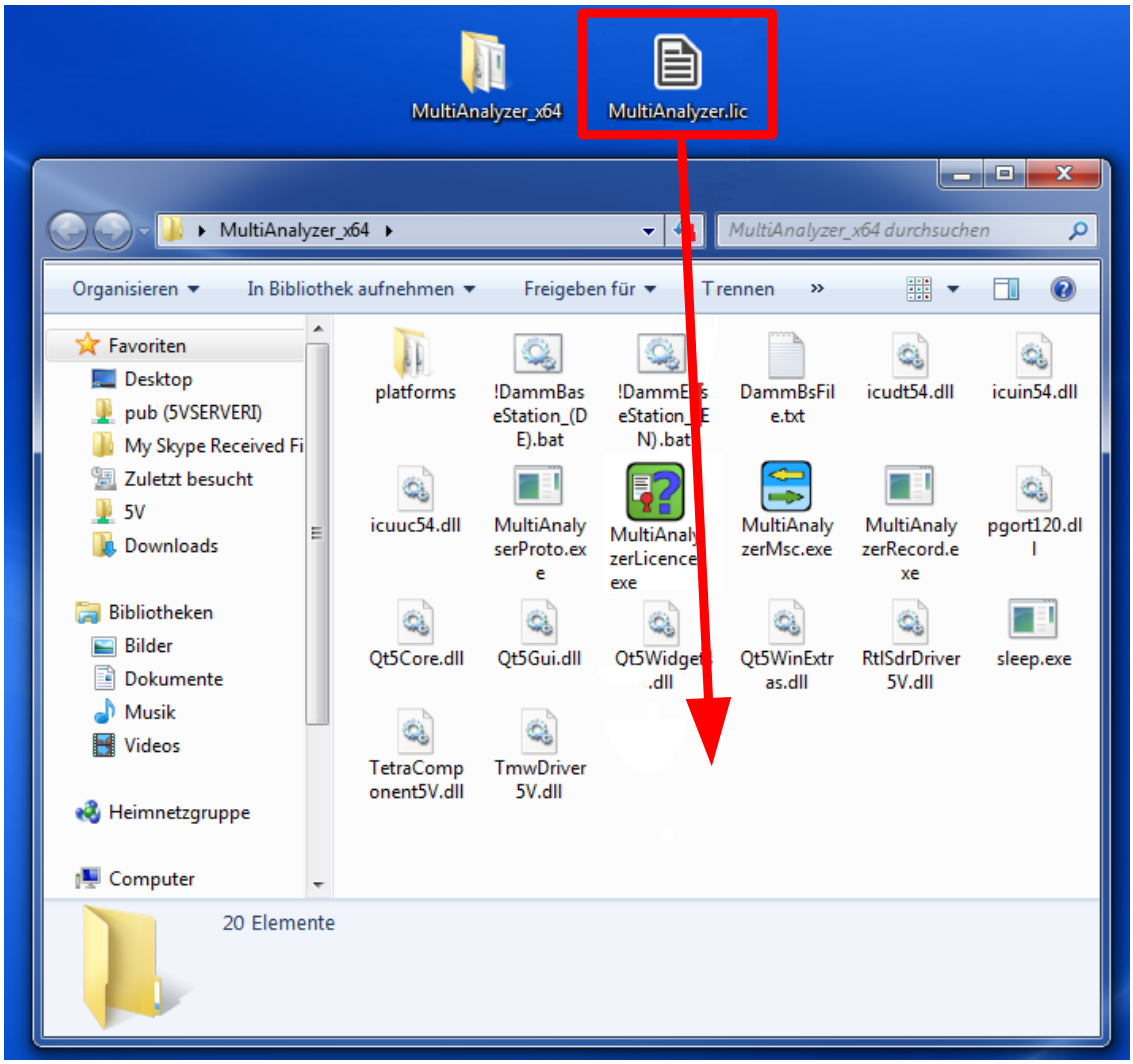

Illustration 6 MultiAnalyzerLicence: Copy File

✔ The programmes are ready to use.

ⓘ To view the licence options, see chapter 4.2 Licence Options.

4.2 Licence Options

If a licence file or dongle، is present, the licence data can be viewed in the **MultiAnalyzerLicence**.

The following information can be checked in the displayed window:

- Bound network card or dongle، ID and update level
- User information
- Enabled options
- The time-out date (if the licence is time restricted)
- Enabled driver

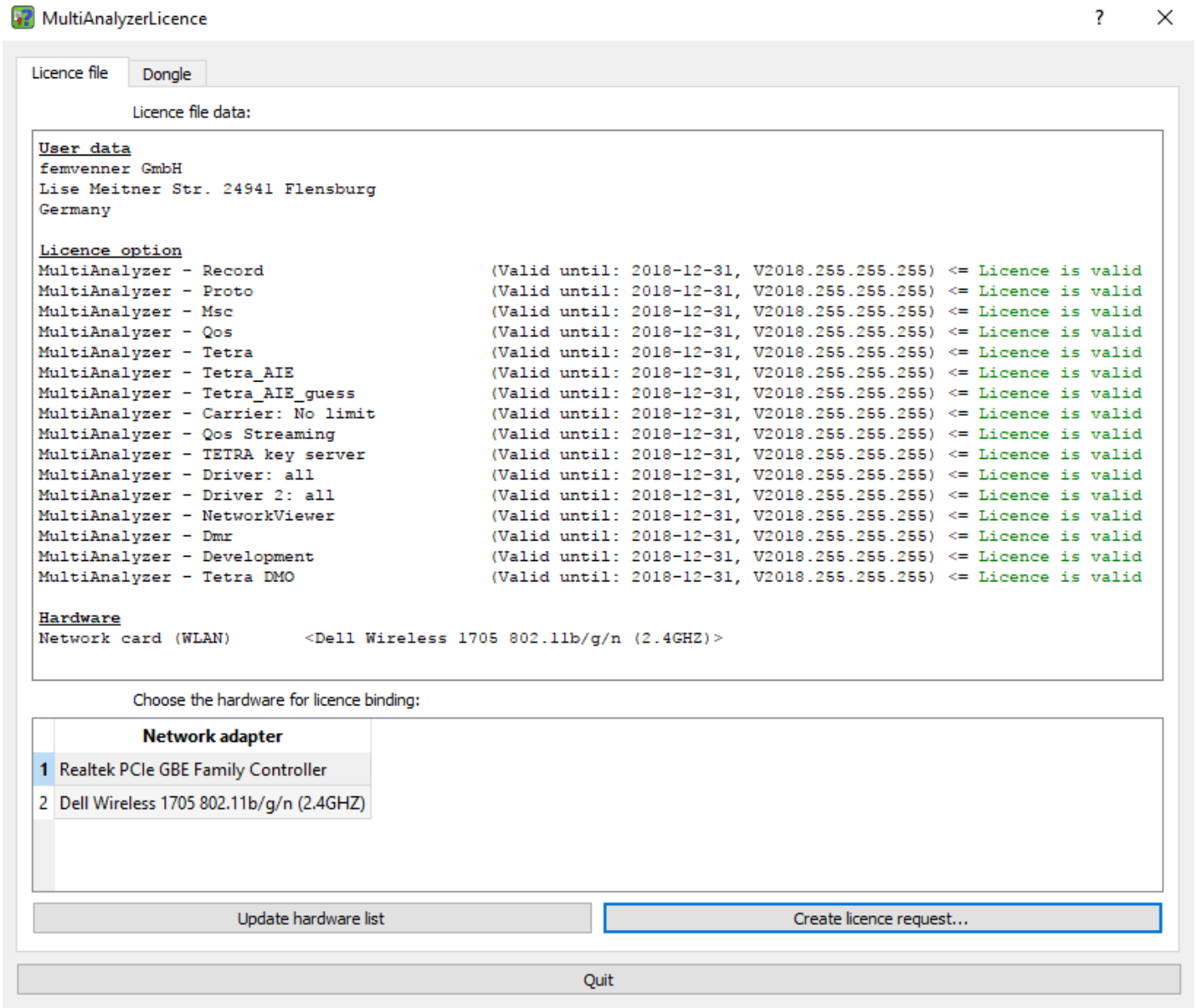

Illustration 7 MultiAnalyzerLicence: Licence File Info

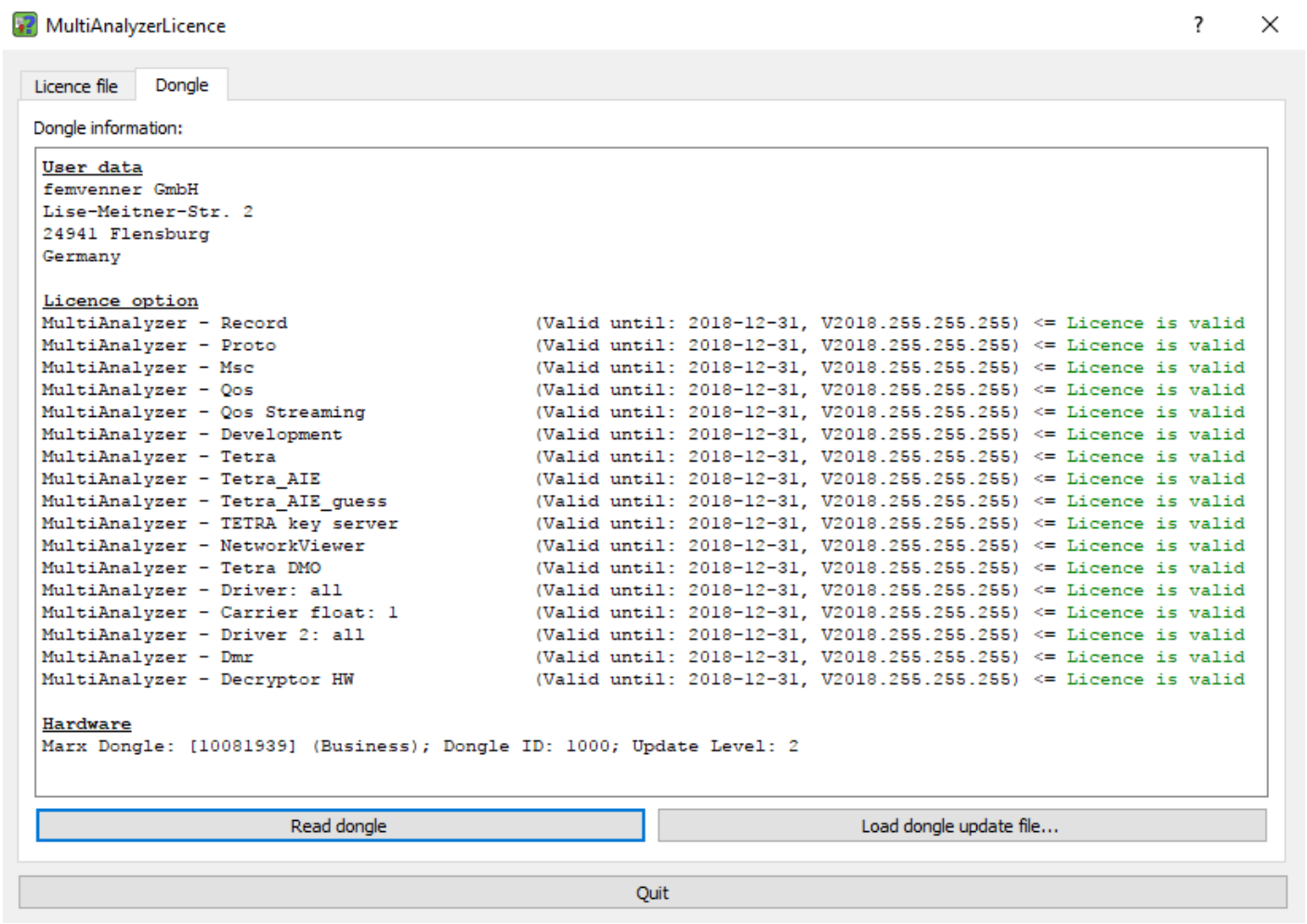

Illustration 8 MultiAnalyzerLicence: Dongle Info

4.3 CarrierManager

The **CarrierManager** is a programme bundle for administration of the carrier licenses. The bundle includes two components:

- **MultiAnalyzerLicenceServer**
  This programme is used to move carrier licenses from the pool to the client dongles, and vice versa. It needs the master dongle, to start the programme.
- **MultiAnalyzerLicenceClient**
  This programme is used to show and update the information of the client dongles,. The programme is also used to write the carrier licences, which are generated by the master dongle, to the client dongles,. The programme can only manage the client dongles,.

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4.3.1 MultiAnalyzerLicenceServer

The **MultiAnalyzerLicenceServer** maintains and distributes the pool of carrier licences.

This chapter provides an overview of the **MultiAnalyzerLicenceServer** interface and menus.

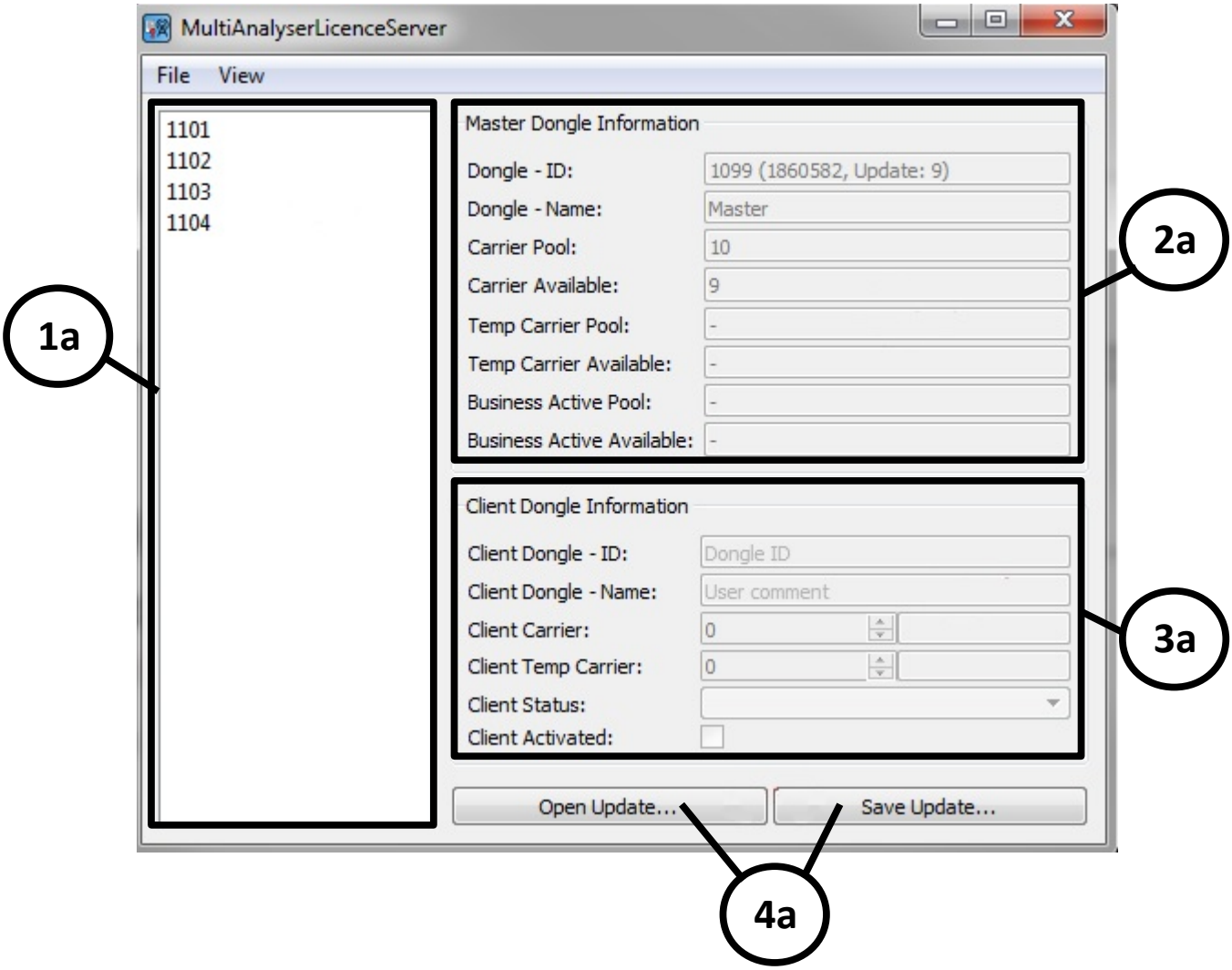

Illustration 9 MultiAnalyzerLicenceServer: Interface

No	Description
1a	List of all owned client dongles.
2a	Information about the master dongle.
3a	Information about a selected client dongle.
4a	Buttons to load and save update files.

Table 1 MultiAnalyzerLicenceServer: Interface

Master Dongle Information in Detail:

None of these information can be changed.

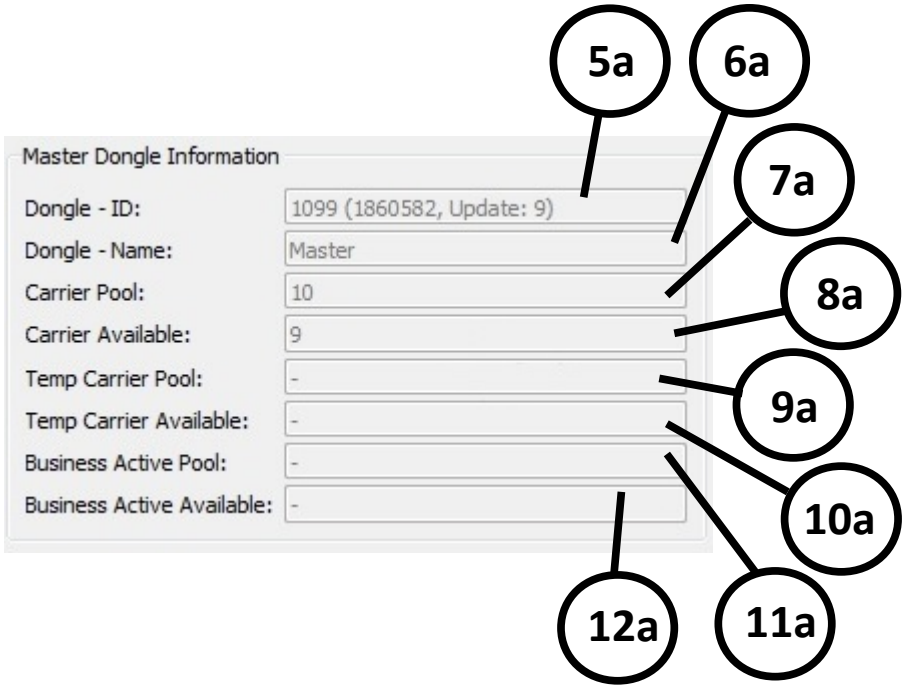

Illustration 10 MultiAnalyzerLicenceServer: Master Dongle Information Detail

No	Description
5a	ID of the connected master dongle.
6a	Name of the connected master dongle.
7a	Number of all owned carrier licences.
8a	Number of all available owned carrier licences, which can be handed out.
9a	Number of all owned temporary carrier licences.
10a	Number of all available owned temporary carrier licences, which can be handed out.
11a	Number of full licences (programme licence and carrier licence).
12a	Number of available full licences (programme licence and carrier licence), which can be handed out.

Table 2 MultiAnalyzerLicenceServer: Master Dongle Information Detail

Client Dongle Information in Detail:

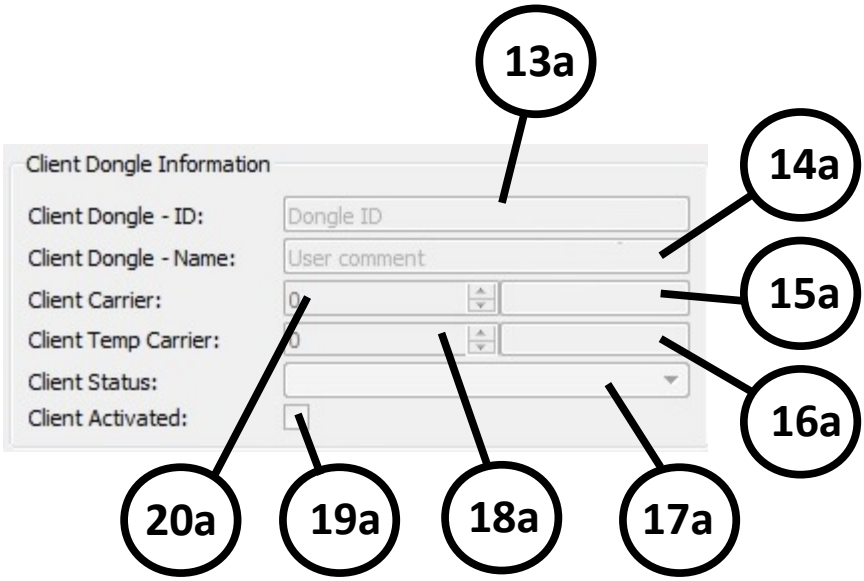

Illustration 11 MultiAnalyzerLicenceServer: Client Dongle Information Detail

No	Description
13a	ID of the client dongle.
14a	Name of the client dongle.
15a	Number of carrier licenses on the selected client dongle.
16a	Number of temporary carrier licenses on the selected client dongle.
17a	Status of the selected client dongle. (OK, Broken, Destroyed, Lost, Stolen).
18a	Number of temporary carrier licenses which the selected client dongle. gets with an update.
19a	Checkbox to indicate whether a full licence is or is not activated on that dongle.
20a	Number of carrier licenses which the selected client dongle. gets with an update.

Table 3 MultiAnalyzerLicenceServer: Client Dongle Information Detail

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Menu ‘File’

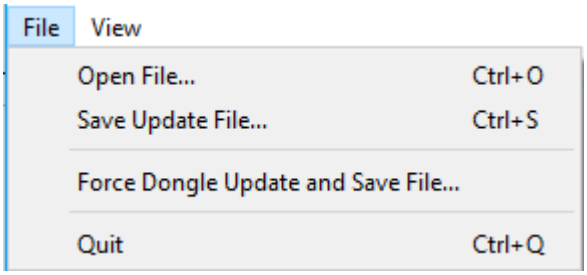


Illustration 12 MultiAnalyzerLicenceServer: Menu ‘File’

Name	Key Combination	Description
Open File...	Ctrl+O	Open the update file.
Save Update File...	Ctrl+S	Save the update file.
Force Dongle Update and Save File...	none	Force the **MultiAnalyzerLicenceClient** to write the dongle‘s data into the selected dongle‘. ⓘ Use only if the normal update does not work.
Quit	Ctrl+Q	Quit the programme.

Table 4 MultiAnalyzerLicenceServer: Menu ‘File’

Menu ‘View’

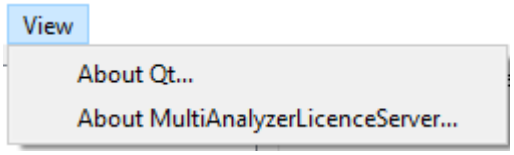


Illustration 13 MultiAnalyzerLicenceServer: Menu ‘View’

Name	Description
About Qt...	Show information about the used tool set.
About MultiAnalyzerLicenceServer...	Show information about the **MultiAnalyzerLicenceServer** themselves.

Table 5 MultiAnalyzerLicenceServer: Menu ‘View’

4.3.2 MultiAnalyzerLicenceClient

The **MultiAnalzyerLicenceClient** is used to update the carrier licences that are provided by **MultiAnalyzerLicenceServer**.

This chapter provides an overview of the **MultiAnalyzerLicenceClient** interface and menus.

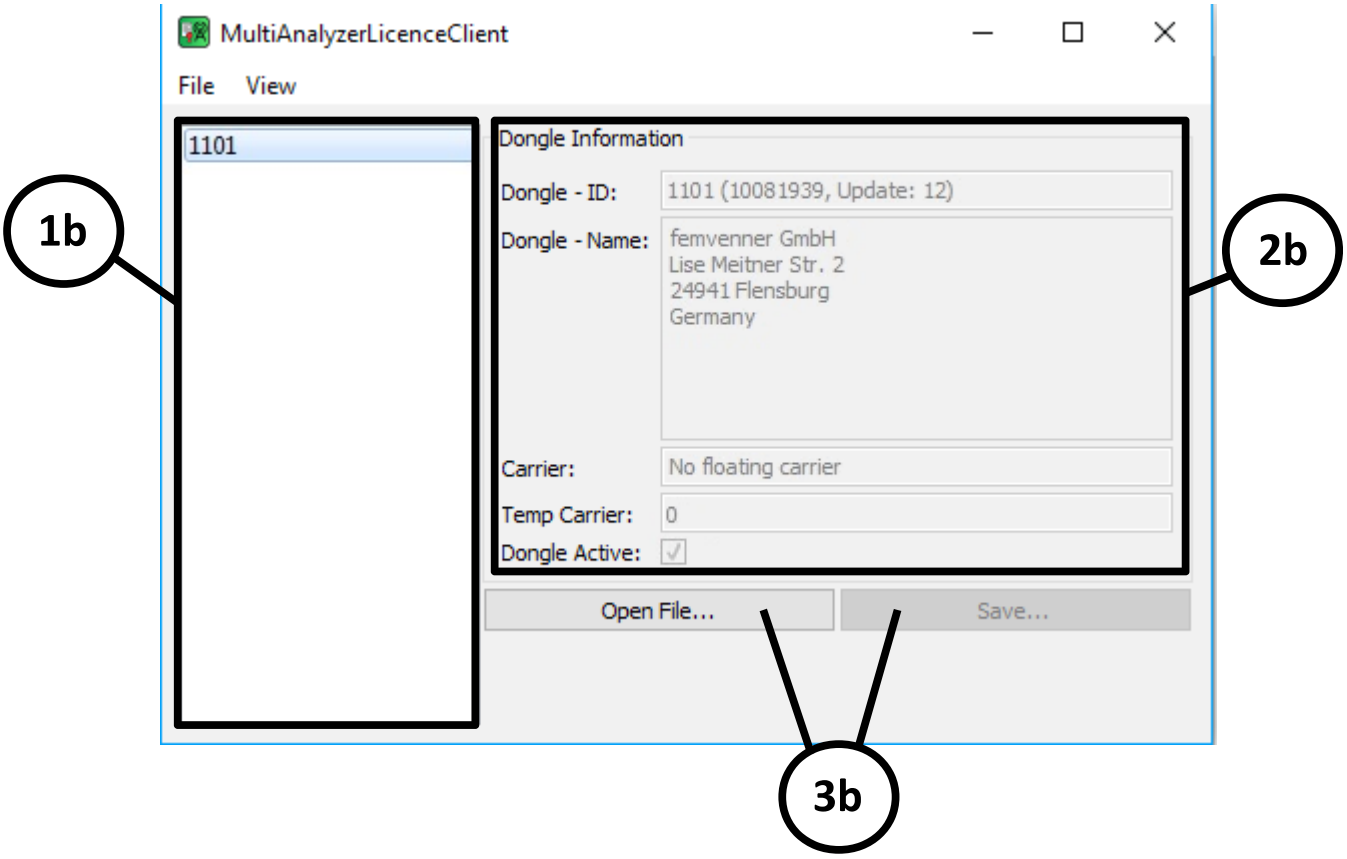


Illustration 14 MultiAnalyzerLicenceClient: Interface

No	Description
1b	List of all connected client dongles.
2b	Section with the information about the selected dongle.
3b	Buttons to load and save update files.

Table 6 MultiAnalyzerLicenceClient: Interface

Dongle Information in Detail:

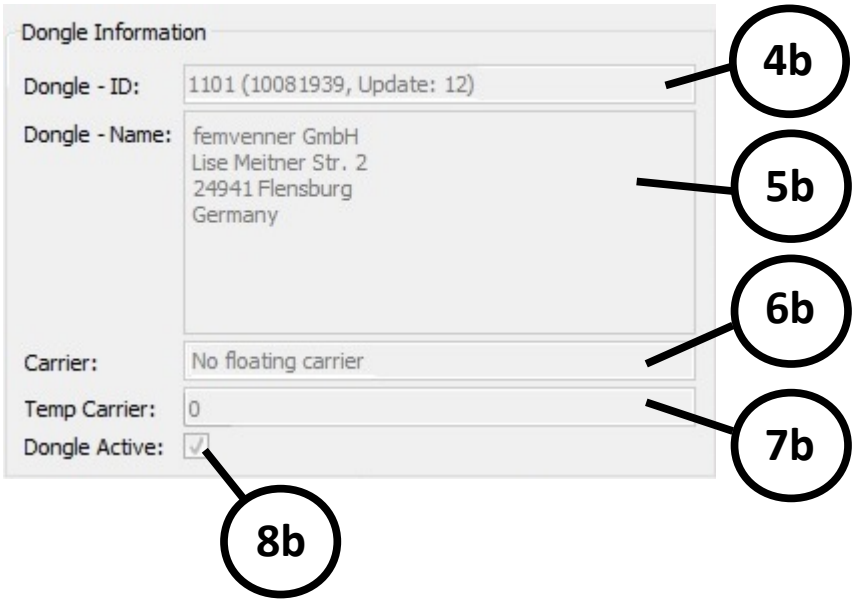


Illustration 15 MultiAnalyzerLicenceClient: Dongle Information Detail

No	Description
4b	ID of the selected dongle.
5b	Name of the selected dongle.
6b	Number of carrier licences of the selected dongle.
7b	Number of temporary carrier licences of the selected dongle.
8b	Checkbox to indicate whether a full licence is or is not activated on this dongle.

Table 7 MultiAnalyzerLicenceClient: Dongle Information Detail

Menu ‘File’

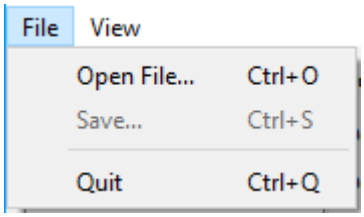


Illustration 16 MultiAnalyzerLicenceClient: Menu ‘File’

Name	Key Combination	Description
Open File...	Ctrl+O	Open the update file.
Save...	Ctrl+S	Save the update file.
Quit	Ctrl+Q	Quit the programme.

Table 8 MultiAnalyzerLicenceClient: Menu ‘File’

Menu ‘View’

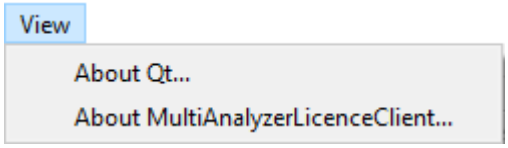


Illustration 17 MultiAnalyzerLicenceClient: Menu ‘View’

Name	Description
About Qt...	Show information about the used tool set.
About MultiAnalyzerLicenceClient...	Show information about the **MultiAnalyzerLicenceClient** themselves.

Table 9 MultiAnalyzerLicenceClient: Menu ‘View’

4.3.3 Transferring the Carrier Licences to a Client Dongle

The licences that are provided on a master dongle, can be transferred to or removed from the client dongle.

To change the carrier licence of a client dongle, , follow the next steps.

➔ **MultiAnalyzerLicenceServer** is running.

➔ A master dongle, is present and connected to the PC.

➔ A client dongle, is present and connected to the PC.

> **NOTICE**
>
> Programme works only with the master dongle, !
>
> The programme can only be started if the master dongle, is connected. Ensure that the right dongle, is connected to the PC.

1. Allocate the carrier licences to the client dongle, in the software (see 18).

ⓘ In this example 2 carrier licences are moved from the pool to the dongle, of number 1000.

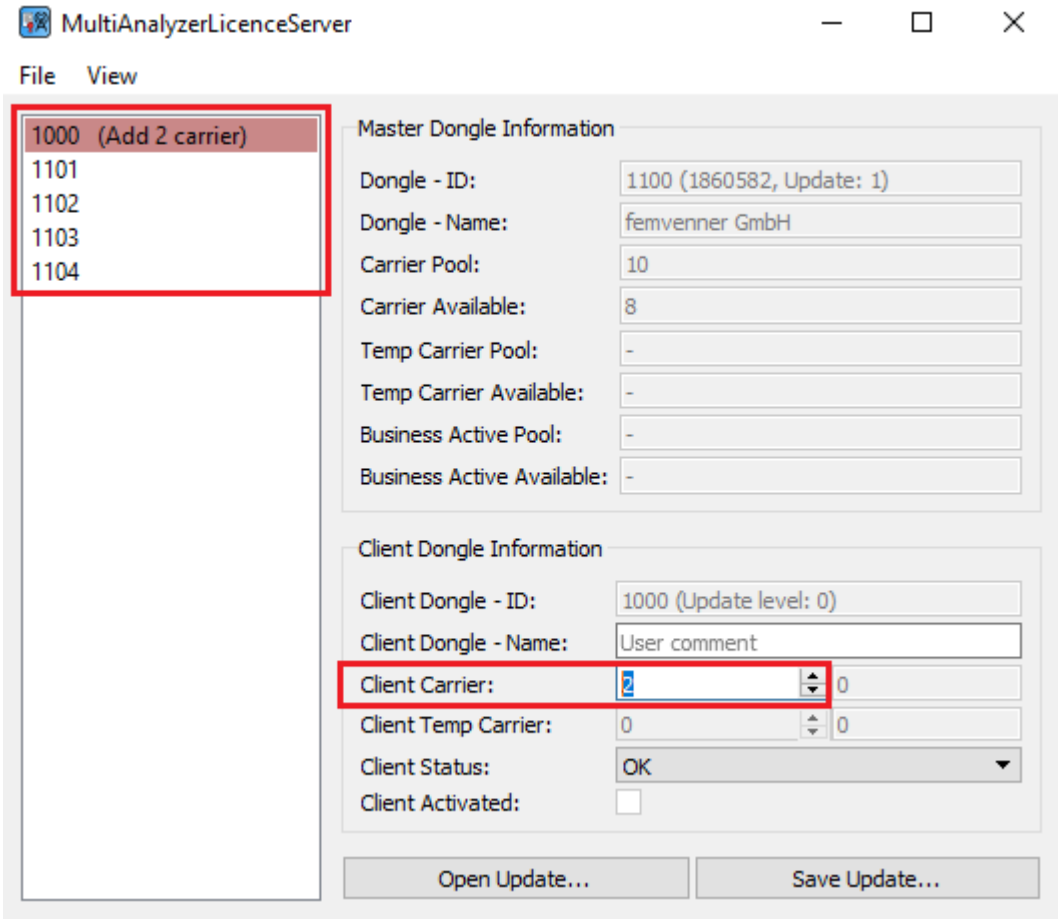


Illustration 18 MultiAnalzyerLicenceServer: Allocate Carrier

2. To generate the update file for the carrier licence, click on the button [Save Update…] (see 19).

Illustration 19 MultiAnalyzerLicenceServer: Save Update File

✔ The update file is generated.

✔ The save dialogue opens to save the update file (see 20).

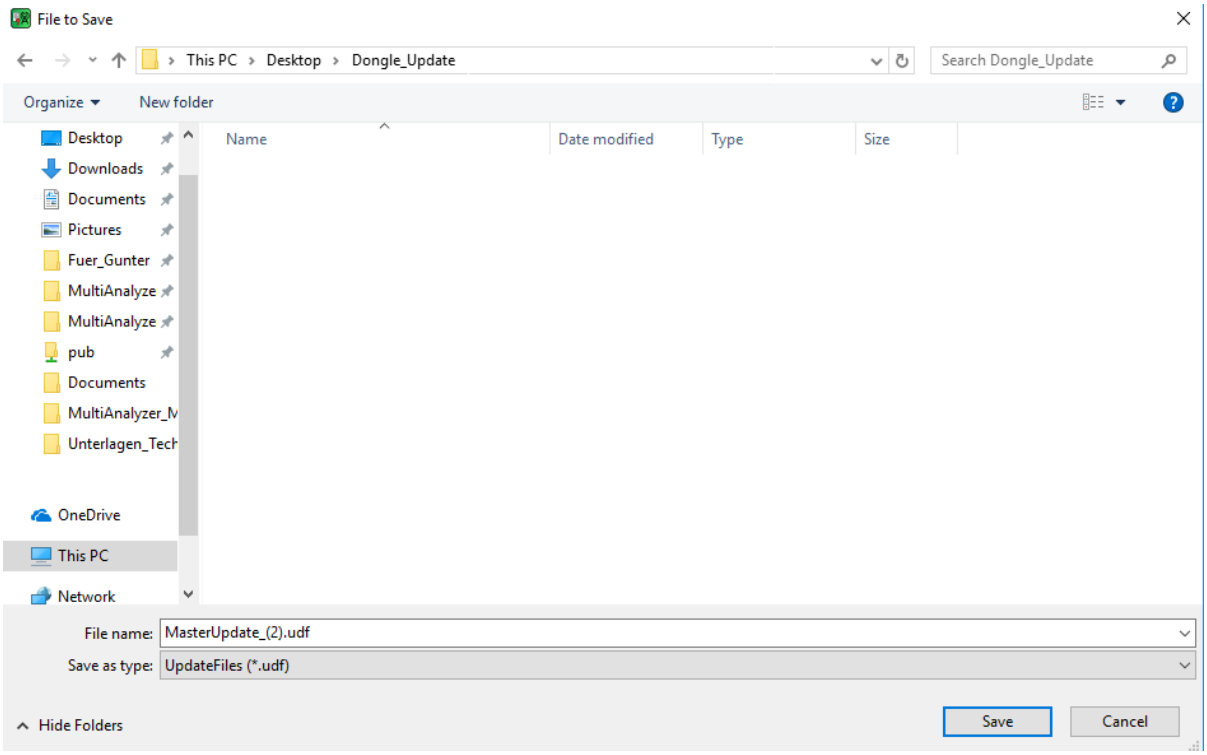


Illustration 20 MultiAnalyzerLicenceServer: File To Save

3. To save the update file, choose the storage path and click on the button [Save].

✔ The colour of the currently used client dongle، is changed (see 21).

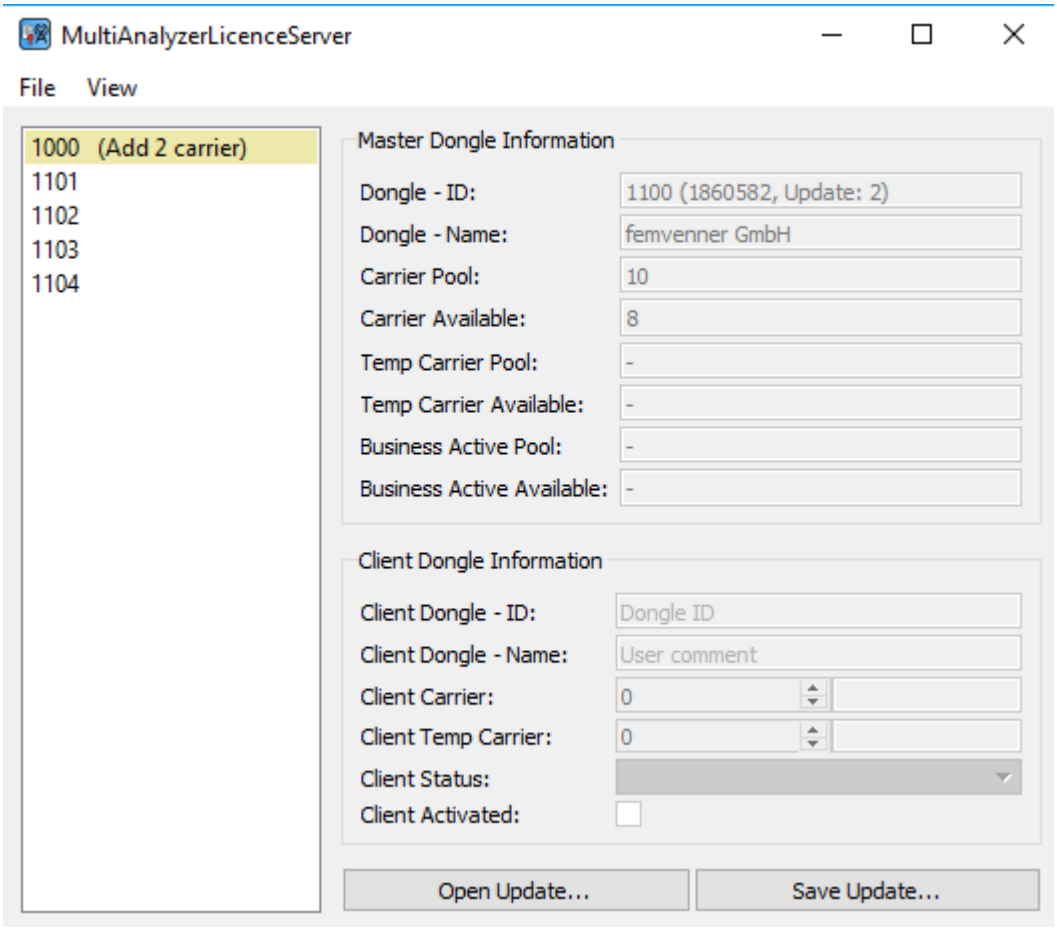


Illustration 21 MultiAnalyzerLicenceServer: Colour Change

4. Open the programme **MultiAnalyzerLicenceClient**.
5. To open the update file for the carrier licence, that was saved in Step 3., click on the button [Open File…] (see 22).

Illustration 22 MultiAnalyzerLicenceClient: Open File

✔ A selection dialogue opens to select the update file (see 23).

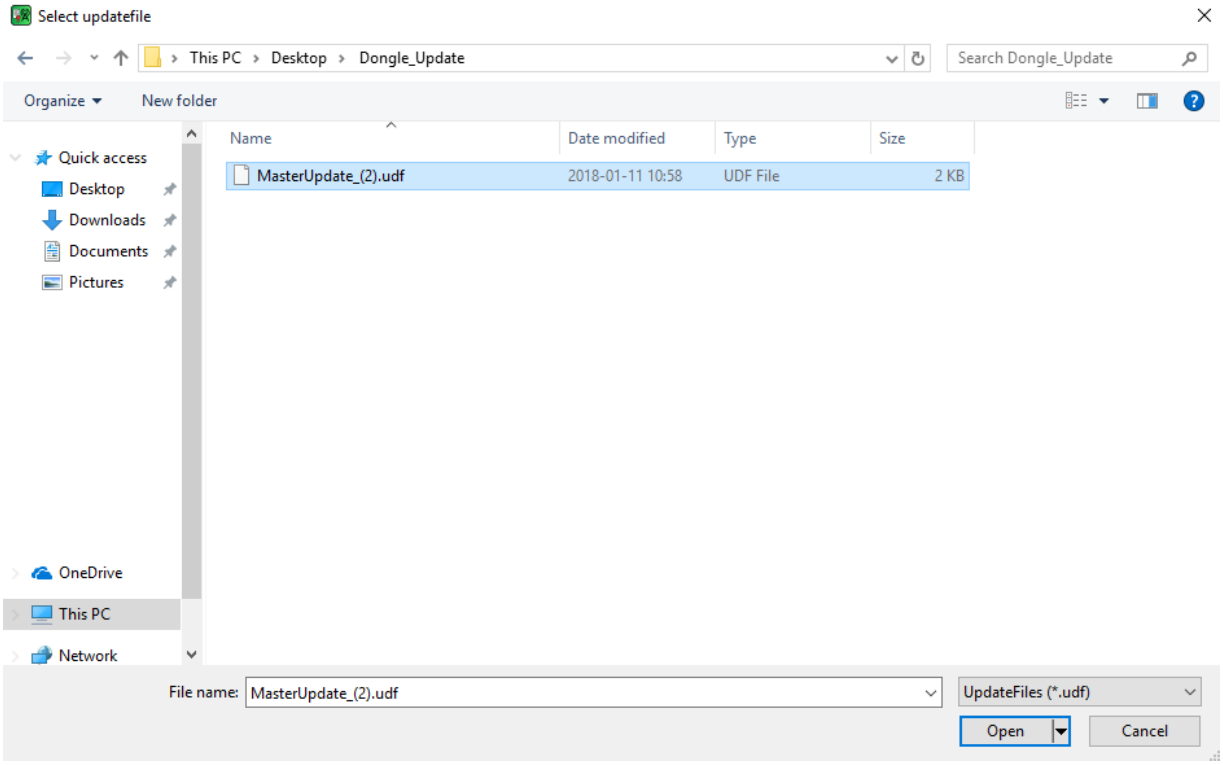


Illustration 23 MultiAnalyzerLicenceClient: Select Update File

6. To open the update file, choose the file and click on the button [Open].

✔ A dialogue opens to inform about the update status (see 24).

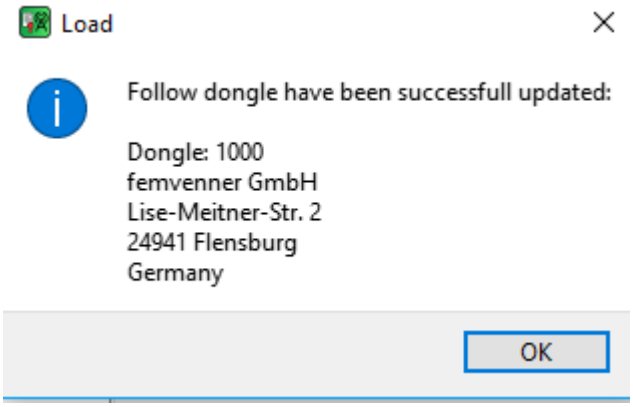


Illustration 24 MultiAnalyzerLicenceClient: Update Status

7. Click on the button [OK].

✔ A dialogue opens to inform about the next steps (see 25).

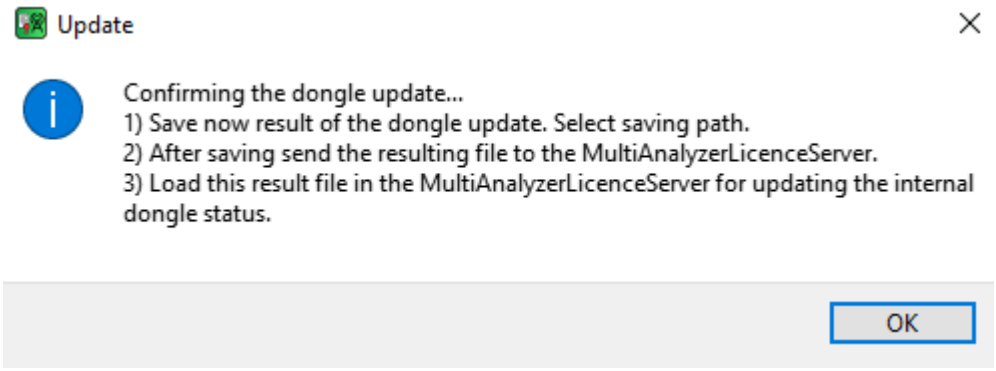


Illustration 25 MultiAnalyzerLicenceClient: Dongle Update Response

8. Click on the button [OK].

✔ A save dialogue opens to save the response file (see 26).

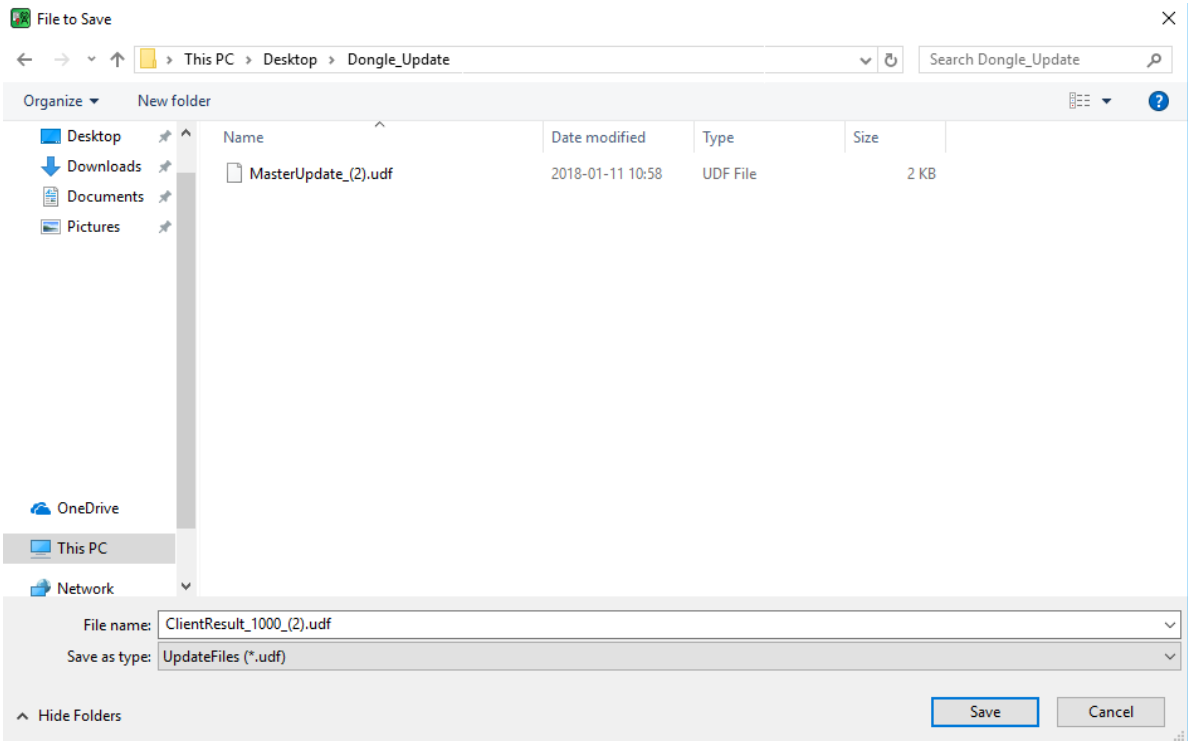


Illustration 26 MultiAnalyzerLicenceClient: File To Save

9. To save the response file, choose the storage path and click on the button [Save].

✔ The dialogue indicates that the dongle، owns 2 carrier (see 27).

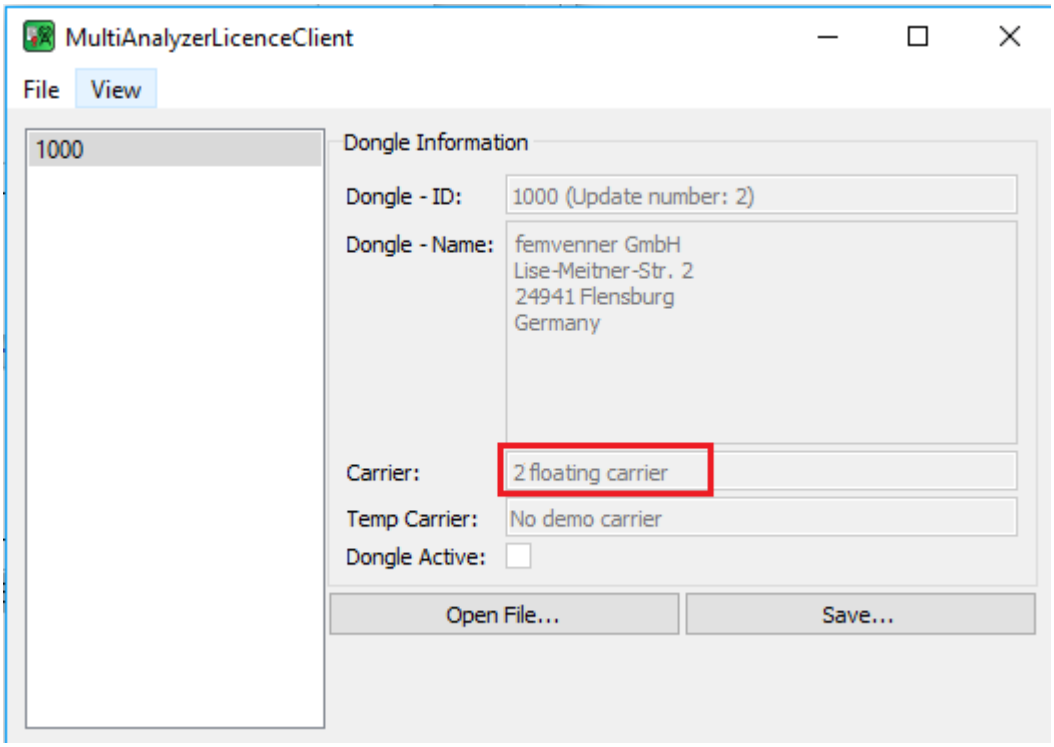


Illustration 27 MultiAnalyzerLicenceClient: Floating-Carrier

10. Re-open the programme **MultiAnalyzerLicenceServer**.

11. To open the response file, that was saved in Step 9., click on the button [Open Update…] (see 28).

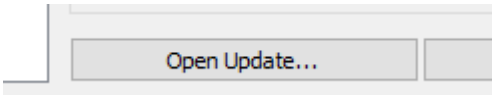


Illustration 28 MultiAnalyzerLicenceServer: Open Update File

✔ A selection dialogue opens to select the response file (see 29).

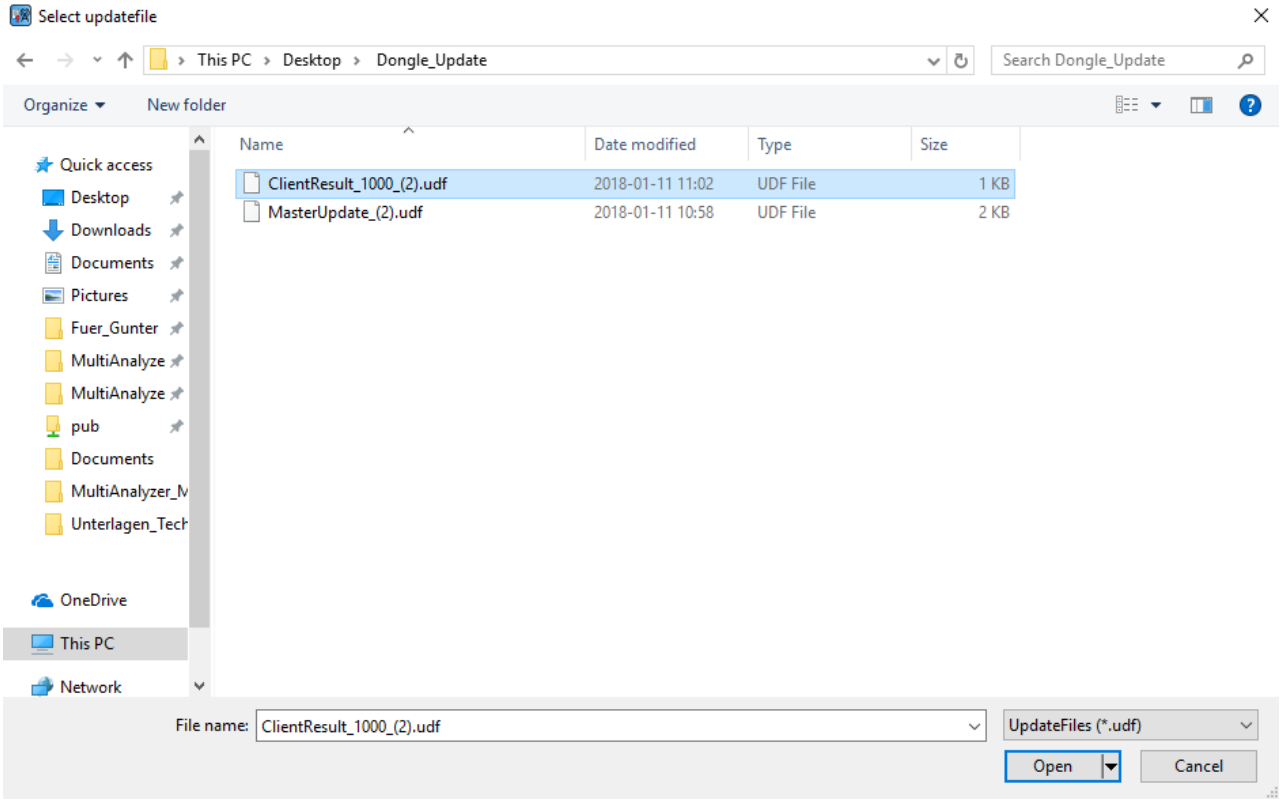


Illustration 29 MultiAnalyzerLicenceServer: Select Response File

12. To open the response file, choose the file and click on the button [Open].

✔ If the response file is loaded, the programme shows (in this example) that the dongle‚ 1000 owns 2 carrier licenses and 8 carrier licenses are still available (see 30).

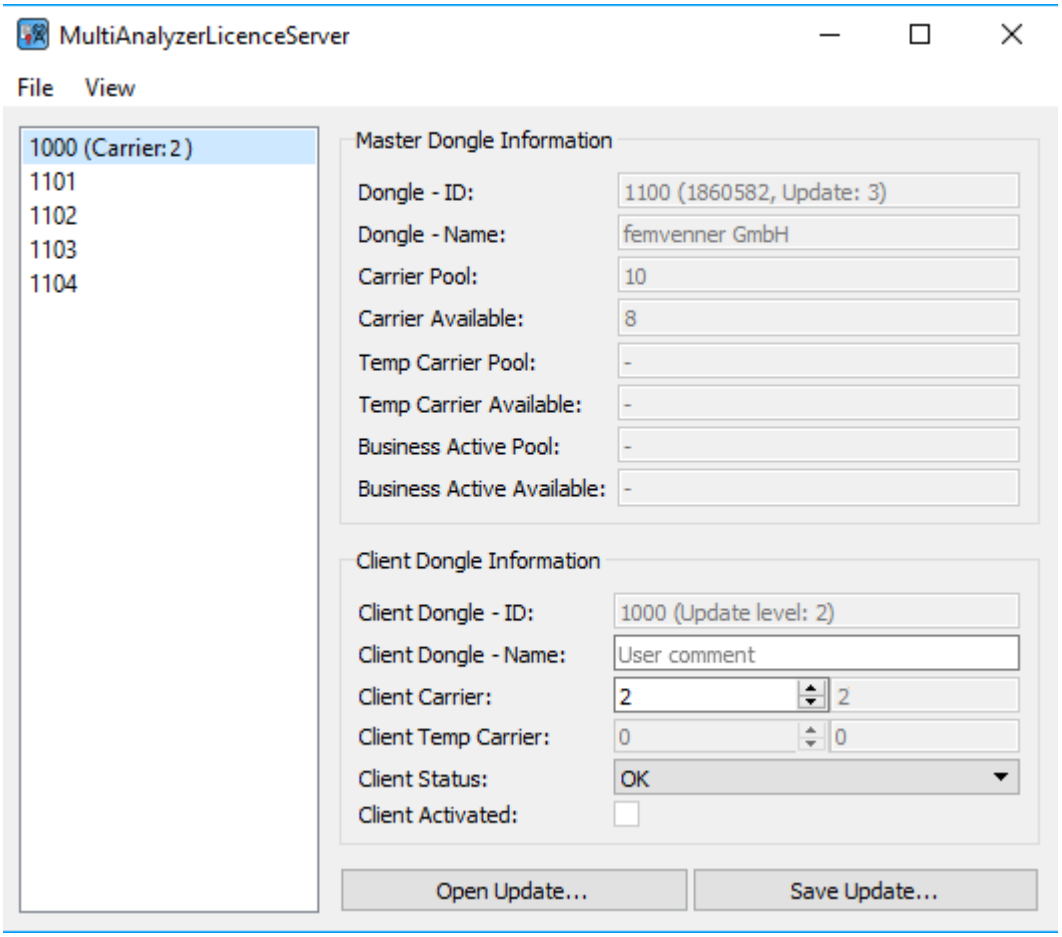


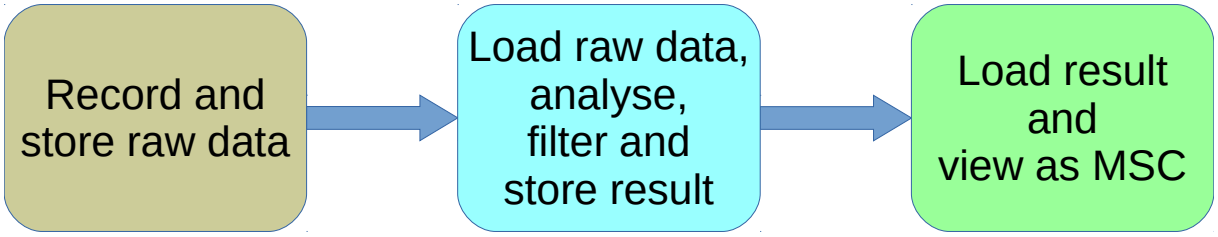
Illustration 30 MultiAnalyzerLicenceServer: Licences Changed

✔ The carrier licences are transferred to the client dongle‚.

ⓘ To view the licence options of the dongle, see chapter 4.2 Licence Options.

5 Record and View Protocol Data

Three components are used to record and watch protocol data.



The GUI programme **MultiAnalyzer** (see chapter 5.1 MultiAnalyzer) or the command line programme **MultiAnalyzerRecord** (see chapter 5.3 MultiAnaylzerRecord) are used to record and store protocol data.

The programmes can handle different drivers for recording devices. These devices can be different receiving hardware or virtual devices e. g. network TMW recording. The recorded data is processed according to the device and protocol type (physical layer, forward error correction, converted). The programmes save the recorded data as not analysed raw data.

The **MultiAnalyzerProto** is used to load the raw data and to analyse the protocol. The **MultiAnalyzerProto** filters redundant data and stores the important data as a human readable text file.

The **MultiAnalyzerMsc** (see chapter 5.6 MultiAnalyzerMsc) is used to load the text file (*.txt) or the record file. The data are prepared in the **MultiAnalyzerMsc** to graphically present the data in a message sequence chart.

Any recorded and stored raw file can be reloaded with the **MultiAnalyzerProto** at a later date.

To present the record file as diagrams, charts or lists, the file can be loaded into the **MultiAnalyzerQoS** (see chapter 5.7 MultiAnalyzerQoS).

5.1 MultiAnalyzer

The **MultiAnalyzer** is the GUI programme to start/stop records and to save the protocol data.

This chapter provides an overview of the different sections, the settings and the menus of the **MultiAnalyzer**.

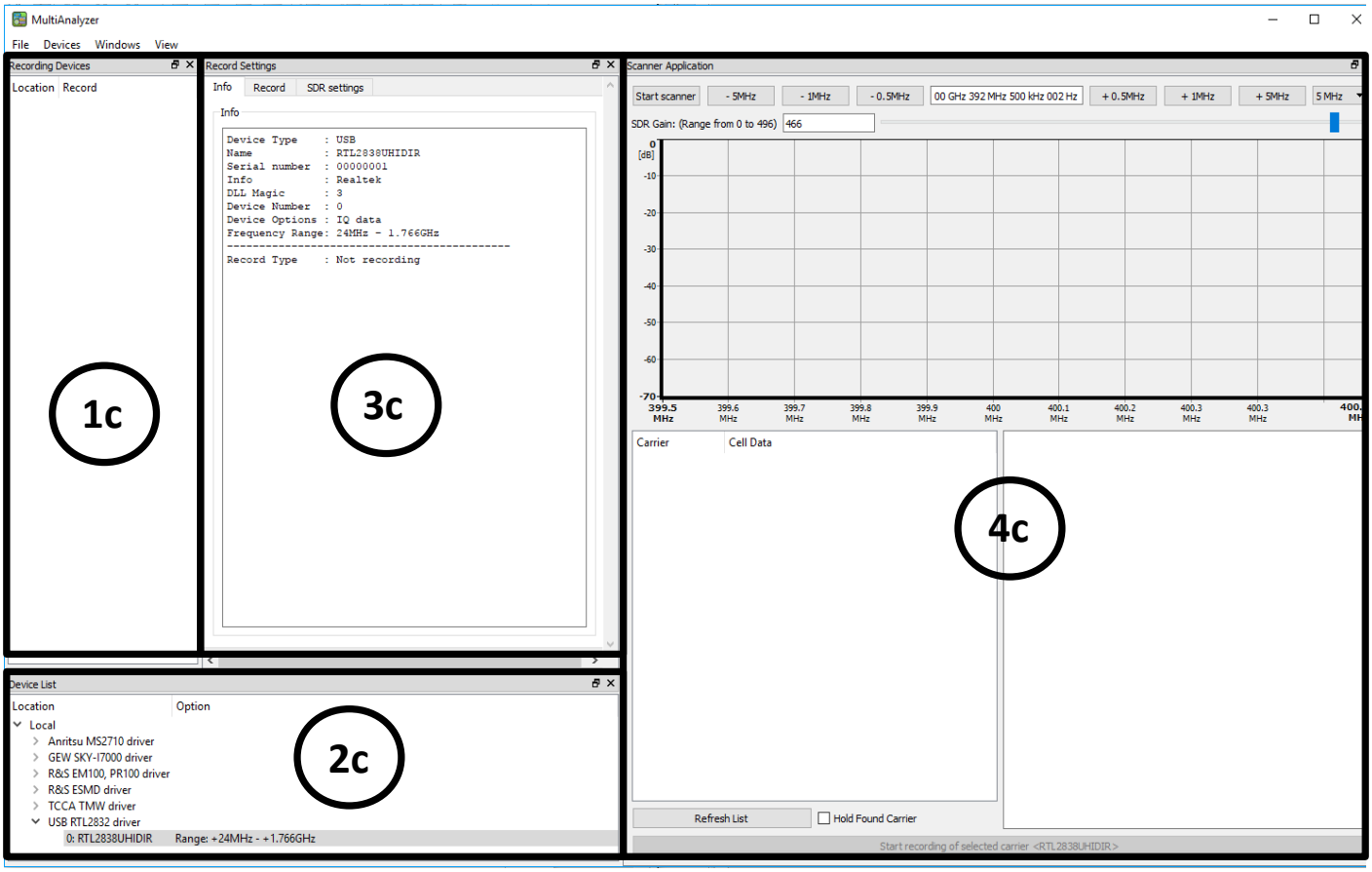


Illustration 31 MultiAnalyzer: Interface

No	Description
1c	List with all used drivers and devices.
2c	List with all unused drivers and devices (sorted by location, driver and device).
3c	Section with different pages that provide configuration information, record settings, and SDR، settings.
4c	The Scanner Application (see chapter 5.2 Scanner Application)

Table 10 MultiAnalyzer: Interface

The section **3c** includes, depending on the selected SDR‹, the current record state (idle or recording), and the SDR‹-driver type, the following tab pages:

Info	Provides the SDR‹ configuration information and the recording status (see chapter 5.1.1 Record Settings – Info).
Record	Provides the record settings like record type, frequency, and start/stop recording (see chapter 5.1.2 Record Settings – Record).
SDR Settings	Provides special SDR‹ settings like gain level or frequency adjustment (see chapter 5.1.3 Record Settings – SDR Settings).
Channel Info	Provides options to set the gain level during a record, the view of the recorded channel spectrum, and the possibilities to graphically present the current record in other programmes (see chapter 5.2.3 Record Settings – Channel Info).
Scanner	Will be available in a future version to provide an overview of the frequency spectrum.

