CEPTOR

Intuitive software for radiomonitoring systems

Product Brochure
Version 03.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The CEPTOR software controls radiomonitoring systems for government authorities entrusted with public safety and security missions as well as for armed forces. An intuitive and clearly structured user interface leads the user through the typical workflows. The tasks are performed quickly and effectively by just selecting the appropriate CEPTOR application and following the steps from job definition via operation to reporting. Practical default settings and partially automated processes deliver the desired results without users worrying about the specific properties of each sensor.

The CEPTOR software is designed for easy operation and fast results. Simplicity of tasks has priority over sophisticated functionality that is difficult to use without extensive training. Small and affordable solutions with local or remote sensors are sufficient to solve most issues. Each sensor in the system is handled as a separate station to support autonomous operation.

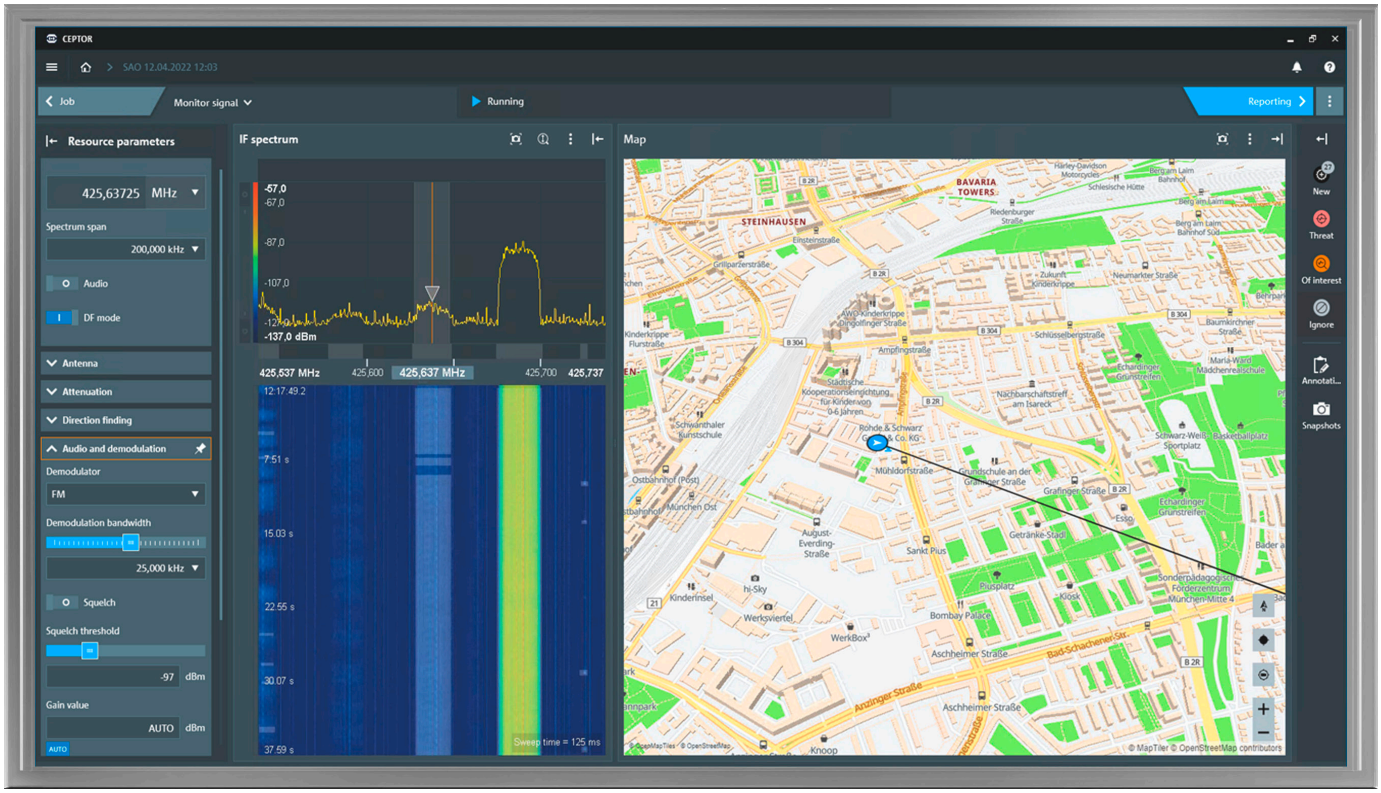
The CEPTOR software supports a wide range of tasks, including:

