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LS OBSERVER

The next Generation Monitoring System

...is not just about monitoring.

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Content

LS OBSERVER System – "Combining Monitoring and Spectrum Management for the ultimate Spectrum Optimisation"

In line with the ever increasing use of wireless devices the radio spectrum is becoming congested and its value increases. If you want to maximise the use of frequencies, efficiency in spectrum management combined with spectrum monitoring is key.

Spectrum monitoring is not enough

The foundation of efficient spectrum management and allocation is accurate data in the licence database. To make sure your licence data is as correct as possible; you need to compare it to long-term real spectrum occupancy data. This is why spectrum monitoring "on its own" is not enough. It is essential to compress and store long-term "historic data" on a permanent basis to be able to analyse the spectrum use at anytime and for any frequency range that needs analysis.

The LS OBSERVER System is a highly modular monitoring system which monitors the entire frequency range. The System consists of a Central Management Unit (CMU), Remote Monitoring Units (RMU), client access (including spectrum analysis display) as well as an interface to several analysis servers and tools, such as spectrum management systems, geo-location capabilities, EMC analysis, etc.

The **key differentiator of LS OBSERVER** compared to conventional monitoring systems is its unique data compression and storage capacity as well as its integrated intelligent software for spectrum analysis. LS OBSERVER in combination with the SPECTRA spectrum management system allows for automated comparison of spectrum data in the licence database with real world spectrum occupancy data, which makes this Combined System Solution the real enabler for truly efficient spectrum allocation and usage.

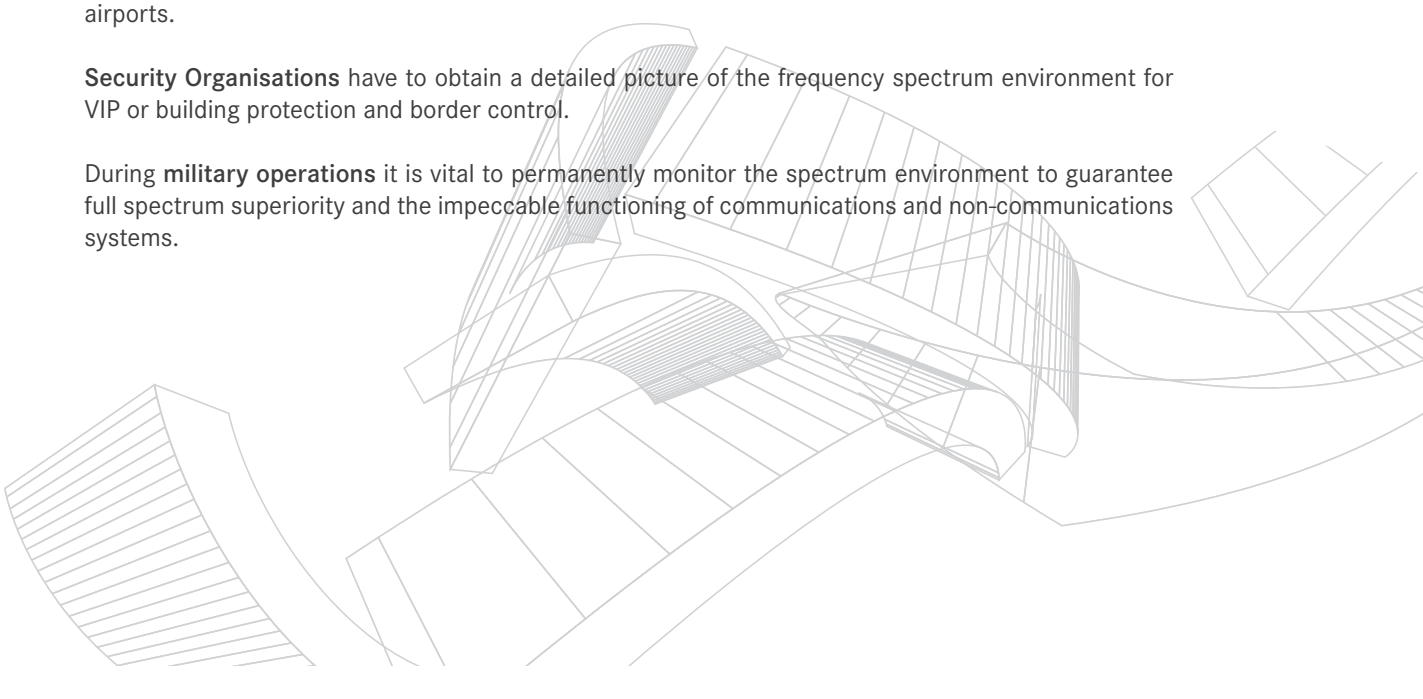
The applications of the LS OBSERVER System are manifold.

As a **regulator** you need to identify and locate both unused and underused frequencies and interference in order to attribute frequencies more effectively. You may also want to measure EMF (electromagnetic fields) continually to ensure that exposure limits are not exceeded at certain locations.

Air traffic controllers and airport managers need to permanently monitor ATC and nearby ATC frequencies and locate the source of interference to guarantee a safe spectrum environment around airports.

Security Organisations have to obtain a detailed picture of the frequency spectrum environment for VIP or building protection and border control.

During **military operations** it is vital to permanently monitor the spectrum environment to guarantee full spectrum superiority and the impeccable functioning of communications and non-communications systems.



LS OBSERVER for Regulators

Spectrum Policy Making

As a regulator you ensure that spectrum is managed and used efficiently. You want to justify to the public that people get the best from their communications services. Monitoring is the underlying and crucial enabler to many ways of achieving this objective, such as measurement campaigns, spectrum inventory or evidence-based regulation.

