LS telcom
Smart Spectrum Solutions

Global Spectrum Experience

Compact and Flexible Radio Monitoring

LS OBSERVER

The next generation monitoring system
...is not just about monitoring.

LS OBSERVER

A fully integrated system for spectrum monitoring

In line with the ever increasing use of wireless devices the radio spectrum is becoming congested. To ensure a stable, interference-free communication spectrum monitoring is the key.

LS OBSERVER is a fully integrated state-of-the-art system for spectrum monitoring, including measurement and control software, as well as monitoring hardware.

Whether classical monitoring, automatic violation detection, direction finding, geolocation, occupancy analysis or demodulation, the LS OBSERVER system offers a wide range of applications.

The key differentiator of LS OBSERVER compared to conventional monitoring systems is its unique data compression and storage capacity directly inside the measuring units, its integrated user-friendly and intelligent software, as well as its interface to spectrum management systems.

How does it work?

The measuring devices, the so-called Remote Monitoring Units (RMUs), "observe" the radio spectrum 24/7. Once started by a remote operator each RMU independently processes and records the measurement data within the unit. Depending on the measurement type, the RMU can store data for up to two years. By this means you can not only view the live measurement data but also download recorded data from the RMU whenever you need it for your analysis. With the help of search filters you can retrieve exactly the required data. This is why only little network bandwidth is needed to connect to the RMU. In addition, the transferred data can be stored on a central server and, if needed later, does not have to be retrieved again.

Either fixed, transportable, portable or handheld - our wide portfolio of remote devices enables monitoring for various applications.

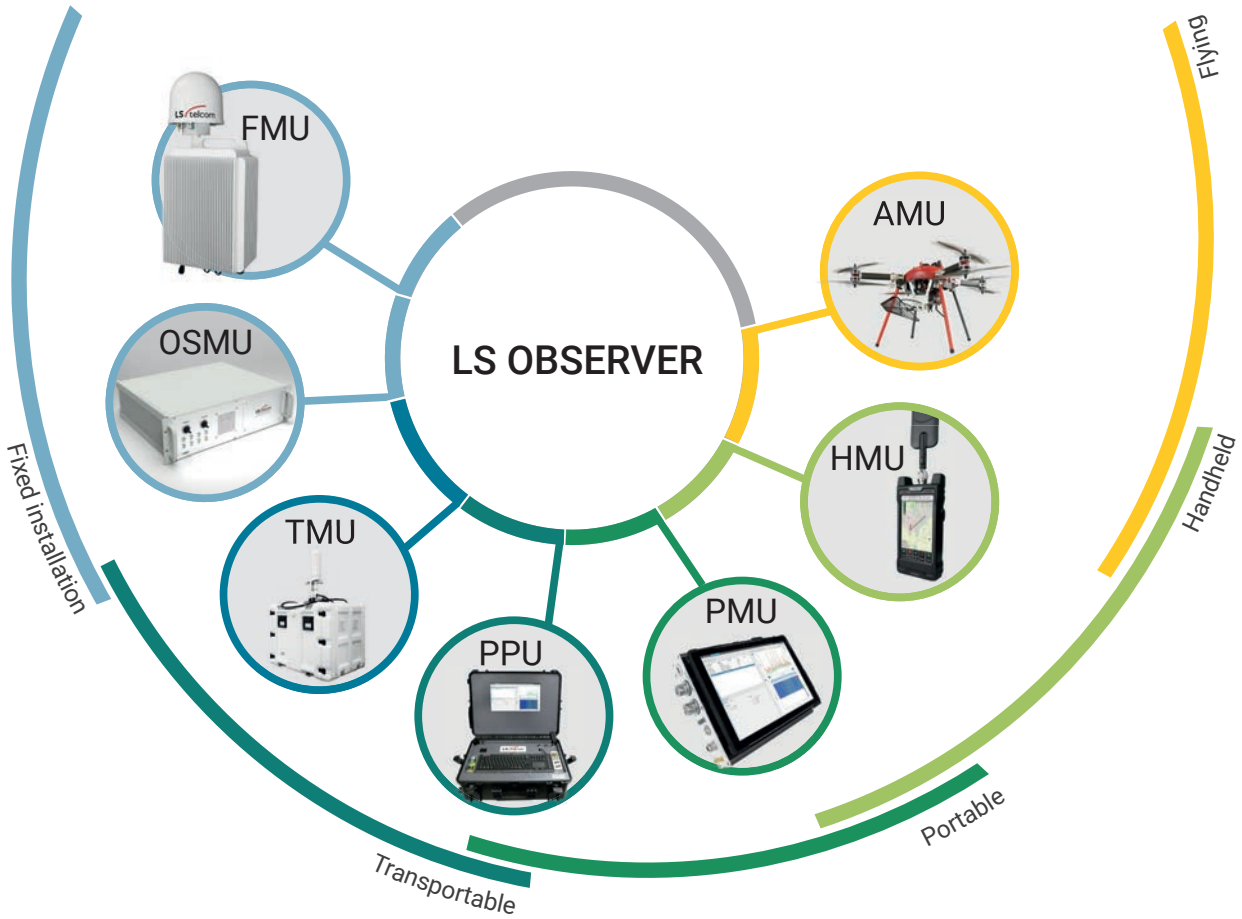
Combining monitoring and spectrum management