- Collection of information about spectral usage and active transmitters
- Searching for new signals and observing known transmitters
- Monitoring and technical classification of signals
- Direction finding
- Geolocation of transmitters
- MobileLocator for homing-in on transmitters with a moving DF sensor

Together with receivers and direction finders from Rohde & Schwarz, the CEPTOR software provides system solutions including automatic detection of signals, direction finding, geolocation, signal classification, displaying and recording results of interest, and reporting of this information.

Key facts

- Radiomonitoring applications for result-oriented, guided workflows
  - Search and observe
  - Collect RF spectrum data
  - Calculate spectral usage
  - R&S®MobileLocator
- Modern GUI design for intuitive operation and quick results
- Job concept for execution of applications and collection of results
- Remote control of systems via wide area networks
- Integrated system monitoring and administration



TYPICAL APPLICATIONS

As frequency spectrum usage continues to grow, knowledge about current usage, active transmitters, new signals or interference problems is crucial for civil regulation authorities, intelligence services, security agencies, business communities and military as well as public and even private services.

Quite often it is sufficient to obtain a fast and simple overview to detect problems and respond quickly. Complex scenarios require powerful system solutions and highly experienced users. Since these resources are not always available, it is better to have lightweight and very easy to use systems. The CEPTOR software helps users to obtain results quickly and easily without overloading them with varied settings and complex measurements.

Spectrum monitoring

Spectrum monitoring helps to ensure reliable communications and to detect interference problems. Information about the actual spectrum occupancy and coverage of transmitters forms the basis for network management and planning. Rohde & Schwarz single-channel receivers and direction finders with the CEPTOR software are used as fixed, transportable, portable and mobile spectrum monitoring stations to handle these tasks. If complex scenarios or ITU-compliant measurements are required, our proven R&S®ARGUS software provides the necessary features.

Detecting interference problems in the frequency spectrum is just the first step. During the next step, the interference problem has to be located and eliminated. R&S®MobileLocator is integrated into CEPTOR for homing-in on the target. It automatically handles multipath propagation problems in urban environments and leads the user to the transmitter.

Communications intelligence (COMINT) and communications electronic support measures (CESM)

For military and intelligence organizations deployed in operations, light tactical COMINT and CESM equipment is paramount to fulfil missions close to contact. The CEPTOR software provides dedicated support for these missions.

It offers a tactically oriented graphical user interface (GUI) that is suitable for mobile maneuvers, disembarked deployments and on the march missions.

It provides swift operation modes to tactical operators in order to discriminate and identify signals within the area of operation and locate those of interest:

- High-resolution RF scanning
- Automatic detection and classification
- Alarms for signals of interest
- Monitoring of analog audio communications
- Direction finding and geolocation

Its automated report functionality allows the operator to immediately generate a formatted report that contains all the necessary fields of COMINT/CESM information and transmit the report to the chain of command.

EASY OPERATION

Intuitive graphical user interface

The modern GUI provides an intuitive task-oriented interface for operators. The system is clearly structured and self-explanatory.

The CEPTOR applications provide result-oriented, well-defined, optimized workflows for typical operator tasks. The operator selects the required application depending on the assigned task and provides input for the most relevant parameters. All other parameters come with predefined values that are appropriate for this type of task.

The home screen is the central entry point of the system and provides an overview of available applications supported by the system. System information with system health status quickly informs operators about available equipment and possible problems. Running, stopped and most recent jobs are listed for quick access and further processing.

Jobs

A job handles the execution of the application for a specific customer task. It contains the task-specific job sensors (receivers, direction finders, etc.) with their parameters and all results produced during job execution. It also contains the operator created reports with selected results and comments.

