



DECODIO

NET

for TETRA

Air interface analysis

Network traffic measurements and statistics

Coverage tests

Network monitoring

Decodio

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DETECT | DECODE | VISUALIZE

DECODIO NET for TETRA

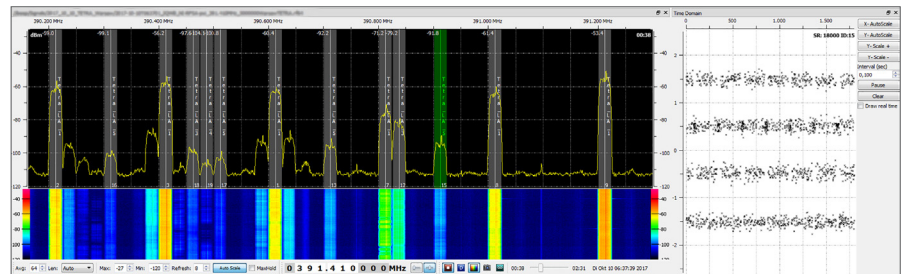
Decodio NET for TETRA is a highly flexible and extendable air interface analysis tool, designed for the deployment, maintenance, quality assurance and monitoring of TETRA networks.

HIGHLIGHTS

- TETRA network air interface analysis
- Network parameters visualization
- Detailed traffic analysis and visualization
- TEA encryption support
- Fully automatic TETRA emission detection

AIR-INTERFACE ANALYSIS

The system acquires the entire TETRA frequency band and is able to decode all carriers in parallel. Multiple uplink and downlink frequencies can thus be monitored simultaneously.



TETRA spectrum with location area codes and demodulation quality visualization

Any TETRA emission can be detected automatically, within a very short time. The network broadcast parameters of all frequencies (SYNC-PDU and SYS-INFO-PDU) are continuously decoded.

StreamID	Label	Frequency	Power	Running	ChannelStatus	CalculatedFreq	MainFreq	System	BER	Quality	MCC	MNC	LA	CN	CC	SecClass	ServiceDetails	Calls
5	TETRA	391.4625	-79.3	true	ACTIVE		391.462500	TMO	0	100				3658	21	1,3	0u067	1
6	TETRA	391.7878	-81.7	true	ACTIVE		391.462500	TMO	0	100				3671	21	1,3	0u067	0
7	TETRA	390.3375	-83.9	true	ACTIVE	390.337500	390.337500	TMO	0	100				3613	16	1,3	0u067	0
8	TETRA	391.5125	-83.5	true	ACTIVE	391.512500	390.337500	TMO	0	100				3660	16	1,3	0u067	0
10	TETRA	380.3367	-98.9	true	DISC		390.337500	Uplink						3613	16	1,3	0u067	0
18	TETRA	390.8877	-80.6	false	STOP	390.887500		TMO	-1	0				3995	1	1	0u75	0
19	TETRA	426.7598	-7.9	true	ACTIVE	426.587500	426.587500	TMO	0	100				1143	4	1	0u060	1
31	TETRA	392.2876	-87.0	true	ACTIVE	392.087500	392.087500	TMO	0	100				3691	27	1,3	0u062	0
32	TETRA	392.0875	-86.8	true	ACTIVE	392.087500		TMO	0	100				3683	27	1,3	0u062	0
33	TETRA	390.9125	-93.3	true	ACTIVE	390.712500	390.712500	TMO	0	100				3636	5	1,3	0u062	0
34	TETRA	390.7125	-90.7	true	ACTIVE	390.712500		TMO	0	100				3628	5	1,3	0u062	0
35	TETRA	390.3126	-98.9	true	ACTIVE	390.312500		TMO	0	100				3612	5	1,2	0u077	2
36	TETRA	390.5126	-100.7	true	ACTIVE	390.312500		TMO	0	100				3620	5	1,2	0u077	0
37	TETRA	391.2125	-52.1	true	ACTIVE	390.612500		TMO	0	100				3648	1	1,2	0u077	0
38	TETRA	392.0374	-53.5	true	ACTIVE	392.012500		TMO	0	100				3681	1	1,3	0u062	0
39	TETRA	392.0124	-53.6	true	ACTIVE	392.012500		TMO	0	100				3660	1	1,3	0u062	0
47	TETRA	392.9127	-86.4	true	ACTIVE	392.912500		TMO	0	100				3716	52	1,3	0u067	0
48	TETRA	382.9113	-53.5	true	DISC	392.912500		Uplink						3716	52	1,3	0u067	0
51	TETRA	392.1125	-82.5	true	ACTIVE	392.112500		TMO	5	65				2340	11	1,3	0u067	0
52	TETRA	391.4625	-85.8	true	ACTIVE	391.462500		TMO	0	90				3658	21	1,3	0u067	0
53	TETRA	390.3375	-78.5	true	ACTIVE	390.337500	390.337500	TMO	0	100				3613	16	1,3	0u067	0
54	TETRA	391.2875	-99.8	true	ACTIVE	394.537500		TMO	30	0				3652	10	1,3	0u067	0

