SOVERON® WAVE
High data rate waveform suite

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SOVERON® WAVE
At a glance

High-performance waveforms designed to fulfill communications needs well into the future

The waveforms for the SOVERON® radio family are based on state-of-the-art technology and form a viable, future-ready foundation for Rohde & Schwarz radiocommunications systems. Rohde & Schwarz drew on its many years of experience in secure radiocommunications in the VHF/UHF band to develop SOVERON® WAVE.

These waveforms enable reliable communications in an anti-access and area-denial environment. Powerful frequency hopping and highly advanced encryption technologies are used to compensate for the influence of follower jammers and interception. SOVERON® WAVE provides the best options for transmitting secure high data rates without satellites in a jammed environment in various ground, air and combined ground-air-ground scenarios. Simultaneous voice and data capability significantly reduces the need for additional radios. The waveforms provide an increased situation awareness through adaptive high bandwidth IP networking. An embedded mobile ad hoc networking concept enables continuously stable communications within agile networks.

Interacting networking waveforms in different scenarios
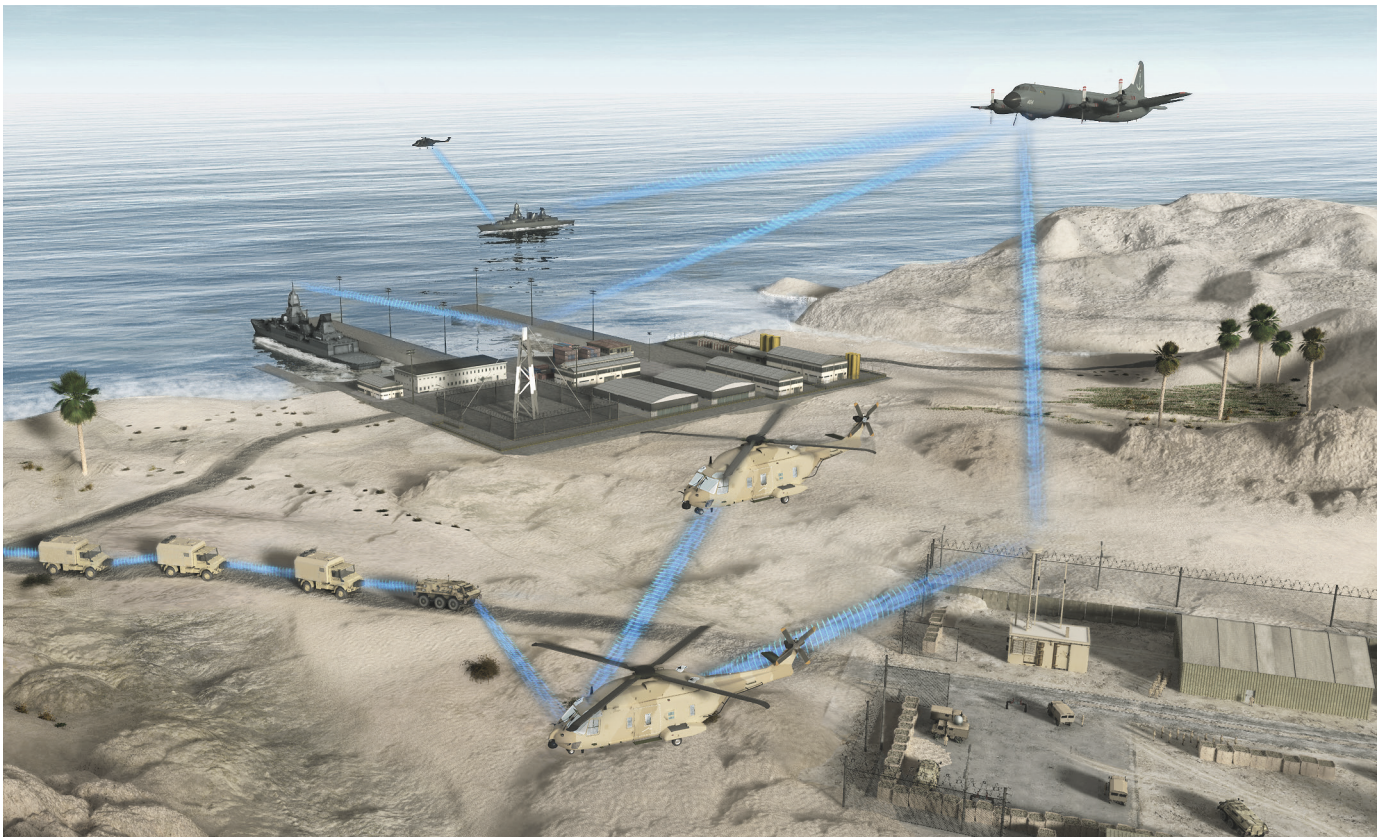
SOVERON® WAVE ensures interoperability across platforms such as land, sea and air, supporting up to four thousand nodes. The waveforms are based on a unique, upgradeable concept that meets today's and tomorrow's communications demands. The figure on page 2 shows the interacting networking waveforms in different scenarios.