Table 11 MultiAnalyzer: Record Settings

Menu ‘File’

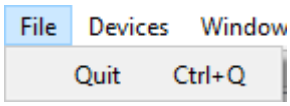


Illustration 32 MultiAnalyzer: Menu ‘File’

Name	Key Combination	Description
Quit	Ctrl+Q	Quit the programme.

Table 12 MultiAnalyzer: Menu ‘File’

Menu ‘Devices’

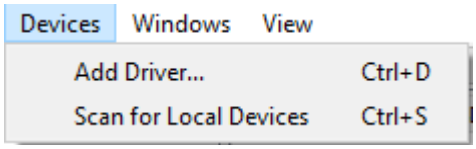


Illustration 33 MultiAnalyzer: Menu ‘Devices’

Name	Key Combination	Description
Add Driver…	Ctrl+D	Add a device or protocol driver DLL.
Scan for Local Devices	Ctrl+S	Rescan for new hardware devices that are connected to the PC.

Table 13 MultiAnalyzer: Menu ‘Devices’

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Menu ‘Windows’

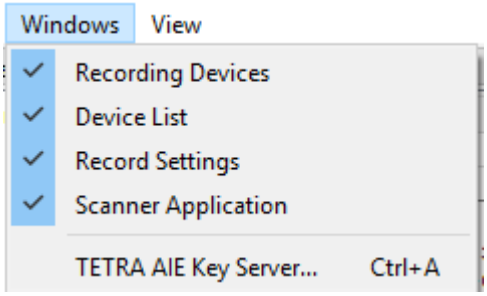

Illustration 34 MultiAnalyzer: Menu ‘Windows’

Name	Description
Recording Devices	Show or hide the window with the recording devices. The window contains all used drivers and devices.
Device List	Show or hide the window with the different devices. The window contains all unused drivers and devices.
Record Settings	Show or hide the window with the record settings. This section contains the tab pages to start or stop recording, change settings, and monitor physical recording. For more information see chapters: • 5.1.1 Record Settings – Info • 5.1.2 Record Settings – Record • 5.1.3 Record Settings – SDR Settings • 5.2.3 Record Settings – Channel Info
Scanner Application	Find and identify carrier within a spectrum (see chapter 5.2 Scanner Application).

Table 14 MultiAnaylzer: Menu ‘Windows’

ⓘ TETRA, AIE, options are described in another document.

Menu ‘View’

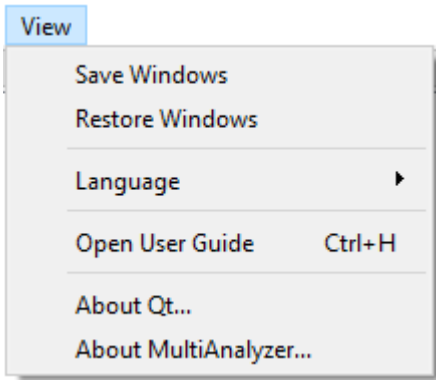

Illustration 35 MultiAnalyzer: Menu ‘View’

Name	Key Combination	Description
Save Windows	none	Save the current window positions. ⓘ At the next start this window positions are reused.
Restore Windows	none	Reuse formerly stored window positions.
Language	none	Change the interface language.
Open User Guide	Ctrl+H	Open the user manual.
About Qt...	none	Show information about the used tool set.
About MultiAnalyzer...	none	Show information about the **MultiAnalyzer** themselves.

Table 15 MultiAnalyzer: Menu ‘View’

5.1.1 Record Settings – Info

Depending on the recording state and the SDR، type, the tab page ‘Info’ shows different sets of data.

The following table provides an overview of these different data:

Idle SDR (IQ)	Recording SDR (IQ)
Info Device Type : USB Name : RTL2832U Serial Number : 77771111153705700 Info : Realtek DLL Magic : 1 Device Number : 0 Device Options : IQ data Frequency Range: 24MHz - 1.766GHz --- Record Type : Not recording *Illustration 36 MultiAnalyzer: Record Settings ‘Info’ Idle SDR (IQ)*	Info Device Type : USB Name : RTL2832U Serial Number : 77771111153705700 Info : Realtek DLL Magic : 1 Device Number : 0 Device Options : IQ data Frequency Range: 24MHz - 1.766GHz --- Record Type : Channel: 392.062500MHz TETRA-DL : 3682 +12.500kHz SDR gain : 236 Frequency shift: -16.700kHz Auto freq.shift: 0.622kHz *Illustration 37 MultiAnalyzer: Record Settings ‘Info’ Recording SDR (IQ)*
Idle SDR (TMW)	**Recording SDR (TMW)**
Info Device Type : STD Name : 1: TMW (UDP) DLL Magic : 7 Device Number : 0 Device Options : TMW(TETRA), TMW(DMR) --- Record Type : Not recording *Illustration 38 MultiAnalyzer: Record Settings ‘Info’ Idle SDR (TMW)*	Info Device Type : STD Name : 1: TMW (UDP) DLL Magic : 7 Device Number : 0 Device Options : TMW(TETRA), TMW(DMR) --- Record Type : Virtual UDP recording <0.0.0.0:9999> *Illustration 39 MultiAnalyzer: Record Settings ‘Info’ Recording SDR (TMW)*

Name	Description	
Device Type	Connection type: • USB: External device connected by USB • STD: Logical device	
Name	Name of the device.	
Serial Number	Serial number of the device.	
Info	Information about the producer.	
DLL Magic	Internal number of the driver DLL.	
Device Number	Number of the device in the driver DLL.	
Device Options	Kinds of data that can be recorded: • IQ data (record from air interface) • TETRA, TMW (record from UDP, interface: TCCA TTR 005-01)	
Frequency Range	Record range of the IQ SDR, frequency spectrum.	
Record Type	Channel	Recording IQ data which are analysed as channel, like TETRA,, etc.
	TETRA TMW	Recording virtual TMW data.
TETRA-DL/UL	The recording channel is of the type TETRA,.	
SDR gain	Gain level of the SDR, (numeral or AUTO for device-controlled).	
Frequency shift	Correction value for frequency calculation of the SDR,.	
Auto freq. shift	Auto correction of SDR, centre frequency, determined by average frequency error.	

Table 16 MultiAnalyzer: Record Settings 'Info' SDR (IQ and TMW)

Extra Functions-Buttons
 Illustration 40 MultiAnalyzer: Record Settings 'Info' Get device info As long from TCP/IP based device supported, the button "Get device info from <IP>" will viewed. Using the button causes a connection to the IP address and the device hardware-data is requested.

Table 17 MultiAnalyzer: Record Settings 'Info' Extra Functions Buttons

5.1.2 Record Settings – Record

Depending on the recording state and SDR‹ type, the tab page ‘Record’ shows different sets of data.

The following table provides an overview of these different data:

Idle SDR	Recording SDR
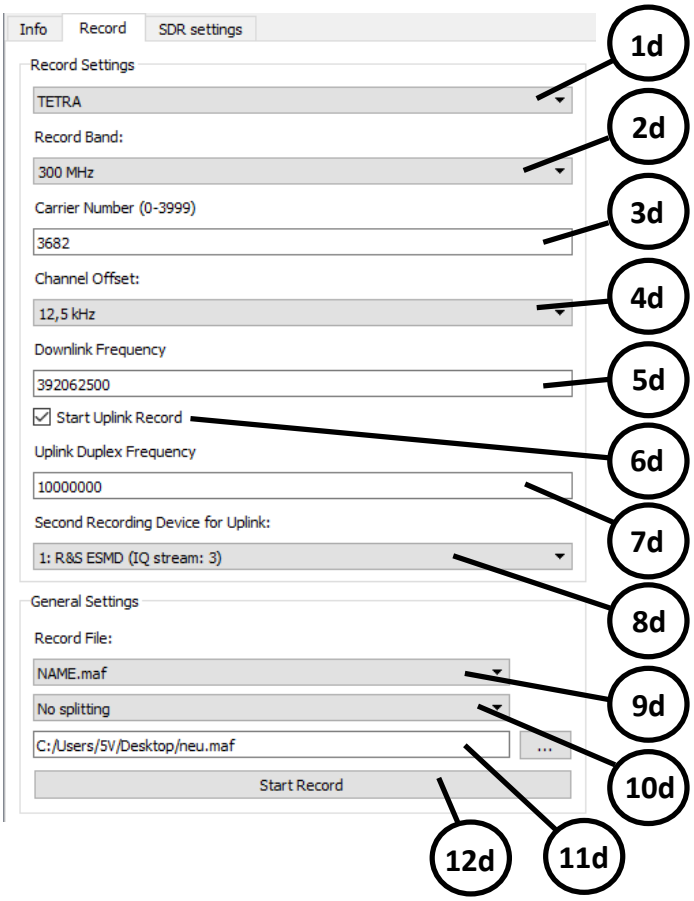	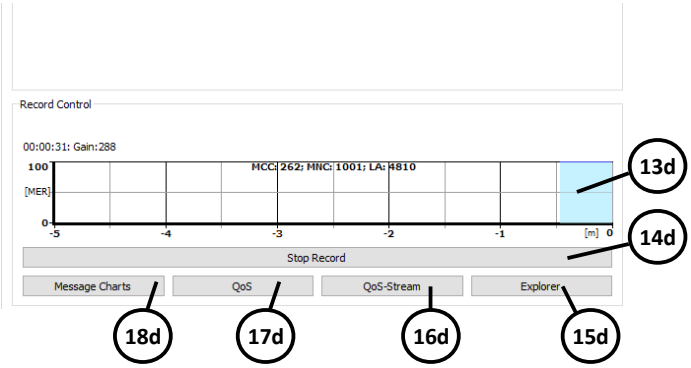
Illustration 41 MultiAnalyzer: Record Settings ‘Record’ (Idle SDR)	*Illustration 42 MultiAnalyzer: Record Settings ‘Record’ (Recording SDR)*

No	Description	No	Description
1d	Drop-down list to select the standard for recording (TETRA‹, DMR‹, TETRA‹-DMO‹).	**13d**	Downlink block error rate history from the last 5 minutes.
2d	Drop-down list to select the frequency band of the downlink carrier.	**14d**	Button to stop recording.
3d	Text field to choose the downlink channel number (0-3999).	**15d**	Button to open the explorer on the storage path level of the record file.
4d	Drop-down list to select the downlink channel frequency offset. The bandwidth of one channel is 25kHz.	**16d**	Button to start the **MultiAnalyzerQosServer** to stream QoS-data.

Idle SDR		Recording SDR	
	For DMR, use the Channel offset of 12,5kHz to align channel. (TETRA, channel 0 with Channel offset of 0kHz = DMR, channel 0 TETRA, channel 0 with Channel offset of 12,5kHz= DMR, channel 1 TETRA, channel 1 with Channel offset of 0kHz = DMR, channel 2)		
5d	Text field to directly set the frequency in Hz.	**17d**	Button to start the **MultiAnalyzerQoS**.
6d	Checkbox to enable uplink recording.	**18d**	Button to start the **MultiAnalyzerMsc** and to show the data as message sequence charts.
7d	Text field to set the duplex frequency in Hz (usually 10Mhz).		
8d	Drop-down list to select the second SDR, for uplink.		
9d	Drop-down list to select the auto name format.		
10d	Drop-down list to select a record file auto splitting option.		
11d	Text field to set the storage path of the record file.		
12d	Button to start the record.		

Table 18 MultiAnalyzer: Record Settings 'Record' (Idle and Recording)

Idle SDR (TMW)	Recording SDR (TMW)
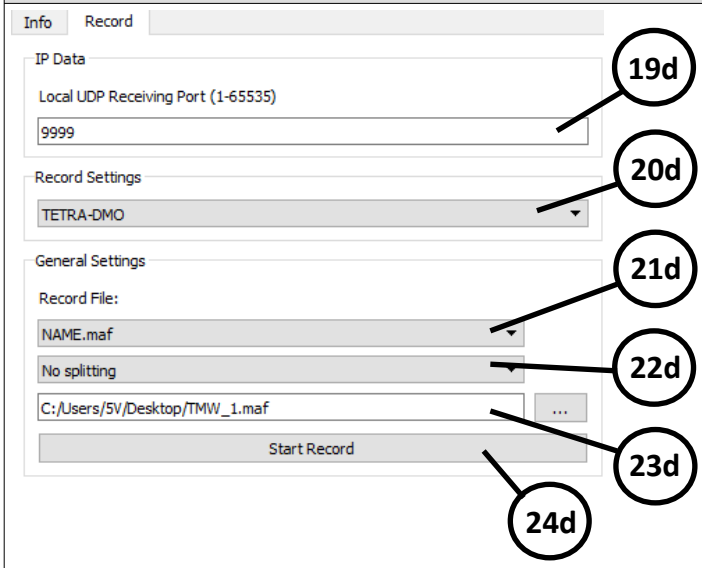	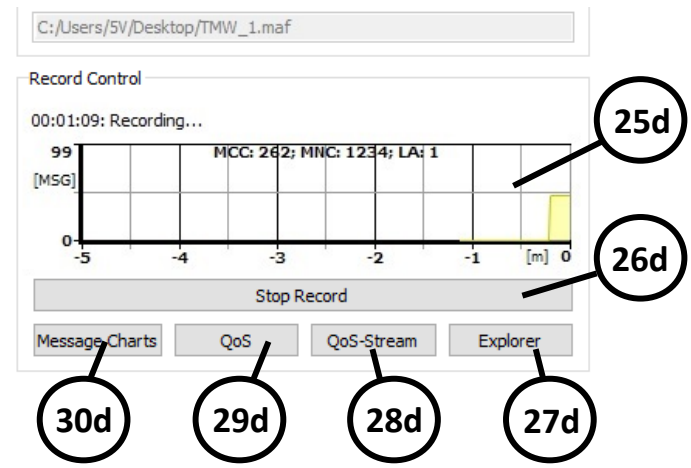
Illustration 43 MultiAnalyzer: IP Data (Idle SDR)	*Illustration 44 MultiAnalyzer: IP Data (Recording SDR)*

No	Description	No	Description
19d	Text field to set the receiving UDP‹ port for TMW data.	**25d**	Number of received message (0-144) history of the last 5 minutes.
20d	Drop-down list to select the standard for recording (TETRA‹, DMR‹, TETRA-DMO‹).	**26d**	Button to stop the record.
21d	Drop-down list to select the auto name format.	**27d**	Button to open the explorer on the storage path level of the record file.
22d	Drop-down list to select a record file auto splitting option.	**28d**	Button to start the **MultiAnalyzerQosServer** to stream QoS-data.
23d	Text field to set the storage path of the record file.	**29d**	Button to start the **MultiAnalyzerQoS**.
24d	Button to start the record.	**30d**	Button to start the **MultiAnalyzerMsc** and to show the data as message sequence charts.

Table 19 MultiAnalyzer: IP Data (Idle and Recording)

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5.1.3 Record Settings – SDR Settings

The SDR‹ settings page provides SDR‹ specific settings. These settings are also valid for starting a scan via the Scanner Application (see chapter 5.2.1 Starting a Scan).

This chapter provides an overview of the SDR‹ settings.

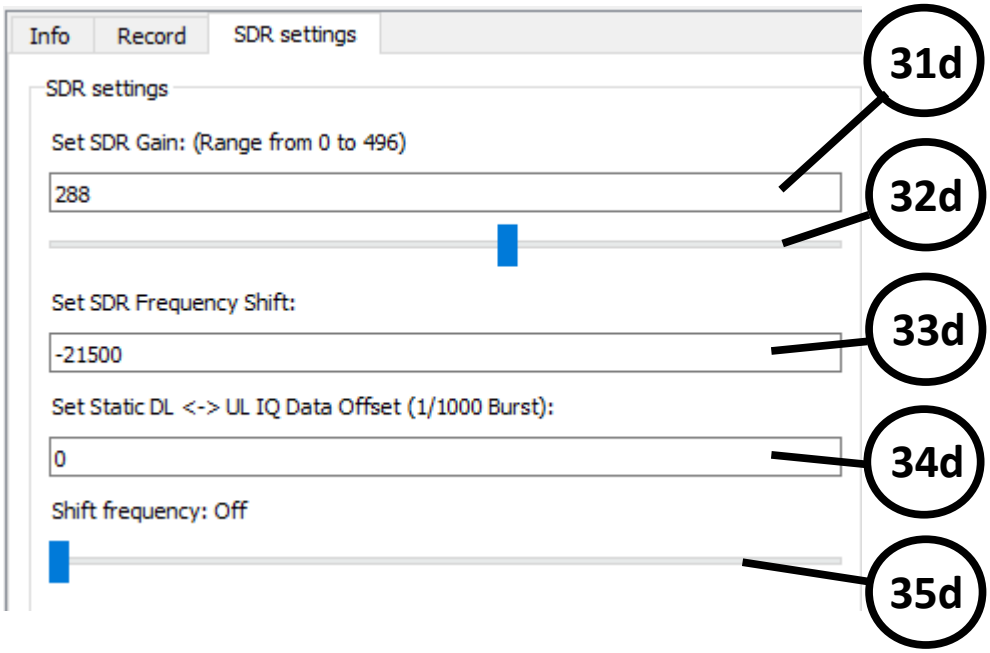

Illustration 45 MultiAnalyzer: Record Settings 'SDR settings'

No	Description
31d	Text field to set the gain level of the SDR‹. ⓘ For a RTL-SDR the value is in tenth. For example, 20,6 is 206.
32d	Slider to set the gain level of the SDR‹.
33d	Text field to correct a systemic frequency offset of the SDR‹. ⓘ SDRs‹ that are not adjusted in frequency, may have a systemic frequency offset. The given value in Hz is used to correct this offset.
34d	Text field to set the static downlink uplink IQ data offset (see chapter The Static Downlink and Uplink Data Offset).
35d	Slider to set the shift frequency between 'On', 'Off' and '500000'.

Table 20 MultiAnalyzer: Record Settings 'SDR settings'

The Static Downlink and Uplink Data Offset

Downlink and uplink are synchronised transmitted at the air interface. If two different kinds of devices are used for downlink and uplink measurements, the IQ data streams are asynchronously delivered from the devices to the PC. So, the IQ data stream of device A has a static offset to device B (see 46):

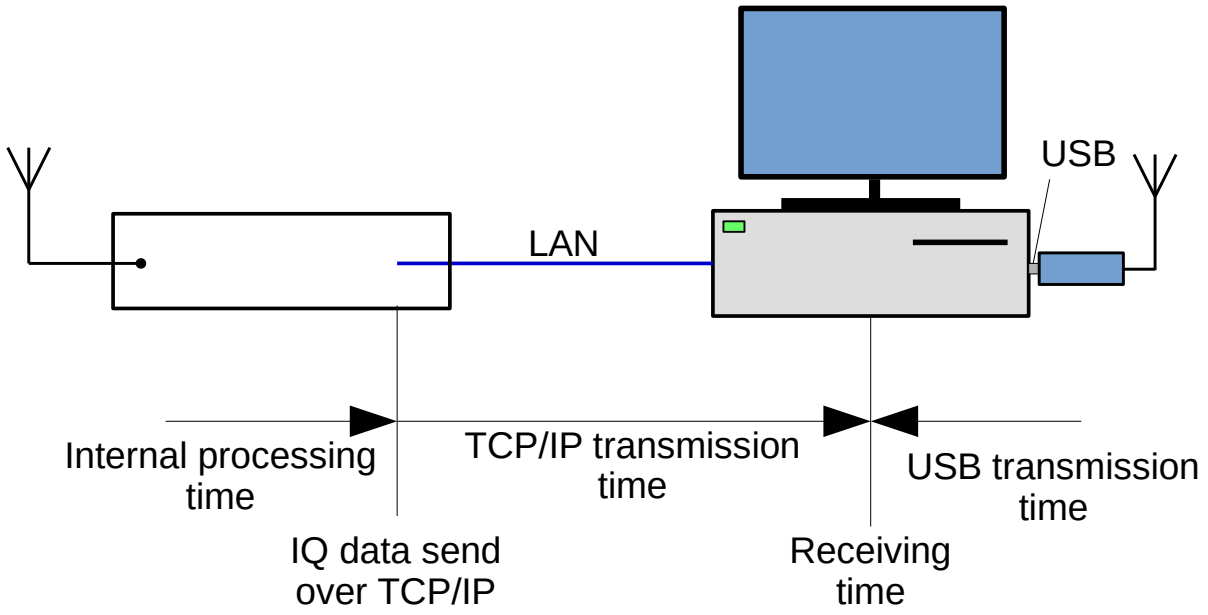

Illustration 46 Downlink Uplink Data Offset

This offset is caused by the internal receiving process of the IQ data and the delivery time at the transmission path. The software requires the static offset to be able to synchronise the uplink and the downlink. The offset value is set in the downlink SDR‹. The uplink value has no effect.

Values for known configurations are shown in the following table:

Configuration		No
Downlink	**Uplink**	
USB RTL2832U	USB RTL2832U	0
R&S EM100	USB RTL2832U	0
USB RTL2832U	R&S EM100	0
AirSpy	R&S EM100	0
R&S EM100	AirSpy	0
AirSpy	USB RTL2832U	0
USB RTL2832U	AirSpy	0

Table 21 Static Offset Values

5.2 Scanner Application

The Scanner Application scans the frequency spectrum, displays the spectrum and identifies carrier of supported standards, like TETRA, and DMR,.

Depending on whether the scanner application is idle or scanning, the programme shows different information.

This chapter provides an overview of the different Scanner Application interfaces.

Scanner Application (Idle)

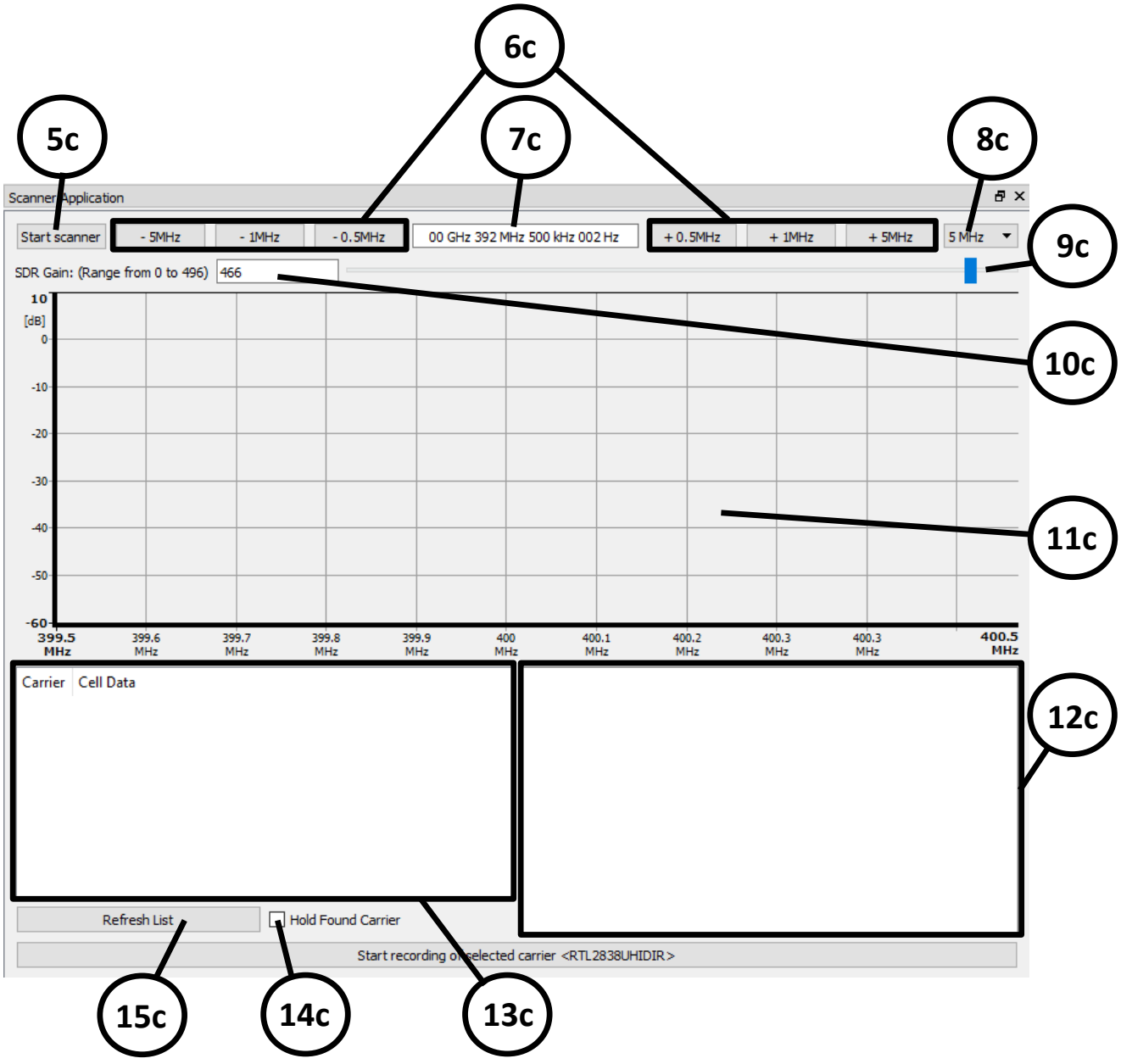

Illustration 47 MultiAnalyzer: Scanner Application Interface (Idle)

No	Description
5c	Button to start/stop the scanner.
6c	Buttons to shift the currently used centre frequency by +/- 0.5, 1 or 5Mhz.
7c	Input window to show and change the currently scanned centre frequency. ⓘ The centre frequency can be changed while scanning.
8c	Drop-Down list to set the spectrum bandwidth around the centre frequency (1, 5, 10MHz). ⓘ The bandwidth can be changed while scanning.
9c	Slider to change the gain level of the recording device. ⓘ The gain level can be changed while scanning.
10c	Text field to change the gain level of the recording device. ⓘ The gain level can be changed while scanning.
11c	Area to graphically show the found carriers.
12c	Area to show important broadcast data when a carrier is selected.
13c	Area that lists the found carrier.
14c	There are two modes for viewing carrier. The current status and all identified. With ‘Hold Found Carrier’ all found carrier maintains in the list. This is useful to identify sporadic transmitting carrier.
15c	Button to refresh the list. ⓘ All carriers will be rescanned.

Table 22 MultiAnalyzer: Scanner Application Interface (IDLE)

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Scanner Application (Scanning)

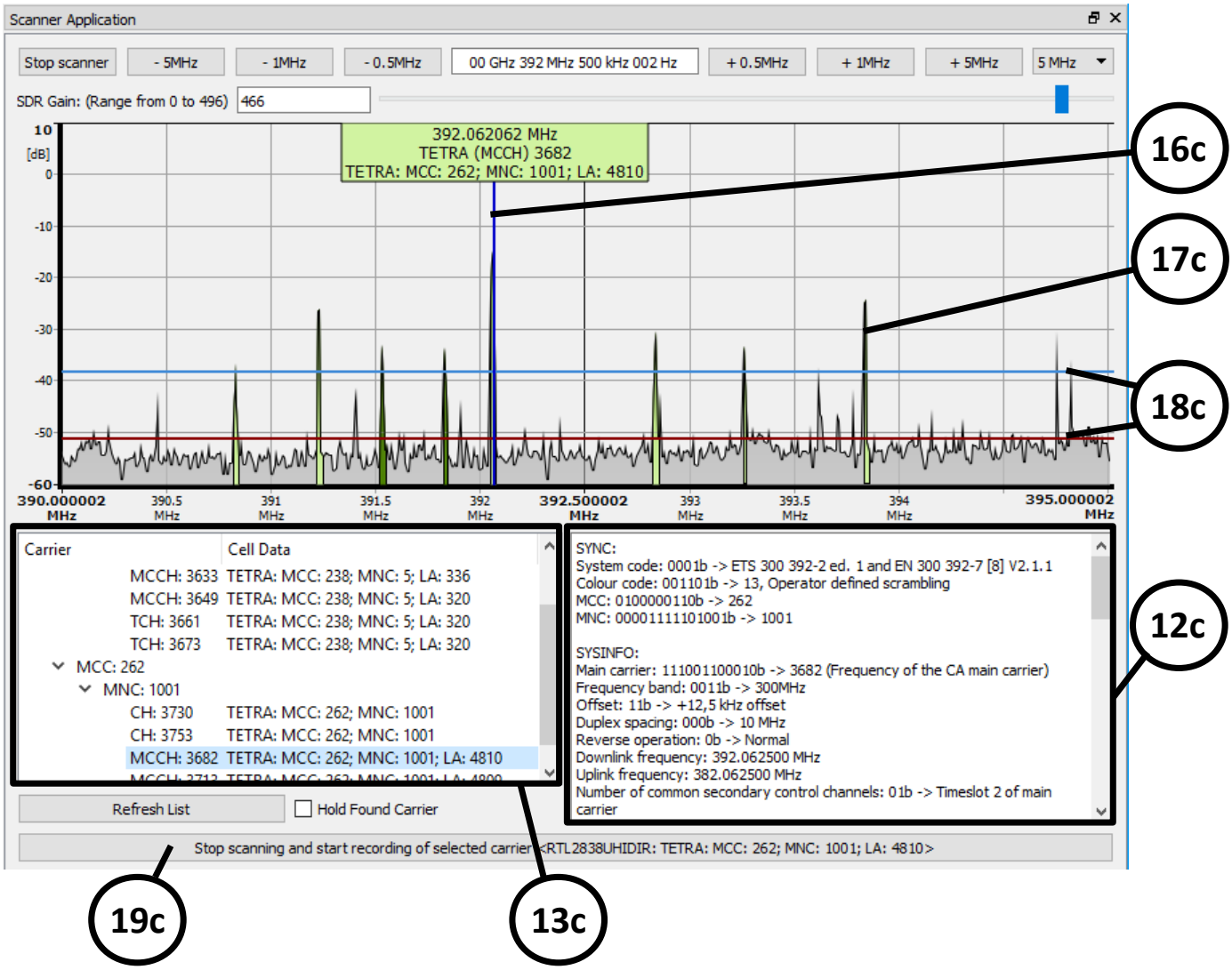

Illustration 48 MultiAnalyzer: Scanner Application Interface (Scanning)

No	Description
12c	Important broadcast data of a selected carrier.
13c	List of the identified carrier. The view is sorted in ascending order: 1. Country 2. Network 3. Channel number The position of the selected carrier is shown in spectrum display (blue vertical line) and the carrier data is printed in the broadcast view (**12c**).

No	Description
16c	A blue vertical line that marks the carrier frequency under the mouse pointer. At the top of the blue line, the carrier frequency and an identified channel is displayed.
17c	Noise is grey-coloured, scan candidates are blue-coloured, identified channels are marked in other colours, depending on the standard (e. g. TETRA‚ is green-coloured).
18c	The horizontal red and blue lines mark the scanning thresholds. The red line represents the auto detected noise level. The blue line represents the resulting threshold at which point the carriers will be identified (13dB above the detected noise level). To be a candidate for channel identification, the peaks have to be above the blue threshold and need to have a known bandwidth. For example, 25kHz for TETRA‚ or 12.5kHz for DMR‚.
19c	Button to stop scanning when a carrier is selected. The button opens the tab page ‘Record’ to start a record (see chapter 5.1.2 Record Settings – Record).

Table 23 MultiAnalyzer: Scanner Application Interface (Scanning)

5.2.1 Starting a Scan

To find and read out a carrier and its information, a scan with the **MultiAnalyzer** can be started.

> ⓘ The settings that are described in chapter 5.1.3 Record Settings – SDR Settings are also valid for the scanner application.

To start a scanning process with the **MultiAnalyzer**, follow the next steps.

➔ Recording devices are available in the ‘Device List’.

1. Choose the scanning device from the ‘Device List’ (see 49).

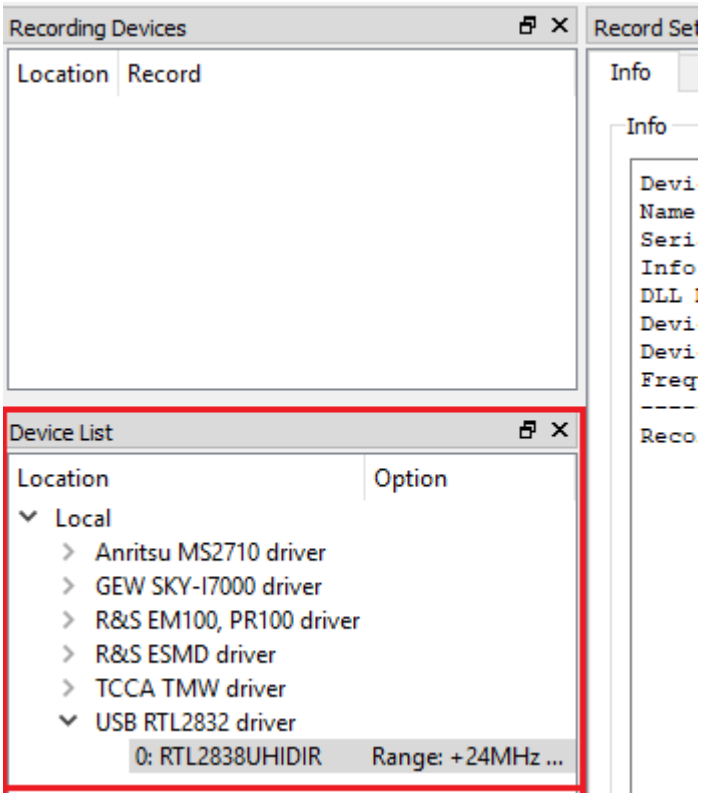

Illustration 49 MultiAnalyzer: Choose a Device (Scanner)

2. To set the centre frequency, use the input window (see 50).

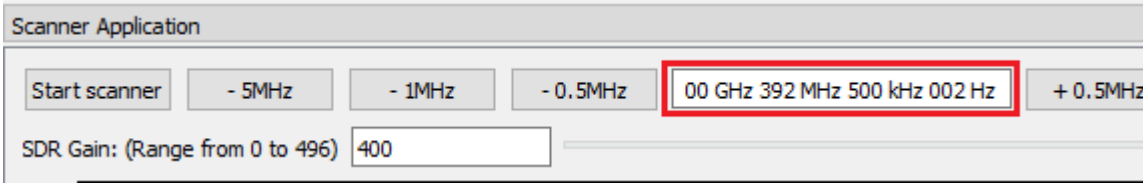

Illustration 50 MultiAnalyzer: Set Centre Frequency (Scanner)

> ⓘ The centre frequency can also be changed by using the buttons that are located on the left and the right side of the input window.

3. To set the gain of the recording device, use the slider or the text field (see 51).

Illustration 51 MultiAnalyzer: Set Gain (Scanner)

4. To set the bandwidth, use the drop-down list (see 52).

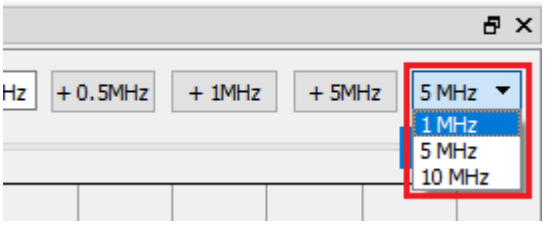

Illustration 52 MultiAnalyzer: Set Bandwidth (Scanner)

5. To start the scanner, click on the button [Start scanner] (see 53).

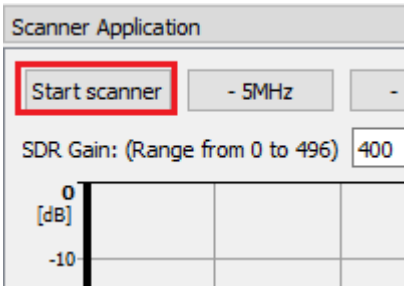

Illustration 53 MultiAnalyzer: Start Scanner (Scanner)

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✔ The scanner application starts scanning (see 54).

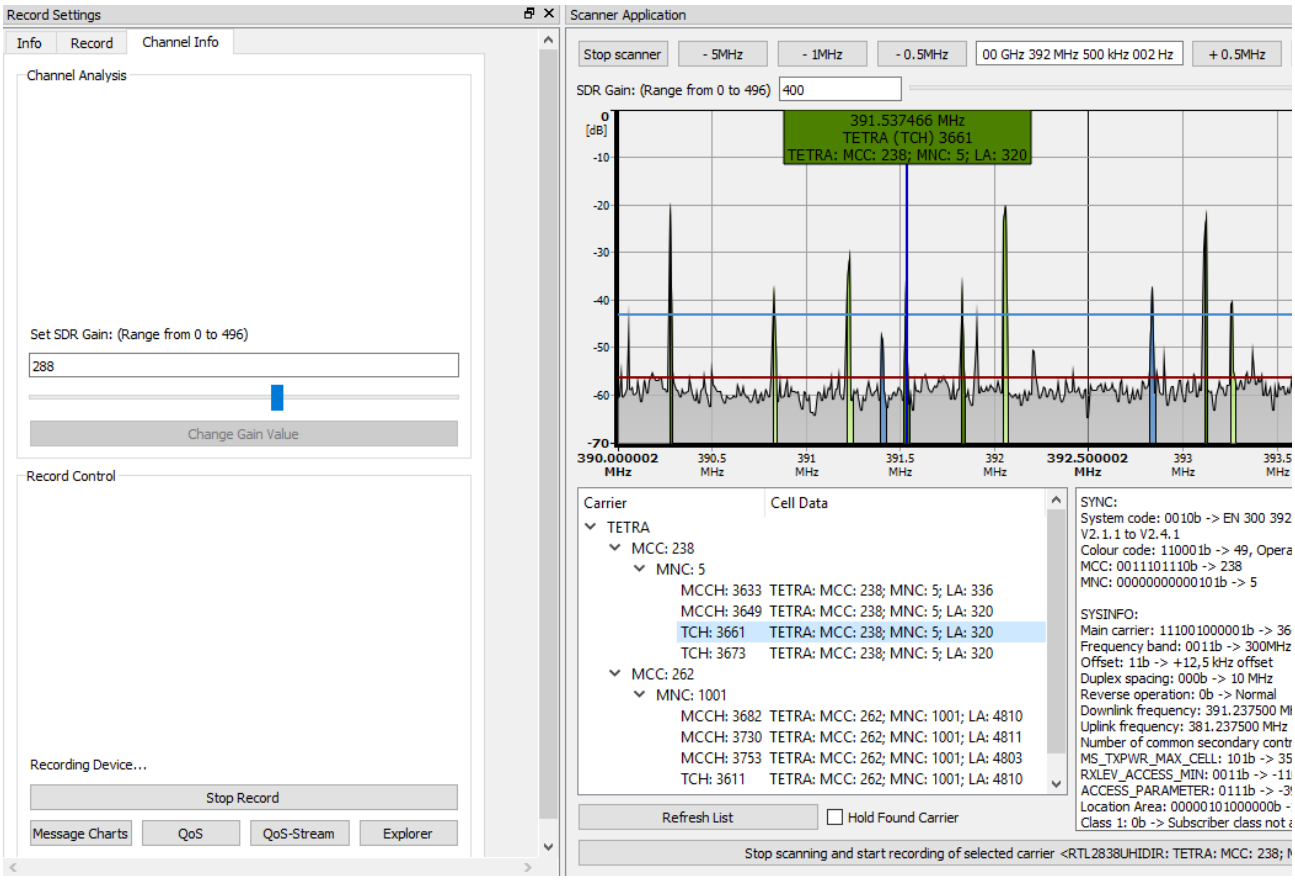

Illustration 54 MultiAnalyzer: Scan (Scanner)

ⓘ To record the data of a found carrier, see chapter 5.2.2 Starting a Record.

5.2.2 Starting a Record

Once a found carrier is chosen, the carrier and its information can be recorded and stored in a file.

To start a channel record of a found carrier, follow the next steps.

➔ A scan with the Scanner Application is running (see chapter 5.2.1 Starting a Scan).

1. Choose the wanted carrier from the list (see 55).

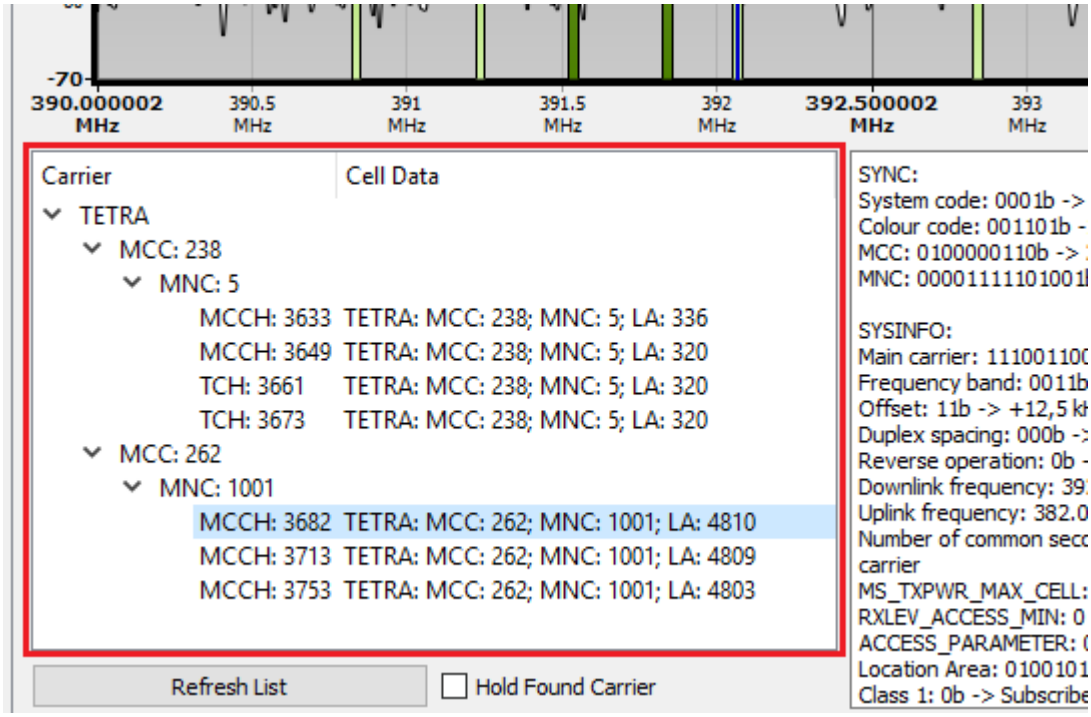

Illustration 55 MultiAnalyzer: Choose Carrier (Record)

2. To stop the scanner, click on the button [Stop scanner] (see 56).

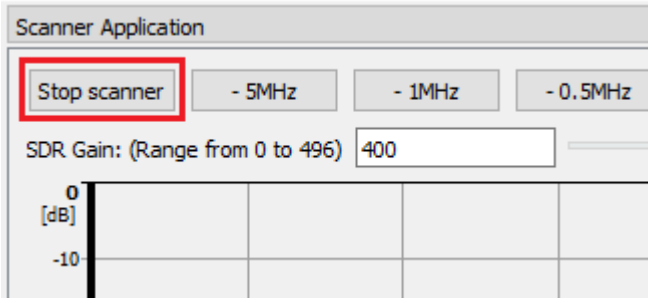

Illustration 56 MultiAnalyzer: Stop Scanner (Record)

✔ The chosen carrier is highlighted (see 57).

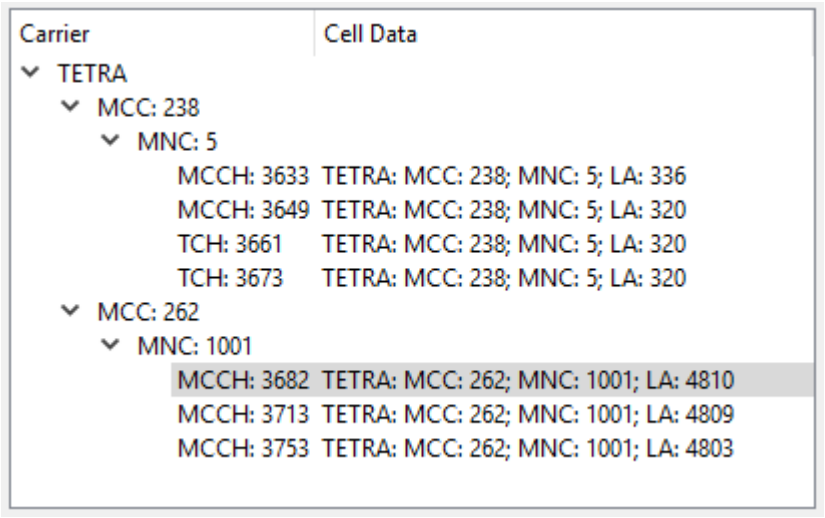

Illustration 57 MultiAnalyzer: Carrier Highlighted (Record)

3. Open the tab page ‘Record’ within the ‘Record Settings’ (see 58).

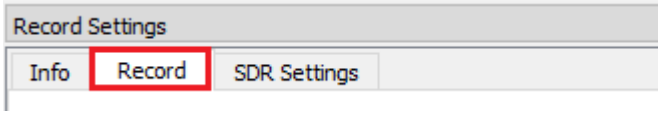

Illustration 58 MultiAnalyzer: Open Tab Page

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4. To start the record, set the settings and the storage path and click on the button [Start Record] (see 59).

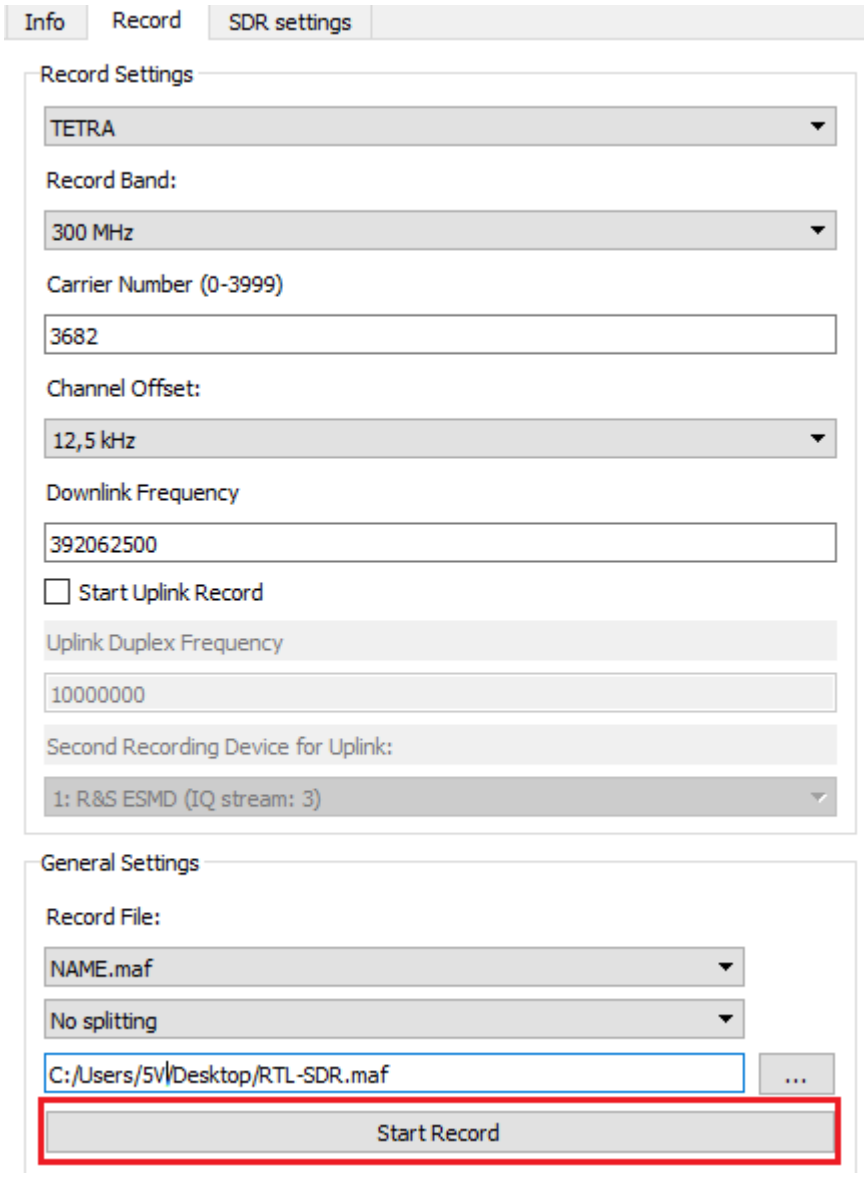
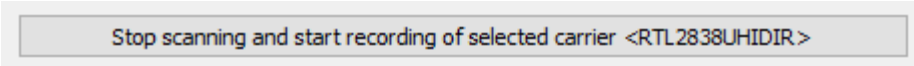


Illustration 59 MultiAnalyzer: Start Record (Record)

The tab page 'Record' also opens by clicking on the following button below within the Scanner Application during a scan



✔ The **MultiAnalyzer** starts recording (see 60).

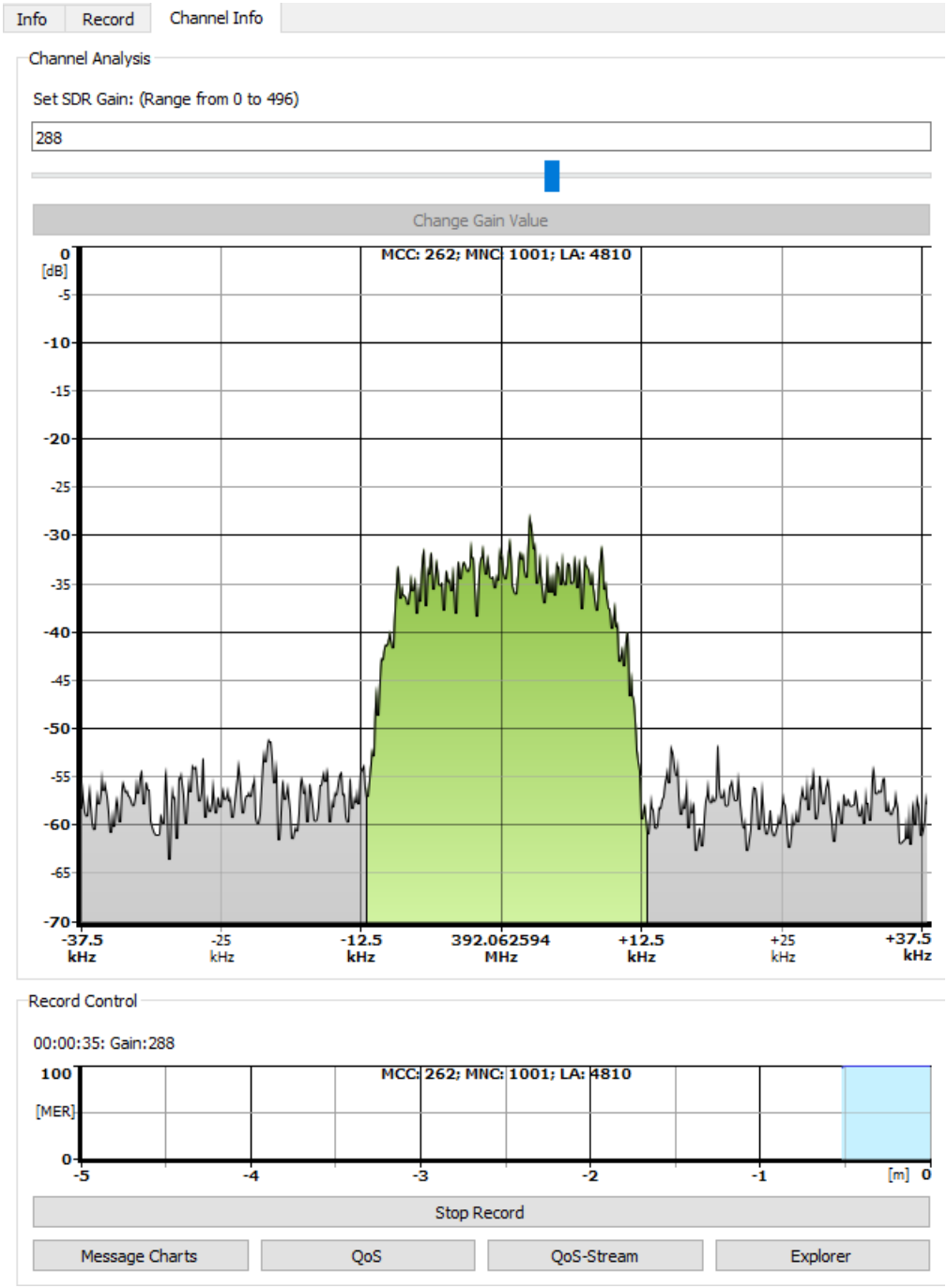


Illustration 60 MultiAnalyzer: Recording (Record)

ⓘ For information about analysing the record file, see chapter 5 Record and View Protocol Data and 5.4 Analyse an Earlier Recorded File.

5.2.3 Record Settings – Channel Info

This chapter provides an overview of the different settings of the tab page ‘Channel Info’.

Depending on the direction (downlink/uplink), the tab page ‘Channel Info’ has different options available.

ⓘ This page is only available if a record with a SDR‹ is running.

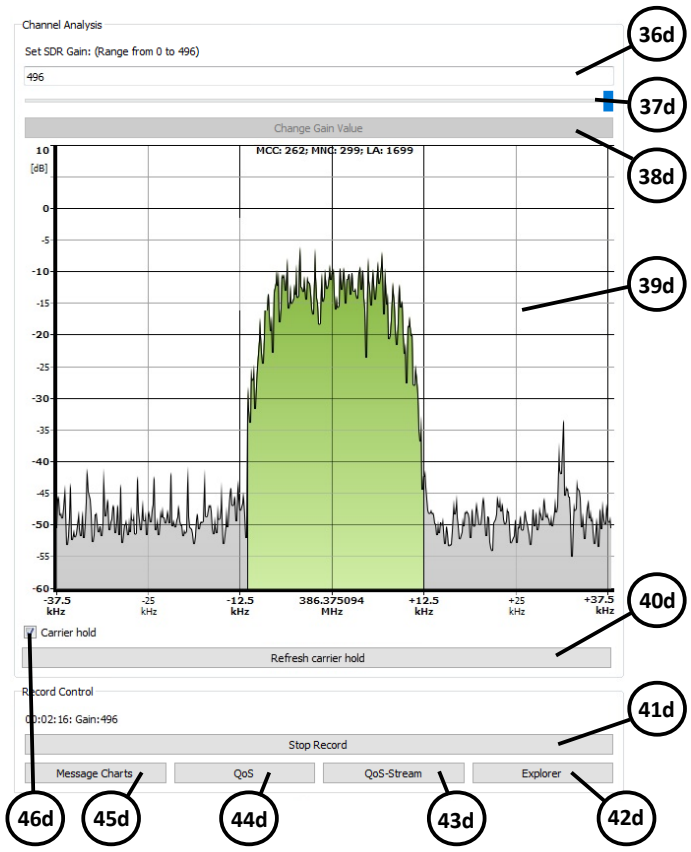


Illustration 61 MultiAnalyzer: Record Settings ‘Channel Info’ (UL)

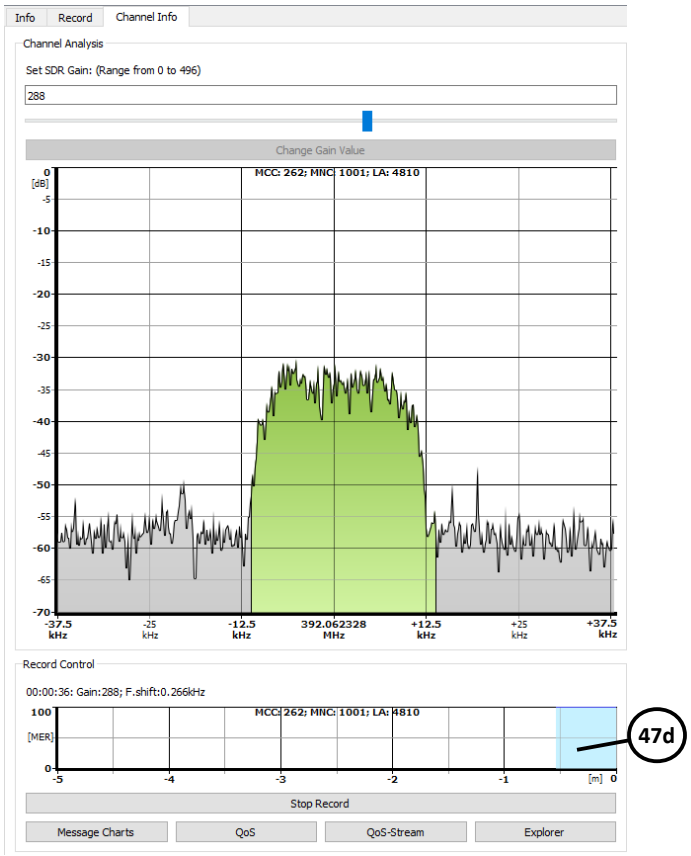


Illustration 62 MultiAnalyzer: Record Settings ‘Channel Info’ (DL)

No	Description	No	Description
36d	Text field to set the gain level of the SDR‹. ⓘ For a RTL-SDR the value is in tenth. For example, 20,6 is 206.	**47d**	Downlink block error rate history from the last 5 minutes.
37d	Slider to set the gain level of the SDR‹.		
38d	Button to set the chosen gain level into action.		
39d	Visualisation of the record channel spectrum. A mouse click inside changes the type of		

	view.
40d	Button to reset the level holding.
41d	Button to stop recording.
42d	Button to open the explorer on the storage path level of the record file.
43d	Button to start the **MultiAnalyzerQosServer** to stream QoS-data.
44d	Button to start the **MultiAnalyzerQoS**.
45d	Button to start the **MultiAnalyzerMsc** and to show the data as message sequence charts.
46d	Checkbox to hold the level if an uplink burst was detected, even if the uplink is not received any more. ⓘ Noise has no influence on that level hold.

Table 24 MultiAnalyzer: Record Settings 'Channel Info' (UL and DL)

5.3 MultiAnaylzerRecord

Another possibility to record is to use the DOS application **MultiAnalyzerRecord**.

> ⓘ For the usage with batch files use the argument "**-batch**" to suppress all interactive actions.

To show a list of all available SDR、devices, start the **MultiAnalyzerRecord** without any arguments:

- MultiAnalyzerRecord.exe

To get an overview of all available start arguments, start the **MultiAnalyzerRecord** with the following arguments:

- MultiAnalyzerRecord.exe -h
- MultiAnalyzerRecord.exe /h

The following chapters provide an overview of the command line arguments to record with **MultiAnalyzerRecord**.

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5.3.1 Record Real-Time TMW Data

To start a real-time TMW data record, use the following command line arguments:

MultiAnalyzerRecord.exe -**TMWIP**=<IPAddress> -**TMWP**=<PortNumber>

-F=<"<ExistingPath>\MyRecordFile.maf">

Required Arguments	
-TMWP=	Receiving port number.
-F=	Path and file name of the record file. Add the file extension ".maf".
Optional Arguments	
-TMWIP=	Local Ethernet interface for receiving UDP data, "0.0.0.0" for all interfaces.
-PROT=	Desired protocol for demodulation (TETRA or DMR). If this option is not given, then TETRA is demodulated.

Table 25 MultiAnalyzerRecord: Recording TMW Data Arguments

Example

MultiAnalyzerRecord.exe -**TMWIP**=*0.0.0.0* -**TMWP**=*9999* -**F**="*C:\MyRecordFile.maf*"

- TMW data is received at all local Ethernet interfaces at port 9999 and stored within the file *C:\MyRecordFile.maf*.

5.3.2 Record Real-Time with a SDR

To start a SDR, air interface real-time record, use the following command line arguments:

MultiAnalyzerRecord.exe **-DLF**=<Frequency> **-F**=<"<ExistingPath>\MyRecordFile.maf"> **-DLG**=<Gain> **-DLFS**=<FrequencyShift> **-DLSD**=<x,y> **-ULF**=<Frequency> **-ULG**=<Gain> **-ULFS**=<FrequencyShift> **-ULSD**=<x,y>

Required Arguments	
Only Downlink	
-DLF=	"Downlink Frequency" in Hz.
-F=	Path and file name of the record file. Add the file extension ".maf".
Downlink and Uplink	
-ULF=	"Uplink Frequency" in Hz.
Optional Arguments	
Only Downlink	
-DLG=	"Downlink SDR Gain" in tenth (12,6dB=126; 20,5dB=205; 30dB=300).
-DLFS=	"Downlink Frequency Shift" in Hz to adjust SDR, systemic frequency discrepancy. 400MHz is set via **-DLF=** but if the carrier is received at 400MHz+17500Hz, the **–DLFS** value has to be set to -17500.
-DLSD=	"Downlink Select SDR Device" to select a specific SDR, device for the Downlink. The necessary parameters are "x=DLL magic" and "y=Device number". These values can be obtained via the "SDR device list" option (see chapter 5.3 MultiAnaylzerRecord).
Downlink and Uplink	
-ULG=	"Uplink SDR Gain" in tenth (12,6dB=126; 20,5dB=205; 30dB=300).
-ULFS=	"Uplink Frequency Shift" in Hz to adjust SDR, systemic frequency discrepancy. 400MHz is set via **-ULF=** but if the carrier is received at 400MHz-12100Hz, the **–ULFS** value has to be set to 12100.
-ULSD=	"Uplink Select SDR Device" to select a specific SDR, device for the uplink. The necessary parameters are "x=DLL magic" and "y=Device number". These values can be obtained via the "SDR device list" option (see chapter 5.3 MultiAnaylzerRecord).
Other Options	
-PROT=	Desired protocol for demodulation (TETRA, or DMR,). If this option is not given, then TETRA, is demodulated.

Table 26 MultiAnalyzerRecord: Recording with SDR Arguments

Examples

Downlink, minimum arguments:

MultiAnalyzerRecord.exe **-DLF**=391837500 **-F**="C:\MyRecordFile.maf"

- This receives a downlink channel at the frequency *391837500*Hz (300MHz+Channel 3673+12,5kHz) with SDR‹ gain of *0*dB and a systemic SDR‹ frequency shift of *0*Hz.

Downlink, recommended arguments:

MultiAnalyzerRecord.exe **-DLF**=391837500 **-F**="C:\MyRecordFile.maf" **-DLG**=280 **-DLFS**=-17500

- This receives a downlink channel at the frequency *391837500*Hz (300MHz+Channel 3673+12,5kHz) with SDR‹ gain of *28,0*dB and a systemic SDR‹ frequency shift of *-17500*Hz.

Downlink and Uplink, minimum arguments:

MultiAnalyzerRecord.exe **-DLF**=391837500 **-F**="C:\MyRecordFile.maf" **-ULF**=381837500

- This receives a downlink channel at the frequency *391837500*Hz (300MHz+Channel 3673+12,5kHz) with SDR‹ gain of *0*dB and a systemic SDR‹ frequency shift of *0*Hz. It also receives an uplink channel at the frequency *381837500*Hz (300MHz+Channel 3273+12,5kHz) with SDR‹ gain of *0*dB and a systemic SDR‹ frequency shift of *0*Hz.

Downlink and Uplink, recommended arguments:

MultiAnalyzerRecord.exe **-DLF**=391837500 **-F**="C:\MyRecordFile.maf" **-DLG**=280 **-DLFS**=-17500 **-ULF**=381837500 **-ULG**=210 **-ULFS**=12100

- This receives a downlink channel at the frequency *391837500*Hz (300MHz+Channel 3673+12,5kHz) with SDR‹ gain of *28,0*dB and a systemic SDR‹ frequency shift of *-17500*Hz. It also receives an uplink channel at the frequency *381837500*Hz (300MHz+Channel 3273+12,5kHz) with SDR‹ gain of *21,0*dB and a systemic SDR‹ frequency shift of *12100*Hz.

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5.3.3 Record Real-Time with a Network Recording Device (NRD)

Network Recording Devices are supported devices, which send IQ-data via network.

