LS telcom
Smart Spectrum Solutions

Unleashing the Full Potential of Your Radio Spectrum

Global Spectrum Experience

Spectrum Regulation

System solutions for spectrum management & monitoring, spectrum consulting & engineering, training

LS telcom Worldwide

LS telcom subsidiaries and offices

LS telcom provides world-leading system solutions for spectrum management and radio monitoring, spectrum consulting and capacity building services

Our solutions enable regulatory authorities and other spectrum users to manage the radio spectrum in an optimal and cost-efficient way so that everyone receives the best from communications services.

Founded in 1992, LS telcom draws upon nearly 30 years of experience in the radio communications market. Over that period, LS telcom, an ISO 9001:2015 certified company, has become a member of many industry associations and organizations and cooperates with leading technology universities. We are also an active sector member of the ITU-R and ITU-D. This ensures we are up-to-date on market and technology developments, standards and regulatory practices.

We are pushing for innovation on all fronts. We were the first company to:

- develop a fully integrated web-based e-licensing solution in spectrum management and apply professional workflow engines to automate process flows in spectrum management,
- enable direction finding and geolocation based on historical measurement data,
- apply the techniques of data mining to spectrum management and radio monitoring.

Today, regulators in over 100 countries worldwide rely on our significant investment in research and development and trust in our products, skills and experience.

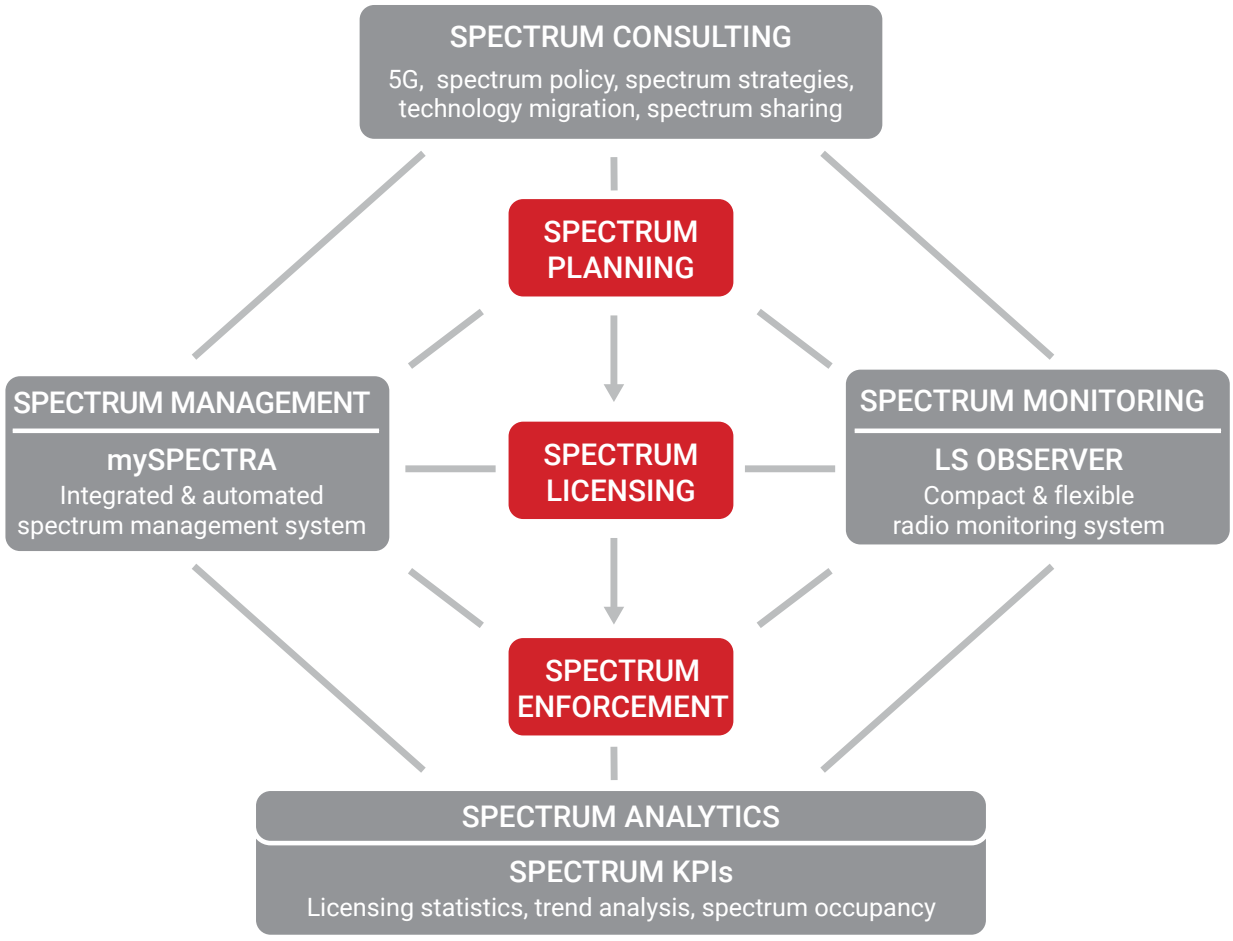
LS telcom is headquartered in Lichtenau, Germany, and operates worldwide with subsidiaries and partners on all continents.

