CURRENT TRENDS IN TACTICAL NAVAL COMMUNICATIONS

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Abstract: Nowadays secure and protected radio-communications – especially at sea – are more important than ever. Mobile naval forces require reliable, jam-resistant and secure voice and data connections. Standardised communication media has long been part of today's naval communications and are now indispensable. Manufacturers specialising in tactical radio-communications offer state-of-the-art solutions that will soon be standard on naval vessels with up-to-date equipment. Today, many of these methods can be implemented in software-defined radios. In radio-communications, interoperability is a particularly important aspect with multinational forces. It is also a must in the co-operation with allied nations in joint combined operations and partnership for peace (PfP) missions. Prerequisites are standardised waveforms, protocols and methods. The use of digital software radios ensures this right from the beginning. Modern systems for radio monitoring and radiolocation are frequently integrated into the communications system. In addition to well-known transmission media, satellite broadcast systems (SBS) and global broadcast systems (GBS) will soon open up completely new prospects. The trend in naval communication systems is toward a comprehensive integrated information monitoring, command and weapons system.

In times of increased necessity for international crisis management, secure and protected Radio-communications—especially at sea—are more important than ever. Mobile Naval forces require reliable, jam-resistant and secure voice and data connections. Standardised communication media, such as e-mail, Intranet, but also Internet connection via radio, has long been part of today's naval communications and is now indispensable. Manufacturers specialising in tactical Radio-communications offer state-of-the-art solutions that will soon be standard on naval vessels with up-to-date equipment.

Even today, the entire frequency spectrum of VLF, LF, HF, VHF and UHF, as well as UHF, SHF and soon also EHF SATCOM is used to set up communication with units and forces at sea. Which of these transmission media is selected depends mainly on the availability of the information channel in terms of coverage range, transmission

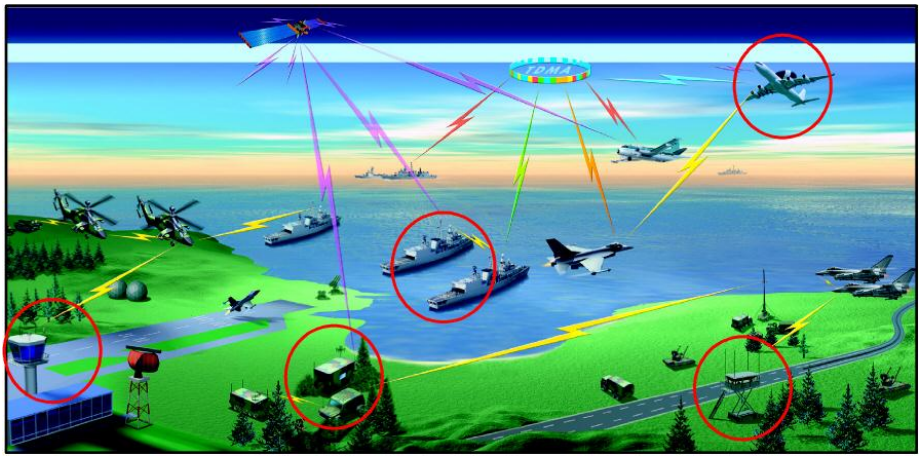

Figure 1: Communications Scenario.

speed and, last but not least, required data rate.

However, the decisive factor is, and will continue to be, the geographical distance to the receiving station. We can distinguish between three such distances: line of sight (LOS), a quasi-optical connection; extended line of sight (ELOS), up to approx. 300 NM; and beyond line of sight (BLOS) for coverage beyond 300 NM. New modulation methods and transmission protocols have contributed to increasing the previously rather low data transmission rates of approximately 2.4 kbps to 9.6 kbps or more in short wave and 16 kpbs to 64 kpbs in the UHF band. Data link methods, such as Link-11, Link-16 and Link-22, play an important role in the exchange of radar data, position data and EW information. These modes permit information exchange about identified contacts, course and speed, as well as target instructions for the assigned weapon control systems and operational commands between the involved units, the maritime headquarters (MHQ) and a commander ashore or afloat. In addition, Link 4/Y is available for the exchange of situation data.

Protection against intentional jamming in the HF range, as well as in the LOS/ELOS range, is a crucial factor in radio system design and influences significantly the transmission waveforms. Standardised methods, such as STANAG 4444, HQ I/II and SATURN, are by now established in naval communications. In the same context, non-NATO COMSEC/TRANSEC methods are used for international operations. Several orthogonal networks can be set up without interfering with each other. With the exception of integrated COMSEC/TRANSEC methods, transmissions must be encrypted additionally to protect them against interception and deception.

Today, many of these methods can be implemented in software-defined radios, which

enables also the subsequent addition of new waveforms or functions via software download. Conventional operating modes are complemented by e-mail, as well as intranet and Internet access.

Important in this context are methods that allow e-mail over the air, such as the R&S Postman II system, which is used to transmit mail, faxes, or TCP/IP service on the Internet or in military intranets via radio. Practical radio demonstrations at the NATO manoeuvre JWID 2001 illustrated that remote stations at sea, on land and in the air were able to participate via short-wave in a coalition-wide area network (CWAN) communication using the STANAG 5066 protocol.