Supported devices are:

- R&S EM100
- R&S ESMD
- Anritsu MS2710xA

To start a real-time record with a NRD, use the following command line arguments:

MultiAnalyzerRecord.exe **-DLF**=<Frequency> **-F**=<"<ExistingPath>\MyRecordFile.maf"> **-DLG**=<Gain> **-DLFS**=<FrequencyShift> **-DLSD**=<x,y> **-DLIP**=<IPAddress> -**DLRP**=<PortNumber> -**NDSO**=<SlotOffset> **-DLNDT**=<DeviceType> **-ULF**=<Frequency> **-ULG**=<Gain> **-ULFS**=<FrequencyShift> **-ULSD**=<x,y> -**ULIP**=<IPAddress> -**ULRP**=<PortNumber> **-ULNDT**=<DeviceType>

Required Arguments	
Only Downlink	
-DLF=	"Downlink Frequency" in Hz.
-F=	Path and file name of the record file. Add the file extension ".maf".
-DLIP	Downlink network recording device IP address.
-DLRP	Port number of the network recording device.
-DLNDT	"Downlink Network Device Type" • „EM100" for R&S EM100 • „ESMD" for R&S ESMD • „MS2710xA" for Anritsu MS 2710xA
Downlink and Uplink	
-ULF=	"Uplink Frequency" in Hz.
Optional Arguments	
Only Downlink	
-DLG=	"Downlink SDR Gain" in tenth (12,6dB=126; 20,5dB=205; 30dB=300).
-DLFS=	"Downlink Frequency Shift" in Hz to adjust the systemic frequency discrepancy. 400MHz is set via **-DLF=** but if the carrier is received at 400MHz+17500Hz, the **–DLFS** value has to be set to -17500.
-DLSD=	"Downlink Select SDR Device" to select a specific SDR device for the downlink. The necessary parameters are "x=DLL magic" and "y=Device number". These values can be obtained via the "SDR device list" option (see chapter 5.3 MultiAnaylzerRecord).

-NDSO=	“Network Device Slot Offset” that compensates the processing and delivering delay from the network device (e. g. 14500 for 14.5 slots offset (can be +/-)). Only one offset has to be given even when two network devices are used.
Downlink and Uplink	
-ULG=	“Uplink SDR Gain” in tenth (12,6dB = 126; 20,5dB = 205; 30dB = 300).
-ULFS=	“Uplink Frequency Shift” in Hz to adjust the systemic frequency discrepancy. 400MHz is set via **-ULF=** but if the carrier is received at 400MHz-12100Hz, the **–ULFS** value has to be set to 12100.
-ULSD=	“Uplink Select SDR Device” to select a specific SDR device for the Uplink. The necessary parameters are “x=DLL magic" and “y=Device number”. These values can be obtained via the “SDR device list” option (see chapter 5.3 MultiAnaylzerRecord).
-ULIP	Uplink network recording device IP address.
-ULRP	Port number of the network recording device.
-ULNDT	“Uplink Network Device Type”
Other Options	
-PROT=	Desired protocol for demodulation (TETRA or DMR). If this option is not given, then TETRA is demodulated.

Table 27 MultiAnalyzerRecord: Recording with NRD Arguments

Examples

Downlink, minimum arguments:

MultiAnalyzerRecord.exe **-DLF**=391837500 **-F**=”C:\MyRecordFile.maf” **-DLIP**=10.0.128.114 **-DLRP**=9001 **-DLNDT**=MS2710xA

- This receives a downlink channel at the frequency *391837500*Hz (300MHz+Channel 3673+12,5kHz) with SDR gain of *0*dB and a systemic SDR frequency shift of *0*Hz.
  The used network device is an Anritsu MS2710xA with the IP address 10.0.128.114 and the receiving port 9001.

Downlink, recommended arguments:

MultiAnalyzerRecord.exe **-DLF**=391837500 **-F**=”C:\MyRecordFile.maf” **-DLIP**=10.0.128.114 **-DLRP**=9001 **-DLNDT**=MS2710xA -**DLG**=-200 -**DLFS**=345

- Same channel as with **Downlink, minimum arguments** with the addition that the gain is set to -20.0 dB and frequency is shifted by 345Hz

Downlink (NRD) and Uplink (USB SDR), minimum arguments:

MultiAnalyzerRecord.exe -**DLF**=391837500 -**F**=”C:\MyRecordFile.maf” -**DLIP**=10.0.128.114 -**DLRP**=9001 -**DLNDT**=MS2710xA -**DLF**=381837500

- This receives a downlink channel at the frequency *391837500*Hz (300MHz+Channel 3673+12,5kHz) with SDR‹ gain of *0*dB and a systemic SDR‹ frequency shift of *0*Hz. It also receives an uplink channel at the frequency *381837500*Hz (300MHz+Channel 3273+12,5kHz) with SDR‹ gain of *0*dB and a systemic SDR‹ frequency shift of *0*Hz.
  The used network device for the downlink channel is an Anritsu MS2710xA with the IP address 10.0.128.114 and the receiving port 9001. For the uplink a RTL-SDR chip based SDR‹ is used.

Downlink (NRD) and Uplink (USB SDR), recommended arguments:

MultiAnalyzerRecord.exe -**DLF**=391837500 -**F**=”C:\MyRecordFile.maf” -**DLIP**=10.0.128.114 -**DLRP**=9001 -**DLNDT**=MS2710xA -**DLF**=381837500 -**DLG**=-200 -**DLFS**=345-**ULG**=380 -**ULFS**=-17100 -**NDSO**=-14500

- Same configuration as with **Downlink (NRD) and Uplink (USB SDR), minimum arguments** with the addition that the gain is set to -20.0 dB and frequency is shifted by 345Hz for Downlink. And for Uplink the gain is set to 38.0 dB and frequency is shifted by -17100Hz.
  Network delay compensation (**-NDSO**) is set to -14.5 slots.

Downlink (USB SDR) and Uplink (NRD), minimum arguments:

MultiAnalyzerRecord.exe -**ULF**=391837500 -**F**=”C:\MyRecordFile.maf” -**ULIP**=10.0.128.114 -**ULRP**=9001 -**ULNDT**=MS2710xA -**ULF**=381837500

- Same configuration as with **Downlink (NRD) and Uplink (USB SDR), minimum arguments** just the uplink and downlink devices are switched.

Downlink (USB SDR) and Uplink (NDR), recommended arguments:

MultiAnalyzerRecord.exe -**ULF**=391837500 -**F**=”C:\MyRecordFile.maf” -**ULIP**=10.0.128.114 -**ULRP**=9001 -**ULNDT**=MS2710xA -**ULF**=381837500 -**ULG**=-200 -**ULFS**=345 **-DLF**=380 -**DLFS**=-17100 -**NDSO**-14500

- Same configuration as with **Downlink (NRD) and Uplink (USB SDR), recommended arguments** just the uplink and downlink devices are switched.

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Downlink (NRD 1) and Uplink (NRD 2), minimum arguments:

MultiAnalyzerRecord.exe -**DLF**=391837500 -**F**="C:\MyRecordFile.maf" -**DLIP**=10.0.128.114 -**DLRP**=9001 -**DLNDT**=MS2710xA -**DLF**=381837500 -**ULIP**=10.0.128.119 -**ULRP**=9000 -**ULNDT**=EM100 -**ULF**=381837500

- Same configuration as with **Downlink (NRD) and Uplink (USB SDR), minimum arguments** except that the EM100 network recording device is used for uplink recording.

Downlink (NRD 1) and Uplink (NRD 2), recommended arguments:

MultiAnalyzerRecord.exe -**DLF**=391837500 -**F**="C:\MyRecordFile.maf" -**DLIP**=10.0.128.114 **-DLRP**=9001 -**DLNDT**=MS2710xA -**DLF**=381837500 -**ULIP**=10.0.128.119 -**ULRP**=9000 -**ULNDT**=EM100 -**ULF**=381837500 -**ULG**=49 -**ULFS**=0 -**DLG**=380 -**DLFS**=345 -**NDSO**-14500

- Same configuration as with **Downlink (USB SDR) and Uplink (NDR**)**, recommended arguments**, except that the EM100 network recording device is used for uplink recording.

Downlink (NRD 1) and Uplink (NRD 1):

ⓘ Due to hardware limitations, this configuration is not supported at the moment. It will be available as soon as it is supported by the hardware.

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5.4 Analyse an Earlier Recorded File

All recorded data is automatically stored in the record file with the extension ".maf". There is no need to additionally save the result file. To reanalyse and generate the protocol output again, take the file and drop it on the wanted programme ("Drag and Drop") (see 63):

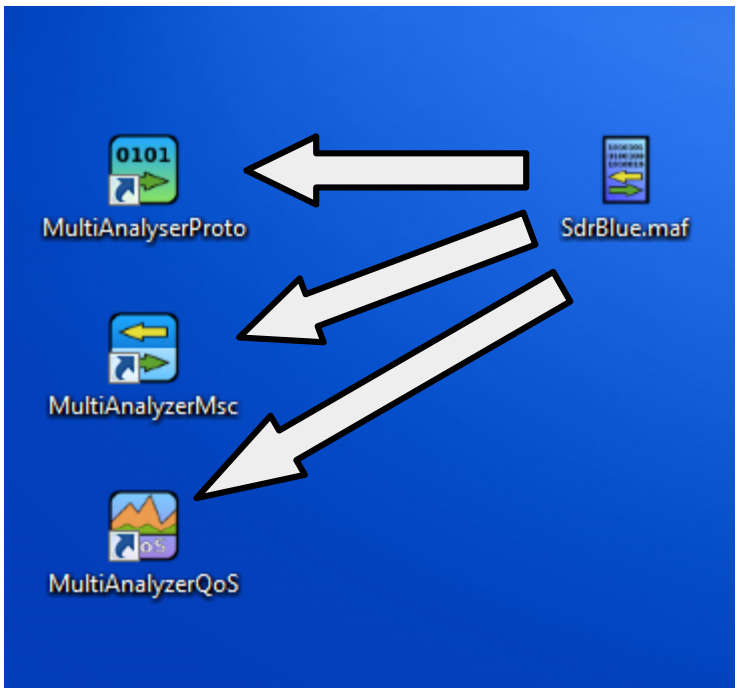

Illustration 63 Analysing via "Drag and Drop"

Depending on the analysing programme, the data is handled as follows:

Name	Description
MultiAnalyzerProto	Programme to analyse the protocol content of the file. The programme creates a resulting text file in the same path. The text file can also be loaded into the **MultiAnalyzerMsc**.
MultiAnalyzerMsc	Programme to analyse the protocol content of the file and to show the result in a message sequence chart.
MultiAnalyzerQoS	Programme to analyse the protocol content of the file and to graphically present the statistic results in the form of diagrams, charts and tables.

Table 28 Analysing earlier recorded Data

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5.5 MultiAnalyzerProto

A possibility to ananlyse the protocol content of a file is to use the DOS application **MultiAnalyzerProto**. The programme creates a resulting text file in the same path. The resulting text file can also be loaded into the **MultiAnalyzerMsc**.

There is no overview of all available start arguments. The type is defined by the argument sequence.

The following chapters provide an overview of the command line arguments to analyse with **MultiAnalyzerProto**.

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5.5.1 Analyse Protocol Data

The start arguments are set in a static sequence. No arguments can be omitted, but argument can declared as unused with a blank “”. At the end, unused arguments can be left out.

Minimum Arguments	
Path and file name for the record data.	• The first argument in sequence in the recorded file. • Or in real-time recording file with the data, for that use the prefix keyword “**ONLINE:***Path+File*”.
Optional Arguments	
Protocol filter	A number (decimal) of the wanted protocol filter, see: • 5.5.2 Protocol Filter DMR • 5.5.3 Protocol Filter TETRA • 5.5.4 Protocol Filter TETRA-DMO In any case, the value 0 means no filter is active. If this argument is not set the standard filter settings are used.
Path and file name for the configuration of AIE guessing	Path and file name of the configuration AIE‹ guessing settings. If this argument is not set no AIE‹ guessing is done.
Path and file name for the configuration of AIE settings.	Path and file name of the configuration AIE‹ decryption settings. If this argument is not set no AIE‹ decrypting is done.
Path and file name for an external analyse DLL.	Path and file name of a user build external analyse DLL. The DLL can export data, analyse and print unsupported parts of the protocol and replace parts of the internal MultiAnalyzer protocol analysis.

Table 29 MultiAnalyzerProto: Arguments for Analysing Protocol Data

Examples

Minimum arguments:

MultiAnalyzerProto.exe "C:\Record\Example.maf”

Minimum arguments (with real-time analysing):

MultiAnalyzerProto.exe "ONLINE:C:\Record\Example.maf”

All arguments:

MultiAnalyzerProto.exe "C:\Record\Example.maf" 0 "C:\Settings\AieGuess.taie" "C:\Settings\Aie.csv" „C:\DLL\MyAnalyse.dll“

Unused arguments:

MultiAnalyzerProto.exe "C:\Record\Example.maf" "" "" "" „C:\DLL\MyAnalyse.dll“

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5.5.2 Protocol Filter DMR

Different protocol option are available. An activated option will suppress redundant/unwanted data. Every option is unique number. These numbers are organized as logical bitmaps. This allows them to be logically linked to "OR" or simply added.

The standard value for DMR، is 111088 (decimal) and defines follow options:

TS/TDMA1 Filter: “Suppress IDLE-PDU”, “Suppress Equal Broadcast”, “Suppress L2 Channel Data”, “Suppress blank Bursts”, “Suppress Late Entry”

MS/TDMA2 Filter: “Suppress IDLE-PDU”, “Suppress Equal Broadcast”, “Suppress L2 Channel Data”, “Suppress blank Bursts”, “Suppress Late Entry”

Filter DMR		
General		
$0x00000001_{(16)}$	$1_{(10)}$	Suppress Slot 1
$0x00000002_{(16)}$	$2_{(10)}$	Suppress Slot 2
TS/TDMA1 Filter		
$0x00000010_{(16)}$	$16_{(10)}$	Suppress IDLE-PDU،
$0x00000020_{(16)}$	$32_{(10)}$	Suppress Equal Broadcast
$0x00000040_{(16)}$	$64_{(10)}$	Suppress L2 Channel Data
$0x00000080_{(16)}$	$128_{(10)}$	Suppress blank Bursts
$0x00000100_{(16)}$	$256_{(10)}$	Suppress Late Entry
MS/TDMA2 Filter		
$0x00001000_{(16)}$	$4096_{(10)}$	Suppress IDLE-PDU،
$0x00002000_{(16)}$	$8192_{(10)}$	Suppress Equal Broadcast
$0x00004000_{(16)}$	$16384_{(10)}$	Suppress L2 Channel Data
$0x00008000_{(16)}$	$32768_{(10)}$	Suppress blank Bursts
$0x00010000_{(16)}$	$65536_{(10)}$	Suppress Late Entry

Table 30 MultiAnalyzerProto: Filter DMR

5.5.3 Protocol Filter TETRA

Different protocol option are available. An activated option will suppress redundant/unwanted data. Every option is unique number. These numbers are organized as logical bitmaps. This allows them to be logically linked to "OR" or simply added.

The standard value for TETRA، is 4080 (decimal) and defines follow options:

Downlink: “Suppress NULL-PDU at the End”, “Suppress equal Broadcasts”, “Suppress Equal D-NWRK PDUs”, “Suppress blank bursts”

Uplink: “Suppress U-Plane PDUs”, “Suppress NULL-PDU at the End”, “Suppress Blank Bursts”, “Suppress U-Plane PDUs”

Filter TETRA		
General (Downlink and Uplink)		
$0x00000001_{(16)}$	$1_{(10)}$	Suppress Slot 1
$0x00000002_{(16)}$	$2_{(10)}$	Suppress Slot 2
$0x00000004_{(16)}$	$4_{(10)}$	Suppress Slot 3
$0x00000008_{(16)}$	$8_{(10)}$	Suppress Slot 4
Downlink Filter		
$0x00000010_{(16)}$	$16_{(10)}$	Suppress NULL-PDU، at the End
$0x00000020_{(16)}$	$32_{(10)}$	Suppress equal Broadcasts
$0x00000040_{(16)}$	$64_{(10)}$	Suppress equal D-NWRK PDUs،
$0x00000080_{(16)}$	$128_{(10)}$	Suppress blank bursts
$0x00000100_{(16)}$	$256_{(10)}$	Suppress U-Plane PDUs،
Uplink Filter		
$0x00000200_{(16)}$	$512_{(10)}$	Suppress NULL-PDU، at the End
$0x00000400_{(16)}$	$1024_{(10)}$	Suppress Blank Bursts
$0x00000800_{(16)}$	$2048_{(10)}$	Suppress U-Plane PDUs،
External Analyse DLL Filter		
$0x00010000_{(16)}$	$65536_{(10)}$	Suppress External Analyse DLL User defined 1
$0x00020000_{(16)}$	$131072_{(10)}$	Suppress External Analyse DLL User defined 2

Table 31 MultiAnalyzerProto: Filter TETRA

5.5.4 Protocol Filter TETRA-DMO

Different protocol option are available. An activated option will suppress redundant/unwanted data. Every option is unique number. These numbers are organized as logical bitmaps. This allows them to be logically linked to "OR" or simply added.

The standard value for TETRA‚-DMO‚ is 110592 (decimal) and defines follow options:

Protocol related filter: “Suppress Blank Bursts”, “Suppress Blank Bursts”, “Suppress U-Plane PDUs”, “Suppress Equal DPres-Sync”

Filter TETRA-DMO		
General		
$0x00000001_{(16)}$	$1_{(10)}$	Suppress Slot 1
$0x00000002_{(16)}$	$2_{(10)}$	Suppress Slot 2
$0x00000004_{(16)}$	$4_{(10)}$	Suppress Slot 3
$0x00000008_{(16)}$	$8_{(10)}$	Suppress Slot 4
Protocol related filter		
$0x00000010_{(16)}$	$16_{(10)}$	Suppress No Call Blank Bursts
$0x00001000_{(16)}$	$4096_{(10)}$	Suppress Blank Bursts
$0x00002000_{(16)}$	$8192_{(10)}$	Suppress Repeated PDUs‚
$0x00004000_{(16)}$	$16384_{(10)}$	Suppress Late Entry PDUs‚
$0x00008000_{(16)}$	$32768_{(10)}$	Suppress U-Plane PDUs‚
$0x00010000_{(16)}$	$65536_{(10)}$	Suppress Equal DPres-Sync

Table 32 MultiAnalyzerProto: Filter TETRA-DMO

5.6 MultiAnalyzerMsc

The **MultiAnalyzerMsc** is used to load the text result files and graphically present the data in the form of message sequence charts.

This chapter provides an overview of the interface and menus of the **MultiAnalyzerMsc**.

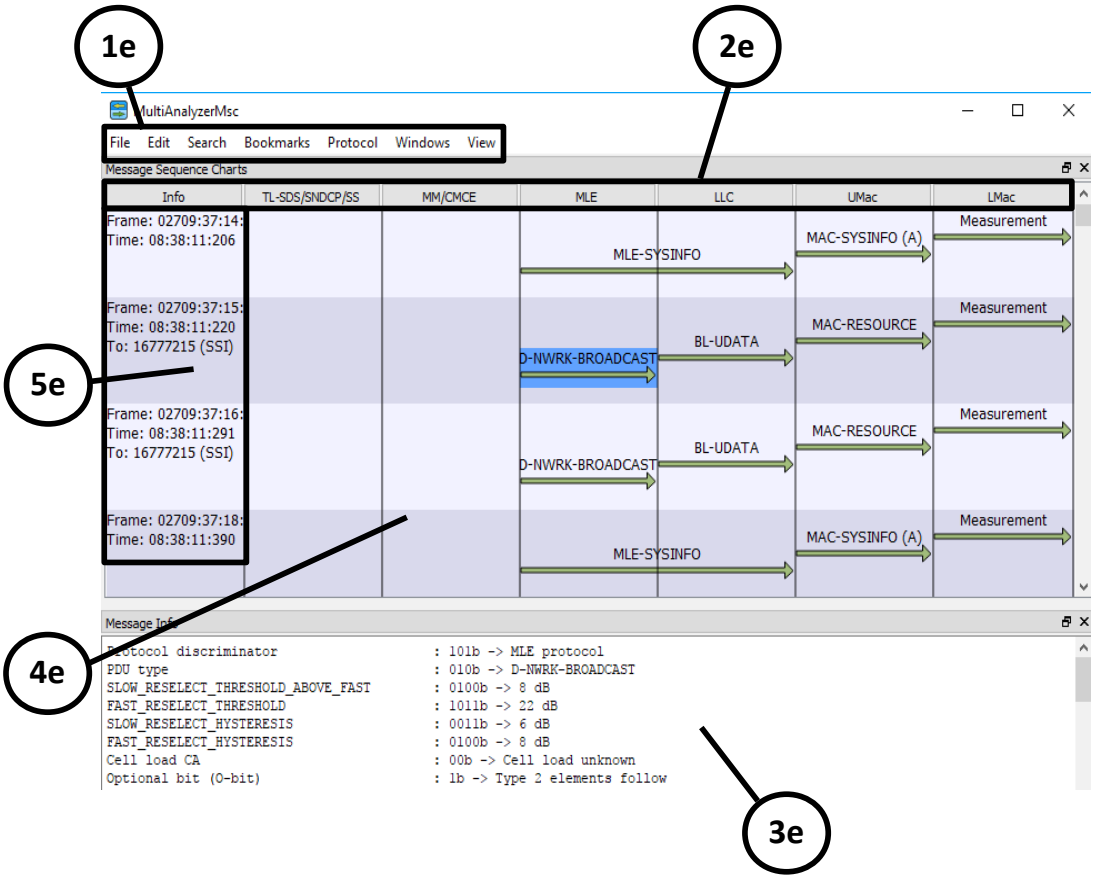


Illustration 64 MultiAnalyzerMsc: Interface

No	Description
1e	The menu bar.
2e	The data is displayed layer depended. The layer names are shown at the top.
3e	The text field shows the PDU‹.
4e	In the middle the protocol PDUs‹ are shown. A yellow arrow means uplink, a green one means downlink. • Click once to show the analysed protocol in the text window below. • Double-click to show the time point in the QoS viewer.
5e	The info column contains general data like frame, time and subscriber number.

Table 33 MultiAnalyzerMsc: Interface

Menu ‘File’

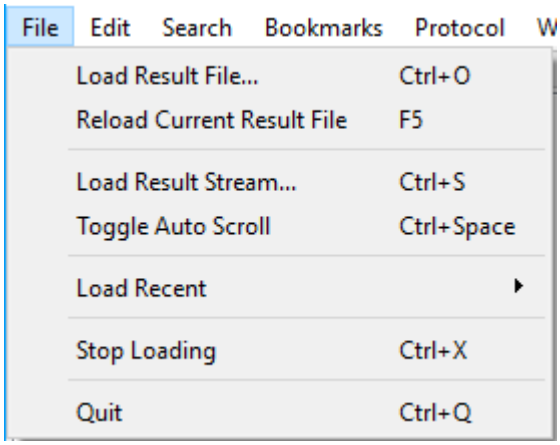


Illustration 65 MultiAnalyzerMsc: Menu ‘File’

Name	Key Combination	Description
Load Result File...	Ctrl+O	Load a file. Loading stops at the end of the file.
Reload Current Result File	F5	Reload the current result file. The programme stops loading at the end of the file and tries to restore the current view position.
Load Result Stream...	Ctrl+S	Load a file. The programme does not stop loading at the end of file and waits that new data is appended to the file (real-time online view).
Toggle Auto Scroll	Ctrl+Space	Toggle auto scrolling. The last message is automatically shown if auto scrolling is enabled. ⓘ Only available in real-time online view.
Load Recent	None	Load a recent file if files already have been viewed. Show a list to pick the recent file.
Stop Loading	Ctrl+X	Stop loading.
Quit	Ctrl+Q	Quit the programme.

Table 34 MultiAnalyzerMsc: Menu ‘File’

Menu ‘Edit’

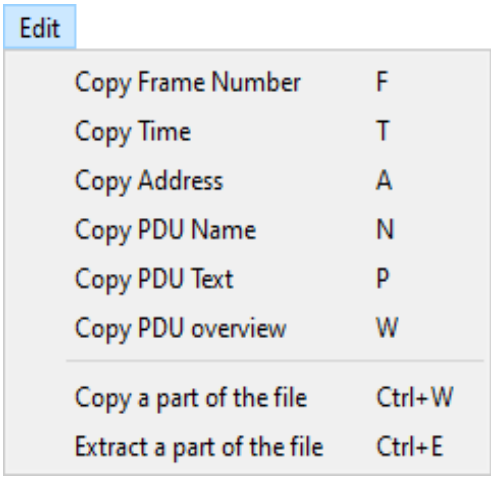


Illustration 66: MultiAnalyzerMsc: Menu ‘Edit’

Name	Key Combination	Description
Copy Frame Number	F	Copy frame information to clipboard.
Copy Time	T	Copy time information to clipboard.
Copy Address	A	Copy address information to clipboard.
Copy PDU Name	N	Copy the selected PDU، name to clipboard.
Copy PDU Text	P	Copy (unformatted) text to clipboard.
Copy PDU overview	W	Copy text representation of MSC to clipboard.
Copy a part of the file	Ctrl+W	Select a time range via Messages and copy the text representation of the MSC to the clipboard.
Extract a part of the file	Ctrl+E	Choose by message a range. Start with this information the **MultiAnalyzerSplitter**.

Table 35 MultiAnalyzerMsc: Menu ‘Edit’

Menu ‘Search’

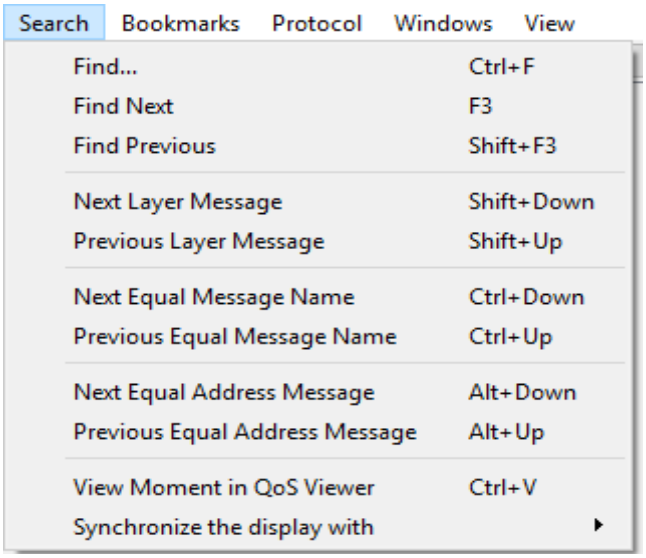


Illustration 67 MultiAnalyzerMsc: Menu ‘Search’

Name	Key Combination	Description
Find...	Ctrl+F	Open the search dialogue for settings (see chapter 5.6.1 Search Dialogue (MultiAnalyzerMsc)).
Find Next	F3	Search forward with unchanged settings.
Find Previous	Shift+F3	Search backward with unchanged settings.
Next Layer Message	Shift+Down	Search forward for the next message in the same layer as the selected message.
Previous Layer Message	Shift+Up	Search backward for the last message in the same layer as the selected message.
Next Equal Message Name	Ctrl+Down	Search forward for the next message with same PDU‚ name as the selected message.
Previous Equal Message Name	Ctrl+Up	Search backward for the last message with same PDU‚ name as the selected message.
Next Equal Address Message	Alt+Down	Search forward for the next message with same subscriber identity as the selected message.
Previous Equal Address Message	Alt+Up	Search backward for the last message with same subscriber identity as the selected message.
View Moment in QoS Viewer	Ctrl+V	View selected PDU‚ in **MultiAnalyzerQoS**.

Name	Key Combination	Description
Synchronize the display with	None	Shows the best possible next time in the own display at which the current display comes closest to the selected other MSC. If changes are made to the other MSC, the display of your own MSC is updated in real time.

Table 36 MultiAnalyzerMsc: Menu 'Search'

Menu ‘Bookmarks’

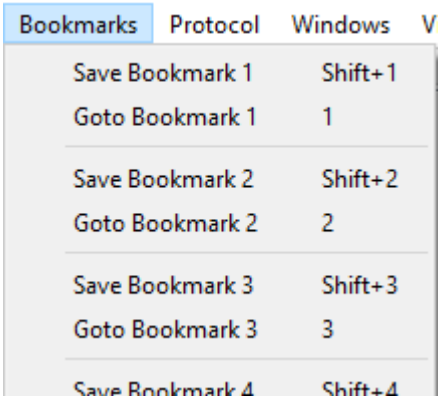


Illustration 68 MultiAnalyzerMsc: Menu ‘Bookmarks’

Name	Key Combination	Description
Save Bookmark 1	Shift+1	Save the selected cursor position.
Goto Bookmark 1	1	Return to the saved cursor position.
	...	
Save Bookmark 10	Shift+0	Save the selected cursor position.
Goto Bookmark 10	0	Return to the saved cursor position.

Table 37 MultiAnalyzerMsc: Menu ‘Bookmarks’

Menu ‘Protocol’

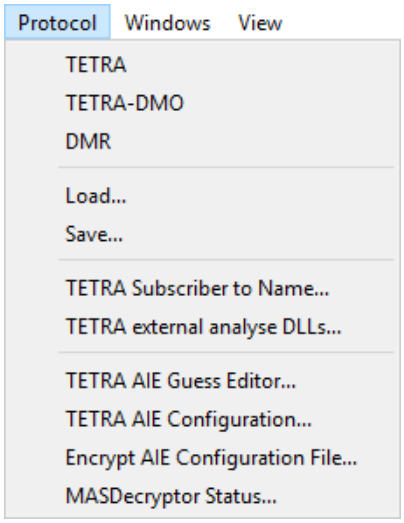


Illustration 69 MultiAnalyzerMsc: Menu ‘Protocol’

Name	Description
TETRA	Open protocol filter settings (see chapter 5.6.3 Protocol Filter Settings).
TETRA-DMO	
DMR	
Load…	Load settings from a file.
Save…	Save settings to a file.
TETRA Subscriber to Name...	See chapter 5.6.4 TETRA Subscriber to Name.
TETRA external analyse DLLs...	Choose up to eight user build external analyse DLL. The DLLs can export data, analyse and print unsupported parts of the protocol and replace parts of the internal MultiAnalyzer protocol analysis.
Encrypt AIE Configuration File	Encrypts an AIE configuration text file to hide its contents (i.e. the keys). **Attention: The file cannot be decrypted and therefore cannot be put back into text form!** However, the (decrypted) content is temporarily used internally. A dongle is required for encryption/decryption. When encrypting, the user determines which dongle may decrypt the file again for internal use.

Table 38 MultiAnalyzerMsc: Menu ‘Protocol’

ⓘ TETRA, AIE, options and the **MASDecryptor** are described in another document.

Menu ‘Windows’

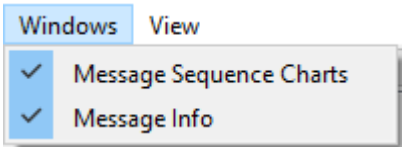


Illustration 70 MultiAnalyzerMsc: Menu 'Windows'

Name	Description
Message Sequence Charts	Show or hide the window that contains the message sequence charts of the loaded data.
Message Info	Show or hide the window that contains the information about the selected PDU.

Table 39 MultiAnalyzerMsc: Menu 'Windows'

Menu 'View'

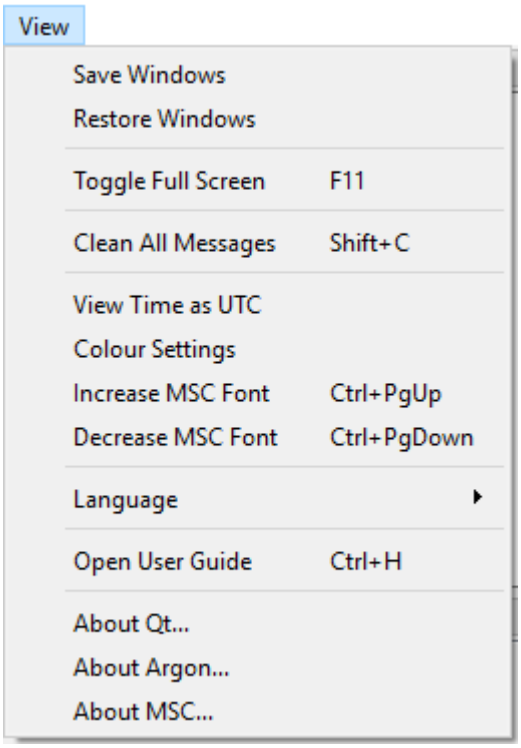


Illustration 71 MultiAnalyzerMsc: Menu 'View'

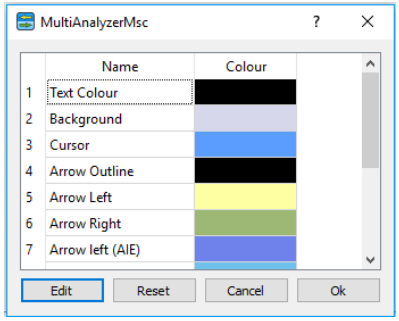
Name	Key Combination	Description
Save Windows	none	Save current window positions. ⓘ At the next start this window positions are reused.
Restore Windows	none	Reuse previous stored window positions now.
Toggle Full Screen	F11	Toggle maximum size (full screen) view.
Clean All Messages	Shift+C	Clean all messages from view and free used memory. ⓘ Makes sense in real-time online view. The user can concentrate on new messages without a large history of old messages. The data that is contained in the file stays untouched.
View Time as UTC	none	Note time in current local time or UTC.
Colour Settings	none	Change the colour of the message charts. **Edit**: Open colour selection dialogue, to edit the colour. **Reset**: Set back to factory default. **Cancel**: Close settings dialogue without saving. **Ok**: Confirm new settings. 
Increase MSC Font	Ctrl+PgUp	Increase the font size.
Decrease MSC Font	Ctrl+PgDown	Decrease the font size.
Language	none	Change the interface language.
Open User Guide	Ctrl+H	Open the user manual.
About Qt...	none	Show information about the used tool set.
About Argon...	none	Show information about the used source code package.
About MSC...	none	Show information about the **MultiAnaylzerMsc** themselves.

Table 40 MultiAnalyzerMsc: Menu 'View'

5.6.1 Search Dialogue (MultiAnalyzerMsc)

The search dialogue allows to set the search options. Different types of options are possible. They can be enabled or disabled with the checkboxes. If more than one option is enabled, both/all conditions need to be true.

- Open the search dialogue via ‘Search’ > ‘Find...’ or use the key combination Ctrl+F.

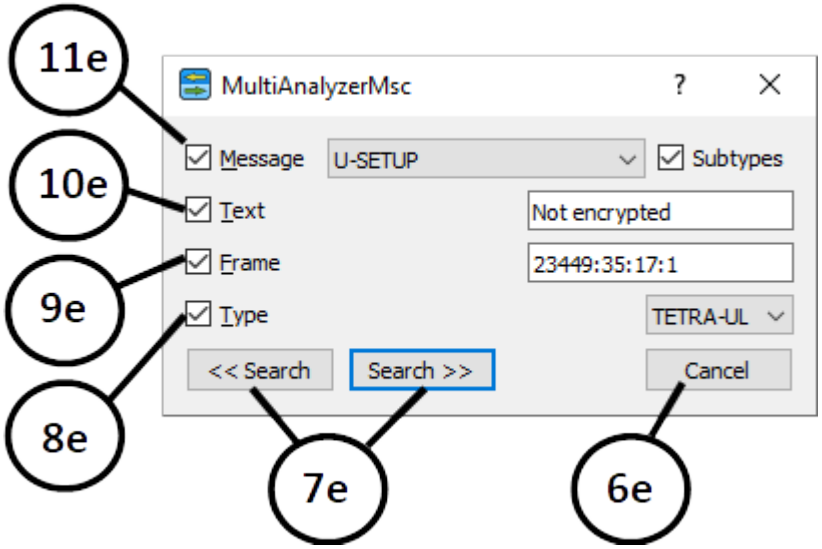


Illustration 72 MultiAnalyzerMsc: Search Dialogue

Name	Description
6e	Button to close the window.
7e	Buttons to start searching backward/forward from the current position.
8e	Finds message of a specific type, e.g. TETRA, downlink, TETRA, uplink.
9e	Goes to/searches for a frame. Numbers from 0 to 9 are allowed. The format is: “Hyperframe :Multiframe : Frame :Slot” “(00000-65535) :(01-60) :(01-18) :(1,2,3,4)” Empty fields mean any value. **Examples:** “00001:01:01:1” → All fields filled, go to exact frame. “_____:01:01:1” → Hyperframe field is not filled, find all frames without hyper frame information. “_____:__:__:1” → Only slot information is filled. Find next slot 1.
10e	Search (case sensitive) for a text in the analysed element section.
11e	Search for the message name. All occurred messages are listed in the drop-down list. Unchecking "Subtypes" causes messages to be searched for in general. For example, if instead of a "MAC-RESOURCE (aie)" all "MAC-RESOURCE" with or without bracket extension should be found.

Table 41 MultiAnalyzerMsc: Search Dialogue

5.6.2 Copy a part of the MAF file

The mask allows you to select the time range to be copied. For this purpose messages from the analysis are used. The time stamp of the message is used to select the start and end point. It is also possible to insert an extra period before or after the selected time as security buffer. As with the **MultiAnalyzerSplitter** the name scheme and the target file are then specified.

For the messages that can be selected in the mask there are different types:

Name	Description
First message	The first message in the log.
Last messafge	The last message in the log.
Visible beginning	The first message in the current view of the log.
Visible end	The last message in the current view of the log.
Cursor	The message under the cursor.
Bookmark 1 to 10	The saved message of the bookmark.

Table 42 MultiAnalyzerMsc: Copy a part of the MAF file, Message types

- Open the search dialogue via ‘Edit’ > ‘Extract a part of the file...’ or use the key combination Ctrl+E.

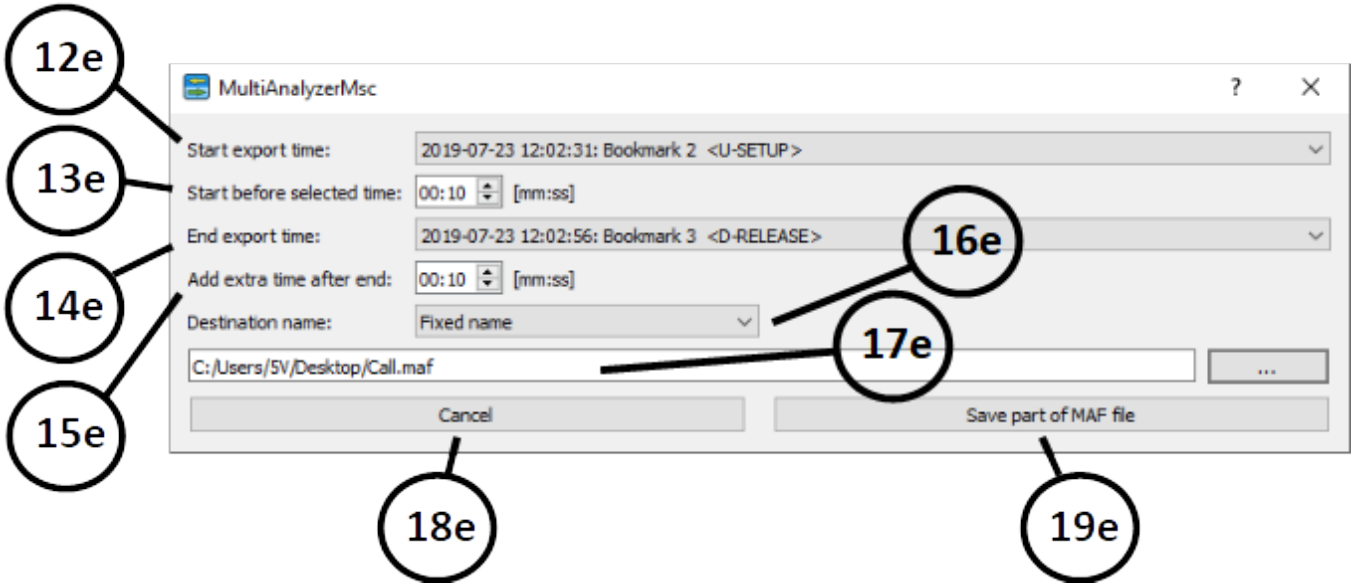


Illustration 73 MultiAnalyzerMsc:Copy a part of the MAF file, Input mask

Name	Description
12e	Message that determines the start time of the range.
13e	A period of time that is to be additionally copied previously the selected time.
14e	Message that determines the end time of the range.
15e	A period of time that is to be additionally copied after the selected time.
16e	Schema of the target file name.
17e	Path and name of the target file.
18e	Button to close the window.
19e	Start saving, the **MultiAnalyzerSplitter** is started with the selected parameters and saves the range without further questions.

Table 43 MultiAnalyzerMsc: Copy a part of the MAF file, Input mask

5.6.3 Protocol Filter Settings

Many redundant protocol information are sent over the air. The filter options help to suppress them and allow the user to focus on the important signalling. Before the analysis starts, the user is requested to define the filter options:

ⓘ A selected option suppresses the described type of information.

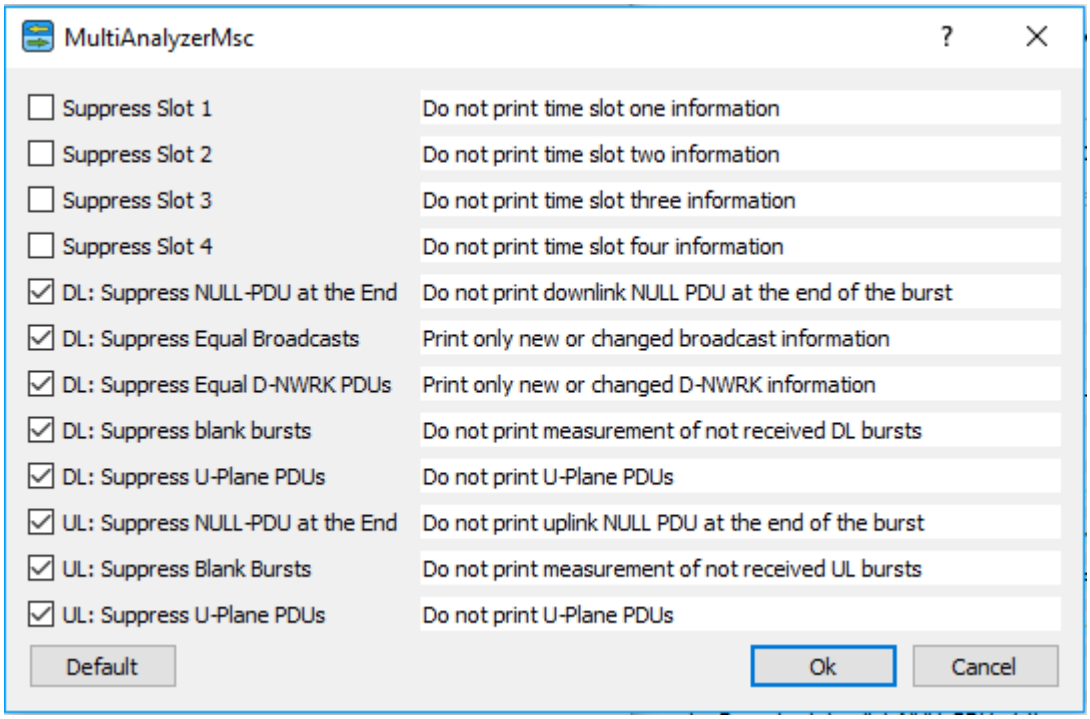


Illustration 74 MultiAnalyzerMsc: Protocol Filter Settings TETRA

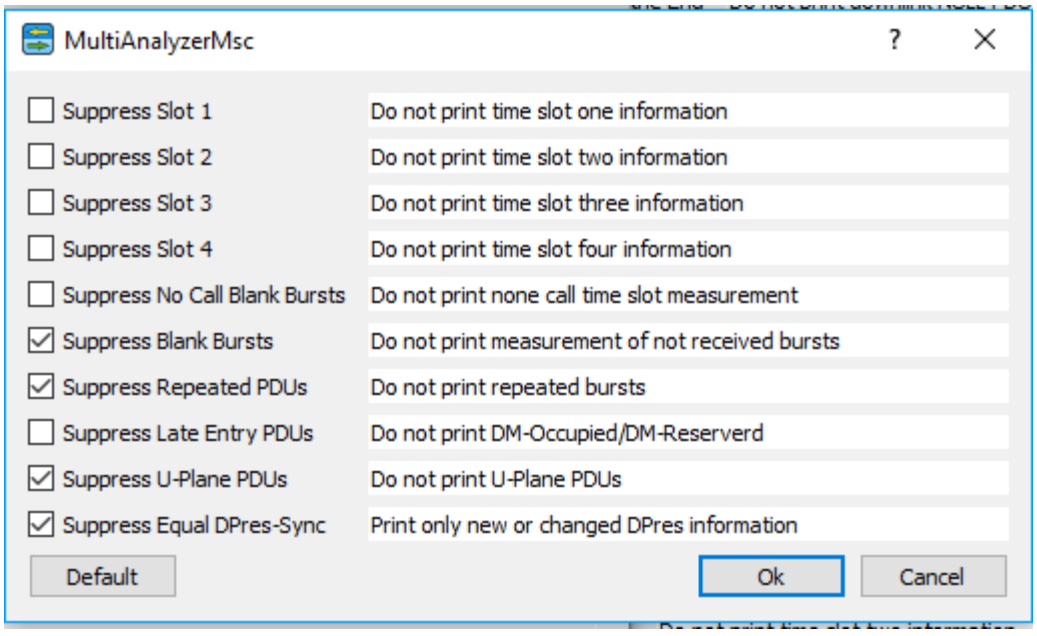


Illustration 75 MultiAnalyzerMsc: Protocol Filter Settings TETRA-DMO

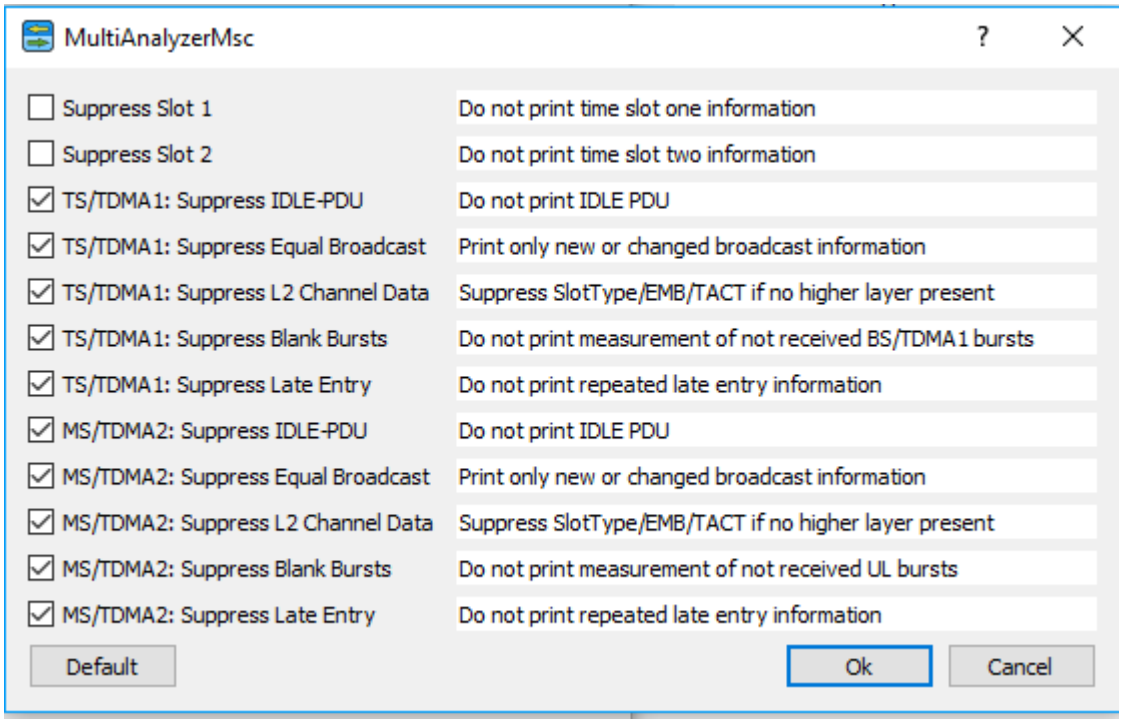


Illustration 76 MultiAnalyzerMsc: Protocol Filter Settings DMR

Some conventions:

“DL”, “TS/TDMA1”: Affects only the downlink direction.

“UL”, “MS/TDMA2”: Affects only the uplink direction.

No specific direction indication means affects all directions.

5.6.4 TETRA Subscriber to Name

TETRA subscriber numbers are in the range of 1 to 16777215. A translation file can translate the numbers into names. The translation data is stored into a CSV formatted file. With the help of the selection dialogue, the translation file can be loaded. This translation file automatically loads at every programme start.

If the selection process of the file is cancelled, the user is asked if the automatic loading during the programme start should also be deleted.

For the file format see chapter Subscriber to Name – File Format.

5.7 MultiAnalyzerQoS

The **MultiAnalyzerQoS** is used to load the record file (e.g. the maf-file) and to graphically present the data in the form of diagrams, charts and tables.

This chapter provides an overview of the **MultiAnalyzerQoS** interface and menus.

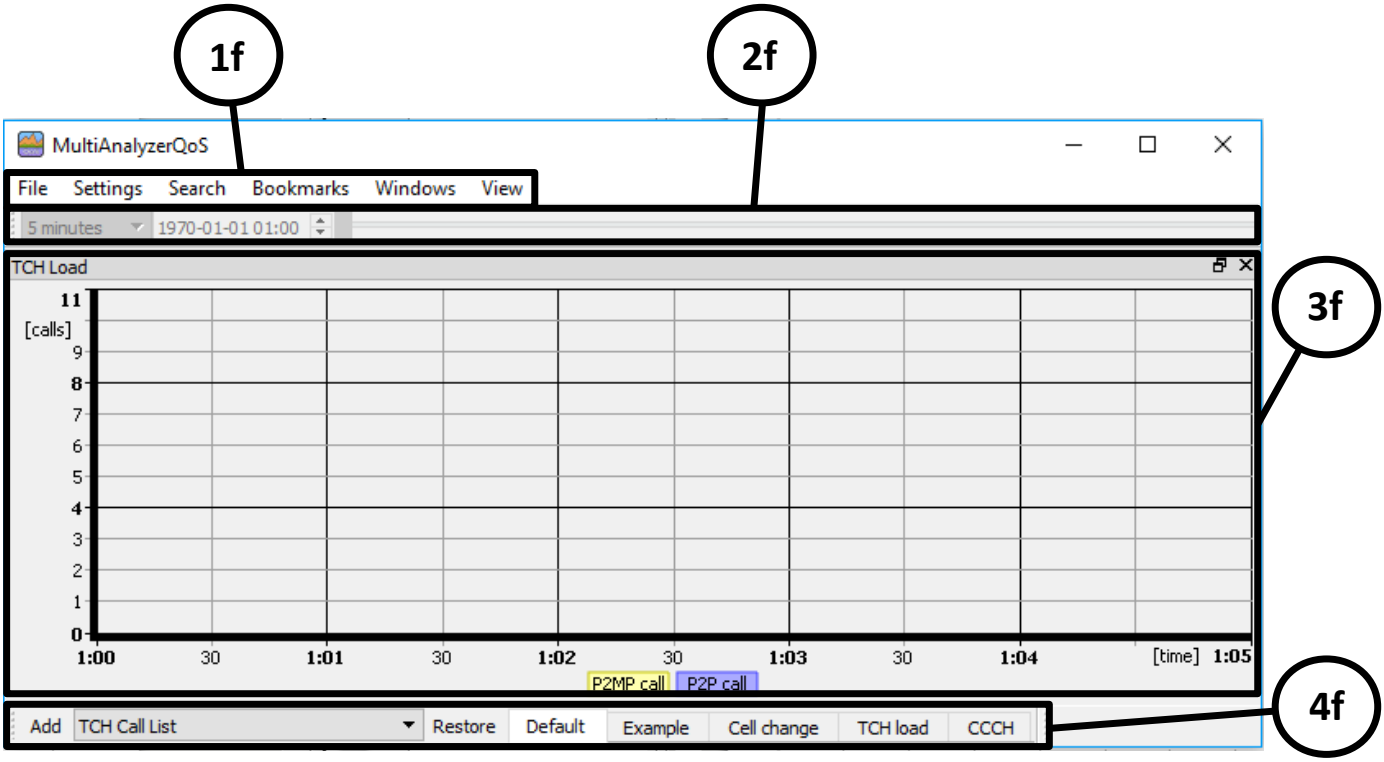


Illustration 77 MultiAnalyzerQoS: Interface

No	Description
1f	The menu bar.
2f	The time toolbar (see chapter 5.7.12 Toolbar).
3f	Main window to show the layout pages and their selected sub windows.
4f	Bar to set layout settings (see chapter Naming the User Layout) or to add sub windows (see chapter Adding a Sub Window).

Table 44 MultiAnalyzerQoS: Interface

Menu ‘File’

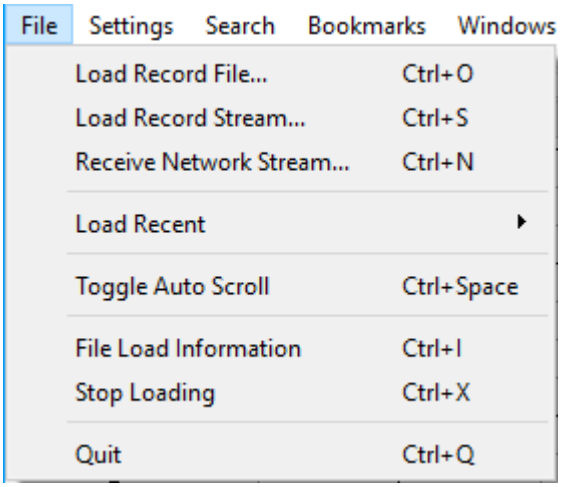


Illustration 78 MultiAnalyzerQoS: Menu ‘File’

Name	Key Combination	Description
Load Record File...	Ctrl+O	Load a file. The programme stops loading at the end of the file.
Load Record Stream...	Ctrl+S	Load a file. The programme does not stop loading at the end of the file and waits until new data is appended to the file (real-time online view).
Receive Network Stream...	Ctrl+N	Open a window to start a real-time network stream (see chapter 5.7.10 Starting Real-Time QoS Stream).
Load Recent	none	List with the last ten files.
Toggle Auto Scroll	Ctrl+Space	Toggle auto scrolling. The programme automatically scrolls with the current time if auto scrolling is enabled. ⓘ Only available in real-time online view.
File Load Information	Ctrl+I	Show details about loaded or received QoS information.
Stop Loading	Ctrl+X	Stop loading.
Quit	Ctrl+Q	Quit the programme.

Table 45 MultiAnalyzerQoS: Menu ‘File’

Menu ‘Settings’

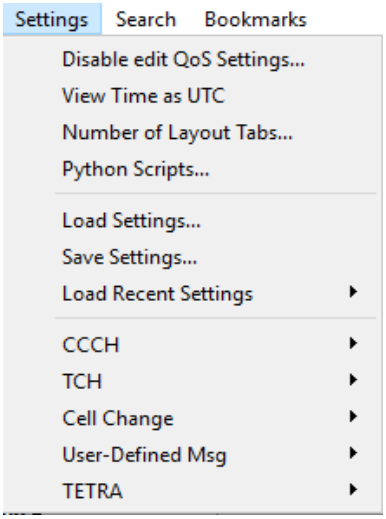


Illustration 79 MultiAnalyzerQoS: Menu ‘Settings’

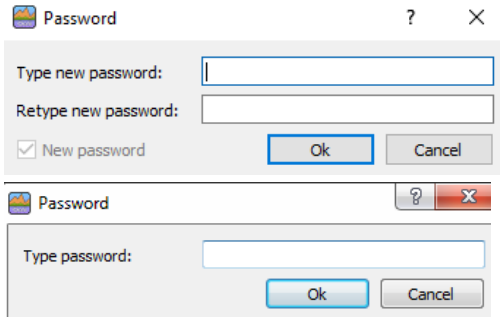
Name	Description	
Disable edit QoS Settings...	Disable the possibility to edit the QoS settings. If the settings are disabled, only the window positions can be changed. To disable the settings, a password is requested, which is also used to enable the settings again. The password have to be entered twice, when it is set, to protect against incorrect entries.	
View Time as UTC	Draw time in current local time or UTC format.	
Number of Layout Tabs...	How many possible views for layouts should be displayed. The range starts with only one view and allows up to ten.	
Python Scripts...	Opens settings for Python script support. See chapter 5.7.9 Python Configuration.	
Load Settings...	Load settings from a file. For encrypted saving, see chapter 7 MultiAnalyzerSaveRules).	
Save Settings...	Save the settings as a file.	
Load Recent Settings	Load settings that have been made recently.	

Table 46 MultiAnalyzerQoS: Menu ‘Settings’

Menu ‘Settings’ (CCCH)

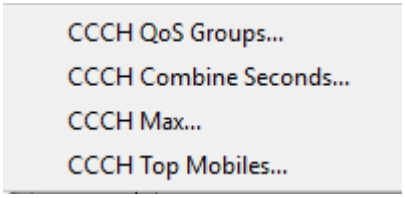


Illustration 80 MultiAnalyzerQoS: Menu ‘Settings’ (CCCH)

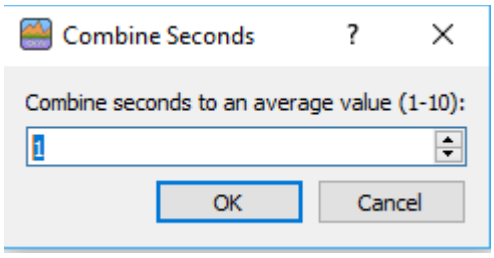
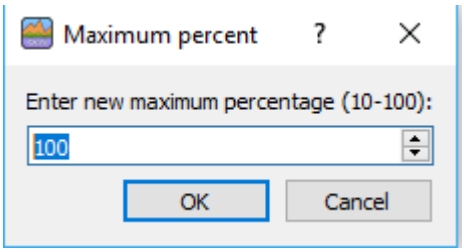
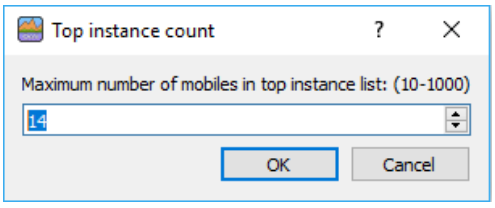
Name	Description	
CCCH QoS Groups...	See chapter 5.7.2 CCCH QoS Groups.	
CCCH Combine Seconds...	Resolution of CCCH‹ Load in seconds (1 to 10s). Multiple seconds create an average value.	
CCCH Max...	Set the maximum value of the CCCH‹ views (10 to 100%).	
CCCH Top Mobiles...	Define the number of radios that are listed in the MCCH‹/SCCH top instances UL‹/DL‹ list.	

Table 47 MultiAnalyzerQoS: Menu ‘Settings’ (CCCH)

Menu ‘Settings’ (TCH)

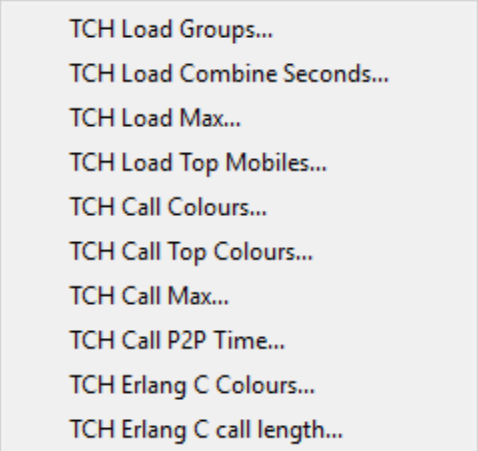
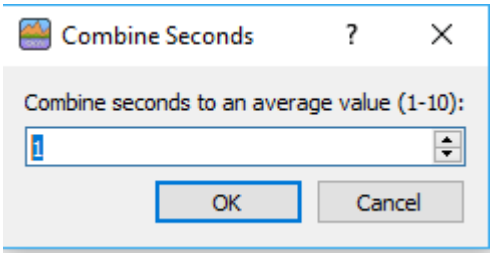
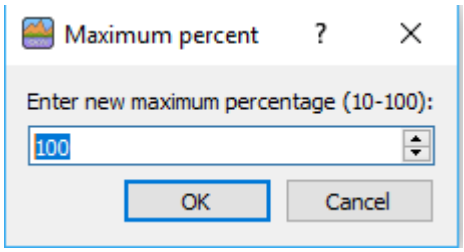
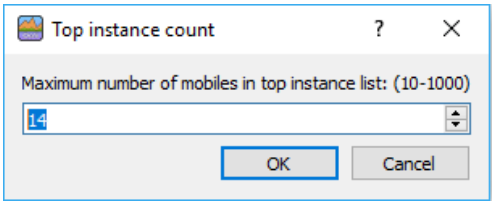
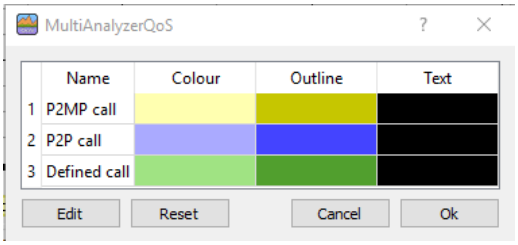
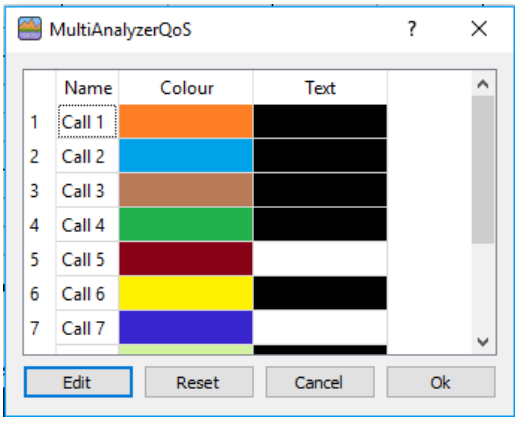
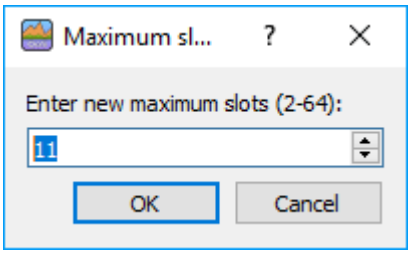
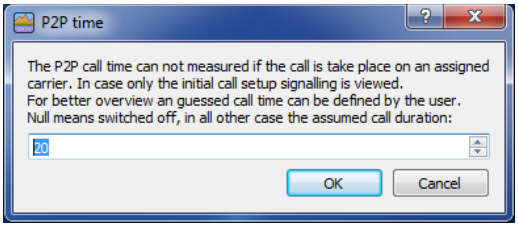


Illustration 81 MultiAnalyzerQoS: Menu ‘Settings’ (TCH)

Name	Description	
TCH Load Groups...	See chapter 5.7.3 TCH QoS Load Groups.	
TCH Load Combine Seconds...	Resolution of TCH‹ Load in seconds (1 to 10s). Multiple seconds create an average value.	
TCH Load Max...	Set the maximum value of the TCH‹ views (10 to 100%).	
TCH Load Top Mobiles....	Define the number of radios that are listed in the MCCH‹/SCCH top instances UL‹/DL‹ list.	
TCH Call Colours...	Change the draw colour of the ‘TCH Load’ view: **Colour**: Fill colour **Outline**: Line around fill area **Text:** Legend text colour **Edit**: Open colour selection	

Name	Description	
	dialogue, to edit the colour. **Reset**: Set back to factory default. **Cancel**: Close settings dialogue without applying the changes. **Ok:** Apply changes.	
TCH Call Top Colours...	Change the colours of the 'TCH Top Call List': **Colour**: Fill colour **Text:** Legend text colour **Edit**: Open colour selection dialogue, to edit the colour. **Reset**: Set back to factory default. **Cancel**: Close settings dialogue without applying the changes. **Ok:** Apply changes.	
TCH Call Max...	Set the maximum value of 'TCH Load' (2 to 64). The value represents available slots of the cell. Every radio adds 4 slots. Decrease this slots by the number of used control channels (MCCH, and SCCH). The resulting value influences the views and TCH Capacity Call Usage directly.	
TCH Call P2P Time...	The P2P, call duration can not be measured in all cases. For uncertain conditions, set a guessed value for the call duration.	