A job involves three steps:

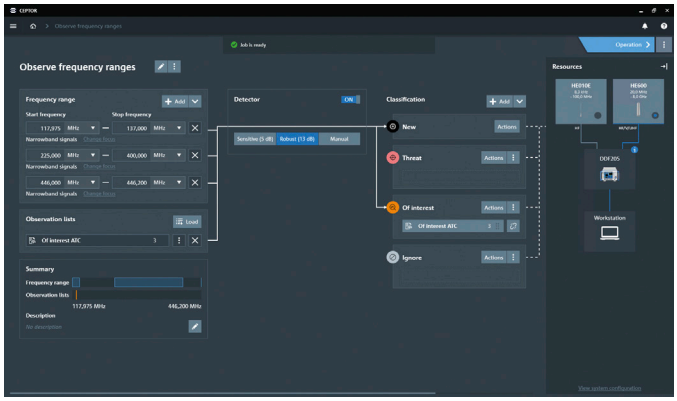
- Start with the job definition and enter the necessary basic parameters for the task such as frequency range or transmitter lists of interest.
- Execute the job to produce the required results with or without operator interaction. Different views are available to monitor and control job execution and production of results.
- Review the produced results, and select and report important information with user-defined content.

Jobs are defined for local or remote sensors to be executed automatically in the background with or without user intervention. When a specific task is completed, the job can be closed. It is retained in the system for future activities until the operator decides to delete the job including the collected results.

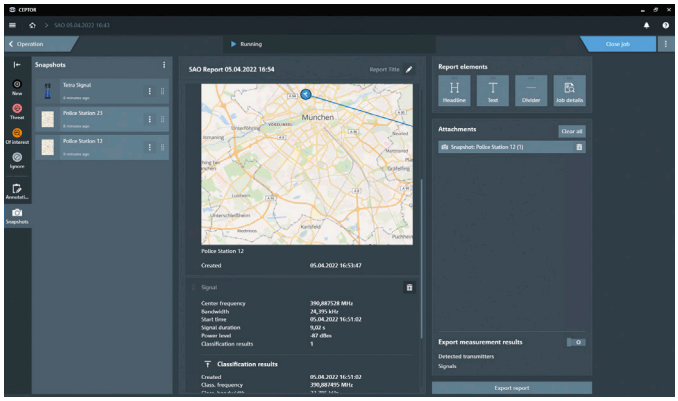
Job templates are on hand to store and reuse user-defined job definitions to repeat specific monitoring or measurement tasks.

CEPTOR home screen

Job definition with resource selection



Review of collected results and report creation



CEPTOR APPLICATIONS

The CEPTOR applications define the workflow with optimized views and settings to deliver the desired results. Various applications are available to assist users in performing their tasks.

Search and observe

The "Search and observe" app allows operators to search for radio signals and concurrently observe known transmitters of interest. The results of the search process are detected signals, transmitters and networks that are sorted into user-defined operational classes such as "Of interest" or "Ignore". Additional information about technical signal parameters, classification, direction finding or location results can be added as input when gathering essential information into a report.

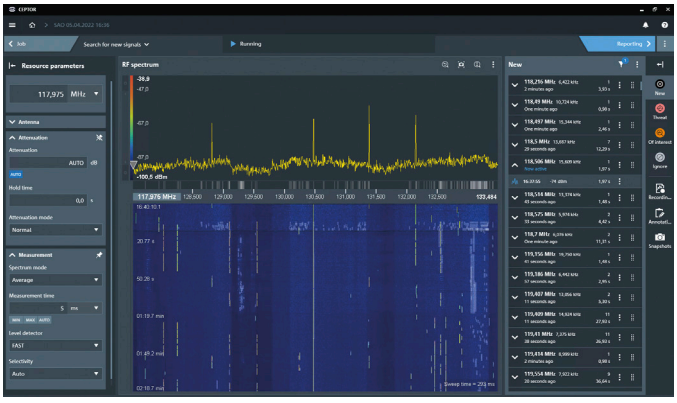
Already known and classified transmitters can be used in this process to relieve the intercept operator of routine tasks. This goal is achieved by automatically sorting new signals into their operational classification based on known signal profiles. Additionally, the system can automatically trigger predefined actions such as alerting and signal monitoring if signals of a defined operational classification (e.g. threats) are detected.

After having gained an initial, rough overview of the frequencies and frequency ranges of interest, the observation (surveillance) of these targets can continue with high priority. In the meantime, the search process can still run to provide an overview of the spectrum activity and automatically detect new, unknown transmitters at the same time.