List of TETRA frequencies

Detailed logs of the network activity and configuration with precise timestamps can be generated, allowing for accurate network troubleshooting.

Thanks to a hierarchical view of the various carriers, the current load and control channel use of a TETRA network can be readily evaluated and aggregated.

The continuous recording of signal quality, power, network load and broadcast parameters allows for early detection of network-related issues and configuration errors.

Detailed carrier information

Item	Frequency	Quality	Status	Load	CellInfo	No of Carriers	No of Calls
MCC						4	5
MNC						2	0
LA						2	0
CN 3075 - MC	426.8825 (E-D)	0%	STOP		MC:426.88250 - Sec:1,2 - CC:22	2	0
SLOT 1			Control	50%			
SLOT 2			Free				
SLOT 3			Assigned	50%			
CN 3075 - MC	426.4965 (E-D)	0%	STOP		MC:426.49650 - Sec:1,2 - CC:23	1	0
SLOT 1			Control			1	0
SLOT 2			Free			1	0
SLOT 3			Free			1	0
CN 3075 - MC	426.7825 (E-D)	0%	STOP		MC:426.78250 - Sec:1,2 - CC:01	1	0
SLOT 1			Control	0%		1	0
SLOT 2			Free			1	0
SLOT 3			Free			1	0
MCC						4	5
MNC						1	2
LA						1	0
CN 3088 - MC	391.4625 (E-D)	100%	ACTIVE	20%	MC:391.46250 - Sec:1,2 - CC:21	1	2
SLOT 1			Control			1	0
SLOT 2			Free		Traffic:0M.61	1	0
SLOT 3			Free		Traffic:0M.62	1	0
CN 3088 - MC	380.3365 (E-D)		ACTIVE		MC:380.33750 - Sec:1,2 - CC:16	3	1
SLOT 1			Control			1	0
SLOT 2			Free			1	0
SLOT 3			Free			1	0
CN 3088 - MC	380.3375 (E-D)	100%	ACTIVE			2	0
SLOT 1			Control			1	0
SLOT 2			Free			1	0

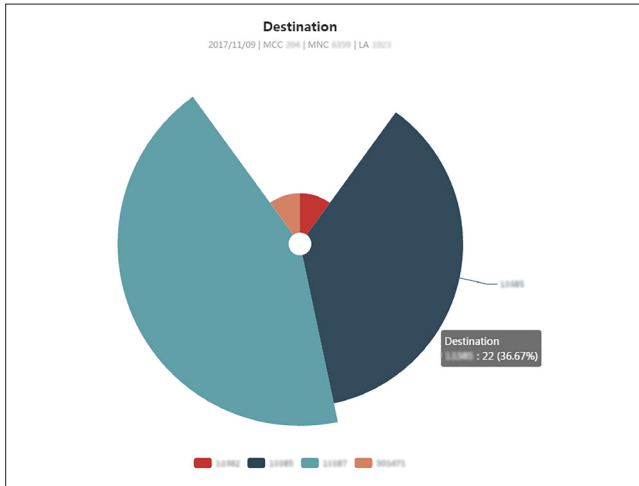
Hierarchical view with network load details

Features such as voice recording, continuous data transmission logging and PDU logging are available for both unencrypted and encrypted networks.

After entering the encryption keys, encrypted signals are transparently decrypted thanks to the integrated support for TEA (1,2,3,4) and TAA1.