From the right spectrum strategy to spectrum efficient operational processes

LS telcom assists all spectrum users, including government ministries and regulatory authorities, with strategic and operational spectrum management. In order to enact efficient operations in spectrum management and radio monitoring, regulators first have to define their goals for spectrum allocation, assignment methods, and pricing policy. Our consulting experts assist regulators with spectrum strategy, master planning, sector policy development and renewal, pricing, demand assessment, guideline development and technology planning.

When defining operational processes, we deliver value through integrating spectrum management and spectrum monitoring. Instead of delivering isolated solutions for spectrum management or radio monitoring, we deliver combined systems that can provide a unique view on licensed, used and under-utilized spectrum.
Monitoring data supports efficient licensing, re-farming and spectrum policy making. Spectrum management data is the basis for more precise monitoring to answer questions such as "Is the licensed spectrum really in use in a particular area?"

Spectrum management and radio monitoring systems store and handle terabytes of data, which begs the question "It's all at hand, but how do we exploit the data to its full potential?"
Our advanced techniques for data mining and analysis leverage huge volumes of spectrum data in a purposeful way. The data can be displayed in many target- and task-oriented ways, so that it can be interpreted by anyone familiar with the radio spectrum – be they management, business analysts, policy makers, engineers or administrative staff.

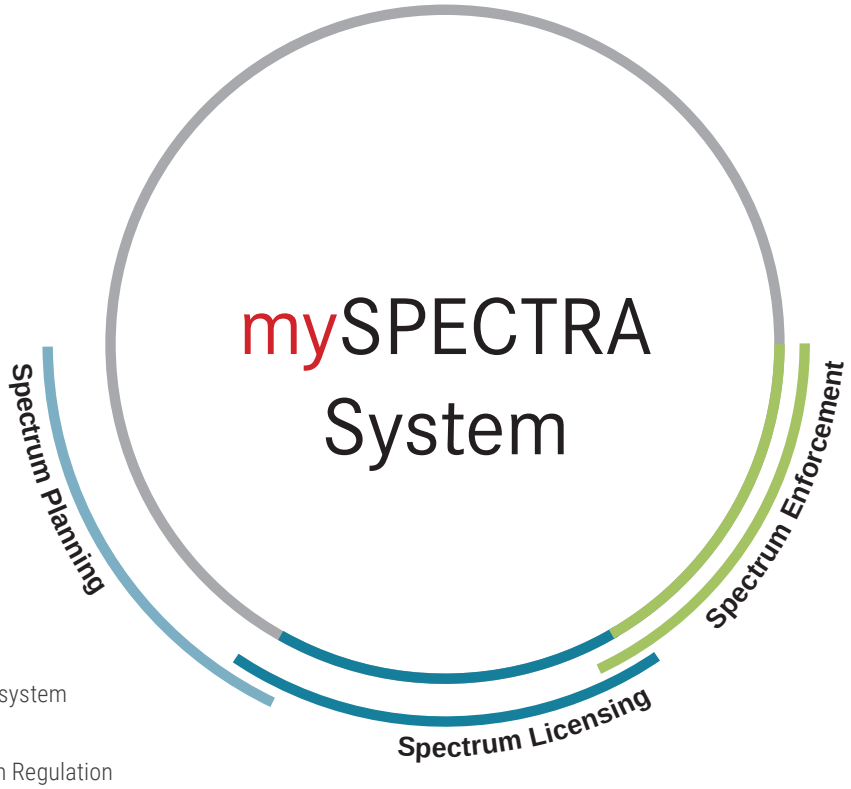


Integrated and Automated Spectrum Management System mySPECTRA

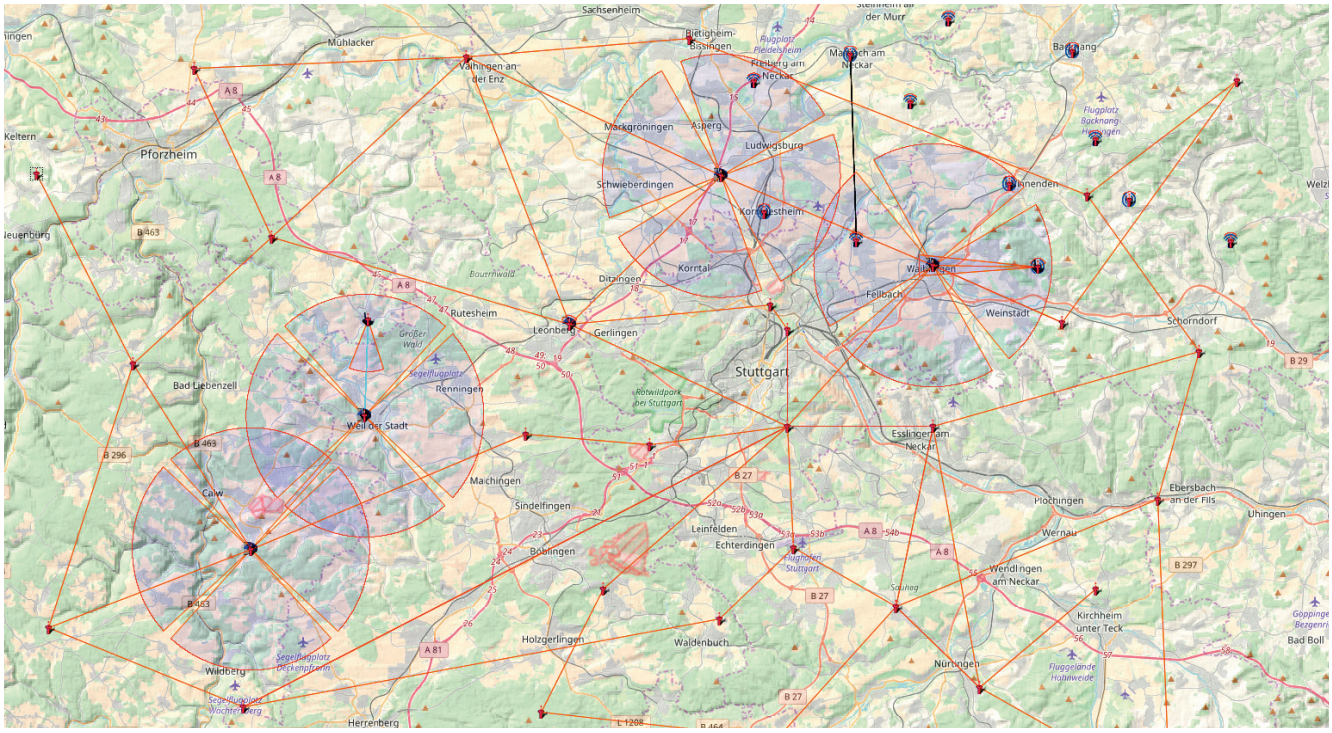
The highly innovative enterprise IT System mySPECTRA is an end-to-end spectrum planning and licensing solution based on a professional workflow engine

Its fully automated workflows guide the user through all the processes of spectrum management, from receiving applications, frequency assignment, international coordination, to issuing licenses, all the way to keeping check on the receipt of payment.

The central data repository stores the mandatory frequency and licensing information for all radio services for instant and easy access by regulatory staff.



The mySPECTRA system



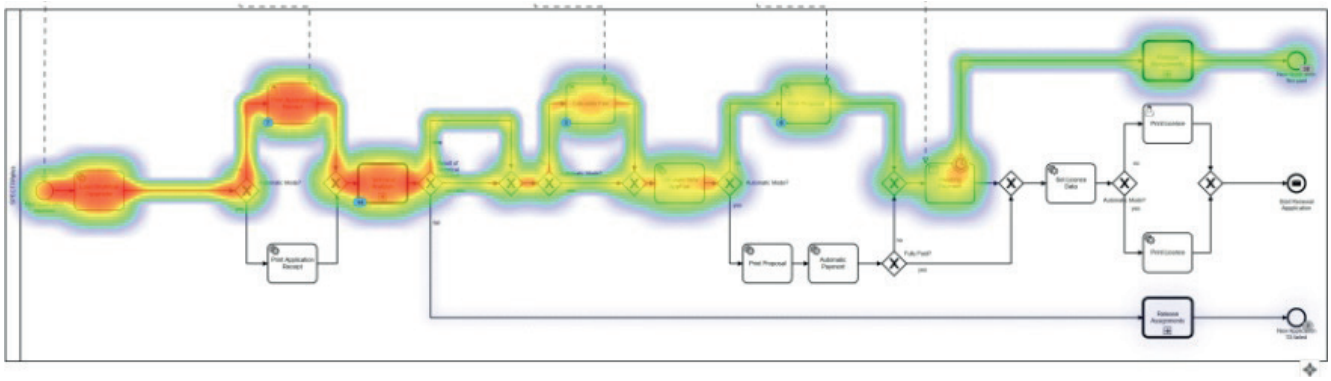
Graphical display of radio links

Regulators face continuous pressure to issue more licenses and reduce license issuing periods to a minimum, as license applicants expect prompt replies to their applications

mySPECTRA handles the increasing number of incoming applications and the associated data volumes with ease and brings structure and clarity into all spectrum management processes.