Network-capable waveforms with advanced encryption concept for international missions

Secure, effective radiocommunications are essential for mission success in military organizations and state agencies. There is a rapidly growing demand for network-capable and reliable waveforms that are suitable for a wide range of simultaneous voice and data transmissions. In addition to using commercial IP data interfaces, it is crucially important to flexibly network various organizational units. SOVERON® WAVE takes the possible hierarchical structures of communications users into consideration and reflect them in the radio network.

In addition to multiple simultaneous voice transmissions, SOVERON® WAVE also offers a strong encryption concept for exchanging voice and data messages. The waveforms are adapted to environmental conditions at all times and help ensure continuously stable communications. The waveforms provide high data rate transmissions within self-administered ad hoc networks.

Four waveforms

SOVERON® WAVE includes four waveforms:
▪ SOVERON® WAVE WB (high data rate wideband)
▪ SOVERON® WAVE AJ-WB (high data rate anti-jam wideband)
▪ SOVERON® WAVE AJ-NB (high data rate anti-jam narrowband)
▪ SOVERON® WAVE AJ-NB-S (anti-jam narrowband soldier)

These network-capable waveforms permit users to transmit voice and data simultaneously. The waveforms are fully IP-based, providing user-transparent IP communications. Such an interface substantially simplifies the use of external applications. The waveforms include mobile ad hoc networking functionality and adaptive data rate adjustment. This ensures that the best network-based communications performance is achieved, independent of the environment.

The SOVERON® WAVE AJ-NB waveform provides a VHF/UHF frequency hopping functionality for mobile units and high-speed airborne platforms. The waveform covers wide transmission ranges and is highly robust against follower jammers and deception. The waveform uses a TDMA-based transmission concept. The soldier waveform (SOVERON® WAVE AJ-NB-S) is optimized for use on handheld radios.

The SOVERON® WAVE AJ-WB waveform provides a UHF frequency hopping functionality used primarily by mobile forces that require high data volumes. The waveform covers wide transmission ranges and is highly robust against follower jammers and deception. The TDMA waveform allows users to transmit large amounts of data without sacrificing anti-jam performance.

The SOVERON® WAVE WB waveform is a UHF fixed frequency waveform featuring a CSMA/CA channel access method. This waveform is designed for networks with high data volumes and wide ranges. The waveform supports a versatile range of applications such as videoconferencing.

The waveforms of SOVERON® WAVE are compatible with SCA 2.2.2.

Key facts

▪ Ad hoc networking to automatically update radio network topologies
▪ Simultaneous voice and data transmissions for effective communications with less equipment
▪ High network capability with up to 4000 addressable radios
▪ TCP/IP traffic optimizer to effectively transmit TCP/IP via radio links
▪ IP-based waveforms to provide a standard interface to reduce application and infrastructure integration efforts
▪ Orthogonal frequency hopping capability to avoid interferences of radiocommunications nets used in parallel

Overview of SOVERON® WAVE and main characteristics					
Waveform	Encrypted voice and data	Networking	Data rate	Range	Frequency hopping
SOVERON® WAVE WB	●	●	very high	standard	fixed frequency
SOVERON® WAVE AJ-WB	●	●	high	high	●
SOVERON® WAVE AJ-NB	●	●	standard	very high	●
SOVERON® WAVE AJ-NB-S	●	●	standard	high	●

SOVERON® WAVE
Benefits and key features

Waveform services

SOVERON® WAVE offers a multitude of excellent services, enabling users to take advantage of many applications with outstanding transmission characteristics at all times.