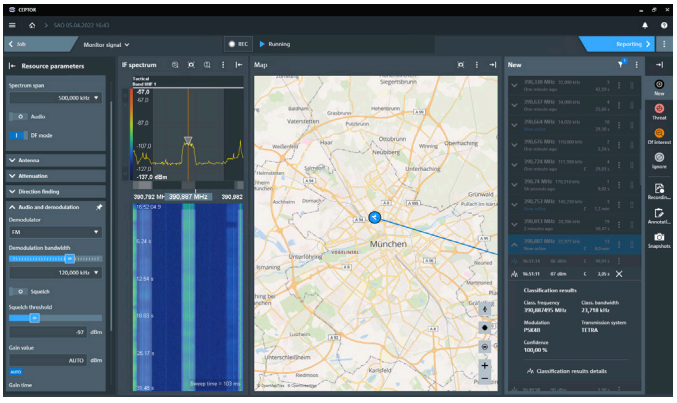
The "Search and observe" app provides two operational views:

- "Search for new signals" provides a high-resolution RF spectrum overview of one or multiple frequency ranges. Automatic signal processing in the background detects conventional signals in the spectrum and lists them on the result panel. Detected signals are automatically compared with predefined transmitter profiles to sort them to the result list with the appropriate operational classification.
- "Monitor signal" uses the fixed frequency mode of the device to allow deeper analysis of the signal of interest. If the receiver supports polychrome display, short-term signals and their behavior over time can be visualized more clearly. Listening to analog audio or using the direction finder mode of the device provides valuable information about the transmitter. Baseband signal classification adds technical signal parameters and the modulation type to the result. An accurate geographic position is calculated for transmitters based on azimuth results from two or more connected direction finders using the high-precision angle of arrival (AoA) method.

Search for new signals



Monitor signal



Collect data

The “Collect data” app saves RF spectrum data for later offline analysis with the “Calculate spectrum usage” app. Depending on the used device, multiple scan ranges can be defined, each with its own specific settings.

Collect data jobs assigned to remote sensors are transferred via WAN to the remote CEPTOR station for independent job execution. Results are downloaded to the local control station upon operator request.

Calculate spectrum usage

This app provides various analysis capabilities for data previously recorded with the “Collect data” app. You can obtain the following information from the recordings:

- Spectrum over time, visualized in RF spectrum and static waterfall diagrams
- Distribution of recorded signal levels by frequency, visualized in a spectrum usage diagram
- Coverage plot, visualized in the map view or for visualization in third-party programs

Since this application does not require monitoring devices during operation, recordings can be analyzed in parallel to a running collect data job.

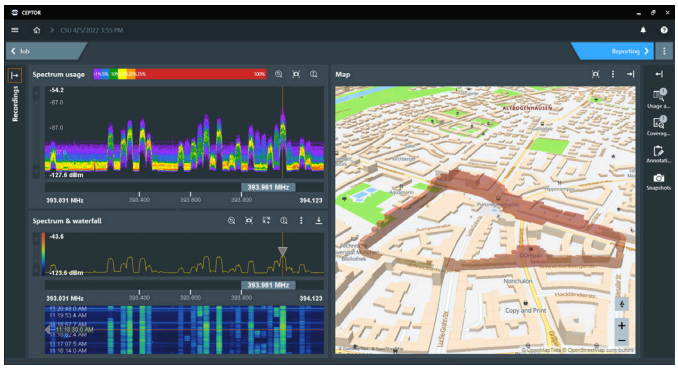
R&S®MobileLocator

MobileLocator determines the location of unknown transmitters in urban environments. Results from a single direction finder installed in any vehicle are used to overcome multipath propagation problems. A map display with bearing line, azimuth histogram and heatmap guides the operator towards the locations of one or more transmitters on the same frequency.

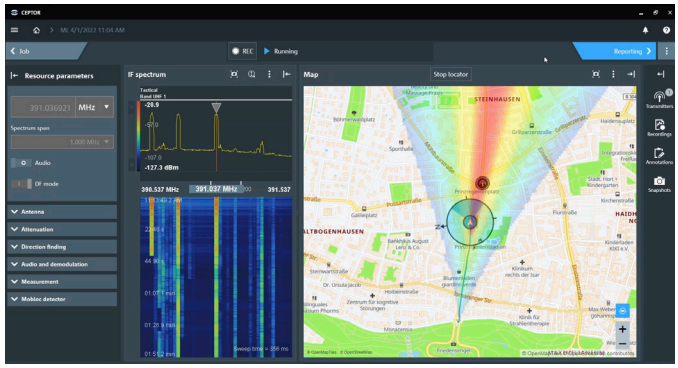
The integrated map display with 2.5D view, landscape, terrain shading and buildings for better orientation simplifies transmitter location within urban environments. Offline OSM vector maps including a high detail level are part of the system installation. Quick zooming, centering the vehicle and map orientation according to driving direction support the operator.

