

MILnews

Electronics for security and defense

Offprint from MILnews 12



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IP-based split-site operation with the R&S® M3SR Series 4100 HF radios



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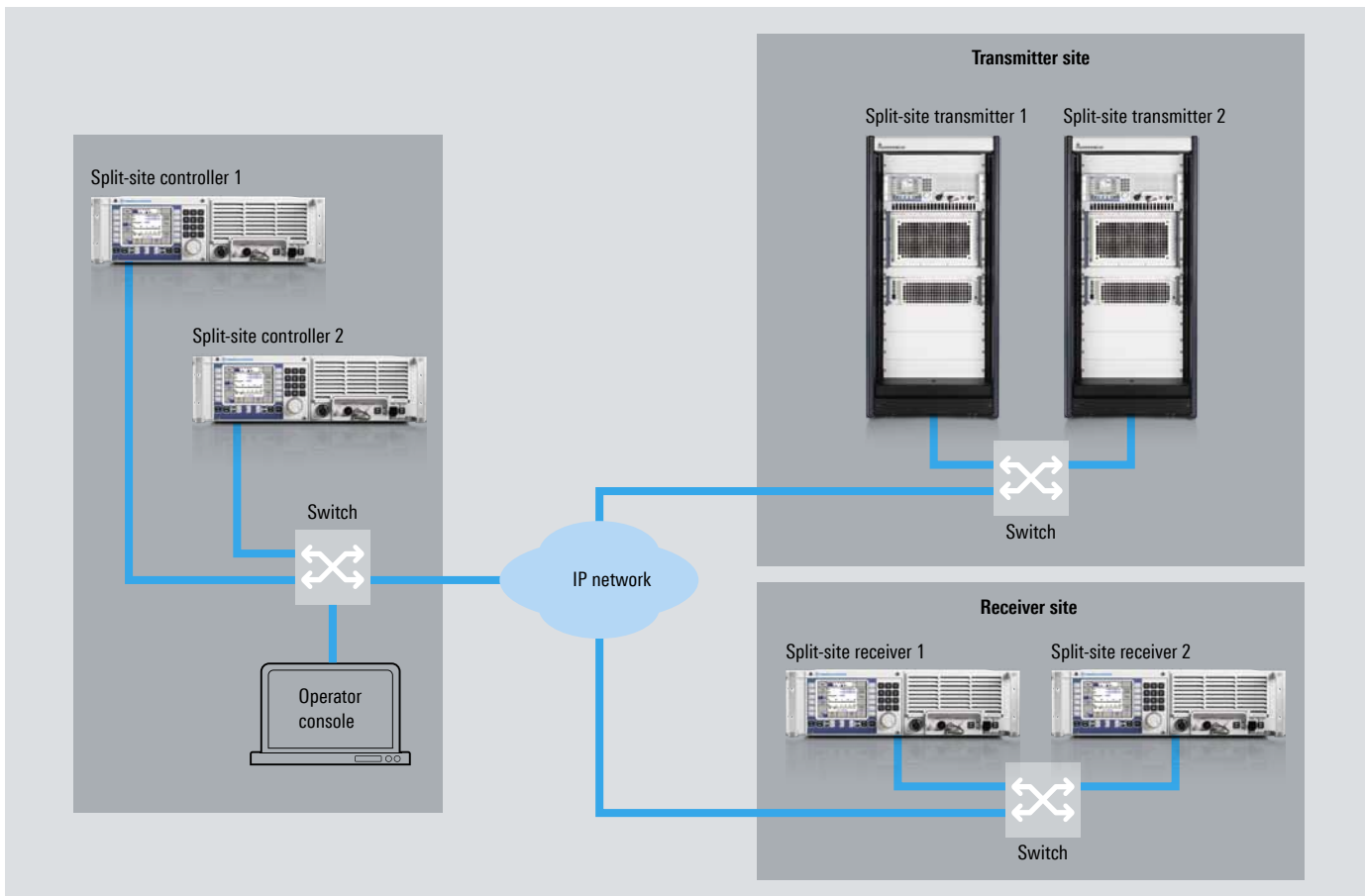
No additional hardware is required for split-site operation with the R&S®M3SR Series4100 family of radios. These radios support uncomplicated and versatile configuration of this mode. Of course, split-site operation with these radios is based on the Internet protocol (IP), which is what many armed forces now expect.

Split-site operation – often indispensable

Operation of high-power transmitters close to receivers at the same site, as occurs in broadcast and ship-to-shore (BRASS) applications, can cause interference to the receivers. In such cases, the transmitters and receivers are located at separate sites (“split-site operation”). In military environments too, it is common to install the transmitter and receiver systems as far as possible from the operational centers to help prevent precise position fixing of the operational centers and attacks against them. Distances between sites can be on the order of several kilometers. Split-site controllers are used to manage the transmitters and receivers.