Measurement Campaigns

Regulators set up measurement campaigns for different frequencies over a certain period of time in the hope that what they measure is needed for future policy making. But who can look into the future? Has it ever happened that the spectrum data you collected during a campaign did not fully cover the band you now need, requiring you to undertake a completely new monitoring exercise?

This is where LS OBSERVER comes in.
LS OBSERVER monitors the entire frequency spectrum and **captures everything all the time**. You can monitor everything the whole year through. Whatever monitoring data you need, you have it in your system and you can retrieve it easily for **instant intelligent decision making.**

Evidence-based Regulation

Whether you need to reform your frequency plan, re-allocate frequencies or organise spectrum auctions, you need real world data to establish your business case.

LS OBSERVER provides you with long-term historical measurement data for spectrum analysis and policy making.

You are in dire need for spectrum to attribute to a new service in a given geographical area? Retrieve the relevant usage information from LS OBSERVER and check whether a licensed frequency band is really used to its full extent. You may consider it worthwhile to pay to exit a user of an under-used frequency and attribute it to someone else making better use of it.

Spectrum Inventory with LS OBSERVER

Achieve the most accurate spectrum inventory results through monitoring

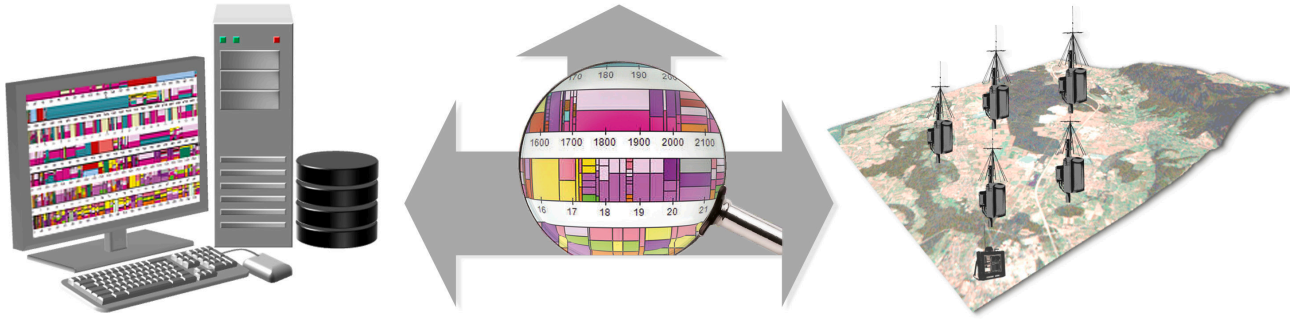
The European Union's radio spectrum policy programme states that spectrum inventory "should allow the identification of frequency bands in which efficiency could be improved and of spectrum sharing opportunities, to the benefit of both the commercial and public sectors."

But how do you identify these, if not through permanent monitoring?

LS OBSERVER remote monitoring stations are small-sized and can be placed literally anywhere, especially an advantage in densely populated areas where spectrum inventory is mostly needed to serve all users in demand for permanently and temporarily licensed spectrum.

To take it one step further LS OBSERVER can be combined with the SPECTRA spectrum management system for the automated data exchange and comparison of "real" measured data, and data in the spectrum management database.
Spectrum inventory becomes an ongoing exercise or at least an iterative process, which increases the accuracy and reliability of the spectrum management database, at a fraction of the time and effort it normally takes to keep such data up to date through manual processes.

Spectrum Management	Spectrum Inventory	Spectrum Monitoring
• "A single view of the spectrum" • Coherent data entry • Availability of sufficient spectrum for all services • Quick and efficient licence 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 licence 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 licence management and fee planning

Geo-Location

Locate illegal transmitters in cities

It is in cities where you are most in need of eliminating illegal frequency use. This is where spectrum is congested, where you have to ensure its optimal attribution, and where illegal use causes greatest interference. As high buildings cause multipath, transmitters cannot be located easily through traditional angle of arrival direction finding.

Therefore a great advantage of geo-location over direction finding is that it enables you to locate illegal transmitters in cities and to take enforcement actions.

EMF Measurements with LS OBSERVER

Regulators, governments and municipalities are responsible for monitoring the human exposure to radio frequencies set out in national and international safety guidelines, standards and regulations to protect against potential public health effects.

With LS OBSERVER you can carry out one-off and regular short-term as well as long-term and permanent EMF (electromagnetic field) measurements including the measurement of individual and total emissions for one or several sites. The measurement results can be used to confirm site certificate procedures and EMF simulations and to set up electromagnetic emission compliance reporting.

LS OBSERVER for EMF measurements consists of the EMF-specific software, portable and fixed monitoring units for short-term and long-term measurements, as well as an isotropic antenna.

Short-term measurements are made with handheld devices or with the unmanned miniature helicopter HELImon that can fly around the antenna. The integrated special EMF software then compares the measurement results with the exposure limits imposed by the relevant standards and regulations, and the actual occupational and general public safety zones can be plotted.

For short-term measurement studies, Maximum Traffic Extrapolation is applied to account for the fact that the measurements are made when traffic may not necessarily be at its maximum.

In heavily frequented public places or in locations where the fraction of exposure limit is particularly high, **continuous EMF measurements** may be needed to ensure and to proof to the public that exposure limits are not exceeded at these locations.

In this case, the fixed monitoring unit LS OBSERVER EMF is the ideal device: it has a very small footprint and can be set up literally anywhere.