Automated spectrum recordings

Display spectrum usage and coverage plot of selected frequency channel



R&S®MobileLocator with heatmap display



CEPTOR FEATURES

Features are available as options to add functionality to the system and applications.

Remote control via WAN

Remote control of sensors connected via WAN ensures that connections with limited bandwidth or connection failures do not interrupt measurements. Data reduction and compression are applied for displaying live results from remote stations on the local control station. Jobs are defined on the control station and transferred to the remote station for autonomous execution. Collect data results are receivable from the remote stations as soon as the connection is established, considering the available bandwidth. Standard IP connectivity is sufficient for remote connection, independent of the underlying technology or VPN infrastructure.

System application interface

The system application interface is an open interface to forward measurement results in real-time to external systems. During job definition, the operator enables data streaming to send signal detections with center frequency, signal bandwidth and activity times, as well as direction finding, geolocation and classification results for selected signals. Data streaming is active during job execution.

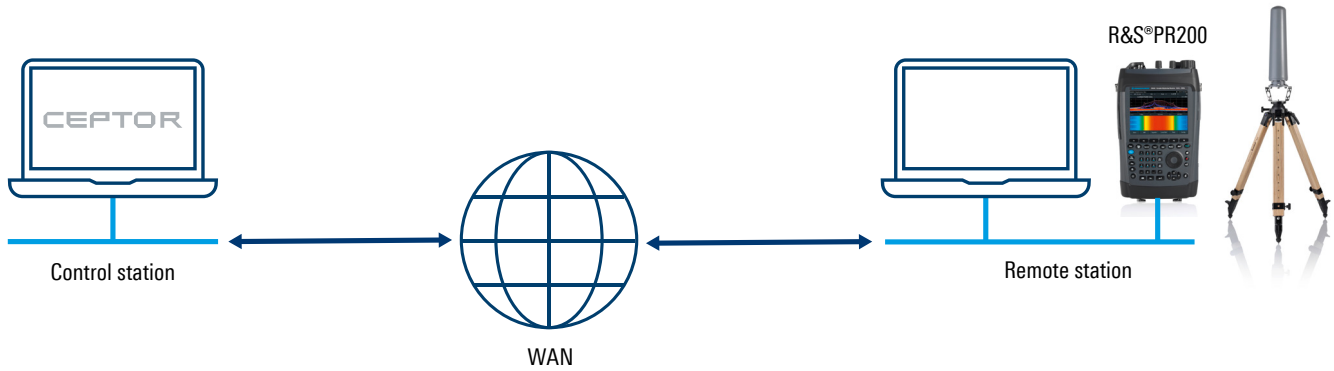
Signal classification

Technical signal classification of unknown signals or verification of known signals provides accurate technical parameters for the transmission such as the center frequency, bandwidth and information about the transmission system and modulation type.

Classification results

Classification result details	
Last classification result	
Created 44 seconds ago	
Class. frequency	390,287534 MHz
Class. bandwidth	24,706 kHz
Class. power level	-34 dBm
Class. SNR	53,6 dB
Modulation	PSK4B
Transmission system	TETRA
Confidence	100,00 %
More details	
Symbol rate	18.000,00 Bd
Analog modulation	USB
Digital modulation	PSK4B