Voice service

Excellent voice transmission quality is an important feature of the SOVERON® WAVE and is achieved with the MELPe vocoder, a selected vocoder technology. A high-performance noise cancellation algorithm ensures clear voice understandability even with significant background noise. SOVERON® WAVE provides dual-channel voice transmissions. This makes it possible to carry out two independent conversations at the same time with a single radio, which can significantly reduce the number of radios necessary. SOVERON® WAVE even enables voice communications in multihop scenarios.

Data services

The waveforms provide data transmissions using transmission control protocol (TCP) and user datagram protocol (UDP). Settings relating to quality of service (e.g. priority classification) and automatic repeat request (ARQ) are supported.
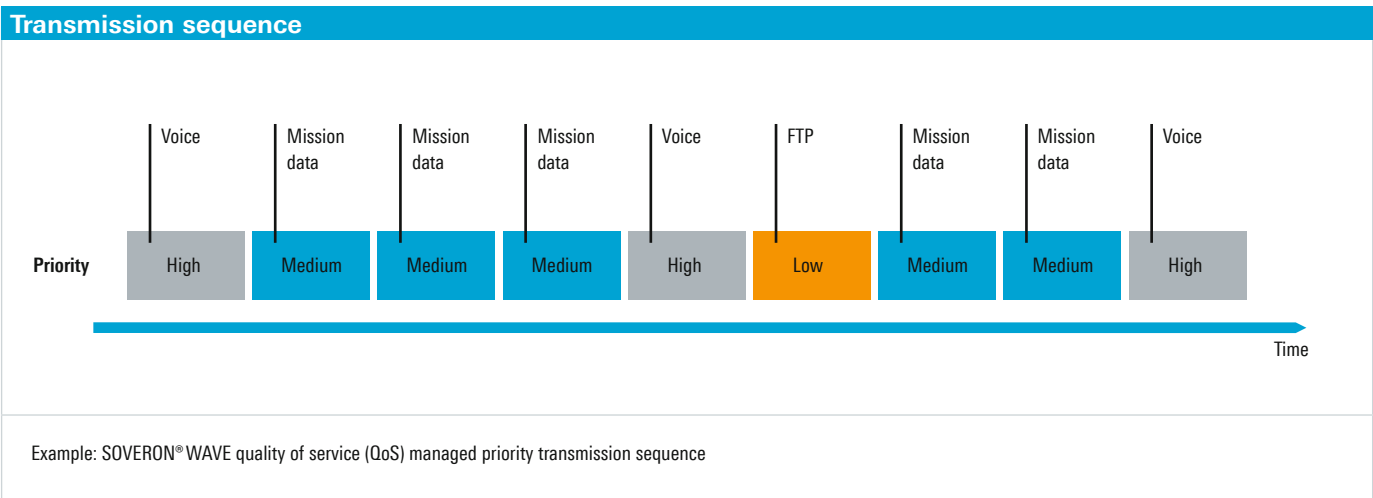
Quality of service

SOVERON® WAVE offers an extensive quality-of-service classification functionality to ensure fast and effective transmission of IP voice and data information in line with established usage characteristics. Data packets are prioritized in a targeted manner, and their transmission sequence is implicitly established. Up to eight levels of classification are available.

UDP feedback mechanism

A field-proven UDP feedback mechanism from Rohde & Schwarz makes it possible to control the flow of external applications when UDP is used. The application receives precise data flow information and can adjust the data rate accordingly. The feedback mechanism helps to avoid possible data-packet and flow-control losses by the transmitter.

TCP/IP traffic optimizer

To effectively transmit TCP/IP via radio links with relatively limited bandwidths and frequent bit errors, specific IP overhead reduction together with increased TCP protocol robustness is required. The TCP traffic optimizer from Rohde & Schwarz supports robust and optimized TCP/IP transmission by monitoring TCP protocol activity and optimizing each TCP flow individually. Optimization is done on the fly and helps to adapt the TCP transmission to the current channel characteristics, maximizing TCP throughput. The end-to-end TCP protocol handshaking continues, maintaining the direct transmit/receive link. In combination with the integrated IP header compression, which reduces IP packet overhead, and an efficient link layer ARQ mechanism, the TCP traffic optimizer allows TCP throughput to be continuously improved. Effects of transmission bit errors can be efficiently compensated and throughput drops mitigated.