LOAD MEASUREMENTS AND STATISTICS

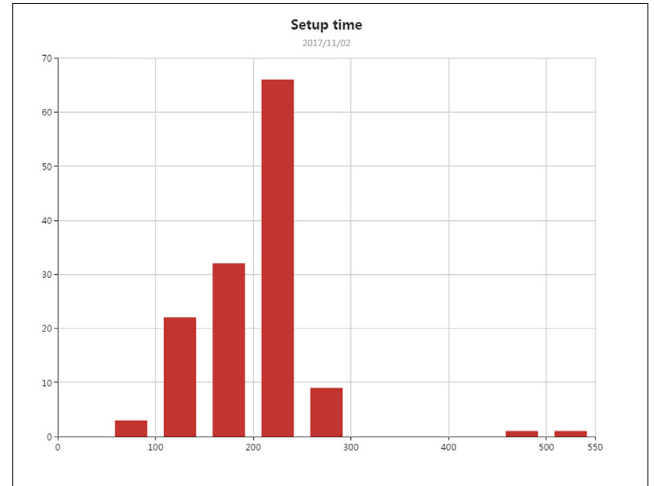
In addition to live monitoring, in-depth analysis of the decoded data is also possible. The visualization component **Decodio ORANGE** offers a convenient interface to display load measurements and statistics in the form of various charts and diagrams.



Traffic breakdown by source and destination
Voice traffic breakdown by source and destination.

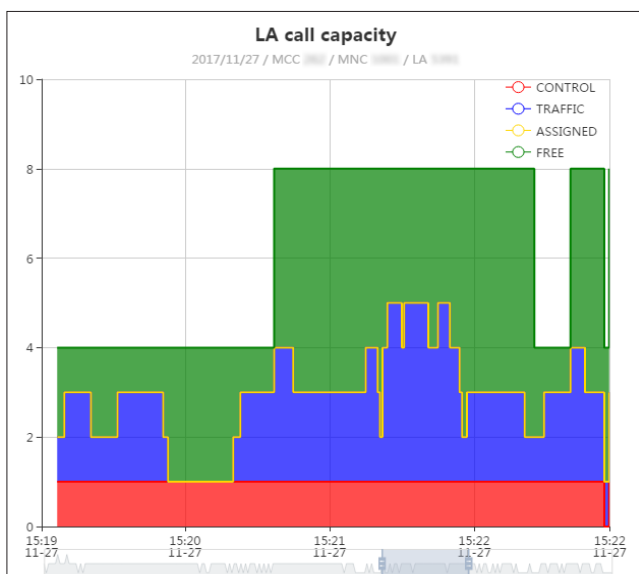
Slot usage
Traffic breakdown by time slot number

Downlink vs. uplink usage
Traffic breakdown between uplink and downlink channels

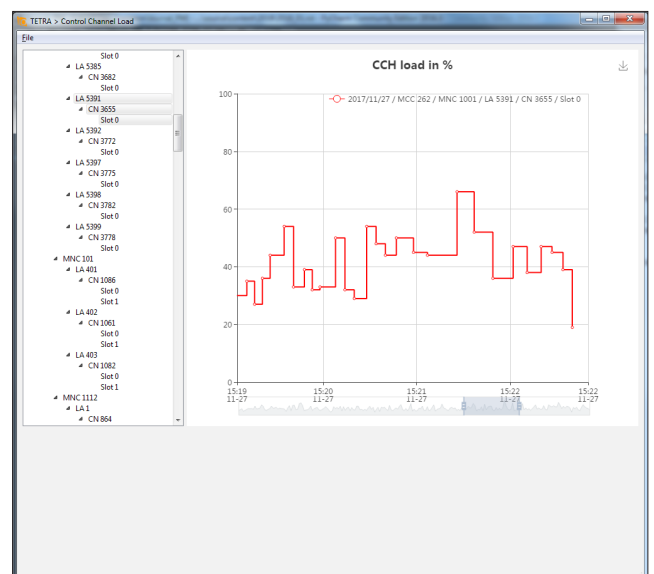


Call setup time distribution
Visualization of the call setup time distribution in a histogram

Call duration distribution
Visualization of the call duration distribution in a histogram



Location area call capacity
Chronological overview of the available and occupied slots over time within a Location Area. Allows to quickly detect capacity bottlenecks and analyze the cell load.