CEPTOR control station connected via WAN to remote monitoring station



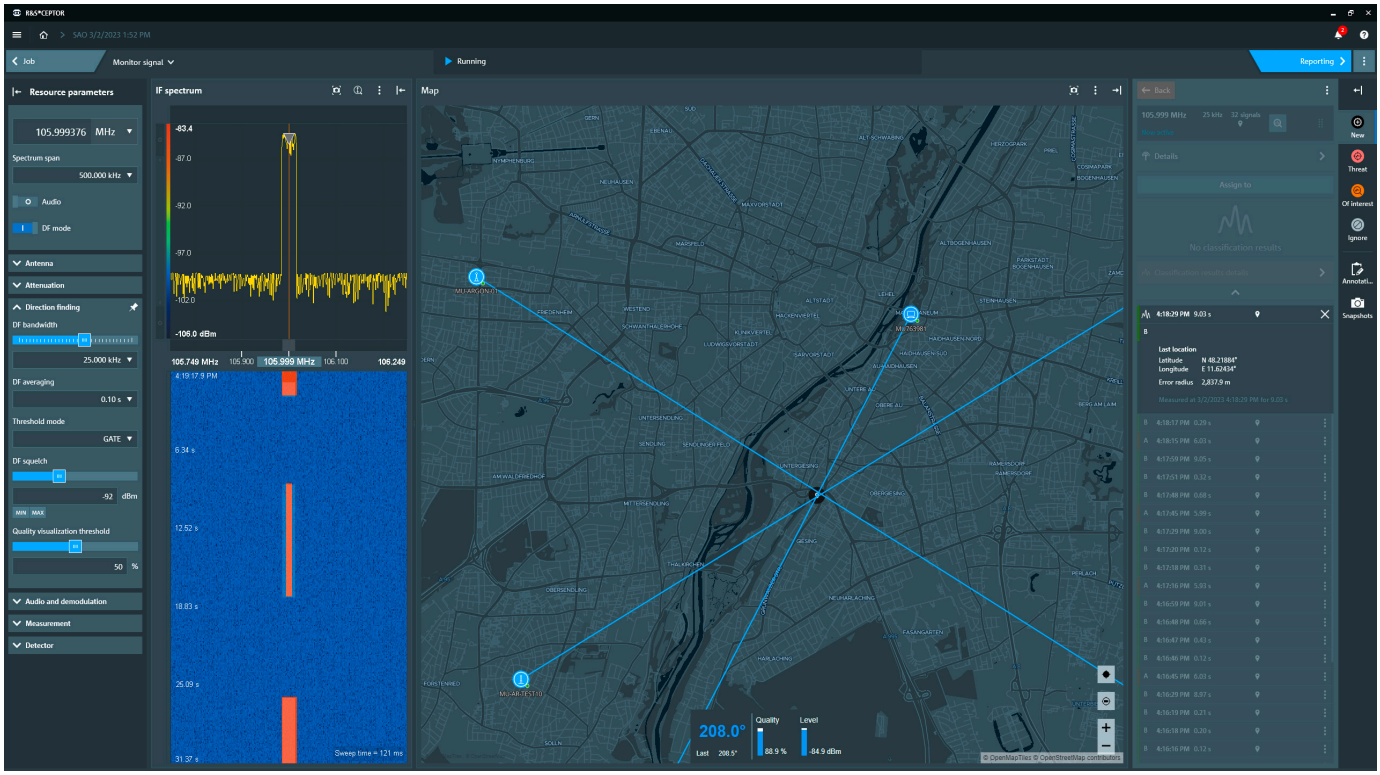
Geolocation

Identifying the precise geographic location of radio signals with single channel locate is a must-have for regulators, military users and a wide range of industries. The angle of arrival (AoA) method provides the ability to locate signals that may be difficult to locate by using other methods. This is because the AoA method relies on measuring the direction of incoming signals, rather than their strength or frequency. As a result, it is possible to locate signals that are weak, intermittent or with short activity periods.

Single channel locate works by measuring the direction of incoming radio waves from a transmitter at multiple, spatially distributed DF stations. This information is then used to triangulate the transmitter's location with a high degree of accuracy. If multiple transmitters are active alternately on the same frequency channel, like in a push-to-talk (PPT) network, they can be separated, located and reported as a communications network.

In conclusion, the angle of arrival method is a powerful technology that provides precise geographic location information for radio signals. It can be used with all our high-quality single channel direction finders and DF antennas to improve the efficiency and effectiveness of your operations.