LS OBSERVER can be combined with spectrum management systems (e.g. SPECTRA) for the automated data exchange and comparison of "real", measured data and licensed data in the spectrum management database.

This combined system solution is the real enabler for truly efficient spectrum allocation and usage.

ITU compatible

The LS OBSERVER system is compatible with the monitoring guidelines and recommendations in the ITU spectrum monitoring handbook.



LS OBSERVER product family

System Overview

Remote Monitoring Unit

From the hardware side, the Remote Monitoring Unit (RMU) of LS OBSERVER consists of the radio frequency front end, an embedded computer, storage as well as interfaces for network connection. Depending on the required frequency range and application several versions are available.

The embedded computer running the intelligent software automatically calculates four different types of data:

- Raw data
- Noise-free data
- Frequency channel occupancy (FCO) data
- Overview data

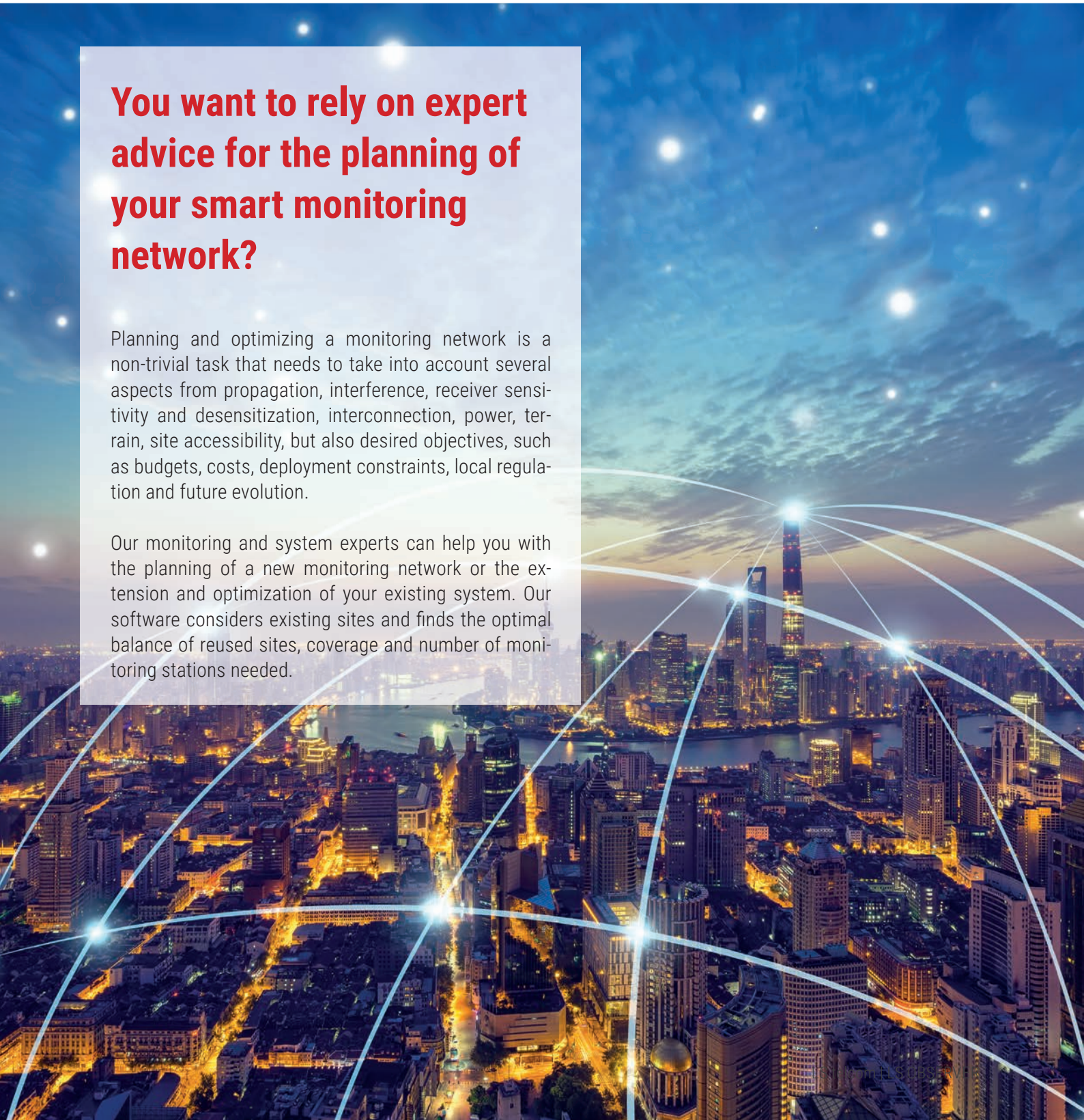
All the data is stored within the unit which has enough storage to store the raw data for up to 30 days and the processed data types for up to 2 years.

