TACTICAL RADIOS

AN ARMADA INTERNATIONAL COMPENDIUM SUPPLEMENT

2018/19

ARMADA INTERNATIONAL : THE TRUSTED SOURCE FOR DEFENCE TECHNOLOGY ANALYSIS

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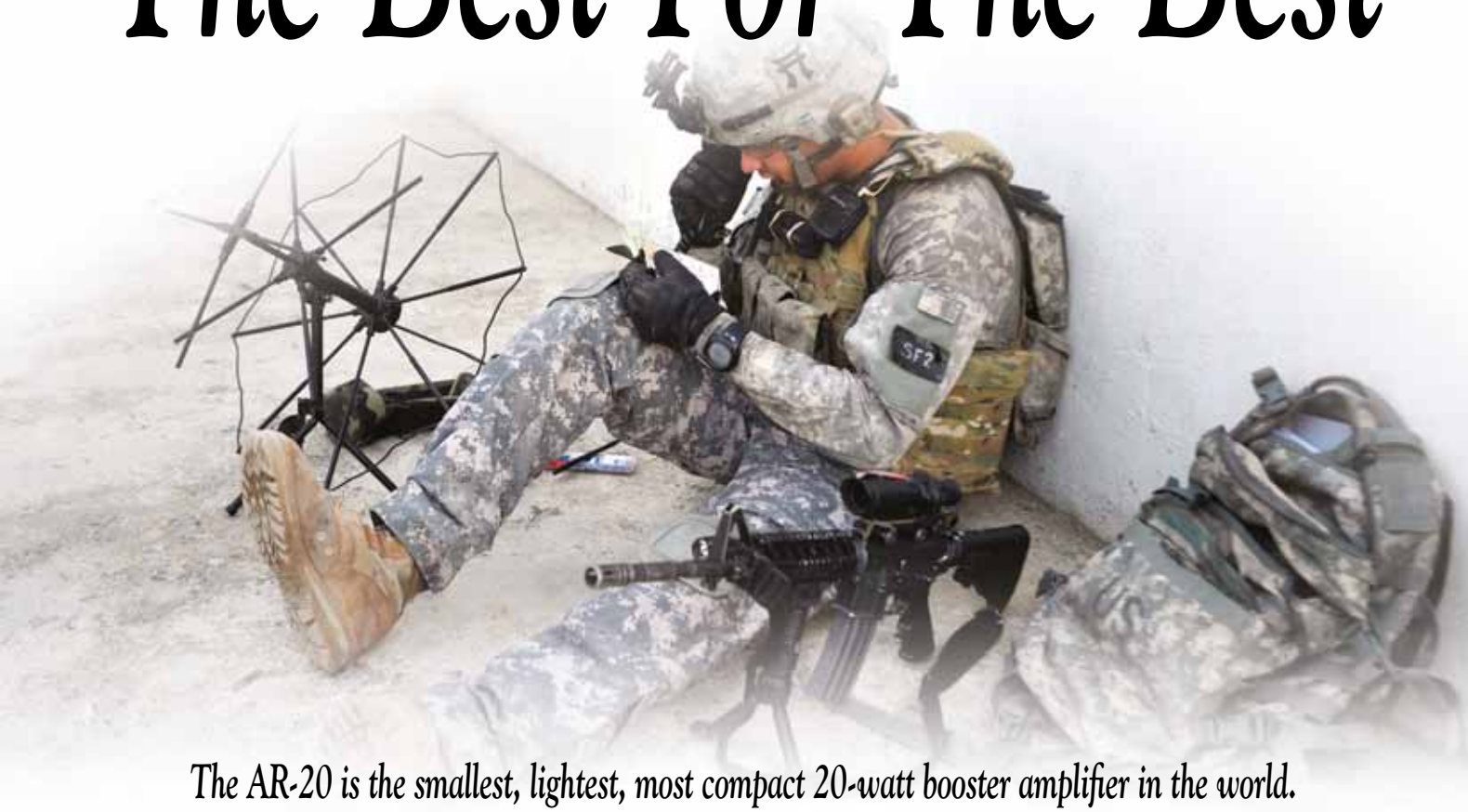

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USMC

Isolated foot patrols in potentially hostile territory rely on their radio communications to connect them with supporting elements as well as staying in touch with each other.

TACTICAL RADIOS - THE FUNDAMENTALS OF CONNECTIVITY

A quick guide to the radio connectivity, the limitations and the advances that digitisation has enabled.

Peter Donaldson

A radio is a lifeline, and without one a soldier can easily become isolated. Communication is a force multiplier, and a radio can even be considered a weapon, perhaps the primary weapon for a reconnaissance soldier or vehicle. Hardest to cater for are special operations forces and dismounted soldiers, particularly when operating either in very remote locations or in difficult radio frequency (RF) conditions such as urban canyons and inside buildings, when fundamental limitations of radio propagation can put them out of contact. Technological developments seek to address these issues while providing troops with an ever widening set of data driven services.

Rivalled only by small electro-optical reconnaissance and targeting devices with night vision capabilities, the single category of military equipment that has gained the

MUOS satcom in manpack radios brings unlimited range and almost global coverage to secure communications for dismounts. This is Harris RF-3169-AT001 UHF antenna for the AN/PRC-117G radio.

most capability in recent years is the tactical radio, particularly those issued to dismounted soldiers. While they are generally still green or brown boxes that can either be held in one hand, strapped to webbing or carried in a backpack, the quantity and variety of information they can provide to users within the Size, Weight and Power (SWaP) envelope have increased significantly.

DATA DIVERSITY

The kinds of information small portable radios can handle has expanded far beyond voice only with the addition of data, still imagery and video including real time feeds from unmanned vehicles, and in some cases they permit ground troops to request UAV operators to direct the vehicles to reconnoitre particular targets, to control the sensors or even the vehicle itself. They also represent a key enabling technology for the soldier-as-a-sensor concept in that they not only empower soldiers to report what they see using voice and text, but they also allow them to feed imagery directly from their observation devices and weapon sights into local tactical networks and further up the chain of command.

Founded on digitisation, Software Defined Radio (SDR) is arguably the most important technological advance in a generation because separating the hardware-defined RF functions from the information processing has given radios the flexibility of modern computers when it comes to improving and adding to their capabilities by downloading updates and complete new waveforms, which are analogous to software applications downloaded to a computer, tablet or smartphone. (See the accompanying article for more).

Harris

PHYSICAL LIMITS

However, the technology is still ultimately governed by the physical laws of radio propagation that describe how signal strength falls off with distance from the source, how different frequencies pass through or are absorbed by the gasses, vapours and dust in the atmosphere, by the materials and structures in the environment signals will pass through or reflect from.

There is a fundamental trade-off between the effective range of a radio and the data rate, or the quantity of information it can transfer in a given time. Like all electromagnetic radiation, radio waves are defined by the three properties of amplitude, frequency and wavelength. The latter pair are inversely related in that the longer the wavelength the lower the frequency, and vice versa, the wavelength being the distance from the peak of one wave to the peak of the next, and the frequency being the number of complete waves that pass a fixed point in a second at the speed of light. While the amplitude is the height of the wave, or the distance from the peak to the trough of the same wave, all other things being equal, the larger the amplitude, the more powerful the signal.

FREQUENCY BANDS

Most tactical radios operate in the Ultra High Frequency (UHF) and Very High Frequency (VHF) portions of the spectrum for short and medium range communications, with longer range capabilities provided by High Frequency (HF) sets or satellite communications (SATCOM) systems, which also use UHF and sometimes higher frequencies because their direct view of the satellite overcomes the line-of-sight restriction that limits the range of terrestrial UHF sets.

WiFi systems including 802.11 and WiMax 802.16 overlap with UHF and 802.11 goes much higher, and Long Term Evolution (LTE) 4G communications also use UHF frequencies, and militaries are looking to integrate all of these into short-range, high data-rate networks.

Using frequencies between 300MHz and 3GHz according to the International Telecommunications Union (ITU), UHF offers high data rates over short ranges, small antennas and lightweight hardware and is commonly used in Soldier Radio (SR) or Personal Role Radio (PRRs) networks. Although their signals are blocked by hills and large buildings, they penetrate walls well enough for indoor reception.

Next in terms of range are VHF sets, which operate over the 30MHz to 300MHz frequency band. Although VHF signals are blocked by hills and mountains, they are slightly bent by the atmosphere and therefore can reach beyond the visual horizon out to ranges of about 100 miles, offering moderate data rates. VHF is the realm of Combat Net Radio (CNR) systems that provide command and control of tactical ground forces down to platoon level, with platoon commanders therefore commonly issued with radios with both VHF and UHF capabilities for communications up and down the chain of command.

Both UHF and VHF can suffer from multipath interference that caused by signals reflected from buildings or canyon walls, for example, arriving at the antenna at the same time, with UHF being more susceptible. However, advanced Multiple Input, Multiple Output (MIMO) techniques such as Orthogonal Frequency Division Multiplexing (OFDM) can take advantage of multipath reflections, reassembling signals from reflected fragments.

Immediately below VHF in the communications bands are HF frequencies from 3MHz 30 MHz, which can provide intercontinental range at lower data rates independent of SATCOM or other

UK MOD

Personal role radios operate in the UHF frequency band, providing short range, high-rate communications and locateion reporting among dismounted squads and with supporting vehicles.

infrastructure, principally by exploiting reflection from the ionosphere.

However, ionospheric propagation is complex and variable because it is affected by several factors including the time of day, how close the radio is to the solar terminator (the line that separates day from night), the season, the sunspot cycle and other solar activity and polar auroras. These factors all affect the maximum usable frequency, the lowest usable frequency and the frequency of optimum transmission. In the past, these issues made HF radios difficult to use, but the development of Automatic Link Establishment (ALE) techniques in software has made them a much more user friendly and practical proposition for troops in the field, and HF manpacks are increasingly widely deployed.

EXTENDED REACH

Efforts to extend the reach of tactical radios without sacrificing bandwidth include adding secure satcom capabilities such as the US Mobile User Objective System (MUOS) dedicated narrowband military UHF system to multi-band V/UHF manpack radios loaded with multiple waveforms.

Another approach is to integrate radio relays and gateways that translate between different waveforms into airborne platforms including manned aircraft, tactical, medium and high-altitude UAVs and aerostats to act as flying cell towers to take signals over geographical and human-made obstacles and compensate for the lack of fixed terrestrial infrastructure.

EMBEDDED INFRASTRUCTURE

Modern tactical radios increasingly run software that enables them to form Mobile Ad-hoc Networks (MANETs), which automatically route messages from a sender to a receiver or a sender to many receivers over the most efficient path. They also perform security chores such as authentication whenever a radio joins or rejoins a network, interrogating any that might be compromised and adjusting the level of trust they are given and even isolating them if necessary. They also implement countermeasures against interception, geolocation and eavesdropping with techniques including frequency hopping, power management, spread spectrum and encryption, recognising the uncomfortable truth that a radio is also an emitter that can reveal a soldier's position.

Smaller, lighter and generally more capable, tactical radios also contribute to situational awareness through more than being communications bearers for tactical data. They are increasingly sources of critical data themselves thanks to embedded GPS receivers, unique identifiers that can show a soldier where his or her squad mates are through Blue Force Tracking functions, displayed on a separate end-user device such as a smartphone or tablet, or on a small screen on the radio itself.

Through robust networking, reliable communications within squads and back up the chain of command, improved situational awareness, integration with sensors and UAVs and convergence with familiar consumer electronics, modern tactical radios are bringing the dream of connectivity everywhere closer to reality than ever before. A

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CODAN
RADIO COMMUNICATIONS

PRC-9651 V/UHF Handheld — Aselsan

Power: 0.5, 1, 2.5, 4Watts (W)
Frequencies/waveforms: 30MHz to 512MHz in 1,300 preset channels, software architecture supports Aselsan's CNR, SK2 VHF, 5100, SK2 UHF, A-CNR, NBNR waveforms and V/UHF-AM.
Security: Frequency hopping, direct sequence spread spectrum, voice & data encryption in waveforms
Weight: 1.4kg
Notes: SDR designed to provide continuous audio, data and video communications for the tactical at up to 64kbps.