Transmission sequence

Priority	High	Medium	Medium	Medium	High	Low	Medium	Medium	High
	Voice	Mission data	Mission data	Mission data	Voice	FTP	Mission data	Mission data	Voice

Time

Example: SOVERON® WAVE quality of service (QoS) managed priority transmission sequence

Wireless communications

SOVERON® WAVE employs a broad range of selected and efficient functions to enable successful radio transmissions. A harmonized waveform design is especially important for large networks with multiple communications links.
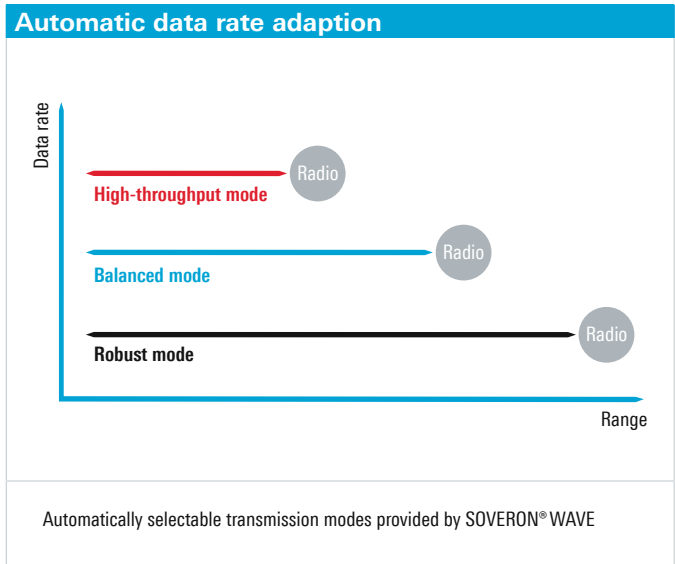
Automatic data rate adaption

SOVERON® WAVE features outstanding channel coding and adaptive equalization technology to compensate for the influences of multipath propagation. For this purpose, the waveforms offer three transmission modes designated as "robust", "balanced" and "high throughput". These three automatically selected transmission modes adapt SOVERON® WAVE transmissions to environmental conditions in a fast, highly effective manner at all times – a feature that significantly increases radio network stability. As a result, data throughput is optimized.

The robust mode is primarily designed for long ranges under conditions of high interference probability. The balanced and high-throughput modes are used as needed to handle high data volumes.

Receive quality indication (RQI)

For users, it is highly valuable to know the quality of received signals at other radio stations within a SOVERON® radio network. The SOVERON® WAVE RQI provides a fast overview of the quality of the currently active radio link.