The Automatic Violation Detection (AVD) feature automatically verifies the conformity of the measured spectrum with the expected spectrum (licensing database) and sends an alarm in case of anomalies. The alarm history, the so-called AVD log file, is stored permanently.

Monitoring network

The concept of LS OBSERVER is to connect all the remote devices to one network. This allows a local operator in the field as well as one at the Central Monitoring Unit (CMU) to manage and access the measurements of all connected units.

All network communication is based on TCP/IP and thus many wired and wireless communication networks (e.g. the public internet secured via VPN) can be used. In the standard version the units can be connected via Ethernet or wireless via 3G-UMTS or 4G-LTE to the network.
Thanks to the internal storage capability and the processing power of the RMU only little data has to be transferred to a remote operator. By this means, the system may also be used in areas where the network connection is unstable or where the bandwidth is small. Even disruptions of the connections will not cause system failures, as the remote unit will continue its operation without being connected to a central control unit. Bigger bandwidths are only required when huge amounts of data need to be downloaded or within IQ data related applications (including TDoA).



You want to rely on expert advice for the planning of your smart monitoring network?

Planning and optimizing a monitoring network is a non-trivial task that needs to take into account several aspects from propagation, interference, receiver sensitivity and desensitization, interconnection, power, terrain, site accessibility, but also desired objectives, such as budgets, costs, deployment constraints, local regulation and future evolution.

Our monitoring and system experts can help you with the planning of a new monitoring network or the extension and optimization of your existing system. Our software considers existing sites and finds the optimal balance of reused sites, coverage and number of monitoring stations needed.

For More Flexibility Various Monitoring Units are Available

Fixed, transportable, portable, handheld and flying

Fixed, transportable, portable, handheld and even flying monitoring units are available within the LS OBSERVER family for various applications. In the standard version different instances of these devices can cover the full frequency range from 9 kHz to 18 GHz*.

Fixed Monitoring Unit

Unlike traditional heavy and bulky monitoring stations, LS OBSERVER Fixed Monitoring Units (FMUs) have a small footprint and allow for “single pole” mounting. Permission to install these small and smart devices is easily obtained, and they can be installed literally anywhere - only two people are needed to set up the FMU. Thanks to its robust design the FMU can be operated in hard weather conditions.

Transportable Monitoring Unit

The Transportable Monitoring Unit (TMU) offers you great flexibility. Whether you load it in the trunk of a vehicle for drive tests or do continuous outside monitoring the TMU is suited for various applications. It is weatherproof and has internal battery power for autarkic operations.

* If that is not enough, talk to us, we have the flexibility and capability to come up with a customized version that meets your needs.

Portable Monitoring Unit

The small and lightweight Portable Monitoring Unit (PMU) is suited for infield operations. For control and measurement display the PMU is equipped with a touch-screen tablet computer. The PMU is powered by a removable battery pack or can alternatively be connected to the power supply grid.

Protected Portable Unit

The Protected Portable Unit (PPU) is suited for outdoor operations under extreme weather conditions. The PPU is easy to transport and can be used for single infield as well as for continuous outdoor measurements.

Handheld Monitoring Unit

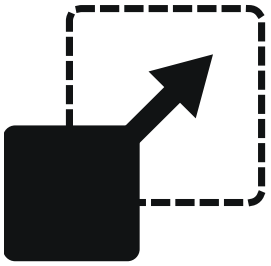
The Handheld Monitoring Unit (HMU) is a very small and lightweight but at the same time powerful device. The HMU is based on Android enabling a user-friendly touch interface. With the integrated compass view transmitter homing becomes as simple as never before.