CEPTOR control station visualizing the geolocation results with live bearing lines



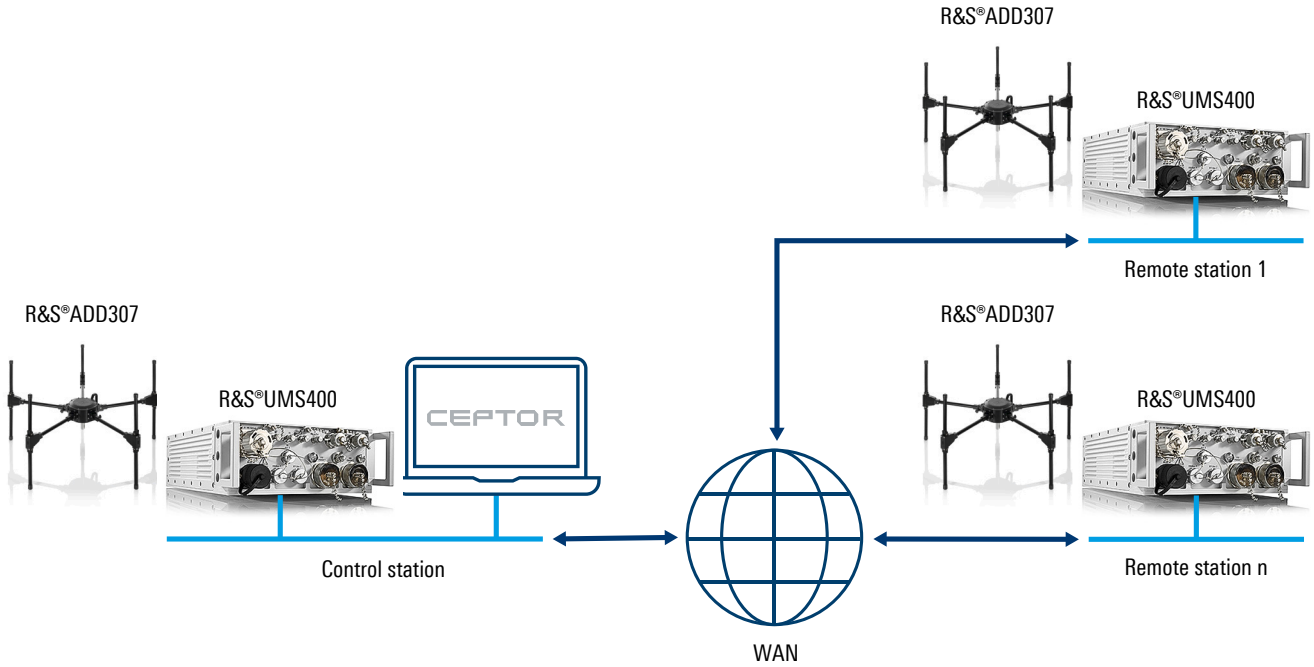
The setup and specific configuration of a geolocation system depend on the required frequency ranges and coverage area. In some cases, the location system may be a portable, handheld device that can be used in the field, while in other cases it may be a more permanent installation with multiple antennas. A dedicated CEPTOR control station controls all connected direction finders to receive azimuth results for the selected frequency from the local station and all remote stations.

Geolocation requires at least two direction finders with an appropriate distance between them. Additional direction finders increase the location accuracy and coverage area. Normally, IP based WAN connections with sufficient bandwidth are used to connect all stations to the CEPTOR control station. Advanced data compression and data reduction methods are used to adapt to the available bandwidth and network delays.

The main components of the geolocation system include:

- Rohde & Schwarz direction finding antennas:
  Different omnidirectional DF antennas are available for portable usage or for permanent installation. Some antennas are equipped with GNSS and compass modules for accurate timing, location and north alignment information. Otherwise, separate modules are connected to the direction finder devices.
- Rohde & Schwarz single-channel direction finders or receivers with DF option:
  These devices are used to collect data at each station from the DF antenna and process it to determine the direction of incoming signals. Each station requires CEPTOR system software for automatic signal detection and to deliver good azimuth results for active signals. CEPTOR system software can be installed at remote stations inside R&S®UMS400 devices or on a separate PC.
- CEPTOR control station:
  CEPTOR system software is used at the control station to manage the operation of the location system. It handles controlling the local device and all remote stations, collecting and storing data, calculating geolocation results and visualizing the results on a map display.