Air Traffic Control and Airport Protection with LS OBSERVER

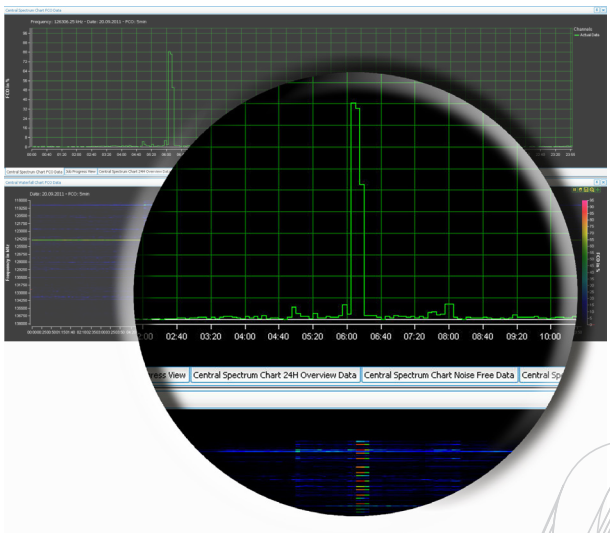
You need to permanently monitor ATC and nearby ATC frequencies around your airport and locate the source of interference to guarantee a safe spectrum environment.

LS OBSERVER “observes” the whole frequency range and detects automatically even the shortest frequency use susceptible of interfering with air traffic communication 24 hours a day, 365 days a year. The system includes geo-location, which enables you to locate illegal transmitters around the airport straight away, speeding the response to remove the interfering source quickly and efficiently.

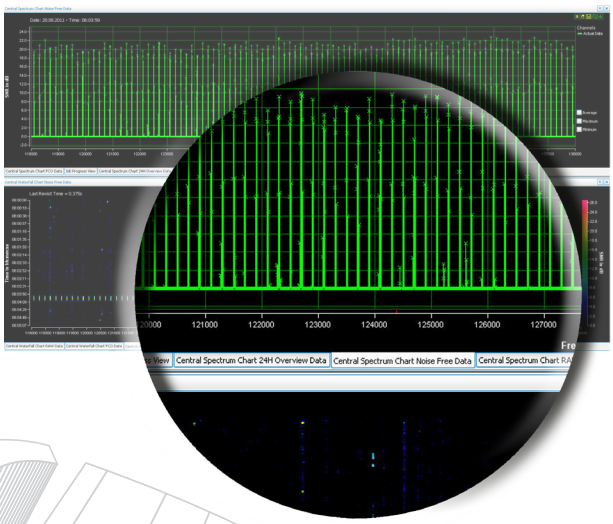
By recording the entire band or the whole spectrum you can review any part of the band and any channel whenever needed, unlike systems which require a band or channel campaign to be set up in advance. You can display data from any time range that the LS OBSERVER measures - historical or real-time measurement data.

With the help of geo-location through TDOA (Time Difference of Arrival) or POA (Power on Arrival) you can also identify the location and thus the source of interference. If interference is caused by an aeroplane for instance, you can determine its position and then correlate this data with radar data of the air traffic organisation or the transponder data of planes and you can eventually determine the flight number and the carrier within minutes of the data fusion.

In addition, with historical measurement data over a long period of time, you can guarantee that any newly assigned frequency to an airport is absolutely safe from interference from existing systems.



Picture 1: 24-hour Frequency Channel Occupancy over interfered ATC band by broadband interferer



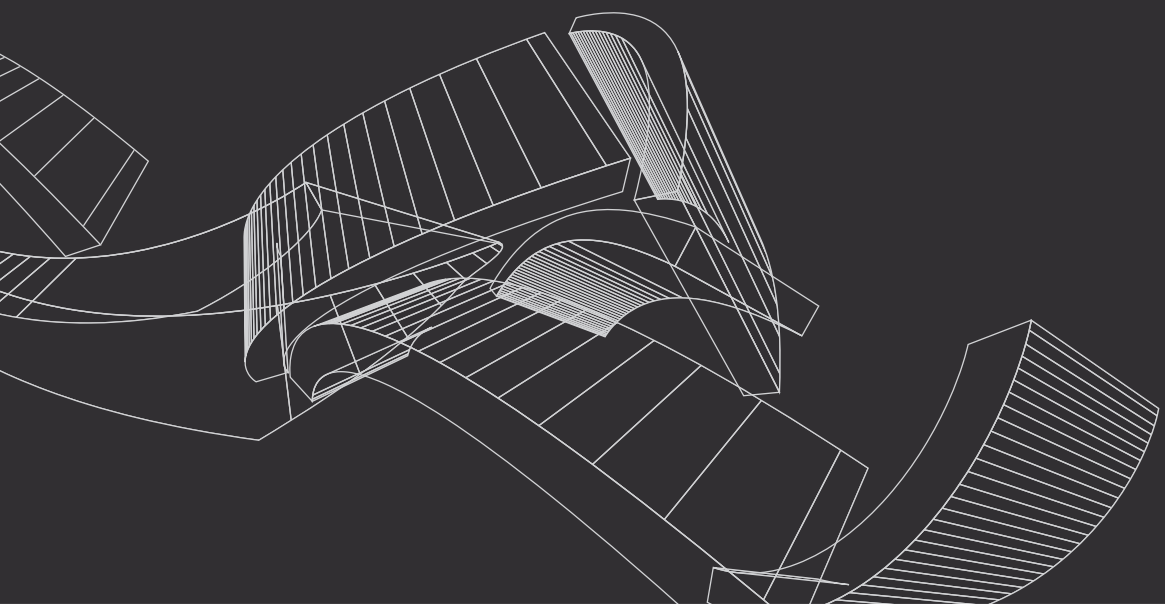
Picture 2: 12 seconds interference caused by a damaged VHF air-to-ground-communication system on board of a plane blocking the whole ATC band

LS OBSERVER for Security Organisations

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 unauthorised frequency use, such as for RCIED (radio controlled improvised explosive devices), bugs and illegal transmitters. In case of sudden unauthorised frequency use the operator can take immediate action against the potential security threat.

