

ROHDE & SCHWARZ

Make ideas real



REGULATORY SPECTRUM MONITORING

Solution overview





EMPOWERING OUR CUSTOMERS TO GUARD THE SPECTRUM

Thanks to some 90 years as a reliable partner, Rohde & Schwarz knows its customers and their applications very well. For them, the company develops and implements innovative spectrum monitoring solutions that are perfectly designed to cope with new communications standards and the latest technologies. The teams at Rohde & Schwarz proactively think ahead and offer customers innovative solutions to meet their individual needs.

Rohde & Schwarz cultivates a long-standing and ongoing tradition of innovation. The company's inventions break new ground and are the basis for developing future-proof hardware and software. The evolving solutions keep pace with new trends and changes in radio communications, including increased signal density, higher frequency ranges, wider bandwidths and more complex signals.

In the field of spectrum monitoring, Rohde & Schwarz is not only the front-runner in terms of technology, but can also claim market leadership. The company possesses in-depth expertise along with a large portfolio of products and systems. As a single-source supplier with great manufacturing depth in terms of company-owned plants, it ensures high quality standards as the basis for reliable operation of its solutions. Depending on the relevant acquisition process or project situation, Rohde & Schwarz can function in the role of a turnkey solutions provider or a sub-supplier.

Alongside its activities in the field of spectrum monitoring, Rohde & Schwarz also develops, produces and markets test & measurement solutions and other electronic capital goods. This serves as the basis for synergies in numerous technologies such as 5G FR2, 6G and digital broadcast. Customers also benefit from in-house solutions in the field of EMC and cellular network analysis.

As an independent and privately-owned company, Rohde & Schwarz is not committed to any government or external investors. This allows the company to define and pursue its own strategy while sustaining the innovation process and benefiting our customers.

APPLICATIONS

Rohde & Schwarz spectrum monitoring systems help national regulatory bodies to ensure coordinated usage of the radio waves. The systems provide a solid foundation for frequency planning and assignment as well as for spectrum enforcement. They measure actual parameter values to provide authorities with information that cannot be obtained otherwise.

Rohde & Schwarz systems provide a comprehensive set of features for all applicable spectrum monitoring tasks performed by regulatory authorities. The systems allow authorities to ensure the availability of electromagnetic spectrum across the entire country. This includes hunting for radio interference, verification of license-compliant operation and detection of illegal transmitters. Rohde & Schwarz spectrum monitoring systems also support country-wide frequency planning based on measurements of spectrum occupancy and network coverage. Moreover, they can support authorities on special occasions. For example, at major sporting events or during state visits, Rohde & Schwarz systems help to ensure interference-free radio communications services.



INTERFERENCE HUNTING

For mitigating radio interference, Rohde&Schwarz offers a comprehensive toolset. The solutions allow regulatory bodies to detect, identify and locate undesired emissions. Since the sources of interference can be as diverse as the signals that are subject to interference, regulatory authorities need different systems and procedures.

Rohde&Schwarz provides fixed stations for detecting radio interference within their coverage range, transportable systems for finding locally and sporadically appearing interference, mobile units for homing in on ominous emissions, aerial systems for interference in the microwave range or in dense urban areas, and portable equipment for tracing any emission to the ultimate source.



DETECTION OF ILLEGAL TRANSMITTERS

Illegal transmitters can interfere with regular radio services, even on out-of-band frequencies. When air traffic communications or radio networks operated by emergency rescue services are affected, life-threatening situations become possible. Moreover, operation of unlicensed transmitters is not only unfair to parties who have registered their own radio equipment, but it also violates the applicable laws and regulations.

Rohde & Schwarz spectrum monitoring solutions include comprehensive features for detecting, identifying and geolocating illegal transmitters. The systems retrieve data for licensed transmitters from spectrum management databases and compare the data with the emissions measured on the air. This allows reliable detection of illegal transmitters while enabling operators to follow up with signal analysis and geolocation procedures – and ultimately, to take enforcement action.