A lot of different licenses of all types of radio services follow their way through the web-based system automatically and solicit action from the user only when necessary. Workflows automate and streamline the handling of the numerous licensing products in a regulator's general service-catalog. Users are guided through complex processes to ensure consistency and compliance with national regulatory laws.

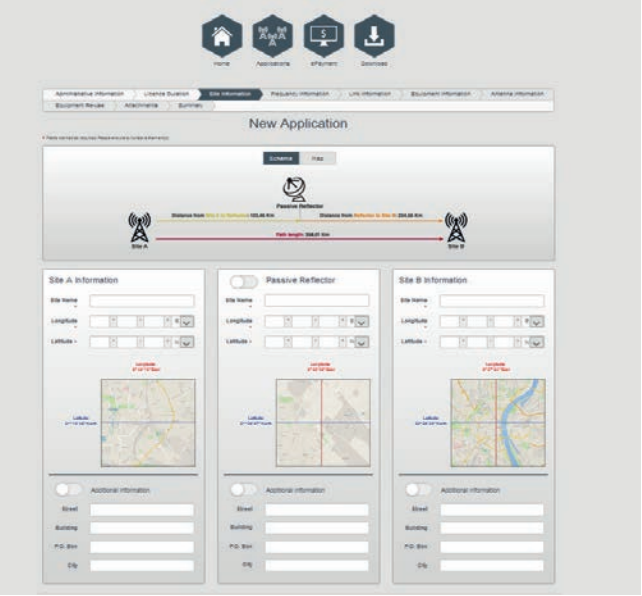
Visualization of workflows: „heatmaps" show bottlenecks in operational processes



Applicants can log in to an online license portal to trigger their license request and manage their profile and application data

They can apply for a new license, amend, renew or cancel an existing one and may view online the status of the application being processed.

Once the application (or renewal request) is submitted, it follows predefined workflows until the receipt of the license and request for payment.

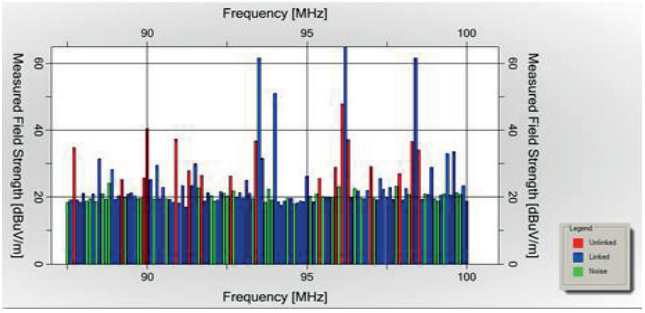


Online licensing portal

Automation of spectrum management processes

There are dedicated workflows available for administrative spectrum management processes such as application, license and invoice processing but also for technical spectrum management processes such as frequency assignment, coordination and notification processes.

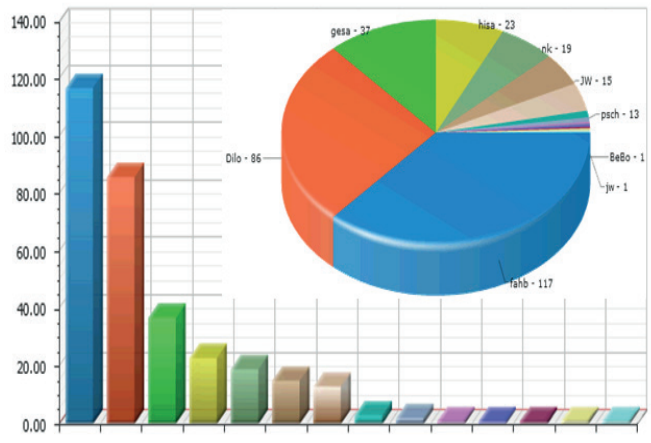
Furthermore, mySPECTRA bridges the gap between spectrum management and radio monitoring. It correlates license data with measurement data to optimize spectrum assignments.