CEPTOR geolocation system with three R&S®UMS400 direction finders



INSTALLATION, CONFIGURATION AND SYSTEM MONITORING

The CEPTOR software is installed on standard laptops or workstations based on Windows 10 and requires IP network connectivity to local sensors. Remote stations are connected via WAN and controllable via the local control station. Each station requires an CEPTOR software instance locally for remote access and autonomous operation.

The CEPTOR installation routine installs all required modules on the operator PC without any further interaction. The usable applications and functionalities depend on the licenses provided on the connected hardlock dongle. New licenses can be easily added to enable additional functionality.

Vector based OSM maps of the complete world are included. Integrated map management functionality is used for importing the necessary geographic area and selecting additional base map layers for hill shading and contour lines.

The home screen shows the system status and allows quick access to station settings to verify the system status in more detail and adapt configurations of individual components, if needed.

Adding new stations, devices and antennas on the system configuration screen requires only a few clicks to select the correct device type and adjust the relevant station and device parameters.

OpenStreetMap (OSM)

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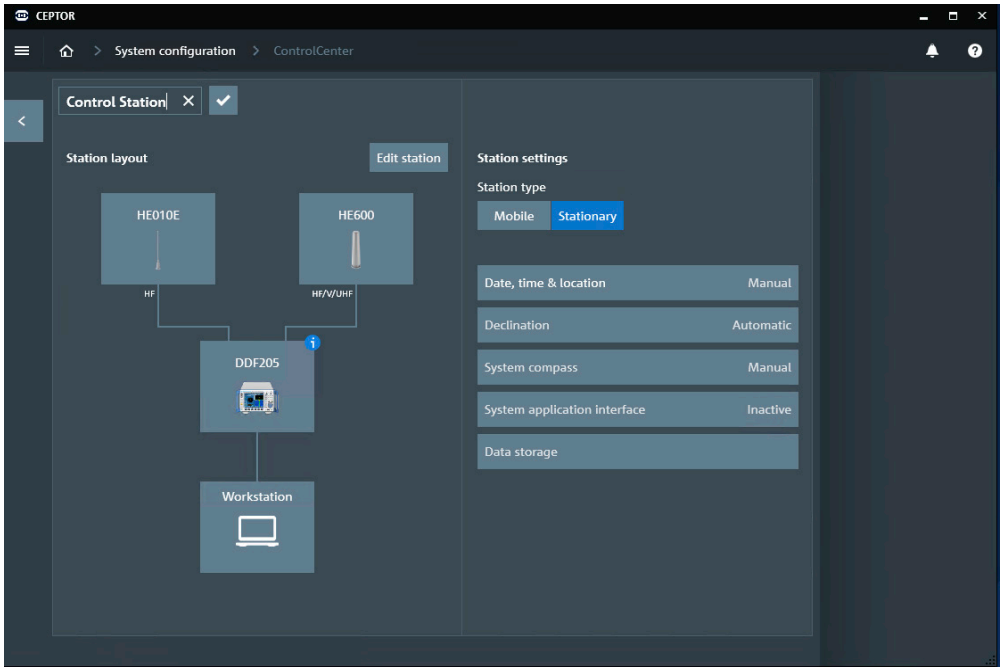
System configuration



ORDERING INFORMATION

Designation	Type	Order No.
Base unit		
CEPTOR	R&S®AR-CEPTOR	3067.5703.02
Hardlock USB small	R&S®AR-WIBU-HL	3067.5710.02
Hardlock USB keyring	R&S®AR-WIBU-HL	3067.5710.03
Hardlock microSD	R&S®AR-WIBU-HL	3067.5710.04
Softlock	R&S®AR-WIBU-SL	3067.6000.02
CEPTOR applications		
Search and observe	R&S®AR-SEARCH	3067.5749.02
Collect data	R&S®AR-COLL	3070.0180.02
Calculate spectrum usage	R&S®AR-CSU	3070.0196.02
R&S®MobileLocator	R&S®AR-MOBLOC	3070.0280.02
CEPTOR features		
Signal classification	R&S®AR-MON-D1	3067.6574.02
Remote control of station	R&S®AR-WAN	3067.6580.02
System interface	R&S®AR-API	3067.6597.02
Single-channel locate	R&S®AR-LOC	3070.0338.02
Service options		
Software maintenance BASIC	R&S®ARS-BASIC	3070.0315.02
Software maintenance ADV	R&S®ARS-ADV	3070.0321.02

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 more than 85 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

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