LS OBSERVER can also be applied to fill a database of frequencies used in a certain area, which will be the base for continuous future frequency usage control.



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 (IED), if you don't know who is emitting and where from?

As a spectrum manager

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

As an area frequency coordinator (AFC)

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

Real-time monitoring and measurement of spectrum is indispensable for many military operations to guarantee impeccable data quality in the database, optimised 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 IRS (intelligence and reconnaissance systems). LS OBSERVER smoothly interfaces with 3rd 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 unauthorised, enemy and underused frequencies. Reports for all command levels can be generated automatically (Please also see our military brochure).

Understanding the LS OBSERVER System - in Detail and in Depth

How does it work?

From the radio frequency front end with LS OBSERVER you can “observe” the complete frequency range and carry out detailed analysis on raw spectrum observation data that is stored for about 30 days. The system then automatically compresses and stores the entire observed spectrum throughout the tuning range of the attached RF front end, while noise and zero occupancy are removed. In the standard version of LS Observer, compressed data is saved in the RMU for up to two years.

Intelligent software will sort out the necessary information and only the data required for analysis is transferred from the radio frequency unit (RMU) to the central server. You can retrieve exactly the data you need with the help of search filters. This is why only little infrastructure is needed to connect to the RF front end device. In addition, the transferred data is stored on the central server and, if needed once more, does not have to be retrieved again from the monitoring unit.

This method saves huge costs on the backhaul infrastructure between the RMUs and the CMU, and opens up a large number of possibilities for RMU locations.

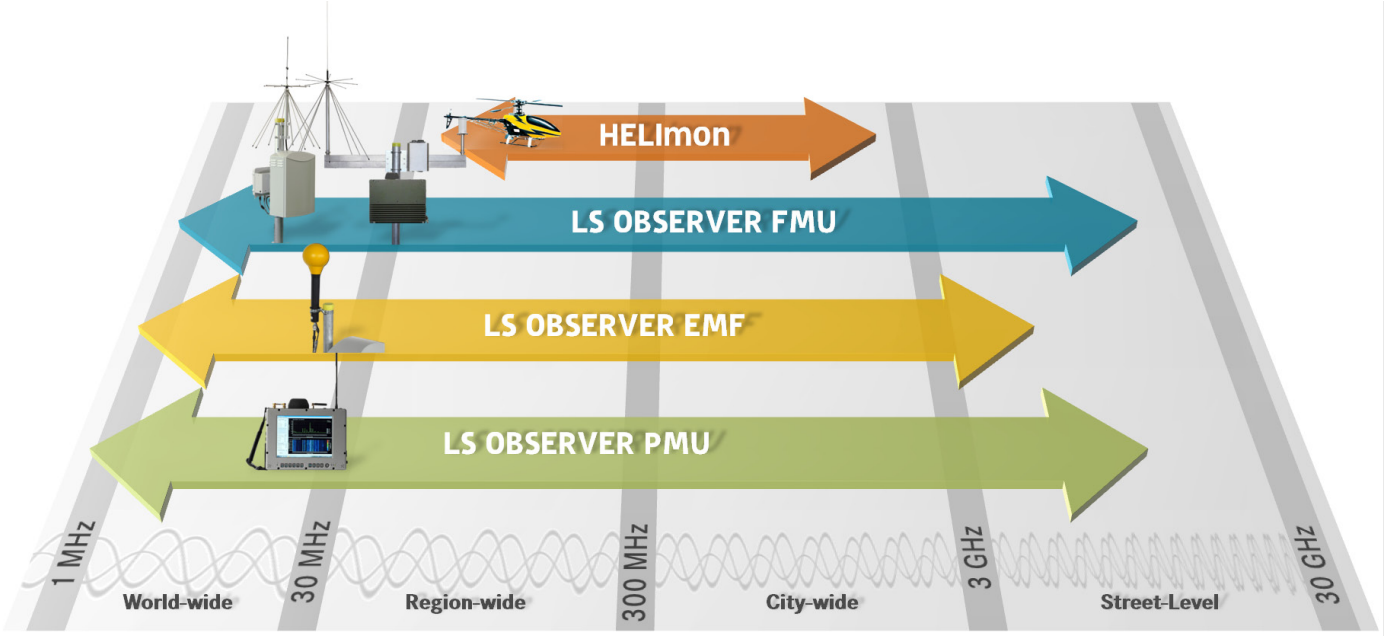
ITU compatible

The LS OBSERVER next generation monitoring hardware and software solution is fully compatible with all the monitoring guidelines and recommendations in the ITU spectrum monitoring handbook.

For More Flexibility Various Monitoring Stations are Available

Fixed, Mobile, Portable, Handheld and Flying Monitoring Devices

Fixed, Mobile, Portable, Handheld and even flying monitoring devices are available with LS OBSERVER for various applications. Different instances of these devices can cover the full frequency range from 1MHz to 40GHz, depending on the receiver front-end. The fixed stations can accommodate several receivers and can thus cover a larger frequency range at the same time.



Fixed Monitoring Devices

Unlike traditional heavy and bulky monitoring stations, LS OBSERVER RF front end devices 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.

This means that many more site locations can be considered for their installation, including, for example, 3G or 4G sites, too. Only two people are needed to set up the LS OBSERVER device whereas an installation team is usually needed to install a conventional monitoring station.

There are two fixed stations available.

The fixed monitoring station LS OBSERVER FMU 100 is suitable for long-term outdoor monitoring and EMF measurements in cities where dense coverage is needed. It has about the size of a public letterbox and can take one internal and one external receiver, such as two scan receivers or one scan and one TDOA receiver. It withstands all kinds of weather.

