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2016/17

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Tactical radio providers continue to digest lessons from recent conflicts and anticipate future threats as they strive to improve their hardware and software products.

TALKING AT THE SAME TIME

It has been another year of frenetic activity in the tactical radios world. *Armada's Tactical Radios Compendium* returns providing readers with a digest of news in the hardware, software, programmes and accessories domains.

Thomas Withington

At the European level, Bittium (formerly Elektrobit) has made important software and waveform improvements to its TAC WIN battlefield internet system. New products have been unveiled by MESIT Defence (formerly DICOM) in the form of the RF-40V vehicular radio. Similarly, Thales debuted a new family of tactical radios at the Eurosatory exhibition held in Paris this June, in the guise of the company's SYNAPS product range. This new product series is derived from the CONTACT programme which is rolling out a new family of tactical radios for the *Armée de Terre* (French

Army) to replace its existing Thales PR4G family transceivers. Work continues on existing major radio programmes in Europe such as the German Army's SVFuA (*Streitkräftegemeinsame Verbundfähige Funkgeräte-Ausstattung*/Armed Forces Joint Composite Capable Radio Equipment) transceiver being realised by Rohde and Schwarz.

I GLOBAL DEVELOPMENTS

Beyond suppliers in Europe and North America, significant tactical radio development work is ongoing in Australia, Israel and South Africa. To this end, Barrett Communications is seeing an increased

demand for High Frequency (HF: three megahertz to 30MHz) communications which offer a comparatively lower cost alternative to Satellite Communications (SATCOM), particularly for cash-strapped nations. New products in the HF domain have been forthcoming over the last year from Barrett in the form of its 4050 HF transceiver. Elbit Systems has also unveiled new HF radios like the HF-8000, the latest member of the firm's E-Lynx tactical radio family. Fellow Israeli tactical radio providers Rafael Advanced Defence Systems is expanding the capability of its BNET tactical radio series to accommodate a brigade-sized deployment using one

network, while forging ahead with the deliveries of new transceivers. Deliveries are also in the offing for new tactical radios to equip the South African armed forces from local firm Reutech.

I NORTH AMERICA

North America is home to one of the most energetic tactical radio industries, while the United States' armed forces has a major appetite for such technology. Several leading tactical radio firms are based in the US, such as General Dynamics which is vying to provide the manpack dimension of the US Army's HMS (Handheld, Manpack, Small Form Factor) tactical radio requirement. New products have been released by Harris in the form of its RF-7850S handheld radio which carries the firm's new Soldier Time Division Multiple Access Waveform and the RF-300H HF transceiver expected to debut in 2017. Harris is also working with TrellisWare, the latter of which is

providing its TSM-X waveform for the new handheld radios which Harris is developing for the United States Special Operations Command (USSOCOM). Meanwhile, Harris has waveforms of its own on the horizon for 2017. Product enhancements continue with Canada's Per Vices Corporation improving its Crimson family of radios, and Raytheon performing similar work for its Maingate product line. Rockwell Collins is also involved in the manpack dimension of the HMS effort, providing its TruNet Manpack transceiver for consideration, which the firm states will be spun out into a distinct product destined for export.

I ACCESSORIES AND THREATS

In the accessories domain, both Elno and Invisio have announced new headphone and hearing protection products, while continuing to fulfil the requirements of the Australian, Canadian, French, United Kingdom and US armed forces.

Atlantic Signal is continuing its supply of tactical communications headsets for the USSOCOM.

As we look towards the future, tactical radio engineers and users face new challenges: The increased use of a software-centric approach will ease the modernisation of software-defined radios as they move through their lives. At the threat level, the efforts of adversaries to hamper or destroy satellite communications could encourage the further development of HF radio, while Russia has displayed its ability to perform serious levels of tactical communications jamming in recent conflicts. Finally, at the hardware level, battery safety will need to be continually improved, while battery size and weight is commensurately decreased. The provision of adequate hearing protection, along with clear audio reproduction, will continue to remain a priority as armed forces equip their troops around the world.

Radio Days

Feverish activity has been witnessed in the European tactical radios domain in the past year, with new products being launched, and existing products receiving important modifications. Meanwhile, suppliers continue to fulfil radio procurements around the continent.

In recent years, the tactical communications community has looked upon the activities of Bittium (formerly Elektrotbit) with interest, particularly the company's TAC WIN product which provides wired and wireless battlefield Internet Protocol (IP) communications from brigade to platoon levels. This can be achieved across ranges of up to 30 kilometres/km (19 miles). The TAC WIN *ensemble* includes a compact Tactical Router and three optional Radio Heads which, between them, cover the segment of the Ultra High Frequency (UHF: 300 Megahertz/MHz to three gigahertz/GHz) radio spectrum used for military tactical communications.