Automatic data rate adaption

Data rate

High-throughput mode — Radio

Balanced mode — Radio

Robust mode — Radio

Range

Automatically selectable transmission modes provided by SOVERON® WAVE

Dynamic channel access method with collision avoidance

The three high data rate anti-jam waveforms, SOVERON® WAVE AJ-NB, SOVERON® WAVE AJ-NB-S and SOVERON® WAVE AJ-WB, feature a very powerful transmission concept based on time division multiple access (TDMA). The TDMA structure can be configured by the user as required and enables both static and dynamic channel allocation. This flexible approach makes it possible to adapt the TDMA structure to the requirements of mission scenarios and meet specific communications needs. While static channel allocation is often used in time-critical tactical data networks with fixed numbers of participants, the dynamic channel access method allows multiple users to exchange messages within radio networks even if they have differently varying data rates. This high level of flexibility enables users to create various radio networks that meet exactly their communications needs for high-quality voice and data operations.
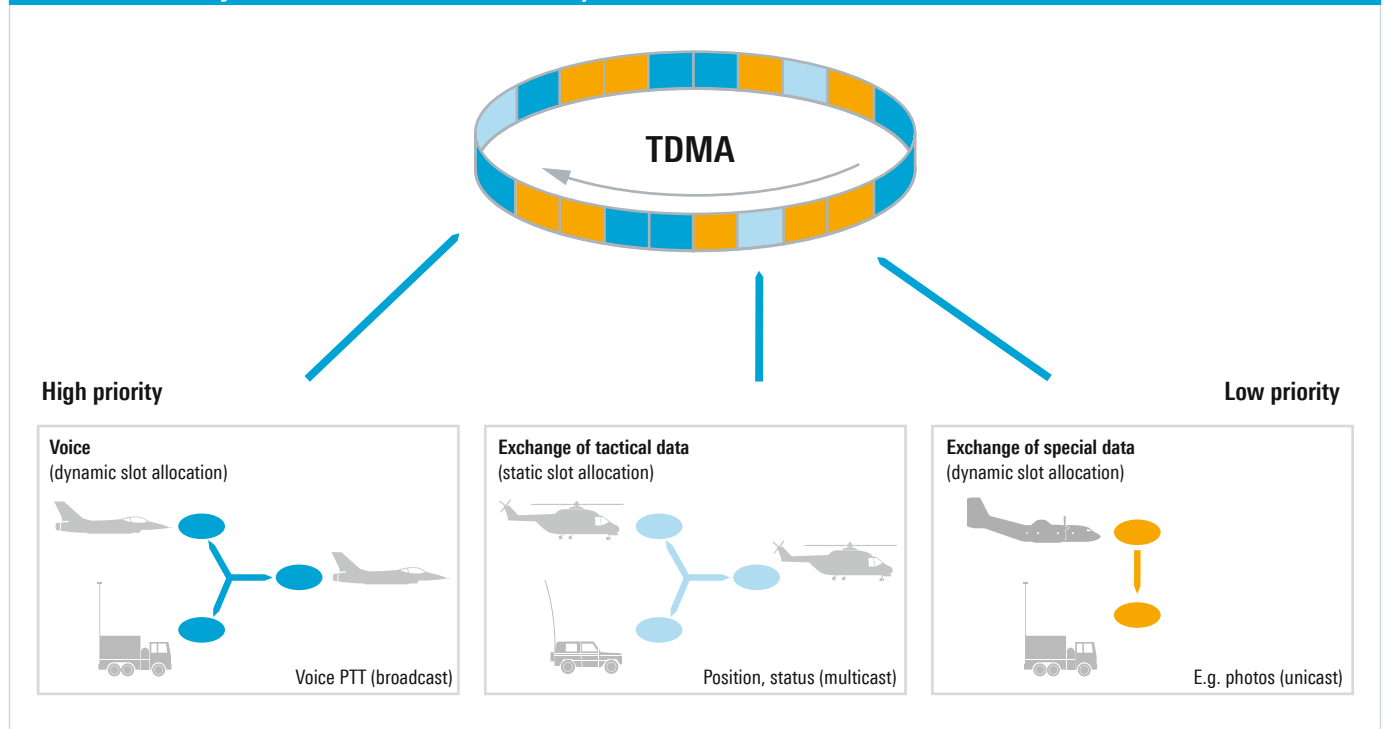
The SOVERON® WAVE WB waveform uses a carrier sense multiple access/collision avoidance (CSMA/CA) channel access method and is capable of transmitting high data rates. The CSMA/CA channel access method is perfect for the dynamic network conditions often found in convoys, for example. This method provides users with flexible "on-the-move" channel usage and features extremely fast channel access options.

The very short transmission times and high data rates of the SOVERON® WAVE WB waveform make it ideal for a versatile range of videoconferencing applications and simultaneous imagery and voice transmissions.

Automatic repeat request (ARQ)

SOVERON® WAVE offers an automatic repeat request function to sustainably improve transmission reliability. The ARQ mechanism acknowledges message receipt by the receiver according to the channel access layer. This is very useful, especially under the difficult propagation conditions of constantly changing environments, and can even decide the outcome of a mission. Due to the ARQ mechanism, transmissions are carried out efficiently, even under difficult channel conditions, since only lost fragments must be retransmitted.