Correlation of license and monitoring data

mySPECTRA brings regulators to the next level when it comes to data and trend analysis

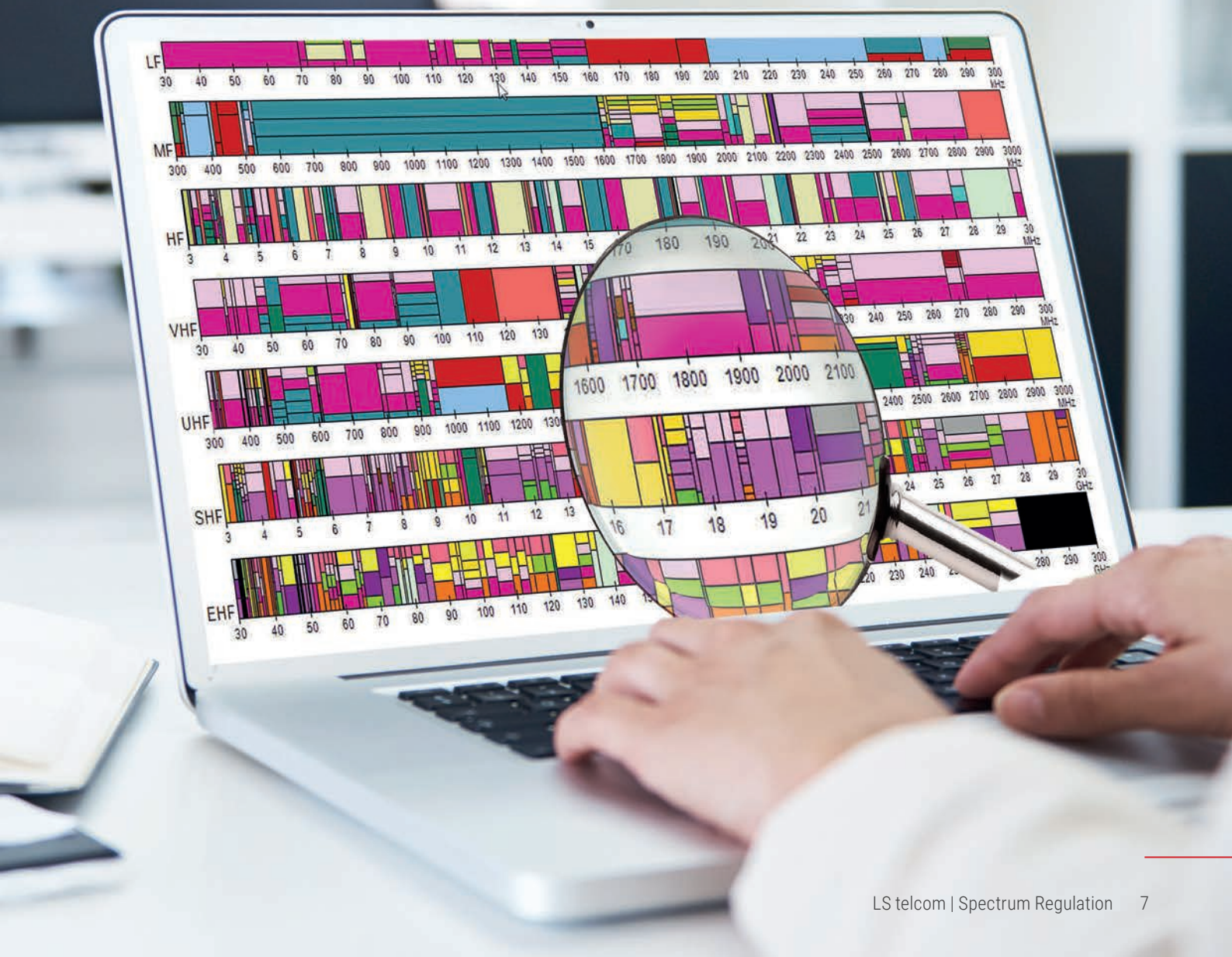
What is the number of license requests per year? How do the figures evolve over time, with the introduction of a new service? How does the licensing revenue evolve? How do I optimize fee calculations? mySPECTRA enables regulators answer these questions by configuring their reports for detailed analysis and by extracting key performance indicators (KPIs) to plan ahead.



Key performance indicators

mySPECTRA:
a host of features and benefits

- Increased user-friendliness through intuitive data entry masks and data management
- Improved data quality through data completeness and plausibility checks
- Open interfaces to ensure smooth data exchange with third party systems
- Workflow-based business processing for consistency in licensing
- Higher operational efficiency through automated frequency assignments, coordination and notification
- E-licensing platforms allowing license applicants to enter, modify or cancel their applications online
- 24/7 access to application and license data
- Spectrum analytics for improved decision making



Compact and Flexible Radio Monitoring System LS OBSERVER

Data collection, data storage & data analysis

Many regulators are dealing with policy making for 5G and IoT these days and spectrum allocation is becoming more complex. Regulators need to know now more than ever, whether the assigned spectrum is really in use and if it is used in the optimal way.