The fixed monitoring station LS OBSERVER FMU 200 is a very robust device and with the size of a compact suitcase (H 32cm x L 42cm x W 16cm) and a weight of 12-15kg it can be easily mounted wherever you need it. It can be fitted with two internal and several additional external receivers. Its shock, water and dust resistance (protection class IP65) makes it deployable in many circumstances. It functions on moving vehicles, under a large range of temperatures and finds multiple applications in the military.

LS OBSERVER FMU2

LS OBSERVER FMU1

LS OBSERVER PMU - Take it with you Wherever You Go

The LS OBSERVER PMU is the smallest monitoring unit available with the LS OBSERVER System. It can be used as handheld, mobile or portable unit and includes a user screen for measurement results display. It allows you to measure, analyse and store measurements within a wide range of frequencies from 9kHz to 4.3GHz or from 100kHz to 12GHz. It is used in applications for field measurements, medium- and long-term surveillance of EMF hot spots and the detection of white spaces. The unit supports a wide range of add-ons such as removable battery and hard-disk. Accessories such as tripod, cables and portable antennas are also available. The LS OBSERVER small and smart sensors can be remote controlled and can run in stand-alone mode 24/7. It functions in the heat of the desert as well as the freezing cold of the arctic.

Flexible Connectivity of Remote Sites

The backhaul connectivity between RMUs and the CMU can be scaled to use whatever resources are available, from low bandwidth PSTN or VSAT connection up to high bandwidth point-to-point links. No longer do you need to base your decisions on where to place a station on the connectivity available locally. Moreover, as there are no special mast or other site requirements, sites can be relocated easily and cheaply. Therefore, you can quickly place mobile and temporary stations, due to the low power and network connectivity required.

Use your own stations

With LS OBSERVER you can also integrate your existing monitoring stations, regardless of the model, make or manufacturer. You may also source stations from any third-party provider and we can integrate these into the LS OBSERVER system.
Being vendor neutral enables us to offer a mix of different monitoring equipment which is most adapted to your requirements. Our experienced team can assist you in determining the number of stations you will need and which type of station to select for which application.

Monitoring with Unmanned Aerial Vehicles (UAV)

Our flying monitoring platform HELImon consists of a remote-controlled unmanned helicopter with an integrated monitoring device, the LSXsensor.

- For the military — The flying monitoring unit can measure frequencies in areas which simply cannot be reached through fixed, handheld or mobile monitoring devices. For the military, HELImon can be extremely useful in flying behind enemy lines or other “out-of-reach” locations to monitor and analyse enemy frequency use for better own and friendly forces frequency allocation and for more targeted jamming.
- For VIP Protection — It can also be used in VIP protection for ad-hoc monitoring exercises, when there is not enough time to set up fixed devices.

How does it work?

The sensor has a running time of up to three hours on battery power and permanent on external power and includes storage capabilities. The data can be downloaded for measurement on a PC for offline analysis, reusing the sensor straight away. You can integrate HELImon with your monitoring system already in operation, with LS OBSERVER, or use it in stand-alone mode.

The size and reach of the helicopter can be adapted according to your environment and requirements. It can be fuel-driven or run on battery for a more unnoticeable operation.

Several ways of flight control exist for the helicopter.

- If line-of-sight (LOS) is guaranteed between the pilot on the ground and the helicopter, the helicopter can be remote-controlled.
- For beyond-line-of-sight (BLOS) the miniature helicopter can either be remote-controlled by first-person view, whereby via an onboard video camera a real cockpit-view is transmitted, or through automated GPS locked waypoints.

Including a GPS receiver on the unmanned aerial vehicle allows the pilot to position it and follow it on a map.

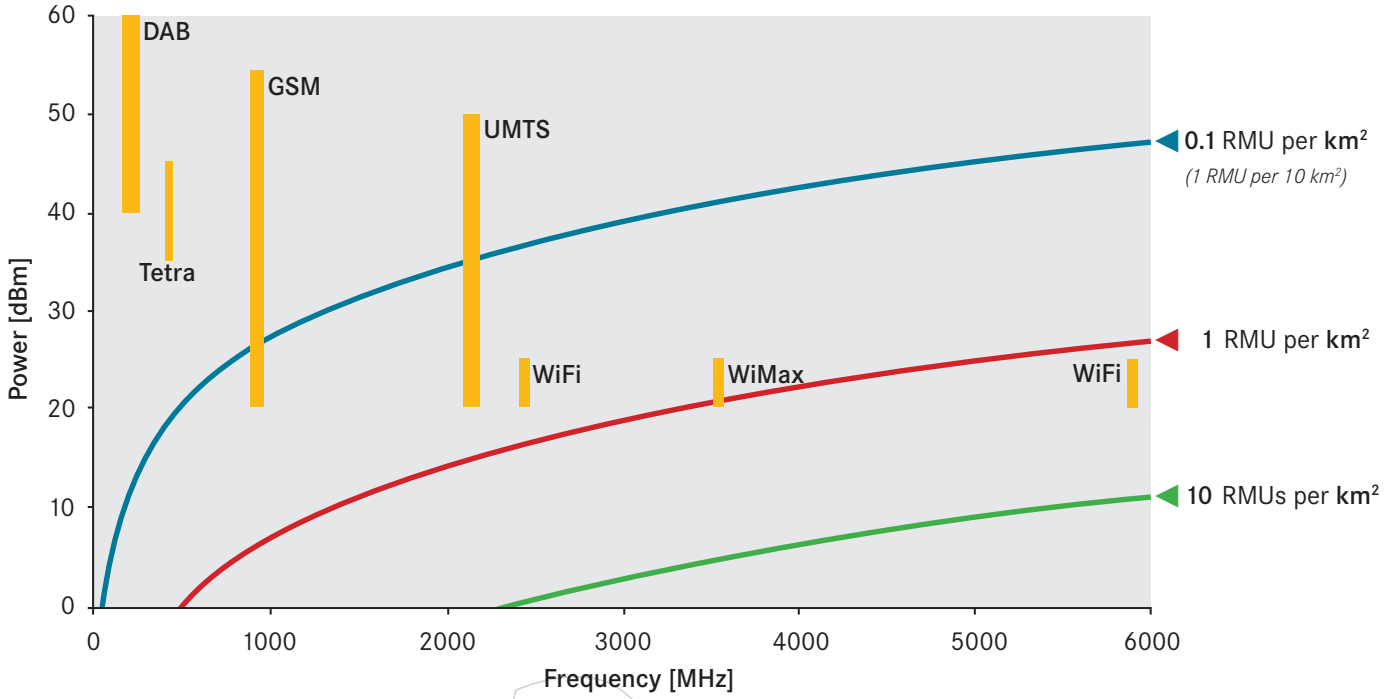
How many monitoring stations do I need?

