

M3TR – universal software radio for the digital battlefield

Military missions in the late 90s are characterized by joint operations of multinational armed forces. Interoperability of the equipment, especially in the field of communications, therefore is the first and foremost aim of the international partners to create one of the most important aspects for efficient cooperation. M3TR features maximum flexibility in terms of frequency bands and waveforms for practically all services and platforms.



Photo 43 248/6

Radiocommunications equipment for defence has to satisfy the rapidly growing demands regarding technical progress, economy and flexibility. With its new family of tactical transceivers Rohde & Schwarz takes these aspects into account. In contrast to conventional combat radios with fixed architecture, which only operate in the tactical VHF band, the M3TR (Multimode Multirole Multiband Tactical Radio) features maximum flexibility in terms of frequency bands, waveforms and functions (FIG 1).

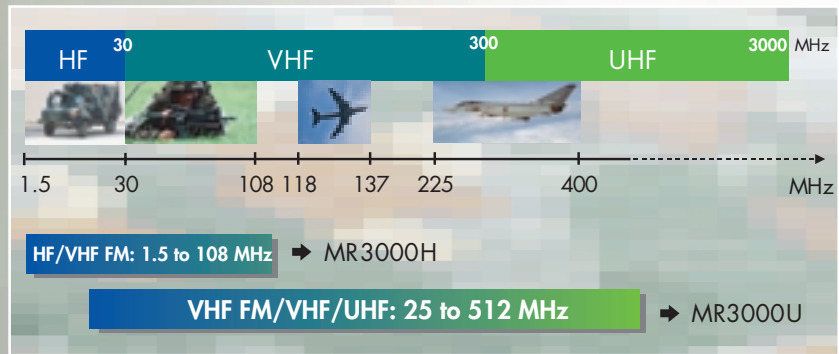
FIG 1 With just two manpack transceivers, M3TR offers all services in the frequency range 1.5 MHz to 512 MHz. Two channels are simultaneously available in VHF FM

The current scenario: like building the Tower of Babel

The present-day tactical communications scenario comprises diverse radio units each covering a subband of the whole HF/VHF/UHF spectrum. This large variety of equipment entails logistic disadvantages and

FIG 2

With just two units, the M3TR transceiver family covers the whole spectrum from shortwave through to UHF, thus providing interoperability and uniform interservice logistics



poor interoperability between the equipment of friendly nations, eg within UN missions.

Different communications standards exist even within NATO and new ones are being prepared. Examples are HAVE QUICK I and II, the future SATURN for UHF or STANAG 4444 for the shortwave band, as well as agreements evolving from the multinational TACOMS POST 2000 study.

Worldwide however, proprietary waveforms or export models that cannot communicate with each other or with restrictions only are predominantly used.

M3TR software radio with its open architecture is a broadband and interservice communication medium that can easily be adapted to present and future applications and waveforms.

The solution with the triple “M”:

... Multiband

The fixed allocation of frequency bands and services, eg combat net radio in the range from 30 MHz to 88 MHz or air defence from 225 MHz to 400 MHz, makes it evident that the multirole features of a radio unit can only be implemented in conjunction with multiband capabilities. For applications making use of various services and networks, two or more independent radio units were previously required. With just two units (MR3000H and MR3000U), the M3TR transceiver family covers

the whole spectrum from shortwave through to the UHF band, thus providing interoperability and uniform interservice logistics (FIG 2).

... Multimode

Thanks to optimized protocols and waveforms M3TR attains high data rates for digital voice, realtime video and visual display data. In command systems this allows among others automated data exchange, for instance for online position display and distribution. With P³I (pre-planned product improvement) even future and planned methods can subsequently be integrated in the equipment through software upgrades. An integrated GPS module synchronizes on demand the system time of the EPM-protected radio circuits and furnishes the current position of the radio operators. These data can be transmitted manually or automatically to the higher-level command system. For optimal utilization of the available frequencies, data and voice can be transmitted simultaneously in a physical channel. M3TR provides for this purpose a special packet data protocol which on request automatically inserts voice packets into the transmission channel. Moreover, SECOS provides a TDMA access method for data transmission in the UHF band.

Data rates (FEC-protected) of 5.4 kbit/s in the shortwave band and of up to 64 kbit/s in the VHF/UHF band can be achieved with a bandwidth of no more than 25 kHz [1].