VERIFICATION OF LICENSE-COMPLIANT OPERATION

If network operators run their transmitters beyond their licensed parameter values – whether intentionally or unintentionally – they risk creating radio interference in other services. However, faulty devices or misconfigured equipment can also lead to emissions that do not comply with the license specifications. In order to avoid harmful interference and ensure regulated usage of the radio frequencies, authorities need to detect and follow up on spectrum violations.

Rohde&Schwarz spectrum monitoring solutions can measure all parameters stipulated in the license, including radiated power and coverage of single transmitters. This allows authorities to obtain the relevant information that is needed to inform the transmitter or network operators of their limits.

Rohde&Schwarz cellular network analysis systems can analyze and survey all common standards and frequency bands used in mobile phone networks. Automatic channel detection and cell position estimation provides quick verification of license compliant operation.



OCCUPANCY MEASUREMENTS

Occupancy measurements generate valuable information for basic spectrum management tasks and especially for frequency planning and assignment. The evaluated records allow assessment of the current status of the spectrum while identifying white spaces and detecting bottlenecks in spectrum usage. The results serve to document the efficiency of the current usage of spectrum allocations.

Rohde&Schwarz spectrum monitoring systems can perform efficient occupancy measurements. They gather data about how much of the capacity in single channels and entire frequency bands is actually being used, even in mobile phone networks, where the systems scan simultaneously through all available cellular networks.

The measurements can run automatically and generate clear presentations of the results. By performing measurements at different positions and times, the systems provide a solid basis for effective spectrum sharing in all frequency bands.



COVERAGE MEASUREMENTS FOR NETWORKS

Broadcast and network operators as well as their users want the maximum possible radio coverage. For this purpose, operators create studies to help avoid blind spots, but they must also consider costs and other constraints. This fact, especially when combined with vague simulations, can result in coverage deficiencies. Furthermore, administrations may be obliged to measure the actual coverage of radio networks in order to verify the specifications that are stipulated in the frequency auctions.

Rohde&Schwarz offers systems for analyzing the coverage of entire radio networks. These systems can make measurements on analog and digital broadcast networks and even on mobile phone networks within selected areas. The systems verify the network planner's simulated propagation predictions and reveal the real quality of service (QoS) in the field. Authorities can thus gain fundamental insights into the broadcast and network coverage for the population as well as the operators' compliance with their obligations.



ASSISTANCE FOR SPECIAL OCCASIONS SUCH AS MAJOR EVENTS

Major events involve numerous personnel working for the organizer along with broadcast operators, spectators and security staff who all rely on the availability of wireless communications. Participants and broadcasters from abroad commonly use foreign radio devices that can operate on frequencies that are locally allocated to other radio services. In order to ensure interference-free spectrum usage despite the extremely high density of radio devices within a limited area, authorities provide special assistance for such events and work to carefully plan and assign the frequencies in advance. To obtain information about the actual usage of the electromagnetic environment, monitoring of the spectrum is essential – both prior to and during the event. This allows detection of interference or unlicensed emissions while enabling a fast response to mitigate any harmful radio interference.

Rohde&Schwarz systems cover the entire spectrum monitoring process needed to support such special events. Mobile or transportable monitoring stations can be used to perform the relevant measurements in advance at the venue. They can detect sporadically occurring emissions and alert authorities. On arrival, all transmitting devices used by the participants can be checked for proper operation. During the event, measurements can continue on the most critical frequency bands. In this manner, Rohde&Schwarz spectrum monitoring systems can make a solid contribution towards ensuring successful events.



ROHDE & SCHWARZ SOLUTIONS

For highly efficient operations, Rohde & Schwarz offers different spectrum monitoring stations. They can be deployed standalone or in a network, forming regional or nationwide systems. Networked stations provide increased efficiency, allowing sharing of resources while enabling geolocation of emitters. They range from compact, lightweight to advanced monitoring stations with extensive measurement capabilities, including the following types of monitoring stations:

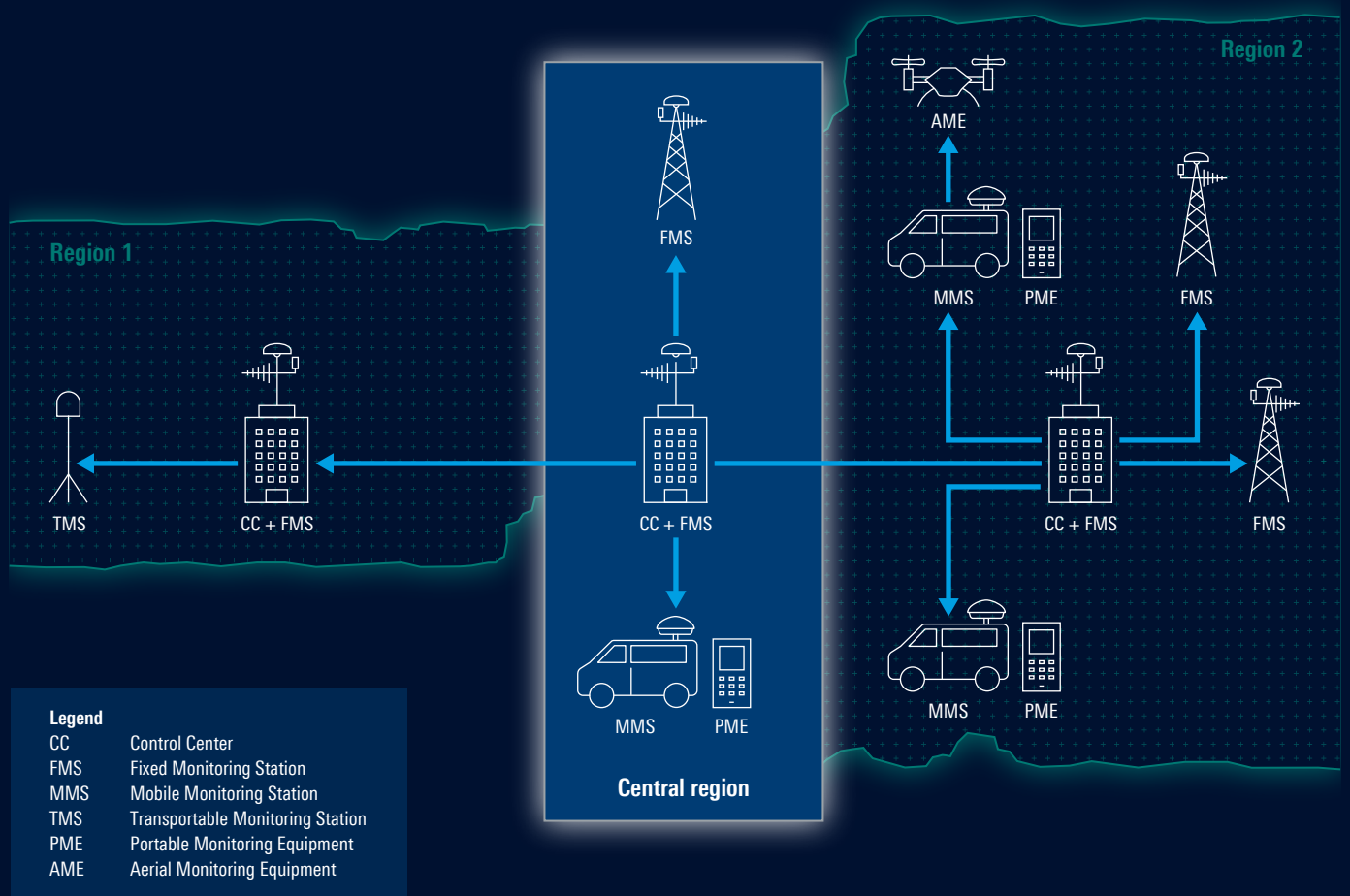
- ▶ Fixed monitoring stations
- ▶ Mobile monitoring stations
- ▶ Transportable monitoring stations
- ▶ Portable monitoring equipment
- ▶ Aerial monitoring equipment
- ▶ Control centers



Each spectrum monitoring station can be tailored to the customer's individual needs. Every type of monitoring station has specific advantages in its own application fields.