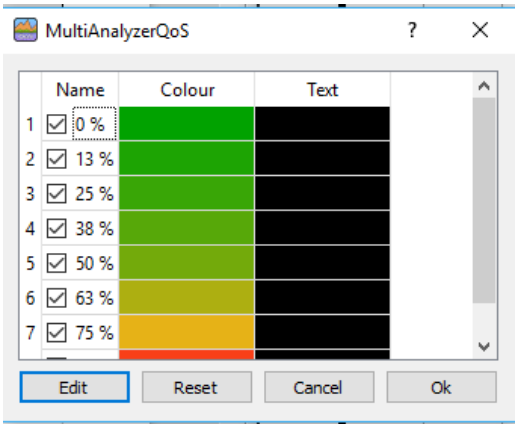
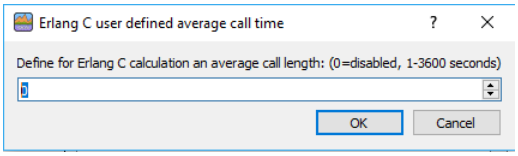
Name	Description	
TCH Erlang C Colours...	Up to eight different sections can be set. Every section can be activated/deactivated with the checkbox. The percentage can individually be set and the previous section ends with the start of the next one.	
	Change the colours of the 'TCH ErlangC' view: **Colour**: Fill colour **Text:** Legend text colour	
	Edit: Open colour selection dialogue, to edit the colour. **Reset**: Set back to factory default. **Cancel**: Close settings dialogue without applying the changes. **Ok:** Apply changes.	
TCH Erlang C call length...	Define an average call length for the Erlang C calculation.	

Table 48 MultiAnalyzerQoS: Menu 'Settings' (TCH)

Menu ‘Settings’ (Cell Change)

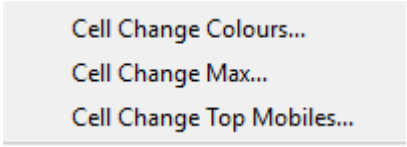


Illustration 82 MultiAnalyzerQoS: Menu ‘Settings’ (Cell Change)

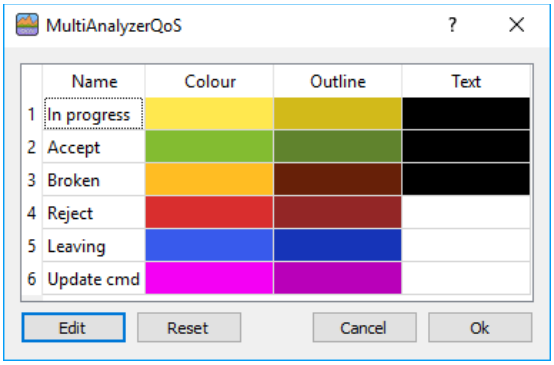
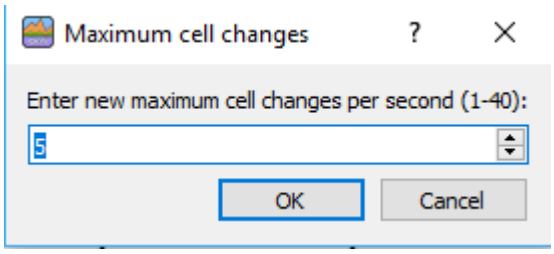
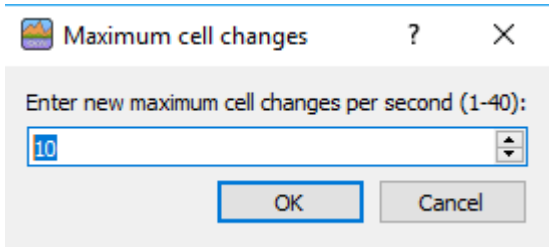
Name	Description	
Cell Change Colours...	Change the draw colour of the ‘Cell Change’ view: **Colour**: Fill colour **Outline**: Line around fill area **Text:** Legend text colour	
	Edit: Open colour selection dialogue, to edit the colour. **Reset**: Set back to factory default. **Cancel**: Close settings dialogue without applying the changes. **Ok:** Apply changes.	
Cell Change Max...	Set the maximum value of the cell change view (1 to N).	
Cell Change Top Mobiles….	Define the number of mobiles that are listed in the top cell change list.	

Table 49 MultiAnalyzerQoS: Menu ‘Settings’ (Cell Change)

Menu ‘Settings’ (User-Defined Msg)

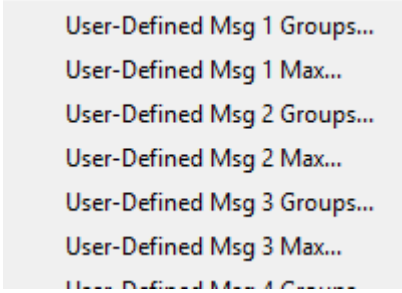


Illustration 83 MultiAnalyzerQoS: Menu ‘Settings’ (User-Defined Msg)

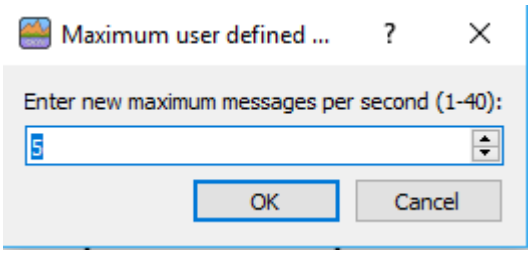
Name	Description	
User-Defined Msg {1-5} Groups...	See chapter 5.7.4 User Defined Messages {1-5} Groups.	
User-Defined Msg {1-5} Max...	Set the maximum value of the bars (1 to N).	

Table 50 MultiAnalyzerQoS: Menu ‘Settings’ (User-Defined Msg)

Menu ‘Settings’ (TETRA)

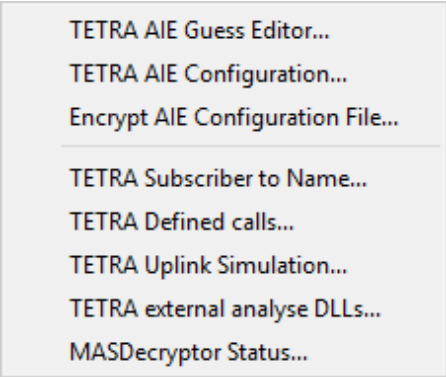


Illustration 84 MultiAnalyzerQoS: Menu ‘Settings’ (TETRA)

Name	Description
Encrypt AIE Configuration File...	Encrypts an AIE configuration text file to hide its contents (i.e. the keys). **Attention: The file cannot be decrypted and therefore cannot be put back into text form!** However, the (decrypted) content is temporarily used internally. A dongle is required for encryption/decryption. When encrypting, the user determines which dongle may decrypt the file again for internal use.
TETRA Subscriber to Name…	See chapter 5.7.5 TETRA Subscriber to Name Dialogue (MultiAnalyzerQoS).
TETRA Defined Calls…	See chapter 5.7.6 TETRA Defined Calls Dialogue (MultiAnalyzerQoS).
TETRA Uplink Simulation...	See chapter 5.7.7 The Uplink Simulation.
TETRA external analyse DLLs...	Choose up to eight user build external Analyse-DLL. The DLLs can export data, analyse and print unsupported parts of the protocol and replace parts of the internal MultiAnalyzer protocol analysis.
MASDecryptor Status...	Displays the connection status and enabled options.

Table 51 MultiAnalyzerQoS: Menu ‘Settings’ (TETRA)

TETRA, AIE, options and the **MASDecryptor** are described in another document.

Menu ‘Search’

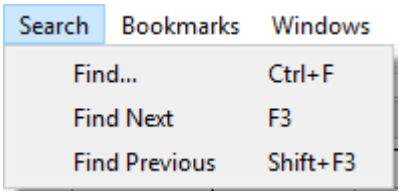


Illustration 85 MultiAnalyzerQoS: Menu 'Search'

Name	Key Combination	Description
Find...	Ctrl+F	Open the search dialogue (see chapter 5.7.8 Search Dialogue (MultiAnalyzerQoS)).
Find Next	F3	Search the next item with the same settings.
Find Previous	Shift+F3	Search the previous item with the same settings.

Table 52 MultiAnalyzerQoS: Menu 'Search'

Menu ‘Bookmarks’

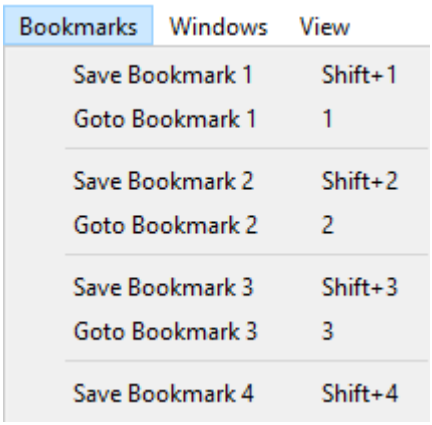


Illustration 86 MultiAnalyzerQoS: Menu ‘Bookmarks’

Name	Key Combination	Description
Save Bookmark 1	Shift+1	Save the selected cursor position.
Goto Bookmark 1	1	Return to the saved cursor position.
...		
Save Bookmark 10	Shift+0	Save the selected cursor position.
Goto Bookmark 10	0	Return to the saved cursor position.

Table 53 MultiAnalyzerQoS: Menu ‘Bookmarks’

Menu ‘Windows’

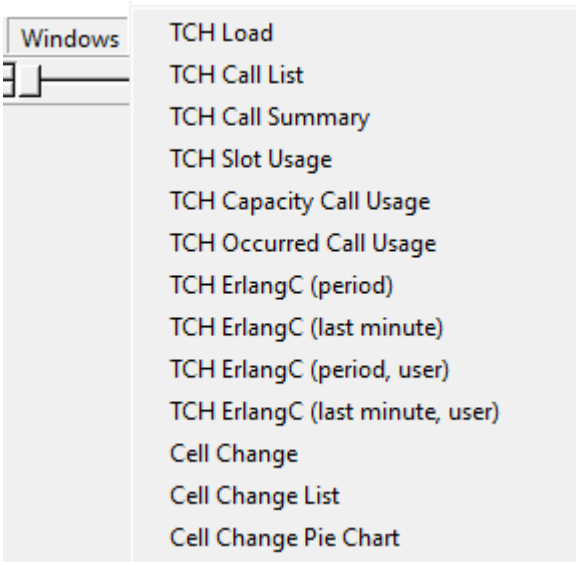


Illustration 87 MultiAnaylzerQoS: Menu ‘Windows’

Show available sub windows that include the measuring results. If the name is selected, the window is visible. The sub windows can be added or closed via the menu section ‘Windows’ or like it is described in chapter Adding a Sub Window and Closing a Sub Window.

Menu ‘View’

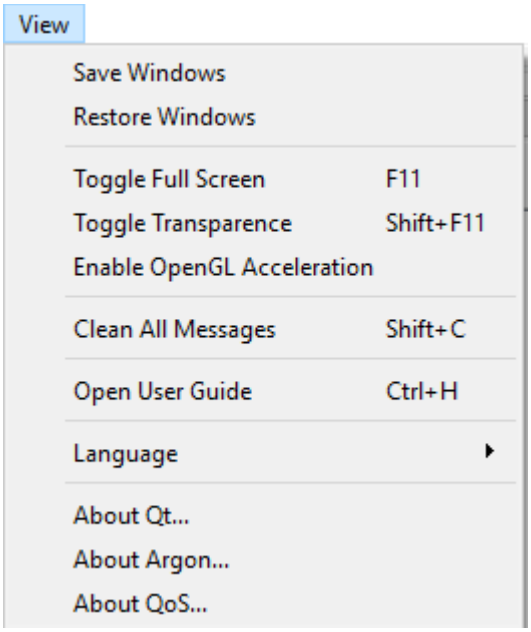


Illustration 88 MultiAnalyzerQoS: Menu ‘View’

Name	Key Combination	Description
Save Windows	none	Save current window position. ⓘ At the next programme start this windows position are reused.
Restore Windows	none	Reuse formerly stored window position now.
Toggle Full Screen	F11	Toggle maximum size (full screen) view.
Toggle Transparence	Shift+F11	Toggle the transparence of the viewed background.
Enable OpenGL Acceleration	none	Draw with OpenGL instead of raster engine. ⓘ Do not work in parallel with activated transparence option. ⓘ Works only if a windows graphic driver with OpenGL support is installed.
Clean All Messages	Shift+C	Clean all messages from view and free used memory. ⓘ Makes sense in real-time online view. The user can concentrate on new messages without a large history of old messages. The data that is contained in the file stays untouched.
Open User Guide	Ctrl+H	Open the user manual.
Language	none	Change the interface language.
About Qt...	none	Show information about used tool set.
About Argon…	none	Show licence information of used Argon algorithm.
About QoS...	none	Show information about the **MultiAnalyzerQoS**.

Table 54 MultiAnalyzerQoS: Menu 'View'

5.7.1 Layout Configuration

After initial start the **MultiAnalyzerQoS** is not configured.

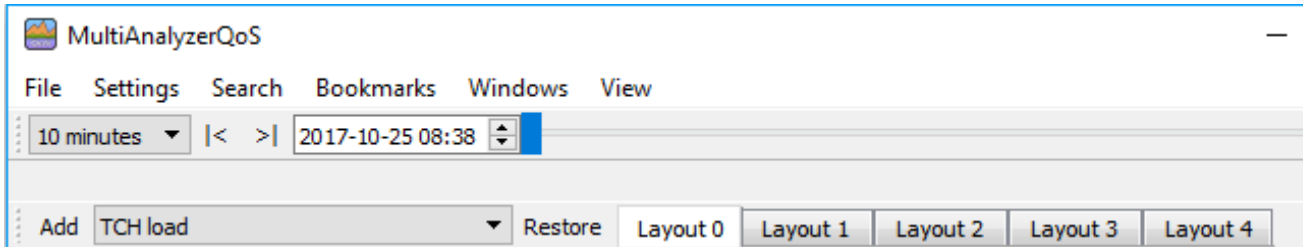


Illustration 89 MultiAnalyzerQoS: Layout

The different layout pages can be renamed and adjusted by adding, moving and closing the sub windows.

ⓘ The layout of the pages can individually be stored and restored. Otherwise the last changes that were made on the layout page, will be displayed at the next programme start.

The following chapters provide an overview about the possibilities of personalising the layout:

- Adding a Sub Window
- Moving a Sub Window
- Detaching and Reintegrating a Sub Window
- Closing a Sub Window
- Naming the User Layout

Adding a Sub Window

All not visible sub windows can be added to the chosen layout page in the main window.

> ⓘ The layout of the pages can individually be stored and restored. Otherwise the last changes that were made on the layout page, will be displayed at the next programme start.

To add a sub window, follow the next steps.

1. Choose a window from the drop-down list at the left bottom (see 90).

Illustration 90 MultiAnalyzerQoS: Drop-Down List

2. To add the chosen sub window, click on the button Add .

✔ The chosen window is added to the layout page in the main window (see 91).

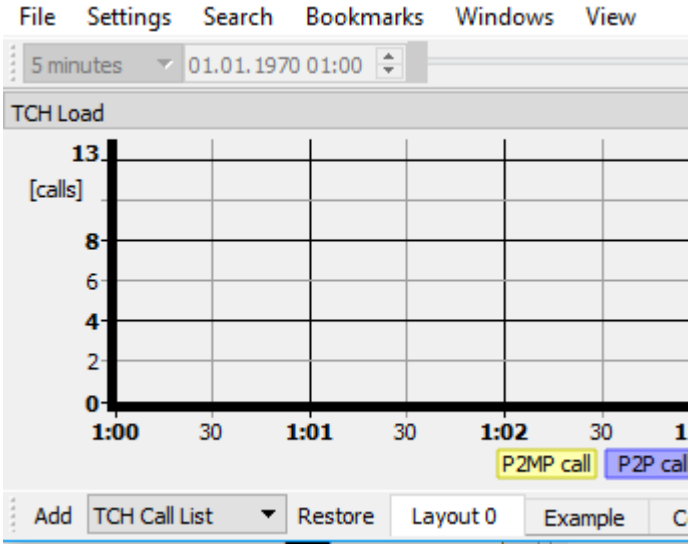


Illustration 91 MultiAnalyzerQoS: Adding Sub Window

> ⓘ Depending on the protocol, not all measurement windows have a function. These inactive windows are marked as disabled like: (!!! DMR: Not used !!!)

> ⓘ It is also possible to add the windows via the menu section ‘Windows’ (see Chapter 5.7 MultiAnalyzerQoS).

> ⓘ To close a sub window, see chapter Closing a Sub Window.

> ⓘ To move or detach a sub window, see chapter Moving a Sub Window and Detaching and Reintegrating a Sub Window.

Moving a Sub Window

Sub windows can be moved within the main window to adjust the view of the layout page.

> ⓘ The layout of the pages can individually be stored and restored. Otherwise the last changes that were made on the layout page, will be displayed at the next programme start.

To move a sub window, follow the next steps.

➔ Sub windows are opened in **MultiAnalyzerQoS**.

> ⓘ To add sub windows, see chapter Adding a Sub Window.

1. Click left on the title bar of the sub window (see 92) and hold the mouse button.

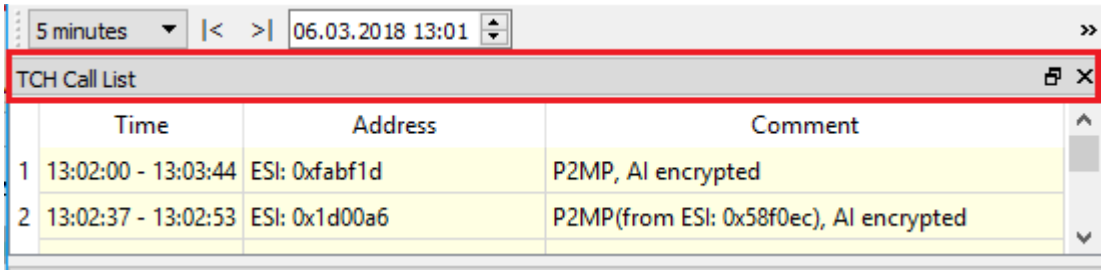


Illustration 92 MultiAnalyzerQoS: Title Bar

2. To change the position of the sub window, drag the sub window on the wanted position.

✔ The new position is marked (see 93).

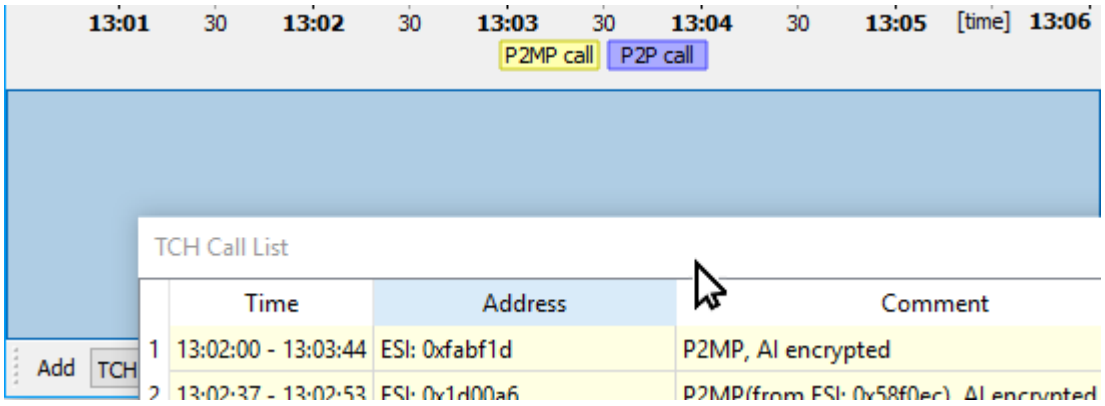


Illustration 93 MultiAnalyzerQoS: Drag Sub Window

3. Drop the sub window.

✔ The position of the sub window is changed (see 94).

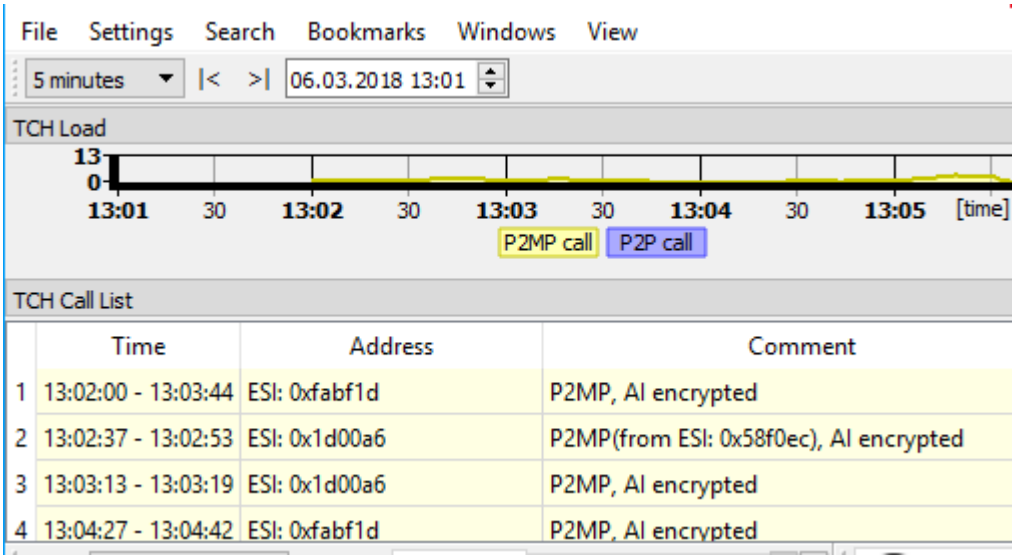


Illustration 94 MultiAnalyzerQoS: Drop Sub Window

ⓘ To close a sub window, see chapter Closing a Sub Window.

Detaching and Reintegrating a Sub Window

It is possible to detach a sub window from the main window and to reintegrate the sub window to the main window again.

> ⓘ The layout of the pages can individually be stored and restored. Otherwise the last changes that were made on the layout page, will be displayed at the next programme start.

To detach and reintegrate a sub window, follow the next steps.

➔ Sub windows are opened in **MultiAnalyzerQoS**.

> ⓘ To add sub windows, see chapter Adding a Sub Window.

1. To detach the sub window from the main window, click on the button in the title bar of the sub window (see 95).

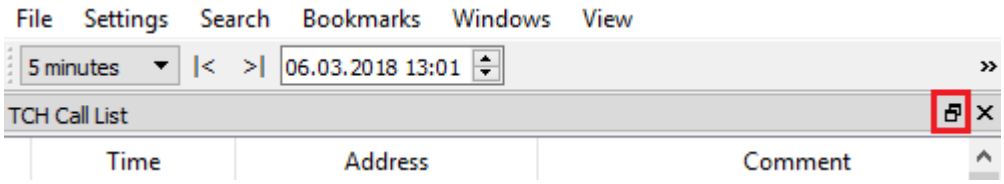


Illustration 95 MultiAnalyzerQoS: Title Bar Detach

✔ The sub window is detached and movable (see 96).

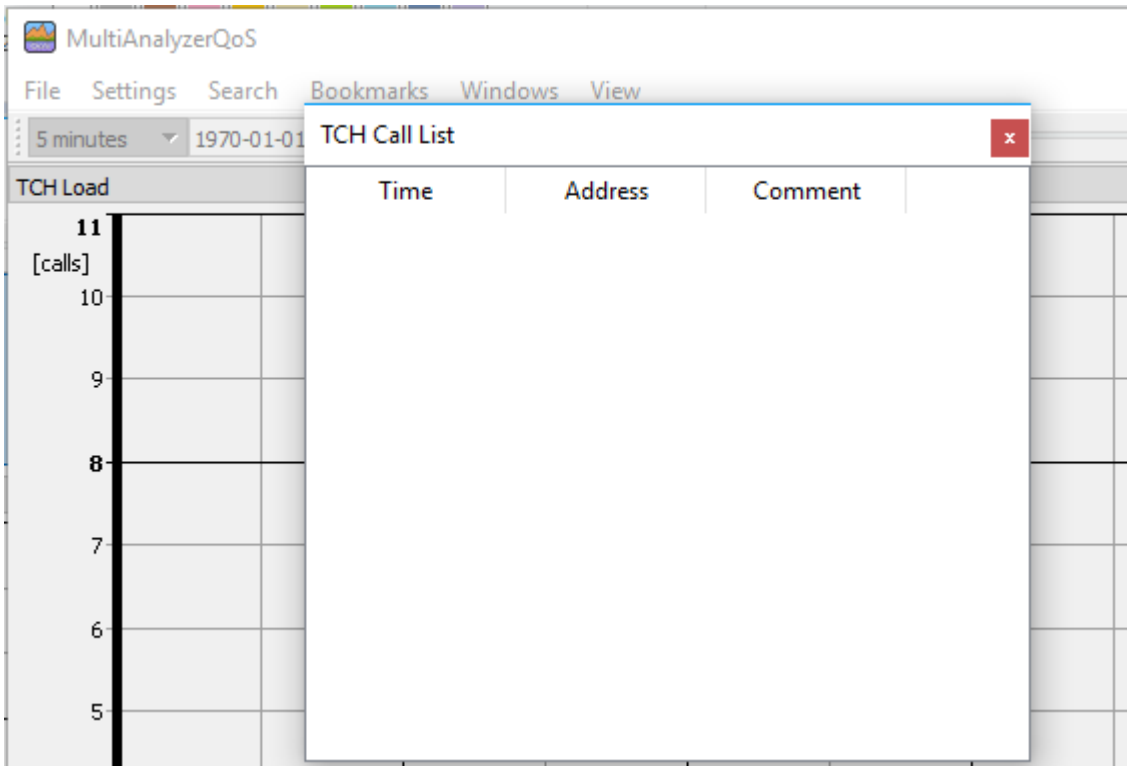


Illustration 96 MultiAnalyzerQoS: Detach Sub Window

2. To reintegrate the window, drag the sub window back into the main window (see chapter Moving a Sub Window).

✔ The new position is marked (see 97).

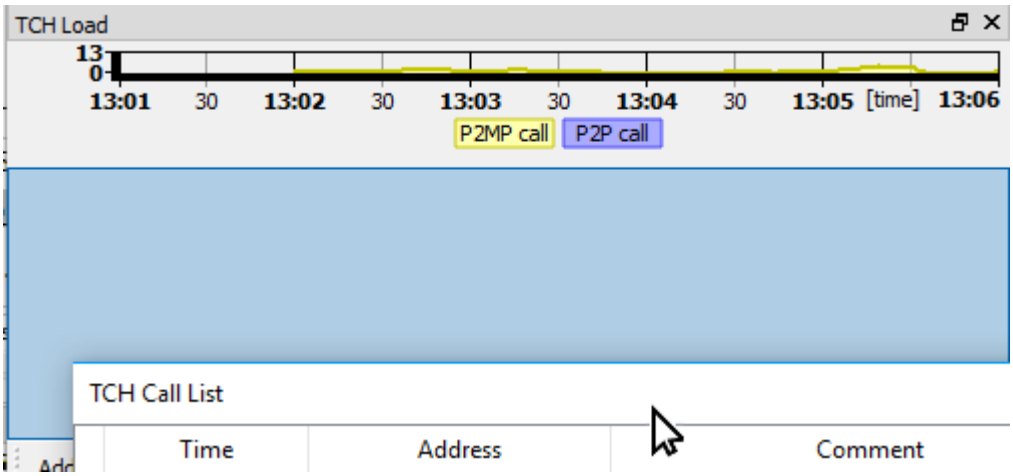


Illustration 97 MultiAnalyzerQoS: Drag Sub Window

3. Drop the sub window.

✔ The sub window is positioned where the sub window has been dropped.

ⓘ To close a sub window, see chapter Closing a Sub Window.

Closing a Sub Window

Every sub window can be closed individually.

> ⓘ The layout of the pages can individually be stored and restored. Otherwise the last changes that were made on the layout page, will be displayed at the next programme start.

To close a sub window, follow the next step.

➔ Sub windows are opened in **MultiAnalyzerQoS**.

> ⓘ To open sub windows, see chapter Adding a Sub Window.

- To close a sub window, click on the button ✕ in the title bar of the sub window (see 98).

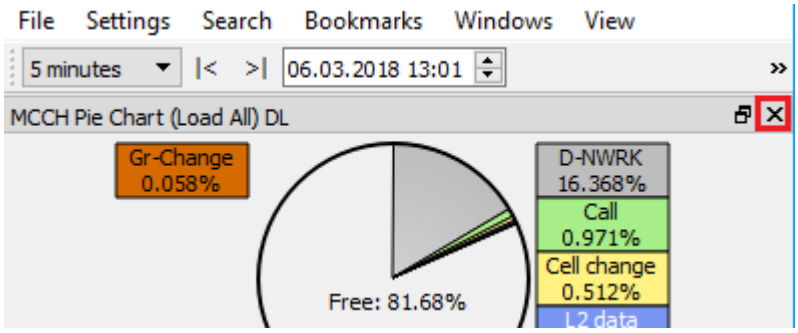


Illustration 98 MultiAnalyzerQoS: Close Sub Window

✔ The window is closed.

Naming the User Layout

Up to five different layouts can be saved. The layouts are presented in a tab sidebar at the bottom on the right. Switching to another layout, stores the current view and loads the chosen one. Every layout can individually be named.

ⓘ The layout is permanently stored at the computer. Every layout can have a custom setting for the background transparency. The global settings can be used as well as the transparency can be switched on or off.

To name the layout, follow the next steps.

1. To open the dialogue for the name change, double-click on the corresponding tab page in the tab sidebar (see 99).

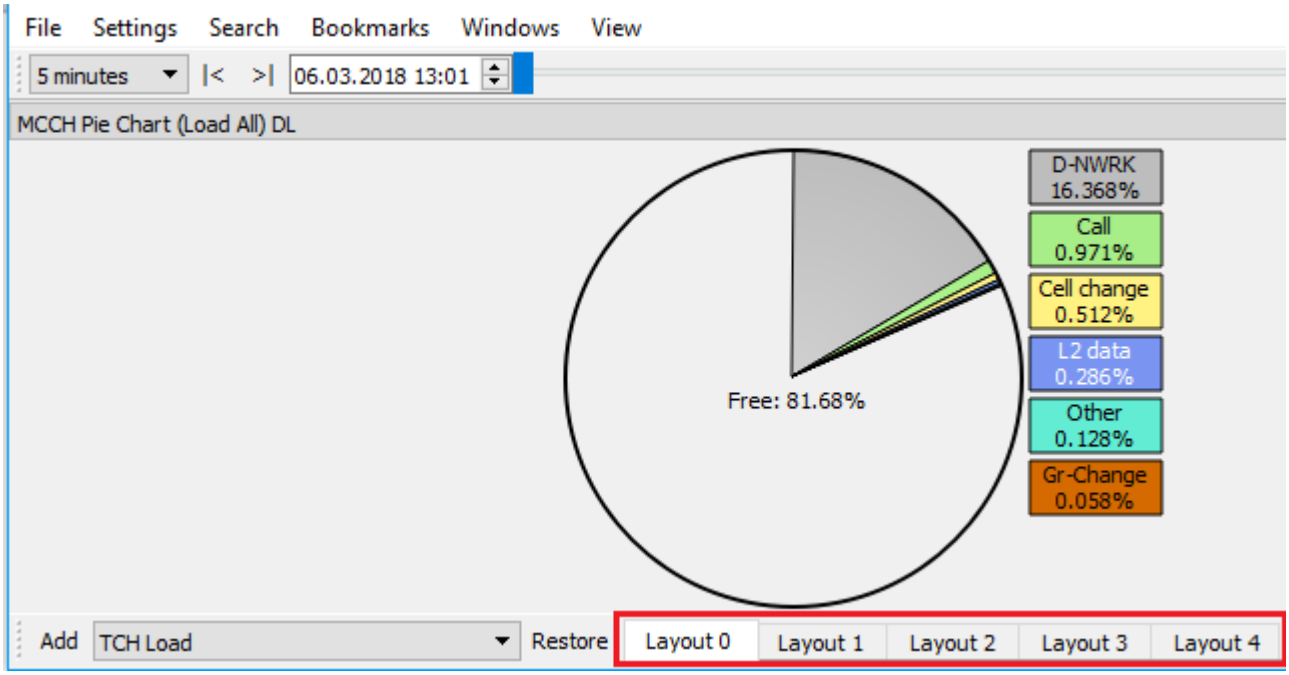


Illustration 99 MultiAnalyzerQoS: Tab Page Sidebar

✔ The dialogue opens (see 100).

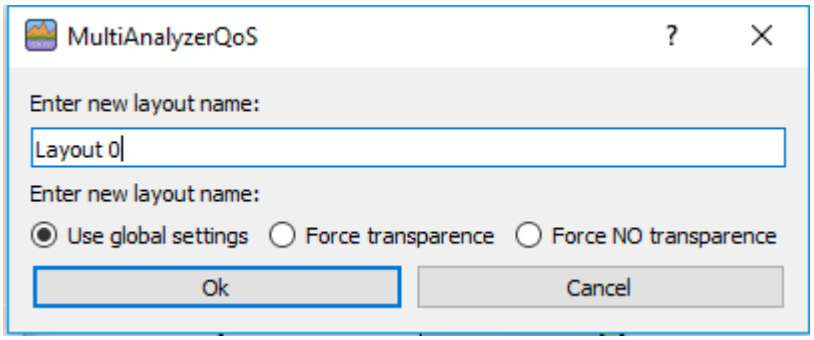


Illustration 100 MultiAnalyzerQoS: Layout Name

2. To change the name of the layout page, enter a name into the text field and click on the button [Ok].

✔ The name of the tab page is changed (see 101).

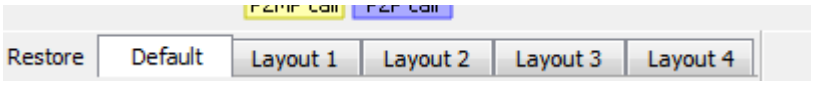


Illustration 101 MultiAnalyzerQoS: Tab Changed Name

ⓘ To adjust the different layout pages, see chapter Adding a Sub Window, Moving a Sub Window, Detaching and Reintegrating a Sub Window and Closing a Sub Window.

5.7.2 CCCH QoS Groups

This chapter provides an overview of the CCCH、Load view settings dialogue. For further information see chapter TETRA: CCCH Load DL/UL and DMR: Channel Load.

- Open the settings dialogue via ‘Settings’ > ‘CCCH’ > ‘CCCH QoS Groups...’.

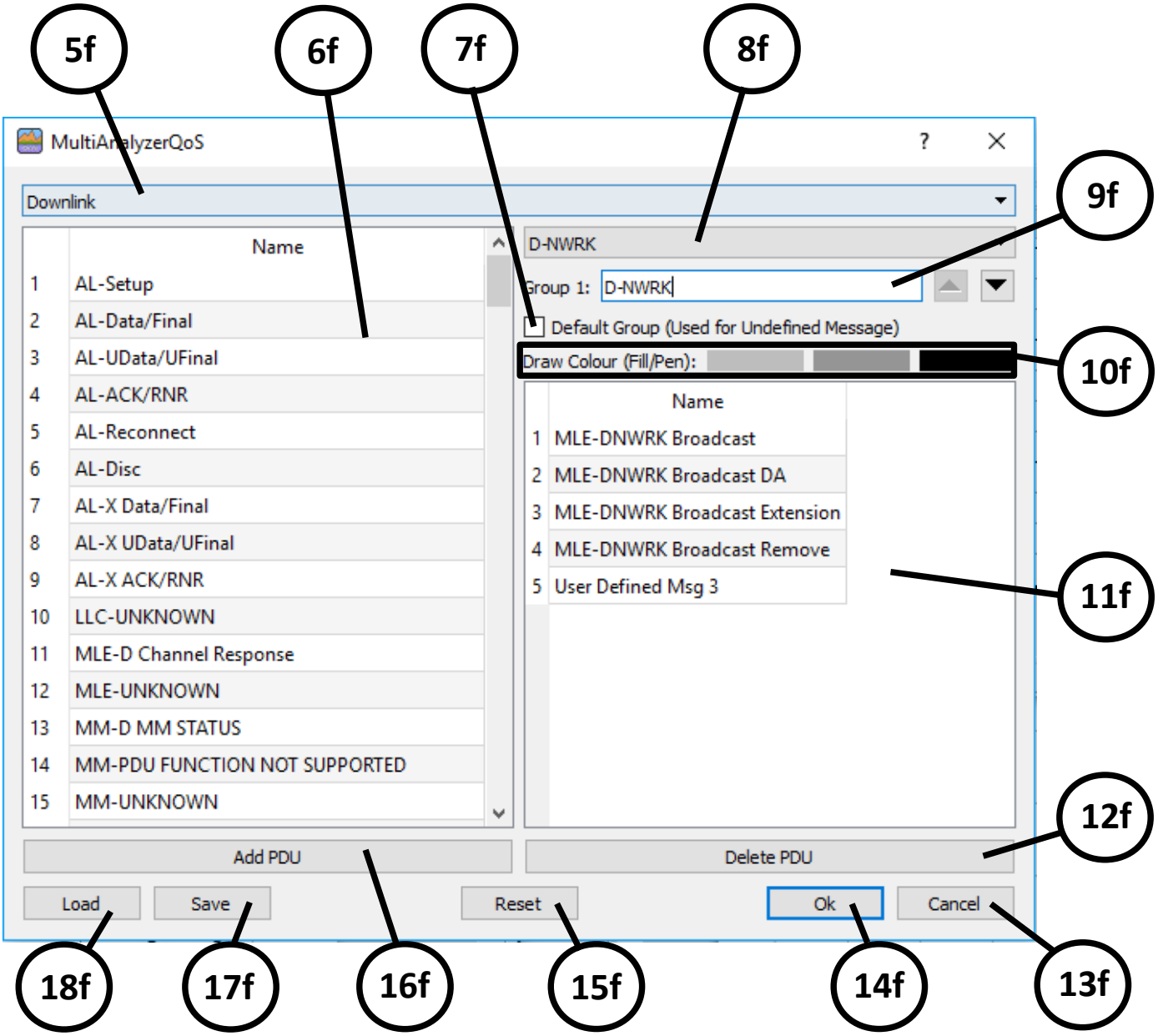


Illustration 102 MultiAnalyzerQoS: CCCH QoS Groups

No	Description
5f	Drop-down list to select the direction (downlink/uplink). All data are handled independently.
6f	List with available unused PDU‚ types.
7f	Checkbox to declare group as default group. All unassigned messages are automatically added to this group.
8f	Drop-down list to select the current group.
9f	Text field to change the current group name and buttons to move the group position (up/down) within the list. The list items will be shown on the bottom of the viewed window. The first item in the list is the last one in the window list and vice versa.
10f	Section to change the draw colour. Left is the fill colour, mid is the outline colour, right is the text colour.
11f	The list with the assigned PDUs‚ to the group.
12f	Button to remove the selected assigned PDU‚ from the current group.
13f	Button to cancel the current settings dialogue.
14f	Button to apply the current settings.
15f	Button to reset the settings to factory default.
16f	Button to add the selected unassigned PDU‚ to the current group.
17f	Button to save the current settings to a file.
18f	Button to load the settings from a file.

Table 55 MultiAnalyzerQoS: CCCH QoS Groups

Downlink and Uplink QoS Groups

This chapter provides an overview of the different QoS groups.

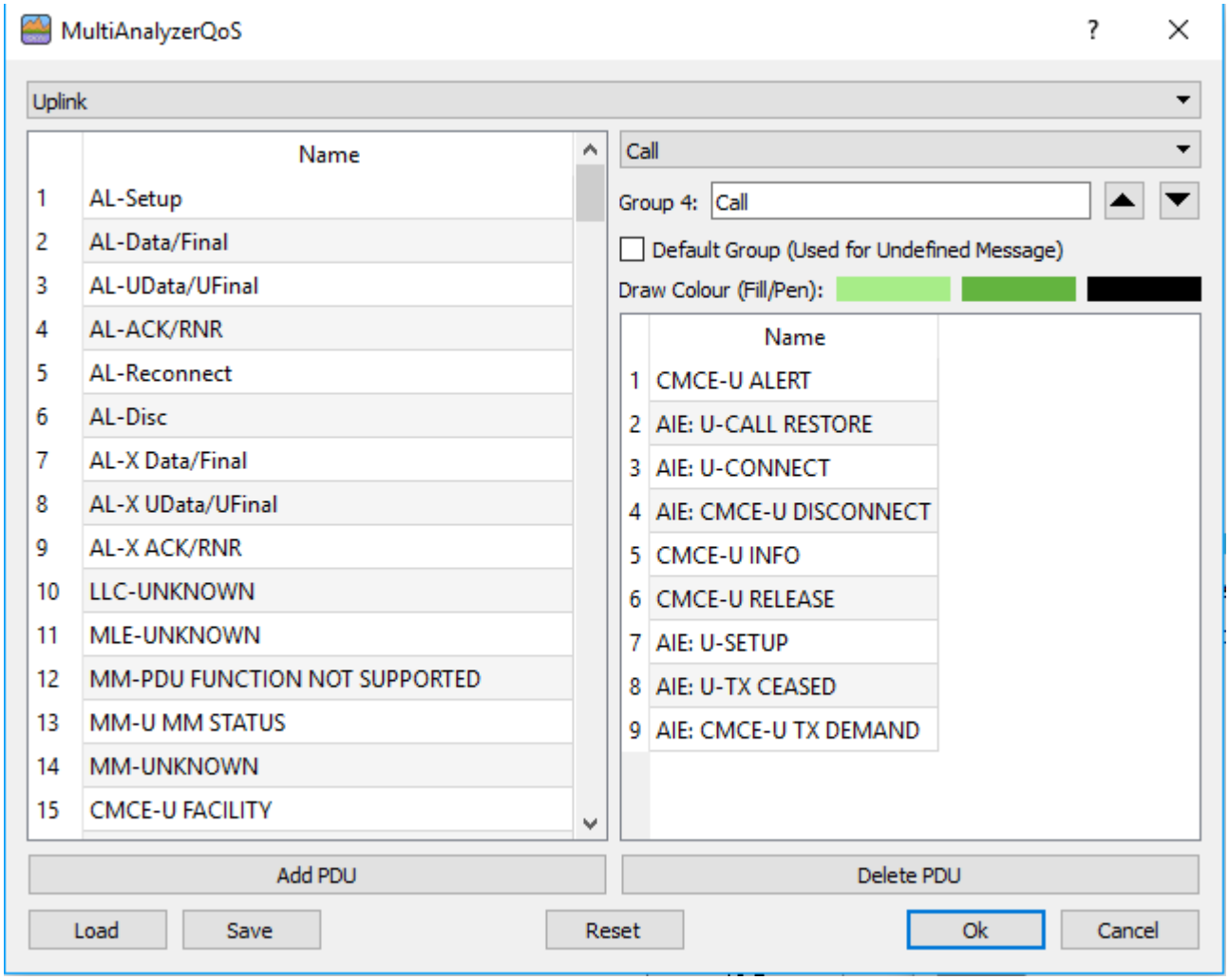


Illustration 103 MultiAnalyzerQoS: DL and UL QoS Groups

At the left side the list of available messages is shown. At the right side there are the settings and the assigned PDUs. One mandatory group is defined by default. The 'Default Group' is used for all PDUs that are not assigned to a user-defined group. This ensures that all occurred signalling is shown.

Depending on the direction type, only PDUs، are listed that are available for the chosen direction. In case of the uplink direction, four additional none PDUs، are listed:

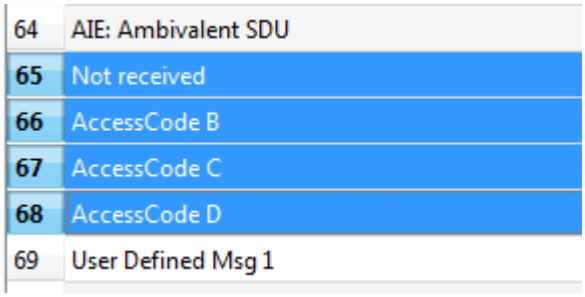


Illustration 104 MultiAnalyzerQoS: None PDUs

Name	Description
Not received	All not received uplink PDUs، are grouped into these groups. Not received PDUs، are determined by: • Unused “reserved slots” • Random-Access Acknowledge without the reception of a corresponding uplink burst
TETRA:	
AccessCode B	Ordinary random access transmissions are using the **AccessCode A** configuration. The other Access Codes are typically reserved for priority access, like emergency calls or special groups access. If the infrastructure reserves too much uplink space for an optional Access Code, a bottleneck for the **AccessCode A** can occur. The viewed optional Access Code means the reserved space for that Access Code and not the effectively used space.
AccessCode C	
AccessCode D	

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5.7.3 TCH QoS Load Groups

This chapter provides an overview of the TCH‹ Load view settings dialogue. For further information see chapter TETRA: TCH QoS Load DL/UL.

- Open the settings dialogue via ‘Settings’ > ‘TCH’ > ‘TCH Call Groups...’.

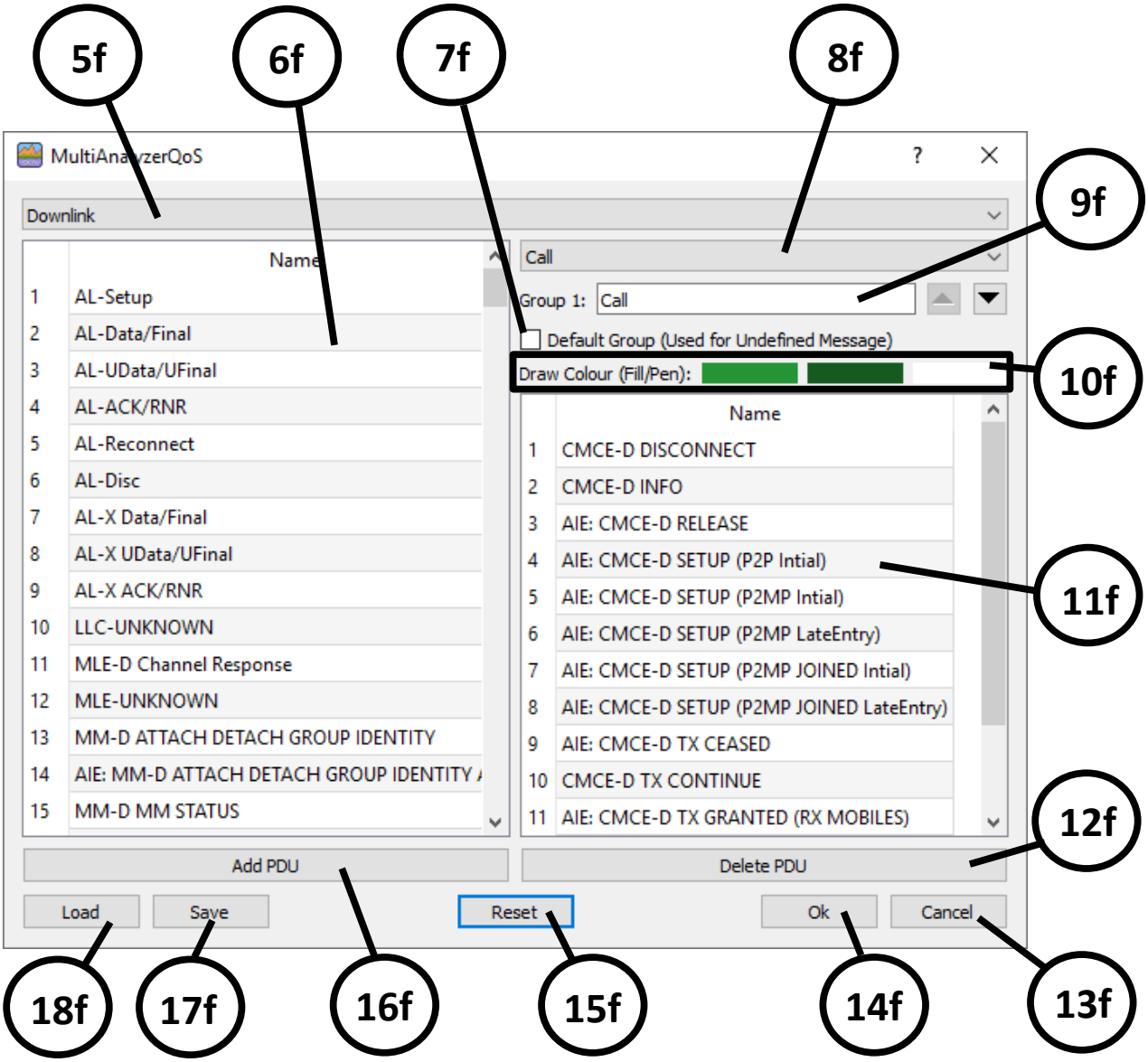


Illustration 105: MultiAnalyzerQoS: TCH Load Groups

No	Description
5f	Drop-down list to select the direction (downlink/uplink). All data are handled independently.
6f	List with available unused PDU‹ types.
7f	Checkbox to declare group as default group. All unassigned messages are automatically added to this group.
8f	Drop-down list to select the current group.
9f	Text field to change the current group name and buttons to move the group position (up/down) within the list. The list items will be shown on the bottom of the viewed window. The first item in the list is the last one in the window list and vice versa.
10f	Section to change the draw colour. Left is the fill colour, mid is the outline colour, right is the text colour.
11f	The list with the assigned PDUs‹ to the group.
12f	Button to remove the selected assigned PDU‹ from the current group.
13f	Button to cancel the current settings dialogue.
14f	Button to apply the current settings.
15f	Button to reset the settings to factory default.
16f	Button to add the selected unassigned PDU‹ to the current group.
17f	Button to save the current settings to a file.
18f	Button to load the settings from a file.

Table 56 MultiAnalyzerQoS: TCH Load Groups

TCH Downlink and Uplink QoS Groups

This chapter provides an overview of the different TCH QoS groups.

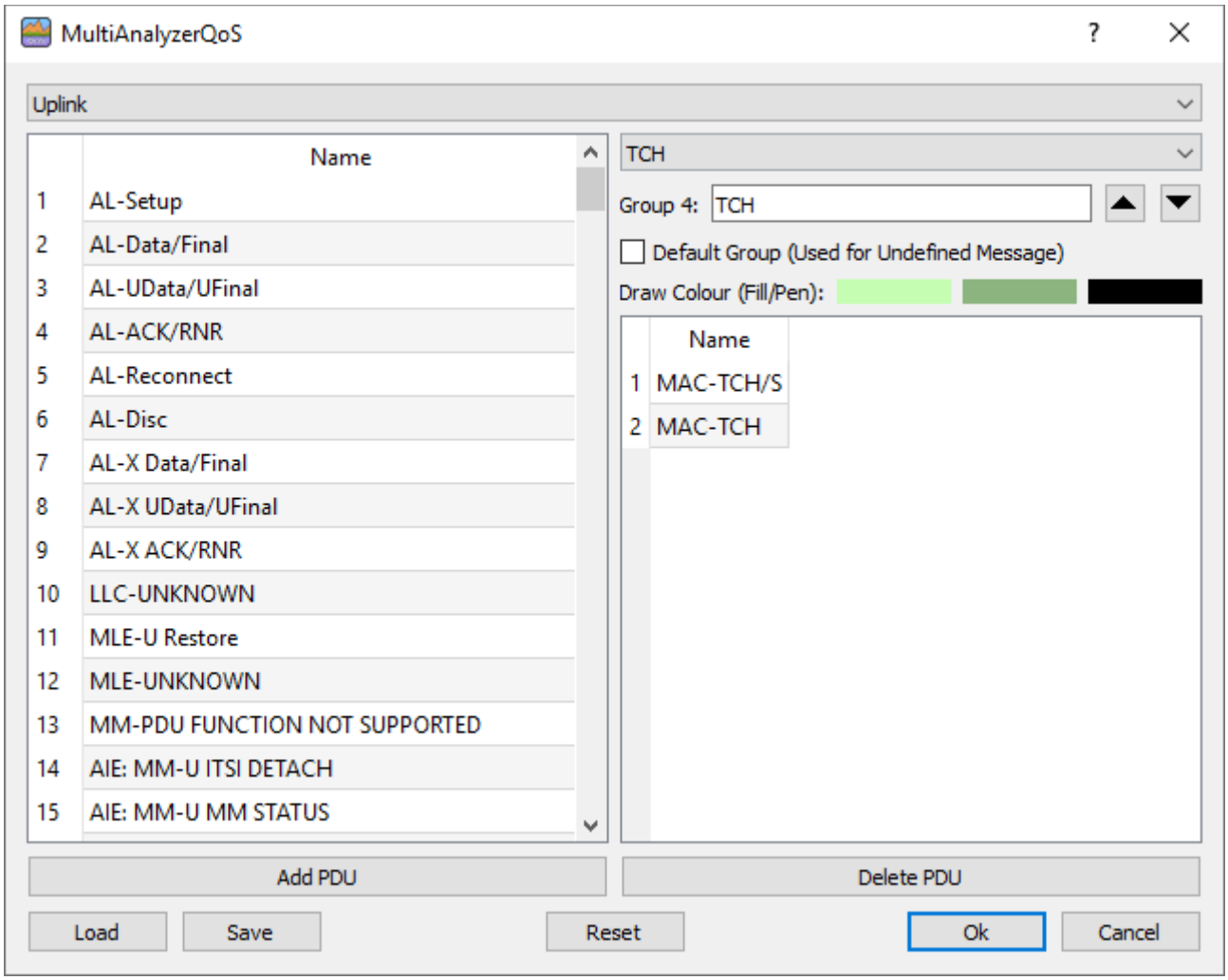
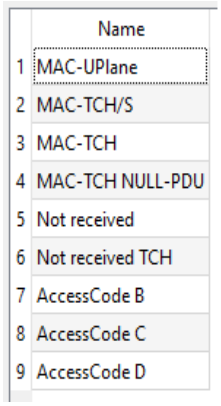


Illustration 106 MultiAnalyzerQoS: DL and UL QoS Groups

At the left side the list of available messages is shown. At the right side there are the settings and the assigned PDUs. One mandatory group is defined by default. The 'Default Group' is used for all PDUs that are not assigned to a user-defined group. This ensures that all occurred signalling is shown.

Depending on the direction type, only PDUs، are listed that are available for the chosen direction. For traffic channel six additional PDUs، and three none PDUs are listed:



	Name
1	MAC-UPlane
2	MAC-TCH/S
3	MAC-TCH
4	MAC-TCH NULL-PDU
5	Not received
6	Not received TCH
7	AccessCode B
8	AccessCode C
9	AccessCode D

Illustration 107: MultiAnalyzerQoS: TCH PDUs

Name	Description
MAC-UPlane	Received U-Plane signalling (E2E or for BDBOS: OPTA)
MAC-TCH/S	Received TCH/S (Speech)
MAC-TCH	Received TCH circuit mode data (TCH2.4, TCH4.8 or TCH7.2)
MAC-TCH NULL-PDU	Replaces TCH(/S) data: • DL: Received in UL. • DL: Replacing TCH(/S) load that wasn't received from UL. • UL: Send if no data from speech codec is present.
Not received	All not received uplink **signalling** PDUs، (but not TCH(/S) load) are grouped into these groups. Not received PDUs، are determined by: • Unused "reserved slots" • Random-Access Acknowledge without the reception of a corresponding uplink burst
Not received TCH	Only for Uplink: SwiMi request TCH(/S) load from mobile. But this load wasn't received (or not send by mobile).
TETRA:	
AccessCode B	Ordinary random access transmissions are using the **AccessCode A** configuration. The other Access Codes are typically reserved for priority access, like emergency calls or special groups access. If the infrastructure reserves too much uplink space for an optional Access Code, a bottleneck for the **AccessCode A** can occur. The viewed optional Access Code means the reserved space for that Access Code and not the effectively used space.
AccessCode C	
AccessCode D	

Table 57 MultiAnalyzerQoS: TCH-PDUs

5.7.4 User Defined Messages {1-5} Groups

This chapter provides an overview of the user-defined messages groups settings dialogue.

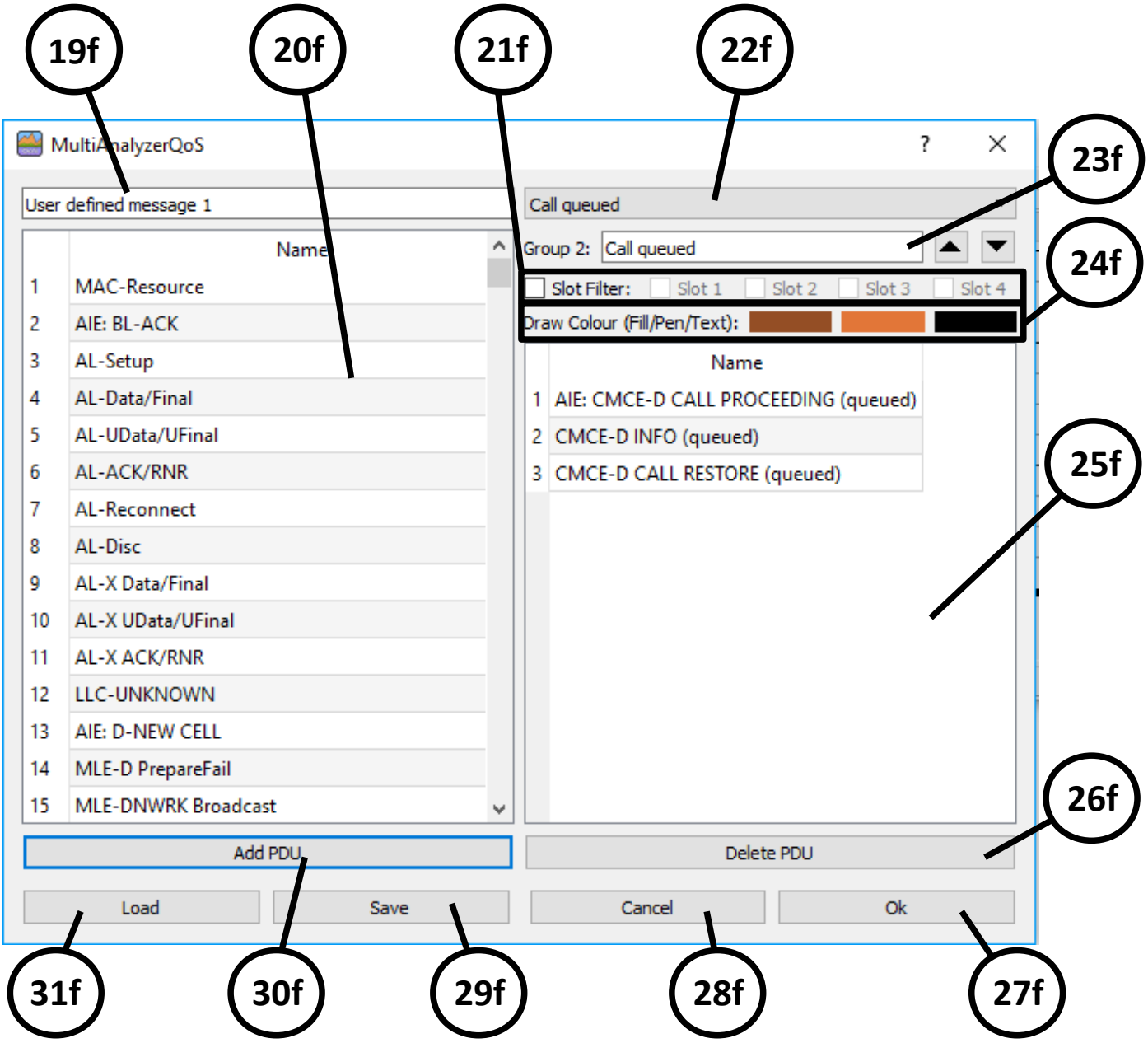


Illustration 108 MultiAnalyzerQoS: User Defined Messages Groups

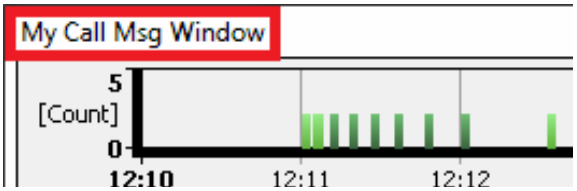
No	Description
19f	Text field to replace the default window name. 
20f	List with available unassigned PDUs.
21f	Checkbox to activate/deactivate the time slot mask. If it is activated, only events are added that are received on the selected time slot(s).
22f	Drop-down list to set the current group.
23f	Text field to change the current group name and buttons to move the group position (up/down) within the list. The list items will be shown on the bottom of the viewed window. The first item in the list is the last one in the window list and vice versa.
24f	Section to change the draw colour. Left is the fill colour, mid is the outline colour, and right is the text colour.
25f	List with the assigned PDUs to the group.
26f	Button to remove the selected assigned PDU from the current group.
27f	Button to apply the current settings.
28f	Button to close the current settings dialogue.
29f	Button to save the current settings to a file.
30f	Button to add the selected unassigned PDU to the current group.
31f	Button to load a definition from a file.

Table 58 MultiAnalyzerQoS: User Defined Messages Groups

5.7.5 TETRA Subscriber to Name Dialogue (MultiAnalyzerQoS)

This chapter provides an overview of the subscriber to name dialogue in **MultiAnalyzerQoS**.

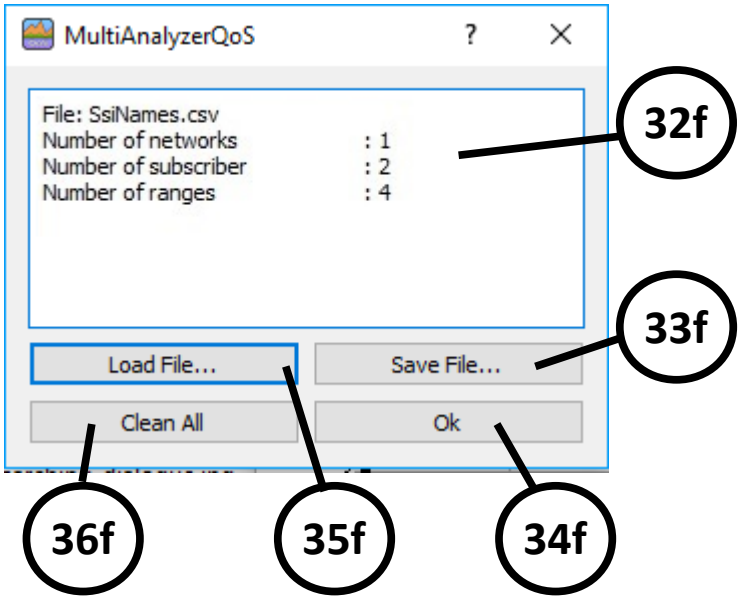


Illustration 109 MultiAnalyzerQoS: Subscriber to Name

No	Description
32f	Field that shows details about loaded files: • Number of networks • Number of subscriber • Number of ranges
33f	Button to save the current loaded data. Useful if data is joined from multiple files. Sets the file for automatic loading at the next start.
34f	Button to leave the dialogue.
35f	Button to load a file. The user is asked if the new data shall be joined to the previous data or if the previous data shall be replaced. The first file load sets the file for automatic loading at the next start.
36f	Button to clean all data from database. Cleans also the automatic loading at the next start.

Table 59 MultiAnalyzerQoS: Subscriber to Name

ⓘ For the file format see chapter Subscriber to Name – File Format.

Subscriber to Name – File Format

The main file format is CSV (Comma-Separated Values). The separator is the semicolon ";".

The different values (exact subscriber or range definition) are stored in the following order:

<table>
<tr><th>Keyword</th><th colspan="2">Description</th></tr>
<tr><td rowspan="5">NETWORK</td><td colspan="2">Defines the network for the keyword SSI‹ and RANGE. All following values belong to this network.</td></tr>
<tr><td>Value</td><td>Description</td></tr>
<tr><td>MCC</td><td>Mobile Country Code (in range from 1 – 1023)</td></tr>
<tr><td>MNC</td><td>Mobile Network Code (in range from 1 – 16383)</td></tr>
<tr><td colspan="2">Example:
NETWORK;262;1001</td></tr>
<tr><td rowspan="5">SSI</td><td colspan="2">Defines the name for a single SSI‹.</td></tr>
<tr><td>Value</td><td>Description</td></tr>
<tr><td>SSI</td><td>The SSI‹ number (in range from 1 – 16777215).</td></tr>
<tr><td>Modulo</td><td>View only the modulo part of the SSI‹, (0=Show full SSI‹, range from 1 – 16777215).</td></tr>
<tr><td>Name</td><td>The name of the subscriber.</td></tr>
<tr><td colspan="2">Example:
SSI;5230025;0;John Doe</td></tr>
<tr><td rowspan="6">RANGE</td><td colspan="2">If no exact match is possible but the subscriber is in a defined range (e. g. number block of an organisation), this range can be named. Overlapping ranges are possible. The first matching range is used. So define small sub-ranges before huge cover ranges.</td></tr>
<tr><td>Value</td><td>Description</td></tr>
<tr><td>Start</td><td>The beginning of the range (from 1 – 16777215)</td></tr>
<tr><td>End</td><td>The end of the range (from 1 – 16777215).</td></tr>
<tr><td>Modulo</td><td>View only the modulo part of the SSI‹, (0=Show full SSI‹, range from 1 – 16777215).</td></tr>
<tr><td>Name</td><td>The name of the range.</td></tr>
<tr><td colspan="2">Example: RANGE;5000;5019;0;Fire fighters, Group A
RANGE;5020;5039;0;Fire fighters, Group B
RANGE;5040;5059;0;Fire fighters, Group C
RANGE;5000;5099;0;Fire fighters</td></tr>
</table>

Table 60 MultiAnalyzerQoS: Subscriber File Format

5.7.6 TETRA Defined Calls Dialogue (MultiAnalyzerQoS)

This chapter provides an overview of the dialogue of defined calls in **MultiAnalyzerQoS**.