Airborne Monitoring Unit

The Airborne Monitoring Unit (AMU) is a fully equipped drone suited for monitoring and direction finding. Flying in up to 100 m height the AMU can monitor signals that are not measurable on the ground.

Scalable system

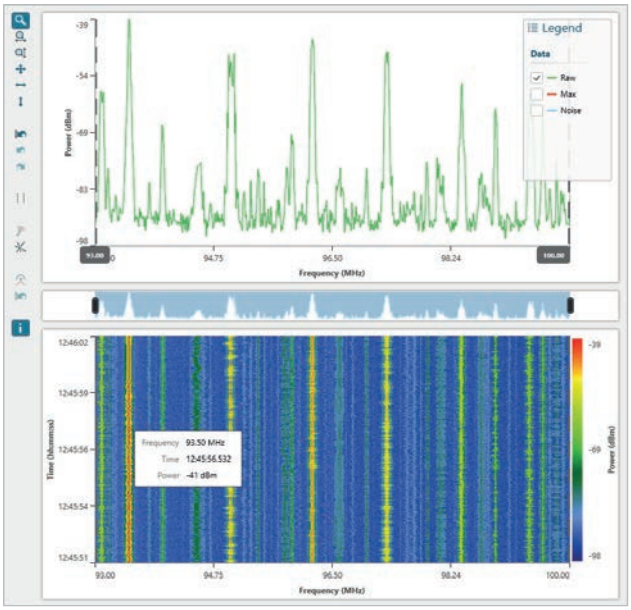
You want to expand your existing monitoring system? No problem, LS OBSERVER is freely scalable.



Applications

Live monitoring

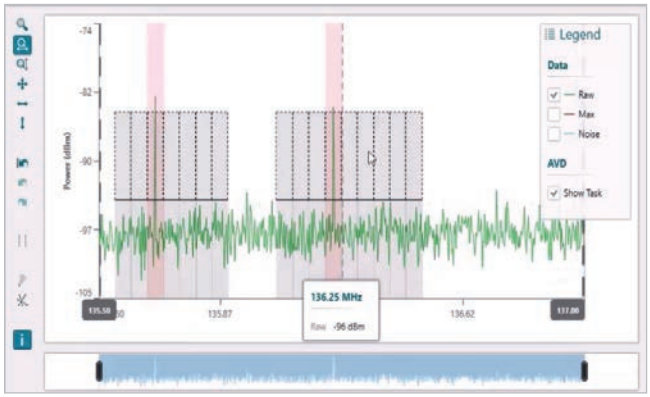
The modern LS OBSERVER Central Monitoring Software (CMS) enables fast and user-friendly monitoring. The live measuring results of a certain RMU are displayed in an interactive FFT and a linked waterfall chart. You can easily zoom in and out, a mouseover with relevant information for each position in the chart is displayed, the measurements can be moved by dragging it with the mouse and each step can be undone or redone. Further there is a resampling button which automatically adapts the actual resolution of the measurement on the zoom level. Besides the actual raw data level the user can display maximum and minimum hold values as well as the noise level.



Automatic Violation Detection

The unique Automatic Violation Detection (AVD) verifies the conformity of the measured spectrum with the expected spectrum (licensing database) within a couple of milliseconds. Taking as an input the technical emitter information from a license database (or entered through a manual input), the software calculates for every monitoring unit in the field the expected signal characteristics at the units' location. So-called masks are generated in order to define the limits allowed for spectrum fluctuations. You can easily set and adapt the alarm rules for each mask element i.e. the expected level and tolerances as well as the time a violation can last without triggering an alarm.

If an emission violates the predefined rules the corresponding mask is highlighted red in the FFT chart and an SMS or e-mail is automatically sent to you. An alert is always recorded in a logbook so the alarms over time can be analyzed later in a waterfall view. In order to enable fast problem identification when an alarm occurs the affected station from your licensing database is highlighted in the map.



Audio and IQ recording

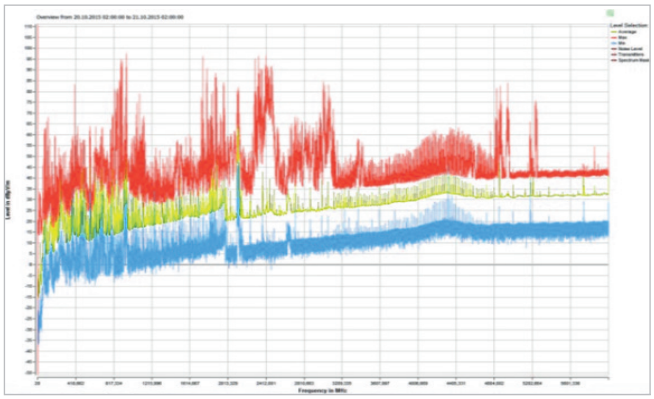
The software offers an integrated demodulator which enables listening to analog audio. You can either listen live or record it for later replay. The currently supported modulation types are FM, AM, USB, LSB and DSB. For further analysis with third party tools, the IQ data provided by the receiver can be recorded.