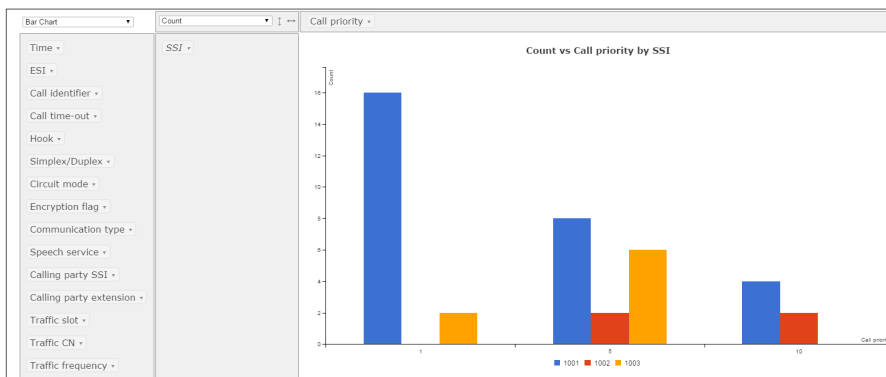


Control channel load
Graphical view of the load of a location area's control channels over time.

Table		Count	Encryption flag			
Time	SSI	Circuit mode	Call identifier	0	1	Totals
11:28:49.254	1	Speech (TCH/S)	499	2	2	
11:48:50.305	2	Speech (TCH/S)	506	2	2	
12:18:47.355	2	Speech (TCH/S)	523	2	2	
14:32:41.351	1	Speech (TCH/S)	686	2	2	
14:54:27.149	1	Speech (TCH/S)	698	2	2	
15:14:07.725	3	Speech (TCH/S)	703	2	2	
15:14:28.181	3	Speech (TCH/S)	704	2	2	
15:14:36.795	3	Speech (TCH/S)	705	2	2	
15:14:50.111	2	Speech (TCH/S)	707	2	2	
15:15:10.938	3	Speech (TCH/S)	709	2	2	
15:17:56.015	2	Speech (TCH/S)	710	2	2	
15:18:27.944	1	Speech (TCH/S)	719	2	2	
15:19:53.090	1	Speech (TCH/S)	720	2	2	
Totals				18	8	26

Pivot table analysis

With **Decodio ORANGE** for TETRA, Data series can be combined at will to generate pivot tables providing deep insight into the call setup parameters and traffic type (such as encryption, SSI, call ID, allocation information).



Custom statistical visualizations can also be easily created and exported.

Individual PDU logging allows in-depth analysis of the network's behavior and fast response to operational issues.

Registration-related issues and radio inventory can be detected and recorded by separately logging the Mobility Management (MM) PDUs.

COVERAGE TESTS

When combined with **Decodio RUNNER**, **Decodio NET** supports multichannel coverage tests, through measurement of the signal power and quality (bit error rate and message erasure rate).

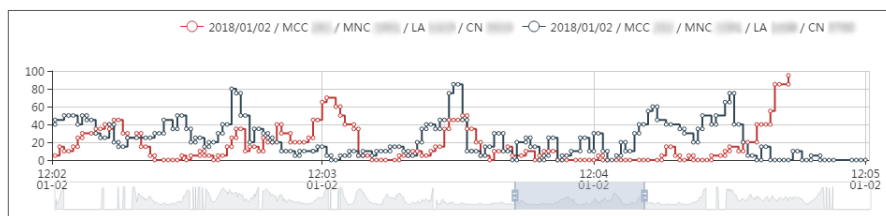
The operator can measure multiple channels in parallel thanks to **Decodio NET**'s high-performance signal processing capabilities.

Combining geographical coordinates with PDU logs allows for a precise localization of events such as handovers and device registrations, which can be then visualized on a map.