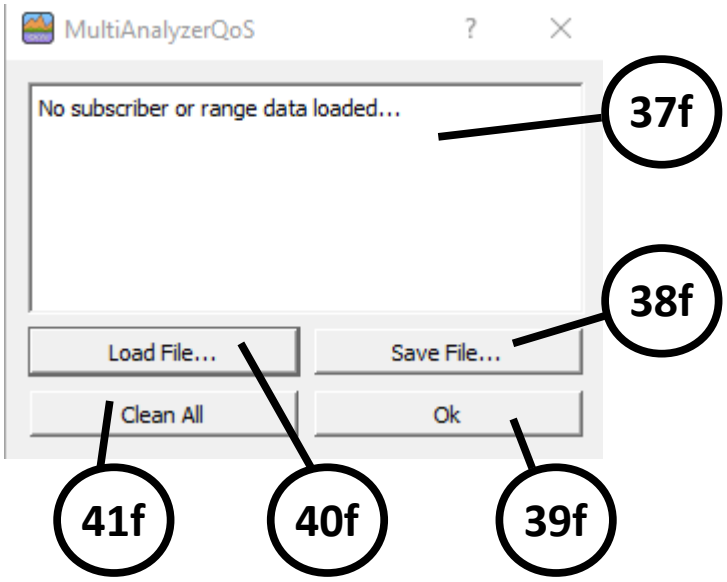


Illustration 110 MultiAnalyzerQoS: Defined Calls

No	Description
37f	Field that shows details about loaded files: • Number of networks • Number of subscriber • Number of ranges
38f	Button to save the current loaded data. Useful if data is joined from multiple files. Sets the file for automatic loading at the next start.
39f	Button to leave the dialogue.
40f	Button to load a file. The user is asked if the new data shall be joined to the previous data or if the previous data shall be replaced. The first file load sets the file for automatic loading at the next start.
41f	Button to clean all data from database. Cleans also automatic loading at the next start.

Table 61 MultiAnalyzerQoS: Subscriber to Name

ⓘ For the file format see chapter Defined Calls – File Format.

Defined Calls – File Format

The main file format is CSV (Comma-Separated Values). The separator is the semicolon ";".

The different values (exact subscriber or range definition) are stored in the following order:

Keyword	Description		
NETWORK	Defines the network for the keyword SSI, and RANGE. All following values belong to this network.		
	Value	**Description**	
	MCC	Mobile Country Code (in range from 1 –1023)	
	MNC	Mobile Network Code (in range from 1 – 16383)	
	List-Type	Defines the behaviour when an address is found or not.	
		0	White-List: Selects P2MP, calls that are **NOT** in the list.
		1	White-List: Selects P2P, and P2MP, calls that are **NOT** in the list.
		4	Black-List: Selects P2MP, calls that are **IN** the list.
		5	Black-List: Selects P2P, and P2MP, calls that are **IN** the list.
	Example: *NETWORK;262;1001;0*		
SSI	Defines the name for a single SSI,.		
	Value	**Description**	
	SSI	The SSI, number (in range from 1 – 16777215).	
	Example: *SSI;5230025*		
RANGE	If no exact match is possible but the subscriber is in a defined range (e. g. number block of an organisation), this range can be named. Overlapping ranges are possible. The first matching range is used. So define small sub-ranges before huge cover ranges.		
	Value	**Description**	
	Start	The beginning of the range (from 1 – 16777215)	
	End	The end of the range (from 1 – 16777215).	
	Example: *RANGE;5000;5019*		

Table 62 MultiAnalyzerQoS: Defined Calls File Format

5.7.7 The Uplink Simulation

Depending on the receiving prerequisite, not all uplink signalling can be received. The **MultiAnalyzerQoS** can simulate this not received uplink information.

The simulated uplink messages are used for the uplink CCCH‹ measurement, see chapters:

- TETRA: CCCH Load DL/UL and DMR: Channel Load
- TETRA: CCCH Top Instances DL/UL and DMR: Top Instances
- TETRA: CCCH Pie Chart (Load All) DL/UL and DMR: Pie Chart (Load All)
- TETRA: CCCH Pie Chart (Load Usage) DL/UL and DMR: Pie Chart (Load Usage)

Option '*DL-PDU*'

The simulation is based on known sequences. If a message is received at the downlink, this typically is a response to a prior corresponding uplink message or the request for a following uplink message (see 111):

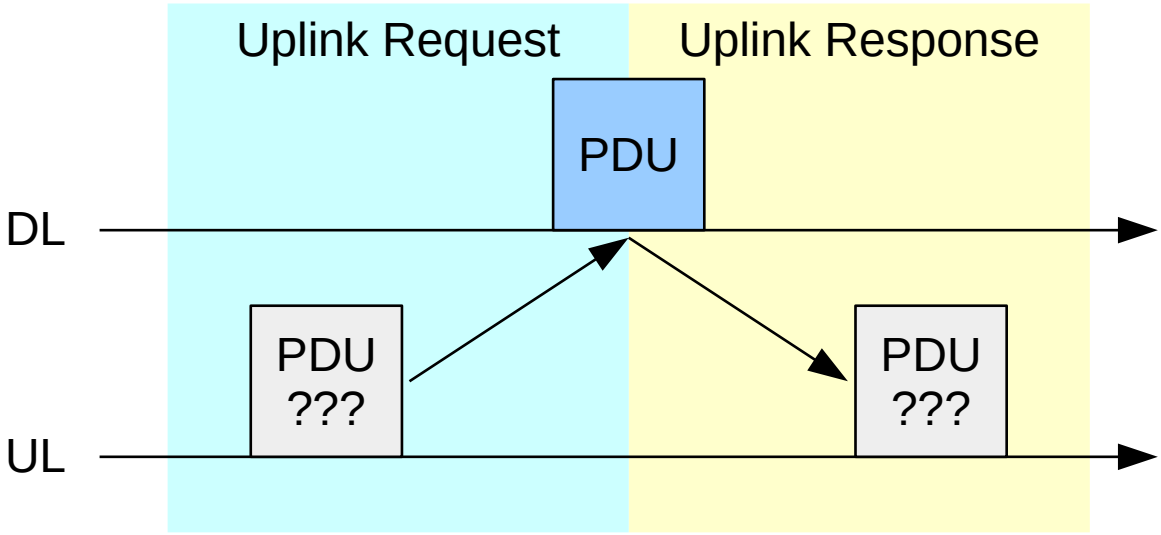


Illustration 111 The Uplink Simulation DL-PDU

The receiving of the downlink PDU‹ and knowing the corresponding message sequence also allows to simulate the associated uplink PDU‹. The used mobile uplink space directly before or directly after the downlink PDU‹ is filled with the uplink message from the known sequence.

Option '*Slot Grants*'

The second option is that no higher layer downlink message is sent as direct response or as request to an uplink message. Only the initial uplink Random-Access Acknowledge and the slot granting is received at the downlink. This sequence at the downlink is typical for SDS (Short Data Service) messages without text information, like GPS (see 112):

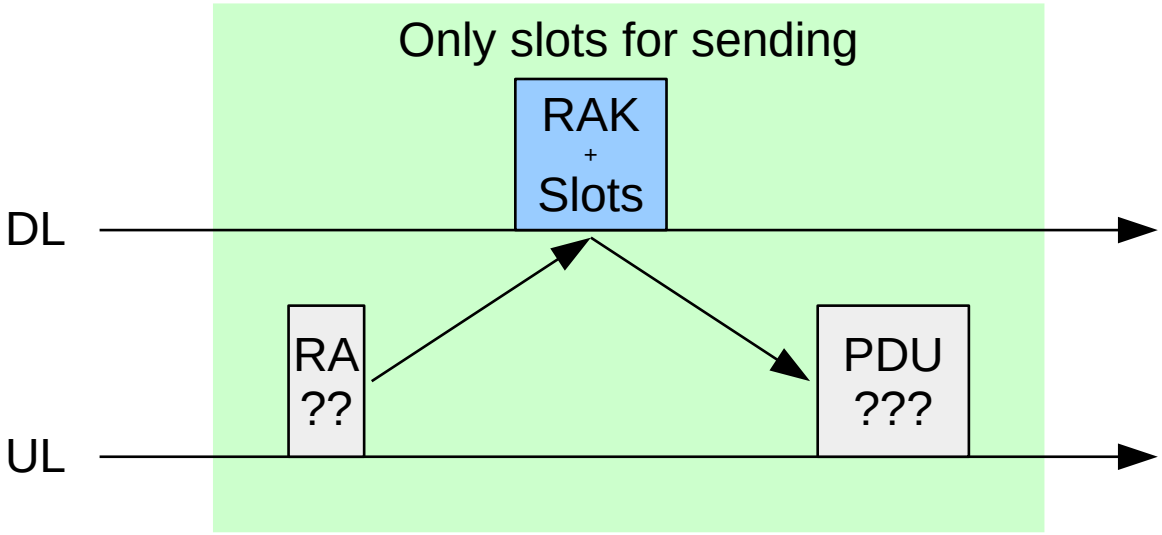


Illustration 112 The Uplink Simulation Slot Grants

The request for one half-slot or one full-slot produces a lot of possibilities for uplink PDUs. If the sequence starts with a request for two or more full-slots, the probability is increased of being a SDS (Short Data Service) message.

TETRA Uplink Simulation Settings

This chapter provides an overview of the TETRA، uplink simulation settings dialogue.

- Open the settings dialogue via ‘Settings’ > ‘TETRA’ > ‘TETRA Uplink Simulation...’.

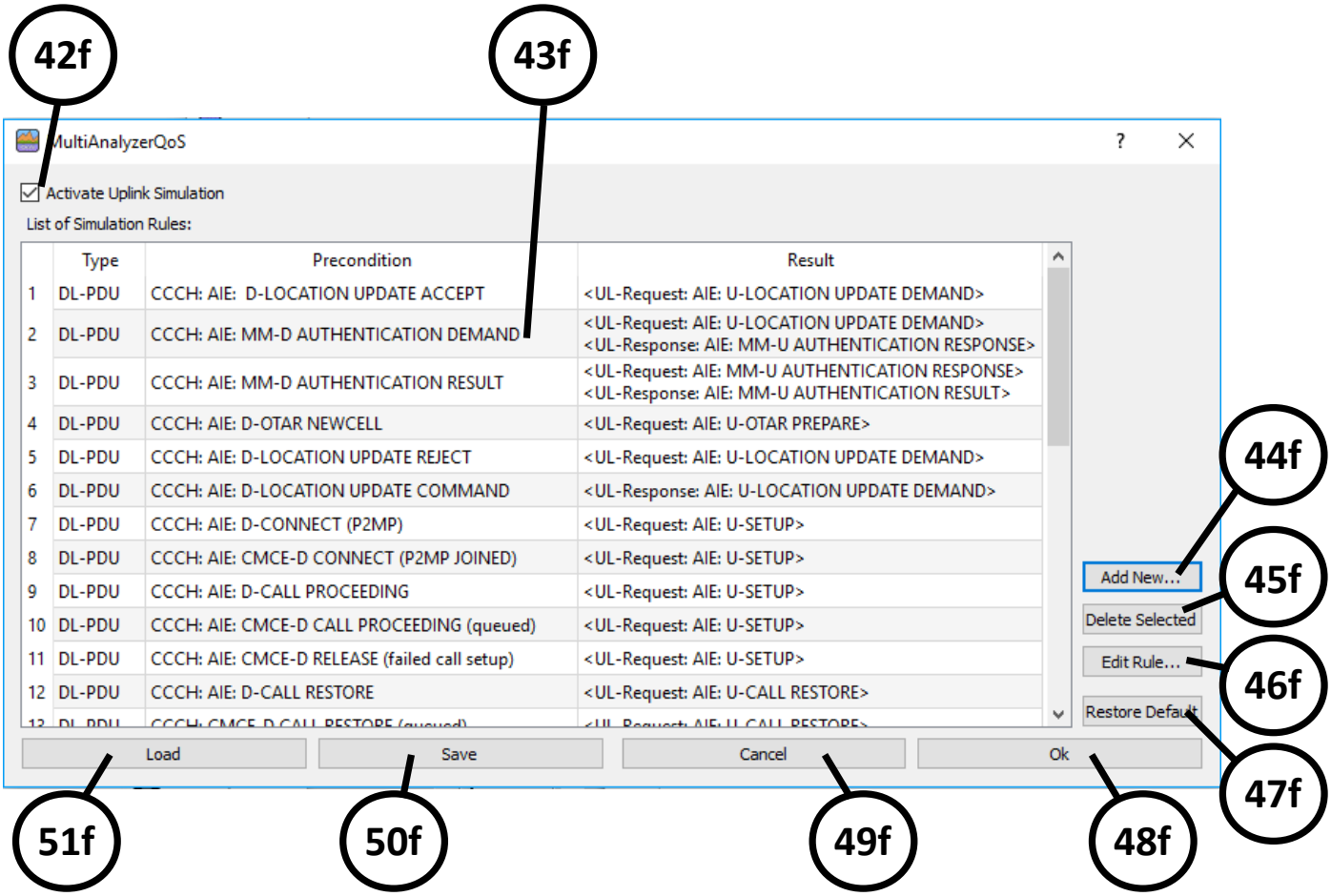


Illustration 113 MultiAnalyzerQoS: Uplink Simulation Settings Dialogue

No	Description
42f	Checkbox to activate/deactivate uplink simulation.
43f	List with the uplink simulation rules.
44f	Button to add a new rule (see chapter TETRA Uplink Simulation Rule Settings).
45f	Button to delete the selected rule(s).
46f	Button to edit the selected rule (see chapter TETRA Uplink Simulation Rule Settings).
47f	Button to reset to factory default. Well known sequences and slot grants rules will be set.
48f	Button to apply the changes.
49f	Button to quit the settings dialogue without applying the changes.

No	Description
50f	Button to save the settings to a file. For encrypted saving see chapter 7 MultiAnalyzerSaveRules.
51f	Button to load settings from a file.

Table 63 MultiAnalyzerQoS: Uplink Simulation Settings Dialogue

TETRA Uplink Simulation Rule Settings

This chapter provides an overview of the uplink simulation rule settings dialogue.

- Open the settings dialogue via ‘Settings’ > ‘TETRA’ > ‘TETRA Uplink Simulation... > ‘Add new...’.

Depending on the rule type ‘**DL-PDU**’ or ‘**Slot Grants**’, that can be switched by the drop-down list at the top, the settings dialogue shows the following available options:

DL-PDU

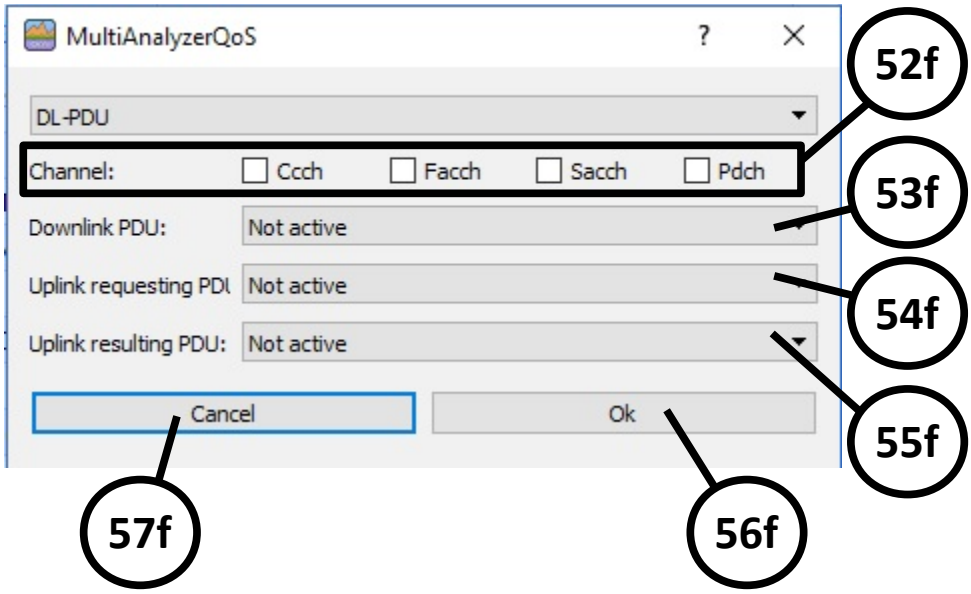


Illustration 114 MultiAnalyzerQoS: Uplink Simulation Rule Settings Dialogue (DL-PDU)

No	Description
52f	The logical channel where the DL‧ and UL‧ PDU‧ sequence occurs.
53f	The higher layer DL‧ PDU‧ that has to be received.
54f	Drop-down list to set the requesting uplink PDU‧ (if the DL‧ PDU‧ is the response to an uplink message).
55f	Drop-down list to set the resulting uplink PDU‧ (if the DL‧ PDU‧ is the request for an uplink message).
56f	Button to use the rule.
57f	Button to quit the settings dialogue without using the rule.

Table 64 MultiAnalyzerQoS: Uplink Simulation Rule Settings Dialogue (DL-PDU)

Slot Grants

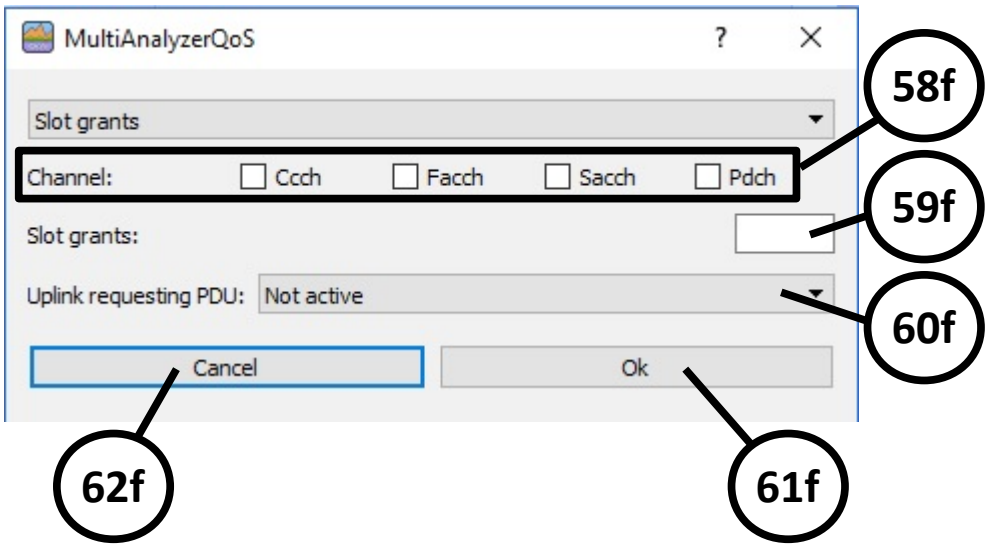


Illustration 115 MultiAnalyzerQoS: Uplink Simulation Rule Settings Dialogue (Slot Grants)

No	Description
58f	The logical channel where the slot request occurs.
59f	Text field to set the number of full slots that are granted from the base station.
60f	Drop-down list to set the requesting uplink PDU.
61f	Button to use the rule.
62f	Button to quit the settings dialogue without using the rule.

Table 65 MultiAnalyzerQoS: Uplink Simulation Settings Dialogue (Slot Grants)

5.7.8 Search Dialogue (MultiAnalyzerQoS)

This chapter provides an overview of the search dialogue in **MultiAnalyzerQoS**.

- Open the search dialogue via ‘Search’ > ‘Find...’ or use the key combination Ctrl+F.

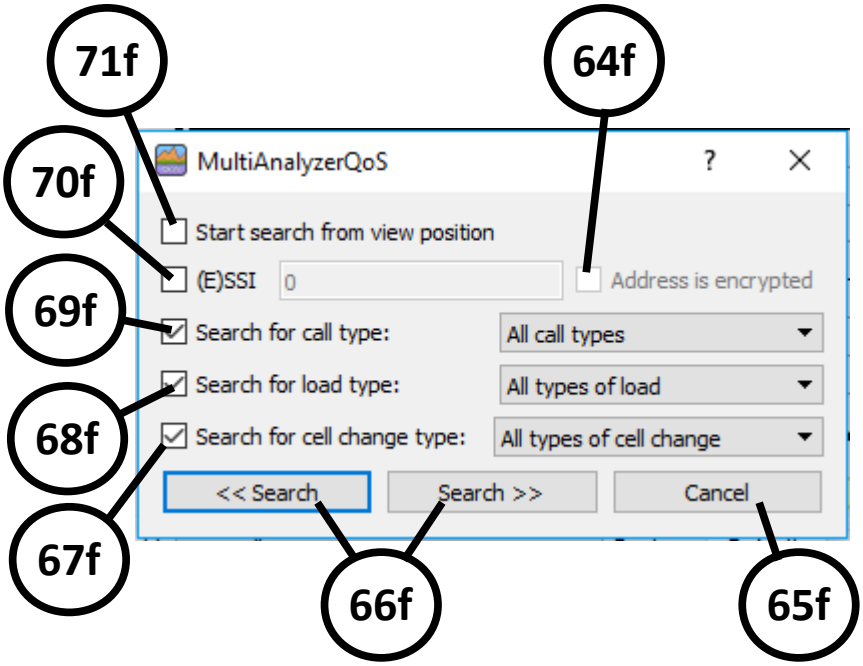


Illustration 116 MultiAnalyzerQoS: Search Dialogue

No	Description
64f	Checkbox that indicates if the subscriber number is air interface encrypted (ESSI‹) or not (SSI‹).
65f	Button to close the dialogue.
66f	Buttons to search backward or forward.
67f	Checkbox to set the search for a cell change event. This is handled as “logical and” with the (E)SSI‹ option (e. g. GPS load with the originating/terminating SSI‹).
68f	Checkbox to set the search for a load type. This is handled as “logical and” with the (E)SSI‹ option (e. g. GPS load with the originating/terminating SSI‹).
69f	Checkbox to set the search for a call type. This is handled as “logical and” with the (E)SSI‹ option (e. g. P2P‹ to or from given SSI‹).
70f	Checkbox to set the search for a wanted subscriber number. If no other type is selected any event/load is found with the wanted subscriber associated.
71f	If selected, the search is started on the currently viewed position. Otherwise it starts from the beginning or end position.

Table 66 MultiAnalyzerQoS: Search Dialogue

5.7.9 Python Configuration

This chapter provides an overview of the configuration of the Python interface. With the Python interface, you can highlight areas, set markers, change background colors, set borders, play warning tones, etc... in real time. The interface also allows you to export data. For real-time display, a script is called each time the display changes. The script retrieves the current displayed data, evaluates it and adds information if necessary or starts external actions (e.g. playing a sound). For e.g. the manual export of data, there is the item "Python Scripts" in the main menu. In the configuration the scripts of the menu can be stored and then executed if required.

- Open the settings via 'Settings' > 'Python Scripts...'.

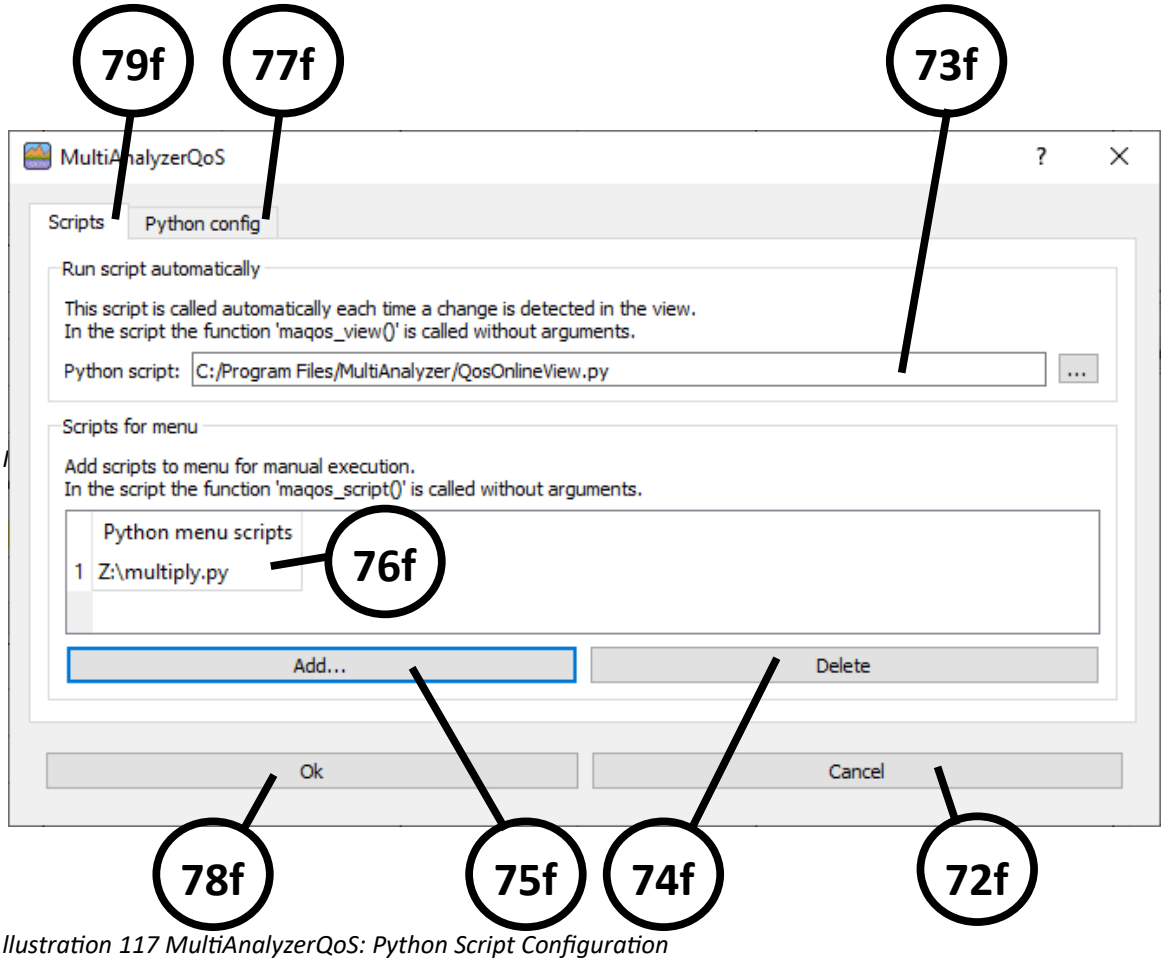


Illustration 117 MultiAnalyzerQoS: Python Script Configuration

No	Description
72f	Button to close the window.
73f	Path and Python script file that is called for the real-time display.
74f	Deletes the selected script file from the Python menu.
75f	Adds a new file in Python menu. The path and file name must be specified. The name in the

No	Description
	menu is generated from the file name.
76f	List of Python scripts that are created in the menu.
77f	Switch to configuration of the Python interpreter.
78f	Applies the settings and changes made.
79f	Switch to this configuration.

Table 67 MultiAnalyzerQoS: Python Script Configuration

- To access the settings for the Python interpreter select the view "Python Config" **(77f)**:

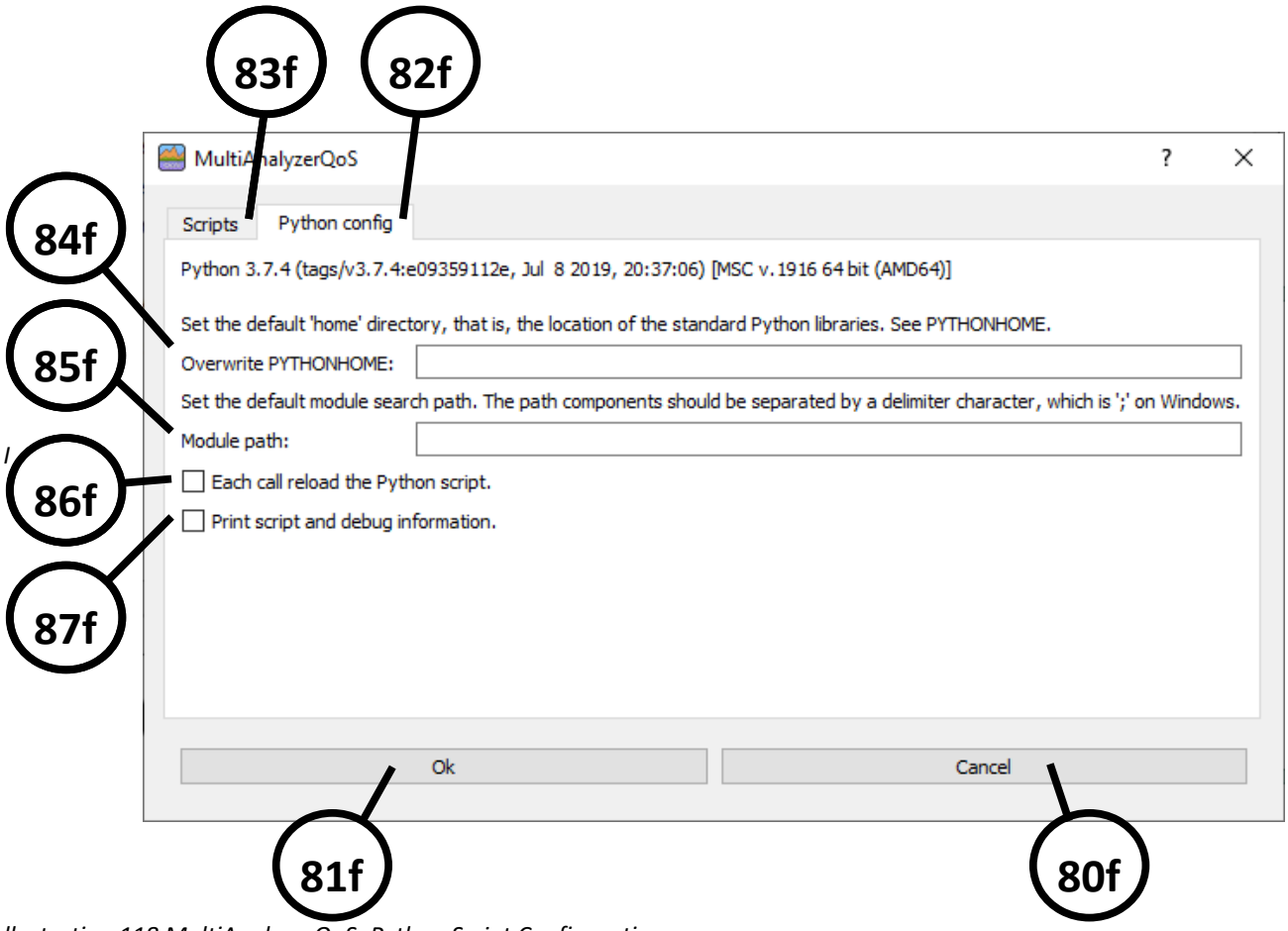


Illustration 118 MultiAnalyzerQoS: Python Script Configuration

No	Description
80f	Button to close the window.
81f	Applies the settings and changes made.
82f	Switch to this configuration.

No	Description
83f	Switch to configuration of the Python script.
84f	With an empty configuration, the system-wide settings for the Python interpreter are used. These are defined in the variable "PYTHONHOME". A value overwrites this configuration.
85f	Specifies an optional search path where further Python modules can be imported.
86f	Suitable for Python script development purposes. Reloads the script with each call. Changes are thus implemented immediately and can be tested.
87f	Suitable for Python script development purposes. Displays the output and error messages on a console. The console is open if the program MulitAnalyzerQoS has been started with the argument "--debug".

Table 68 MultiAnalyzerQoS: Python Script Configuration

5.7.10 Starting Real-Time QoS Stream

The QoS data can not only be read from a file, it can also directly received over the IP network. With the real-time QoS streaming option, the streamed QoS data can be received and viewed in real-time. The two modes Unicast UDP، and the Multicast UDP، are supported. Both modes can be used with the version IPv4 or IPv6. With the multicast protocol, an unlimited random number of clients can simultaneously receive the QoS data.

To start a real-time QoS stream in **MultiAnalyzerQoS**, follow the next steps.

1. Open the window to receive the network stream via 'File' > 'Receive network stream...' or use the key combination Ctrl+N.

✔ The streaming address settings dialogue opens (see 119).

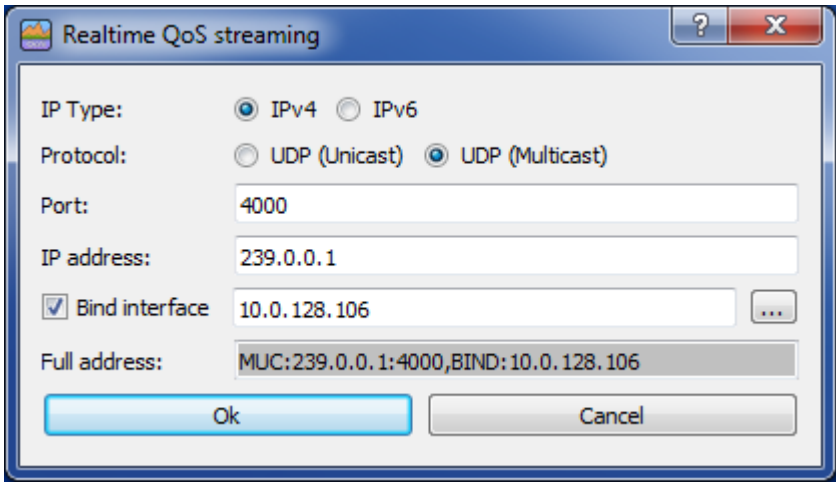


Illustration 119 MultiAnalyzerQoS: Receive Network Streaming

ⓘ For more information about the streaming address settings dialogue see chapter 5.8.2 Streaming Address Settings.

2. Enter the required data.

	Name	IP Address	Port
Unicast	**UDP** (for IPv4)	The connection interface for receiving UDP data. For all interfaces use: “0.0.0.0”	The receiving port. Use a value from 1 to 65535.
	UDP (for IPv6)	The connection interface for receiving UDP data. For all interfaces use: “::”	
Multicast	**MUC** (for IPv4)	The receiving multicast address. Use a value in the IPv4 multicast range between 224.0.0.0 and 239.255.255.255.	
	MUC (for IPv6)	The receiving multicast address. Use a value in the range from IPv6: FF00::/8.	

3. To choose an adapter, select the checkbox ‘Bind interface’ and click on the button […] (see 120).

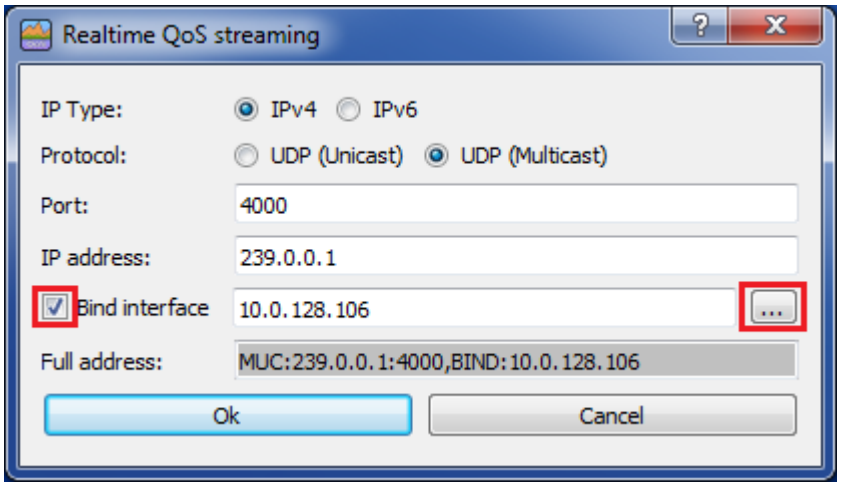


Illustration 120 MultiAnalyzerQoS: Bind Interface

NOTICE

Default adapter can be changed by Windows while in use!

If the network adapter is not bound, the default is used. The default adapter can be changed by Windows while the adapter is used. Bind the network adapter for multicast streaming.

✔ The dialogue opens to choose a network adapter (see 121).

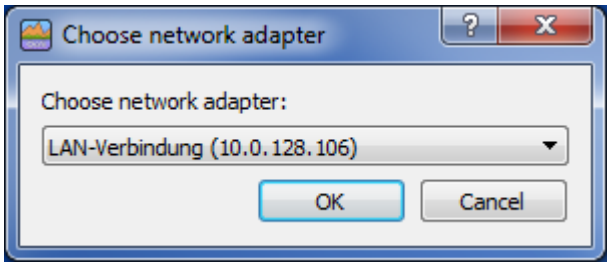


Illustration 121 MultiAnalyzerQoS: Choose Network Adapter

4. Choose a network adapter and click on the button [OK].

✔ The dialogue to choose the network adapter is closed.

5. To start the network stream, click on the button [Ok] (see 122).

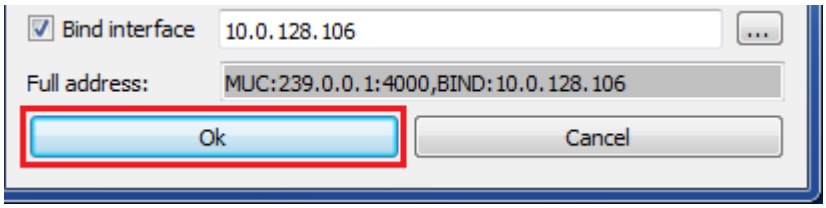


Illustration 122 MultiAnalyzerQoS: Start Network Stream

✔ The stream is started.

✔ The receiving process of the data can be watched via the file load information.

6. To watch the receiving process, open the file load information via ‘File’ > ‘File load information’ or use the key combination Ctrl+I.

✔ The dialogue opens to read the file information (see 123).

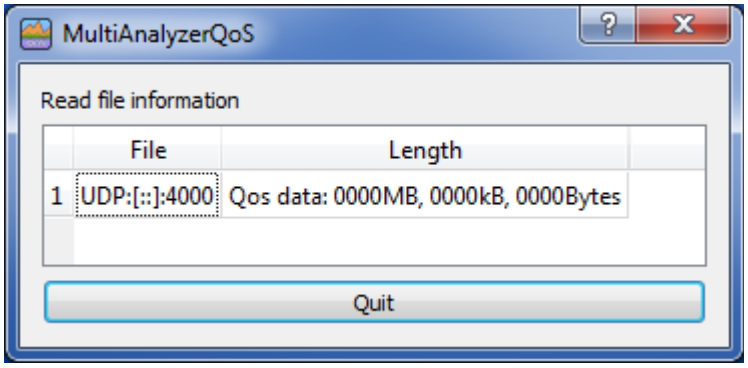


Illustration 123 MultiAnalyzerQoS: File Load Information

5.7.11 Loading a File (MultiAnalyzerQoS)

There are two modes for loading a record file (*.maf) into the **MultiAnalyzerQoS**:

- The record is finished

  This mode is used by default. For example, if a file is dropped onto the programme or the menu option ‘Load Record File..’ is used. The file is loaded until the end. After that the loading process is stopped. No further data is refreshed from the record file.

- The record is currently running

  This mode is used if the data is loaded via the menu option ‘Load Record Stream...’. The file loading never ends, new data is immediately refreshed and can be viewed in real-time.

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5.7.12 Toolbar

The time toolbar shows the current date and time and viewed range of the data. The shown or changed values of the toolbar applies to all sub windows. Depending on whether a recorded file is loaded or a record stream is running, the toolbar has a different appearance (see 124).

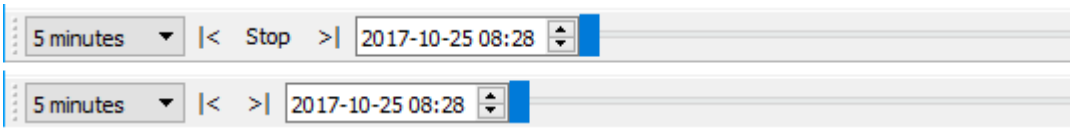


Illustration 124 MultiAnalyzerQoS: Toolbar Time

The following table provides an overview of the available settings:

Icon	Description
5 minutes	Drop-down list to set the viewed range. It can be set in steps: 1 minute, 2 minutes, 5 minutes, 10 minutes, 15 minutes, 20 minutes, 30 minutes and 1 hour. ⓘ The zoom range can also be changed by using the left mouse button+mouse wheel.
|< >|	Buttons to move the current viewed time by one step. The step depends on the zoom level.
Play Stop	Buttons to freeze or continue the real-time update of the views. ⓘ They are only available in the “real-time online view” during a record stream (see chapter 5.7.11 Loading a File (MultiAnalyzerQoS))
10.11.2015 19:52	Field that shows the current viewed date and time. It is also possible to directly jump to the entered point.
	Slider that shows the position within the record data. It is also possible to move the position. ⓘ The position can also be changed by using the mouse wheel.

Table 69 MultiAnalyzerQoS: Toolbar Time

5.7.13 Cells

The data is sorted by cells. Different cells can be loaded at the same time. Every cell owns an own tab page. The name of the tab page is the “Location Area” number or if unknown the channel number:

Illustration 125 MultiAnalyzerQoS: Cells

By clicking on the corresponding tab page the currently viewed cell changes.

The coloured icons represent the current receiving status:

Icon	Description
	Data loading/receiving is completed.
	Currently receiving/loading data. No data has been lost. ⓘ Only available in online mode.
	No new data has been received for more than 5 seconds. ⓘ Only available in online mode.
	Currently receiving data. But in the past there was a gap of more than 5 seconds of receiving data. ⓘ Only available in online mode. ⓘ The status can be reset to green ( ) by double-clicking on it.
	Currently receiving data. But data has been lost in the past. ⓘ Only available in online mode. ⓘ The status can be reset to green ( ) by double-clicking on it.

Table 70 MultiAnalyzerQoS: Cells

5.7.14 Presentation of Measuring Results

The different measuring results are presented in sub windows. The list and the view state of the sub windows can be found under the menu ‘Windows’ (see chapter 5.7 MultiAnalyzerQoS). The single sub windows are presented on the following pages.

The content of the windows can be copied or saved with a right-click on the content:

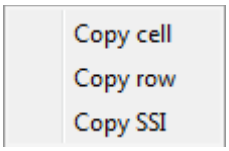
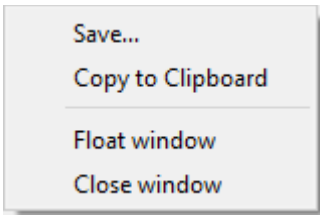
Copy Text		Copy Graphic	
			
Copy cell	Copy selected cell text.	**Save...**	Save graphic as a picture. The file format is determined by the suffix. For example, “.png” for PNG pictures or “.jpg” for JPEG pictures. The supported formats are listed in the list of file types within the save dialogue.
Copy row	Copy complete row and separates different cells with semicolon.	**Copy to clipboard**	Copy graphic to clipboard.
Copy SSI	Try to find SSI‚ information.	**Float window**	Make the current window float.
		Close window	Close the current window.

Table 71 MultiAnalyzerQoS: Copy Content

TCH Call Load

The ‘TCH Load’ shows the used channel resources for speech or circuit-mode calls. The load is measured on the CCCH‚ channel(s) by the initial call setup and late entry signalling. The view shows the used resources over the time. Two groups are shown, yellow for group calls (P2MP‚) and blue for individual calls (P2P‚). The P2P‚ calls have no late entry information, so the call time has to be assumed for the measurement.

A double-click on the screen shows the point in time of the closest message to the click in the **MultiAnalyzerMsc**.

- Supported protocols: TETRA‚ and DMR‚

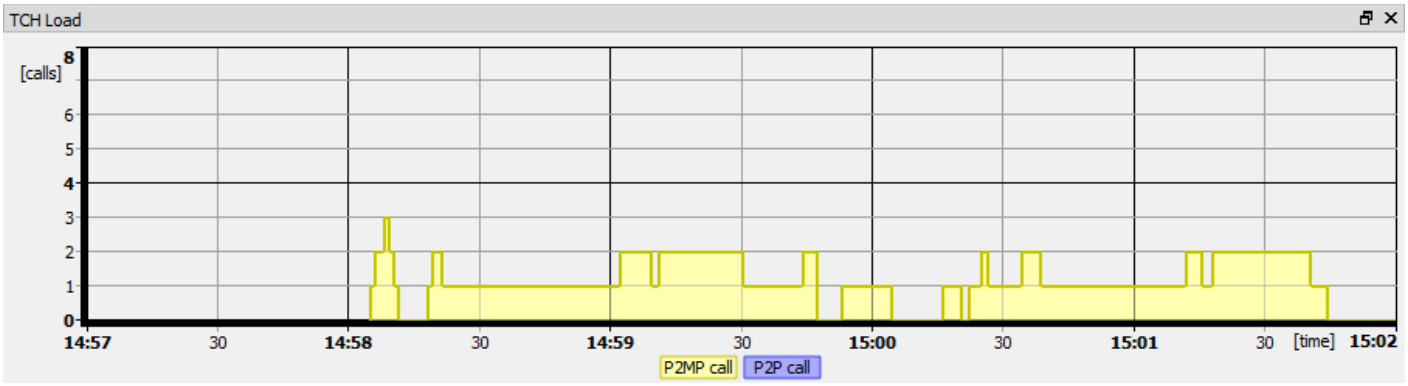


Illustration 126 MultiAnalyzerQoS: TCH Load

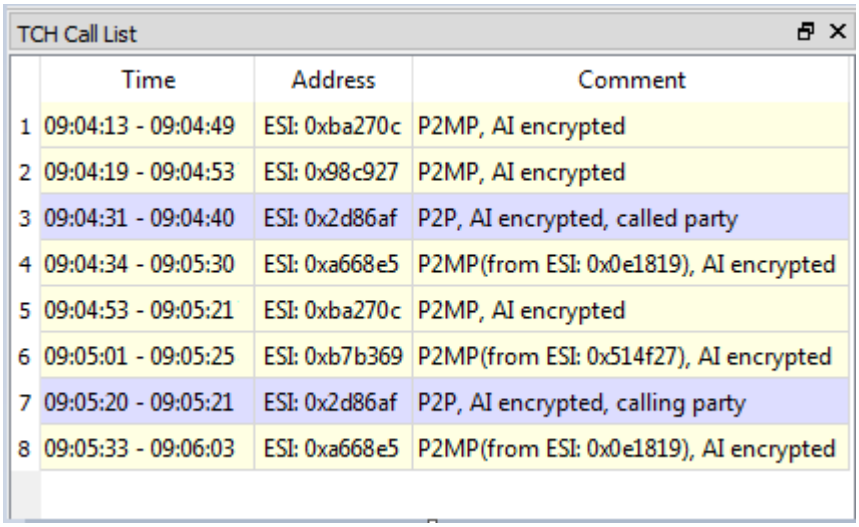
TCH Call List

The ‘TCH Call List’ shows all occurred calls in the current time range. The starting and ending time of the call is displayed in column ‘Time’. The terminating address is displayed in column ‘Address’. The call type (P2MP, or P2P,), the air interface encryption status and if known the initiator of the call is displayed in column ‘Comment’.

The background is filled with the legend colour of the ‘TCH Load’ view that can be set in the menu section ‘Settings’ (see chapter 5.7 MultiAnalyzerQoS).

A mouse click on the call selects the call in the ‘TCH Load’ display.

- Supported protocols: TETRA, and DMR,



	Time	Address	Comment
1	09:04:13 - 09:04:49	ESI: 0xba270c	P2MP, AI encrypted
2	09:04:19 - 09:04:53	ESI: 0x98c927	P2MP, AI encrypted
3	09:04:31 - 09:04:40	ESI: 0x2d86af	P2P, AI encrypted, called party
4	09:04:34 - 09:05:30	ESI: 0xa668e5	P2MP(from ESI: 0x0e1819), AI encrypted
5	09:04:53 - 09:05:21	ESI: 0xba270c	P2MP, AI encrypted
6	09:05:01 - 09:05:25	ESI: 0xb7b369	P2MP(from ESI: 0x514f27), AI encrypted
7	09:05:20 - 09:05:21	ESI: 0x2d86af	P2P, AI encrypted, calling party
8	09:05:33 - 09:06:03	ESI: 0xa668e5	P2MP(from ESI: 0x0e1819), AI encrypted

Illustration 127 MultiAnalyzerQoS: TCH Call List

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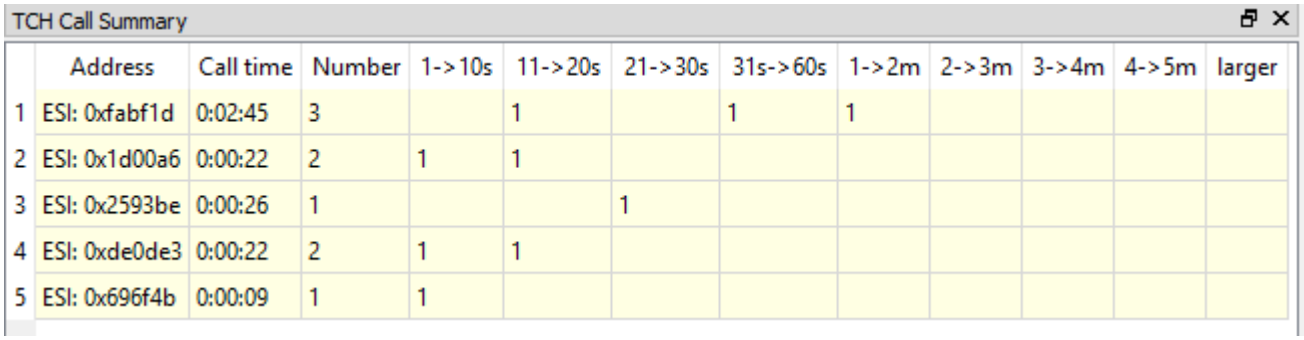
TCH Call Summary

The ‘TCH Call Summary’ shows all occurred calls in the current time range. The total call duration is displayed in the column ‘Call time’. The number of calls is displayed in the column ‘Number’. The further columns split the calls into the occurred call durations.

- Supported protocols: TETRA, and DMR,


TCH Call Summary

	Address	Call time	Number	1->10s	11->20s	21->30s	31s->60s	1->2m	2->3m	3->4m	4->5m	larger
1	ESI: 0xfabf1d	0:02:45	3		1		1	1				
2	ESI: 0x1d00a6	0:00:22	2	1	1							
3	ESI: 0x2593be	0:00:26	1			1						
4	ESI: 0xde0de3	0:00:22	2	1	1							
5	ESI: 0x696f4b	0:00:09	1	1								

Illustration 128 MultiAnalyzerQoS: TCH Call Summary

TCH Slot Usage

The pie chart ‘TCH Slot Usage’ is optimised for the real-time view of the used traffic channels. It shows the maximum usage of TCH‹ slots during the last 6 seconds.

- Supported protocols: TETRA‹ and DMR‹

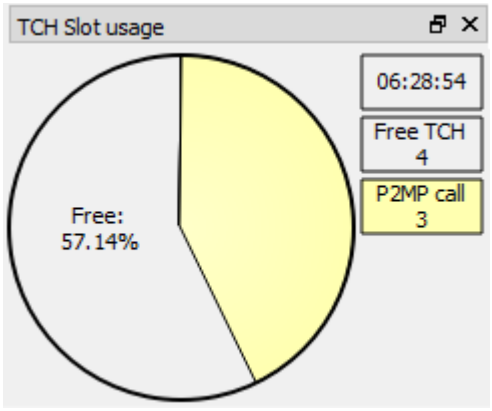


Illustration 129 MultiAnalyzerQoS: TCH Slot Usage

TCH Capacity Call Usage

This pie chart ‘TCH Capacity Call Usage’ shows the top ten calls. The eleventh item displays a summary of all other calls. Hundred percent of the pie chart corresponds to the theoretical speech capacity. The capacity is the “viewed time range” multiplied with the “usable TCH‹ slots”. This means all slots of the cell that are not used as CCCH‹ slots (MCCH‹/SCCH). The number of TCH‹ slots are set in the menu section ‘Settings’ (see chapter 5.7 MultiAnalyzerQoS).

A mouse click on the call selects the call in the ‘TCH Load’ display.

- Supported protocols: TETRA‹ and DMR‹.

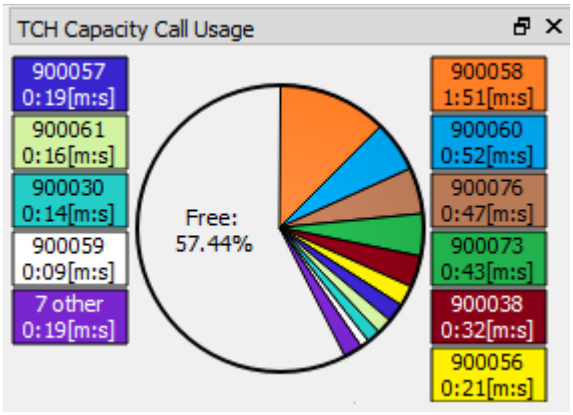


Illustration 130 MultiAnalyzerQoS: TCH Capacitiy Call Usage

TCH Call Occurred Call Usage

The ‘TCH Occurred Call Usage’ pie chart shows the top ten calls. The eleventh item displays a summery of all other calls. Hundred percent of the pie chart corresponds to the used call time and not to the theoretical speech capacity.

A mouse click on the call selects the call in the ‘TCH Load’ display.

- Supported protocols: TETRA, and DMR,

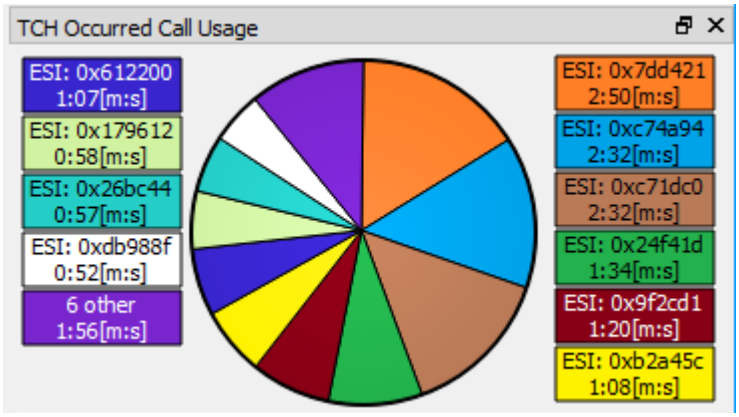


Illustration 131 MultiAnalyzerQoS: TCH Occurred Call Usage

TETRA: TCH QoS Load DL/UL

The ‘TCH Load DL’ and ‘TCH Load UL’ show the occurred load on the traffic channel. The single PDUs, are grouped and displayed into different colours. Depending from current channel state like active speech [TCH+SACCH] or no active speech [FACCH] typical load conditions can occur. The signalling depending on active traffic channel speech is drawn at the bottom, speech payload (TCH, Uplane, NULL-PDU) is drawn in the mid and the SACCH signalling is drawn on the top. The FACCH diagram is likewise a usual MCCH/SCCH. The channel states in the DL and UL direction can be independent of each other.

A double-click on the screen shows the point in time of the closest message to the click in the **MultiAnalyzerMsc**.

- Supported protocols: TETRA,

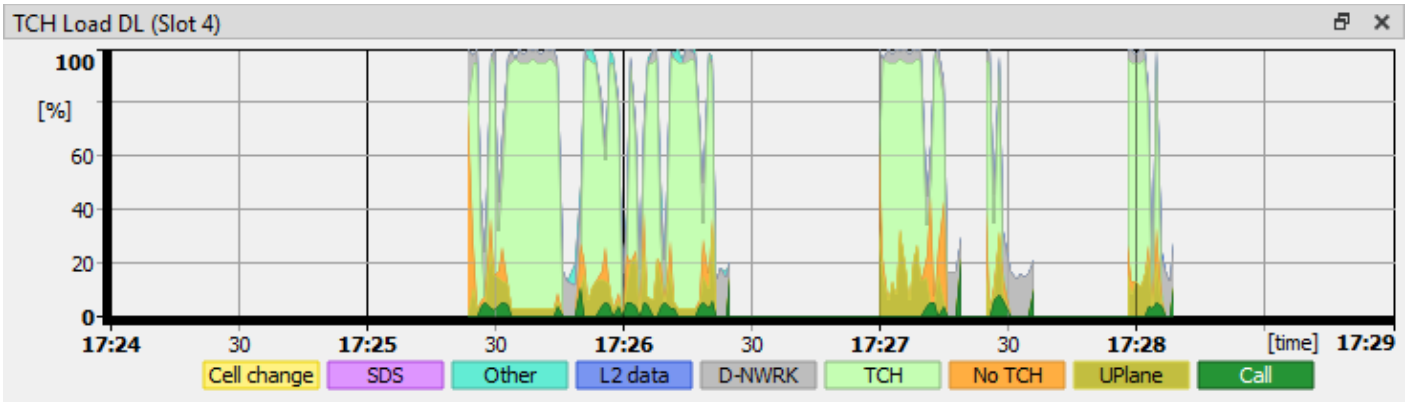


Illustration 132: MultiAnalyzerQoS: TCH Load DL

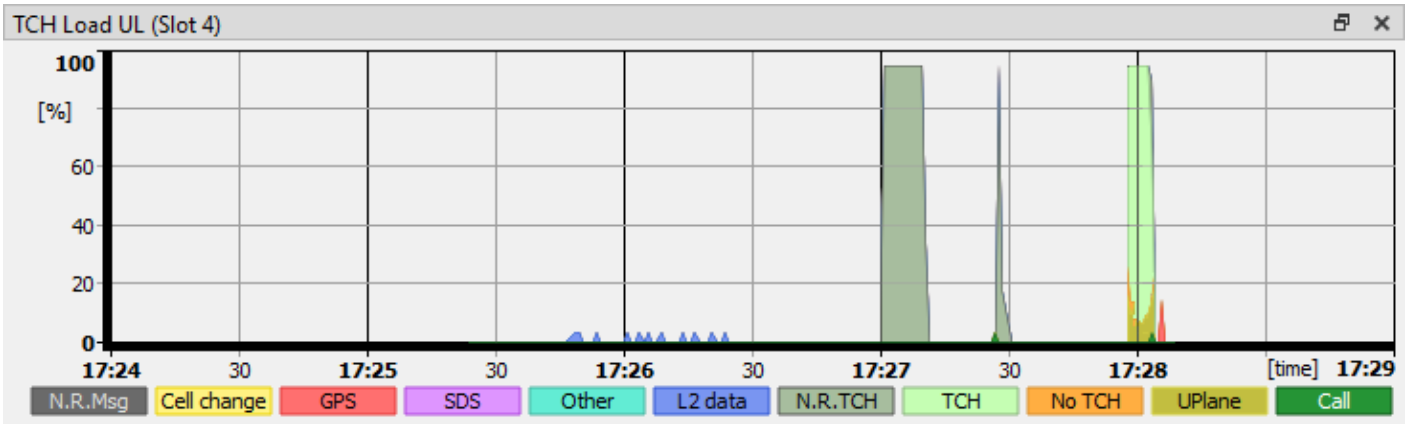


Illustration 133: MultiAnalyzerQoS: TCH Load UL

TETRA: TCH QoS Top Instances DL/UL

The ‘TCH Top Instances DL’ and ‘TCH Load UL’ show the top instances that caused load on the traffic channel in the current time range. The column ‘Address’ indicates the corresponding mobile or group. The downlink column ‘Bits’ represents the total sent bits. The uplink column ‘H.S.’ (Half Slots) represents the used half slots. The column ‘Group’ shows the total sent bits per H.S. divided into separate types of signalling. The number of PDUs, that caused the load are displayed in parentheses.

The background is filled with the legend colour of the most used group from the ‘TCH QoS Load’ view that can be set in the menu section ‘Settings’ (see chapter 5.7.3 TCH QoS Load Groups).

- Supported protocols: TETRA,

TCH Top Instances DL (Slot4)

	Address	Bits	Group
1	ESI: 0xae4284	229510	Call: 5816 bits (=62x) UPlane: 21700 bits (=175x) No TCH: 9920 bits (=80x) TCH: 192074 bits (=778x)
2	ESI: 0x97fc35	63537	Call: 1040 bits (=11x) UPlane: 9052 bits (=73x) No TCH: 5084 bits (=41x) TCH: 48361 bits (=211x)
3	ESI: 0xe01004	15629	Call: 1060 bits (=12x) UPlane: 2108 bits (=17x) No TCH: 1364 bits (=11x) TCH: 11097 bits (=46x)
4	ESI: 0x8d3a6d	2816	Other: 2816 bits (=18x)
5	ESI: 0x1a20e3	256	Call: 160 bits (=2x) L2 data: 96 bits (=2x)
6	ESI: 0x8c40f0	152	L2 data: 152 bits (=3x)
7	ESI: 0x3299d8	112	Other: 112 bits (=1x)
8	Unknown	48	Other: 48 bits (=1x)
9	ESI: 0x0f2f64	48	L2 data: 48 bits (=1x)

Illustration 134: MultiAnalyzerQoS: TCH Top Instances UL

TCH Top Instances UL (Slot4)

	Address	H.S.	Group
1	ESI: 0x0f2f64	356	N.R.TCH: 356 hs (=0x)
2	ESI: 0x8c40f0	203	TCH: 2 hs (=2x) N.R.TCH: 196 hs (=0x) GPS: 5 hs (=1x)
3	ESI: 0x1a20e3	41	Call: 1 hs (=1x) N.R.TCH: 40 hs (=0x)
4	ESI: 0x8d3a6d	10	L2 data: 10 hs (=10x)
5	ESI: 0x3299d8	1	L2 data: 1 hs (=1x)

Illustration 135: MultiAnalyzerQoS: TCH Top Instances DL

TCH Erlang C

These pie charts show the probability that further calls result in queuing for the new subscribers. This value is calculated by the following formula:

Number of time slots: c

Total traffic: $a = \frac{\text{Number of calls} * \text{Average call time}}{Time}$

$$\mathbf{P\ [W]} = \frac{\frac{a^c}{c!} * \frac{c}{c-a}}{\left(\sum_{n=0}^{c-1} \frac{a^n}{n!}\right) + \frac{a^c}{c!} * \frac{c}{c-a}}$$

The number of time slots (c) describes the possible slots, that are available for speech calls within a cell. This is normally

(4-number of control channels)+(Further carrier frequencies*4)=Available Slots

In case of an MCCH, an SCCH and another carrier for calls, the result is (4-2)+(1*4)=6. The value must correctly be set since it has a big impact on the calculation. The setting is done in the menu section 'Settings' > 'TCH Max...' (see chapter 5.7 MultiAnalyzerQoS).

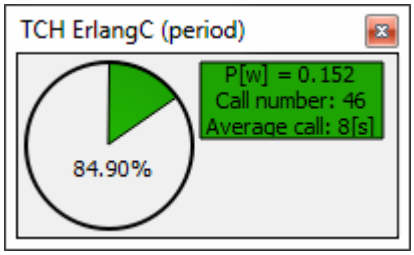
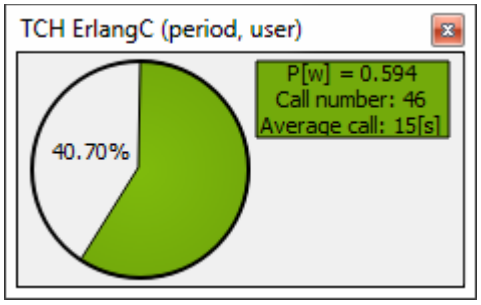
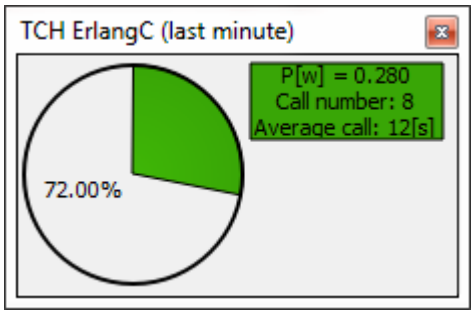
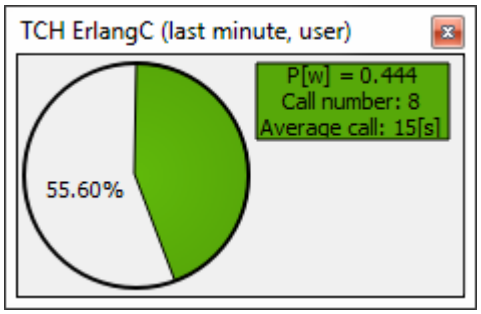
The 'Number of calls' is automatically determined from the measurement.

The 'Time' depends on the respective pie chart. Normally the general used period is used (applies to displays with the heading: 'period'). The representation corresponds to the average value over this period.

As an alternative, only the data of the last minute of the period can be displayed (applies to displays with the heading: 'last minute'). This display shows recent changes, so it reacts faster to a changed swelling/going-down behaviour of calls.

The 'Average call time' can automatically be determined from the shown call period. As an alternative, a defined value can be assumed (applies to displays with the heading: 'user'). A defined, e. g. a planning value can be compared with the actual measured value. The setting for the defined value is done in the menu section 'Settings' > 'TCH Erlang C call length...' (see chapter 5.7 MultiAnalyzerQoS).

An overview of the Erlang C pie charts:

Name	Description
TCH Erlang C (**period**)	• Data of the entire displayed time period are used. • The average call time has been measured. 
TCH Erlang C (**period, user**)	• Data of the entire displayed time period are used. • The average call time has been set by the user. 
TCH Erlang C (**last minute**)	• Data of the last minute are used. • The average call time has been measured. 
TCH Erlang C (**last minute, user**)	• Data of the last minute are used. • The average call time has been set by the user. 