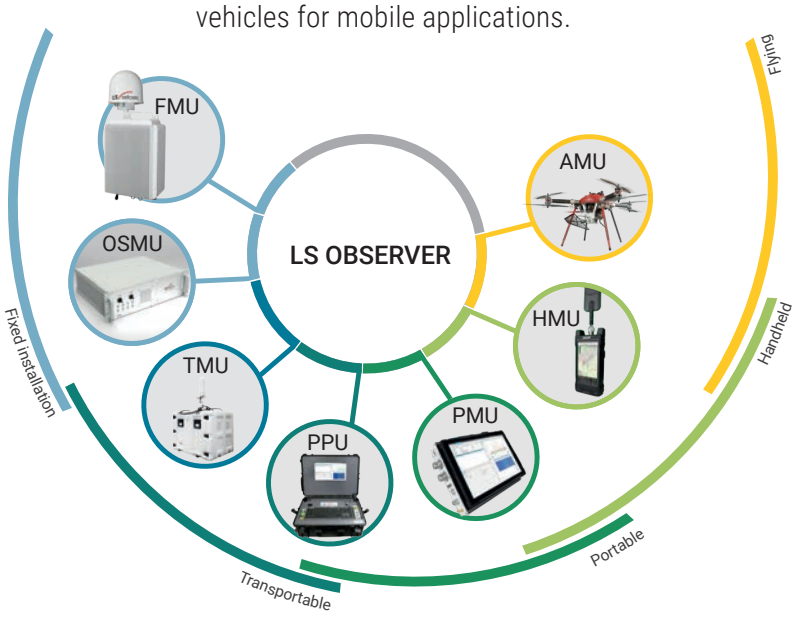
LS OBSERVER supports you in your day-to-day business and on a strategic and operational level. LS OBSERVER promptly delivers the data you need for complaint management and enforcement, and is your foundation for evidence-based regulation and policy making.

LS OBSERVER is a radio monitoring, intelligent data collection and analysis system. It features uncontested data storage capacities and several geolocation and direction finding techniques.

The LS OBSERVER system consists of the central monitoring software and various types of remote monitoring units.

The central monitoring software controls the monitoring stations and is the hub where all data strings come together. The software analyses the data from all the monitoring units and correlates the measurement data with the licensing data. Automatic violation detection, geolocation, direction finding and all other results are displayed and visualized with the software.

Each remote monitoring unit is an intelligent system, which consists of one or several receivers that can perform radio monitoring and direction finding in parallel. Each unit also includes data processing, data analysis and long-term data storage capacities. Choose from a wide array of different monitoring units, such as handheld, portable, transportable, fixed and airborne devices. Our experts can also integrate the monitoring units into vehicles for mobile applications.



Optimize frequency use and react immediately to illegal use with automatic violation detection in LS OBSERVER

Automatic violation detection software in LS OBSERVER automatically alerts the operator, when the measured signal strength does not correspond to the reference or "wanted" signal strength at a given location. The reference signal strength that should be received by a given monitoring station is either calculated based on licensed transmitters' parameters in the spectrum-licensing database, or is extracted from historic measurement data. A logbook registers all the alerts; and emails, text messages or other events can be triggered, depending on the customer's needs.

Other criteria based on power level or bandwidth can also trigger alerts. This information can also be used to correct data in the licensing database, which may lead to an optimized overall frequency re-use.

Geolocation and Direction Finding

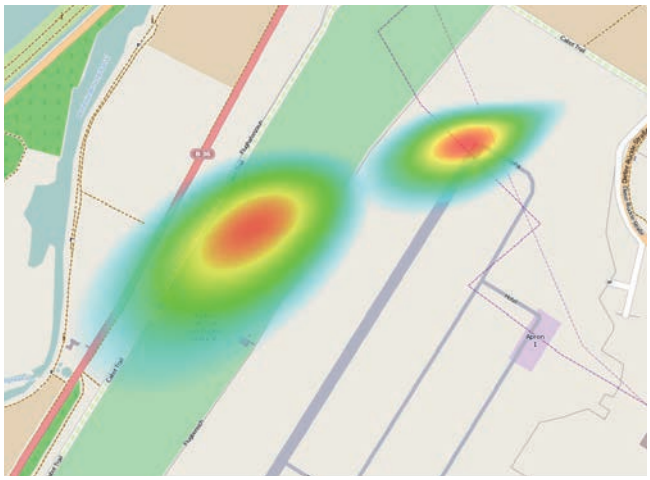
With LS OBSERVER DF Time Travel® there is no need to wait for a transmitter to go on air again in order to locate it

You receive an interference complaint that occurred an hour ago? The day before? There is nothing you can do about it now… unless you have LS OBSERVER DF Time Travel®.