Analysis

Four different types of data can be downloaded from the RMU for analysis:

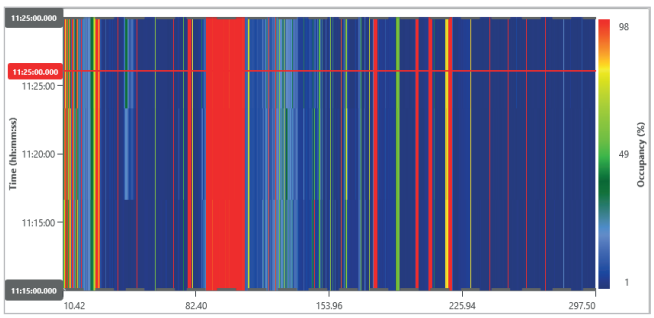
Overview data

When you analyze long term measurements you need the data in an aggregated version. The overview data gives you a meaningful picture of the spectrum over the complete measuring time. Therefore, the averaged signal level over the measurement time is displayed in the FFT chart. Additionally, the maximal and minimal signal level (max/min hold) is displayed in order to detect single bursts or discontinuities.



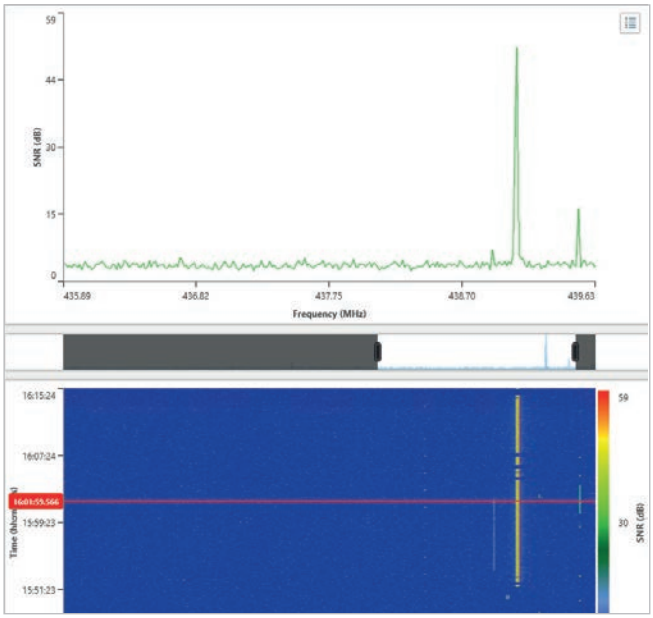
Frequency Channel Occupancy (FCO) data

The Frequency Channel Occupancy (FCO) is displayed in a waterfall chart giving you a very good overview of the spectrum usage over time. You can choose between different time bases (5, 15, 30 or 60 minutes) for the FCO calculation. By clicking in the waterfall chart the corresponding FFT occupancy chart is displayed.



Noise free data

To help you separating noise from signal and evaluating the signal quality and strength an intelligent algorithm eliminates the noise from the raw data and calculates the signal-to-noise ratio (SNR). The noise free data is presented in FFT and waterfall chart view.



Raw data

The raw data contains the full measurement information provided by the receiver. As in live monitoring it is presented in a FFT and linked waterfall chart.

Direction Finding/Angle of Arrival (AoA)

Connected to a DF antenna you can perform standalone on site direction finding with a LS OBSERVER unit. Besides a compass view for classical "homing" the software automatically calculates the line of bearing starting from the actual RMU GPS position and displays it on a map.

Geolocation

Triangulation

Multiple lines of bearing from several measurements can be overlaid in the map to geolocate the unknown emitter. This can be obtained either by multiple sequential measurements with one unit or by combining parallel DF measurements from several network devices. Whether you are in the field or at a central monitoring unit you can manage other devices as a master for direction finding. A heatmap visualization on the map helps you to identify the most likely transmitter location.

Time Difference of Arrival (TDoA)

The TDoA method calculates the emitter location based on the time difference of a certain signal at different locations. The great advantage of TDoA is that multipath signals e.g. caused by high buildings in dense urban areas do not affect the geolocation accuracy.