The Tactical Router forms the IP networks with the Radio Heads enabling deployed tactical radios to communicate with the Tactical Router and thus access battlefield IP services. Bittium told *Armada* that the *Maavoimat* (Finnish Army), which was the original TAC WIN

customer, is now taking the system into service, and that Finnish Army soldiers are being trained to operate it. The firm continued that, as the TAC WIN uses a software defined architecture, it can be continually improved with relative ease, allowing new capabilities to be inserted into the TAC WIN as software upgrades when they become available. Such development efforts have manifested themselves in the realisation of a VOIP (Voice Over IP) capability which the firm announced for the TAC WIN this year. This capability has been added to the TAC WIN systems already in service with the Finnish Army. One of the attractions of the VOIP service is that it allows users equipped with a laptop or smartphone outfitted with the necessary software, to use VOIP to communicate with tactical radios in the field which access the IP network via the use of the Radio Heads (*see above*).

Beyond Finland, the company shared with *Armada* that it had commenced



Important modifications are in the offing for Bittium's TAC WIN battlefield internet system, including its use of the forthcoming ESSOR waveform.

deliveries of the first TAC WIN products to an undisclosed international customer. It added that software developments continue with the next TAC WIN software



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MESIT Defence has taken its RF-40 handheld radio (pictured here) as the baseline for its new RF-40V which provides the user with mobile communications and a 'grab and run' capability.

release currently under development and expected to be available by the end of this year, with a further release planned for 2017. These releases will improve the data throughput of TAC WIN and make the waveforms it employs yet more robust. Other recent enhancements for TAC WIN include a demonstration of its ability to carry the pan-European ESSOR waveform. ESSOR is a programme which is managed by OCCAR (*Organisation Conjointe de Coopération en Matière d'Armement*/ Joint Armament Control Organisation), a European intergovernmental organisation managing collaborative arms programmes involving Belgium, France, Germany, Italy, Spain and the United Kingdom. The ESSOR initiative aims to develop a high data rate wideband networking waveform for software defined radios which can be made available to the ESSOR participating nations of Finland, France, Italy, Poland, Spain and Sweden. This intends to improve interoperability via a waveform which can be used across the participating nations and other third party nations in the future. Bittium is one of several companies involved in the development of ESSOR, alongside Thales, Selex/Leonardo, Radmor, Saab and Indra. The Finnish defence forces plan to employ the ESSOR waveform in

their tactical radios from company level, down to platoon and squad levels.

Bittium demonstrated the interoperability of ESSOR at the Eurosatory exhibition in Paris in June where the TAC WIN showed that it can carry voice, video and data traffic using the waveform between the TAC WIN and Thales PR4G tactical radios (*see below*). A similar demonstration at the event showed the TAC WIN using ESSOR to perform live video streaming with a Selex/Leonardo tactical radio. Bittium plans more field trials in Finland to prove ESSOR's capabilities *vis-à-vis* TAC WIN. Beyond this, it hopes to begin demonstrating the operational capability of the TAC WIN-ESSOR combination from 2017 with a project to this effect lasting up to four years.

■ MESIT

Alongside enhancements to existing products such as TAC WIN, new transceivers have entered the marketplace. Launched in September 2015 at the Defence Security Equipment International (DSEI) exhibition held in London, MESIT Defence' (formerly DICOM) RF-40V follows the handheld RF-40 radio launched earlier that year. The RF-40V incorporates the handheld RF-40 radio in its chassis offering a 'grab and run' capability for the user. In effect this provides two radios within one for the user; a handheld radio for dismounted operations and a vehicular radio for mobile communications.

The RF-40V uses the same waveforms as the RF-40; principally line-of-sight frequency modulation/amplitude modulation, the WF-40 Very High Frequency

(VHF: 30MHz to 300MHz) and UHF Mobile *Ad-Hoc* Networking wideband waveform and the HW-20 VHF EPM (Electronic Protection Measure) wideband waveform. In addition, like the RF-40, the RF-40V can accommodate a Mission Module. This is equipped to provide a second channel for fast, high data rate (circa 37 megabits-per-second/mbps) L-band (one to two gigahertz) ground-to-ground communications. The company told *Armada* that it has teamed with the UK's SlingShot to offer that company's Beyond-Line-Of-Sight (BLOS), Satellite Communications (SATCOM) on-the-move radio *appliqué*. This *appliqué* provides International Maritime Satellite's (INMARSAT) L-band Tactical Satellite (L-TAC) SATCOM services carried across the company's INMARSAT-4 constellation, with L-TAC handling encrypted and unencrypted voice and data traffic for military users. Speaking in October 2015 at the Defence and Security exhibition in Bangkok, the firm told the author that it was awaiting customers for both the RF-40 and RF-40V and expected production of the RF-40V to commence by mid-2016.