DF Time Travel® is a unique technology, which enables you to locate transmitters based on recorded data. LS OBSERVER scans the radio frequency spectrum continuously and provides the required information for the unique DF Time Travel® technology. Based on the recorded frequency/level/time information, LS OBSERVER together with DF Time Travel® can determine the direction of a signal that occurred in the past. The monitoring operator simply enters the center frequency and the bandwidth of the signal to be located for a certain timeframe and is provided with the line of bearing. The system covers a much larger frequency range than other systems that provide geolocation in post-processing.

DF Time Travel® technology integrated vehicle

Cross section AoA / heatmap AoA



Multi-spot geolocation

Locate a transmitting source with even more precision by combining heatmaps based on several DF and geolocation techniques

An LS OBSERVER system containing several monitoring stations enables you to combine direction finding with geolocation. Using a hybrid direction finding approach based on both power difference of arrival (PDoA) and angle of arrival (AoA) will guarantee even better results.

Our heatmap and multispot AoA take into account reflections and the possibility of several signals being on the same channel. The overlapping of different direction finding techniques allows the consideration of both the main beam and side beams too. The joint display and visualization of beams and heatmaps provides a more accurate and more precise location of transmitting sources.

Integrate inspection processing with your monitoring units

A dedicated Inspection App for Android devices facilitates inspection processes. The inspection plan is directly loaded into the App. Inspection measurements and documentation can be entered in a highly user-friendly environment. Violations are detected and documented on the spot and send back to the central spectrum management and monitoring system.

Inspection App on a Handheld Monitoring Unit

With our unique set of intelligent monitoring hardware and software products, regulators can

- Measure the complete frequency range on a permanent or temporary basis wherever needed
- Store all the measured data and have it available whenever needed
- Identify interference and locate transmitters at any time; even when the transmitter is no longer on the air
- Analyze huge amounts of data for the purpose of spectrum re-farming, evidence-based spectrum policy making and regulation
- Visualize the data in a clear manner, understandable for everyone in the regulator's organization

Data Mining, Big Data Analysis & Data Display

SpectrumMap™ for top level strategic decision making

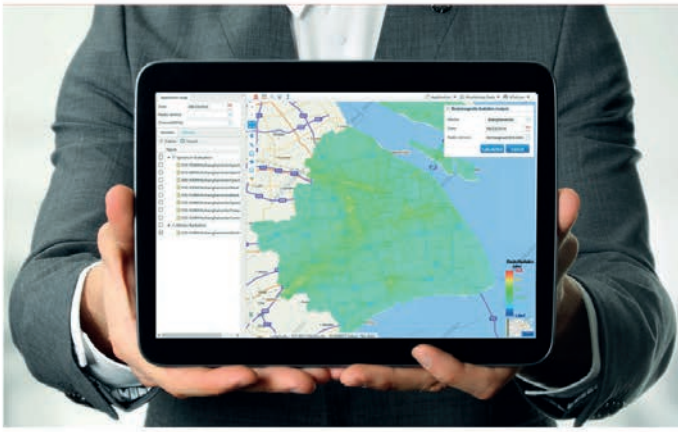
SpectrumMap™ is a cloud-based data mining and analysis system, which gathers real spectrum usage data from multiple sources, such as fixed monitoring sites, mobile, handheld and portable devices, no matter from which provider or manufacturer.

The easy to use interface allows staff not qualified as engineers such as policy makers, band planners, licensing teams, as well as skilled engineering teams, and enforcement, to use a range of analytical tools via web apps. Users can zoom in on a map and display the monitoring data in a way that makes sense to them. The data can be visualized for the area of interest by band, channel or service type.

Key applications, which are available as web apps, include:

- Field strength of single frequencies to whole bands for all users
- Selectable coverage analysis of user selectable bands
- Band occupancy
- Spectrum utilization
- Electromagnetic radiation hazard analysis
- Dynamic band analysis where the display steps through user selectable frequency steps

In contrast to conventional monitoring system control tools, SpectrumMap™ focuses on presenting the data in a geographical area rather than needing to identify monitoring sites and individually calculating the coverage of each site. The system interpolates results between measurement points for complete and accurate coverage. It offers new and exciting opportunities for regulators to take fast, effective and well-informed decisions on spectrum management.



Display of accumulated coverage measurements

Spectrum & Technology Consulting

Regulators across the world rely on our expert spectrum and technology consulting to make the right spectrum policy decisions...

...and create the most appropriate technology environments and legal frameworks for wireless services to prosper - to the benefit of everyone. Many regulators are now looking to pave the way for 5G with a sound regulatory framework. Many questions need answering: Which spectrum is, and should be made available for 5G? How will authorization for new 5G spectrum bands be made, in particular, at frequencies in the millimeter wave bands?