TETRA: CCCH Load DL/UL and DMR: Channel Load

The ‘MCCH Load’ (or one of the secondary control channels) shows the occurred signalling load on the control channel. The single PDUs, are grouped and displayed into different colours. Depending on the infrastructure and the configuration, different typical idle load conditions can occur (e. g. a high background D-NWRK broadcast load). The active load is added on top.

A double-click on the screen shows the point in time of the closest message to the click in the **MultiAnalyzerMsc**.

- Supported protocols: TETRA, and DMR,

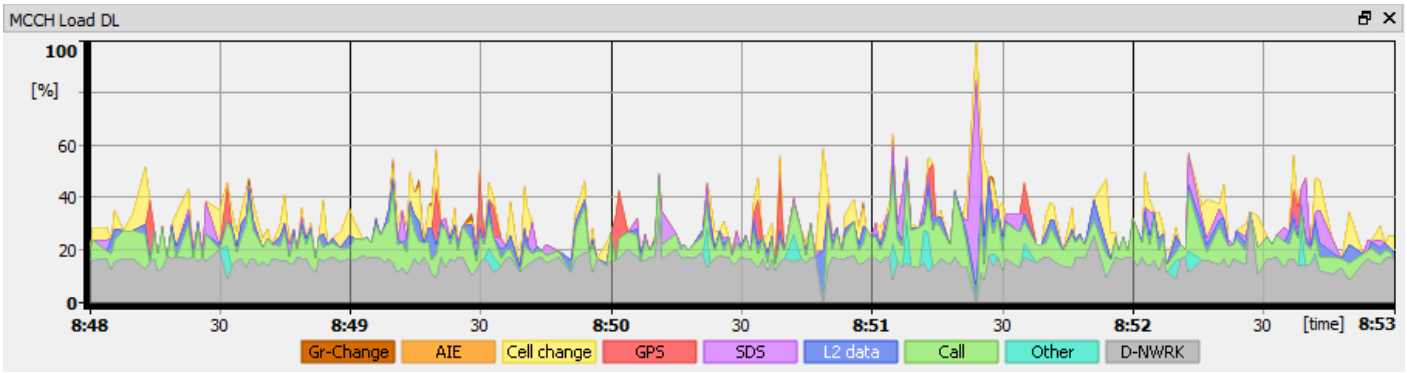


Illustration 136 MultiAnalyzerQoS: MCCH Load DL

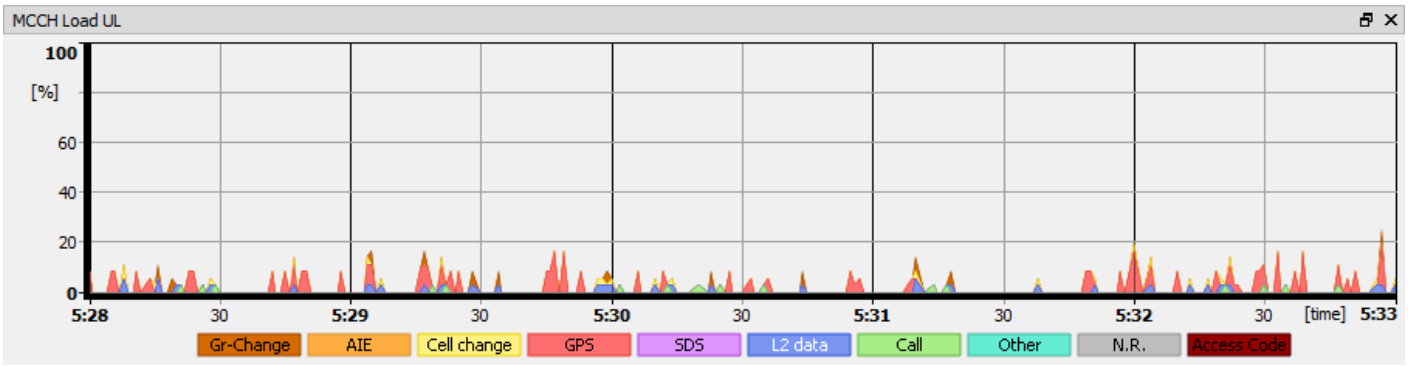


Illustration 137 MultiAnalyzerQoS: MCCH Load UL

TETRA: CCCH Top Instances DL/UL and DMR: Top Instances

The ‘MCCH Top Instances’ (or one of the secondary control channels) shows the top instances that caused load on the control channel in the current time range. The column ‘Address’ indicates the corresponding mobile or group. The downlink column ‘Bits’ represents the total sent bits. The uplink column ‘H.S.’ (Half Slots) represents the used half slots. The column ‘Group’ shows the total sent bits per H.S. divided into separate types of signalling. The number of PDUs، that caused the load are displayed in parentheses.

The background is filled with the legend colour of the most used group from the ‘M/SCCH Load’ view that can be set in the menu section ‘Settings’ (see chapter 5.7 MultiAnalyzerQoS).

- Supported protocols: TETRA، and DMR،

MCCH top instances DL

	Address	Bits	Group
1	ESI: 0xba270c	11888	Call: 11888 bits (=91x)
2	ESI: 0xcc1812	9872	Other: 2188 bits (=11x) GPS: 7684 bits (=33x)
3	ESI: 0xb9340d	8768	Call: 8768 bits (=67x)
4	ESI: 0x605a30	8160	Call: 8160 bits (=63x)
5	ESI: 0x61bca7	8148	Other: 6068 bits (=31x) L2 data: 2080 bits (=40x)
6	5408896	7608	L2 data: 2036 bits (=39x) Cell change: 5572 bits (=33x)
7	4460000	7108	L2 data: 1832 bits (=35x) Cell change: 5276 bits (=33x)
8	ESI: 0xa668e5	7052	Call: 7052 bits (=54x)
9	5408311	6316	L2 data: 1352 bits (=26x) Cell change: 4964 bits (=30x)
10	5408866	5812	L2 data: 1536 bits (=30x) Cell change: 4276 bits (=27x)

Illustration 138 MultiAnalyzerQoS: MCCH Top Instances DL

MCCH top instances UL

	Address	H.S.	Group
1	ESI: 0xa6b2de	5	GPS: 5 hs (=3x)
2	ESI: 0x12f5a6	5	L2 data: 2 hs (=2x) Cell change: 3 hs (=3x)
3	ESI: 0xe4e0f7	3	L2 data: 1 hs (=1x) Cell change: 2 hs (=2x)
4	ESI: 0x7f9bfd	2	L2 data: 1 hs (=1x) Cell change: 1 hs (=1x)
5	Unknown	2	N.R.: 2 hs (=2x)
6	ESI: 0xee33e3	2	L2 data: 1 hs (=1x) Cell change: 1 hs (=1x)
7	ESI: 0x5e7a74	2	L2 data: 1 hs (=1x) Cell change: 1 hs (=1x)
8	ESI: 0xffe4f8	2	L2 data: 1 hs (=1x) Cell change: 1 hs (=1x)
9	ESI: 0x0564a8	2	L2 data: 1 hs (=1x) Cell change: 1 hs (=1x)
10	ESI: 0xb21f27	2	Call: 2 hs (=2x)

Illustration 139 MultiAnalyzerQoS: MCCH Top Instances UL

TETRA: CCCH Pie Chart (Load All) DL/UL and DMR: Pie Chart (Load All)

The ‘MCCH Pie Chart (Load All)’ (or one of the secondary control channels) shows the occurred signalling load in the current time range in the form of a pie chart. The single PDUs, are grouped and displayed into different colours. The legend describes the groups and the percentage of the **total signalling bandwidth**.

- Supported protocols: TETRA, and DMR,

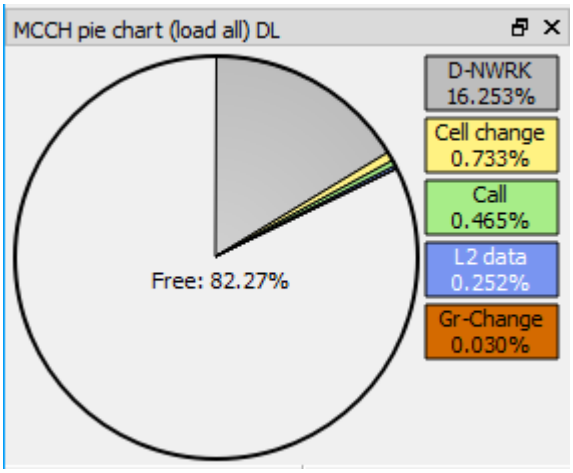


Illustration 140 MultiAnalyzerQoS: MCCH Pie Chart (Load All) DL

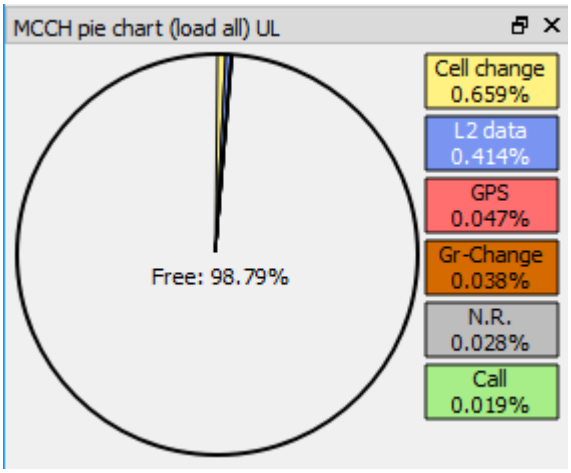


Illustration 141 MultiAnalyzerQoS: MCCH Pie Chart (Load All) UL

TETRA: CCCH Pie Chart (Load Usage) DL/UL and DMR: Pie Chart (Load Usage)

The ‘MCCH Pie Chart (Load Usage)’ (or one of the secondary control channels) shows the occurred signalling load in the current time range in the form of a pie chart. The single PDUs, are grouped and displayed into different colours. The legend describes the groups and the percentage of the **occurred signalling**.

- Supported protocols: TETRA, and DMR,

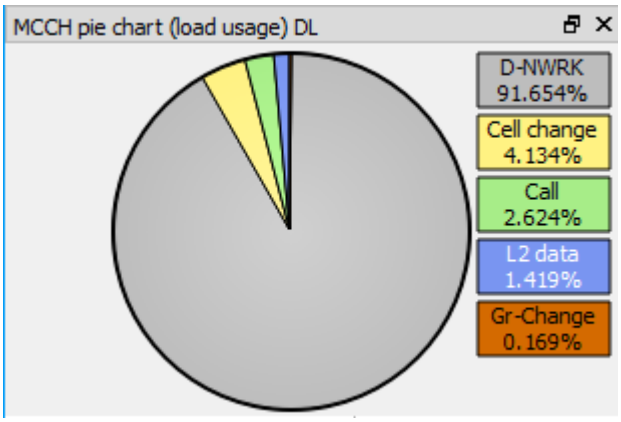


Illustration 142 MultiAnalyzerQoS: MCCH Pie Chart (Load Usage) DL

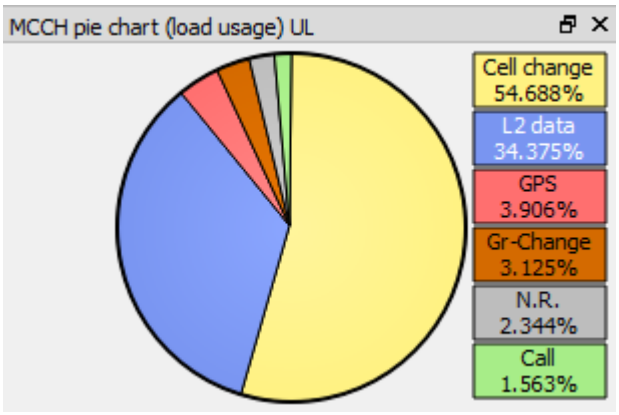


Illustration 143 MultiAnalyzerQoS: MCCH Pie Chart (Load Usage) UL

User Defined Message Bar

This view shows user-defined messages in the form of a bar chart. One occurrence per second is represented by one bar. Up to 10 groups can be defined. Every group can hold up to 128 different messages. For every group the colour can be set by double clicking on the legend.

- Supported protocols: TETRA, and DMR,

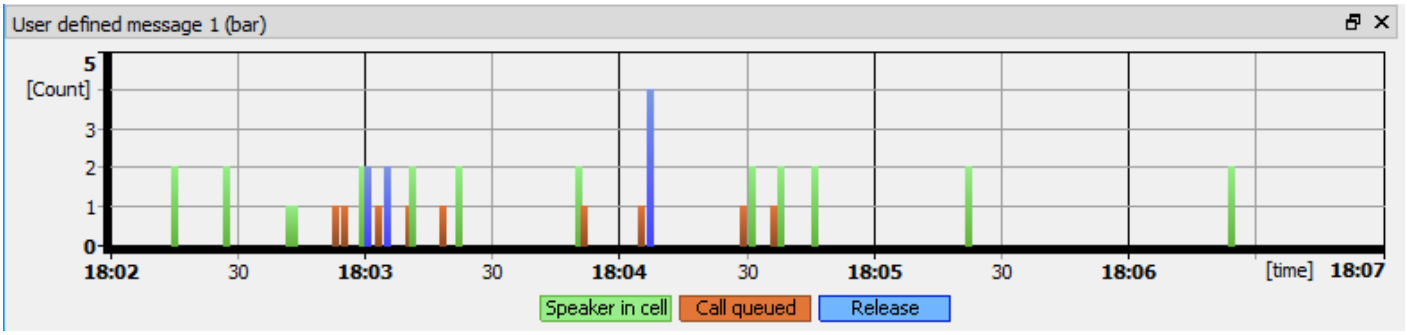


Illustration 144 MultiAnalyzerQoS: User Defined Message Bar

In this example the following groups and messages are defined:

Name	Description
Speaker in cell	Collection of messages that contain the signalling of a successful call setup that was initiated by the originating mobile in the recorded cell: *D-CONNECT (all call types), D-CONNECT-ACK*
Call queued	Collection of messages that contain the signalling of a call setup that is queued: *D-CALL PROCEEDING (queued), D-INFO(queued), D-CALL RESTORE(queued)*
Release	An initiated call setup is rejected either by SwMI, or by the called subscriber. For example, the call setup is discontinued or the terminating subscriber is busy or unknown… *D-RELEASE on CCCH channel*

Table 72 MultiAnalyzerQoS: User Defined Message Bar

The correlation of the call queued condition and the TCH‹ load can be viewed if the windows ‘TCH Load’ and ‘User defined messages’ are viewed combined:

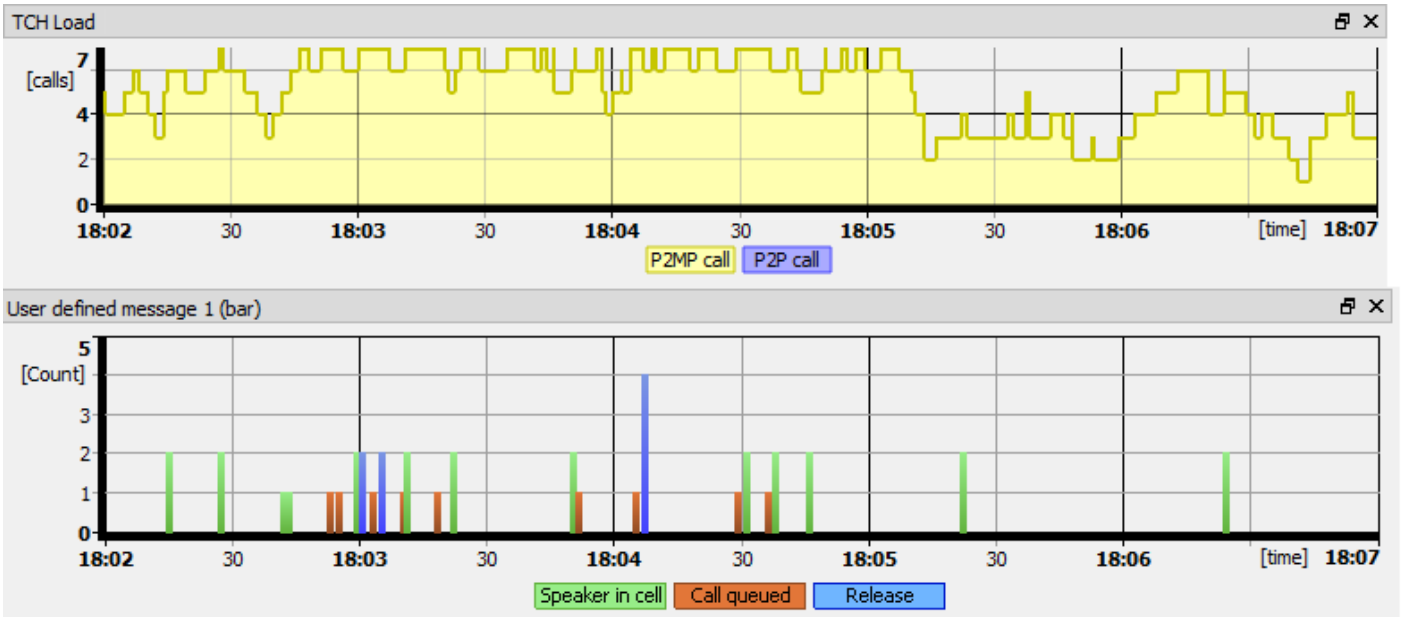


Illustration 145 MultiAnalyzerQoS: Comparison TCH Load and User Defined Message Bar

This view allows conclusions about the mobile user behaviour:

1. Patient user: Once the call queued condition is indicated to the calling user, the user presses and holds the PTT (Push-To-Talk) and is connected after the resource becomes available.
2. Impatient user: Once the call queued condition is indicated to the calling user, the user releases the PTT and the call is cancelled.
3. Short call queued period: If the time period of the call queued condition is short, the call is connected.

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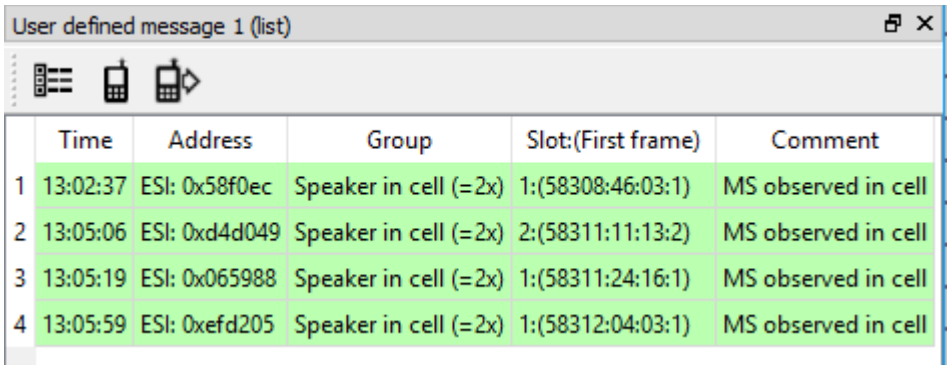
User Defined Message List

This is the corresponding list for the User Defined Message Bar view. To adjust the view, the view has additional buttons available:

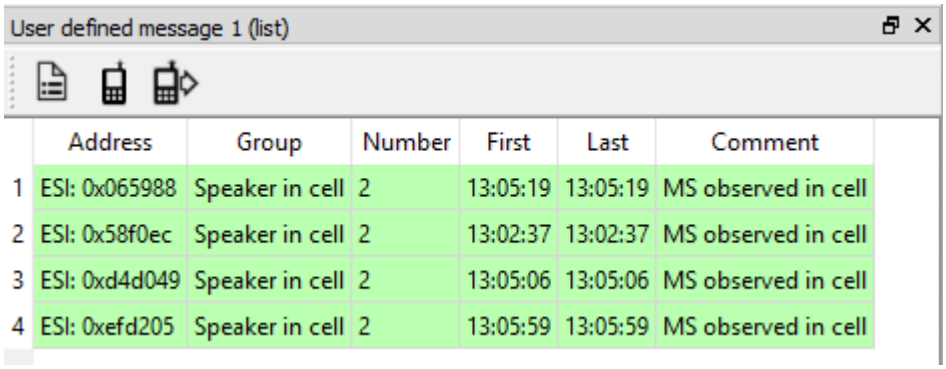
Button	Description
	Full list (see 146). The view shows the group and the originator or terminator subscriber identity. The number of the messages are displayed in parentheses within the column 'Group'. By clicking on the button, the view changes to the summary view.
	List summary (see 147). The view shows the group and the originator or terminator subscriber identity. The number of the messages are displayed in the column 'Number'. Additionally the time of the first and the last message is displayed. By clicking on the button, the view changes to the full list view.
	Button to show all entries or only the MS that is observed in the cell.
	The list only shows entries from the mobile.
	The list only shows entries to the mobile.

- Supported protocols: TETRA, and DMR,



	Time	Address	Group	Slot:(First frame)	Comment
1	13:02:37	ESI: 0x58f0ec	Speaker in cell (=2x)	1:(58308:46:03:1)	MS observed in cell
2	13:05:06	ESI: 0xd4d049	Speaker in cell (=2x)	2:(58311:11:13:2)	MS observed in cell
3	13:05:19	ESI: 0x065988	Speaker in cell (=2x)	1:(58311:24:16:1)	MS observed in cell
4	13:05:59	ESI: 0xefd205	Speaker in cell (=2x)	1:(58312:04:03:1)	MS observed in cell

Illustration 146 MultiAnalyzerQoS: User Defined Message (List) - Full List



	Address	Group	Number	First	Last	Comment
1	ESI: 0x065988	Speaker in cell	2	13:05:19	13:05:19	MS observed in cell
2	ESI: 0x58f0ec	Speaker in cell	2	13:02:37	13:02:37	MS observed in cell
3	ESI: 0xd4d049	Speaker in cell	2	13:05:06	13:05:06	MS observed in cell
4	ESI: 0xefd205	Speaker in cell	2	13:05:59	13:05:59	MS observed in cell

Illustration 147 MultiAnalyzerQoS: User Defined Message (List) - Summary

Record Information

The record information window shows the basic cell data of TETRA‹ or DMR‹.

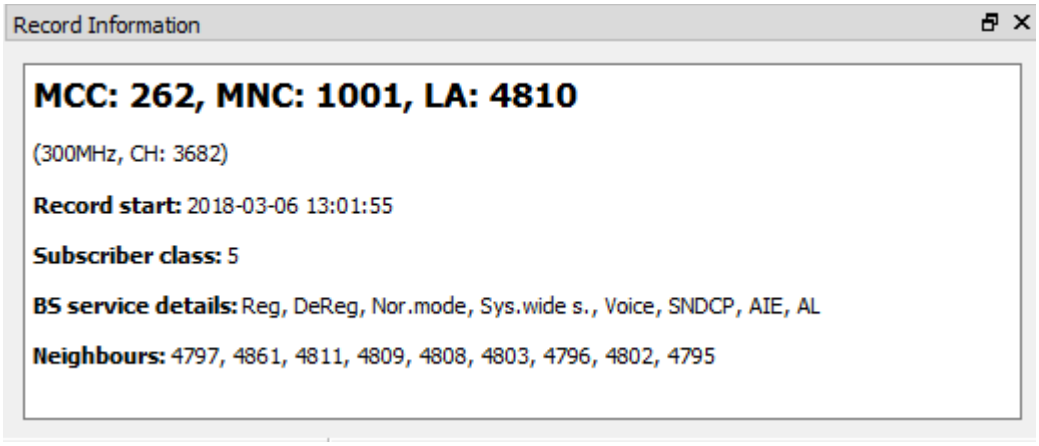
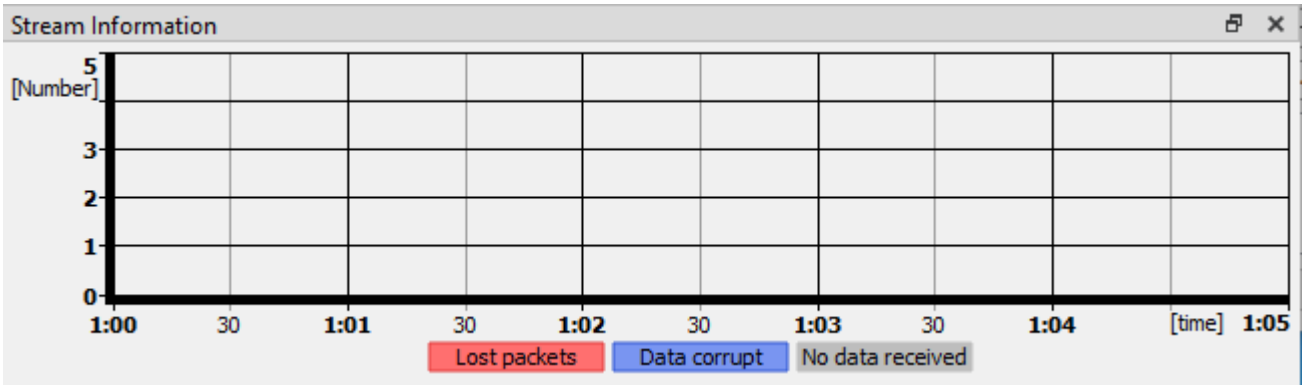


Illustration 148 MultiAnalyzerQoS: Record Information

Stream Information

The ‘Stream Information’ shows information about the packet transfer within a stream in form of a bar chart. The number of shown packages can be defined between 5 and 256. For every group the colour can be set by double clicking on the legend.



5.7.15 TETRA Cell Change Basics

The QoS analysis do not only determines the occurring cell changes but also their temporal profile. To understand which times are measured, the cell change process has to be understood in detail. There are different sections in which a cell change can be split. Depending on which cell change segment is present, the segment time is added up on the total time:

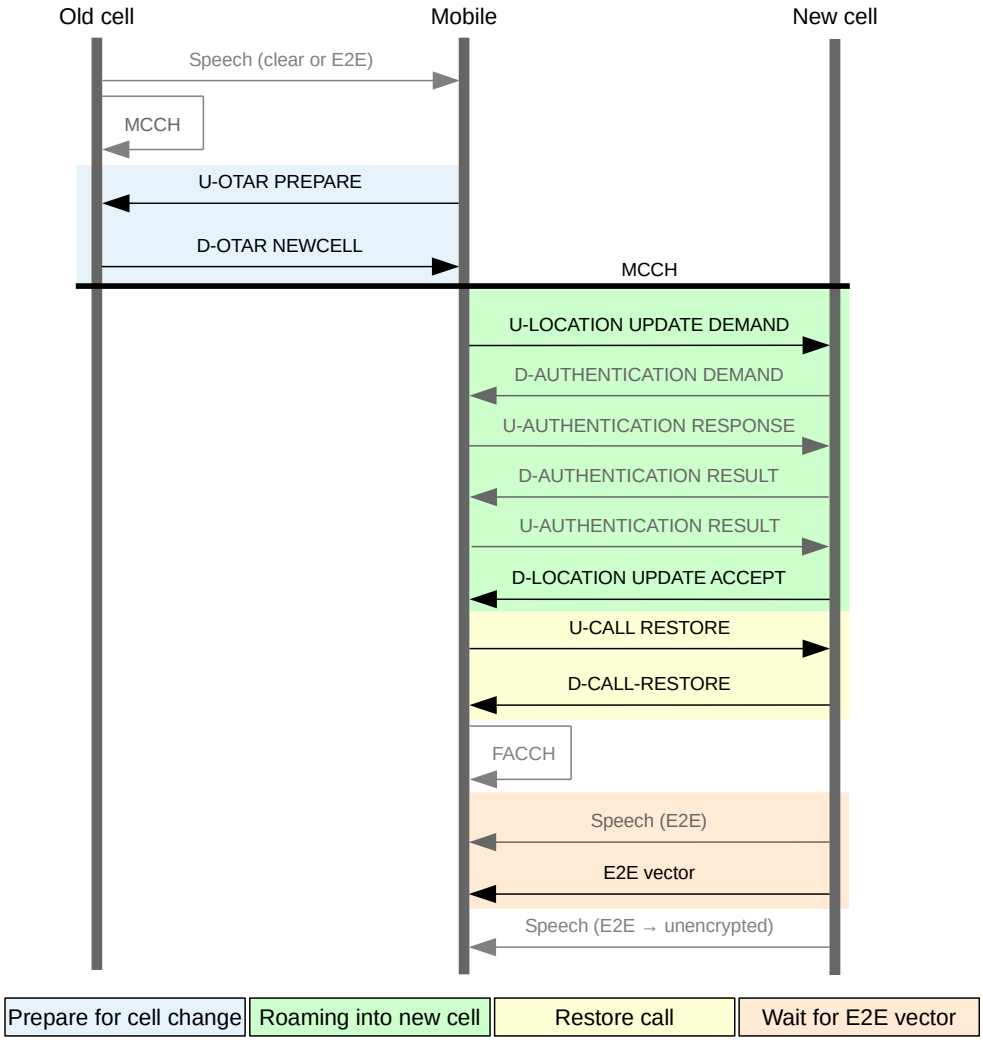


Illustration 149 TETRA Cell Change Basics

- **'Prepare for cell change'** is the last signalling in the old cell before leaving the cell. It is not mandatory. It depends on whether the mobile is involved in a call or an encrypted security class 3 network is used.
- **'Roaming into new cell'** is the initial signalling in the new cell. An authentication procedure is optionally conducted.
- **'Restore call'** is an optional section when the terminal is involved in a call (listening or speaking).
- **'Wait for E2E vector'** is an optional section if the ongoing call is E2E encrypted and the terminal is a listening party.

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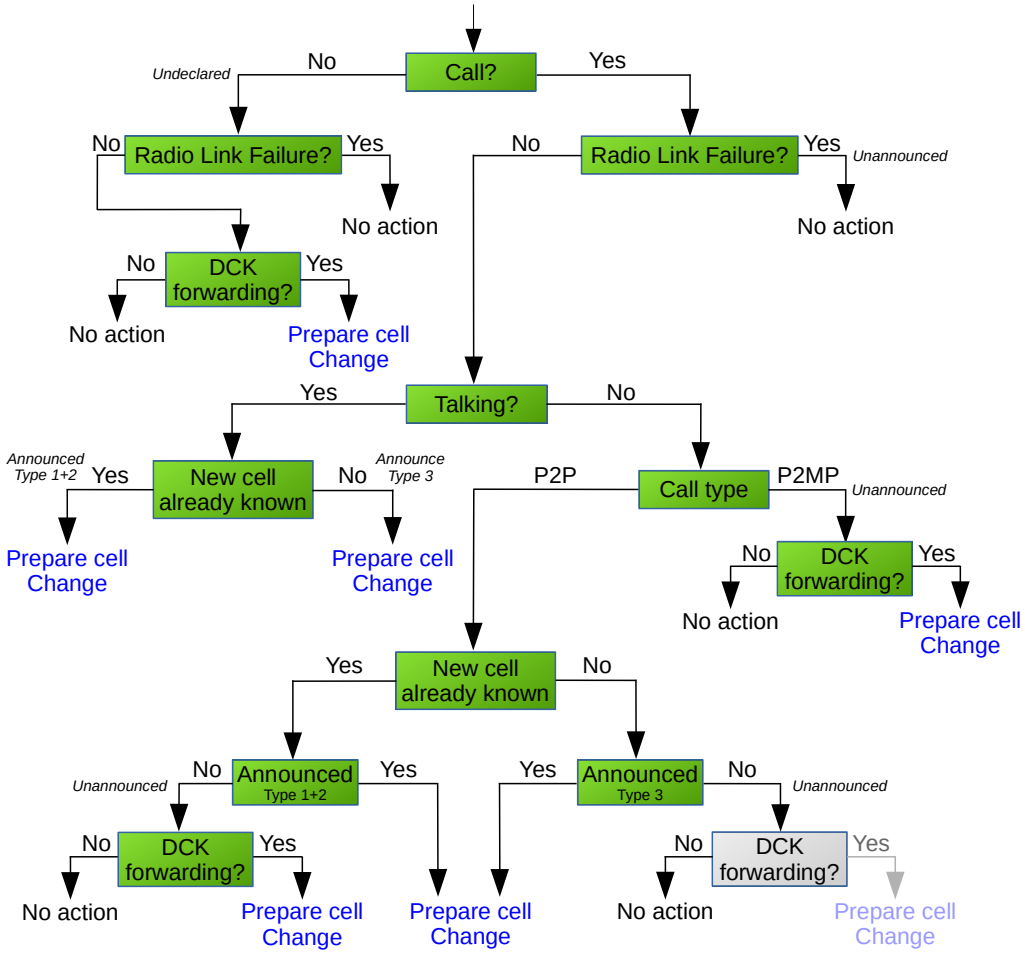
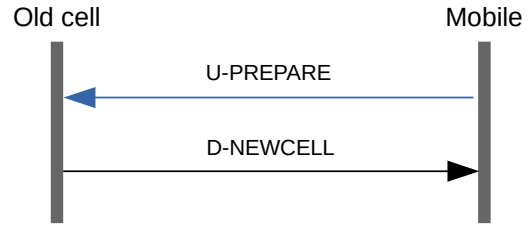
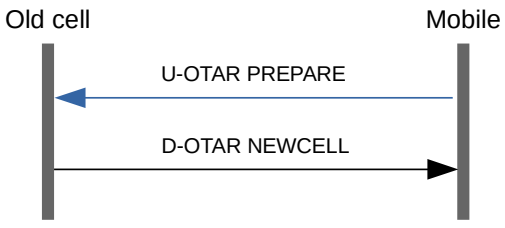
Section	Description
Prepare for cell change	Before a mobile changes the cell, it may indicate its intention to the SwMI:  *Illustration 150 Cell Change Flowchart* In case of 'Prepare cell Change', signalling is sent from/to the mobile:

Announced



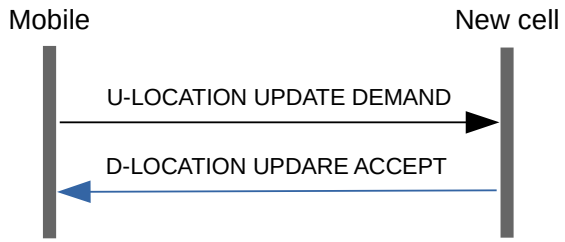
DCK forwarding

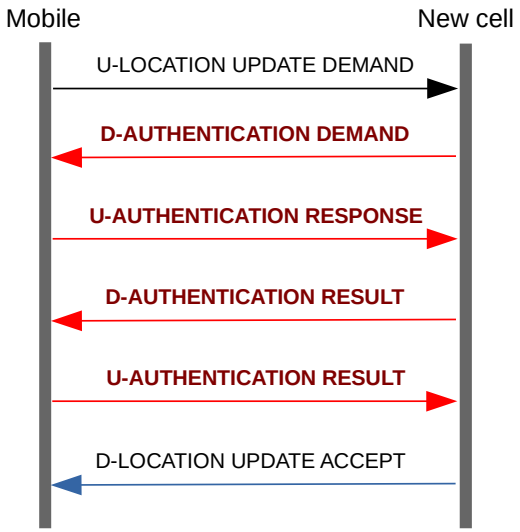


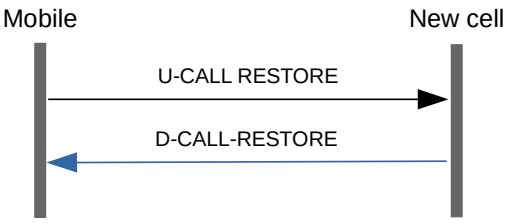
Duration measurement

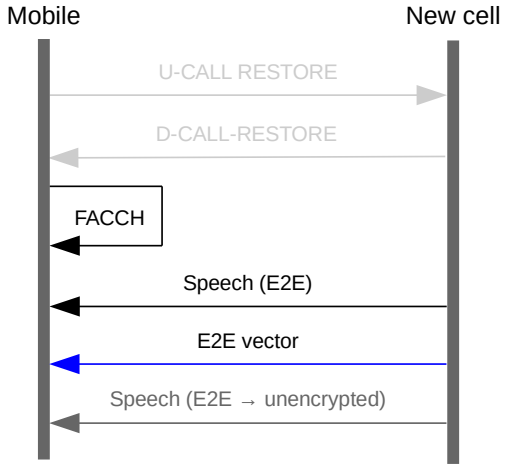
The duration is measured from the starting message 'U-(OTAR) PREPARE' until the end message 'D-(OTAR) NEW CELL'. The duration includes all repetitions of these messages.

ⓘ When a mobile is involved into a call as listening party, this is the starting point of the audiophile gap.

<table>
<tr><th>Section</th><th>Description</th></tr>
<tr><td rowspan="4">Roaming into new cell</td><td colspan="2">Depending on whether the location update is performed encrypted or unencrypted, an authentication may be additionally performed.</td></tr>
<tr><td>Roaming (unencrypted/encrypted)</td><td>Roaming with authentication</td></tr>
<tr><td> 


</td></tr>
<tr><td colspan="2">Duration measurement</td></tr>
<tr><td></td><td colspan="2">The duration is measured from the starting message ‘U-LOCATION UPDATE DEMAND’ until the end message ‘D-LOCATION ACCEPT’. The duration includes the optional authentication and repetition of messages.</td></tr>
</table>

Section	Description
Restore call	If a mobile is involved in a call (listening and speaking), the call will be restored after the successful ‘Roaming into new cell’: 
	Duration measurement
	The duration of the call restoration increases the time of ‘Roaming into new cell’ section. ⓘ The time in which the terminal has received no speech and an audible gap occurred, is the sum of the time that is required for the roaming and for the call restoration.

Section	Description
Wait for E2E vector	If the conversation is end-to-end encrypted, the terminal has to receipt the next encryption initialisation vector for decoding the speech. This leads to an additional delay. The speaking terminal of the call does not know when the listening terminal changes the cell. Therefore, the encryption initialisation vector is periodically transmitted by the talking terminal. 
	Duration measurement
	For now this time is not measured. ⓘ The time of waiting for the E2E vector increases the audible gap. The audiophile gap stops after receiving the E2E vector.

5.7.16 Types of Cell Change Measurements

The **MultiAnalyzer** distinguishes between the following types of cell change:

Name	Description
In progress	Includes all cells change types that are just performed but not completed yet.
Accept	Includes **successful** 'Roaming into new cell'. If the mobile is involved into a call, the duration time of the section 'Restore call' is included. If a call restoration is included, the result is printed in the list (accept or fail with reason).
Broken	Includes an **unsuccessful** 'Roaming into new cell'. It was started but not finished. This means no final message 'D-LOCATION ACCEPT' or 'D-LOCATION REJECT' was received.
Reject	Includes an **unsuccessful** 'Roaming into new cell'. It was started but the SwMI actively rejects the mobile with a 'D-LOCATION UPDATE REJECT'. If known (unencrypted or decrypted), the reject reason is printed in the list.
Leaving	Includes all types of the section 'Prepare for cell change' and the de-registration of mobiles.
Update cmd	If the SwMI is unsure whether a mobile stays on the current cell or not, the SwMI can initiate a new registration using the message 'D-LOCATION UPDATE COMMAND'. If the 'D-LOCATION UPDATE COMMAND' is transmitted unencrypted to an encrypted security class 3 terminal, the SwMI requests the terminal to renew its DCK. The duration is measured from the first message 'D-LOCATION UPDATE COMMAND' and includes all repetitions and optionally the authentication PDU exchange until the end of the wanted registration (similar to the 'Roaming into new cell' section).

Table 73 Types of Cell Change Measurement

Cell Change (TETRA)

The ‘Cell Change’ (TETRA) shows the occurred cell changes over the time:

- Violet bars represent a ‘D-Location Update Command’, that is transmitted by the base station.
- Green bars represent the mobiles that successfully changed to the recorded cell.
- Blue bars indicate the leaving mobiles (undeclared with DCK forwarding, unannounced and announced cell reselection).
- Red bars represent the incoming terminals that are rejected by the SwMI, or the mutual authentication.
- Orange bars represent the broken cell changes.
- Yellow bars represent the cell changes that are in progress and not finished (in online view or at the end of the record file).

Repetitions of single messages that are transmitted or received by a terminal are joined into one cell change event for that terminal. Each message repetition increases the measured duration time.

A double-click on the screen shows the point in time of the closest message to the click in the **MultiAnalyzerMsc**.

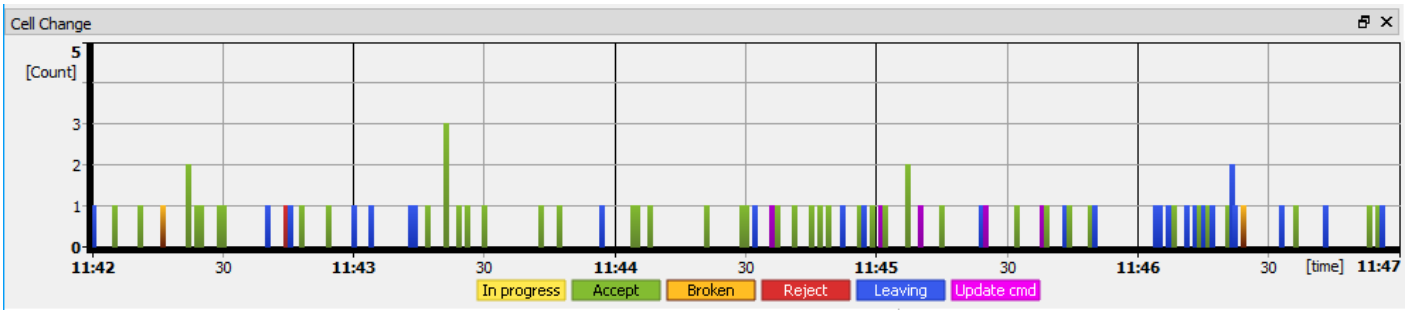


Illustration 151 MultiAnalyzerQoS: Cell Change (TETRA)

Cell Change (DMR)

The ‘Cell Change’ (DMR◂) shows the occurred cell changes over the time:

- Violet bars show a ‘Mass_Reg’ that is transmitted by the trunked station.
- Green bars represent the terminals that successfully changed to the recorded cell (C_ACKD[Reg_Accepted]).

  ⓘ This also can be a successful de-registration.

- Blue bars represent the trunked station command for leaving this channel (Move and Vote_Now).
- Red bars represent the incoming terminals that are rejected by the trunked station.
- Orange bars represent the broken cell changes.
- Yellow bars represent the cell changes that are in progress and not finished (in online view or at the end of the record file).

Repetitions of single messages that are transmitted or received by a terminal are joined into one cell change event for that terminal. Each message repetition increases the measured duration time.

A double-click on the screen shows the point in time of the closest message to the click in the **MultiAnalyzerMsc**.

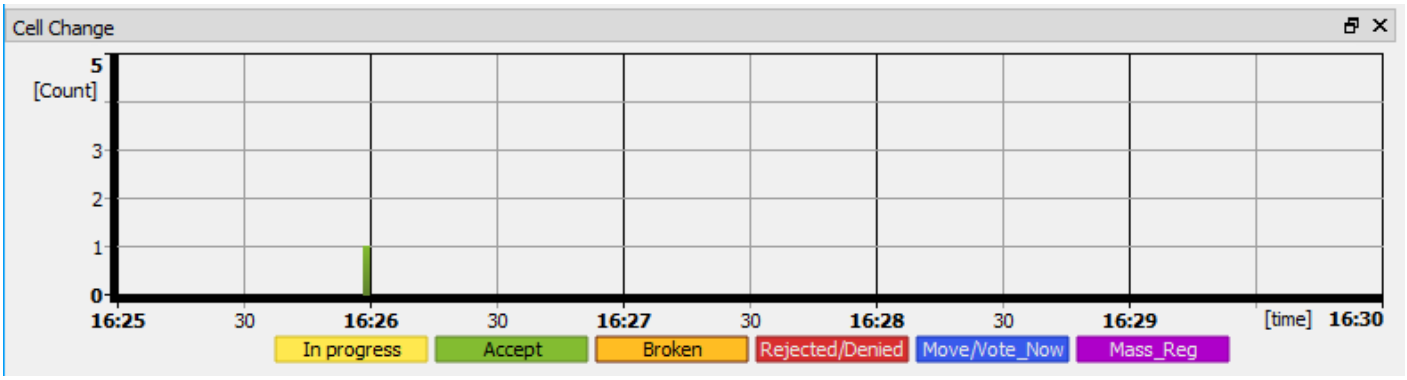


Illustration 152 MultiAnalyzerQoS: Cell Change (DMR)

Cell Change List

The ‘Cell Change List’ presents all occurred cell changes within the current time range. The column ‘Time’ contains the event time, the column ‘Address’ the active mobile. The column ‘Duration’ indicates the needed time and the column ‘Comment’ the type of the cell change measurement according to chapter 5.7.16 Types of Cell Change Measurements. If known, the cell change type and in case of rejection the cause is printed.

The background is filled with the legend colour of the ‘Cell Change’ view that can be set in the menu section ‘Settings’ (see chapter 5.7 MultiAnalyzerQoS).

- Supported protocols: TETRA, and DMR,

Cell Change List

	Time	Address	Duration	Comment
1	11:42:05	ESI: 0x5e80c8	425 ms	Accept: Service restoration roaming location updating (Call restoration: Ok)
2	11:42:11	5408416	906 ms	Accept: Roaming location updating
3	11:42:16	4436166	6148 ms	Broken: Unknown type
4	11:42:22	5408301	1190 ms	Accept: Roaming location updating
5	11:42:22	7434440	793 ms	Accept: Roaming location updating
6	11:42:24	ESI: 0x4c249b	226 ms	Accept: Encrypted
7	11:42:25	ESI: 0x5749bc	226 ms	Accept: Encrypted
8	11:42:29	ESI: 0xb005cf	170 ms	Accept: Encrypted
9	11:42:30	ESI: 0x79757f	226 ms	Accept: Encrypted
10	11:42:40	ESI: 0x345385	680 ms	Leaving
11	11:42:45	5408869	1728 ms	Reject: ITSI attach (Congestion)
12	11:42:45	ESI: 0x465db6	113 ms	Leaving
13	11:42:48	ESI: 0xd5e603	226 ms	Accept: Encrypted
14	11:42:54	ESI: 0xc684a0	-	Accept: Encrypted
15	11:43:00	ESI: 0xdf6978	170 ms	Leaving
16	11:43:04	ESI: 0x5e80c8	170 ms	Leaving
17	11:43:13	ESI: 0x5f7ea9	113 ms	Leaving
18	11:43:14	ESI: 0xd886f8	170 ms	Leaving

Illustration 153 MultiAnalyzerQoS: Cell Change List

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Top Cell Change List

The ‘Top Cell Change List’ shows the top instances that perform cell changes in the current time range. The different cell change types are split and sorted into columns.

The background is filled with the legend colour of the ‘Cell Change’ view. The number of the displayed instances and the legend colour can be defined in the menu section ‘Settings’ (see chapter 5.7 MultiAnalyzerQoS).

- Supported protocols: TETRA, and DMR,

Top Cell Change List

	SSI	All	In progress	Accept	Broken	Reject	Leaving	Update cmd
1	7401668	12		9	2	1		
2	4436166	5		5				
3	6430097	4		4				
4	ESI: 0x5749bc	3		1			2	
5	6700665	3		1	2			
6	ESI: 0x12b6f1	3		1			2	
7	ESI: 0x594c7a	2		1			1	
8	4402905	2		2				
9	ESI: 0x4b6c0f	2		1			1	
10	ESI: 0x25ac33	2		1			1	
11	All other	38		20			18	

Illustration 154 MultiAnalyzerQoS: Top Cell Change List

How to read and interpret the table 'Top Cell Change List'?

A mobile avoids cell changes as long as the reception conditions are adequate. When the mobile frequently changes the cell, this has several reasons. The reasons can be divided into two different categories:

Completely legitimate reasons:

- The mobile moves frequently from one cell to another.
- The mobile is constantly exposed changing reception conditions. For example, caused by body-damping, object-damping, indoor close to a window or near to a wall, the user sits in the car….

Reasons that point to general problems:

- Coverage problems.
- Not optimal broadcast parameters.
- Link budget problems (downlink can be received but the SwMI、can not confidently receive uplink).
- Problems with the antenna wiring or the manner how the device is carried.
- Problems with the transmitter, receiver hardware, or external amplifier.
- A jamming source.
- Blocking conditions by a talking device near by the receiving terminal.
- Extreme signalling overload condition on the control channel.

The analysis can not identify what the problem is. However, it can identify the effected mobile subscribers. This allows the operator a more detailed analysis:

Problem	Description of the Problem	Solution
The mobile moves frequently from one cell to another	-	Ascertain the expected work flow for subscriber.
The mobile is constantly exposed changing reception conditions	For example, the mobile is at an intersection or at a cell boundary of two cells. The body-damping or object-damping will cause easily fast cell changes. Indoor coverage conditions fluctuate very fast.	Check to optimise the coverage, the broadcast parameter, or improve the manner the mobile is carried.
Coverage problems	Is the time that is needed for cell change higher than usual? Are there cumulative broken cell changes? On encrypted class 3 networks, is the cell change	Ascertain the location of the subscribers and check the local coverage.
Not optimal broadcast parameters		
Link budget problems		

Problem	Description of the Problem	Solution
	unencrypted or does the mobile not initiate DCK forwarding? Are other mobile affected at the same location?	
Problems with the antenna wiring or the manner how the device is carried	Like the first one but only the identified mobile is affected. All other mobiles in the area show normal behaviour.	Check the hardware and the wiring.
Problems with the transmitter or receiver hardware or external amplifier		
A jamming source	Is the behaviour periodical or are there some other principles? For example the effect occurs at a specific time of the day.	Make out the location of the subscribers and check the spectrum with a spectrum analyser.
Blocking conditions	A transmitting terminal (involved as transmitting party in a call) may block the receiving terminal, if the distance between the two terminals is small (two colleagues are standing close together).	To prevent a blocking condition, the two terminals has not to stay on the same cell.
Extreme signalling overload condition on control channel	Is the control channel load high?	Take a look at the control channel analysis. In case of a high control channel load, enhance the control channel resources (add SCCH).

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Cell Change Pie Chart

The ‘Cell Change Pie Chart’ shows the occurred cell change signalling in the current time range in the form of a pie chart. The single PDUs، are grouped and displayed into different colours. The legend describes the events, the percentage and the number of event occurrence in parentheses.

- Supported protocols: TETRA، and DMR،

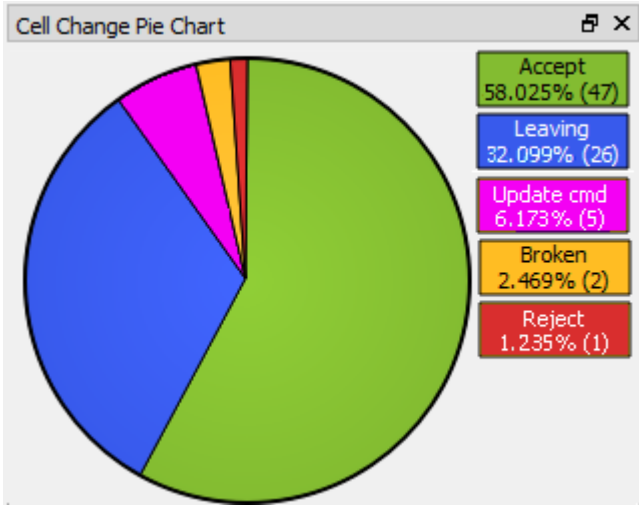

Illustration 155 MultiAnalyzerQoS: Cell Change Pie Chart

Cell Change Pie Chart (Clear/AIE)

The ‘Cell Change Pie Chart (Clear/AIE)’ is similar to the usual ‘Cell Change Pie Chart’ but the types are split into unencrypted (clear) and air interface encrypted (AIE،) parts. The values in parentheses are the occurred PDUs، and the total number.

- Supported protocols: TETRA،

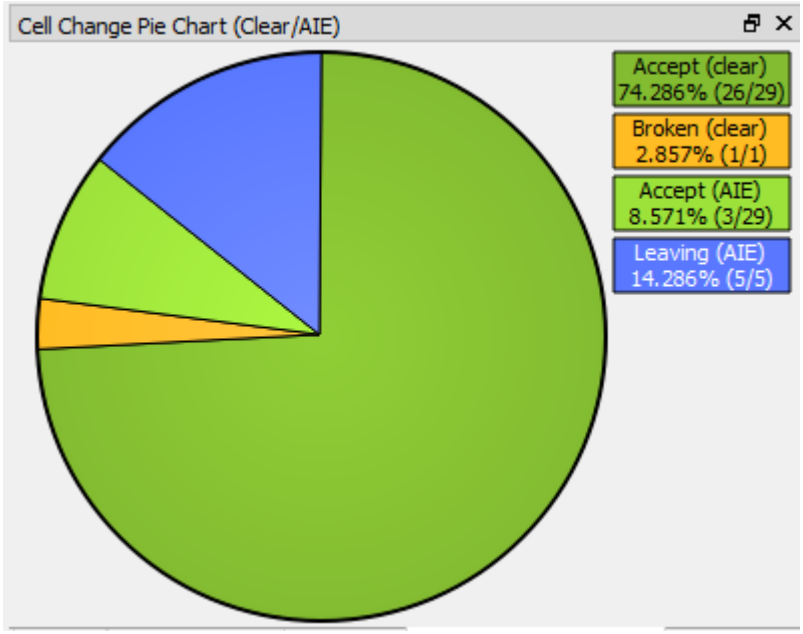

Illustration 156 MultiAnalyzerQoS: Cell Change Pie Chart (Clear/AIE)

Cell Change Duration (All)

The ‘Cell Change Duration (All)’ chart shows the duration of the cell change types in the form of a histogram. An increment of 500ms is used over a range up to 2 seconds. All values that are above the 2 seconds appear in the column ‘larger’. The column ‘unknown’ includes all cell changes where the time detection was not possible.

- Supported protocol: TETRA.

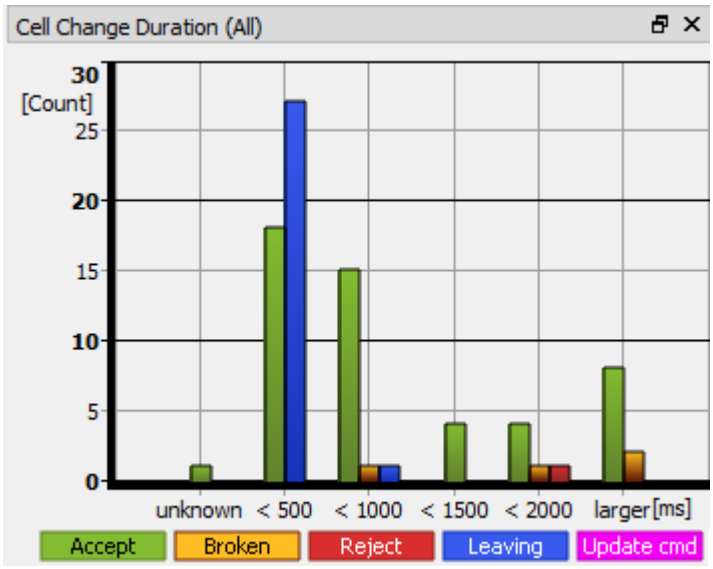

Illustration 157 MultiAnalyzerQoS: Cell Change Duration (All)

Cell Change Duration (Call Restoration)

The ‘Cell Change Duration (Call Restoration)’ chart shows only the duration of the cell change with call restoration in the form of a histogram. An increment of 500ms is used over a range up to 2 seconds. All values that are above the 2 seconds appear in the column ‘larger’. The column ‘unknown’ includes all cell changes where the time detection was not possible.

- Supported protocol: TETRA.

> The measured duration is the audiophile gap that is caused by the current cell (waiting for the E2E vector is not included).

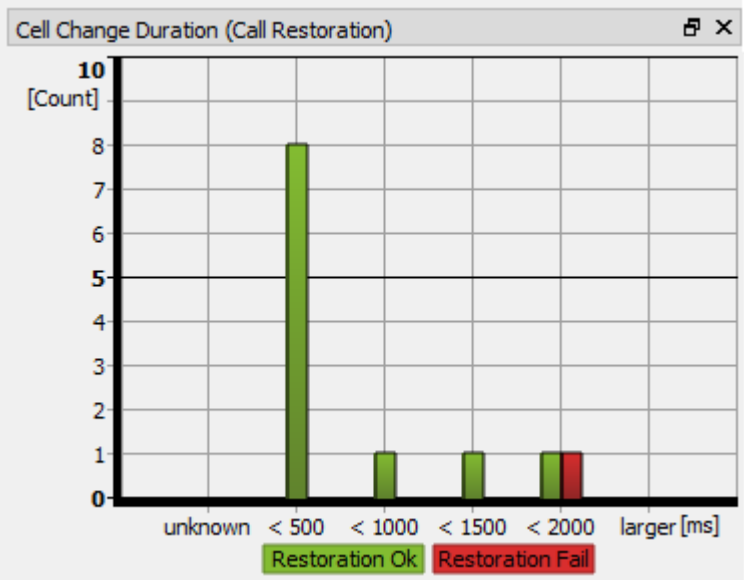

Illustration 158 MultiAnalyzerQoS: Cell Change Duration (Call Resoration)

5.8 MultiAnalyzerQosServer

The **MultiAnalyzerQosServer** reads one or more record files in real-time that are recorded by the **MultiAnalyzer** (see chapter 5.1 MultiAnalyzer). The server analyses the data. The resulting high-level QoS data is streamed over the IP network in real-time and can be received and viewed by the **MultiAnalyzerQoS** programme (see chapter 5.7 MultiAnalyzerQoS). The stream can be sent as unicast to a single client or as multicast to an unlimited number of clients (see 159):

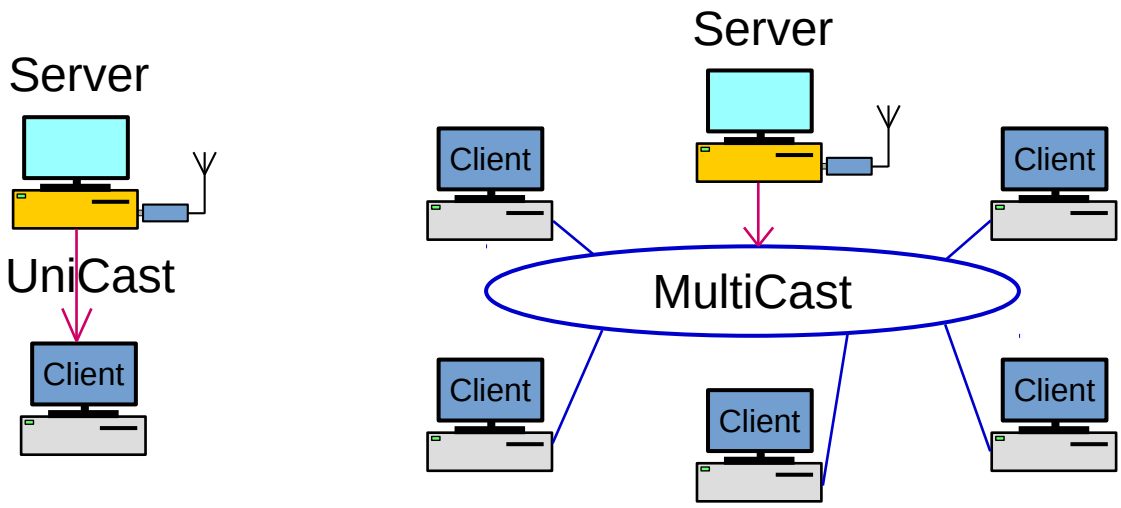

Illustration 159 MultiAnalzyerQosServer: Stream Unicast and Multicast

The IP network hardware provides the sharing of the IP multicast data, e. g. router and switches, so this is not a part of the **MultiAnalyzer** package. In doubt the user may need to configure the support of multicast in his network hardware. The IPv4 and IPv6 versions are supported both.

The receiving procedure with the **MultiAnalyzerQoS** viewer is described in chapter 5.7.10 Starting Real-Time QoS Stream. For multicast streaming, the same address for client and server is used.

5.8.1 Server Interface

This chapter provides an overview of the **MultiAnalyzerQosServer** interface. Depending on the chosen mode, the interface has a different appearance.

Three different setting options are available:

Name	Description
Use local QoS settings	The local QoS settings are used.
Use stored QoS settings	The QoS setting files that were stored in **MultiAnalyzerQoS** are used.
Use single file settings	The single setting files are used. For this option it can be chosen between TETRA DMO and TETRA TMO.

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Use local QoS settings

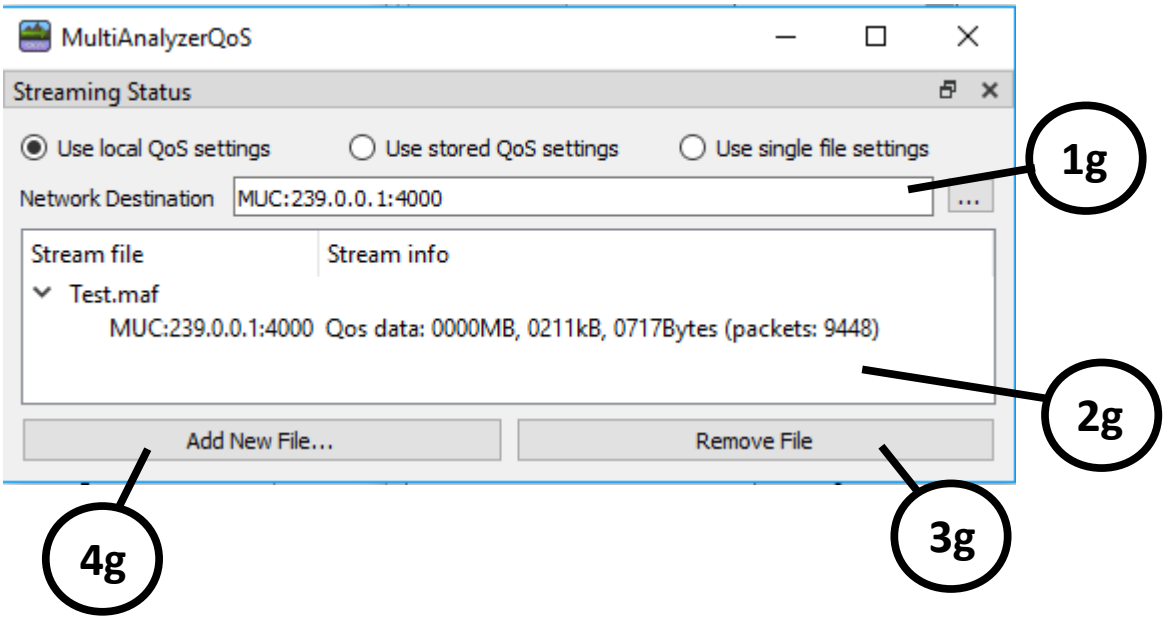

Illustration 160 MultiAnalyzerQosServer: Interface Local Settings

No	Description
1g	This is the destination address for the streaming data. It is split into three parts: • The keyword that defines the streaming type, 'UDP' for Unicast or 'MUC' for Multicast. • The destination address for streaming IPv4 or IPv6. • The destination Port with a value between 1 and 65535. It is not possible to use the same address and port for different streaming files. If the streaming is started by the recording **MultiAnalyzer**, the destination address stays unchanged but the used port number is increased by ten until a free port is found. The button [...] opens the streaming address settings dialogue (see chapter 5.8.2 Streaming Address Settings).
2g	Information about the streaming files.
3g	Button to stop the streaming of the chosen file. The file streaming also stops if the **MultiAnalyzer** recording is stopped.
4g	Button to manually start a new streaming. The streaming can also be started from the recording **MultiAnalyzer** and the button [QoS-Stream] (see chapter 5.1.2 Record Settings – Record).

Table 74 MultiAnalyzerQosServer: Interface Local Settings

Use stored QoS settings

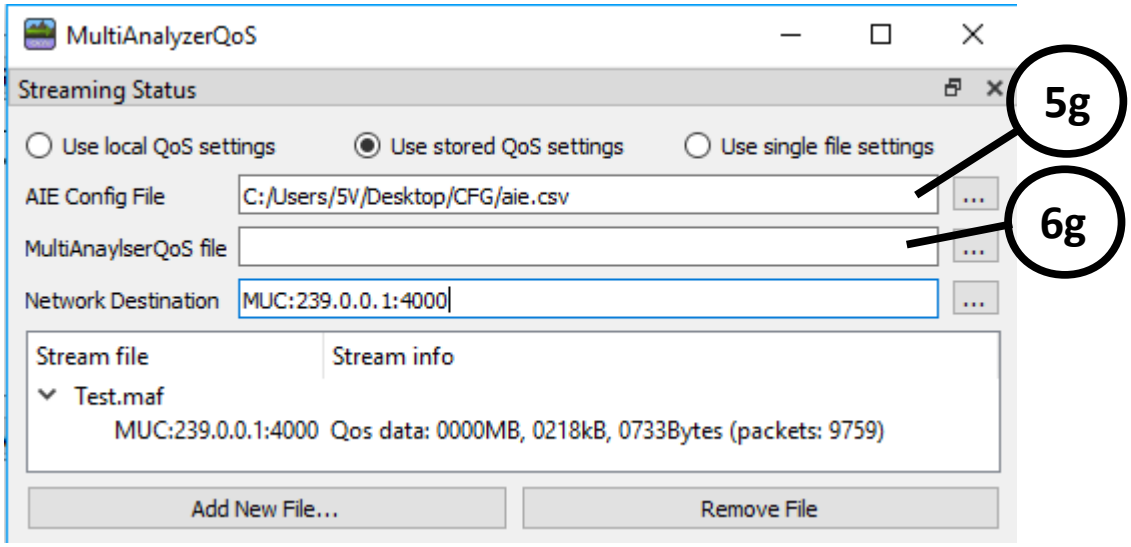

Illustration 161 MultiAnalyzerQosServer: Interface Stored Settings

No	Description
5g	The used AIE، configuration file. The button [...] opens the selection dialogue to choose the file.
6g	The used QoS settings file. The button [...] opens the selection dialogue to choose the file.