The number of monitoring stations to be deployed will depend on several parameters, such as the service or kind of frequencies as well as the bandwidth to be measured. The number of devices needed is also subject to the landscape, i.e. urban, rural, hilly or plain country.

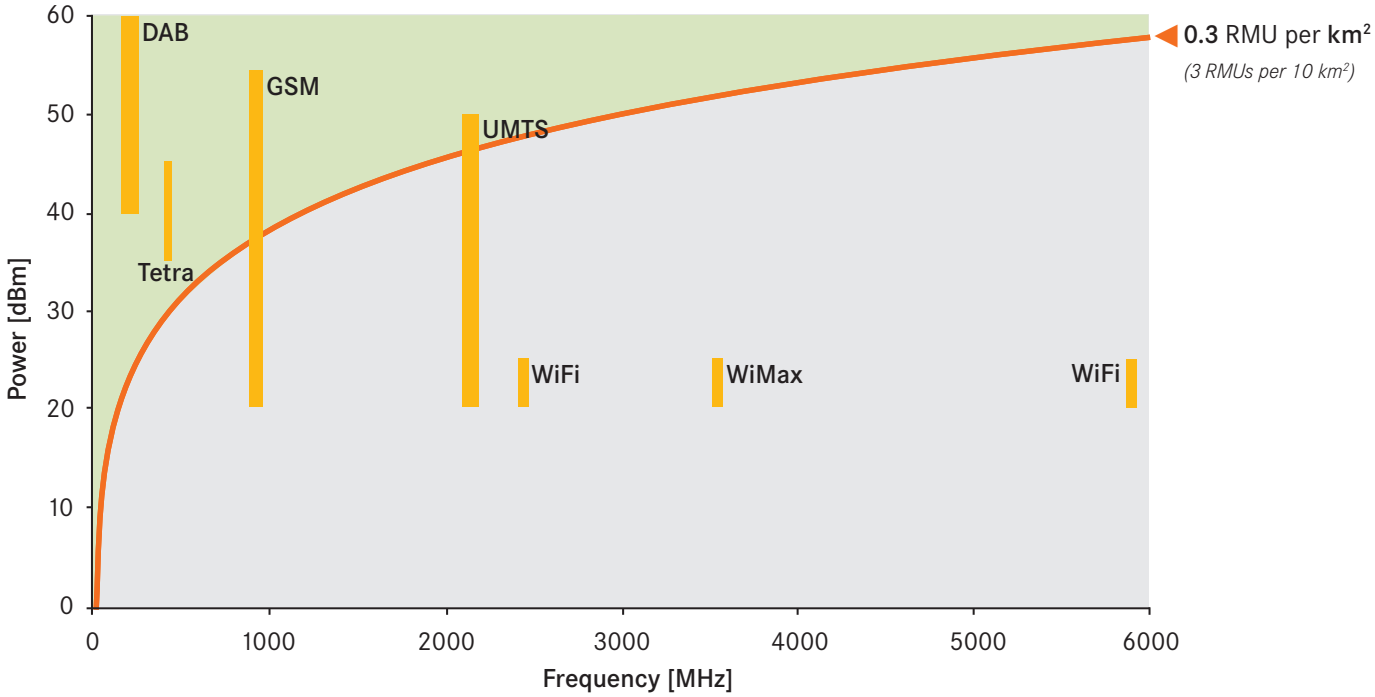
In addition, existing locations and sites as well as potential new locations for the mounting of the stations will, of course, also influence their required number.

The table below gives an example of the number of stations required depending on the frequency/ service to be measured and whether you are looking to equip an urban or rural area. The required number of stations will be higher if TDOA is involved. An unknown transmitter has to be received by at least three RMUs.

Number of stations needed per service being monitored



Typical service monitoring for a 3 station geo-location network



These diagrams are based on semi-rural topography and are diagrammatic only.

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

Planning and optimising 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 optimisation of your existing system. Our software considers existing sites and finds the optimal balance of re-used sites, coverage and number of monitoring stations needed.