In Radio-communications, interoperability is a particularly important aspect with multinational forces. It is a must among the three forces, but even more so in cooperation with allied nations in joint combined operations and partnership for peace (PfP) missions. Standardised waveforms, protocols and methods are necessary prerequisites. The use of digital software radios ensures this right from the beginning.

The new generation of digital software radios with their multi-band, multi-mode and multi-role capability also complies with the demand for improved performance at lower weight and less space. Unlike the previously fixed allocation of the frequencies

Figure 1: The New Generation of Digital Software Radios.

of radios to sub bands from the HF/VHF/UHF ranges—for example, combat net radio in the range from 30 MHz to 88 MHz or NATO navies from 225 MHz to 400 MHz—these modern multi-band radios cover an ample scope of frequency ranges. Owing to VLSI components with a more complex design, a multi-band radio can thus replace several conventional Transceivers. Long operational life is another demand placed on this type of unit: a useful life of 20 years or more calls for future-oriented concepts that allow inexpensive and flexible fitting and retrofitting at any time. The R&S M3xR product series from Rohde & Schwarz is a proof that high modularisation and a joint platform concept meet the above requirements. Thus, even future or planned methods can be retrofitted as software extensions owing to the pre-planned product improvement (P^3I) concept.

New waveforms (e.g. SATURN, STANAG 4444), protocols (e.g. STANAG 066) or possibly even methods such as TETRA may be loaded onto the unit from a laptop using a fill-gun (loadable buffer) or even directly via the air interface (over the air management, OTAM), without any hardware modifications being necessary.

Figure 2: A Modern Console.

The signals management and control system SiMCoS, which can be set up by means of flexible network topology, is an example of a contemporary hardware and software solution for processing and distributing information. Systems of this kind typically include subsystems such as the automatic message handling system (AMHS), frequency and antenna management (FAM) and computer-aided workstations for the operators. They are based on an open processor structure that includes the use of asynchronous transfer mode (ATM) processors, synchronous digital handling (SDH)/Giga Ethernet or similar high-speed data bus systems. The systems are designed as modern local area networks (LANs) with server clusters and computer workstations operating in a client/server configuration.

AMHS includes text processing in ACP 127/123/mil.X.400 format (STANAG 4406) for transmitting and receiving messages (teletype, fax, and data) and is connected to the external communication system. For the transmission or reception of encrypted data, separate lines with high cross-talk attenuation have to be switched, taking into account RED/BLACK separation. High-priority data—for situation display, for example—can be connected with any communication line, provided that the line is equipped with high-speed data modems. SiMCoS automatically handles all routine work and, as expected, also includes automatic routing functions.

Even in the event of a power supply failure, AMHS is protected against data loss and ensures 100% redundancy, as well as secure and error-free storage of all information. All vital communication subsystems of a ship are interconnected. There are no restrictions for InterCom system and digital information distribution system (IDS) switching, onboard loudspeakers, alarm systems or the FAM system.

Especially the latter is indispensable in a modern naval communications system, since it supports the radio operators by suggesting the optimum available radio link on the basis of a selection of operational data. For this purpose, information about the desired distance, date and time of day (HF links), as well as the direction of the receiving station and, last but not least, the S/N ratio of transmitter/transmitter and transmitter/receiver is evaluated. These FAM suggestions about the frequency band to be used, the frequency, the optimum output power and the most suitable antenna available all form an integral part of the automatic message handling system.

Modern systems for Radio-monitoring and radiolocation are frequently integrated into the communication system, e.g. the R&S COMINT (communication intelligence) suite. These systems are used to search for, detect and process communication signals in the 10 kHz to 3 GHz frequency range. They include special antennas, state-of-the-art receivers, digital direction finders, as well as recording and analysis equipment.

In addition to the well-known transmission media, such as HF/VHF/UHF radio and SATCOM, satellite broadcast systems (SBS) and global broadcast systems (GBS)

with their data rates of several Mbps will soon open up completely new prospects. In particular, with regard to communication via Internet, which is increasingly gaining importance (e.g. database access, voice over IP), these media ideally complement the previous mainly narrowband media. The US projects Joint Maritime Command Information System (JMCIS) and Maritime Command, Control and Information System (MCCIS) of the German Navy are the first projects in this field. In most cases, however, the Internet applications involve asymmetrical communication: a relatively short request results in a far larger data stream in response. This can be remedied by combining narrowband media, such as HF for request purposes, and broadband media, such as GBS for data download from the Internet. Future transmission paths are expected to be a mix of well-known transmission media, where not only military but also economic criteria are of importance. A crucial aspect will be the increased integration of COTS (commercial off-the-shelf) products.

The trend in naval communication systems is toward a comprehensive integrated information monitoring, command and weapons system. This system will cover all external radio and telephone frequencies, as well as onboard command functions, thus providing considerable support for the operator and making the conventional radio operator on board the information manager.

The large extent to which EDP has become part of naval command systems, especially on ships and vessels, is striking. The era in which EDP was viewed rather critically and with only limited acceptance finally seems to have been relinquished to the past.

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