For instance, the locations where **D-LOCATION-UPDATE-ACCEPTS** are detected on the air interface can be recorded to evaluate the roaming behavior of terminals

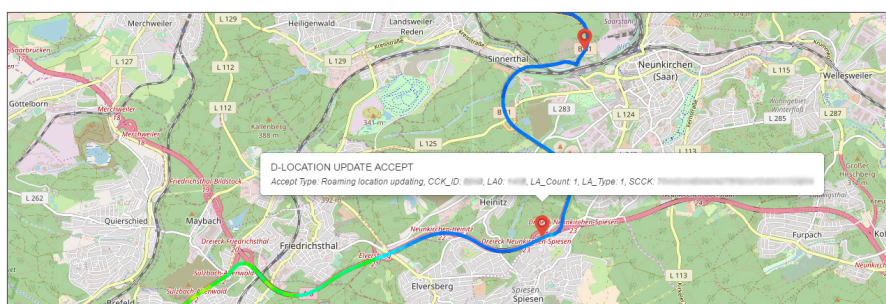
while driving through adjacent Location Area, on both the uplink and downlink channels.

Since **Decodio NET** operates exclusively on the air interface, it is able to measure the actual behavior of any terminals, even mobile stations integrated in vehicles. This enables the direct comparison of mobile and portable radio behaviors.



Quality measurements

Comparison of the signal quality over time (power level in dBm, BER, MER) for multiple channels



Drive-test

Colored visualization of the signal quality (power level, BER, MER) along the drive-test route.

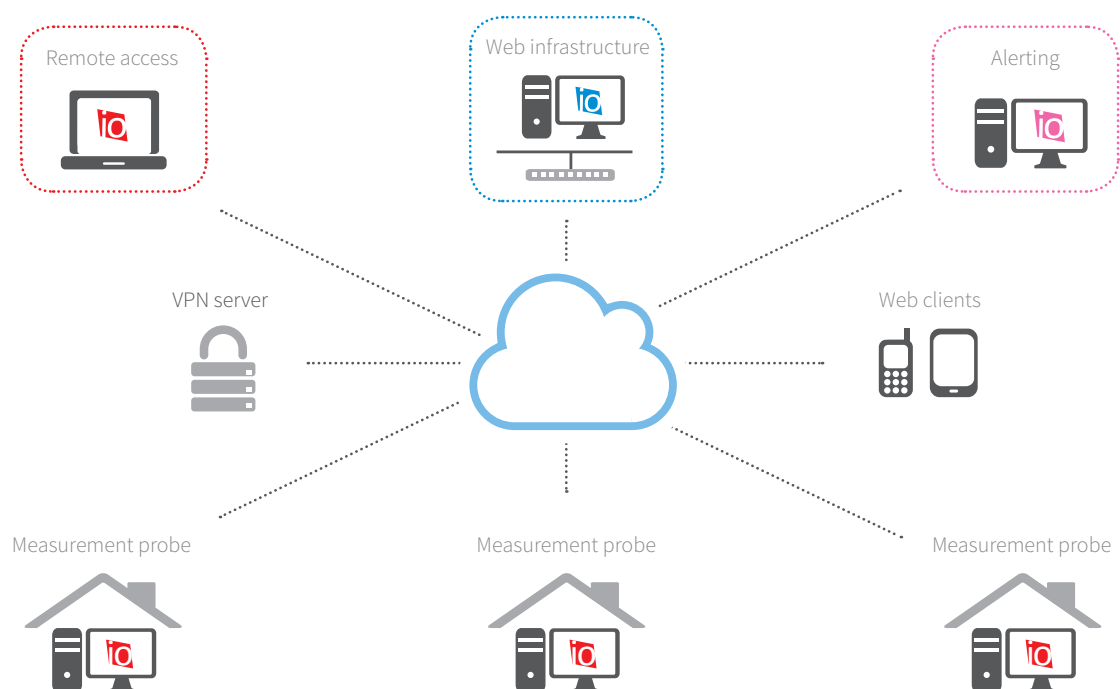
PDU-OUTPUT LOGS

Mobility Management (MM)	Logging of authentications, registration attempts, connection disruptions and rejections.
Circuit Mode Control Entity (CMCE)	Logging of all PDUs within one LA with Channel Number, Call ID, SSI/ESI and more. Chronological overview of all transmitted PDUs (SETUP, CONNECTED, CEASED, etc.) of the different channels.
Setup	Call setup logging with configuration details (simplex/duplex, circuit mode, encryption) and information about transmitter and receiver (SSI/ESI).
Release	Call end logging with details and reason for termination.
Short Data Services (SDS)	Logging of transmitted data packages with information about length, message type (location, text, messaging, etc.) delivery status and content.
Capacity	Logging of time slot usage within a LA.
Inventory	List of registrations and handovers.
CCH LOAD	Logging of control channel load within a LA.
CALL SETUP TIME	List of call establishment durations with details about the communication setup.
PTT LENGTH	Information about call duration (in both milliseconds and number of time slots), along with Call ID and Usage Marker.