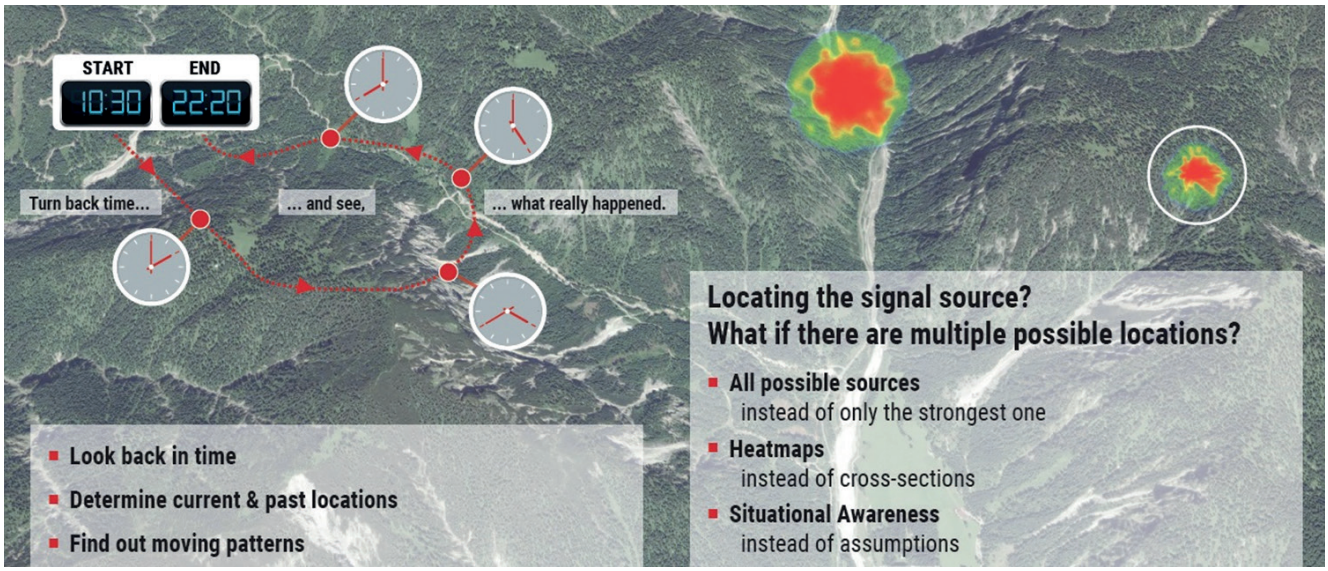
Gain Ratio of Arrival (GROA+®)

The GROA+® method calculates the emitter location based on power differences of a certain signal at different locations. The geolocation accuracy depends on precise wave propagation calculation considering topographic data. Through detailed maps and intelligent algorithms LS OBSERVER makes GROA+® to a very precise method for geolocation - we do not rely on the free space propagation model, but make use of topographic and clutter information to allow the usage of more sophisticated wave propagation models. The great advantage of GROA+® is that it can locate emitters based on historical data stored in the RMU.

Hybrid technologies

To make geolocation even more precise LS OBSERVER also offers hybrid combinations of above described geolocation techniques.

Technology	**Triangulation**		**TDoA**	**GROA+®**	
Operation mode	sequential	parallel	parallel	sequential	parallel
Antenna	directional		omnidirectional	omnidirectional	
Min. number of units	1	2	3	1	3



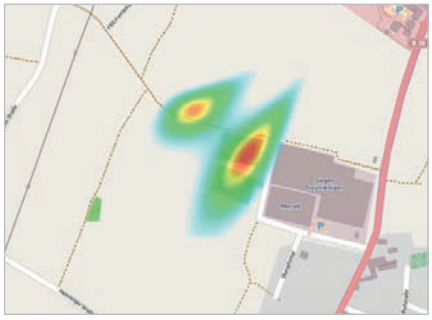
Next generation direction finding with the AOA 1xx antenna system

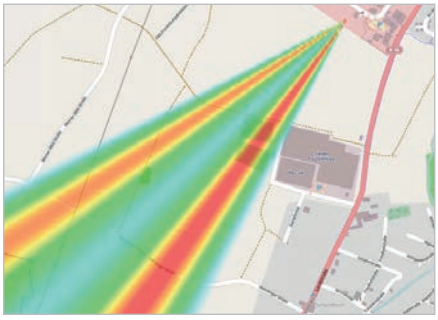
With the AOA 1xx antenna system and the unique DF Time Travel® functionality LS telcom offers an innovation on the sector of direction finding. Working over an ultra-wide frequency range of 8 kHz up to 12 GHz (dependent on the configuration), the AOA 1xx forms the most compact full band solution for monitoring and direction finding in one module.