Rohde & Schwarz spectrum monitoring systems provide open interfaces to existing spectrum management systems. Moreover, the systems are modular and scalable in order to fulfill individual requirements and deliver the ultimate in investment protection.

Rohde & Schwarz solutions range from single standalone stations to nationwide spectrum monitoring systems



FIXED MONITORING STATIONS

Fixed monitoring stations are the backbone that most regulatory authorities rely upon. Typically, they can be designed with sufficient space for operators and equipment, allowing comprehensive measurements and evaluations. The stations can be attended or unattended, and they can be controlled locally or remotely, or operate automatically 24/7.

Fixed monitoring stations are usually equipped with antennas on high masts for large coverage areas. Within these areas, they can process multiple monitoring tasks. Such comprehensive systems perform direct and automatic measurements and are often the first point of action when interference is reported. The operators can then verify the interfering emission with minimal effort and follow up on the case.

Attended fixed monitoring stations are preferably equipped with high-end receivers. Many operators appreciate such sophisticated monitoring receivers due to their ability to cope with state-of-the-art signals and resolve complex interference scenarios. Their excellent RF parameters across extensive frequency ranges, combined with ultra-wide bandwidth and top signal processing performance, make them an indispensable core component of all monitoring stations.

For remote controlled stations and sites where weather protection for the equipment is not available or feasible, Rohde & Schwarz offers a product line of compact monitoring stations. These weatherproof systems are contained in outdoor housings and can be mounted without any additional shelter directly on masts underneath the antennas. This also reduces the length of the antenna cables to provide increased system sensitivity.



MOBILE MONITORING STATIONS

Mobile monitoring stations can be moved to the actual sites where measurements need to be performed. They can fill gaps and extend the range of a remote controlled network of fixed monitoring stations. The mobile units can be universally equipped for various tasks or configured for specific applications. Customers can also select different vehicle categories to fulfill their individual requirements.

Mobile monitoring stations for multi-purpose missions are usually integrated into large vans, offering a fatigue-proof working environment. They incorporate masts for lifting the antennas, thus increasing coverage. Such comprehensively equipped mobile stations are highly practical for performing all spectrum monitoring tasks.

In contrast to such general-purpose vehicles, specialized interference hunting vehicles have a direction finding antenna on the roof top. This enables the mobile station to take continuous bearings while on the move.

The interference hunting unit can home in on emitters and finally arrive at the emission source. Even portable direction finders with compact antennas installed with a magnet mount on a vehicle roof can quickly transform any automobile into a mobile interference hunter. Other specialized mobile monitoring stations can perform coverage measurements for mobile phone or broadcast networks. Further types are used to measure microwave links or are equipped for diverse spectrum monitoring applications. Different antennas, receivers and other system components make it possible to optimize the mobile units to handle specific tasks.

With decades of experience in integrating mobile monitoring stations, Rohde & Schwarz has developed mature and well-balanced integration concepts for the different platforms. Whether they are specialized to handle specific tasks or intended for universal applications, all mobile monitoring stations are meticulously engineered for efficient and safe operations in the field.



TRANSPORTABLE MONITORING STATIONS

Rohde & Schwarz transportable monitoring stations complement fixed and mobile stations in day-to-day operations. They can be deployed at any site for spectrum clearance tasks, for identifying sporadic radio interference or for other temporary measurements. The systems offer great flexibility due to their compact, lightweight design along with minimal infrastructure requirements and simple setup.

Rohde & Schwarz transportable monitoring stations can be controlled remotely and/or operated in automatic measurement mode. The systems can detect, identify and locate sporadic interference or perform preventive spectrum monitoring such as in the context of major events.

Whether defective devices, such as faulty discharge lamps, intermodulation or unauthorized transmissions, the systems can promptly detect irregularities and help to track them down. When operated autonomously, the systems can perform 24/7 radio surveillance and automatically trigger recordings and alarms or take other actions.

Thanks to their weatherproof design, Rohde & Schwarz transportable monitoring stations support complete outdoor operations. Except for an electrical power supply, the systems do not require any further connections. These minimal infrastructure requirements, combined with a large range of options and accessories, make the transportable monitoring stations highly flexible for deployment in any environment.