SOVERON® anti-jam waveforms: static and dynamic channel allocation

TDMA

High priority

Voice
(dynamic slot allocation)

Voice PTT (broadcast)

Exchange of tactical data
(static slot allocation)

Position, status (multicast)

Low priority

Exchange of special data
(dynamic slot allocation)

E.g. photos (unicast)

Advanced networking capabilities

The state-of-the-art, network-capable SOVERON® WAVE offers a number of special functions for operating versatile radio networks. Users can establish and optimize radio networks that meet the requirements of any mission scenario.

Ad hoc networking

SOVERON® WAVE features a very powerful integrated self-forming and self-healing mobile ad hoc networking (MANET) functionality. MANET enables users to independently set up and automatically update radio network topologies. Voice and data communications routing is decentralized, which allows effective data distribution within a network. There is no need for a central data routing hub. SOVERON® WAVE uses an enhanced optimized link state routing (OLSR) protocol to provide high-performance ad hoc networking.

Multihop capability

The SOVERON® WAVE multihop capability is based on the MANET functionality and supports the automatic exchange and distribution of voice and data transmissions within the entire network. Multiple radios will forward the messages directly. The multihop network topology allows the use of several radios organized in a communications row. This sort of multihop communications increases the effective range of a network, and results in an extended coverage range that can be several times greater than its standard line of sight (LOS). Multihop communications capability also increases the networkability of VHF/UHF radios in difficult terrain where communications partners are often unreachable via direct LOS links. Depending on situational requirements, a radio network can be automatically established via multiple hops. The SOVERON® WAVE multihop capability significantly increases the contactability of mobile communications users, which can decide the outcome of critical missions.

Transparent relay data operation

SOVERON® WAVE enables transparent, secure relay data operation, i.e. two radio users exchange encrypted data via a third radio station acting as a secure relay. The relay station transmits the data it receives directly to the intended recipient without having to decrypt the message for itself.

Multicast and unicast

The IP-based SOVERON® WAVE supports IP-multicast and IP-unicast transmissions. This is an important prerequisite for advanced IP transmission methods.

Multihop MANET topology
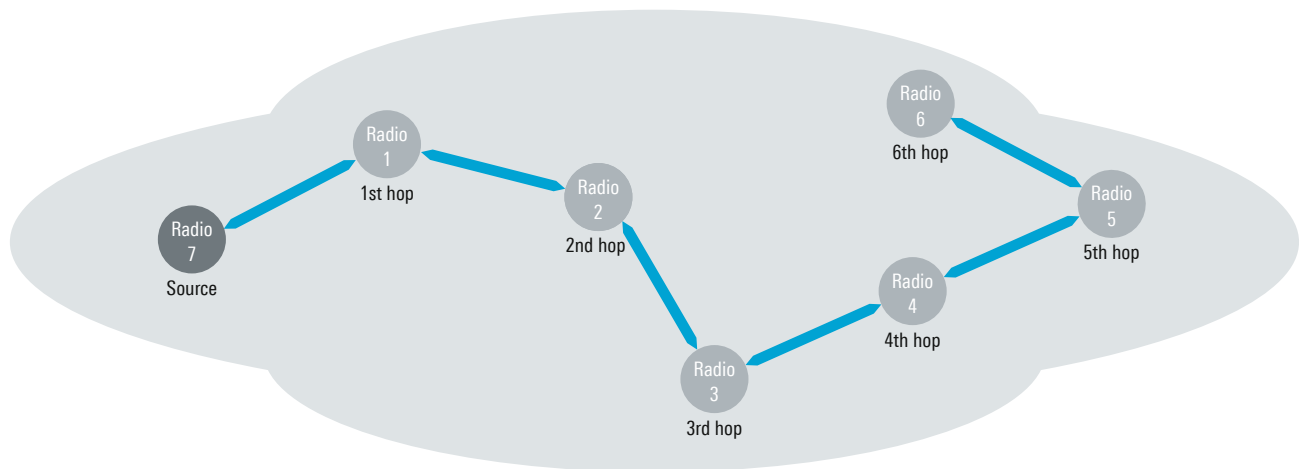
SOVERON® WAVE supports multihop MANET topologies with several hops in a row

Powerful security concept

High-performance encryption concepts with strict red/black separation are an essential feature of SOVERON® WAVE.