Rohde&Schwarz has offered split-site functionality for many years with the R&S®GP2000 remote control processor for the R&S®XK2000 HF transceiver family. Analog and digital fixed links were used to transfer data between the remote control processor, the assigned R&S®XK2900L transmitter and the R&S®EK2000 receiver. Now, the R&S®M3SR Series4100 family of software defined HF radios also offers split-site functionality, but based on the flexible Internet protocol with its numerous practical benefits.

FIG 1 Split-site system with the R&S®M3SR Series4100 radios.



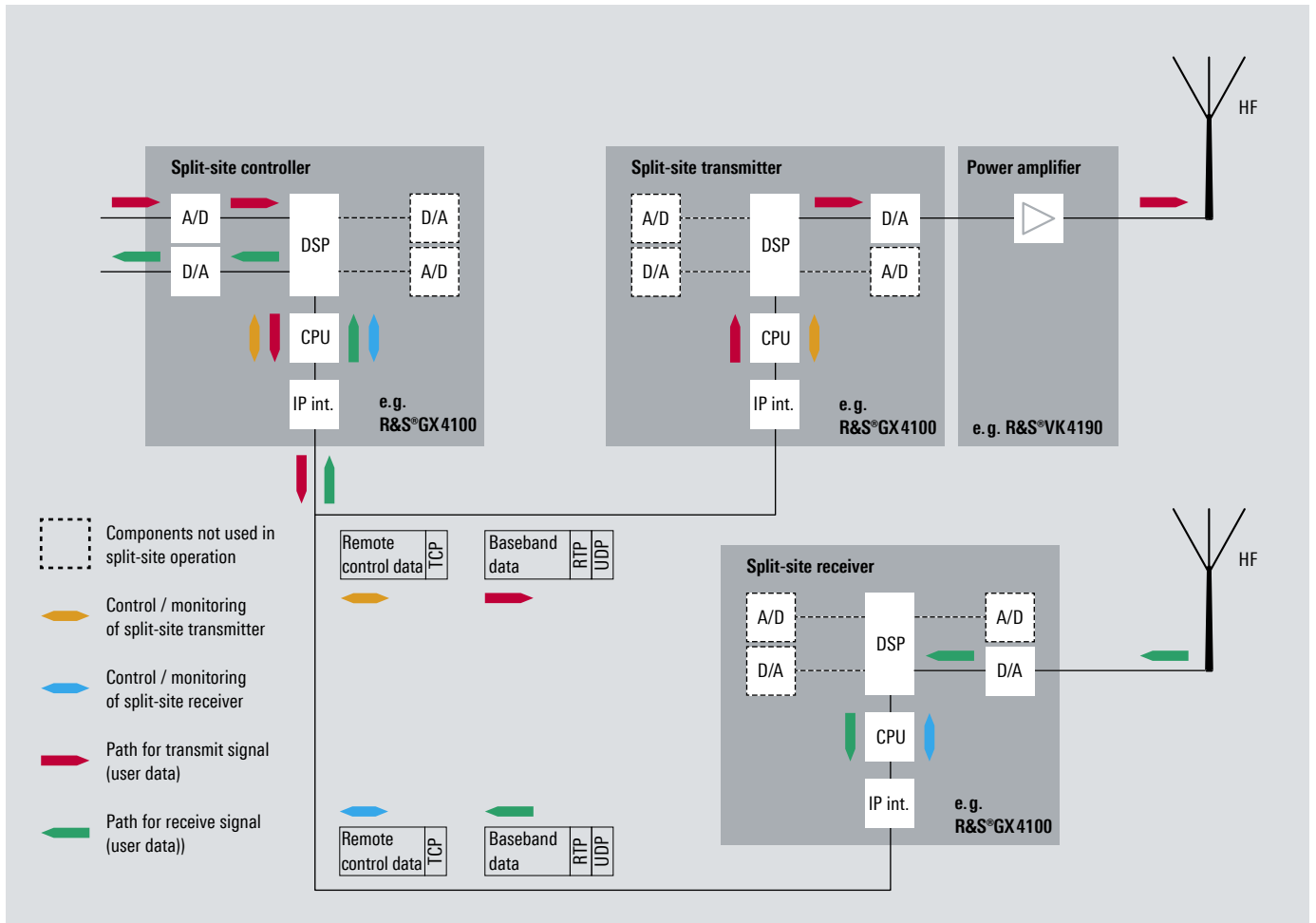


FIG 2 Simplified split-site signal path.