PORTABLE MONITORING EQUIPMENT

Rohde & Schwarz portable monitoring equipment is user-carried, lightweight, battery-powered and versatile tools that are built for field operations. They support interference hunting, site surveys and many other spectrum monitoring tasks. Portable equipment is always the right choice for the final meters of the job – as well as in locations that mobile monitoring stations are unable to access, such as in buildings or on difficult terrain.

Portable monitoring equipment from Rohde & Schwarz can detect, analyze and locate radio signals across wide frequency bands from HF to SHF. As the heart of the system, a portable receiver, available with various options, antennas and accessories, ensures high operational flexibility.

For reliable signal detection, Rohde & Schwarz portable monitoring equipment offers large bandwidths, high scan speeds and different spectrum visualizations. With parallel time domain and frequency domain analysis, the systems permit deeper exploration of the spectrum, such as the separation between wanted and interfering signals, even if they are on the same frequency. Moreover, their measurement capabilities in line with ITU recommendations help operators to investigate any prohibited deviations occurring in transmissions.

The portable monitoring equipment can be controlled directly via the receiver's keypad and display, or via a notebook for more extensive recording and signal analysis capabilities. Even without an external computer, their modern, application-oriented user interface ensures easy operation. All these features, combined with low weight and long battery life, make the systems into powerful and easy-to-operate tools for on-site spectrum monitoring and interference hunting



AERIAL MONITORING EQUIPMENT

Aerial monitoring equipment provides monitoring and analysis capabilities for wireless transmissions that are difficult to reach using conventional systems on the ground. The Rohde & Schwarz aerial monitoring system was designed for monitoring microwave links. For such measurement tasks, aerial monitoring systems facilitate operations and can save considerable time.

Rohde & Schwarz aerial monitoring systems can be used to verify whether point-to-point microwave links are operating within the technical specifications defined in their licenses. Since microwave transmissions typically involve directional propagation with tight beamwidths high above ground, these tasks can be

tricky to handle using conventional mobile or handheld solutions. Carried on a commercial drone, however, an aerial monitoring system can easily ascend to the main lobe of a microwave link and hover there to perform the desired measurements.

The system's high degree of mobility combined with a drone's high performance camera can even make it possible to identify a single antenna on a densely crowded radio tower as a potential source of unlicensed microwave links. Aerial units are better equipped than ground based systems to deal with phenomena like reflection, refraction and multipath propagation.



CONTROL CENTERS

Within nationwide spectrum monitoring systems, control centers are the central points where many threads converge and depart. Control centers usually allow remote control of monitoring stations. They also provide interfaces to spectrum management systems, coordinate measurements and compile interference reports.

The structure of nationwide spectrum monitoring systems differs from country to country. Often one central control center forms the core. In addition, subordinated regional control centers or attended fixed monitoring stations can coordinate area-specific tasks. Nationwide monitoring systems often comprise a large number of different monitoring stations, including fixed, transportable, mobile, aerial and portable units.

Control centers can continuously monitor the operating status of all monitoring stations within the nationwide systems. If irregular events or disruptions occur at the remote stations, this feature can generate alarms in the control center and alert operators or maintenance personnel. As a result, the downtimes will be reduced and the system availability will be improved.

Rohde&Schwarz spectrum monitoring systems provide open interfaces to existing spectrum management systems. Moreover, the systems are modular and scalable in order to fulfill individual requirements and deliver the ultimate in investment protection.



Service at Rohde & Schwarz You're in great hands

- ▶ Worldwide
- ▶ Local and personalized
- ▶ Customized and flexible
- ▶ Uncompromising quality
- ▶ Long-term dependability

Rohde & Schwarz

The Rohde & Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems, and networks & cybersecurity. Founded 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

Rohde & Schwarz training

www.training.rohde-schwarz.com

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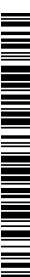
PD 3683.9563.62 | Version 01.02 | April 2024 (nk)

Regulatory spectrum monitoring

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