Communications security (COMSEC)

SOVERON® WAVE encrypts every transmission using the advanced encryption standard (AES). This approach not only encrypts the payload of the transmitted IP packets. It also encrypts the entire transmission with all of its additional IP header information. This advanced encryption concept leaves no systematic signatures. A message authentication code (MAC) is assigned to every data transmission to provide sustainable protection from subsequent manipulation of the data to be transmitted.

Red/black separation

The encryption algorithms are hosted in a dedicated radio security module (RSM). This sort of functional isolation enables highly stringent and consistent red/black separation. The encryption cannot be compromised by other radio hardware or software components. Strict red/black separation is an important, fundamental security aspect that ensures sustainable communications security.

Highly stringent and consistent red/black separation
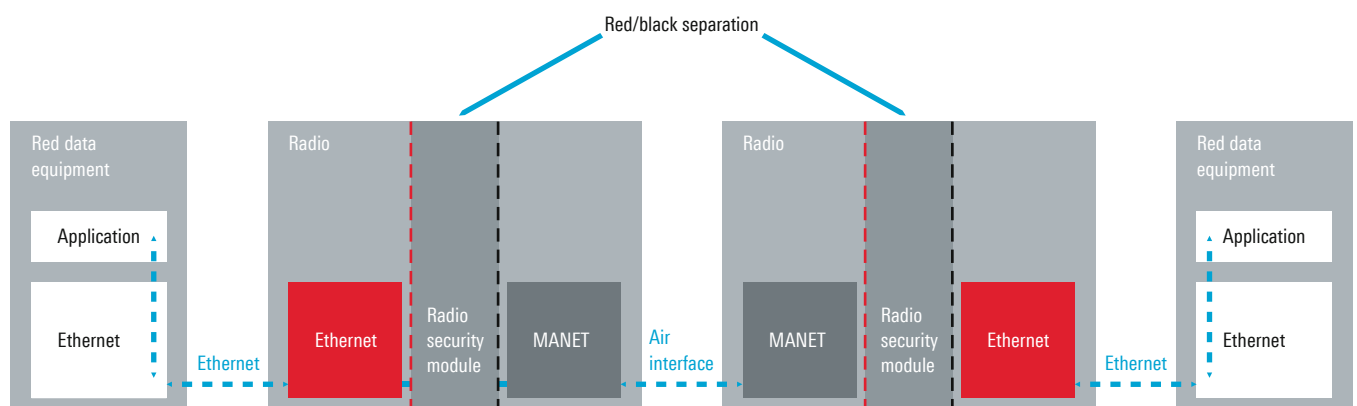
The embedded radio security module (RSM) enables consistent radio red/black separation

Electronic protection mechanisms and time management

Transmitting at a fixed frequency is not sufficient in many scenarios. To compensate for a variety of interferers and third-party influences, high-performance frequency hopping methods are required. These methods can be used in difficult communications environments without sacrificing transmission performance. In these situations, time management is crucial for continuously stable radiocommunications.
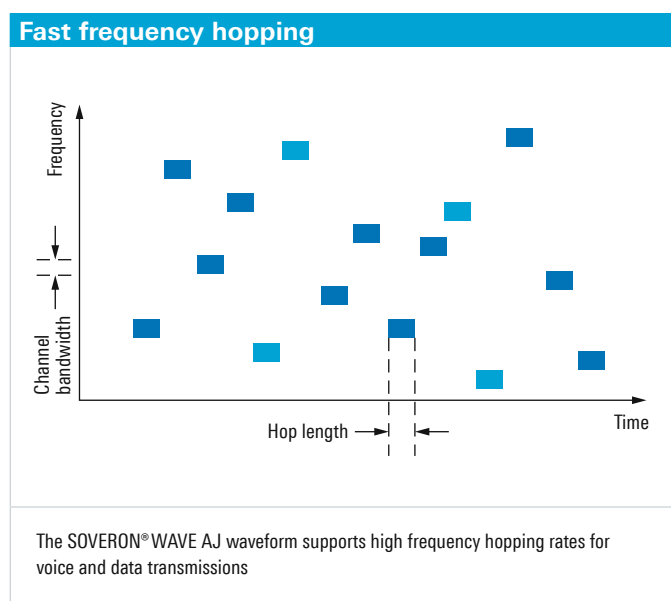
Transmission security (TRANSEC)