NETWORK MONITORING

An optional remote control interface allows to remotely operate **Decodio NET** and to retrieve decoded data through a graphical interface. This makes it possible to deploy a network of distributed sensors in order to monitor communication networks over large geographical areas while gathering the acquired data in a single location

Additionally, database and web-based visualization functionalities as well as automatic SNMP alerting with remote access can be added to a network of distributed sensors thanks to the optional **BLUE** and **PINK** components.



TECHNICAL DATA

Decodio software components	Decodio RED (ORANGE , BLUE , PINK available as options) Support for TETRA TMO/DMO ETSI EN 300 392-1 (General network design) ETSI EN 300 392-2 (Air-interface) ETSI EN 300 392-7 (Security) ETSI EN 300 395-2 (Codec)
Frequency range	Typically 9 kHz – 6 GHz (hardware-dependent)
Bandwidth	Typically up to 40 MHz for portable systems and 80 MHz for fixed installations (hardware-dependent)
TETRA scanner	TETRA emission detections happens in less than 2 seconds (within acquisition bandwidth)
Supported receivers	Provided upon request. Support for recording and playback of wideband IQ signals with timestamp and geographical coordinates
Decoded broadcast parameters	Frequency, main frequency, channel status, quality (BER, MER), mobile country code (MCC), mobile network code (MNC), location area (LA), color code (CC), security class, service details, SLOW_RESELECT_THRESHOLD_ABOVE_FAST, FAST_RESELECT_THRESHOLD, SLOW_RESELECT_HYSTERESIS, FAST_RESELECT_HYSTERESIS
Decoded SYS-INFO	PDU type, broadcast type, main carrier, frequency band, offset, duplex spacing, reverse operation, number of common secondary control channels in use, MS_TXPWR_MAX_CELL, RXLEV_ACCESS_MIN, ACCESS_PARAMETER, radio downlink timeout, security information, authentication required, supported security classes, CCK-ID, SDS-TL addressing method, GCK supported, section, extended service broadcast
Decoded D-MLE-SYSINFO	LA, subscriber class, BS service details, de-/registration, priority cell, minimum mode service, migration, system wide services, TETRA voice services, circuit mode data service, SNDCP service, air-interface encryption, advanced link supported
Decoded SYNC	System code, colour code, sharing mode, TS reserved frames, U-plane DTX, Frame 18 extension,
Decoded D-MLE-SYNC	MCC, MNC, neighbour cell broadcast, neighbour cell enquiry, cell service level, late entry information
Decoded call parameters	Channel number, frequency, slot, source ID, destination ID, encryption, EndToEnd, priority, communication type, simplex-duplex, usage marker
Decoded voice content	Live playback and WAVE file recording

DECODIO NET FOR TETRA CONFIGURATIONS

Configuration	NET_16	NET_32	NET_64	Custom
Number of channels decoded in parallel	16	32	64	Customizable
Support for multiple receivers	no	yes	yes	Customizable

SOFTWARE OPTIONS

PDU-OUTPUT/Decodio ORANGE	PDU file generation with statistical and graphical analysis and export features
Decryption modules	Class 2, 3 TEA1,TEA2,TEA3,TEA4 TAA1
Decodio RUNNER	Coverage and signal quality mapping, interference detection, handover analysis.
Remote interface	JSON -based TCP interface for remote control and decoded data retrieval, suitable for system integration
Decodio BLUE	Centralized database for calls and signal quality measurements with web-based interface
Decodio PINK	Automated network monitoring (Decodio QoS) with support for custom rules and NMS interface (SNMP traps)

HARDWARE OPTIONS

Decodio **NET** is available on various hardware platforms, and thus suitable for various applications.

Being suitable for mobile systems based on portable spectrum analyzers and laptop computers makes **Decodio NET for TETRA** a unique and versatile solution for inter-connected TETRA monitoring.

Decodio AG

Technoparkstrasse 1
8005 Zürich
Switzerland

phone: +41 44 552 08 70
email: info@decodio.com
internet: www.decodio.com