PRC-5712 Soldier Radio — Aselsan

Power: 125mW
Frequencies/waveforms: 380MHz to 400MHz, 99 pre-set channels
Security: Encryption optional, whisper function
Weight: less than 370g with antenna, NiMH battery
Notes: Provides voice and data comms in talk groups of up to five with others monitoring, range up to 1km in rural terrain. Full duplex capability enables conferencing and VOX.

PRC-5333 Sahara V/UHF Handheld — Aselsan

Power: 5W max
Frequencies/waveforms: 30MHz to 512 MHz, wideband and narrowband networking waveforms, proprietary SK2 V/UHF
Security: Encryption & frequency hopping for voice & data
Weight: 950g with battery, without antenna
Notes: New Software Defined Networking Radio (SDNR) for continuous audio, high speed data and video comms & situational awareness. Built-in GNSS, camera, 4-in multi-touch screen.

PRR 1 — AT Electronic and Communication International

Power: 100mW EIRP max
Freqencies/waveforms: 2.4GHz, spread spectrum, 240 operating channels, eight selectable nets
Security: Time hopping, frequency hopping and OFDM resist interception, jamming.
Weight: 0.23kg (radio), 0.22kg (battery pack)
Notes: Voice and data radio for units of up to 30 with up to four simultaneous calls rebroadcast option, works among buildings and in open terrain at up to 1,000m.

PRR 1M — AT Electronic and Communication International

Power: 100mW EIRP max
Frequencies/waveforms: 2.4GHz, spread spectrum, 240 operating channels, eight selectable nets
Security: Time hopping, frequency hopping and OFDM resists interception, jamming.
Weight: 1kg
Notes: PRR designed for operation within groups of up to 30 users allows for full duplex communication in ad-hoc digital networks, needs no additional infrastructure. Can link to another network through transceiver connected via USB.

2090 HF manpack transceiver — Barrett Communications

Power: 10W to 30W PEP
Frequencies/waveforms: 1.6MHz to 30MHz, operates in J3E (USB, LSB), H3E (AM) J2A (CW) J2B (AFSK) modes
Security: Secure Call narrowband voice encrypter, optional DES 56 with fall-back to analogue FFT scrambler.
Weight: 3.9kg plus 1.3kg li-ion battery pack
Notes: A low-cost, high-performance HF manpack, 2090 features optional 2G Automatic Link Establishment (ALE).

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BLD100 Tactical Radio — Benelec

Power: 1W to 3W
Frequencies/waveforms: VHF 30MHz to 88MHz, full civilian CTSS squelch, standard military 150Hz sub-audio tone
Security: external encryption modules
Weight: 0.295kg inclucing battery & antenna
Notes: Fixed frequency handheld radio in IP67 housing, complies with Mil Std 810C, D, E & F. Features built-in data modem.

BL350U UHF FM tactical radio — Benelec

Power: 2W to 4W
Frequencies/waveforms: 380MHz to 420 MHz, up to 128 channels with 12.5Hz or 25Hz spacing
Security: AES 256bit encryption optional
Weight: 0.285kg inc 1700mAH Li-ion battery
Notes: Up to 14 hour battery life, IP54 water & dust protection, priority channel & talkback scaning, 1,200/2,400 baud modem, programming via USB, voice operated transmission (VOX).

Tough SDR Handheld — Bittium

Power: 5W (PEP)
Frequencies/waveforms: 30MHz to 2500MHz/ Bittium Narrowband Waveform, Bittium TAC WIN Waveform with data throughput up to 25Mbps, ESSOR High Data Rate Waveform, supports porting of legacy and national waveforms
Security: Red/black separation, secured boot, tampering detection & response, emergency erase, COMSEC and TRANSEC allowing implementation of national algorithms, Application Sandbox for customer applications
Weight: 950g with battery
Notes: SDR-based tactical handheld radio for individual soldiers, such as squad or platoon leader, providing a uniquely wide frequency range. With flexible configuration options and routing networks, supporting 'thousands' of radios in one network. Built-in GNSS, camera, 4-in multi-touch screen.

PRQ-7 Combat Survivor Evader Locator (CSEL) — Boeing

Power:
Freqencies/waveforms: VHF, UHF, satcom
Security: TNSA certified encryption and decryption of OTH and LOS messages
Weight: 0.9kg
Notes: When activated by the Isolated Person (IP), 6-channel CSEL handheld automatically transmits the IP's GPS location and identification and enables the IP and rescue centres to exchange messages.

2110M Manpack (Military) — Codan Radio Communications

Power: 5W or 25W selectable
Frequencies/waveforms: 1.6MHz to 30MHz Tx, 250kHz to 30MHz Rx, all in 10Hz steps
Security: CES-128 & AES-256 voice encryption & internal frequency hopping options
Weight: 2.9kg or 5kg with 8Ah NiMH battery, 0.3kg smart handset
Notes: Features 2nd Gen digital voice technotogy, over 60 hours battery life, STANAG 4538 and Mil Std 188-141B ALE, integrated GPS receiver.

Sentry-V Handheld VHF Radio — Codan Radio Communications

Power: up to 5W
Frequencies/waveforms: Optional bands: 30MHz to 88MHz or 136MHz to 174MHz. Supports 12.5kHz / 25kHz channel spacing, analog FM, DVOA, P25 conventional/ trunking & DMR
Security: Optional AES 256 encryption, over-the-air zeroise to disable compromised radios
Weight: 0.58kg with Li-ion battery
Notes: Features built-in radio repeater, GPS positioning & report, shows group member positions on screen, text & image transmission, voice recording, Bluetooth smartphone link.

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PRC7700H manpack — Datron

Power:	100W
Frequencies/waveforms:	TX: 1.5MHz to 30 MHz (10Hz steps), RX: 100kHz to 30MHz/ waveforms, modulation types, wide & narrow bands, and communications security can be updated via software
Security:	Integrated high-level encryption option with front panel quick-connect key fill port and zeroize button
Weight:	
Notes:	IP-addressable, digital, ALE-capable HF manpack SDR combining DSP-IF circuitry and powerful microprocessors, also suitable for mobile, rack-mounting or desktop use.

PRC1099A — Datron

Power:	5W to 20W, PEP or average, manpack; 5/20/100/400W in mobile configuration
Frequencies/waveforms:	1.6MHz to 30 MHz, 10Hz Steps, 100 programmable channels/
Security:	optional add-on
Weight:	4.4kg plus 2.4kg battery pack
Notes:	Rugged (MIL-STD-810), immersible manpack with internal automatic antenna tuner, remotely controllable and with FED-STD-1045A ALE capability.

PRC2100V — Datron

Power:	Up to 10W (Manpack) & 75W (mobile or base station
Frequencies/waveforms:	30MHz to 88MHz, 100 programmable channels
Security:	Embedded ECCM, COMSEC for voice and data
Weight:	4.2kg plus 1.8kg battery pack
Notes:	Interoperable in all encryption and hopping modes with the HH2100V handheld radio, can be used in a network to provide base station, vehicle, manpack, or retransmit capabilities.

PRC1077V — Datron

Power: 500mW, 2W and 5W selectable
Frequencies/waveforms: 30MHz to 88 MHz, 15 channel presets
Security: optional voice scrambler
Weight:
Notes: Interoperable in FM clear-voice mode with Datron Squad Radio family and most other single-channel 30MHz to 88MHz VHF/FM radios using a 150Hz tone-squelch or CTCSS squelch system

HH2100V Spectre-V — Datron

Power: Up to 5W output power in three programmable steps
Frequencies/waveforms: TX: 1.5MHz to 30MHz (10Hz steps), RX: 100kHz to 30MHz
Security: Supports all Spectre-V family hopping and encryption modes, embedded ECCM, COMSEC
Weight: 1.2kg with battery
Notes: Meets MIL-STD-810 for reliable operation in harsh environments, accurate position and time-of-day capability is afforded by the embedded GPS receiver, offers short messaging

HH7700 — Datron

Power: 500mW, 2W and 5W, user selectable
Frequencies/waveforms: 30MHz to 88MHz
Security: optional embedded voice scrambler
Weight:
Notes: compact and lightweight VHF/FM handheld transceiver, offers VOX for hands free operation and whisper mode, interoperable in FM clear-voice mode with Datron Squad Radio family

HH3100 Spectre M — Datron

Power: up to 7.5W
Freqencies/waveforms: 30 MHz to 512MHz (depending on model), 100 programmable channels
Security: Embedded ECCM & COMSEC with Spectre 40, 64, and new AES-256
Weight: 1.2kg inc battery
Notes: Spectre M family offer secure communications in ruggedised form-factors, provide a sophisticated feature-set, and utilise a simplified user interface, includes three versions: HH3100V, HH3100A, and HH3100M. Ground-to-Air AM operation in some models

RF13 Portable VHF Transceiver — Dicom

Power: 0.2W, 5W, 50W
Frequencies/waveforms: 30MHz to 88MHz, 2,320 channels with 25kHz spacing, nine presets
Security: internal digital voice encryption
Weight: Transceiver weighs 2.5kg without batteries or accessories, < 10.9kg for complete set in carrying bag with spare battery
Notes: Integrated VHF communications system based on RF13 portable radio transceiver has been developed, provides selective calling for up to 99 users

RF23 EPM Multiband Handheld Transceiver — Dicom

Power: 2W nominal, 0.2W reduced, 5W increased (FM), 1W nominal, 0.1W reduced (AM)
Frequencies/waveforms: 25MHz to 146MHz
Security: Voice & data encryption, emergency erasing of operational data in fixed frequency channels, including encryption unit codes and FH network data
Weight: 0.85kg (transceiver), 0.3kg or 0.45kg (battery pack)
Notes: Voice and data transceiver for tactical command; features enhanced resistance to EW. Uses TNC connector to expand range of antennas; features inbuilt GPS receiver with location information distributed with voice or data as a part of the waveform.

TACTICAL RADIOS LISTING

RF2305 Manpack — Dicom

Power:	5W FM, 1W AM
Frequencies/waveforms:	25MHz to 146MHz
Security:	Voice & data encryption, emergency erasing of operational data in fixed frequency channels, including encryption unit codes and FH network data
Weight:	4kg
Notes:	Tactical command radio based on RF23, range increased to 15km with improved antenna & counterweight, maintains complete RF23 functionality

RF40 Handheld — Dicom

Power:	5W normal 10W burst
Frequencies/waveforms:	30MHz to 512MHz, LOS FM/AM (STANAG 4204/4205), WF40 (VHF/UHF MANET waveform), HW20 (VHF EPM waveform)
Security:	AES-based encryption, up to 384 bit key length 0.9kg inc battery pack
Notes:	Back compatible with RF20, multi-channel radio with simultaneous voice & data capability, integral GNSS receiver for GPS, GLONASS & Galileo systems, will accept further legacy and custom waveforms

TWH-101 and TWH-104 Personal Radios — EID Tactical Radio Systems

Power:	100mW for TWH-101R and 400mW for -104R
Frequencies/waveforms:	Operates in the 2.4GHz ISM band with low-probability-of-detection TDMA waveform.
Security:	AES encryption, user downloadable keys
Weight:	225g to 680g including batteries
Notes:	Provides full-duplex audio conference, simultaneous data, dual PTT, stereo operation, VOX, whisper mode, voice prompt menus, automatic network management, embedded GPS/GLONASS.