Table 75 MultiAnalyzerQosServer: Interface Stored Settings

Use single file settings (TETRA DMO)

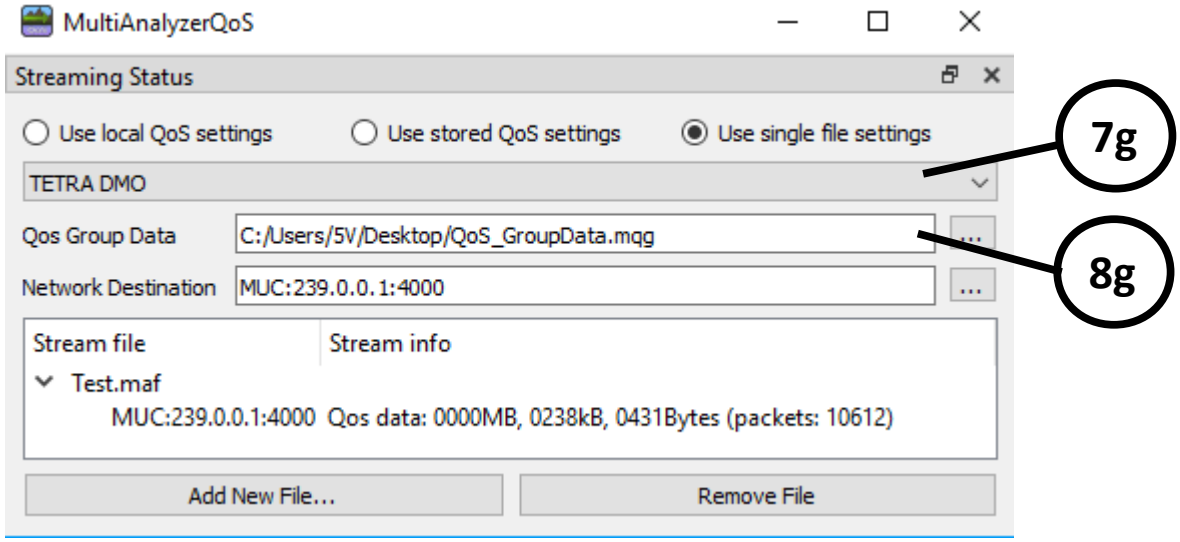

Illustration 162 MultiAnalyzerQosServer: Interface Single File Settings (TETRA DMO)

No	Description
7g	Drop-down list to change between the modes TETRA‚ DMO‚ and TETRA‚ TMO‚.
8g	The used CCCH group settings file (see chapter 5.7.2 CCCH QoS Groups). Every client uses this setting. The file includes groups, names and colours. The button [...] opens the selection dialogue to choose the file.

Table 76 MultiAnalyzerQosServer: Interface Single File Settings (TETRA DMO)

Use single file settings (TETRA TMO)

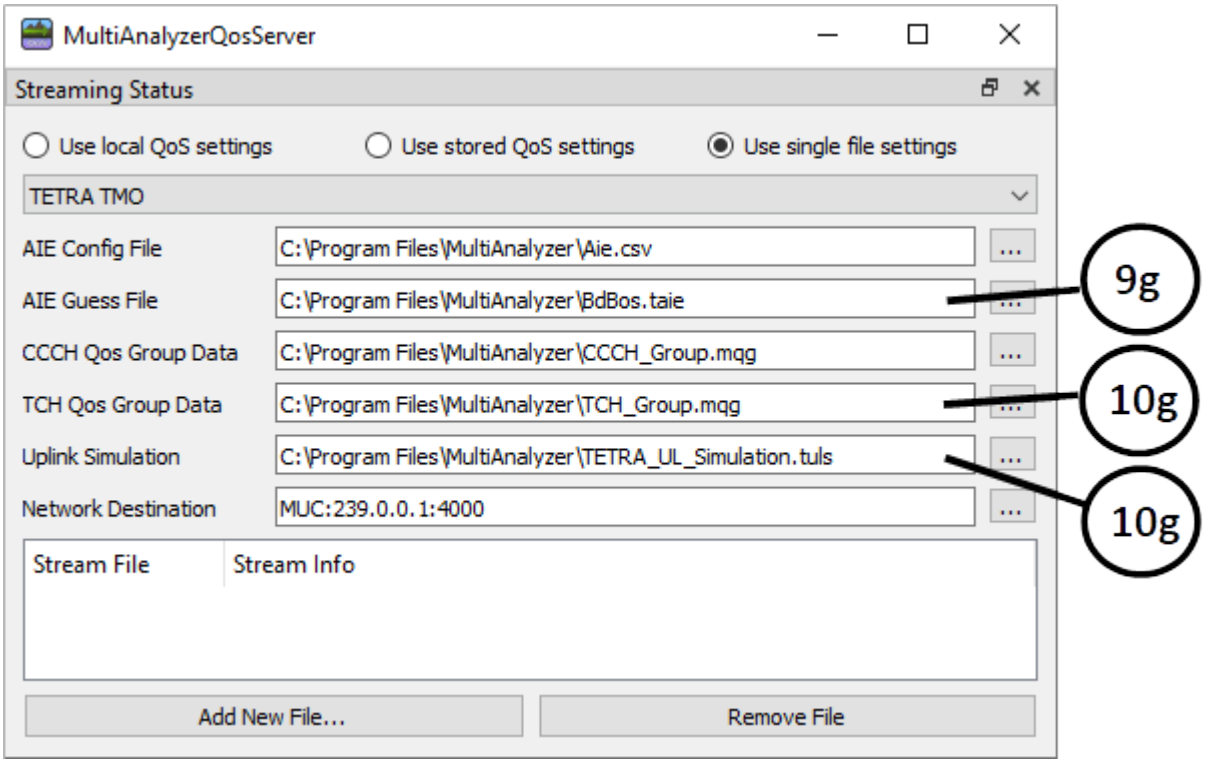

Illustration 163 MultiAnalyzerQosServer: Interface Single File Settings (TETRA TMO)

No	Description
9g	The used AIE، guess file. The button [...] opens the selection dialogue to choose the file.
10g	The used TCH group settings file (see chapter 5.7.3 TCH QoS Load Groups). Every client uses this setting. The file includes groups, names and colours. The button [...] opens the selection dialogue to choose the file.
11g	The used file for uplink simulation. The button [...] opens the selection dialogue to choose the file. For more information see chapter TETRA Uplink Simulation Settings.

Table 77 MultiAnalyzerQosServer: Interface Single File Settings (TETRA TMO)

5.8.2 Streaming Address Settings

This chapter provides an overview of the streaming address settings dialogue.

This settings dialogue generates a valid destination streaming address. Depending on the chosen option, the result is an unicast or a multicast IPv4 or IPv6 address.

> To start a real-time QoS stream, see chapter 5.7.10 Starting Real-Time QoS Stream.

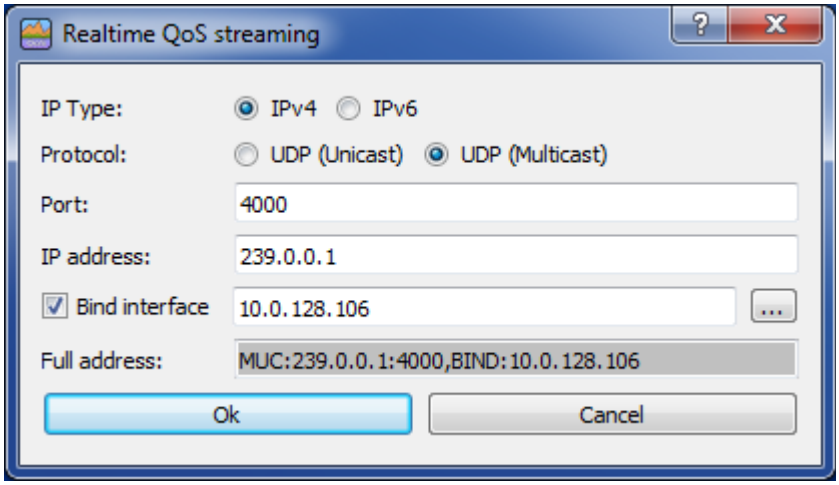

Illustration 164 MultiAnalyzerQoSServer: Streaming Address Settings Dialogue

	Name	IP Address
Unicast	**UDP** (for IPv4)	The destination IPv4 client address for sending UDP data. In the format: NNN.NNN.NNN.NNN
	UDP (for IPv6)	The destination IPv6 client address for sending UDP data. In the format: [NNNN:NNNN:NNNN:NNNN:NNNN:NNNN:NNNN:NNNN] Well known short cuts are allowed.
Multicast	**MUC** (for IPv4)	The destination IPv4 multicast address. Use a value in the IPv4 multicast range from 224.0.0.0 to 239.255.255.255. The client uses the same address and port for receiving.
	MUC (for IPv6)	The destination IPv6 multicast address. Use a value in the range from IPv6: FF00::/8. The client uses the same address and port for receiving.

Table 78 MultiAnalyzerQosServer: Streaming Address Settings

A red coloured background indicates a problem in the input. A white background indicates that no mistake is found. It is needed to set an IP address. Named addresses for unicast are not accepted.

For multicast streaming, the client needs to use the same address as the server. To configure the client, the address from line ‘Full address’ can be used.

We recommend for multicast usage, to bind the network adapter. This means the user explicitly choose the used network adapter by IP address.

NOTICE	Default adapter can be changed by Windows while in use! If the network adapter is not bound, the default is used. The default adapter can be changed by Windows while the adapter is used. Bind the network adapter for multicast streaming.

To bind the network adapter, open the dialogue by selecting the checkbox ‘Bind interface’ and using the button […]:

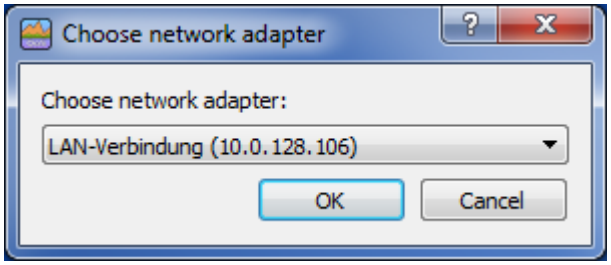

Illustration 165 MultiAnalyzerQosServer: Choose Network Adapter

ⓘ “,BIND=” is added after the address and configures the used network adapter by IP address. Mainly for Multicast streaming the binding is highly recommended!
Exampe: *,BIND=10.0.128.6* or *,BIND:[2001:0:509c:564e:471:21a2:f5ff:7f95]*

6 MultiAnalyzerSplitter

Analysing long recordings produces a large amount of data. However, if only the analysis from a certain time is desired, this can be disturbed by the other data. Also the sending of such long recordings is cumbersome. The separation programme can be used to split recordings into parts or cut out certain points in time, see chapter 6.1 Split Files.

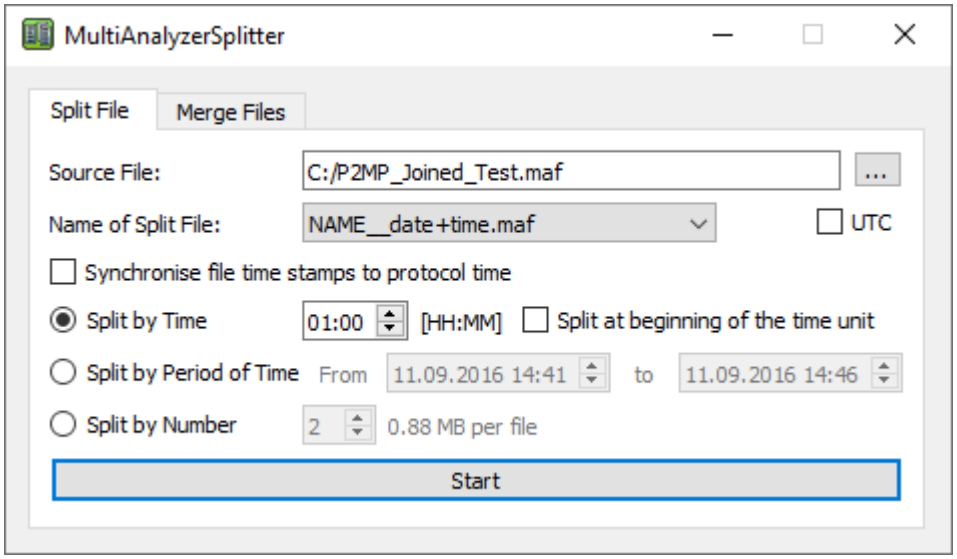

Illustration 166: MultiAnalyzerSplitter: Split File

A recording that is divided into several segments can also be reassembled. The sub-segments can be created either by splitting with the **MultiAnalyzerSplitter** or directly when recording with the **MultiAnalyzer** by automatically splitting by time segments. The **MultiAnalyzerSplitter** offers the possibility to merge these separated segments into one file, see chapter 6.2 Merge Files.

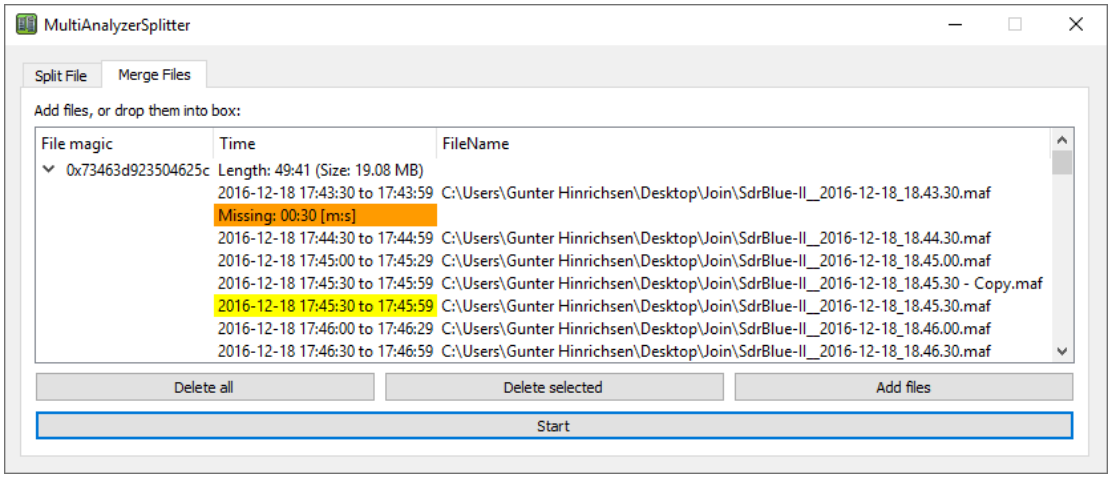

Illustration 167: MultiAnalyzerSplitter: Merge File

6.1 Split Files

After selecting the source recording, the recording is analysed in advance. The start/end time is determined. If it is possible, the elapsed time is determined in the protocol.

The file can be split according to three criteria:

- Each segment contains a certain period of time.
- A desired time range is copied.
- A desired number of segments is generated.

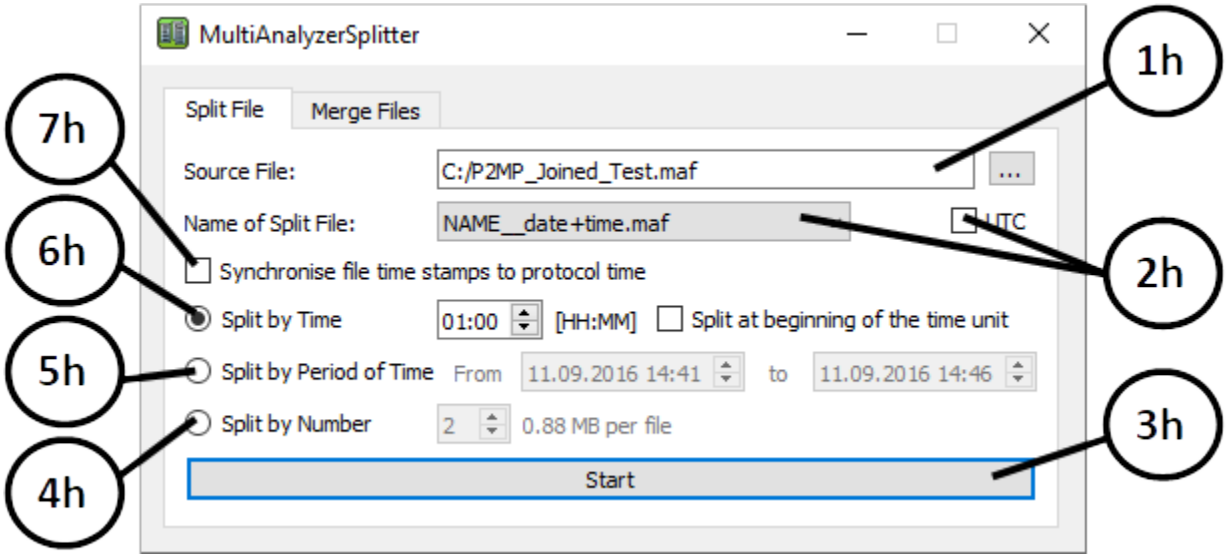

Illustration 168 MultiAnalyzerSplitter: Interface Splitting

No	Description
1h	Text field to set the source file for splitting.
2h	Drop-down list to set the name format for the split files. If the time shall be embedded in the name, the embedded time represents the starting time of the file. The time can be local or an UTC time stamp.
3h	Button to start splitting.
4h	This option creates a specified number of files from the source file.
5h	This option cuts a specific time range. The start time and the end time are specified.
6h	This option splits the file by time. The time will be expressed in hours and minutes. With the additionally activated option ‘Split at the beginning of the time unit’, the file is split when the full time is reached. For example, at 01:00 (one hour) every full hour (Start time: 8:15, 1st split: 9:00, 2nd split: 10:00 etc.). Without this option, the file is split every time after one hour has passed (Start time: 8:15,

No	Description
	1st split: 9:15, 2nd split: 10:15 etc.).
7h	This option is only available when the time is sent in the log. If enabled, the timestamp in the output files is modified and adjusted to the log time.

Table 79 MultiAnalyzerSplitter: Interface Splitting

6.2 Merge Files

All files to be merged are selected in the file dialogue or added directly to the list using Drag & Drop. Different records are recognized and treated individually. Missing or overlapping time periods are highlighted with different colours in the list.

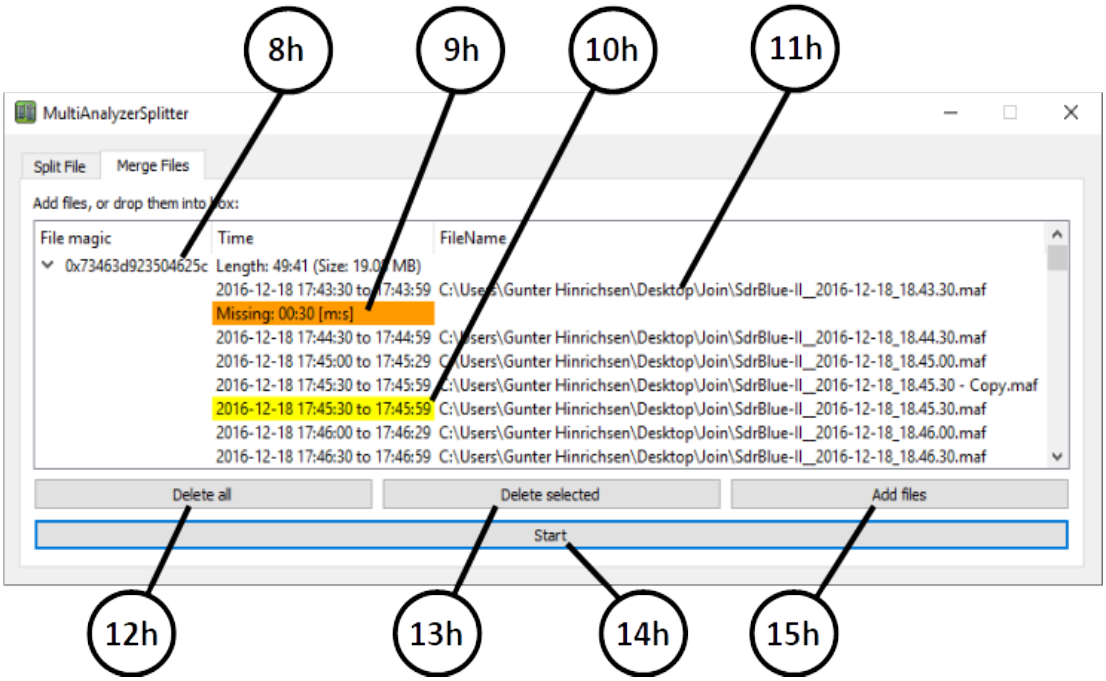

Illustration 169: MultiAnalyzerSplitter: Interface Joining

No	Description
8h	Each recording owns a random identification number. This distinguishes different records from each other. Individual segments of a recording have the same identification number.
9h	If there is a gap in the recording between two segments, this gap is highlighted in orange.
10h	If time periods of two segments overlap, the time period of the second file is highlighted in yellow.
11h	The list of files to merge. The list is sorted by identification number and start time of the segment.
12h	Delete all entries from the list.
13h	Delete selected entries from the list.
14h	Starts the merge. There must be at least two segments in the list for each recording (identification number); each recording asks for the destination file name.
15h	Adds one or more files to the list.

Table 80 MultiAnalyzerSplitter: Interface Joining

7 MultiAnalyzerSaveRules

The **MultiAnalyzerSaveRules** is a preferences programme to control the allowed save options. Some of the configuration data can contain sensitive information. This information can be saved encrypted. A user with **administrator rights** can restrict the allowed save option system-wide.

The following configuration files can be saved encrypted:

- TETRA, AIE, guess settings
- TETRA, uplink simulation
- The general QoS settings (because it contains the settings above)

If one of these settings is saved, a dialogue requests the allowed and possible save options (see chapter 7.2 Save Options). The possible options are set in the settings (see chapter 7.1 Save Settings).

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7.1 Save Settings

The programme needs **administrator rights**. The settings are valid system-wide. The security to change these options depends on the protection of the administrator access. The settings are stored by closing the programme.

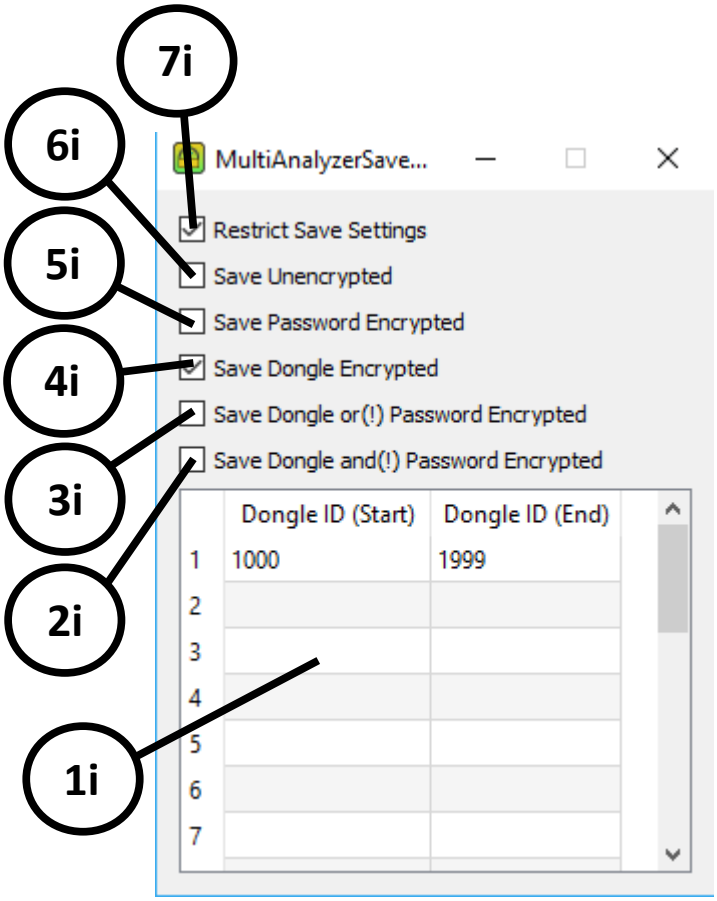


Illustration 170 MultiAnalyzerSaveRules: Changing Save Options

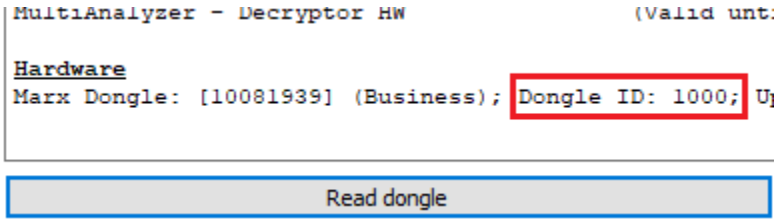
No	Description
1i	Limit the allowed dongles‹ for encryption. Up to twenty different dongle‹ number ranges can be set. The starting and the ending dongle‹ ID is set. The dongle‹ ID can be read with the programme **MultiAnalyzerLicence** (see chapter 4.2 Licence Options):  Every costumer has a reserved dongle‹ ID range of 1000. Every range begins with a full thousand range, i.e. 1.000 – 1.999, or 10.000 – 10.999.
2i	Allow to save the settings dongle‹ and password encrypted. A range of dongle‹ IDs (**1i**) is needed for working.
3i	Allow to save the settings dongle‹ or password encrypted. A range of dongle‹ IDs (**1i**) is needed for working.
4i	Allow to save the settings dongle‹ encrypted. A range of dongle‹ IDs (**1i**) is needed for working.
5i	Allow to save the settings password encrypted.
6i	Allow to save the settings unencrypted.
7i	General enable/disable restrictions. If disabled, unencrypted and password encrypted is allowed.

Table 81 MultiAnalyzerSaveRules: Changing Save Options

7.2 Save Options

If the settings for TETRA, AIE, , TETRA, uplink simulation or the general QoS settings are saved, a dialogue opens to request the allowed and possible save options. These options are shown below (see 171) and can be set via the save settings (see 7.1 Save Settings).

This chapter provides an overview of these possible save options in **MultiAnalyzerSaveRules**.

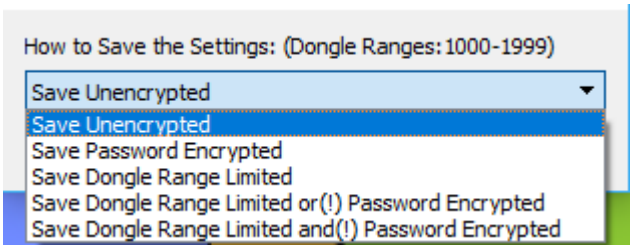


Illustration 171 MultiAnalyzerSaveRules: Save Options

Name	Description	
Save unencrypted	The data is saved unencrypted. Everyone can load the data.	
	Password needed	No
	Dongle, needed	No
Save password encrypted	The data is saved password encrypted. For decryption, the password is needed.	
	Password needed	Yes (mandatory)
	Dongle, needed	No
Save dongle range limited	The data is saved dongle, encrypted. For decryption, a dongle, with a number in a corresponding range is needed.	
	Password needed	No
	Dongle, needed	Yes (mandatory)
Save dongle range limited or(!) password encrypted	The data is saved password **or** dongle, encrypted. For decryption, a dongle, with a number in a corresponding range is needed, or if not available, the password is needed.	
	Password needed	Yes (optionally, if no dongle is present)
	Dongle, needed	Yes (optionally, if Dongle is present no password is needed)
Save dongle range limited and(!) password encrypted	The data is saved password **and** dongle, encrypted. For decryption, a dongle, with a number in a corresponding range **and** the password is needed.	
	Password needed	Yes (mandatory)
	Dongle, needed	Yes (mandatory)

Table 82 MultiAnalyzerSaveRules: Save Options

If an option with a password is selected, the password needs to be set.

The minimum length of the password is eight characters.

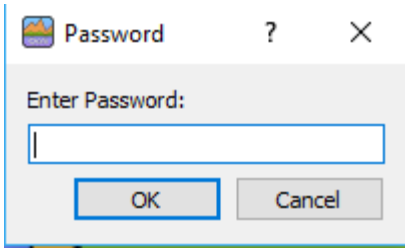


Illustration 172
MultiAnalyzerSaveRules: Password

The password is used hashed with “Argon2d” for AES encryption.

8 MultiAnalyzerNetworkViewer

The **MultiAnalyzerNetworkViewer** is used to visualise the data of radio towers and the connection between the radio towers.

This chapter provides an overview of the **MultiAnalzyerNetworkViewer** interface and menus.

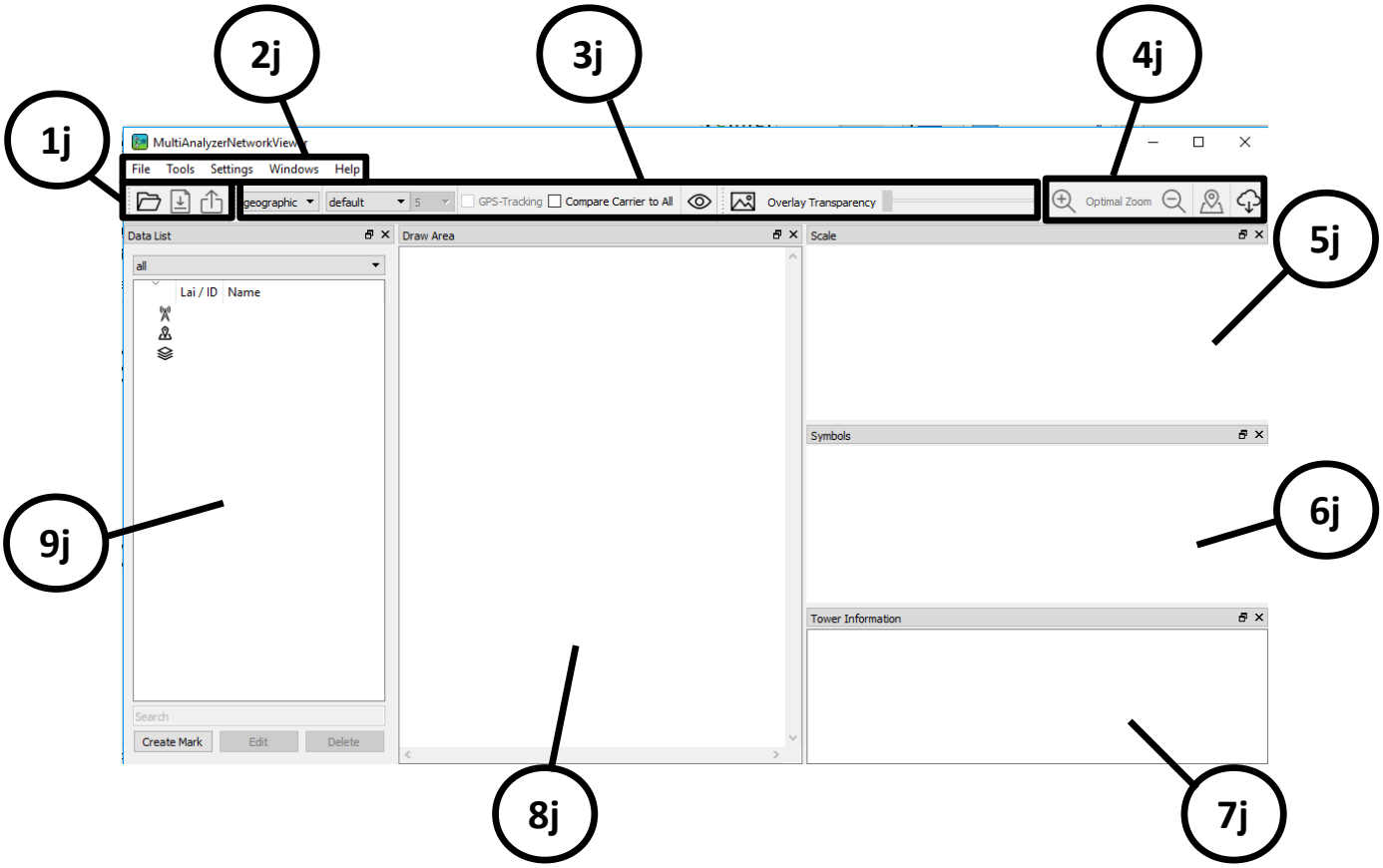


Illustration 173 MultiAnalyzerNetworkViewer: Interface

No	Description
1j	The toolbar ‘Load and Save’ (see chapter 8.1 Toolbars).
2j	The menu bar.
3j	Basics toolbar to change e. g. the graph style and mode (see chapter 8.1 Toolbars).
4j	Geographical tools (see chapter 8.1 Toolbars).
5j	The docking window ‘Scale’ shows e .g. the current zoom level and scale factor when a graph is drawn in geographic style (see chapter 8.3 Docking Windows). ⓘ This docking window presents its information only if a graph is drawn in the geographic style.
6j	The docking window ‘Symbols’ shows the towers and marks (see chapter 8.3 Docking Windows).
7j	The docking window ‘Tower Information’ shows the information of towers and marks.
8j	The docking window ‘Draw Area’ shows the drawn graph (see chapter 8.3 Docking Windows).
9j	The docking window ‘Data List’ shows e. g. the tower list, mark list and overlay list (see chapter 8.3 Docking Windows).

Table 83 MultiAnalyzerNetworkViewer: Interface

Menu ‘File’

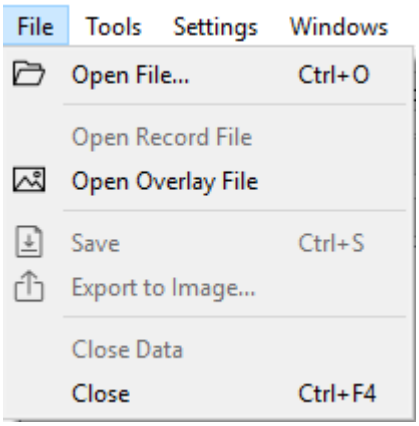


Illustration 174 MultiAnalyzerNetworkViewer: Menu ‘File’

Name	Key Combination	Description
Open File...	Ctrl+O	Open a CSV file, record file, or overlay file.
Open Record file	none	Open a record file. ⓘ Only available if a CSV file is loaded.
Open Overlay file	none	Open an overlay file.
Save	Ctrl+S	Save the data from the programme to a CSV file.
Export to Image...	none	Export the current view to an image.
Close Data	none	Close the current data.
Close	Ctrl+F4	Close the programme.

Table 84 MultiAnalyzerNetworkViewer: Menu ‘File’

Menu ‘Tools’

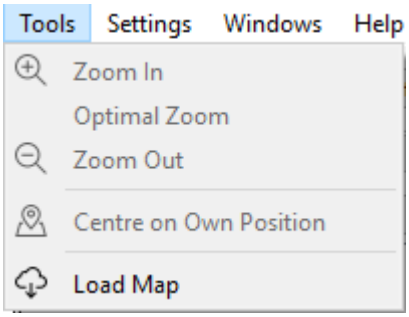


Illustration 175 MultiAnalyzerNetworkViewer: Menu ‘Tools’

Name	Description
Zoom In	Increase the zoom level by one level. ⓘ Only available if a geographic graph is drawn and the zoom level can be increased by one.
Optimal Zoom	Zoom to the optimal zoom level. ⓘ Only available if a geographic graph is drawn.
Zoom Out	Decrease the zoom level by one level. ⓘ Only available if a geographic graph is drawn and the zoom level can be decreased by one.
Centre on Own Position	Centre the map on the tracked GPS position. ⓘ Only available if a geographic graph is drawn and the GPS tracking is activated.
Load Map	Load the tiles of a map to the cache. ⓘ Only available if downloading is allowed.

Table 85 MultiAnalyzerNetworkViewer: Menu ‘Tools’

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Menu ‘Settings’

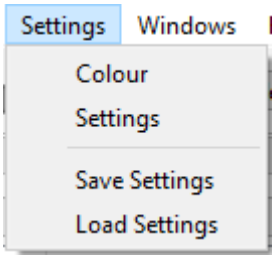


Illustration 176 MultiAnalyzerNetworkViewer: Menu ‘Settings’

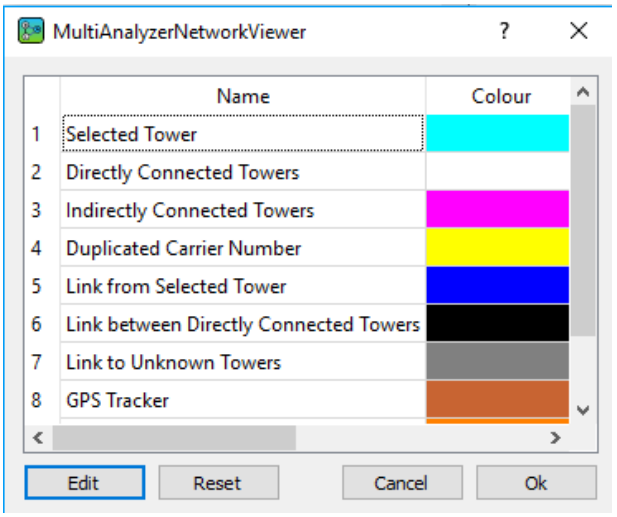
Name	Description
Colour	Change the colours of the tower status. **Edit**: Open colour selection dialogue, to edit the colour. **Reset**: Set back to factory default. **Cancel**: Close settings dialogue without applying the changes. **Ok:** Apply the changes. 
Settings	Change the settings (see chapter 8.2 Settings).
Save Settings	Save the settings to a file.
Load Settings	Load the settings from a file.

Table 86 MultiAnalyzerNetworkViewer: Menu ‘Settings’

Menu ‘Windows’

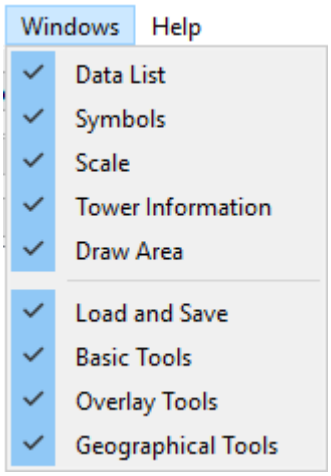


Illustration 177 MultiAnalyzerNetworkViewer : Menu ‘Windows’

Name	Description
Data List	Show or hide the docking window that contains the loaded data. (see chapter 8.3 Docking Windows).
Symbols	Show or hide the docking window that contains the symbols (see chapter 8.3 Docking Windows).
Scale	Show or hide the docking window that contains the information about the scale and the map (see chapter 8.3 Docking Windows).
Tower Information	Show or hide the docking window that contains the information about the tower (see chapter 8.3 Docking Windows).
Draw Area	Show or hide the docking window that contains the area to draw the graph (see chapter 8.3 Docking Windows).
Load and Save	Show or hide the toolbar that contains the tools for loading and saving the data (see chapter 8.1 Toolbars).
Basic Tools	Show or hide the toolbar that contains the basic tools (see chapter 8.1 Toolbars).
Overlay Tools	Show or hide the toolbar that contains the tools for the overlay (see chapter 8.1 Toolbars).
Geographical Tools	Show or hide the toolbar that contains the graphical tools (see chapter 8.1 Toolbars).

Table 87 MultiAnalyzerNetworkViewer: Menu ‘Windows’

Menu ‘Help’

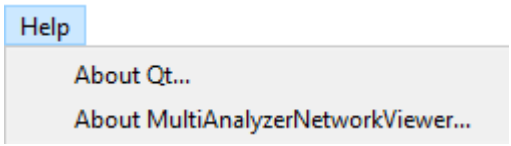


Illustration 178 MultiAnalyzerNetworkViewer: Menu ‘Help’

Name	Description
About Qt...	Show information about Qt.
About MultiAnalyzerNetworkViewer...	Show information about **MultiAnalyzerNetworkViewer.**

Table 88 MultiAnalyzerNetworkViewer: Menu ‘Help’

8.1 Toolbars

This chapter provides an overview of the different toolbars in **MultiAnalyzerNetworkViewer**.

Load and Save

Illustration 179 MultiAnalyzerNetwork Viewer: Load and Save

Icon	Description
	Button to open a CSV file, record file, or overlay file.
	Button to save the data from the programme to a CSV file. ⓘ Only available if data is loaded.
	Button to export the view of the Draw Area to an image. ⓘ Only available if a graph is drawn in the Draw Area.

Table 89 MultiAnalyzerNetworkViewer: Load and Save

Basic Tools

Illustration 180 MultiAnalyzerNetworkViewer: Basic Tools

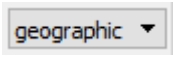
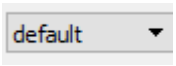
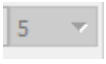
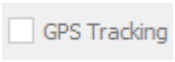
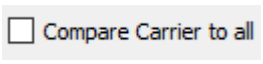
Icon	Description
	Drop-down list to change the graph style between ‘geographic’ and ‘circle’ (see chapter 8.5 Graph Styles).
	Drop-down list to change the geographic graph mode between ‘default’, ‘show all’ and ‘Range in km’ (see chapter 8.5 Graph Styles). ⓘ Only available if the graph style is set to ‘geographic’.
	Drop-down list to change the visibility range of the graph. ⓘ Only available if the graph style is set to ‘geographic’ and the geographic mode is set to ‘Range in km’.
	Checkbox to activate or deactivate the tracking of the GPS positions. ⓘ Only available if the graph style is set to ‘geographic’.
	Checkbox to activate or deactivate ‘Compare Carrier to all’. The carriers by default are only compared to their direct neighbour carriers.
	Button to make all hidden elements visible.

Table 90 MultiAnalyzerNetworkViewer: Basic Tools

Overlay Tools

Illustration 181 MultiAnalyzerNetworkViewer: Overlay Tools

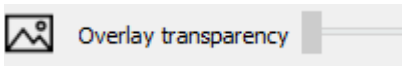
Icon	Description
	Slider to change the transparency of the overlays. ⓘ Only available if an overlay file is loaded.

Table 91 MultiAnalyzerNetworkViewer: Overlay Tools

Geographical Tools

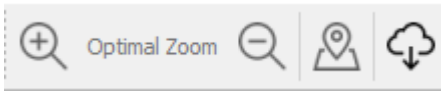


Illustration 182 MultiAnalyzerNetworkViewer: Geographical Tools

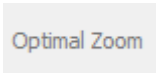
Icon	Description
	Button to increase the zoom level by one level. ⓘ Only available if a geographic graph is drawn and the zoom level can be increased by one level.
	Button to zoom to the optimal zoom level. ⓘ Only available if a geographic graph is drawn.
	Button to decrease the zoom level by one level. ⓘ Only available if a geographic graph is drawn and the zoom level can be decreased by one level.
	Button to centre the map on the tracked GPS position. ⓘ Only available if a geographic graph is drawn and the GPS tracking is activated.
	Button to load the tiles of a map to the cache. ⓘ Only available if downloading is allowed.

Table 92 MultiAnalyzerNetworkViewer: Geographical Tools

8.2 Settings

This chapter provides an overview of the **MultiAnalzyerNetworkViewer** settings dialogue.

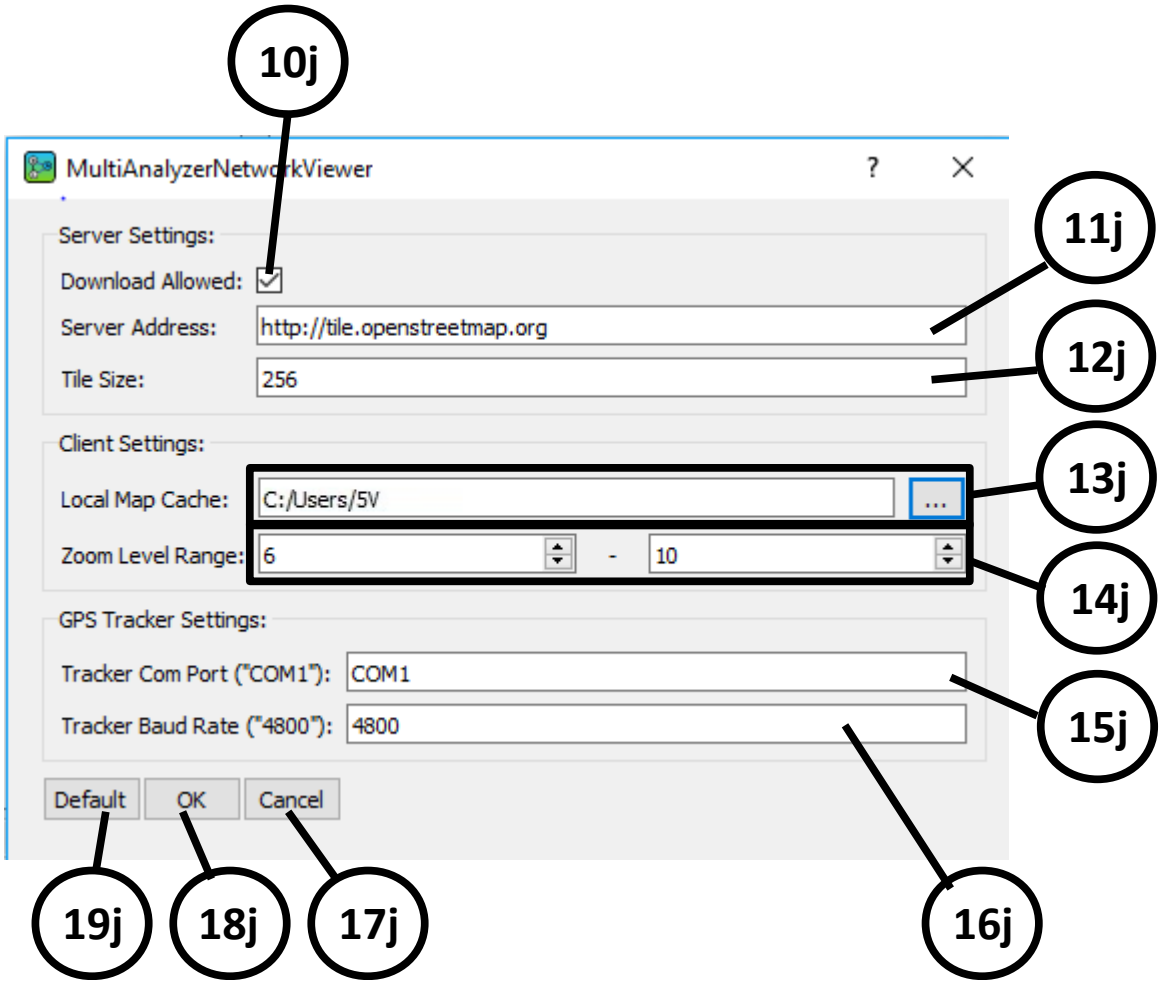


Illustration 183 MultiAnalyzerNetworkViewer: Settings Dialogue

No	Description
10j	Checkbox to activate and deactivate the possibility to download the map from the internet. If it is deselected, the map is only loaded from the local cache (**13j**).
11j	Text field to set the server address of the map server.
12j	Text field to set the pixel size of a single tile of the map. ⓘ The Tile Size is a server-specific parameter and specifies the size of a tile in pixel (e. g. 256 means one tile consists of 256x256 pixel).
13j	Text field to set the path to the local map cache. In this folder, the downloaded tiles of the map are saved. The tiles for the map are primarily loaded from the cache.

No	Description
	ⓘ The programme automatically stores the map tiles, which are used for zooming and scrolling in the geographic view, in this cache. There is no need to download the map tiles again and it is possible to offline work with maps.
14j	The minimum and maximum zoom level that are allowed to zoom in or out. ⓘ Reducing the amount of map data to be downloaded from a server can be achieved by restricting the Zoom Level Range.
15j	Text field to set the COM port where a GPS mouse is connected.
16j	Text field to set the baud rate of the GPS mouse.
17j	Button to close the window without saving the settings.
18j	Button to close the window and save the settings.
19l	Button to reset the settings to default.

Table 93 MultiAnalyzerNetworkViewer: Settings

8.3 Docking Windows

This chapter provides an overview of the different docking windows in **MultiAnalyzerNetworkViewer**.

Scale

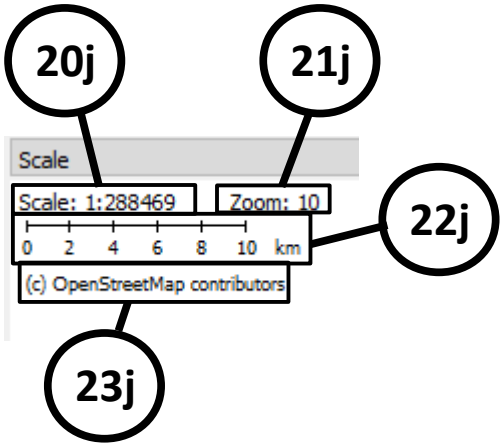


Illustration 184 MultiAnalyzerNetworkViewer: Scale

No	Description
20j	The scale factor shows the factor of the distance of 1 centimetre on the monitor compared to the real distance.
21j	The zoom level shows the current zoom level of the drawn graph.
22j	The scale shows an example of the distance.
23j	The copyright information shows the source of the map data.

Table 94 MultiAnalyzerNetworkViewer: Scale

Symbols

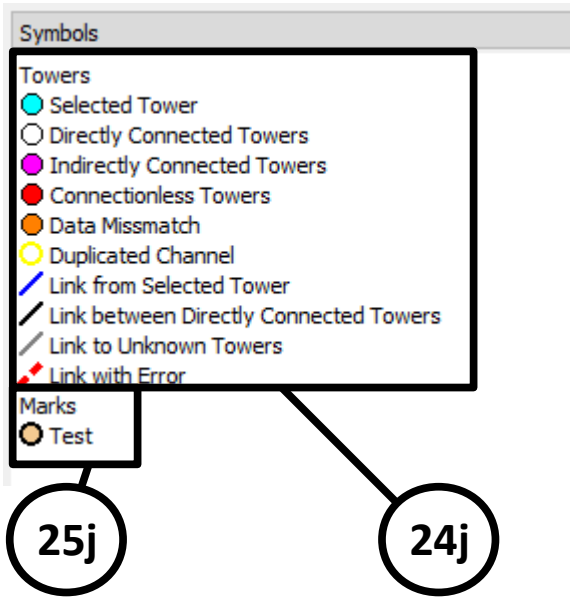


Illustration 185 MultiAnalyzerNetworkViewer: Symbols

No	Description
24j	This section shows the definitions of all colours that are used by the towers in the graph. To change the colours of the towers, see chapter 8 MultiAnalyzerNetworkViewer menu section 'Settings'.
25j	This section shows all created or loaded marks including their colours.

Table 95 MultiAnalyzerNetworkViewer: Symbols

Draw Area

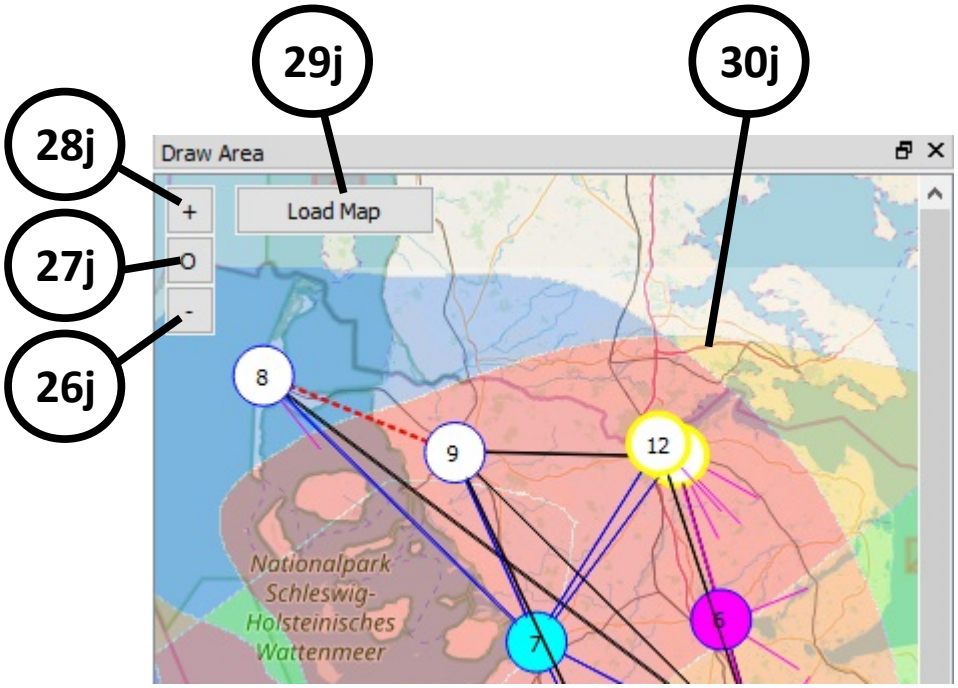


Illustration 186 MultiAnalyzerNetworkViewer: Draw Area

No	Description
26j	Button to decrease the zoom level by one level. ⓘ Only available if a geographic graph is drawn and the zoom level can be decreased by one.
27j	Button to zoom to the optimal zoom level. ⓘ Only available if a geographic graph is drawn.
28j	Button to increase the zoom level by one level. ⓘ Only available if a geographic graph is drawn and the zoom level can be increased by one.
29j	Button to load the tiles of a map to the cache. ⓘ Only available if a geographic graph is drawn and downloading is allowed.
30j	The area where the graph is drawn.

Table 96 MultiAnalyzerNetworkViewer: Draw Area

The Draw Area has the following key bindings available:

Function	Key Combination	Description
Zoom in	Page Up	Increases the zoom level by one level.
Zoom out	Page Down	Decreases the zoom level by one level.
Zoom to Default	Home/Pos 1	Changes the zoom level to the default zoom level.
Move Map up	Arrow Up	Moves upward within the map.
Move Map down	Arrow Down	Moves downward within the map.
Move Map left	Arrow Left	Moves to the left within the map.
Move Map right	Arrow Right	Moves to the right within the map.
Highlight Cell	Space	Highlights a cell on the map.
Select Highlighted Cell	Return/Enter	Selects the highlighted cell.

Table 97 MultiAnalyzerNetworkViewer: Draw Area Keybindings

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Data List

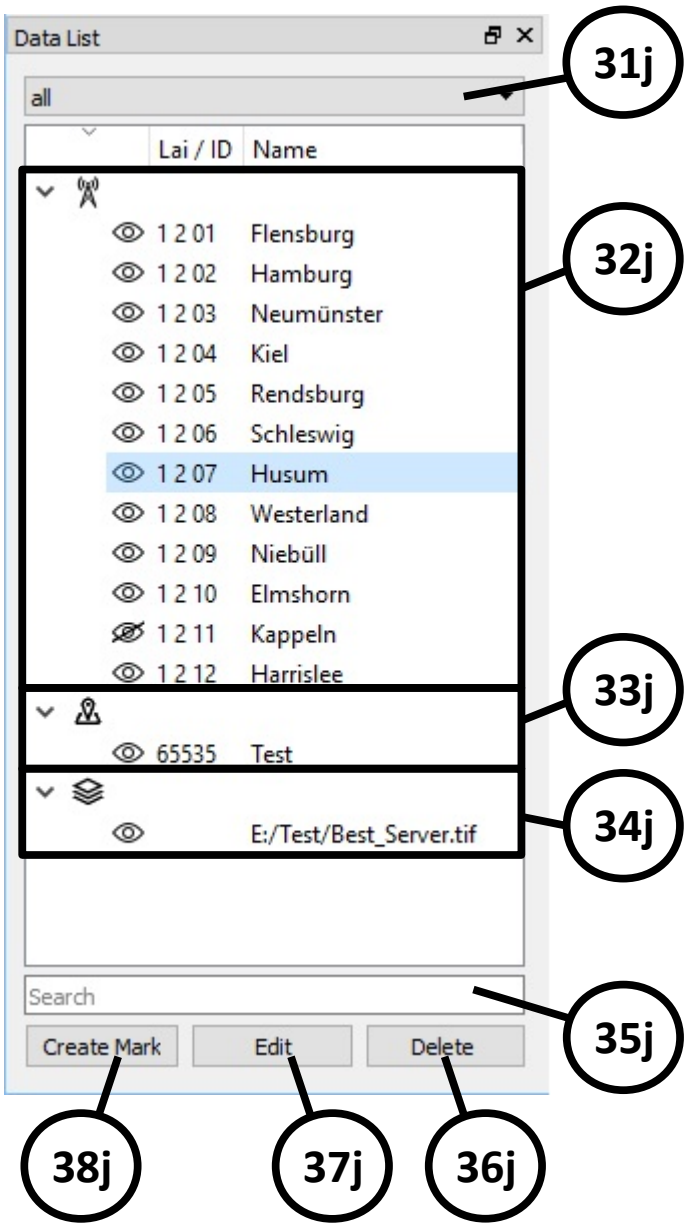

Illustration 187 MultiAnalyzerNetworkViewer: Data List

No	Description
31j	Drop-down list to filter the elements in the list. The options are: • all • drawn • not drawn • connected • indirect connected
32j	The tower list shows the towers and their visibility status.
33j	The mark list shows the marks and their visibility status.
34j	The overlay list shows the loaded overlay files.
35j	Search bar to search for elements from the list. The first found element will be highlighted.
36j	Button to delete an element in the list (see chapter 8.13 Deleting a Data List Element). ⓘ Only available if a tower or a mark from the list is selected.
37j	Button to edit an element in the list (see chapter 8.11 Editing the Tower Information and 8.12 Editing the Mark Information). ⓘ Only available if a tower or a mark from the list is selected.
38j	Button to create a mark (see chapter 8.9 Creating a Mark (Pop-Up Menu) and 8.10 Creating a Mark (Data List)).

Table 98 MultiAnalyzerNetworkViewer: Data List

ⓘ Graph elements will be drawn, if they have an “eye” icon.
Graph elements will not be drawn, if they have a “crossed eye” icon.

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8.4 Loading a File (MultiAnalyzerNetworkViewer)

It is possible to load CSV files, record files (e. g. *.maf, *.tmw), or overlay files. Already loaded CSV files can be extended by additionally loading a record file.

ⓘ If incomplete recorded data is loaded, the programme opens a dialogue to fill in the missing information (see chapter 8.4.2 The Data of a Record File).

ⓘ For information about saving the data, see chapter 8.6 Saving Data.

To load a file into the **MultiAnalyzerNetworkViewer**, follow the next steps.

1. Open the selection dialogue to choose a file via ‘File’ > ‘Open File...’ or use the key combination Ctrl+O.

✔ The selection dialogue opens (see 188).

ⓘ By default the selection dialogue shows only CSV files.

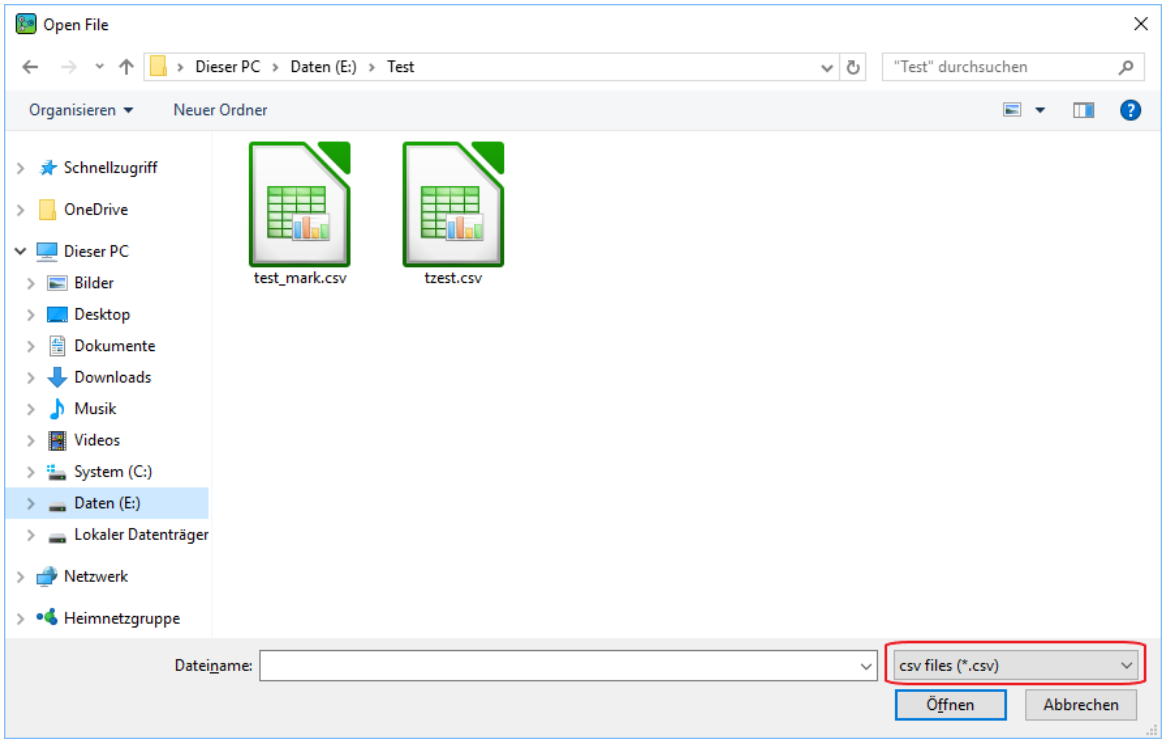
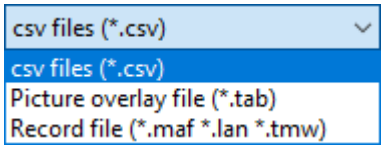


Illustration 188 MultiAnalyzerNetworkViewer: Open File

ⓘ The files that to be shown can be changed via the drop-down list:



2. To open the file, choose the file and click on the button [Open].

   ⓘ Overlay files are directly loaded into the programme.

✔ **MultiAnalyzerNetworkViewer** shows the following dialogue:

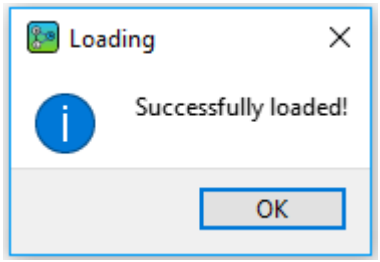


Illustration 189
MultiAnalyzerNetworkViewer:
Loading Succeed

✔ The file is loaded into the **MultiAnalyzerNetworkViewer**.

   ⓘ If the programme is not able to automatically load the file, see chapter 8.4.1 Data Order Dialogue.

   ⓘ For information about the different graph styles to present the data, see chapter 8.5 Graph Styles).

8.4.1 Data Order Dialogue

If a CSV file is loaded and the programme is not able to automatically load the file, the programme opens a dialogue to define the order of the CSV file.

This chapter provides an overview of the dialogue to order the data in **MultiAnalyzerNetworkViewer**.

Illustration 190 MultiAnalyzerNetworkViewer: Data Order

No	Description
39j	Drop-down list to select an order.
40j	Button to delete the selected order.
41j	The selected order of data types. The entries can be moved right/left between the lists and up/down within the right list. ⓘ The entries on the list are associated with the columns of the CSV file (the entry on the top represents the first column of the file).
42j	Buttons to move an entry between the two lists (**50j** and **41j**) or to move the entry up and down within list **41j**.
43j	Buttons to add an entry to the left list or to delete an entry from the left list (see chapter Adding an Entry and Deleting an Entry). The column name is to be specified in the field (**49j**). ⓘ It is neither possible to add a name that already exists nor to add an entry without a name. ⓘ The following entries can not be deleted from the list: • Ignore • LAC • Carrier • MCC • Longitude • Neighbour • MNC • Latitude • Name ⓘ The entry 'Ignore' is used for an entry that is unknown by the programme and can be used in the right list multiple times.
44j	Drop-down list to specify the separator between the columns. The separator can be a comma, a semicolon, a hash, a blank, or a tab.
45j	Drop-down list to specify the separator between the values in a column if there are more than one value included in a column (see 190, column 'Name'). The separator can be a comma, a semicolon, a hash, a blank, or a tab.
46j	A preview of the loaded data. The data in the CSV file is displayed as follows: 1 Flensburg;9.437;54.782;1;2;1;0;0;1;0;5;3#4#5#6#7#9#11#12;10;0;0;0 2 Hamburg;9.993682;53.551086;1;2;2;0;1;1;0;5;3#4#5#8#10;10;0;0;1 3 Neumünster;9.984016;54.072945;1;2;3;0;2;1;0;5;1#4#5#11;10;0;0;2 4 Kiel;10.13489;54.32133;1;2;4;0;3;1;0;5;1#2#3#5#6#11#12;10;0;0;3 *Illustration 191 MultiAnalyzerNetworkViewer: Example CSV File*
47j	Button to close the window without applying the changes.
48j	Button to close the window and apply the changes.