... Multirole

M3TR offers comprehensive multirole features allowing its easy integration into tactical communication networks (FIG 3). In addition to its use as a functional terminal in the respective subnet, eg CNR (combat net radio) or PRN (packet radio net), M3TR can also act as an interface between the individual subnets. Manpack Transceiver MR3000, for instance, can be used as a radio component in a RAP (radio access point) which establishes the interface to fixed networks such as ISDN/PSTN, LAN and WAN. M3TR is suitable for portable use as well as for use on all mobile platforms and, in addition to the above interfaces, also provides intelligent gateway and relay functions. M3TR is not restricted to use in strictly military networks: by loading the appropriate software the transceivers can be used as terminals in civilian PMR (professional mobile radio) networks. Implementation of the latest ETSI standard TETRA25 is planned.

EPM – protection of communication by frequency hopping and encryption *

In all military applications the effective protection against interception and jamming is in the foreground. In addition to the EPM (electronic protection measures) standard method SECOM specially developed for M3TR, the NATO methods HAVE QUICK I and II, SATURN as well as

SECOM for ground-to-air communication are also incorporated. Other national or proprietary standards such as SINCGARS, PR4G, SEM, etc, can be integrated if required.

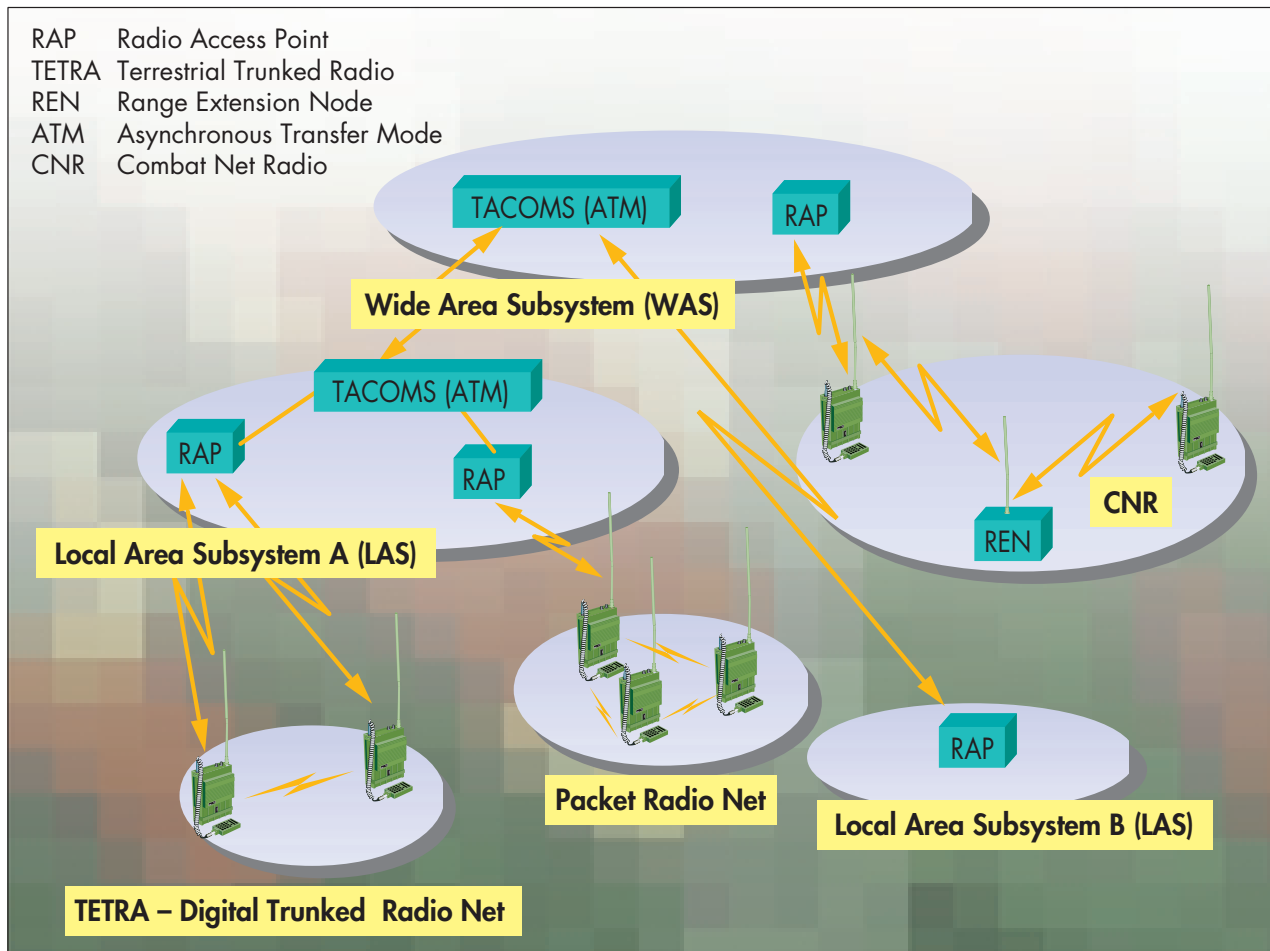
The newly developed SECOM with its extremely high hop rates and secure synchronization method in the HF and VHF bands is setting standards. Within an EPM net, several orthogonal sublinks can simultaneously