TWH-104G1 and TWH-104G3 Portable Gateways — EID Tactical Radio Systems

Power:	400mW
Security:	AES encryption
Range:	2km line of sight
Maximum data rate:	115.2kbps
Weight:	0.225kg inc batteries: 9VDC to 33VDC in TWH-104G1, 3VDC from 2 x LR6 cells or 2 x NiMH LR6 rechargeable batteries
Notes:	Creates a gateway between a TWH network and external equipment such as CNR, legacy radios etc.

Micom 3 Pathfinder manpack — Elbit Systems of America

Power:	25W
Frequencies/waveforms:	1.6MHz to 30MHz HF-SSB, 200 preset channels
Security:	Digital AES vocoder encryption, internal modem with optional AES encryption
Weight:	3.6kg without battery
Notes:	Provides long-range communications in demanding dismounted operations. Automatic Link Establishment per MIL-STD-188-141B standard.

PNR-500 Personal Network Radio — Elbit Systems Land & C4I Tadiran

Power:	up to 800mW
Frequencies/waveforms:	380MHz to 430MHz or 400MHz to 450MHz UHF, 100kHz channel spacing, 15 presets
Security:	AES encryption
Weight:	Under 430g including battery
Notes:	Offers SOF, snipers & CT units simultaneous voice and data communication at ranges to 1,500m, long-range links via VIC-500 vehicle intercom or tactical VHF/HF radio.

PNR-1000A Personal Network Radio

Elbit Systems Land & C4I Tadiran

Power: 0.5W, 1W, 2W adjustable
Frequencies/waveforms: 225MHz to 512 MHz
Security: AES 256 encryption based on FIPS 197 standards
Weight: < 0.36kg
Notes: E-Lynx family SDR for dismounts providing full-duplex voice, data and video, ad hoc networking for 64 members. Self-synchronises without master station or GPS, features embedded GPS position reporting.

CNR-710 Handheld

Elbit Systems Land & C4I Tadiran

Power: 5W, 20W with amplifier
Frequencies/waveforms: 30MHz to 88 MHz VHF/FM, 25kHz channel spacing, 10 presets, software controls programming, network management, data comms etc
Security: Voice and data encryption, advanced frequency-hopping synchronisation
Weight:
Notes: Handheld member of CNR family. Features synchronous/asynchronous data transmission, error correction coding, automatic data rate adaptation. More powerful manpack, airborne & vehicle configurations available.

CNR-710MB multiband radio

Elbit Systems Land & C4I Tadiran

Power: 5W handheld & manpack, 20W high-power manpack, vehicular & airborne
Frequencies/waveforms: 30MHz to 512MHz, 25kHz channel spacing, 20 preset channels
Security: Digital COMSEC, orthogonal frequency hopping ECCM
Weight:
Notes: Multi-band radio providing ground, sea, and air units with wide frequency coverage and waveforms. Dynamic network synchronisation eliminates the need for a central control station.

MTCR-7200 V/UHF radio

Elbit Systems Land & C4I Tadiran

Power: 5W (handheld), 50W high power
Freqencies/waveforms: 30MHz to 512MHz narrowband waveform, 225MHz to 512MHz wideband waveform, designed to Software Communications Architecture (SCA) requirements
Security: AES256 encryption and Elbit/Tadiran algorithm, synchronous orthogonal frequency hopping
Weight: 0.68kg (handheld, without battery)
Notes: Family of multi-waveform tactical IP SDRs, supporting triple-play and full mobile tactical ad hoc networking in all terrains and scenarios, availabel as handheld, manpack, vehicle & marine configurations. Simultaneous voice, video on same network channel.

PRC-434G/CS survival radio

Elbit Systems SAR and Data Links - Elisra

Power: approx 1W UHF & 121.5MHz
Frequencies/waveforms: 225MHz to 299.975MHz + 121.5MHz, 3,000 channels in 25kHz steps
Security: Encrypted individual identification code assigned to each user; LPI/LPD
Weight: less than 0.85kg
Notes: ASARS- and NATO-compatible radio featuring automatic activation, transmission of GPS location data and digital emergency messages, can be activated by another PRC-434. Endurance of 30 hours at 1:10 Tx/Rx ratio.

Hook 3 combat survival radio

General Dynamics Mission Systems

Power: 1W – UHF; capable of 5W (FM), 200mW – VHF; capable of 2W (FM), 406 SARSAT 5.0W min, UHF SATCOM 5.0W ± 2dB
Frequencies/waveforms: 121.5MHz, 123.1MHz; 225MHz to 320MHz; capable of 100MHz to 512MHz; 406 SARSAT, Hook 2 & satcom
Security: Hook 2 waveform is secure, 256bit AES encryption for satcom
Weight: 0.624kg
Notes: New Hook family CSAR radio that is smaller, lighter and more power-efficient than its predecessors. Fully compatible with existing Hook 2 radios, Quickdraw2 interrogator, satcom base station.

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AN/PRC-112G Transceiver — General Dynamics Mission Systems

Power: 1W (UHF), 100mW (VHF), 5W min (406 SARSAT), 5W +/- 2dB (UHF satcom)
Frequencies/waveforms: 121.5MHz and 123.1 MHz, 225MHz to 320MHz and 406MHz SARSAT4, Hook 2 waveform
Security: 256bit AES encryption , low probability of interception/detection through encrypted two-way burst data transmission
Weight: 0.78kg without batteries (typical)
Notes: Position accurate to 25m, automatic response to interrogation; uses canned, pre-programmed, free-format and situation report encrypted messages. Provides Terminal Area Communications/ Terminal Area Guidance (TAC/TAG).

AN/PRC-154A Rifleman Radio — General Dynamics Mission Systems

Power: Selectable up to 5W
Frequencies/waveforms: 225MHz to 450MHz, 1250MHz to 1390MHz, 1755MHz to 1850MHz, SRW and future waveforms
Security: Programmable COMSEC and TRANSEC, Type 1, Type 2, not a Controlled Cryptogrphic Item (non-CCI)
Weight: 0.767kg with battery, 0.43kg without
Notes: Small handheld networking radio providing secret or sensitive-but-unclassified communication for leaders or squad members in a single non-CCI device, designed to operate with AN/PRC-155. Compatible with Sidewinder vehicle mount.

AN/PRC-155 Two-Channel Manpack Radio — General Dynamics Mission Systems

Power: 20W or 50W with external amplifier
Frequencies/waveforms: 30MHz to 2200MHz (banded) 121.5MHz VHF and 243MHz UHF guard channels/SRW, MUOS, SINCGARS, SATCOM
Security: COMSEC and TRANSEC (Types 1 & 2)
Weight: 4.7kg or 6.6kg with battery
Notes: Software defined ad hoc networking radio with embedded encryption and GPS; designed to be reconfigurable and interoperable with current and future radio platforms; extends classified network beyond vehicles.

AN/PRC-150(C) HF Manpack Radio — Harris Tactical Communications

Power: 1W, 5W, 20W PEP, -1/+2dB (1W, 5W, 10W FM)
Frequencies/waveforms: 1.6MHz to 60Mhz/HF features: encrypted data, ALE, frequency hopping, vocoder, data link layer protocol, VHF features: vocoder, encrypted data
Security: US Type-1 and coalition encryption, enhanced frequency hopping
Weight: 4.7kg without batteries
Notes: Falcon III family advanced HF-SSB/VHF-FM secure voice and data manpack radio. Provides up to 9,600bps (HF), and selectable ARQ modes reduce on-the-air transmission time and enhance secure data transmission.

AN/PRC-152A Wideband Networking Radio — Harris Tactical Communications

Power: user selectable 250mW to 5W, 10W satcom mode
Frequencies/waveforms: 30MHz to 520MHz and 762MHz to 870MHz. NB: AM/FM, VULOS, SINCGARS & HAVEQUICK I/II (standard), HPW, HPW IP, APCO P25 Phase 1 trunking, conventional and OTAR (optional). WB: ANW2C (standard), SRW (optional). UHF satcom: Mil-Std-188-181B dedicated channel is standard, Mil-Std-188-182A, 183A DAMA, Mil-Std-188-181C, 183B IW Phase 1, High Performance Waveform (HPW) & HPW IP, SATCOM TDMA capability waveform, all optional.
Security: Sierra II programmable crypto, secret or sensitive but unclassified
Weight: 1.22kg max with GPS, battery and antenna
Notes: Handheld networking SDR for simultaneous voice and data, including video.

AN/PRC-117G Wideband Multi-band Multi-mission Radio — Harris Tactical Communications

Power: NB 10W, satcom 20W; WB 20W peak, 5W average
Frequencies/waveforms: 30 MHz to 2GHz. NB: AM/FM, VHF/UHF LOS, SINCGARS, Havequick I/II standard, SATURN, APCO P25 & P25 OTAR optional; WB: SRW, ANW2 C, ROVER III L-Band receive (optional)
Security: Sierra II-based, Type 1 encryption for WB/NB NSA-certified top secret and below
Weight: 3.7kg without battery, 5.44kg with
Notes: Software defined tactical radio focused on wideband data, interoperability with fielded waveforms.

Falcon III AN/PRC-158 Multi-Channel Manpack

Harris Tactical Communications

Power: Narrowband: 10W, SATCOM: 20W; Wideband: 20W
Frequencies/waveforms: 30MHz to 2.5GHz NB: VHF 30MHz to 225MHz, UHF 225 MHz to 2.5GHz. NB waveforms: AM/FM, VHF/UHF LOS, SINCGARS, Havequick, (SATURN, APCO P25 capable) ; WB waveforms: SRW, ANW2C
Security: Sierra II-based, Type 1 (Suite A/B) NSA certified Top Secret and below
Weight: 5.76kg inc battery
Notes: Each channel can be used to transmit and receive simultaneously. Can run MUOS satcom without changing power amplifier.

RF-330-E-HH wideband networking handheld

Harris Tactical Communications

Power: 3.2W max, user selectable
Frequencies/waveforms: UHF: 225MHz to 450MHz, 99 channel presets (L-Band: 1250MHz to 1390MHz and 1755MHz to1850MHz, extention to 2.5GHz optional)/ ANW2C, others available
Security: Type 3 AES 256 for voice, video & data
Weight: 0.576kg
Notes: Lightweight radio designed for operations in geographically challenging environments. Can serve as a 'black' relay for secure, encrypted video and data between multiple Type 1 tactical sets.

RF-7800H-MP wideband HF/VHF radio

Harris Tactical Communications

Power: HF: 1W, 5W, 20W PEP; VHF: 1W, 5W, 10W FM
Frequencies/waveforms: 1.5MHz to 59.999MHz/ Fixed frequency, 2G ALE, 3G ALE, Serial Tone ECCM Falcon II, Interoperable, VHF FM, 75 channel presets
Security: Citadel, CAM (Customer Algorithm Modification), AES, AVS (Analog Voice Security)
Weight: 3.9kg without batteries
Notes: RF-7800H-MP manpack provides wideband data performance and interoperability with fielded Falcon II HF radios. Synchronous and IP applications include Harris Wireless Messaging Terminal, Tactical Chat IP and hC2 Patrol.

RF-7800V-HH VHF Handheld Radio

Harris Tactical Communications

Power: Selectable 0.25W, 1W, 2W, 5W and up to 10W
Freqencies/waveforms: 30MHz to 108MHz/ Quicklook 1A, Quicklook 2, Quicklook 3, Free Channel Search, Quicklook Wide, TNW, Export SINCGARS with Pavillion encryption (optional)
Security: 128bit & 256bit Harris proprietary (Citadel) and AES Customer Algorithm Modification Weight: 1.09kg with battery
Weight:
Notes: Designed for traditional CNR missions, ground-to-air and company, and below comms, provides high-speed narrowband networking, manpack performance in a handheld, can be used with 50W amplifier for mid-tier networking.