Using up to 28 high precision antennas, the system can not only analyze the situation at one frequency but supports a full band, all time direction finding, a feature which is uncontested in the market. In addition, it has the unique capability to receive and analyze both horizontally and vertically polarized signals along with monitoring from 8 kHz up to 12 GHz with a combined antenna system. The AOA 1xx consists of a robust design able to cope with extreme weather and shock conditions, suitable for 24/7 operation at fixed sites or mobile applications when mounted on a vehicle.

The DF Time Travel® technology allows you to perform direction finding not only live as usual but also in the past based on recorded DF/spectrum measurements, so signals can be tracked even when they are not currently transmitting. You can freely choose the band or frequency of interest for direction finding not limited to one channel or the real time bandwidth as in traditional systems.

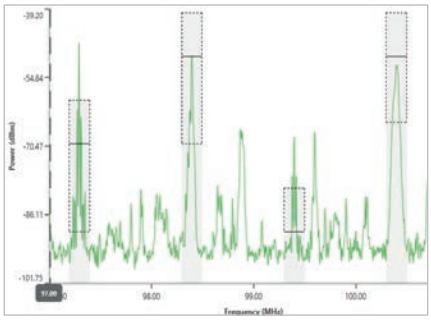
Especially in dense urban areas reflections can have a high influence on the DF accuracy. The used DF method as well as a multi-spot heatmap visualization reduces the reflection caused miscalculations to a minimum. Whereas standard direction finding only considers the most likely results while other information is discarded the multi-spot feature is considering multiple possible geolocations which helps the user to separate source of reflections or further transmitters on the same channel from the actual searched signal.





Parallel Tasking with True Multi-Receiver Option

Most of our remote monitoring units have the capability to integrate multiple receivers enabling multitasking operations. By this means you can for example perform monitoring, direction finding and analysis in parallel at the same time with only one unit. By choosing our multi-receiver option you can save time and increase the effectiveness of your measurements.

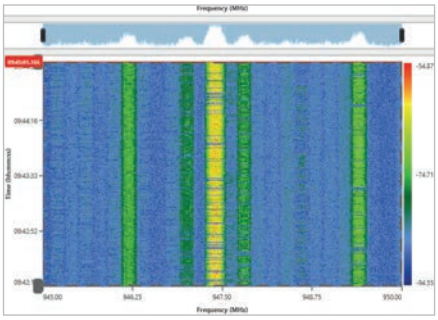


Receiver 1

- Wideband continous spectrum monitoring
- AVD

Receiver 2

- Direction finding



Receiver 3

- IQ recording
- Demodulation
- Signal analysis

We integrate your existing monitoring or spectrum management system in LS OBSERVER

You already have a spectrum management system	You already have both – the SPECTRA spectrum management system and a third party monitoring system	You already have a monitoring system in use
We integrate the complete LS OBSERVER system into your existing spectrum management system.	We combine LS OBSERVER with your existing systems for automated comparison of license data in the database and monitoring data; the basis for permanent spectrum inventory and spectrum usage optimization.	We integrate LS OBSERVER with your existing monitoring system to automate data compression, storage and analysis*.

*depending on equipment manufacturer, only if interface is defined and open for use

LS OBSERVER for Regulators

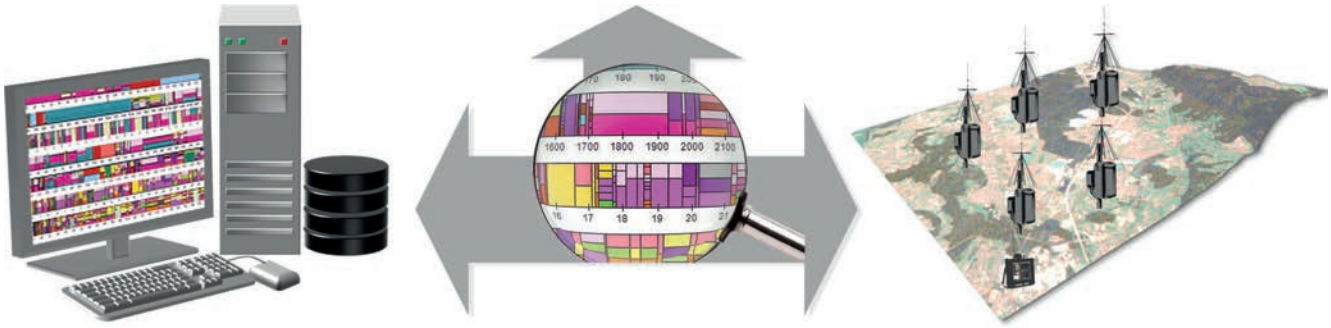
Interface to spectrum management

As a regulator you need to identify and locate interference as well as unused and underused frequencies in order to attribute frequencies more effectively.