be established in point-to-point, point-to-multipoint and broadcast/multicast mode. The system responds fully adaptively (intelligent hopping) or via a preset threshold (mixed mode) to dynamic changes in channel availability and network quality. Intelligent hopping means the continuous checking of the quality of the employed frequencies and elimination of jammed channels from the network. Mixed mode denotes that

* See also article on page 24 of this issue, describing the INFOSEC module for M3TR

M3TR

FIG 3 M3TR software radio not only allows flexible integration into tactical communication networks but can also act as an interface between various networks



at a certain percentage of jammed frequencies (eg 20%) automatic switchover is made from the hopping mode to the FCS (free channel search) mode.

Network synchronization and access can be planned and controlled individually for each user. Methods like late net entry, break-in and hailing are available for this purpose.

The COMSEC part of the SECOM EPM method is based on the RSCA cryptoalgorithm developed by Rohde & Schwarz. The method uses key lengths of up to 256 bits (approx. 10^{77} variants). Assuming uninterrupted transmission, the same bit sequence would be repeated after about 2×10^9 years. The keys required for the EPM method can be distributed by means of a KDD (key distribution device) or via OTAR (over-the-air rekeying). Prior to OTAR all keys are multiply encrypted and the non-encrypted original is saved in the read-protected security processor only.

The COMSEC part also features open architecture. Crypto units to NATO standards or from other manufacturers may be used as an external option, whereas NATO encryption methods can directly be integrated in the transceiver.

Communication management – a must with complex configurations

Planning of radio networks, in particular those with EPM, with manual methods is possible for a few operators only, if at all. The use of computer-aided planning tools is indispensable for complex configurations.

Rohde & Schwarz therefore offers a planning and management software optimized for M3TR. It consists of software modules for key, frequency and network management as well as modules for the configuration of terminals and the distribution of device data. It supports the following applications:

- Network configuration (address management)
- Programming of terminals
- Frequency planning for overall networks and subnetworks
- Security management
- Mission planning
- Time planning
- Data distribution to terminals

The configuration data can be transmitted via any of the M3TR data interfaces, by means of a fill gun (loadable buffer memory) or even via the air interface by means of OTAM (over-the-air management). The link establishment to the transceivers thus set up is then convenient and easy. The operator chooses a mode (network) and activates the push-to-talk key or data transmission mode on the terminal. Everything else is done automatically.

With M3TR communication becomes ever so easy – and there are no bounds to it.

Ulrich Otto

REFERENCES

- [1] SECOS EPM system for the three forces. MIL NEWS from Rohde & Schwarz (1999) No. 2, pp 12–14

M3TR – specs and facts

The two Manpack Transceivers MR3000H and MR3000U providing seamless coverage of the transmission range from 1.5 MHz to 108 MHz (model H) and from 25 MHz to 512 MHz (model U) form the core of the M3TR transceiver family. Both units are designed for reception from 1.5 MHz to 512 MHz. Despite the high processing power – one central processor (RISC), two DSPs and up to two crypto processors – battery operation of up to 57 hours is ensured by effective power management. A total storage capacity of 25 Mbyte allows up to 99 presets including several EPM methods to be saved simultaneously. The presets store all vari-

able parameters of the selected method, such as hopsets, modulation modes and addressing.

Installation kits comprising one or two transceivers plus extras are available for mobile and stationary use. The 10 W RF output power of the manpack (20 W HF) can be boosted to 50 W (up to 400 W HF) using compact amplifiers. Frequency-hop-compatible co-site filters in command vehicles ensure interference-free parallel operation of several lines. An optional switching unit provides interfaces for practically all land-based communication networks. Connections to ISDN/PSTN, TCP/IP, UDP as well as to serial and optical interfaces for data

terminals are therefore supported. Furthermore there are comprehensive remote-control capabilities. The RC unit has the same MMI as the remote-controlled transceiver and can be sited several kilometers away. All settings of the active transceiver are copied to the RC unit.

Are that many technical features portable? Without any doubt: the manpack model of MR3000 weighs as little as 3.5 kg, with a volume of less than 3.5 liters. If this is thought to be still on the high side, the control unit can be detached from the transceiver and set up at a distance of max. 3 m: ideal for portable use or easy installation in vehicles.