RF-7800H-MP Wideband HF/VHF set

Harris Tactical Communications

Power: HF:1W, 5W, 20W PEP, -1/+1 dB, VHF: 1W, 5W, 10W FM
Frequencies/waveforms: 1.5MHz to 59.999MHz, 75 channel presets/ Narrowband: fixed frequency, 2G ALE, 3G ALE, Serial Tone ECCM Falcon II interoperable, VHF FM; Wideband: MIL-STD-188-110C Appendix D, DTE synchronous data and IP data
Security: Citadel, CAM (Customer Algorithm Modification), AES, AVS (Analog Voice Security)
Weight: 3.9kg without battery
Notes: Light, compact manpack. Wideband waveform supports data rates up to 120kbps in bandwidths from 3kHz to 24kHz. Synchronous and IP applications include Harris Wireless Messaging Terminal, Tactical Chat IP and hC2 TM Patrol.

RF-7850S Advanced Wideband Secure Personal Radio

Harris Tactical Communications

Power: 3.2W
Frequencies/waveforms: 225MHz to 2500MHz/ NB: TDMA Networking Waveform with optimised voice and guaranteed GPS reporting, frequency hopping, VHF-UHF Line-Of-Sight interoperable with Harris radios; WB: Soldier-TDMA Networking Waveform serves team, squad, platoon deployments, simultaneous voice & data
Security: 256bit Citadel, 256bit AES
Weight: 0.775kg with standard battery
Notes: RF-7850S enables networked platoon-wide full duplex audio, multiple, concurrent talk-groups, simultaneous voice, position reporting and IP data up to 1.5Mbps, ad hoc mesh networking.

RF-7850M-HH Multiband Networking Handheld

Harris Tactical Communications

Power: Selectable .25W, 1W, 2W, 5W and up to 10W
Frequencies/waveforms: Narrowband: 30MHz to 512 MHz, Wideband: 225MHz to 512 MHz, AM: 108MHz to 512MHz/ NB: TDMA Networking Waveform (TNW) 25K and 75K; WB: M-TNW, ANW2 C (optional)
Security: Quicklook 1A, 2, 3 and Quicklook-Wide ECCM, 1128bit & 256bit Harris proprietary Citadel AES 128 & 256, Customer Algorithm Modification encryption
Weight: less than 1kg with battery
Notes: Intended for traditional CNR missions, ground-to-air and company and below voice and data comms. Optional 50W amplifier enables use in mid-tier tactical networks. Provides manpack performance in a handheld, interoperable with Falcon II and III sets.

RO Tactical Radio

Harris Tactical Communications

Power:
Frequencies/waveforms: L-band (1616 - 1626.5 MHz) Iridium satcom/ Defense Information Systems Agency Enhanced Mobile Satellite Services
Security: NIST certified AES 256 voice and data encryption (can be used by coalition troops)
Weight: 0.510kg without antenna
Notes: Using Distributed Tactical Communications System satcom service, operator can reach thousands of other RO tactical radios within a 100-250 mile range anywhere with sight of sky.

SINCGARS RT-1523 VHF Radio

Harris Tactical Communications

Power: 1mW, 100mW, 5W, 50W (with power amplifier)
Frequencies/waveforms: 30MHz to 87.975MHz/ SINCGARS Security: Internal Encryption Module, CT/PT
Security:
Weight: 3.5kg with battery
Notes: Offered in vehicle and manpack configurations. In the mobile role, the radio works with an embedded tactical data router, and as amanpack it features a standard point-to-point-protocol interface. Both allow a C2 application to access the tactical internet.

SINCGARS RT-1702 VHF Combat Net Radio

Harris Tactical Communications

Power: 1mW (LO), 100mW (MED), 5W (HI), 50W (PA with RFPA power amplifier)
Frequencies/waveforms: NB: STANAG 4204 compliant (SC); WB: SINCGARS (FH)
Security: Country unique Pavilion SINCGARS
Weight: 3.5kg including BB-2590 battery
Notes: Manpack or vehicle-mount radio that provides situational awareness through real-time maps, location and IP data with an optional, embedded 12-channel GPS.

SARBE G2R PLB Evo

Kannad

Power: 500mW at 282.8MHz
Frequencies/waveforms: 121.5MHz and 243MHz SAR homing/voice, 406MHz digital data transmission
Security: 256bit encrypted data communication
Weight: 0.723kg
Notes: Software defined dual role SAR/CSAR personal locator beacon with pull-pin activation. Short, randomised burst data transmision and on-demand stop-start ensure LPI/LPD in CSAR mode.

SR600 UHF Soldier Radio

Kongsberg Defence Systems

Power: 10mW to 1W
Frequencies/waveforms: 225MHz to 400MHz, to 5MHz bandwidth
Security: Embedded AES256 encryption
Weight: 0.7kg
Notes: Software-defined, IP-based SR600 connects all soldiers within a squad while offering full integration into the platoon/ company network. Allows the squad leader full intra- and inter squad radio communication with a single radio. Also features high data capacity to share video over realistic combat distances

MH300 Handheld Multi-Role Radio (MRR)

Kongsberg Defence Systems

Power: 15mW, 1W
Frequencies/waveforms: 30MHz to 87.975MHz
Security: Built in encryption, up to level secret, comprehensive crypto and key management provided
Weight: 1.055kg
Notes: Software configurable handheld MRR suited to CNR voice and advanced data networks. Features include tactical SMS with free-text or predefined messages (individual or group), "grab and run" from vehicle installation.

MP300

Kongsberg Defence Systems

Power: 10mW, 0.5W, 5W, 50W/ MRR special waveform
Frequencies/waveforms: 30MHz to 87.975MHz
Security: Built-in COMSEC; electronic protective measures including NBDS in fixed-frequency operation, frequency hopping, multi-hop packet radio service with automatic routing, multipath integration.
Weight:
Notes: Software upgradable manpack for CNR and advanced data network services. Features: up to 19.2kbps data with forward error correction, voice, transparent and packet data, interference cancelling.

Tactical Network Rover (TNR)

L-3 Communications Systems West

Notes: Handheld transceiver that provides a multi-megabit, bidirectional data link capability to dismounted combat troops. Combines video downlink receiver functionality with broadband IP networking capability. TNR uses the existing ROVER communications infrastructure for air-to-ground interoperability and ground-to-air networking within a Net-T network, supporting digitally aided close air support, ground force position sharing, chat and large file transfers.

Tactical Network Rover e (TNRe) video receiver

L-3 Communications Systems West

Power:
Freqencies/waveforms: Supports UHF, L-, S-, C- and Ku-Band operations/ capabilities include DDL, DVB-T, Tactical, BE-CDL, CDL, Legacy digital, 466ER, VNW and FM analog 128bit & 256bit Harris proprietary (Citadel) and AES Customer Algorithm Type 1 and AES encryption
Security:
Weight:
Notes: Small-form-factor hand-held radio provides full bidirectional connectivity to vehicles or the dismounted user. Receives full-motion video and sensor data, enables secure digital video, chat, VoIP and other network-enabled applications.

Tactical Rover e (TACe) video receiver

L-3 Communications Systems West

Security: Type 1 encryption
Notes: Pocket-sized receiver that provides encrypted digital and analog video with aircraft and sensor positional data directly to the dismounted user for real-time situational awareness. Interoperable with fielded ISR and fighter aircraft video transmitters. Receives and displays video, aircraft position and sensor point of interest simultaneously. Features automatic waveform search, speed dial preset recall allows quick switching between multiple video feeds.

Tactical Rover p (TACp)

L-3 Communications Systems West

Power:
Frequencies/waveforms: L, S, C & Ku bands/ DDL, DVB-T, Tactical, CDL, legacy digital (455), 466ER, VNW, FM analogue. Handles H.261, H.264, MPEG-2, MPEG-4, MJPEG, analog NTSC/PAL video feeds
Security: AES & triple DES supported
Weight: 0.549kg
Notes: Small, light, IP-based, multiband,secure, digital and analog receiver designed for ease of integration. Interfaces allow connection with 'virtually any' warfighter system, existing display device, computer and power source.

Streamcaster 4200 MIMO tactical radio — L-3 Communications/Silvus Technologies

Power:	1W to 4 W
Frequencies/waveforms:	400MHz to 6GHz in bands inc UHF, ISM 900, L, upper L, broadcast B, federal S, S, 2.4GHz ISM, low C, federal C-1 & C-2, high C, 5.2 and 5.8 GHz ISM/ Mobile Networked MIMO (MN-MIMO)
Security:	DES standard, AES/GCM 128/256 optional (FIPS 140-2), Suite B
Weight:	0.43kg
Notes:	Wideband Multiple Input, Multiple Output (MIMO) video and data radio optimised for tactical use in portable and embedded applications where size, weight, power or cost are critical.

Personal Role Radio (PRR) — Leonardo

Power:	50mW
Frequencies/waveforms:	2.4GHz direct sequence spread spectrum modulation
Security:	Encryption optional
Weight:	
Notes:	Compact and lightweight PRR with a typical operating range of 500m in open terrain, and through three floors of a building, features wireless press to talk with up to 2m range, operates independently of any infrastructure, interfaces with combat net radios.

Enhanced Personal Role Radio (EZPRR) — Leonardo

Power:	100mW
Frequencies/waveforms:	2.4GHz direct sequence spread spectrum modulation
Security:	Encrypted
Weight:	
Notes:	Typical operating range is 800m in open terrain, and through three floors of a building; wireless Press To Talk (PTT) with 2m range; features interchangeable switch pack, tailorable audio ancillaries; independent of infrastructure.

SWAVE HH — Leonardo

Power:	5W peak
Freqencies/waveforms:	30MHz to 512MHz; supports EPM waveforms, such as Selex ES proprietary FFH SelfNET EASY II and wideband networked waveforms including Selex ES SelfNET SBW.
Security:	COMSEC via AES-256 crypto engine
Weight:	less than 1kg with battery pack
Notes:	SCA-compliant Software defined handheld radio that provides wideband secure voice/data services for demanding tactical needs. Can support legacy and new waveforms, operates with fielded radios, C4I systems.

SWave Enhanced Handheld (HH-E) — Leonardo

Power:	5W (50W in vehicles)
Frequencies/waveforms:	30MHz to 512MHz V-UHF/ NB VuLOS V/U AM/FM (STANAG 4204/4205), IP MIL-STD-188-220C (datalink), SelfNET EASY II (EPM/ECCM), SelfNET Networking Soldier Broad band Waveform (WB MANET), SelfNET Nar rowband Adaptive Waveform (NB MANET)
Security:	Embedded programmable COMSEC and TRANSEC, embedded AES 256 crypto engine, support for custom crypto algorithms
Weight:	0.63kg with standard battery
Notes:	Body-worn radio for soldier and commander use at platoon or section level, offering simultaneous voice and data communications at the tactical edge, configurable for vehicle use.

Soldier System Radio Plus (SSR Plus) — Leonardo

Power:	2W
Frequencies/waveforms:	350MHz to 400MHz , 400MHz to 450 MHz
Security:	AES 256
Weight:	0.3kg
Notes:	Developed to support both section and platoon level communications up to company level, SRR Plus can operate without infrastructure on 256 nets, two simultaneously and each with up to 32 members. Range of more than 2km claimed. Automatic relay mode identifies members who are out of coverage and retransmits voice and data to them.

Frontline Soldier Radio (FSR) — Leonardo

Power:
Frequencies/waveforms: 350MHz to 450MHz for SBW and SNW and 2.4GHz for PRR waveform; also supports user-defined waveforms
Security: All-informed, independent encrypted voice and data
Weight:
Notes: Small, lightweight section/platoon radio offering: dual net operation, automatic position reporting, ad hoc networking, wireless remote control, voice interrupt, embedded GPS, relay capability, in-ear hearing protection.