Brief Overview of the LS OBSERVER System

Remote Monitoring Network

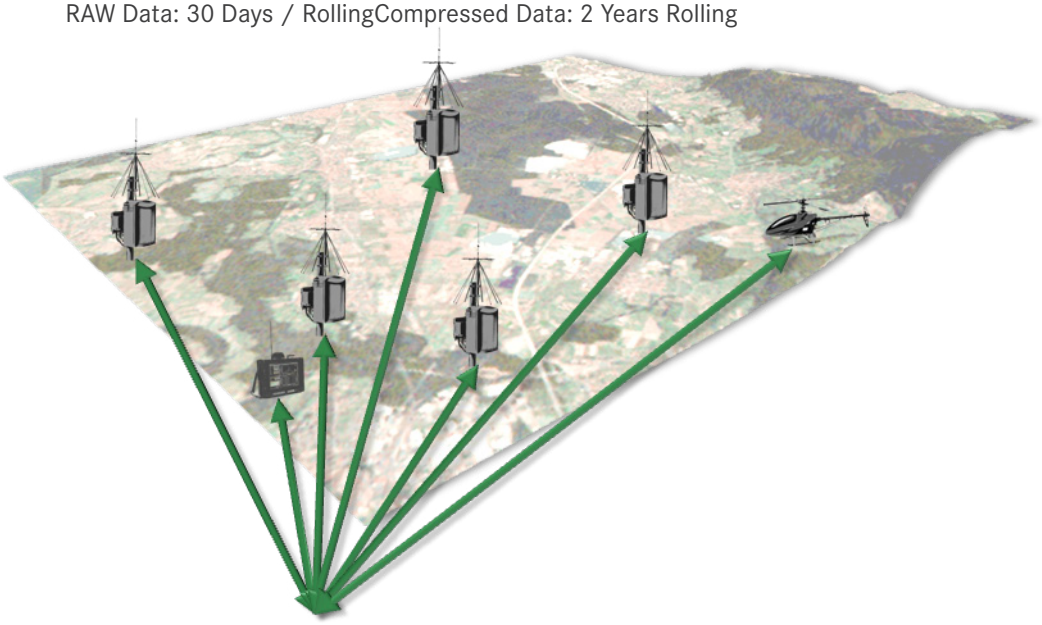
Fixed Monitoring Unit

Portable Monitoring Unit

Flying Monitoring Unit

Including 3rd party radio frequency front end, depending on requirements (frequency range, applications, such as EMC probe, EMF,etc.)

Local Processing
RAW Data: 30 Days / RollingCompressed Data: 2 Years Rolling

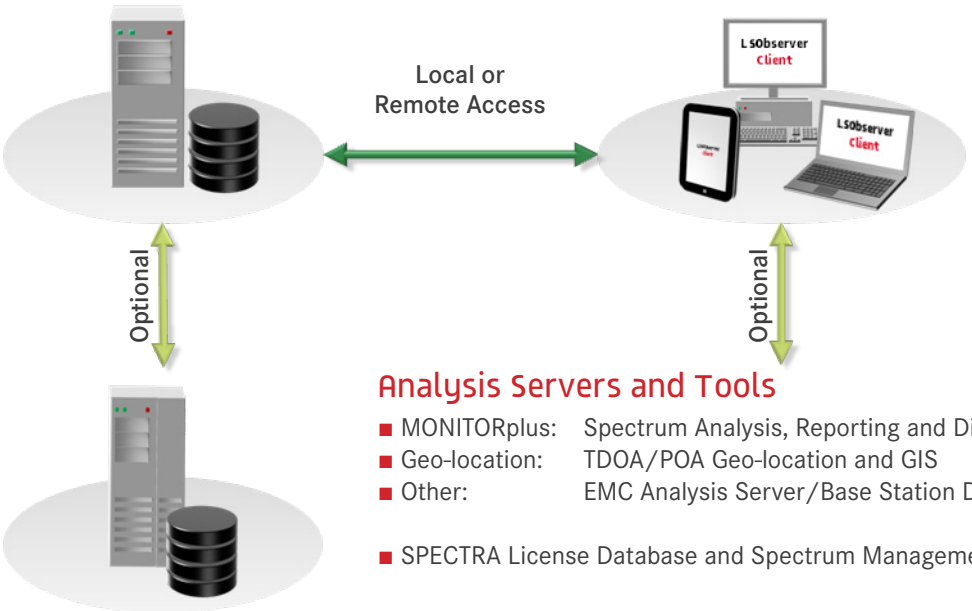


Central Management Unit

- Network Management
- Access Control
- Profile Management
- Storage of Previous Data Requests (can be Back up of RMU)

Client

Spectrum Analysis Display



Analysis Servers and Tools

- MONITORplus: Spectrum Analysis, Reporting and Display
- Geo-location: TDOA/POA Geo-location and GIS
- Other: EMC Analysis Server/Base Station Data Server

- SPECTRA License Database and Spectrum Management

The Remote Monitoring Unit (RMU)

The remote monitoring unit (RMU) of LS OBSERVER consists of the third-party radio frequency front end, the intelligent software for data compression and analyses as well as the data storage system. The front end receiver(s) can be chosen depending on the frequency range to be measured and the respective field of application such as monitoring, EMF analysis, EMC probes or location determination via TDOA.

The RMU software prepares the data for compression by removing noise and zero occupancy. On the data storage system, the raw data is stored for about thirty days and the compressed data for up to two years.

The Central Management Unit

The Central Management Unit provides network management and access control functionality and serves to set the profile management tasks. It stores all previously retrieved data and can also function as a back-up for the RMU data.

Client Access

The client access is a laptop or desktop PC or Windows tablet for the visualisation of spectrum monitoring and analysis results.

Analysis Server and Tools

The LS OBSERVER System can be connected to the spectrum management system SPECTRA or any other third-party system via the MONITORplus interface as well as to other third-party geo-location, EMC analysis server and tools.

Key System Features

General Features

- Flexible configuration, including redundancy capability
- Re-use existing monitoring equipment
- Scalable to customer's requirements
- Easy to install

Special Features

- Powerful automated analysis capability
- Flexible resource prioritisation control
- Long term monitoring data storage
- 24 hours a day 7 days a week total spectrum storage
- Up to 7.5 GHz per second spectrum monitoring

Sites

- Very few site requirements; only low power and thin back haul network connectivity necessary
- Small footprint installation
- Vehicle installation and mobile monitoring
- Integration of geo-location capability

Network Management

- Central network management & centralised configuration of remote units
- Central backup capability
- Managed security access

Integration & Interface with Other Systems

- Integration with LS telcom back office products
- Export of data in ITU formats
- Able to import legacy data

How do I implement LS OBSERVER?