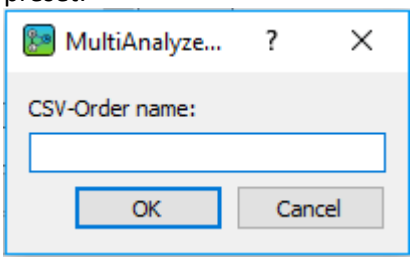
No	Description
	If a new order was built, a new dialogue opens to set the name of the new preset. 
49j	Text field to add an entry for an individual column. A new column can only be added if the entry is not already present in the left list.
50j	All available entries. New added entries are first listed here. The entries can be moved between the right and left list. It is only possible to delete an entry if the entry is located in this list.

Table 99 MultiAnalyzerNetworkViewer: Data Order

Adding an Entry

If the CSV file contains more columns than predefined entries exist, a new entry can be added to the list.

> ⓘ The entries on the list are associated with the columns of the CSV file (the entry on the top represents the first column of the file).

To add a new entry to the order list, follow the next steps.

1. Enter a name into the field (see 192).

> ⓘ It is neither possible to add a name that already exists nor to add an entry without a name.

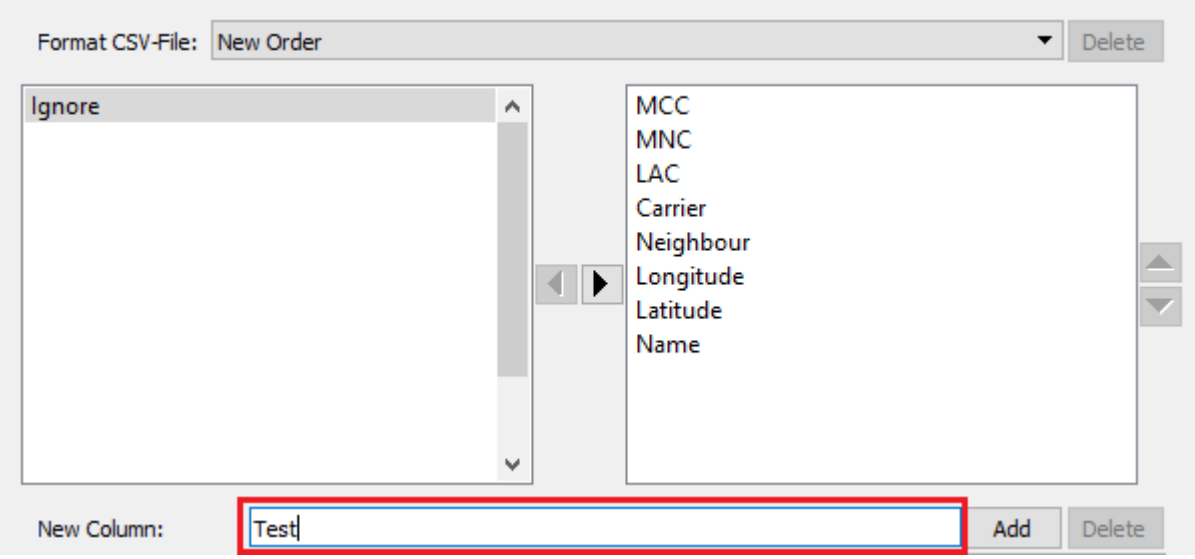


Illustration 192 MutliAnalyzerNetworkViewer: New Column Name

2. To add the new entry, click on the button [Add] (see 193).

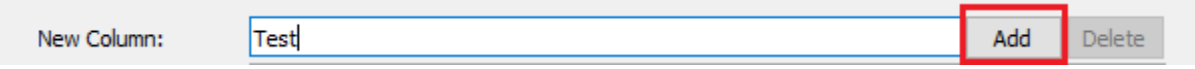


Illustration 193 MultiAnalyzerNetworkViewer: Add New Entry

✔ The new entry is added to the left list (see 194).

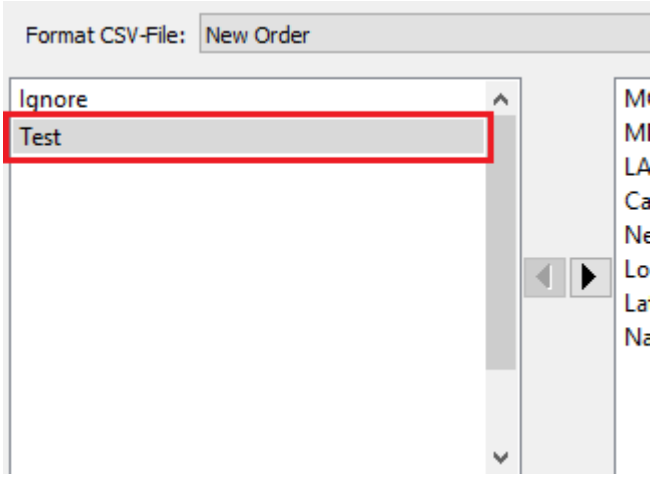


Illustration 194 MultiAnalyzerNetworkViewer: New Entry Added

ⓘ To move an entry, see chapter Moving an Entry.

ⓘ To delete an entry, see chapter Deleting an Entry.

Moving an Entry

The entries can be moved between the lists. It is also possible to change the order of the columns within the right list.

ⓘ The entries on the list are associated with the columns of the CSV file (the entry on the top represents the first column of the file).

ⓘ The following entries can not be moved between the lists:

- MCC
- MNC
- LAC
- Longitude
- Latitude
- Carrier
- Neighbour
- Name

To move the entries within the lists, follow the next steps.

➔ The lists contain new added entries or entries that can be moved between the lists.

ⓘ To add an entry, see chapter Adding an Entry.

1. To move an entry from the left list to the right list, select the wanted entry and click on the right arrow button (see 195).

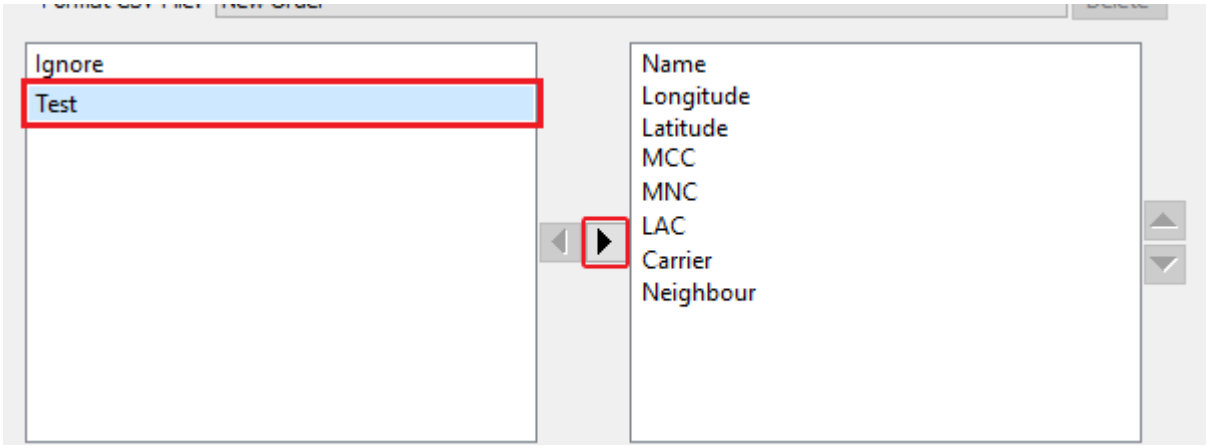


Illustration 195 MultiAnalyzerNetworkViewer: Move Entry

✔ The selected entry is moved to the right list (see 196).

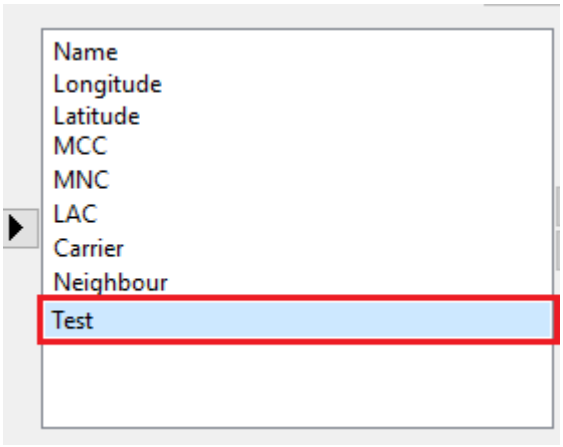


Illustration 196 MultiAnalyzerNetworkViewer: Entry Moved

2. To arrange the order of the right list, select the wanted entry and use the up/down arrow buttons (see 197).

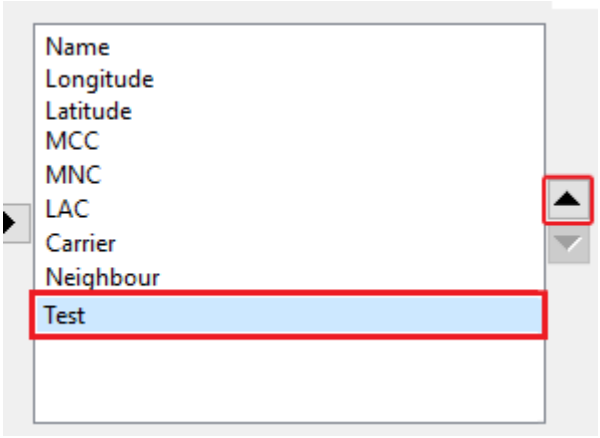


Illustration 197 MultiAnalyzerNetworkViewer: Entry Order

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✔ The order of the entries is changed (see 198).

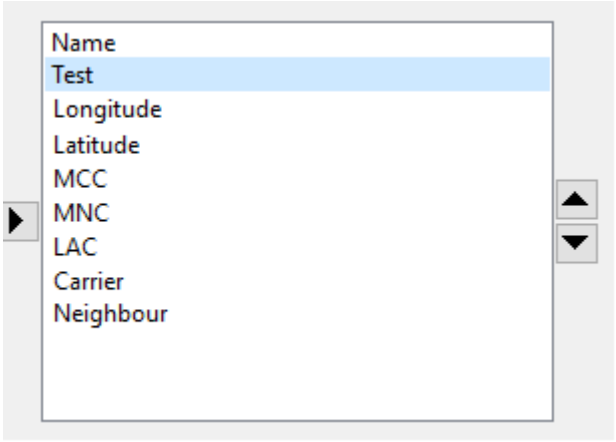


Illustration 198 MultiAnalyzerNetworkViewer: New Order

ⓘ To delete an entry, see chapter Deleting an Entry.

Deleting an Entry

It is possible to delete not needed entries from the list.

ⓘ The entries on the list are associated with the columns of the CSV file (the entry on the top represents the first column of the file).

ⓘ The following entries can not be deleted from the list:

- MCC
- MNC
- LAC
- Longitude
- Latitude
- Carrier
- Neighbour
- Name

To delete an entry, follow the next steps.

➔ The entries that shall be deleted are located in the left list.

ⓘ To move an entry, see chapter Moving an Entry.

1. Select an entry from the left list that shall be deleted (see 199).

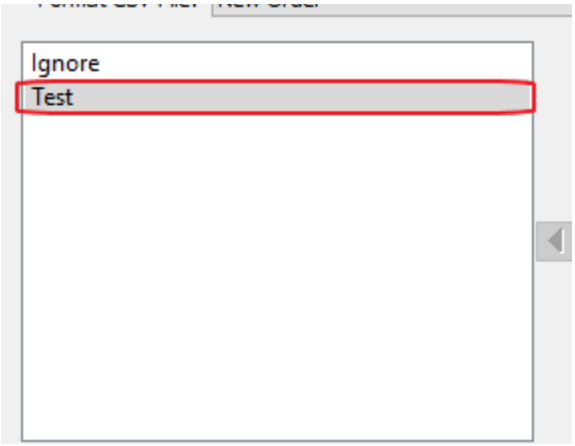


Illustration 199 MultiAnalyzerNetworkViewer: Selected Entry

1. To delete the selected entry, click on the button [Delete] (see 200).

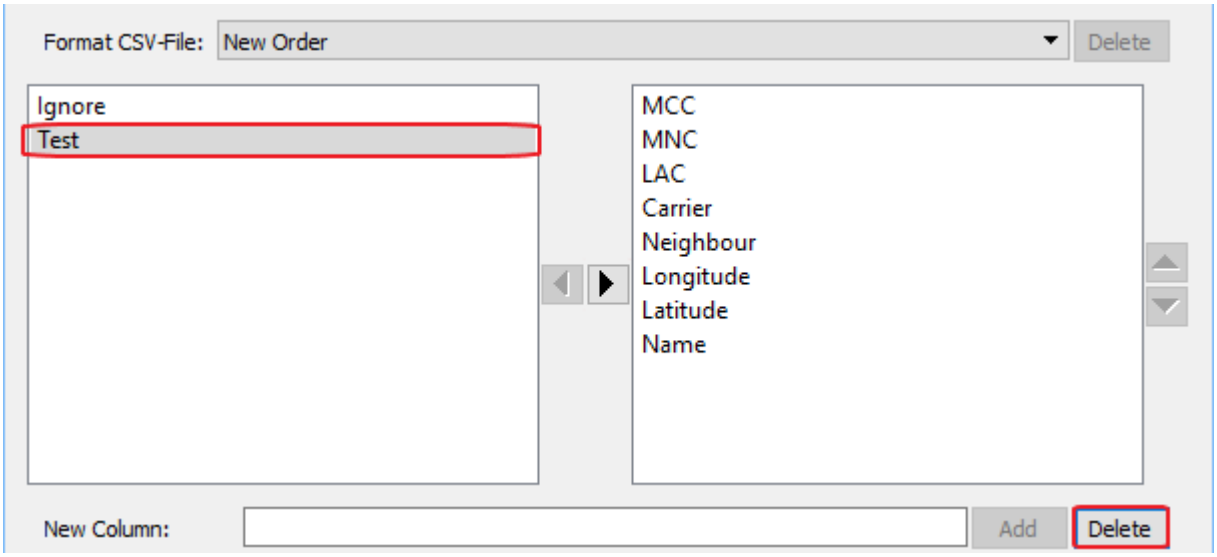


Illustration 200 MultiAnalyzerNetworkViewer: Delete Entry

✔ The entry is deleted (see 201).

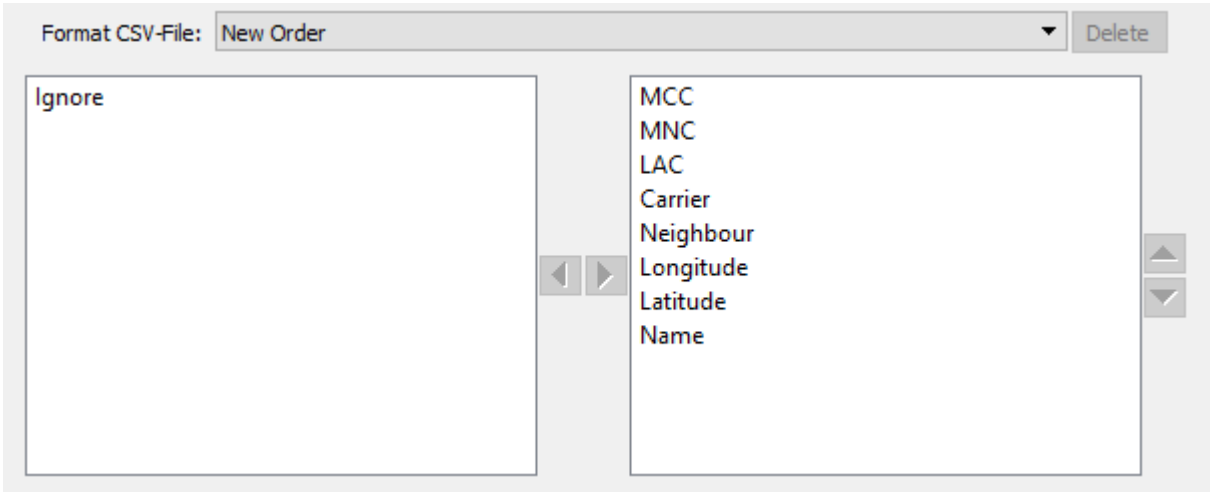


Illustration 201 MultiAnalyzerNetworkViewer: Entry Deleted

ⓘ To add an entry, see chapter Adding an Entry.

8.4.2 The Data of a Record File

If a record file with incomplete data is loaded, a dialogue opens to complete the missing information.

This chapter provides an overview of the dialogue to complete the data of a record file.

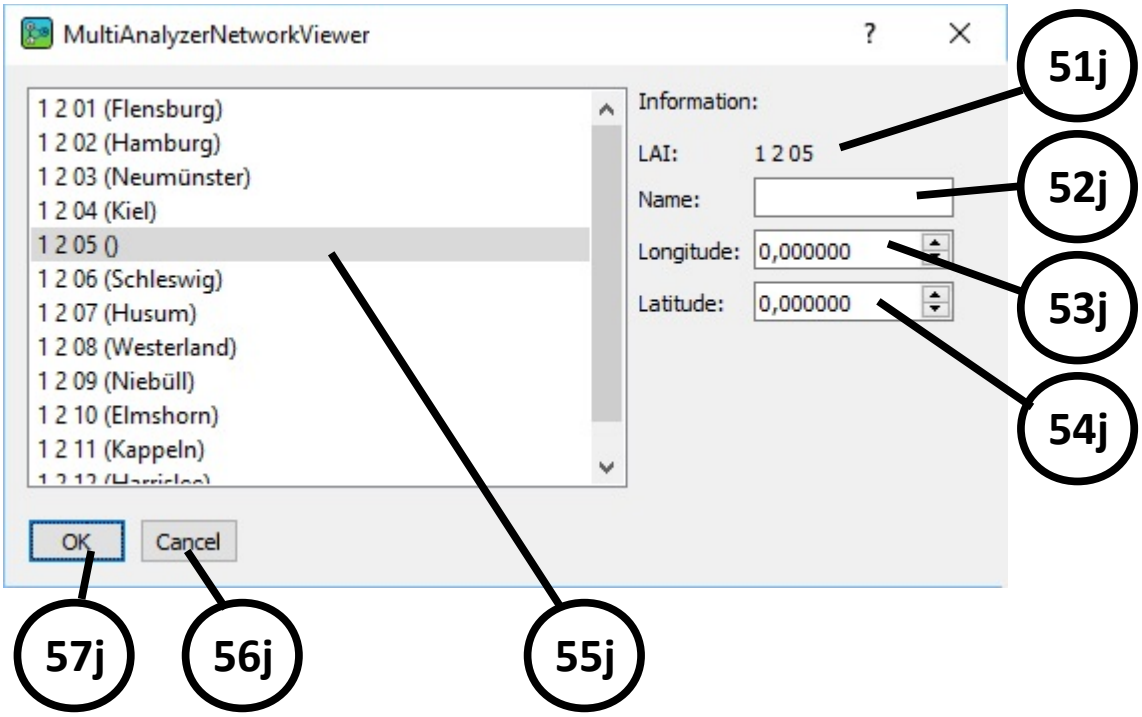


Illustration 202 MultiAnalyzerNetworkViewer: Incomplete Data Record File

No	Description
51j	The ‘LAI‘ of the tower. The ‘LAI‘ consists of the mobile country code, mobile network code, and the local area code.
52j	The name of the selected cell. ⓘ The text field can be used to change the name of the cell.
53j	The longitude position of the selected tower cell. ⓘ The field can be used to change the longitude of the tower cell.
54j	The latitude position of the selected tower cell. ⓘ The field can be used to change the latitude of the tower cell.
55j	The list of incomplete towers. Each tower in this list has at least one missing information.
56j	Button to close the window without applying the changes.
57j	Button to close the window, apply the changes and update the view.

Table 100 MultiAnalyzerNetworkViewer: Incomplete Data Record File

ⓘ By selecting a tower, the available information are filled into the fields ‘LAI’ (**51j**), ‘Name’ (**52j**), ‘Longitude’ (**53j**), and ‘Latitude’ (**54j**). Changes to these information are directly visible in the list.

ⓘ It is also possible to change these information after the file has already been loaded (see chapter 8.11 Editing the Tower Information).

8.5 Graph Styles

The graph can be displayed in two styles. The first style builds up on the coordinates of the towers and the second style shows the graph in a circle. The ‘geographic’ style is set by default. Both graphs are build from the same data.

The styles can be changed by using the drop-down list (see 203).

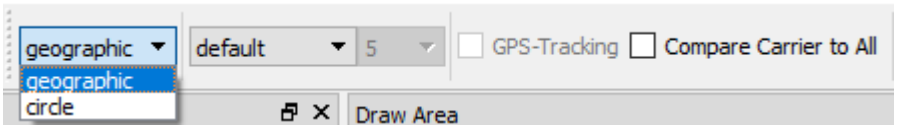


Illustration 203 MultiAnalyzerNetworkViewer: Available Graph Styles

Geographic

The geographic graph style builds up the coordinates of the tower cells.

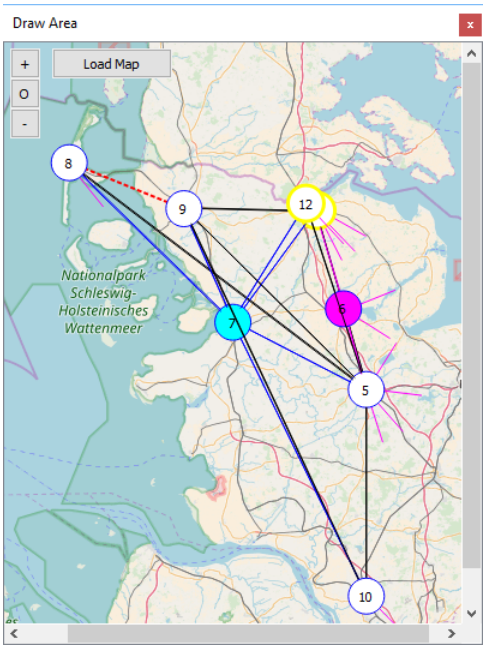


Illustration 204 MultiAnalyzerNetworkViewer: Graph Geographical Style

To export the graph to an image, see chapter 8.7 Exporting a Graph to an Image.

The geographic style has three different modes available to build the graph (see 205).

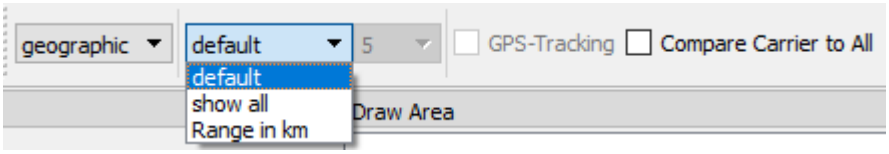


Illustration 205 MultiAnalyzerNetworkViewer: Geographic Style Modes

default	This mode displays all elements of the area between the highest and the lowest longitude and latitude. ⓘ This mode is also used to select the elements for the graph style 'circle'.
show all	This mode displays all tower cells that are contained in the loaded data.
Range in km	This mode displays all elements that are located within the radius (km) around the selected element. The radius can be set to 5, 10, 25, 50, or 100.

Table 101 MultiAnalyzerNetworkViewer: Geographic Style Modes

Circle

The circle graph style is a model view of the map to show the base stations and their neighbours.

Marks are not drawn in this style.

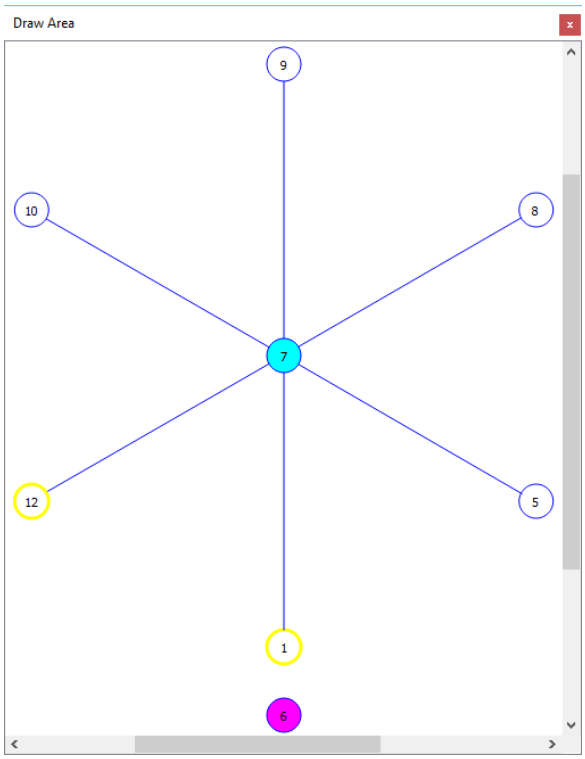


Illustration 206 MultiAnalyzerNetworkViewer: Graph Circle Style

To export the graph to an image, see chapter 8.7 Exporting a Graph to an Image.

8.6 Saving Data

Data that are loaded into the **MultiAnalyzerNetworkViewer** can be saved as a CSV file. The save function can also be used to combine CSV data and record data. For that a CSV file and a record file has to be loaded to the **MultiAnalyzerNetworkViewer**.

> ⓘ For information about loading data, see chapter 8.4 Loading a File (MultiAnalyzerNetworkViewer).

To save the data as a CSV file, follow the next steps.

➔ Data is loaded into the **MultiAnalyzerNetworkViewer**.

> ⓘ The elements to save the data are only available if the programme has data to save.

1. Open the dialogue to save the data via ‘File’ > ‘Save’ or use the key combination Ctrl+S.

> ⓘ It is also possible to use the button in the toolbar:
>

✔ The save dialogue opens to save the data file (see 207).

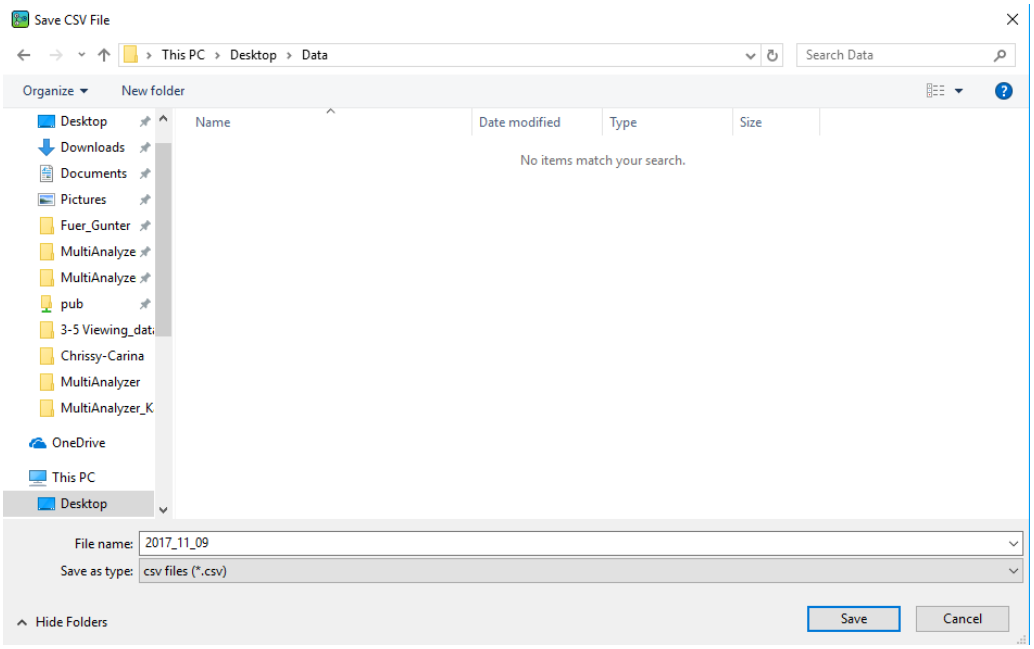


Illustration 207 MultiAnalyzerNetworkViewer: Saving Data

2. To save the data file, choose the storage path and click on the button [Save].

> ⓘ If an existing file is chosen, the data of the existing file will be overwritten.

✔ The data file is saved.

8.7 Exporting a Graph to an Image

The shown graph can be saved to an image file (*.jpg or *.png).

To save the graph to an image file, follow the next steps.

➔ A graph is drawn in the Draw Area.

ⓘ The elements to export a graph to an image are only available if a graph is drawn.

1. Open the dialogue to save the graph into an image file via ‘File’ > ‘Export to Image’.

ⓘ It is also possible to use the button in the toolbar:

ⓘ For information about the different graph styles, see chapter 8.5 Graph Styles.

✔ The save dialogue opens (see 208).

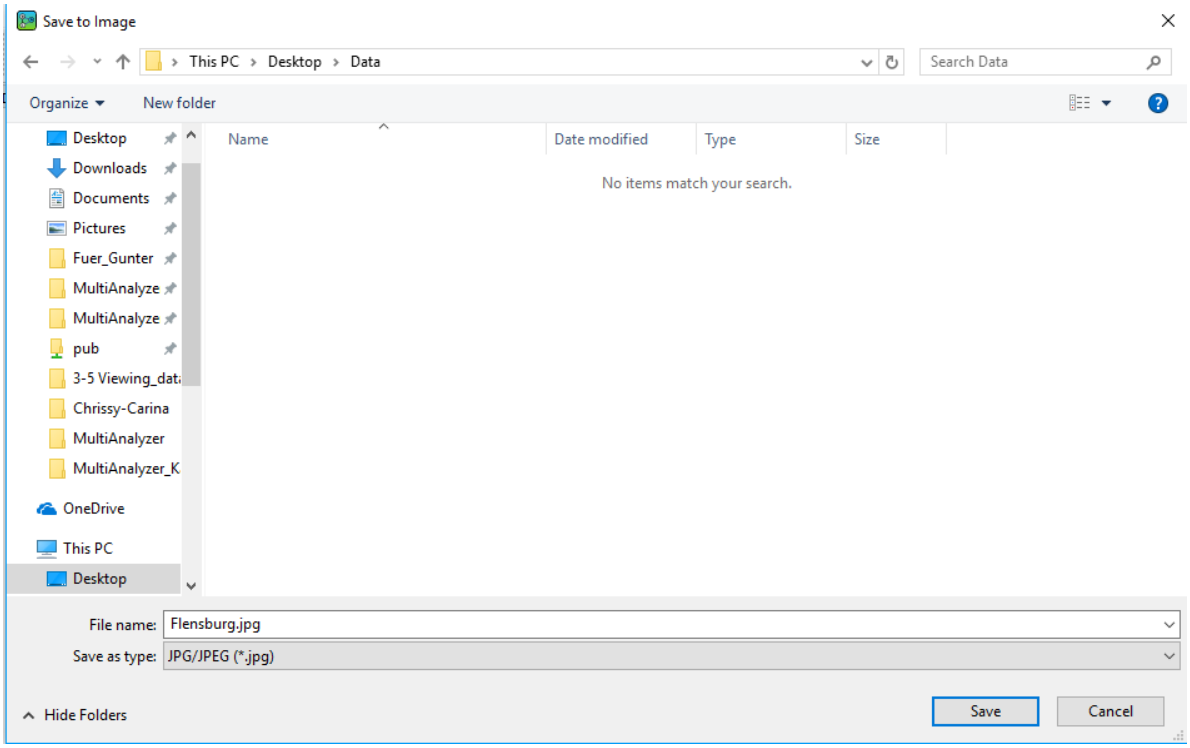


Illustration 208 MultiAnalyzerNetworkViewer: Export to Image

2. To save the image file, choose the storage path and click on the button [Save].

ⓘ If an existing file is chosen, the data of the existing file will be overwritten.

✔ The image file is saved.

8.8 Loading a Map

For a geographical display of the data, map data can be downloaded in tiles. Generating the tiles for maps consume much resources of a server.

NOTICE

Massive downloading can cause ban from server!

The consequences of massive downloading of tiles could be a ban for downloading from the server. Download only as much as needed.

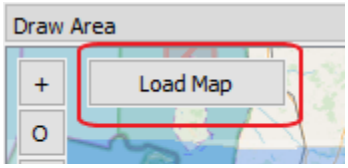
ⓘ Reducing the amount of map data to be downloaded from a server can be achieved by restricting the ‘Zoom Level Range’ (see chapter 8.2 Settings).

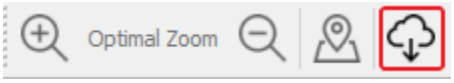
The raw map data is open source and free to use. So, it is possible to build an own local server to generate tiles from the raw map data. A few companies sell access to their map servers for more heavier use.

This chapter provides an overview of loading a map into the **MultiAnalyzerNetworkViewer**.

- Open the dialogue to load a map via ‘Tools’ > ‘Load Map’.

ⓘ It is also possible to use the button in the toolbar or the button within the Draw Area:





ⓘ The elements to download a map are only available if the setting ‘Download allowed’ is activated (see chapter 8.2 Settings).

ⓘ The downloaded data are saved to the path for the ‘Local Map Cache’, which is set in the ‘Settings’ (see chapter 8.2 Settings). Existing data will be overwritten.

ⓘ If a graph is drawn, the dialogue is preset with the data of the graph.

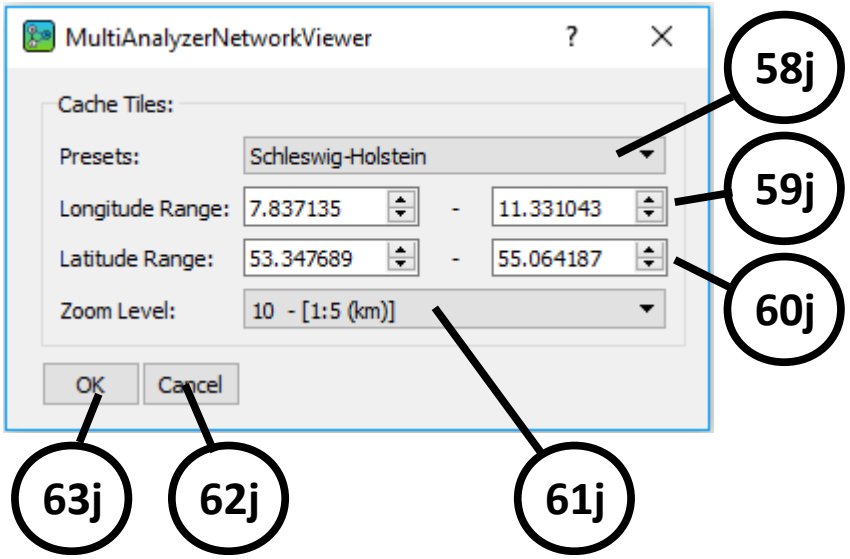


Illustration 209 MultiAnalyzerNetworkViewer: Load Map

No	Description
58j	Drop-down list to select one of the defined presets. There are 16 presets for the federal states of Germany. ⓘ If data are changed, the preset changes to “custom”.
59j	The longitude range that the downloaded map should contain.
60j	The latitude range that the downloaded map should contain.
61j	Drop-down list to set the zoom level of the map section.
62j	Button to close the dialogue and start downloading the map data.
63j	Button to close the dialogue without downloading.

Table 102 MultiAnalyzerNetworkViewer: Load Map

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8.9 Creating a Mark (Pop-Up Menu)

Marks can directly be created within the Draw Area via the pop-up menu. When creating a mark via the pop-up menu, the longitude and latitude data is directly copied into the mark information dialogue from the position of the mouse click.

To create a mark via the pop-up menu, follow the next steps.

➔ Data are loaded into **MultiAnalyzerNetworkViewer** (see chapter 8.4 Loading a File (MultiAnalyzerNetworkViewer)).

➔ A geographic graph is drawn (see chapter 8.5 Graph Styles).

1. To open the pop-up menu, right-click on the wanted position on the drawn graph.

✔ The pop-up menu opens (see 210).

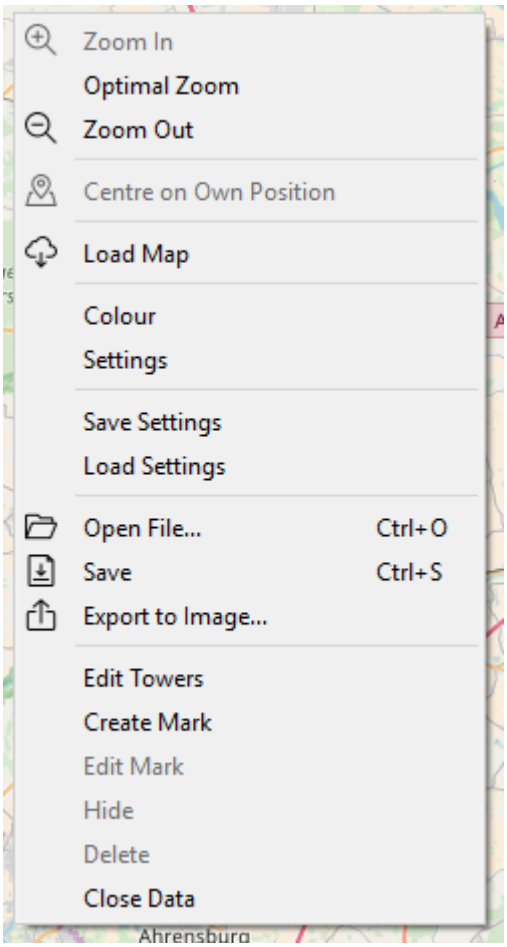

Illustration 210 MultiAnalyzerNetworkViewer: Mark Pop-Up Menu

2. To open the mark information dialogue, click on the menu option ‘Create Mark’ (see 211).

Illustration 211
MultiAnalyzerNetworkViewer: Menu Option Create Mark

✔ The mark information dialogue opens (see 212).

ⓘ The data for longitude and latitude is taken from the position of the click on the map.

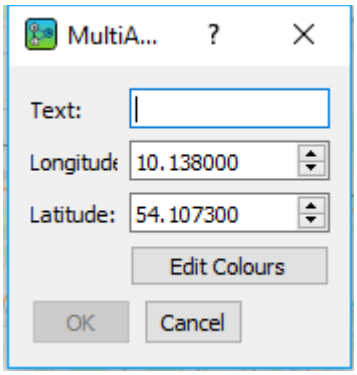

Illustration 212
MultiAnalyzerNetworkViewer: Mark Info

ⓘ The data of the longitude and latitude can be changed by using the text fields.

ⓘ The colours of the background, the border, and the text of the mark can be changed via the button [Edit Colours].

3. To create the mark on this position, insert a name into the empty field and click on the button [OK] (see 213).

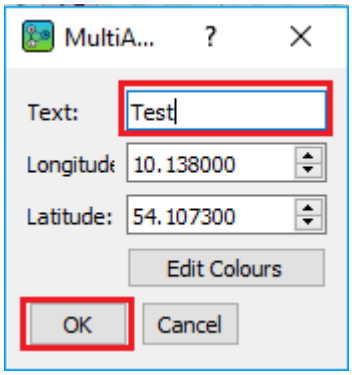

Illustration 213 MultiAnalyzerNetworkViewer: Mark Test (Pop-Up)

✔ The mark is created.

ⓘ It is also possible to change the data of the mark afterwards (see chapter 8.12 Editing the Mark Information).

✔ The mark is shown on the Draw Area and on the Data List (see 214).

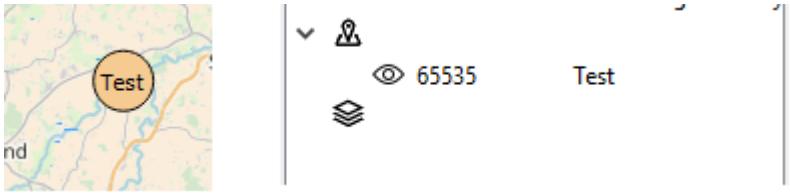

Illustration 214 MultiAnalyzerNetworkViewer: Mark Draw Area and Data List (Pop-Up)

8.10 Creating a Mark (Data List)

Marks can be created at any time via the Data List whether or not data is loaded into the **MultiAnalyzerNetworkViewer**.

To create a mark using the Data List, follow the next steps.

1. To open the mark information dialogue, click on the button [Create Mark] on the Data List (see 215).

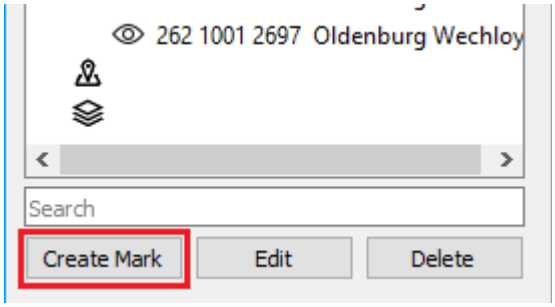

Illustration 215 MultiAnalyzerNetworkViewer: Create Mark Data List

✔ The mark information dialogue opens (see 216).

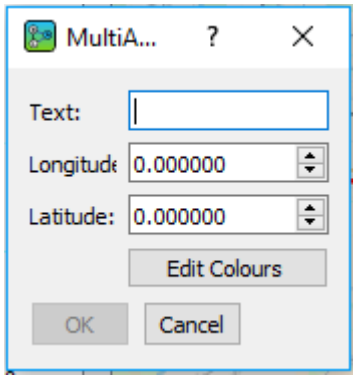

Illustration 216 MultiAnalyzerNetworkViewer: Empty Mark

ⓘ The colours of the background, the border, and the text of the mark can be changed via the button [Edit Colours].

2. Fill in the information for the longitude and latitude into the dedicated fields (see 217).

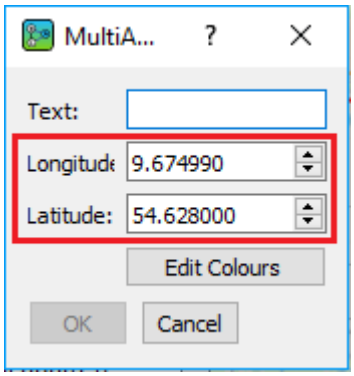

Illustration 217 MultiAnalyzerNetworkViewer: Enter Info

3. To create the mark, insert a name into the empty text field and click on the button [OK] (see 218).

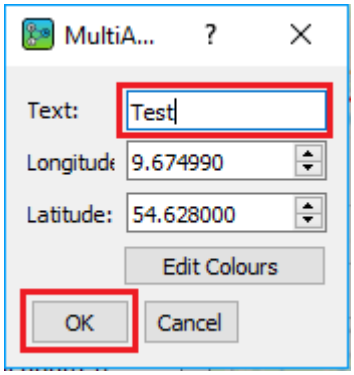

Illustration 218 MultiAnalyzerNetworkViewer: Mark Test (Data List)

✔ The mark is created.

ⓘ The data of the mark can also be changed afterwards (see chapter 8.12 Editing the Mark Information).

✔ The mark is shown on the Data List and if a graph is drawn, it is also shown on the Draw Area (see 219).

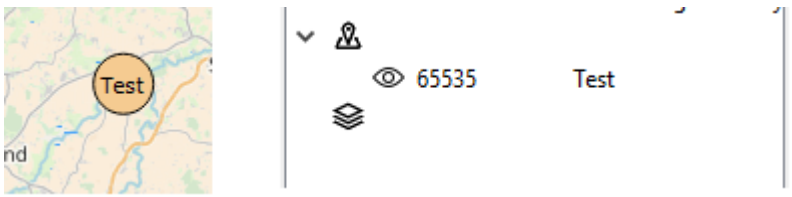

Illustration 219 MultiAnalyzerNetworkViewer: Mark Draw Area and Data List (Data List)

8.11 Editing the Tower Information

The information of the towers (name, longitude and latitude) can be edited at any time.

To edit the tower information, follow the next steps.

➔ Data are loaded into **MultiAnalyzerNetworkViewer** (see chapter 8.4 Loading a File (MultiAnalyzerNetworkViewer)).

1. To open the tower information dialogue, select a tower from the Data List and click on the button [Edit] (see 220).

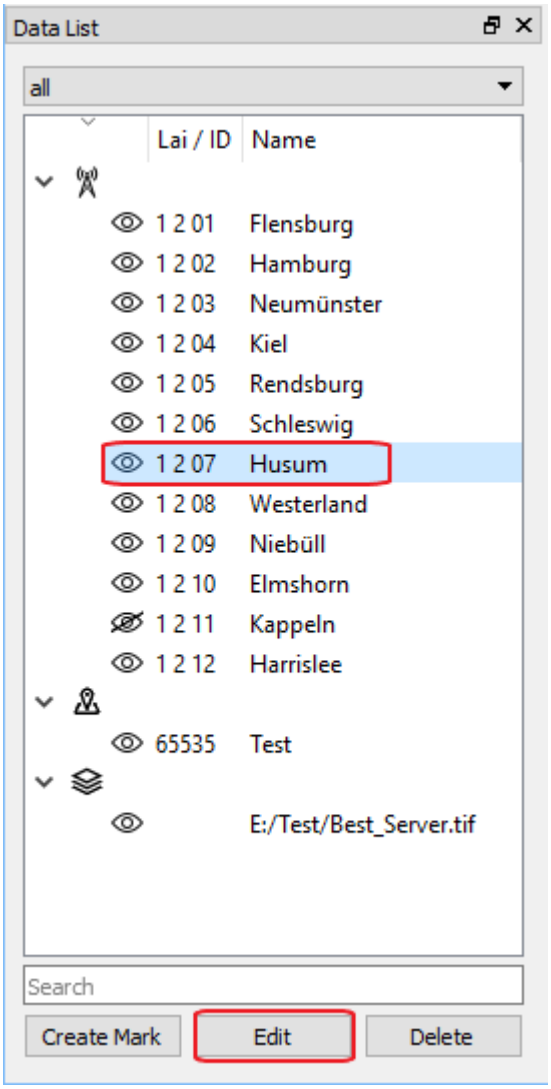

Illustration 220 MultiAnalyzerNetworkViewer: Tower Data List

ⓘ The information dialogue can also be opened by right-clicking on a tower that is located in the Draw Area and choosing the menu option 'Edit Tower' or by double-clicking on the Data List area.

✔ The tower information dialogue opens (see 221).

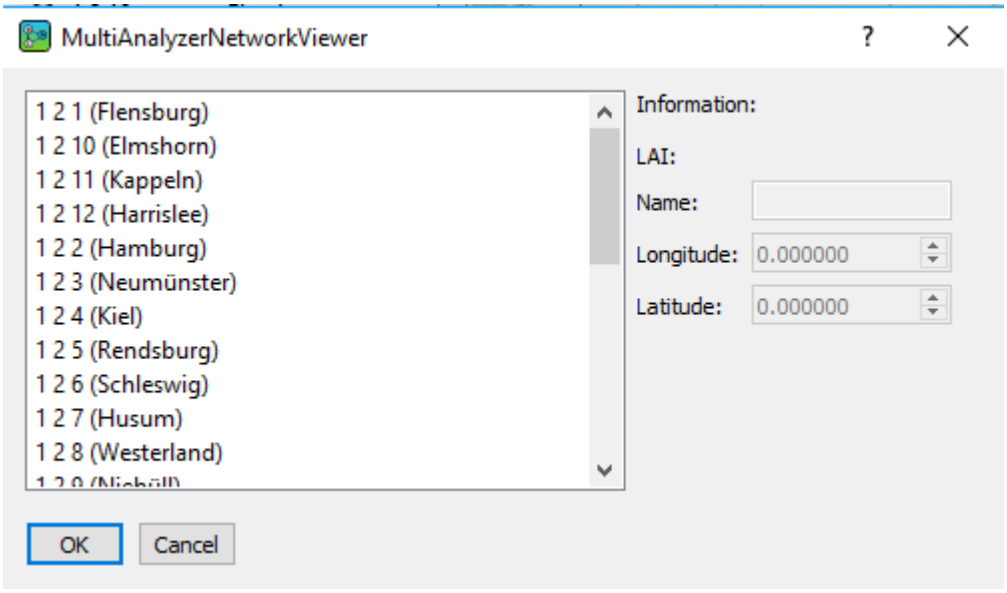

Illustration 221 MultiAnalyzerNetworkViewer: Dialogue Edit Tower

2. Choose the tower that shall be changed and fill in the information (see 222).

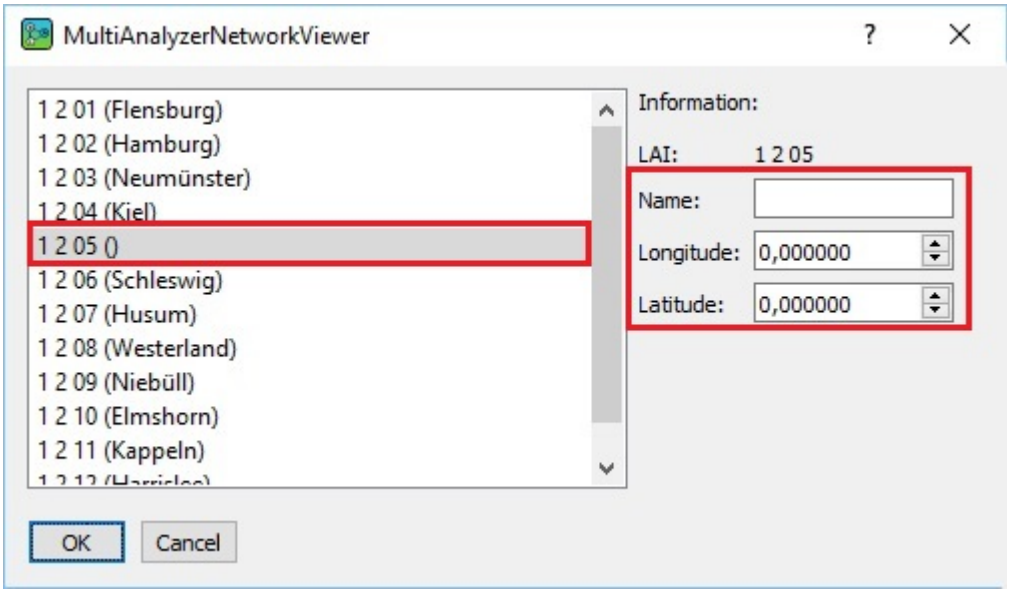

Illustration 222 MultiAnalyzerNetworkViewer: Dialogue Edit Tower (Selected Tower)

ⓘ For information about the interface, see chapter 8.4.2 The Data of a Record File.

3. To save the changes, click on the button [OK].

✔ The changes are saved and the list is updated.

8.12 Editing the Mark Information

The information of the created marks (name, longitude and latitude) can be edited at any time.

To edit the mark information, follow the next steps.

➔ A mark has already been created (see chapter 8.9 Creating a Mark (Pop-Up Menu) and 8.10 Creating a Mark (Data List)).

1. To open the mark information dialogue, select a mark from the Data List and click on the button [Edit] (see 223).

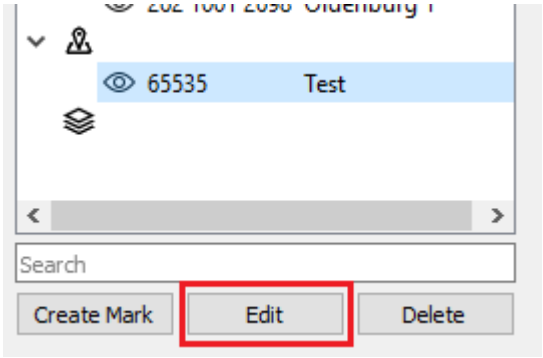

Illustration 223 MultiAnalyzerNetworkViewer: Mark Data List

ⓘ The information dialogue can also be opened by right-clicking on a mark that is located in the Draw Area and choosing the menu option ‘Edit Mark’ or by double-clicking on the Mark within the Data List.

✔ The mark information dialogue opens (see 224).

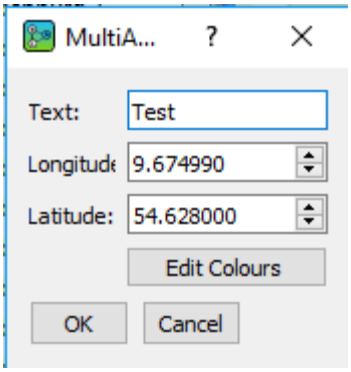

Illustration 224 MultiAnalyzerNetworkViewer: Dialogue Edit Mark

2. Change the wanted information and click on the button [OK].

✔ The information is changed (see 225).

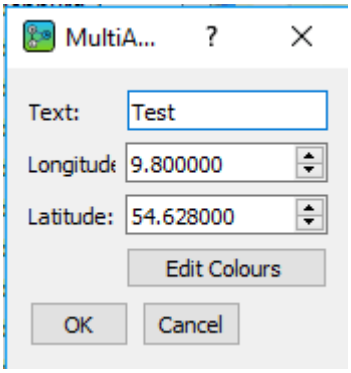

Illustration 225
MultiAnalyzerNetworkViewer: Dialogue Mark Edited

8.13 Deleting a Data List Element

Elements can be deleted from the Data List.

> ⓘ For information about hiding and unhding an element, see chapter 8.14 Hiding and Unhiding an Element.

To delete an element from the Data List, follow the next steps.

➔ Deletable elements are available in the Data List.

- To delete an element, select an element that shall be deleted from the Data List and click on the button [Delete] (see 226).

> ⓘ An element can also be deleted by right-clicking on an element that is located in the Draw Area and choosing the menu option ‘Delete’.

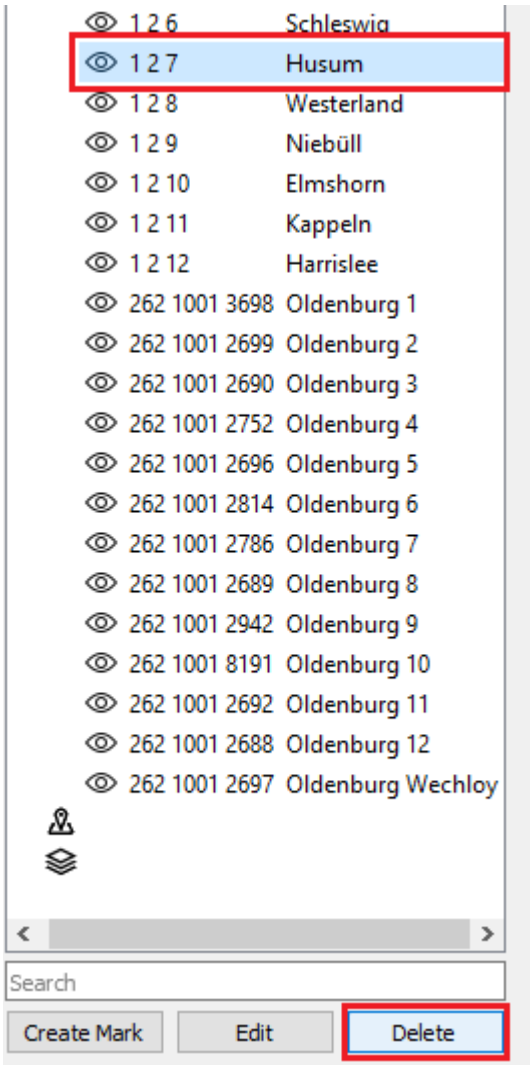

Illustration 226 MultiAnalyzerNetworkViewer: Delete Element

✔ The element is deleted from the list (see 227).

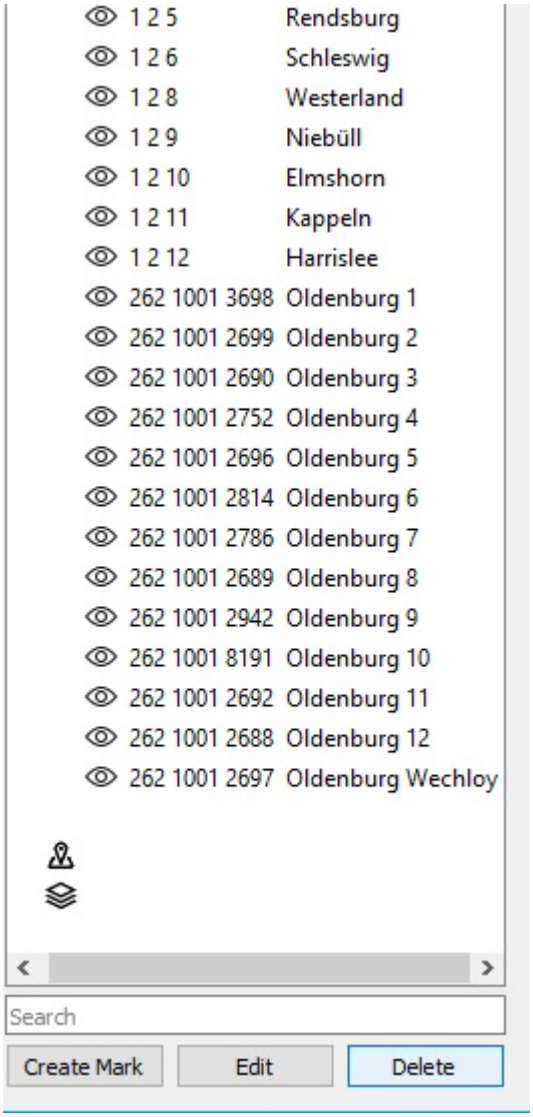

Illustration 227 MultiAnalyzerNetworkViewer: Deleted Element

8.14 Hiding and Unhiding an Element

Elements can be hidden via the pop-up menu. The elements are still available in the Data List and can be made visible again.

> ⓘ For information about deleting an element, see chapter 8.13 Deleting a Data List Element.

To hide and unhide an element, follow the next steps.

➔ Data are loaded into **MultiAnalzyerNetworkViewer**.

➔ A geographic graph is drawn in the Draw Area (see chapter 8.5 Graph Styles).

1. Choose the element that shall be hidden from the Draw Area.
2. To open the pop-up menu, right-click on the chosen element.

✔ The pop-up menu opens (see 228).

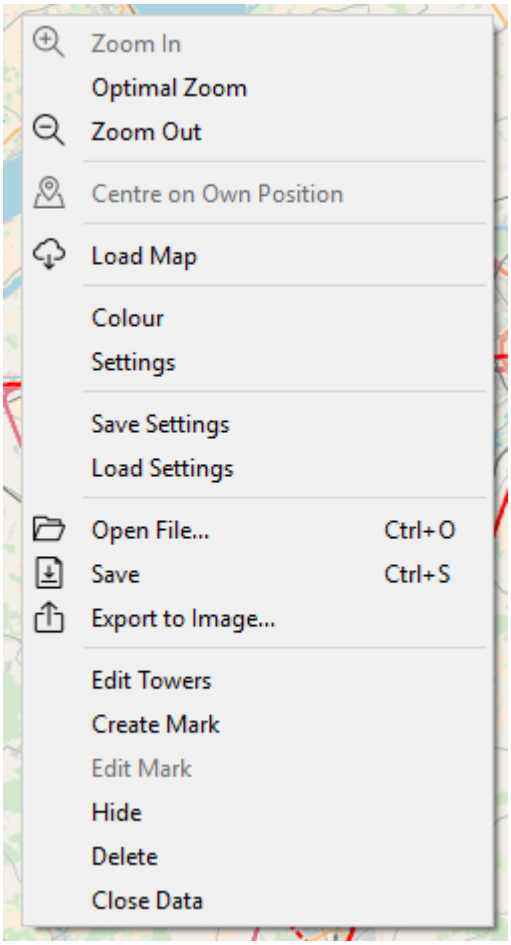

Illustration 228 MultiAnalyzerNetworkViewer: Hiding Pop-Up Menu

3. Click on the menu option ‘Hide’ (see 229).

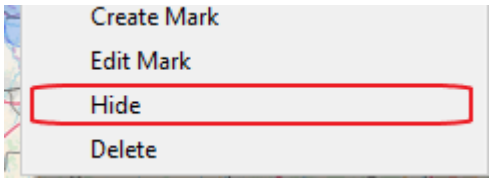

Illustration 229 MultiAnalyzerNetworkViewer: Menu Option Hide

✔ The element is hidden on the Draw Area and the eye icon in the Data List is changed to a crossed eye icon (see 230).

Illustration 230 MultiAnalyzerNetworkViewer: Crossed Eye

4. To unhide one element, click again on the hidden element in the Data List.
5. To unhide all elements, click on the eye icon in the basic tools toolbar (see 231).

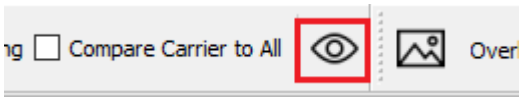

Illustration 231 MultiAnalyzerNetworkViewer: Eye Icon

✔ The elements are visible again (see 232).

Illustration 232 MultiAnalyzerNetworkViewer: Element Visible

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8.15 Activating GPS-Tracking

The **MultiAnalyzerNetworkViewer** has the opportunity to track GPS signalling.

To activate the GPS-Tracking, follow the next steps.

➔ A device for GPS-Tracking is available.

➔ The ‘Tracker Com Port’ and the ‘Tracker Baudrate’ are set in the settings (see chapter 8.2 Settings).

- To start the GPS-Tracking, select the checkbox ‘GPS Tracking’ in the toolbar (see 233).

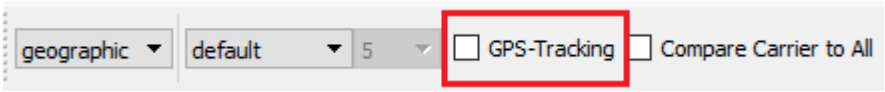

Illustration 233 MultiAnalyzerNetworkViewer: GPS-Tracking

✔ GPS-Tracking is activated.

✔ The element ‘Centre on Own Position’ is available in the menu and in the toolbar (see 234).

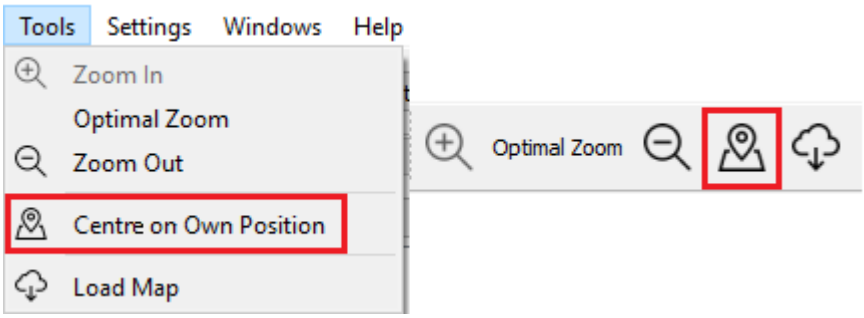

Illustration 234 MultiAnalyzerNetworkViewer: Centre On Own Position

ⓘ The tracked position will be updated every 10th second.

ⓘ If the ‘Tracker Com Port’ and ‘Tracker Baudrate’ are set wrong in the setting window (see chapter 8.2 Settings), the programme can not receive data for tracking the position.

ⓘ To deactivate the GPS Tracking, deselect the checkbox ‘GPS Tracking’.

9 Glossary

A

AIE	**A**ir **I**nterface **E**ncryption	The Air Interface Encryption protects all signalling, identity and traffic across the radio link.

C

CCCH	**C**ommon **C**ontrol **Ch**annel	Common Control Channels are organisation channels in GSM networks. They are used to establish a communication connection.

D

DL	**D**own**l**ink	A radio transmission route between a sending base station and a receiving terminal.
DMO	**D**irect **M**ode **O**peration	Communication between two or more radios without the usage of a base station and separated from the network.
DMR	**D**igital **M**obile **R**adio	The Digital Mobile Radio is a European communication standard.
Dongle	-	A copy-protected hardware.

L

LAI	**L**ocation **A**rea **I**dentity	This identifier is used to update the location of mobile subscribers.

M

MCCH	**M**ain **C**ontrol **Ch**annel	-
MS	**M**ulti **S**lot	The bundling of several Time Slots (see **TS**).

N

NRD	**N**etwork **R**ecording **D**evice	Network Recording Devices are supported devices that send IQ-data via network.

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P

P2P	**P**eer-**to**-**P**eer	P2P is a communication model in which each party has the same capabilities. The P2P network allows every node to function as a client as well as a server.
P2MP	**P**eer-**to**-**M**ulti**p**oint	P2MP is a communication network that provides a path from one location to multiple locations.
PDU	**P**rotocol **D**ata **U**nit	Information that is delivered as a unit amongst coequal entities of a network. These information may contain control information, network address, or user data.

S

SDR	**S**oftware **D**efined **R**adio	A broader term to sum up concepts of high-frequency station and receiver where several parts are software realised.
SSI	**S**hort **S**ubscriber **I**dentity	Identification number to identify the mobile radios.
SwMI	**Sw**itching and **M**anagement **I**nfrastructure	The SwMI includes the base stations, switches and controllers. TETRA mobile registers and communicates with the SwMI.

T

TCH	**T**raffic **Ch**annel	A mobile radio channel to transport data or voice.
TDMA	**T**ime **D**ivision **M**ultiple **A**ccess	A provided time range for a station with full bandwidth.
TETRA	**Te**rrestrial **T**runked **Ra**dio	TETRA is a standard for digital trunked radio.
TMO	**T**runked **M**ode **O**peration	Communication between two or more radios via the network. The reach is not bounded to the operating place. All members can move within the network.
TS	**T**ime **S**lot	A dedicated period within a transmission frame.

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U

UDP	**U**ser **D**atagram **P**rotocol	UDP is a minimal message-oriented transport layer protocol.
UL	**U**p**l**ink	A radio transmission route between a sending terminal and a receiving base station.

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