Swave MB1 manpack/vehicle radio — Leonardo

Power: Up to 20W, or 50W with vehicle amplifier
Frequencies/waveforms: VuLOS V/UHF AM/FM (NB), MIL-STD-188-220C (data link IP), SINCGARS, HQ I/II , SelfNET EASY II (EPM), DAMA (MIL-STD-181A, MIL-STD-182A, MIL-STD-183, MIL-STD-184 (TACSAT), SelfNET Networking Soldier Broadband Waveform (WB MANET), SelfNET Narrow Band Adaptive WF (NB MANET)
Security: Embedded customisable COMSEC, TRANSEC
Weight: under 8kg inc battery
Notes: Family of reconfigurable manpack radios for dismounted and vehicular use, supporting wideband IP voice and data, secure CNR voice and video.

SRX 2200 single band portable — Motorola Solutions

Power: 1W to 3W @ 700MHz to 800MHz, 1-6W VHF, 1-5W UHF range 1
Frequencies/waveforms: 136MHz to 174MHz VHF, 380MHz to 470MHz UHF range 1, 700MHz to 800 MHz
Security: Supports ADP, AES, DES, DES-XL, DES-OFB, DVP-XL encryption algorithms, and WPA-2, WPA, WEP WiFi security protocols
Weight: 309g without battery
Notes: SRX 2200 is a two model range of combat radios with features such as embedded ILI, night vision goggle compatibility and tactical inhibit.

Handheld Radio 3501 — Radmor

Power: 3/1/0,1 W
Freqencies/waveforms: 30MHz to 88MHz, 2,320 channels
Security: Analogue and digital scramblers, 10 user-selected encryption keys
Weight: 0.940kg
Notes: R3501 advanced set features a GPS receiver, selcall capability, a built-in FFSK or 4LFSK modem with multiple data rates, includes forward error correction; STANAG 4204 interoperability

Personal Radio 35010 — Radmor

Power: 10mW, 100mW, 400mW
Frequencies/waveforms: 2,405MHz to 2,480MHz (ISM band)
Security: AES encryption
Weight: 0.27kg without batteries
Notes: R35010 connects team members in small radio networks. Range in open areas is several hundred metres. Features wireless PTT, optional built-in GPS and conferencing.

RRC 9210 VHF Manpack — Radmor

Power: 0,5W; 5W;10W
Frequencies/waveforms: 30MHz to 87.975MHz
Security: COMSEC keys for voice, data encryption, frequency hopping ECCM
Weight: 3.4kg
Notes: CNR-IP manpack operates with all members of the Thales PR4G family; simultaneous, voice and data transmissions use single channel; data rates reach 42.66kbps/s; STANAG 4591 MELP vocoder boosts voice quality.

Microlight DH500 — Raytheon

Power: 0.1W to 4W
Frequencies/waveforms: 225MHz to 2GHz/ Eight-hop relay, CPSM with DSSS, TDMA, CDMA and FDMA
Security: supports commercial Advanced Encryption Standard (AES) for Secure But Unclassified (SBU) transmission through Type 1 for classified transmission
Weight: 0.76kg
Notes: Provides simultaneous voice, data and video, automatic position location reporting, giving commanders the ability to see the location of all people and assets at all times, even in GPS-denied environments.

EPLRS-XF-I — Raytheon

Power: 50W max
Frequencies/waveforms: 225MHz to 450MHz/ enhanced positioning, IP MANET
Security: AES encryption
Weight: 8kg
Notes: Manpack vehicle and airborne EPLRS radio providing robust, on-the-move, high-speed, automated data exchange using a contention-free networking architecture.

AN/PSC-5D — Raytheon

Power: 10W to 20W
Frequencies/waveforms: 30MHz to 512MHz, 142 channel presets/ SINCGARS, SATCOM, DAMA, HAVEQUICK I/II, AM, FM, FSK, B/SB/DESB/SOQ PSK
Security: embedded encryption engine, embedded COMSEC for voice and data
Weight: 5.2kg
Notes: provides lightweight, secure, network-capable, multi-band/multi-mission, anti-jam, voice/ imagery/ data communications capability in a single package.

MCR3005 Manpack — Reutech

Power: 10W max
Freqencies/waveforms: 118MHz to 400MHz V/UHF
Security: User definable tamper proof QCM-R module for full INFOSEC and TRANSEC autonomy, LPI via DSSS
Weight:
Notes: LANDSEC HMI features integrated texting from front panel. Has CNIS Link-ZA compliant tactical data link, Bluetooth for peripherals, automatic GPS position reporting, local/networked remote control, Li-ion battery with gauge.

MCR2005 Manpack — Reutech

Power: 10W max
Frequencies/waveforms: 30MHz to 88MHz
Security: User definable tamper proof QCM-R module for full INFOSEC and TRANSEC autonomy
Weight:
Notes: LANDSEC HMI features integrated texting from front panel. Has CNIS Link-ZA compliant data link, Bluetooth for peripherals, auto GPS position reporting, local/networked RC, built-in antenna tuning, Li-ion battery with gauge.

MCR1025 Manpack — Reutech

Power: 30W
Frequencies/waveforms: 1.6MHz to 30MHz, HF
Security: User definable tamper proof INFOSEC, TRANSEC module
Weight:
Notes: Features integrated texting from front panel, CNIS Link-ZA compliant data link, Bluetooth for peripherals, auto GPS position reporting, ALE to MIL-STD-188-141A, APP A, data to MIL-STD-188-110A and STANAG 4285 local/ networked RC, built-in antenna tuning, Li-ion battery with gauge.

PCR4001 — Reutech

Power:
Frequencies/waveforms:
Security: Anti-jamming, LPD waveform
Weight:
Notes: LANDSEC family personal role networked radio for short-range intra-team communications with integral GPS position reporting. Provides multiple talker capability with PTT priority override and access to two external CNRs. Offers simultaneous voice, data and image transfer, built-in rebroadcast and gateway functions. PTT keys access four independent networks. Hot-swappable battery lasts up to 18 hours.

TR620 — Reutech

Power: 5W
Frequencies/waveforms: 30MHz to 88MHz FM ground-to-ground and 118MHz to 137MHz AM ground-to-air communications.
Security: Analogue voice scrambling compatible with the TR610 and TR6000 in FM mode; provides AES 256 encryption for secure FH voice.
Weight:
Notes: Handheld transceiver based on flexible DSP/SDR technology that allows configuration flexibility and an upgrade path; qualified to MIL-STD-810F.

TR2000 Manpack/Vehicle set — Reutech

Power: 25W on internal battery or 100W on 26V vehicle battery
Frequencies/waveforms: HF
Security: ECCM for voice and data
Weight:
Notes: Part of tactical HF product range for modern battlefield; offers ALE to MIL-STD-188-110A, built-in GPS, Bluetooth connectivity for peripherals. Micro DSP technology allows configuration flexibility and provides upgrade path.

TR2400 Manpack/Vehicle set — Reutech

Power: 25W on internal battery or 100W on 26V vehicle battery
Freqencies/waveforms: HF
Security: ECCM for voice and data, user-defined digital encryption
Weight:
Notes: Configurable as manpack, vehicle and fixed-installation HF radio. External co-location filter enables multi-transceiver operation. Features ALE to MIL-STD-188-110A, embedded STANAG 5066 data link protocol. Environmental & EM compliance to MIL-STD-810E and MIL-STD-461C.

TR6000 Manpack/Vehicle set — Reutech

Power: 10W on man-portable battery, 40W on 27V vehicle battery typical
Frequencies/waveforms: Low band VHF ground-to-ground, ATC band ground-to-air
Security:
Weight:
Notes: Can be used as vehicle transceiver without need for external power amplifier. Features wireless peripheral connectivity via Bluetooth, GPS position reporting. Micro DSP technology allows configuration f lexibility, upgrade path.

MR3000P tactical handheld transceiver — Rohde & Schwarz

Power: 0.1W to 5W
Frequencies/waveforms: 25MHz to 146MHz / SECOM-P, AM, FM
Security: Embedded COMSEC
Weight:
Notes: Optional GPS reporting, 8.33kHz ATC channel spacing, DFF, radio network management system.

MR300xU/H multiband manpack/vehicle set — Rohde & Schwarz

Power: 0.5W to 20W (with external amplifier up to 150/500W)
Frequencies/waveforms: 1.5MHz to 108MHz / ALE 2G/3G, SECOM-H, ST4285, ST4529, ST4539,ST4415, AM, FM, SSB
Security: Embedded COMSEC, 256bit key
Weight:
Notes: Vocoders adapted to mode of operation and bandwidth, GPS reporting and message services, IP over air capability, SIP-based remote voice operation, wide range of accessories, radio network management system.

AN/PRC-148 MBITR/JEM — Thales

Power: 0.1W, 0.5W, 1W, 3W and 5W user selectable (waveform dependent)
Frequencies/waveforms: 30MHz to 512 MHz contiguous. Implemented and planned waveforms and modes include: AM/FM, Havequick I/II, MIL-STD-188-241-1/-2 (SINCGARS), MIL-STD-188-181B (56kbps), MIL-STD-188-181C, -182B, -183B (SATCOM IW), ANDVT, Project 25, Over The Air Cloning (OTAC), retransmission
Security: Programmable encryption engine supports NSA crypto modernisation requirements, certified by NSA.
Weight: 0.867kg with battery
Notes: An evolution of the combat- proven AN/PRC-148 MBITR, the JEM is a JTRS-approved production radio, is part of a complete communications system for mounted and dismounted operations.

AN/PRC-148B MBITR2 — Thales

Power: 5W in all frequencies
Frequencies/waveforms: 30MHz to 512 MHz , Soldier Radio Waveform (SRW) , MIL-STD-188-241-1/-2 (SINCGARS - Standard/ FH2 EOM), MIL-STD-188-181C, -182B, -183B (SATCOM IW) , HAVEQUICK I and II, ANDVT (LPC-10, MELP), AM/FM, Project 25.
Security: Programmable encryption engine supports NSA crypto modernisation requirements, certified by NSA.
Weight: 1.225kg
Notes: Combines AN/PRC-148 and AN/PRC-154 wideband tactical handheld radio capabilities to integrate dismounts into the wideband tactical IP and voice network via the SRW, simultaneously connecting with older nets via narrowband.

AN/PRC-6809 Multi-Band Inter/intra Team Radio — Thales

Power: 0.1W to 5W
Freqencies/waveforms: 30MHz to 512MHz contiguous , Havequick II frequency hopping ECCM waveform, country-specific ECCM waveforms
Security: Type 3 DES (optional), 256bit AES (optional)
Weight: 0.867kg
Notes: Non-Type 1 version (without NSA approved cryptographic algorithms) of the AN/PRC-148 compatible with all MBITR family products and available to US, allied and coalition forces.

AN/PRC-154A Rifleman Radio — Thales

Power: User selectable up to 5W
Frequencies/waveforms: 225MHz to 450MHz (UHF band), 1250MHz to 1390 MHz and 1750MHz to 1850MHz (L-band); supports SRW
Security: Programmable COMSEC and TRANSEC NSA certified for Type 1 secret and below, non-CCI.
Weight: 0.771kg with battery
Notes: Low-cost, body-worn radio that transmits voice and data simultaneously using the SRW, bringing secure secret and below squad-level communications to the soldier at the tactical edge, enables situational awareness and blue force tracking.

AN/PRC-154B Rifleman Radio — Thales

Power: user selectable up to 5W
Frequencies/waveforms: UHF band 225MHz to 450MHz, L-Band 1250MHz to 1390 MHz, 1750MHz to 1850MHz/ Soldier Radio Waveform (SRW)
Security: embedded encryption, COMSEC, TRANSEC
Weight: 0.771kg with battery
Notes: Increased RF range, battery life, and added visual HMI display built on the successful and field proven AN/PRC-154A Programme of Record Rifleman Radio.