Regulators have to prepare for WRC-19 and beyond. Licensing options will need to go beyond the exclusive, individual rights approach, most commonly used for mobile assignments today and incorporate more spectrum sharing. Beside pricing, auctions and trading; secondary markets, licensed shared access (LSA), dynamic spectrum access (DSA) and other techniques will play an increasing role to accommodate existing spectrum users and enable new, innovative players to emerge. Many more end-user devices and different methods of interaction between devices, arising with 5G and the Internet of Things (IoT), add to the complexity of developing an efficient licensing framework.

LS telcom's consulting team guides you through the jungle of new licensing, access and connectivity methods as well as current and future technologies. We help you set up a technical and legal environment that supports national growth and greater economic efficiency.

Over the last 25 years, LS telcom has assisted over 100 regulators across the world with policy making, capacity building, spectrum strategy and planning, technology studies and spectrum inventories.

LS telcom is already assisting governments and regulators with developing their spectrum policy and regulations towards 5G. For example, we have assisted the UK government with a report on 5G infrastructure requirements, and undertook a project that examined approaches to spectrum assignment in the EU with a view to enabling the future availability of 5G. As a member of the UK's 5G Innovation Centre (at the University of Surrey), we are at the leading edge of 5G developments.

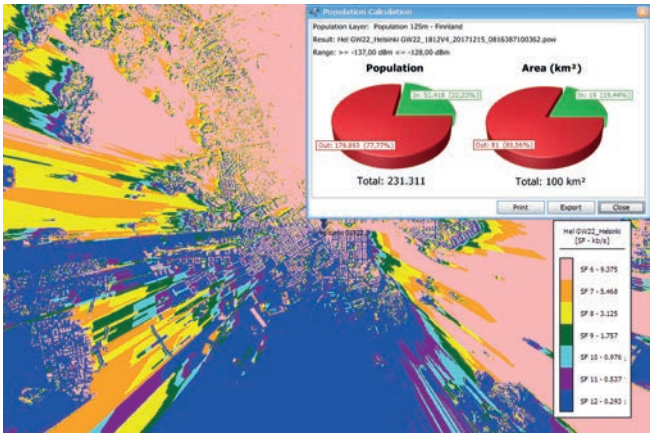
While the drive for spectrum efficiency is global, the answers and solutions for efficient spectrum use vary from country to country. As a member of the ITU, we have unrivalled visibility of global developments and at the same time, we draw upon our huge "case-by-case" experience having worked with numerous regulators on all continents.

LS telcom's consultants and radio engineers assist regulators with:

- Sector policy development and renewal (telecoms, broadcasting, transport, government, utilities)
- Spectrum strategy, policy, master planning and guidelines
- Spectrum planning, re-planning and re-farming (including key bands such as 600 and 700 MHz and 3.5 GHz)
- Implementation of spectrum pricing and use of economic tools
- Assessment of spectrum supply and demand
- Spectrum and technology developments (5G, IoT and M2M, white spaces, cognitive radio)
- Technical analysis of wireless networks and network planning
- Spectrum audits and inventory
- Technology migration (DVB-T to DVB-T2, analog to digital, 3G to 4G)
- Technical sharing, spectrum re-farming and compatibility analysis
- Training and capacity building

Spectrum engineering

Technical issues remain at the heart of efficient spectrum management. Assessing coverage, compatibility and co-existence whether between national or cross-border services is essential to avoid harmful interference. More and more users are looking at sharing as a way to retain their spectrum allocations whilst encouraging new and efficient uses. But sharing brings increased risk of interference. LS telcom has always been at the forefront of spectrum technology and our technical experts routinely solve complex engineering problems; analyze, plan and optimize networks; and model costs, capacity and coverage. Our radio engineers have a vast experience of working with regulators in countries across all regions and continents.



Coverage analysis assessing population and area covered

LS Training Academy

We offer an enormous range of training courses designed for regulators and spectrum users on topics including spectrum management and radio monitoring technologies as well as spectrum regulation and policy.

Our courses address professionals at all skill levels and seniorities, whether technical, managerial, administrative or engineering.

In addition to our standard courses, we offer customized training as well as complete capacity building programs tailored to the needs of your organization. From a training needs analysis to the design and delivery of bespoke courses, LS telcom can ensure that your organization is fit and ready to tackle the increasingly complex issues of spectrum management today.


Home of the LS Training Academcy

Trust in

30

years of know-how and experience

ITU-R

and

ITU-D

sector member

An

ISO 9001:2015

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

DBA

For more information on products and solutions, please visit our website at www.LStelcom.com or contact us:

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