Split-site operation with the R&S®M3SR Series4100

In the R&S®M3SR Series4100 family of software defined HF radios, the split-site controller functionality is implemented entirely in software and no special hardware is required. Standard R&S®M3SR Series4100 radios are used as the split-site transmitter and receiver. For data transfer between the split-site controller and the transmitter and receiver, the IP interface included in the radios is used. FIG 1 shows a typical split-site system with these radios.

Consistent usage of the Internet protocol (IP)

The IP interface in the R&S®M3SR Series4100 radios has been used so far primarily for the internal remote control protocol and allows connection of control units and external remote control applications. Moreover, the radios can also be used as IP routers for IP over air (IPoA) services. Here, IP data is transmitted using optimized waveforms transparently via radio to another R&S®M3SR Series4100 or R&S®M3TR radio [1].

For the split-site functionality, the IP interface is extended with the real-time transfer protocol (RTP). This protocol is standardized for streaming data and is capable of transporting user data in the baseband with low delay. The split-site solution developed by Rohde&Schwarz distributes the signal processing tasks among the digital signal processors (DSP) in the radios that are involved. FIG 2 shows the simplified signal path.

During transmission, the split-site controller preprocesses the digitized user data and generates a baseband signal. This signal is converted by the CPU into an RTP data stream and then routed via the IP network to the assigned split-site transmitter. The transmitter processes the data stream using its CPU and DSP and generates the HF transmit signal.

The DSP in the split-site receiver converts the incoming HF signals into a digital baseband signal. This signal is passed to the CPU for conversion into an RTP data stream and then routed via the IP network to the assigned split-site controller.

The controller processes this stream using its CPU and DSP and generates the signal for output at the appropriate interfaces.

Besides the actual user data, auxiliary information such as push to talk (PTT) and squelch is transported in the header of the RTP data stream. The information is encoded in accordance with the EUROCAE standards, document ED137, part 1 [2].

Split-site operation also supports complex waveforms such as automatic link establishment (ALE 2G / ALE 3G in accordance with STANAG 4538) as well as modem waveforms (e.g. STANAG 4285 and STANAG 4539). Of course, classic HF modes such as SSB (J3E), AM (A3E) etc. can also be used.

Baseband

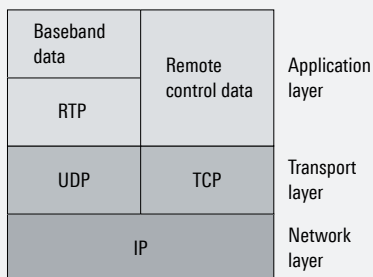
The baseband is the frequency range in which user data is transmitted. In classic voice transmission, for example, frequencies between 300 Hz and 3400 Hz (= baseband) are used for transmission.

Transmission control protocol (TCP)

TCP expects an acknowledgment for each packet that is sent. If no acknowledgment is received, the lost packet is retransmitted. This ensures proper transmission of the control data.

Realtime transfer protocol (RTP)

RTP uses the user datagram protocol (UDP). UDP is connectionless and does not need an acknowledgment for the transmitted packets. This enables faster transport of data, since no time is used to acknowledge reception. RTP packets are numbered in ascending order. Packets that arrive in the wrong sequence are detected and reordered.



The IP stack.

Support for secure links too

The interfaces in the R&S®M3SR Series 4100 radios for user and remote control data are unchanged. Crypto devices and – if red/black separation of the control signals is required – a trusted filter (firewall functionality) can be used. Encryption is possible using external IP security solutions that are available commercially.

High availability and flexibility

Communications links today are based increasingly on the Internet protocol, which is progressively replacing the classic analog and digital telecommunications links. One of the objectives in the development of IP was to enable the transport of data packets via alternative routes in case connections fail. With appropriate network planning, high availability can be ensured for the entire system.

The ability to assign a split-site controller dynamically to a certain transmitter and receiver offers great flexibility in configuring the overall system. This makes it possible to select the transmitters and receivers with the sites and antennas that are the best match for the current task. Usage of costly transmit antenna switches can be kept to a minimum by means of an appropriate system design. Even if individual split-site components fail, the remaining components can be re-allocated dynamically, which helps to bolster the overall availability.

Components	Hardware
Split-site transmitter	R&S®GX 4100 (receiver / exciter)
	R&S®VK 4190 (1000 W power amplifier)
	R&S®IN 4190 (1000 W power supply)
Split-site receiver	R&S®GX 4100 (receiver / exciter)
	R&S®IN 4000A (power supply)
Split-site controller	R&S®GX 4100 (receiver / exciter)
	R&S®IN 4000A (power supply)

FIG 3 Possible hardware configuration for split-site operation with the R&S®M3SR Series 4100 HF radios.