BCC 67 Panther VHF Manpack Radio — Thales

Power: selectable up to 5W or 20W boosted mode in vehicle configuration
Frequencies/waveforms: 30MHz to 108MHz
Security: Secured voice and data 16kbps digital encryption, high EPM protection including frequency hopping, free channel search and mixed mode
Weight: 5.9kg with battery
Notes: Interoperable with Jaguar radios. Battery life: 32 hr with rechargeable Li-Ion battery pack. Advanced CNR services includig group selective call, alert, authentication, passive late entry, over-the-air rekeying.

St@r Mille Handheld — Thales

Power: 2W
Frequencies/waveforms: UHF 310MHz to 470MHz, supports squad, platoon and weapon system waveforms
Security: Embedded AES-256 encryption
Weight: 0.38kg without battery
Notes: Light and compact, the software-defined ST@R Mille enables simultaneous voice and data communications featuring automatic position reporting. Features standard V24, USB and Ethernet interfaces. Range greater than 1.5km in open terrain.

SYNAPS-H — Thales

Power: 25W on internal battery or 100W on 26V vehicle battery
Frequencies/waveforms: VHF & UHF/ Waveform library provides NATO, coalition & advanced networking waveforms. Manoeuver waveforms provide collaborative combat capabilities over wideband networks
Security:
Weight:
Notes: Handheld terminal of new SYNAPS networking SDR family designed to provide an easy and adaptable radio solution for network centric transformation of all forces. RF module performance extends communication range.

TC9210 PR4G VHF Manpack Radio — Thales

Power: selectable up to 10W
Freqencies/waveforms: 30MHz to 88MHz/ CNR mode (voice or data), iMux mode (simultaneous voice and data), SuperMux mode (data at 21.6kbps), GeoMux mode: voice + data + BFT, SuperMux HD (60kbps), Single Radio Relay (three bounces voice or data), FireMux mode (Weapon System Triggering)
Security: High grade built-in encryption and advanced protection schemes including Fast Frequency Hopping (FFH), Free Channel Search (FCS) and mixed FH and FCS modes
Weight: 3.4kg without battery
Notes: An advanced combat net radio with simultaneous voice and IP capabilities.

TRC 3700 HF Manpack Radio — Thales

Power:
Frequencies/waveforms: 1.5MHz to 30MHz
Security: Built-in digital encryption for voice and data and wide band hopping on the move, automatic hop band selection, intelligent frequency hopping with spectrum cleaning.
Weight:
Notes: This digital HF software defined radio handles digital ciphered voice and high speed data based on multiple waveforms; features fast 2G and 3G automatic link establishment.

TRC 9110 PR4G VHF Handheld Radio — Thales

Power:
Frequencies/waveforms: 30MHz to 88MHz
Security: High grade built-in encryption, and advanced protection schemes including Fast Frequency Hopping (FFH), Free Channel Search (FCS) and mixed FH and FCS modes
Weight:
Notes: Handles simultaneous voice and data and features a built-in IP router. Capabilities include automatic data relay, dynamic voice/data allocation to boost data rate.

TRC 9105 VHF Handheld Radio — Thales

Power: 2W
Frequencies/waveforms: 30MHz to 88MHz
Security: High grade built-in programmable encryption, advanced EPM including Fast Frequency Hopping (FFH), Free Channel Search (FCS) and mixed FH and FCS modes
Weight: 1kg without battery
Notes: Handles simultaneous voice and data with, for example, a SuperMux mode with a throughput of 21.6kbps and features a built-in IP router. Capabilities include automatic data relay, dynamic voice/data allocation to boost data rate. GPS built in.

F@stnet Twin — Thales

Power:
Frequencies/waveforms: VHF and UHF
Security:
Weight:
Notes: F@stnet Twin keeps infantry leader in touch with soldiers through the embedded UHF soldier channel while being continuously in touch with the commanding level thanks to the embedded VHF channel. Designed for interoperability with legacy waveforms; handles simultaneous voice and data.

SquadNet soldier radio — Thales

Power:
Frequencies/waveforms: waveforms: 865MHz to 880MHz, 100 talk groups over 50 channels with up to 50 users per channel/
Security: programmable encryption with red/black architecture
Weight: 250 including battery
Notes: 'Unique' waveform ensures communication is maintained across urban, wooded and mountainous terrain. In open terrain SquadNet gives a 2.5km range point-to-point, extending to 6 km with automatic network relaying, maintaining secure comms over IP networks with an Android app.

R-168-1KE (Kvartz-N) handheld HF radio — Yaroslavl Radioworks

Power: 4W
Freqencies/waveforms: 1.5MHz to 9.999MHz
Security: Offers clear and secure communications
Weight: 0.85kg
Notes: Designed by the Sozvezdie JSC for both urban conditions and broken terrain with limited signal propagation plus long-range communications of up to 300km. Offers USB/LSB operation, compatibility with older radio types.

R-168-5KNE HF manpack — Yaroslavl Radioworks

Power: 8W max, 1W reduced
Frequencies/waveforms: 1.5MHz to 29.9999MHz
Security: Built-in encryption, 256 hop frequencies, 20 hops/sec hop rate
Weight: 3kg plus battery
Notes: Operates in simplex, dual-frequency simplex, FH, adaptive communication and listening watch modes. Also employs frequency telegraphy for automatic reception.

R-168-0.1UME VHF handheld — Yaroslavl Radioworks

Power: 0.15W min
Frequencies/waveforms: 44MHz to 56MHz
Security: Built-in encryption for voice and data; with encryption, range falls from at least 1.2km to 1km
Weight: 1.5kg
Notes: Connects company and platoon commanders, squad leaders, soldiers. Voice prompt reports channel number, encryption operation and operating modes in darkness. Replaces R-168-0.1U and Barmitsa-RS.

R-168-0.1UM1E VHF handheld — Yaroslavl Radioworks

Power: 2W min
Frequencies/waveforms: 44MHz to 56MHz
Security: built-in encryption for analogue data; digital data from external data terminal.
Weight: 1.5kg
Notes: Connects company and platoon commanders, squad leaders, soldiers. Covert voice prompting, modular for ease of repair, automated fill, sealed alloy case. Replaces: R-147, P-162-0.1B, R-163-0.5R, R-163-1U, R-168-0.1U, R-168-0.5U, Barmitsa-RS.

R-168-0.1UME VHF monoblock handheld — Yaroslavl Radioworks

Power: 1W nominal, 5W max
Frequencies/waveforms: 33MHz to 56MHz
Security: Built-in encryption for voice and data; with encryption, voice range falls from at least 3km to 2.5km, data transmission range 2km.
Weight: 0.3kg
Notes: Monoblock radio connects company and platoon commanders, squad leaders, soldiers. Provides FM voice or 16kb/s secure voice, data rates of 2.4kb/s or 16kb/s via RS-232 interface.

R-168-0.5MKME VHF handheld — Yaroslavl Radioworks

Power: 1W min
Frequencies/waveforms: 30MHz to 80MHz
Security: Built-in encryption of voice and data, frequency hopping
Weight: 0.9kg
Notes: Provides single- and multi-channel clear and secure tactical comms. Features rechargeable battery, two antenna types, microphone headset. Range for simplex and double-frequency simplex operation 3km with ASP-1.5 antenna, 1.5km with ASP-1.0 antenna or 2 and 1km with FH.

R-168-0.5UDE VHF — Yaroslavl Radioworks

Power: 1W nominal, 5 W max
Freqencies/waveforms: 146MHz to 174MHz
Security: Encrypted voice and data, whisper mode
Weight: 0.3kg
Notes: Enables open and secure comms with R-168 system on coincident frequencies, connects company and platoon commanders, squad leaders, soldiers, allows them to communicate with aircraft, warships. Range up to 5km.

R-168-5UN-1E VHF manpack with digital display — Yaroslavl Radioworks

Power: 1W low, 8W high
Frequencies/waveforms: 30MHz to 87.975MHz
Security: clear and secure analogue via built-in ciphering unit; digital data from external data terminal
Weight: 11.5kg with battery
Notes: Provides platoon, company, battalion coms. Offers simplex or two-frequency simplex at any of 6 preset frequencies, remote control at up to 500m, emergency data erasure. Replaces heavier R-159, R-159M, R-163-10U.

R-168-0.5UDE UHF monoblock radio — Yaroslavl Radioworks

Power: 1W nominal, 5W max
Frequencies/waveforms: 146MHz to 174MHz
Security: 16kb/s secure voice, built in encryption for analogue data, digital data from external terminal
Weight: 0.3kg
Notes: Connects company and platoon commanders, squad leaders, soldiers through tactical command link allows them to communicate with aircraft, warships, rest of R-168 system at coincident frequencies. Range is up to 5km.

Trellisware

Trellisware's TSM waveform is designed to provide mobility and scalability across one network, and robust communication in harsh RF environments including crowded urban landscapes, forming infrastructureless, self-healing networks.

WAVEFORM EXPANSION

Common architecture is the key to uniting disperate waveforms for secure, interoperable communications.

Peter Donaldson

Software Defined Radios (SDRs) are essentially computers with radio transmission and reception hardware, and as such their capabilities are largely dictated, as with any other computer, by the software applications that run on them.

In the case of SDRs, those applications are the waveforms that describe the signal in the air in terms of frequency/wavelength, the modulation techniques that determine how the carrier signal is changed to add information to it, the types of information carried such as voice, data, still images and video, security techniques such as frequency hopping and encryption, and networking and network management techniques. All of these things were implemented in the past in hardware, in analogue and relatively inflexible digital circuitry, but implementing them in software makes them much easier to update and, critically, to implement on different radios in support of interoperability – in theory.

BURGEONING WAVEFORMS

Practical implementation is a complex field because it is subject to all the in-service, international and inter-company wrangling that any effort with so many stakeholders suffers. To this must be added all the legacy waveforms that must be considered and the new ones recently implemented or under development. As of November 2017, the United States (US) Department of Defense's (DoD) inventory contained 68 communications waveforms, among them updated legacy waveforms such as the Single Channel Ground and Airborne Radio System (SINCGARS); key waveforms that came out of the US Joint Tactical Radio Radio System (JTRS) such as the Soldier Radio Waveform (SRW) and the Wideband Networking Waveform, (WNW) and secure military satcom waveforms such as the narrowband Mobile User Objective System (MUOS).

Other nations also develop their own waveforms for secure communications, companies have their own proprietary waveforms that they package with the radio systems they sell, while alliances and blocs such as the North Atlantic Treaty Organisation (NATO) and the European Union (EU) are developing standardised waveforms of their own, so the overall picture is a complex one.

However, the Software Communications Architecture (SCA) developed under the JTRS programme provides an internationally accepted basis for development that allows waveforms that comply with it to run on a wide variety of hardware platforms and eases the transfer of information between waveforms, where permissible, in the interests of interoperability. It also allows individual platforms to run multiple waveforms, reducing the burden on field commanders who previously had to manage two or more different sets to communicate up and down the chain of command.

TACTICAL FREQUENCIES

The tactical communications space is traditionally occupied by narrowband, wideband and soldier systems waveforms. Narrowband tactical radios tend to be VHF sets that provide secure links to, from and between vehicles, aircraft and dismounts generally over ranges up to 50km, although longer ranges are possible, at bandwidths limited to about 96kbps. Connected groups of users typically use 25kHz of bandwidth each. One of the issues with these sets is that many nations use their own waveforms that are not interoperable with others, particularly when operating in secure modes, while the large installed base means that they have to be taken into account when developing alliance and coalition architectures.

Wideband waveforms are found in fixed, vehicle-mounted and airborne installations, occupying bandwidths measured in MHz, offering ranges of around 5km (unless between airborne platforms with direct lines of sight between them), and data rates of several megabits per second (mbps), enabling them to serve as the backbone of the tactical internet.