The three SOVERON® WAVE anti-jam waveforms contain a fully developed, state-of-the-art orthogonal frequency hopping method. While SOVERON® WAVE AJ-NB and SOVERON® WAVE AJ-NB-S can be used in the tactical VHF bands from 30 MHz to 88 MHz and from 137 MHz to 174 MHz and in the UHF band from 225 MHz to 512 MHz, SOVERON® WAVE AJ-WB is designed for the UHF band. The average frequency hopping rate is independent of the transmission mode selected. Wideband transmission with the SOVERON® WAVE AJ-WB waveform makes it possible to send large volumes of data within a radio network. With both methods, encrypted voice and data content is specifically prepared for transmission using a selected interleaving process. This significantly increases the probability of successful transmission even in jamming scenarios. The transmission hops themselves are specifically designed to withstand the influence of follower jammers. The SOVERON® WAVE anti-jam waveforms are also set up for use at high speeds up to Mach 2 and are designed to compensate for interference associated with multipath propagation and Doppler effects.
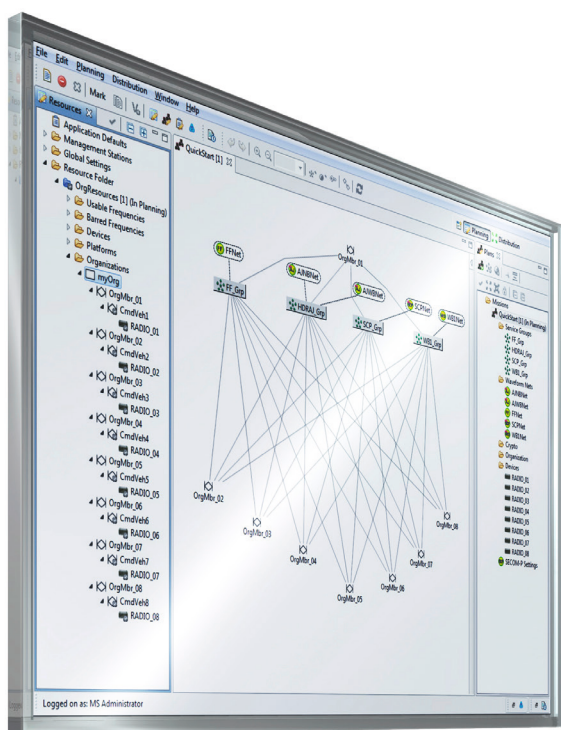
Time management

A standardized network time within a radio network is mandatory for continuous use of the anti-jam frequency hopping methods. The network time can be provided by an external source or established by the radio system itself. All SOVERON® WAVE anti-jam waveforms feature an automated mechanism that distributes and continuously updates the network time within a radio network to ensure that communications users are synchronized with each other at all times.

New communications users can join networks actively or passively to receive the valid network time. The active method allows operators to initiate network time requests and receive an immediate response. In the passive method, however, the technology attempts to find suitable synchronization signals to use for automatic synchronization.

Fast frequency hopping

The SOVERON® WAVE AJ waveform supports high frequency hopping rates for voice and data transmissions

Management tools

SOVERON® RNMS network management system

SOVERON® RNMS is a network management system for SOVERON® software defined radios from Rohde & Schwarz. SOVERON® RNMS provides a very clear structure and intuitive operation. The tool simplifies network planning and makes it possible to establish mission optimized networks.

SOVERON® CRYPTO security management system

SOVERON® CRYPTO is a state-of-the-art key generation system. The intuitive operational tool is used to manage, change and define appropriate COMSEC and TRANSEC communications keys used in the radios and entirely different networks. It follows the highest security standards.

Network management for the SOVERON® software defined radio family

Product overview

Designation	Type
SOVERON® WAVE WB software, networking high data rate wideband waveform, UHF frequency range	R&S®GS5000WB
SOVERON® WAVE AJ-WB software, networking EPM (ECCM) waveform, UHF frequency range	R&S®GS5000AW
SOVERON® WAVE AJ-NB software, networking EPM (ECCM) waveform, VHF/UHF frequency range	R&S®GS5000AN
SOVERON® WAVE AJ-NB-S software, networking EPM (ECCM) waveform, VHF/UHF frequency range	R&S®GS5000AS

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