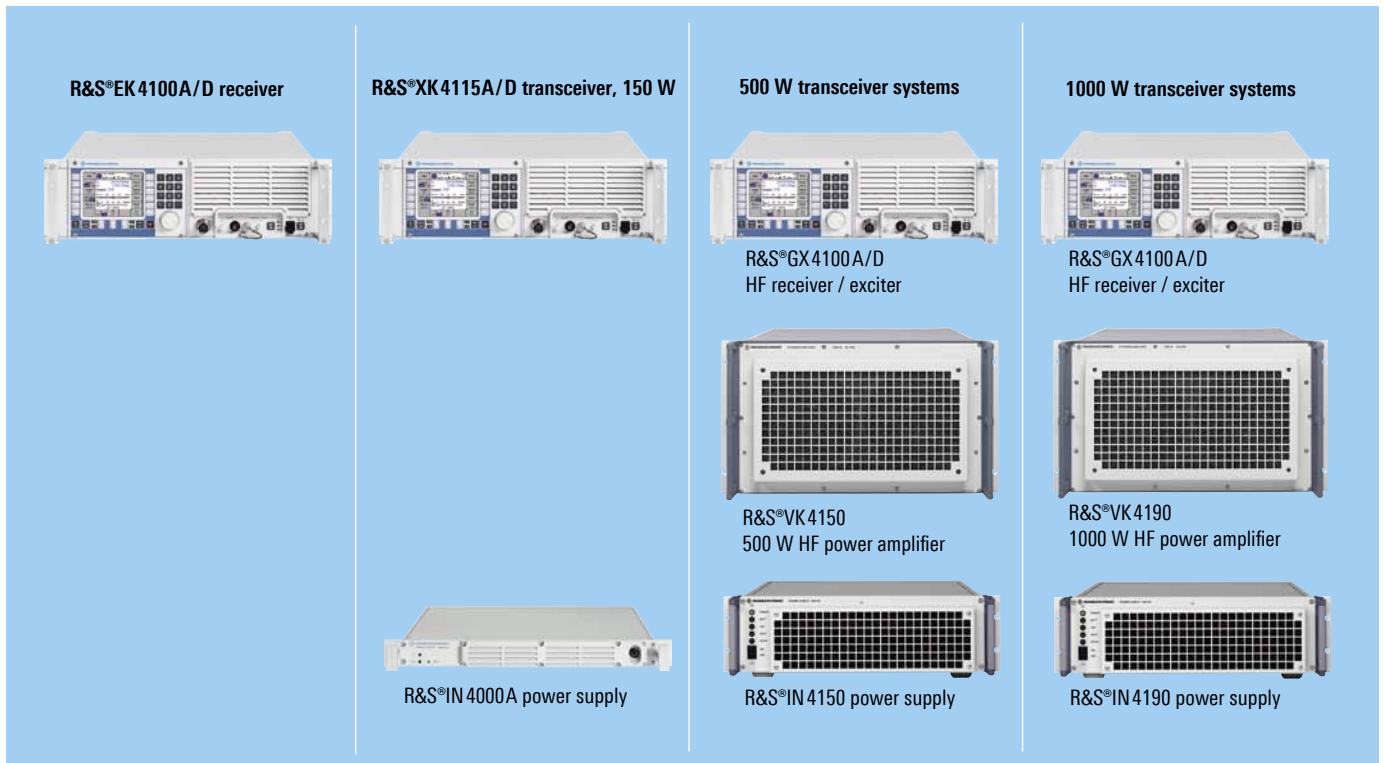


FIG 4 Overview of the R&S®M3SR Series4100 HF radios.

Lower maintenance and logistics costs

Generally, each base unit in the R&S®M3SR Series4100 radio family (R&S®GX4100, R&S®EK4100 or R&S®XK4115, FIG 4) can be configured as a split-site controller by activating an appropriate software option (R&S®GS4156S). The R&S®M3SR Series4100 equipment used in the transmitter and receiver systems does not require any special hardware extensions for split-site operation. FIG 3 shows an example which illustrates the benefits of configuration for split-site operation: A split-site radio line can be implemented using three identical R&S®GX4100 receivers / exciters. This represents a significant benefit for the users and also simplifies logistics and reduces the need for spare units.

Summary

The new IP-based split-site operation with the R&S®M3SR Series4100 software defined HF radios meets all of the requirements placed on today's advanced systems such as built-in future-readiness, flexibility and lower maintenance and logistics costs. By also providing applications developed by Rohde&Schwarz such as military message handling systems (MMHS) in accordance with STANAG 4406 (e.g. R&S®MMHS [3] and R&S®STANAG 5066 [4]), Rohde&Schwarz is consistently meeting its customers' requirements for integrated, IP-based all-in-one solutions in strategic land-based communications networks as well as in tactical radio networks.

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