Soldier systems communications use customised wideband waveforms loaded onto personal role radios that connect dismounted soldiers to each other and higher levels of command through gateways, with the JTRS-derived Soldier Radio Waveform (SRW) gaining widespread traction.

This established architecture means that NATO standard waveforms must be able work with national systems through gateways to preserve the large investments made in legacy tactical radio systems. One significant implication is that some platforms will need to run both the NATO waveform and the national waveform on the same SDR platform.

NATO'S NBWF

The main purpose of the NATO Narrowband

US Army

A US Army soldier teaches a Polish army comrade how to use a SINCGARS radio during the Puma 2 Exercise, part of Saber Strike 18 in Poland. SINGCARS is a legacy waveform ported to modern SDRs.

Waveform (NBWF) is to enable coalition interoperability within the lower tactical levels though a Combat Net Radio (CNR) waveform defined in a standardisation agreement (STANAG). While implementation remains a work in progress, NBWF definition includes channel bandwidths of 25kHz and 50kHz with on-air bit rates of up to 82kbps in VHF or the lower end of the UHF bands. It uses Continuous Phase Modulation (CPM), which makes very efficient use of the spectrum at the cost of complexity in receivers optimised to run it, and Time Division Multiple Access (TDMA) techniques.

The NBWF is one of several waveforms implemented on SDR hardware in an effort run by the Department of Communication, Information, Systems and Sensors (CISS) in the Belgian Royal Military Academy, the aim of which is to study, develop and implement waveforms for cognitive radio ad hoc networks. In concept, SDRs in such networks will be able to configure and change parameters including waveform, frequency, bandwidth and power autonomously according to the needs of the user and conditions in the electromagnetic environment.

In the wideband arena, the European Secure Software Defined Radio (ESSOR) programme is working on what appears to be the front runner for NATO wideband waveform standardisation. A cooperative Technology Demonstration Programme (TDP) involving Finland, France, Italy, Poland, Spain and Sweden within the European Defence Agency (EDA) framework. This TDP developed and implemented the ESSOR SDR architecture – which is based on the SCA developed in the US under the JTRS architecture – and a compliant High Data Rate networking Waveform (HDR WF), which ESSOR is promoting as a NATO wideband waveform STANAG.

HDR WF is a frequency hopping waveform that operates in the UHF band with 1.25MHz channels, offers data rates of up to 1Mbps, carries IP data and achieves network synchronisation with or without Global Navigation Satellite System (GNSS) signals.

The waveform has been successfully demonstrated in the laboratory and in field interoperability exercises observed by NATO on hardware from several vendors. Building on the TDP, ESSOR moved into the next phase, known as Operational Capability 1 (OC1) earlier this year with the intention of making several enhancements that will optimise its waveform for modern operational needs and address the definition and dissemination of a global SDR standard based on ESSOR. Other activities will work towards the public release of the ESSOR architecture and for the potential worldwide adoption of the waveform, potentially also in the public security domain in addition to the military.

PROPRIETARY SYSTEMS

Meanwhile, industry and national militaries continue to develop their own waveforms. Aselsan, for example, has implemented new 5199 narrowband networking waveform on its 9661/9651 SDR family to meet new-generation C2 requirements such as high data rates, reliability, security, flexibility and IP data communication.

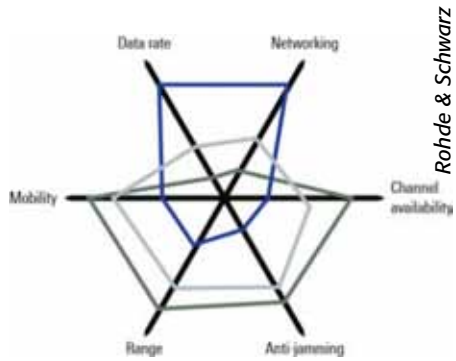
One important requirement was to reduce the number of radios needed for simultaneous voice and data communications, to route data traffic between two different radio networks without additional equipment, to meet data rate and prioritisation requirements, and to provide both information security and protection from electronic attack.

Known as 5199 NBNR, the waveform uses end-to-end encryption and an advanced frequency hopping scheme while supporting multiple voice groups within the limited available spectrum by merging multiple hierarchical user groups into a single physical radio net.

Operating over the 30MHz to 512MHz band in 25kHz channels, it offers user data rates up to 16kbps when using a single frequency per slot per radio net, and multiples of this when several frequencies per slot are used in each net. This also applies when frequency hopping is in use.

The company has also developed a new Wide Band Networking Radio Waveform (WBNR) with Mobile Ad hoc Networking (MANET) capabilities for the 9661 SDR family, offering full IP-based communication and high data rates, according to the company. With with self-forming and self-healing features, it supports comms on the move for up to 150 users in a single network, protecting it with security features including encryption, authentication, frequency hopping etc. Channel widths are 1MHz with frequency hopping, but 5MHz in fixed-frequency mode.

It also automatically routes data between different nets without the need for additional routing devices, a capability shared with the NBNR with which it also seamlessly shares IP data, according to Aselsan, and with external IP networks such as the TASMUS tactical area communication system. Aselsan also



Rohde & Schwarz

Diagram shows the trade-offs that have to be made in waveforms between the key factors of data rate, networking capability, channel availability, jamming resistance, range and mobility.

Trelliswware is working evolving the next generation Soldier Radio Waveform for the US Army, including the narrowband mode of SRW 2.0 next gene radios, which improves range, network scalability, and mitigates RF interference and jamming.

provides VHF/FM low band and CNR-mode waveforms.

Similarly, Rohde & Schwarz continues to port its latest high data rate waveforms to new radios, with, for example, the new Software Defined Airborne Radio (SDAR) launched in June featuring HDR waveforms that can transmit data and up to two voice channels in parallel, at high speed and with different priorities. Users can select the waveform that best suits a given communications scenario in terms of range, data rate and jamming resistance, notes the company, adding that the waveforms can also handle the effects on transmission arising from high platform speeds, suiting them to jet aircraft applications. The company's SDTR vehicle-mounted and SDHR handheld sets also run these waveforms.

Commenting on data rate – the volume of data that a radio can transmit in a second – the company notes that it is important to distinguish between the 'on-air' rate and the inevitably lower rates available to networks and individual users.

Waveforms can also be judged on how well they support MANET capabilities, as the more that members of these networks move in relation to each other, the more information will have to be exchanged to keep them connected, so waveforms with high data rates have a distinct advantage here, advises Rohde & Schwarz.

Channel availability also has to be considered, and the R&S waveforms implement two types of scheme to allow many sets to share frequencies. Carrier Sense Multiple Access (CSMA) requires radios that wants to transmit to check that no others are transmitting on that frequency before it starts, an approach that optimises data rates with low to moderate network loadings. Timeslot based methods, such as Time Division Multiple Access (TDMA), on the other hand, ensure every radio gets its turn on a busy network, but might have to wait for its next slot to finish sending its data.

Countering jamming requires high power from the waveform, along with frequency hopping schemes that complete several thousand hops per second to ensure smooth communications under hostile conditions.

R&S' three HDR waveforms offer different combinations of these attributes, also balancing them against mobility and range. The Anti-Jam Narrowband (AJ-NB) has the highest channel availability, jamming protection, range and mobility, but sacrifices networking capabilities and data rate. Meanwhile the Anti-Jam Wideband (AJ-WB) provides moderate capabilities in all areas, coming second to the AJ-WB in the latter's strong areas, and beating it for networking and data rate. The Wideband (WB) waveform, finally, beats all the others in networking capabilities and data rate but cannot match them in the other areas.

BARRAGE RELAY

TrellisWare Technologies' TSM waveform is designed to provide mobility and scalability across a network, along with robust communication in harsh environments characterised by Radio Frequency (RF) volatility, high mobility of all operators and high levels of signal interference. The company says that TSM has been proven on deployments in urban environments and in subterranean spaces including caves and tunnel, and inside buildings where RF propagation is difficult, enabled by the company's proprietary Barrage Relay technology.

Barrage Relay networking has a robust physical layer, says the company, that incorporates receive-side collaborative combining techniques to handle extreme RF multipath fading and enable simultaneous relaying of voice, data, video and position location information. By eliminating routing and minimising network overhead, Barrage Relay is designed to enable much more reliable performance than traditional MANET techniques can.

While TSM runs on TrellisWare's own tactical radios, it is designed to run on many other SDRs. The company emphasises that Barrage Relay is not based on technologies such as Wi-Fi, DECT, WiMax or LTE chips, and it is not dependent on internet-driven routing protocols, relying instead on advanced digital signal processing.

The latest version of the waveform, TSM-X, says the company, has been chosen as the primary MANET technology for US Special Operations Forces's next generation of handheld and manpack radios and can support more than 200 nodes in a single RF channel. Highlights include cellular voice quality, up to 16 voice channels, and support for multiple HD video streams.

TSM-X provides up to 16Mbps of user throughput for single-hop traffic, and up to 7.5Mbps for multi-hop, multi-cast traffic. It also supports wide frequency coverage (UHF, L-band and S-band) in single radio platform for better penetration of barriers and obstacles, and enables users to customise voice, position location and data access to suit different mission profiles.

With a mix of government, alliance owned and proprietary waveforms becoming available, all based on a common communications architecture, the building blocks are in place for truly interoperable secure communications across a wide range of military and parapublic organisations, wherever policy supports it. A

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Bittium's new Tough Mobile is a rugged, secure smartphone that can run the new VoIP client and SDR waveforms including that of the company's TAC WIN system, participating in wideband tactical wireless networks.

BANDING TOGETHER

What's 'coming through the airwaves' that will make a difference in tomorrow's army.

Peter Donaldson

A major thrust of progress in tactical communications is towards integration of radio bearers of all kinds into systems that provide services that are nearly seamless in the most challenging of conditions presented by geography, distance, mobility, interference or jamming. Traditional VHF, UHF and even HF radios in military inventories are being replaced by software-defined equivalents and, increasingly, by multiband sets where users need to communicate up and down chains of command, giving them one set to manage rather than several, for example, and satcom waveforms are running successfully on tactical radios. Networks are being extended by relays, rebroadcast systems and gateways, IP networking for voice, data and video is becoming commonplace, and sophisticated multiplexing protocols are overcoming multipath interference problems in urban environments.

INTEGRATED VHF PACKAGE

In June, Barrett Communications announced completion of a $5 million (AUD$ 7 million) contract modernising an Middle Eastern nation's tactical VHF inventory with systems based on Barrett's PRC-2080+ multi-role radios in handheld, manpack, mobile, base station and rebroadcast configurations to carry secure voice and data over line-of-sight ranges. Training included in the contact has been undertaken to support full deployment within months of the announcement.

In stand-alone configuration, the 5W VHF handheld PRC-2080+ supports squad level comms, weighing 1.3kg with its rechargeable 6.5Ah lithium ion battery and covering the 30MHz to 88MHz frequency band, reaching out reliably to 8km in open terrain using the a whip antenna. It comes with a handset or an optional tactical headset.

Inserting the PRC-2080+ into the manpack dock creates the PRC-2081+ 25W backpack radio, the dock containing a the amplifier and a larger capacity 10Ah battery pack, an AC/DC charger and a collapsible section whip antenna, and a framed backpack.

Doubling in power, the PRC-2082+ Mobile package also provides a vehicle docking station for the PRC-2080+ transceiver and a 50W VHF amplifier, which provides a range extension and a more reliable link when connected to the vehicle's whip antenna system. Accessories include a rugged external speaker and a tactical installation kit. The package can equip jeeps, patrol boats, APCs, and tanks, and is can be connected to combat net radio systems.

The Barrett PRC-2084+ VHF base package contains all the components of the mobile package, adding a module that allows it to draw power from a variety of AC and DC sources.