Flexible System Configuration according to Your Needs

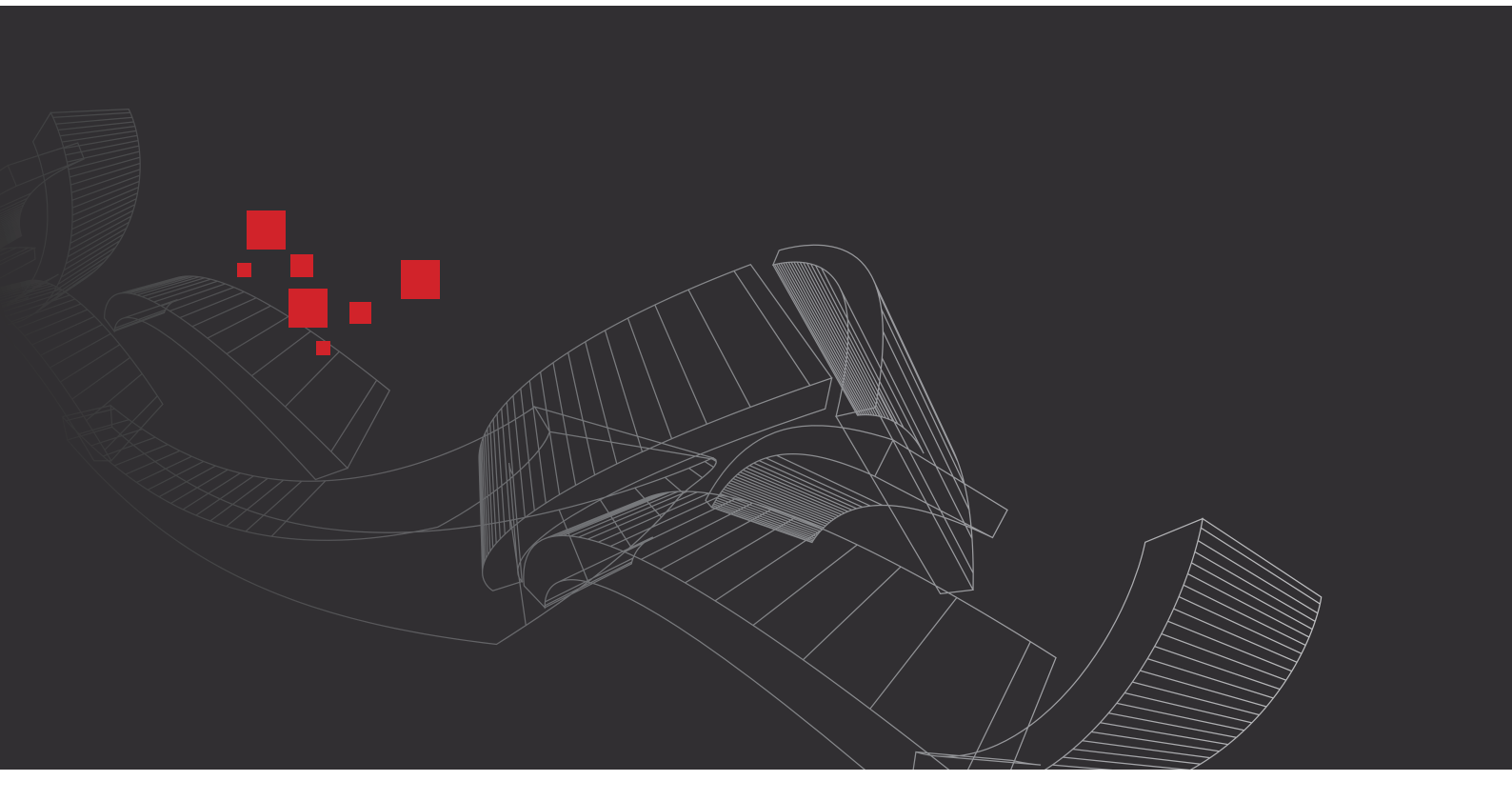
LS OBSERVER can be used as a standalone system with simple single user access for direct user interrogation of monitoring units or in a fully redundant virtualised server environment. The central management unit manages all attached remote monitoring units' health, configuration, security and network availability. The server-client architecture allows for integration of both desktop and remote users on either fixed or wireless connections.

There are various possibilities to implement LS OBSERVER depending on the monitoring objective, budget and systems already in place.

The table below gives an overview of potential implementations:

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
• Integrate the complete LS OBSERVER system (as stand-alone or networked system) into your existing spectrum management system • Integrate third-party monitoring units with LS OBSERVER and your existing system	We combine LS OBSERVER with your existing systems for automated comparison of licence data in the database and monitoring data; the basis for permanent spectrum inventory and spectrum usage optimisation.	Integrate LS OBSERVER with your existing monitoring system to automate data compression, storage and analysis*
Get a real historical picture of spectrum occupancy		
Get a single view of the spectrum		
The foundation for spectrum inventory Better spectrum planning and allocation		

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




LS OBSERVER

"Why should I monitor with LS OBSERVER?"

"We already have a monitoring system, but we would like to use LS OBSERVER"

"You can integrate your existing monitoring system in LS OBSERVER."

"We need an integrated solution for spectrum management and monitoring for instant comparison of monitoring data with data in our licence database."

"Intertwine your spectrum management and monitoring activities by combining LS OBSERVER with our SPECTRA Spectrum Management System for ultimate efficiency in spectrum management, spectrum allocation and use."

"Will I be able to afford LS OBSERVER?"

"Yes. You can start small and grow the system at your own pace and budget. Your advantage is that LS OBSERVER monitoring stations run on very low power and low bandwidth connectivity and there are few site requirements."

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