Spectrum monitoring serves as the eyes of the spectrum management process. It is necessary in practice because in reality authorized use of the spectrum does not ensure that it is being used as intended.

With LS OBSERVER you can achieve this objectivity. The intelligent software combines measured data from monitoring with spectrum management.

Spectrum management	Spectrum inventory	Spectrum monitoring
▪ "A single view of the spectrum" ▪ Coherent data entry ▪ Availability of sufficient spectrum for all services ▪ Quick & efficient license attribution ▪ Management of spectrum trading ▪ Dynamic Spectrum Access/ white space management	▪ Identify frequency bands in which efficiency could be improved ▪ Identify spectrum sharing opportunities ▪ Better spectrum planning	▪ Increased data accuracy of license database (through comparison of measured data and data in the database) ▪ Spectrum policy making based on real data ▪ Monitoring is the foundation of evidence based regulation



Data mining and analysis

- Automatic report generation
- Evidence based regulation
- Better license management and fee planning

LS OBSERVER – Ensuring Safety and Functionality

Airports and hubs

Airports and other transportation hubs have a high demand for wireless communication. To ensure safety and functionality in both air traffic related (e.g. ATC, Air Navigation) and airport operation related communication (e.g. terminal infrastructure, TETRA) monitoring plays an important role. With the AVD function of LS OBSERVER you immediately get informed about interferences or disruptions. Further, with LS OBSERVER you can identify the problem and geolocate illegal or defective emitters.

Industry 4.0/IoT

Modern smart factories consist of countless devices communicating wireless with each other. Disruptions caused by interference can end in production losses or malfunctions. To prevent you from this, LS OBSERVER continuously monitors the radio spectrum in and around your factory buildings and automatically informs you in case of anomalies.

Security organizations

With LS OBSERVER you can identify the frequency environment in and around secure sites, such as embassies and other government establishments as well as on national borders.

Permanent monitoring of all relevant frequencies allows you to detect and locate any new signals. You can permanently compare the measured spectrum data with the frequency usage date registered in the database to detect any unknown or unauthorized frequency use, such as for RCIED (radio controlled improvised explosive devices), bugs and illegal transmitters. In case of sudden unauthorized frequency use the operator can take immediate action against the potential security threat.

LS OBSERVER for the Military

Efficient spectrum management today is the foundation for information superiority and military dominance. But…

…as a soldier

How do you protect yourself in a convoy from improvised explosive devices (IEDs), if you don't know who is emitting and from where?

…as a spectrum manager

How do you assure without monitoring that the spectrum usage data in your database is absolutely correct to guarantee optimized spectrum usage to your forces?

…as an area frequency coordinator (AFC)

How do you cope with unauthorized use of spectrum and prevent interference from it, if you don't know who is emitting and from where?

Real time monitoring and measurement of spectrum is indispensable for many military operations to guarantee impeccable data quality in the database, optimized spectrum use of communications and non-communications systems, interference free frequency assignment to and protection of the forces, as well as to support electronic warfare and intelligence and reconnaissance.

Intelligence collection management

LS OBSERVER detects even the shortest of voice transmissions. Much faster than traditional systems that often revisit a channel only every few minutes and miss a lot of transmissions. The meticulous information on real frequency use that the system provides you with enables you to figure out the tiniest bit of enemy action for identification through intelligence and reconnaissance systems (IRS). LS OBSERVER smoothly interfaces with third party SIGINT and COMINT analysis software.

Get a pin sharp picture of the spectrum environment

LS OBSERVER can be integrated with the SPECTRAmil spectrum management and electronic warfare solution for the smooth comparison of measured data with spectrum usage data stored in the database to obtain the perfect picture of your spectrum environment. The complete solution allows for automated analysis of military spectrum usage and quick identification of unauthorized, enemy and underused frequencies. Reports for all command levels can be generated automatically.

Trust in more than

30

years of know-how and experience

ITU-R

and

ITU-D

sector member

An

ISO 9001

ISO 14001

ISO 27001

certified company

System solutions and consulting services for

- Spectrum management
- Licensed shared access
- Radio monitoring
- Geolocation and direction finding
- Radio network planning and optimization

Customers in more than

100

countries

GCA

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