The PRC-2083+ re-broadcast system doubles up on the base package's components and adds a co-location filter assembly and AC/DC power supply with battery backup, all housed in a rugged transportable case.

Typically used to link two low band VHF networks to overcome problems created by distance or terrain, its two networks can also use different security options – frequency hopping and encryption.

TACTICAL VOIP GAINS GROUND

Tactical Voice over Internet Protocol (VoIP) is gaining ground, and Finland's Bittium launched a VoIP software member of its product line at Eurosatory in June. The Tough VoIP Softphone client can be used for instant messaging, conference calls and screen sharing in addition to voice calls when installed on a PC or a smartphone and connected to the Tough VoIP service, and has a Push-To-Talk (PTT) facility. It can also can act as a remote control for third party Combat Net Radios (CNR) and can send instant messages with them using the VoIP service and the Tough Comnode terminal or the Radio over Internet Protocol (RoIP) router in the company's TAC WIN system.

This Tough Comnode terminal is a multifunction data transfer device that serves as a VoIP phone, an IP router, and an SHDSL repeater, the latter a reference to Symmetrical High-Speed Digital Subscriber Line technology that provides equal transmit and receive data rates over wired connections.

Together with Bittium's TAC WIN, an SDR-based tactical wireless IP network, the Tough VoIP system was the subject of a $2.7 million (€2.3 million) order for maintenance and further development from the Finnish Defence Forces (FDF) in May. This followed a $16.7 million (€14.3m) order in April under a framework agreement signed in August 2017 and covering the 2018 to 2020 period as part of the renewal of the FDF's C3 system.

Designed for both military and public safety use and compatible with existing fixed and wireless infrastructures, TAC WIN enables MANETs and other networks to be formed into a single logical IP network quickly at any location, thanks to the tactical router that forms the core of the system. This router enables users to form both wired and wireless broadband data transfer IP connections freely, and connect to different types of terminals and other communication systems.

Supporting reformed FDF combat doctrine that emphasises mobility and C2 on the move, TAC WIN serves as the backbone network for tactical data transfer.

The company has also been showcasing its Tough SDR radios in handheld and vehicular form, sets that can run the TAC WIN waveform in addition to the ESSOR

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High Data Rate (HDR) waveform, which is a candidate for the NATO requirement, and the proprietary Bittium Narrowband Waveform.

ARCTIC HF TRIAL

Illustrating the continued relevance of HF to remote operations, Codan reports successful testing of its 2110M manpack and Sentry-H High Frequency (HF) SDR sets in the Arctic earlier this year. During exercise Northern Warrior 2018, a communications detachment from 35 Canadian Brigade Group (35 CBG) was deployed to provide communications to Arctic Response Company Group personnel, to test new equipment in the cold environment.

The 5.3kg, 25W Patrol 2110M manpack features Automatic Link Establishment (ALE) that meets Mil-Std-188-141B and Fed-Std-1045 requirements and third generation (3G) ALE that meets STANAG 4538. Its digital voice quality removes the hisses, crackles and pops formerly associated with HF communications, ensuring intelligibility even with signal-to-noise ratios down to -3dB and digital data rates as low as 600bits per second. It also offers interoperability with other military grade and commercial radio sets, frequency hopping and voice encryption and embedded GPS positioning.

The set is also compatible with the company's SprintChat software that uses the 3G ALE waveform to provide peer-to-peer email, file transfer and chat functions, plus internet email and phone SMS messaging when there is a SprintNet station in the network.

The other set tested in the Arctic, the Sentry-H, is a 150W base and mobile/vehicle radio with a built-in power amplifier. Sentry-H adds Codan's new Secure Interoperability Function (SIF), which was developed to simplify the use of applications that require different encryption types or keys when communicating across different networks, or assets within existing networks that require a unique key, the company explains. SIF automates the switching of encryption technology, ensuring quick secure communications in demanding conditions while preventing users from inadvertently transmitting using the wrong key/mode.

Sentry-H also works with Virtual Control Point (VCP) software, which is a Windows application designed to give users full control of the radio from laptops with connectivity via wired Ethernet, and with the Sprint software referred to above.

MULTIBAND HANDHELD

Multiband communications are of growing importance to tactical users, and industry is providing a new generation of sets that cover the whole of the VHF band from 30MHz to 300MHz and beyond into the lower reaches of the UHF band. One of the latest is Datron's HH3100 Spectre-M Multiband 30MHz to 512MHz handheld Launched at DSA 2018 in Malaysia in April.

Spectre-M provides accurate positioning and timing thanks to its embedded GPS receiver, while frequency hopping and AES-256 standard digital encryption waveforms offer a high level of jamming resistance and communications security in a set that meets Mil-Std-810G environmental ruggedness standards, the company emphasises.

Along with the extended frequency range, Amplitude Modulated (AM) ground-to-air capability allows the user to communicate effectively with a wide range of different supporting elements for efficient battlespace coordination.

The new handheld is backward compatible with any other Datron VHF set in encrypted modes, so current users can add new capabilities without being forced to upgrading their existing inventory, the company says.

It's worth noting that the HH3100 Spectre is a family of radios and the full 30MHz to 512MHz coverage is only provided by the HH3100M, while the HH3100V covers 30MHz to 88MHz and the HH3100A spans 30MHz to 136MHz.

SPECIAL ROLE RADIO WITH COFDM

Naturally, special operators have their own sets of comms needs that vary with the mission in hand and the location and environment in which it has to be carried out, and for industry being selected by Special Operations Force (SOF) organisations puts something of a halo over them and their products. One of the latest to launch a device for this sector is Domo Tactical Communications (DTC), which revealed its new 2W Special Role Radio (SRR) in February.

Designed to provide both SOF and other tactical operators with robust encrypted, tactical mobile communication links, the SRR runs DTC's own Coded Orthogonal Frequency Division Multiplexing (COFDM) waveform. This enables it to handle high bandwidth data, video and audio signals in, dynamic, non-line-of-sight environments plagued by interference from multipath reflections; COFDM solves this by combining reflected signals to enhance reception.

The core technology in the radio is DTC's proprietary SOL8 SDR, enabling it to serve as a tactical MANET IP Mesh node, a Peer-to-Peer (P2P) COFDM transmitter or a P2P receiver streaming video to a tablet PC, says the company.

Packaged in a familiar Personal Role Radio (PRR) format, the SRR also has dual on-board HD-capable video encoders and supports multiple camera interfaces, including HDMI, to stream live video in operational environments. Other features include an "open mic" full duplex audio channel, an embedded GPS receiver and SD card data storage.

BIG ARMY

In another example of technology developed for special operations improving the capabilities of the wider force, Harris has introduced the AN/PRC-163 Army Radio, a two-channel tactical handheld SDR with advanced ISR features.

According to Harris, each channel delivers seamless line-of-sight, high-speed networking and satcom, meaning that the radio can simultaneously transmit information through combinations of legacy satcom, VHF/UHF and MANET applications, and future applications as they become available. An an expansion slot provides space for an ISR Full-Motion Video (FMV) mission module.

Based on the original AN/PRC-163 developed for US SOCOM, the Army version's cross-banding technology allows users to send information up and down the chain of command, as well as across the battlefield network backbone, while connecting to computing devices, including Android smartphones, says Harris.

MOUNTED OR DISMOUNTED

Elbit Systems is offering seamless tactical communications through networking radios connected via multi-bearer IP software. The radios are the PNR-1000 advanced personal networking radio and the GRX-8000 high capacity relay while the software is the Integrated RoIP & Collaboration Services (IRCS) product.

The PNR-1000 is a 225MHz to 512MHz (V/UHF) member of the E-Lynx SDR family that provides ad hoc networking including automatic voice and data relay for up to 64 dismounted soldiers in a package claimed to weigh less than 360g. For voice communications full duplex conferencing is possible for up to six simultaneous speakers, and a double Push To Talk (PTT) system enables a dynamic networking hierarchy. Networking capabilities also include support for multiple hops, self forming and self healing, with data rates up to 320kbps.

When connected to a vehicle intercom system, the PNR-1000 enables soldiers to dismount and move freely without losing connectivity. It also provides intra-team conferencing and interconnectivity to long-range VHF/HF/UHF networks, via the vehicle's tactical radios.

The GRX-8000 relay covers NATO Band

IV frequencies from 4.4GHz to 5GHz in the UHF portion of the RF spectrum. Elbit describes it as an ultra-high capacity, IP and multi-interface radio relay system that is capable of multi-mode, high-speed data transmission at rates up to 100Mbps.

It supports point-to-point and point-to-multi-point communications and features a multiplexer that handles IP and serial trunk data at the same time, enabling different link and trunk data rates and running legacy protocols in addition to the latest IP schemes.

Elbit also emphasises that the GRX-8000 is "very immune" to incidental interference and hostile jamming. Electronic protection measures adopted include frequency hopping, while inbuilt Forward Error Correction (FEC) and interleaving counter high-power and long-duration pulse jammers, for example.

Adaptive power control continuously adjusts output power to the minimum required for error-free communication, which contributes to a low probability of interception and minimises the risk that the GRX-8000 will interfere with friendly radios nearby, for example.

Similarly, adaptive frequency control helps it to avoid continuous wave jammers – even when operating in "fixed frequency" High Capacity (HC) mode – by automatically changing frequency when a threat is detected or link performance is degraded. In more highly contested environments it switches to frequency hopping at the cost of data rate.

Using advanced VoIP and RoIP technologies, the IRCS system facilitates direct communication among a diverse set of devices including VHF, HF and multi-channel radio relays, local and wide area networks, Private Automated Branch eXchange (PABX) phone systems, satellite and cellular networks.

Elbit stresses that this enables all echelons – from high-ranking commanders down to the individual soldier in the field – to communicate directly with anyone in the military network, "dramatically improving" both C2 and operational coordination. All messages of whatever format are automatically routed through the best communication hub, says the company. "All that is required is to key the requested station or enter its subscriber ID."

As an illustration, the company says that an officer at General HQ can directly call and receive reports from special forces, operating thousands of kilometres away, with the use of an IP or analogue phone or the IRCS Access application on a PC. Or out in the field, a tank commander using a VHF radio can send combat photographs directly to his commander's computer at division HQ. Similarly, a doctor on a medevac mission can directly report the types of injuries to the receiving hospital's medical personnel. In Elbit's fourth example, a member of a rapid intervention unit can use any radio to communicate directly with and pass instructions to a wide range of personnel, units and forces including commanders at HQ, strike aircraft, artillery and warships.

A different approach can be seen in Thales overarching new SYNAPS system, which went through its first full-scale demonstration in France in November of last year in front of 20 armed forces who already operate older Thales communications equipment. The concept is to provide the optimum combination of high data rates, security, integrity and confidentiality through a new generation of SDRs and complementary waveforms.

Based on developments conducted for the French military's CONTACT programme, touted as the largest SDR effort in Europe, SYNAPS is designed to enable what Thales terms a unique collaborative combat capability though its support for both hierarchical and transverse communications – up, down and across chains of command.

Compliant with NATO & ESSOR standards including the JTRS Software Communications Architecture (SCA), SYNAPS is designed to meet the requirements land land, air and naval forces of all sizes.

Supporting voice, messaging, video, chat, blue force tracking and C4I applications, it applies a differentiated quality of service protocol, the most critical data transfers taking priority. Thales also claims "excellent" range performance and protection against jamming, while providing the optimum combination of data rates, security and connectivity, adapting automatically as deployments are reconfigured during a mission.

The French armed forces are likely to be the first to benefit from this capability when their receive their CONTACT system from 2019. A

ON THE COVER:
US Army Maj. Chad Amaker uses a field radio to communicate with his headquarters leadership team after conducting an airborne operation onto the Malamute drop zone at Joint Base Elmendorf-Richardson, Alaska, July 17, 2018. (*USAF*)

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