■ ROHDE AND SCHWARZ

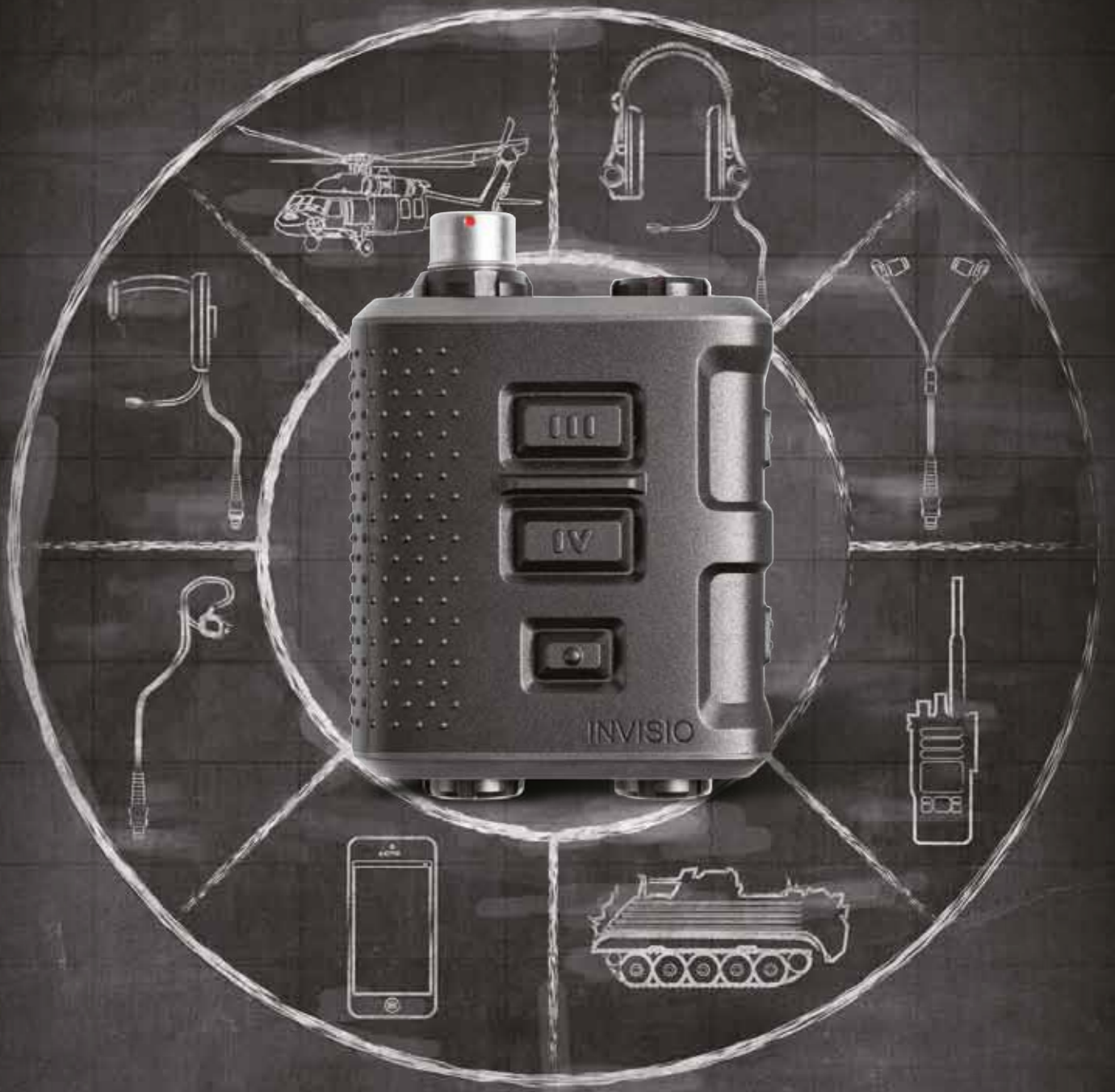
While new products grace the marketplace from European suppliers, work continues on existing major programmes. Rohde and Schwarz told *Armada* via a written statement that, currently, one of its most important programmes is the development for the *Heer* (German Army) of its SVFuA (*Streitkräftegemeinsame Verbundfähige Funkgeräte-Ausstattung*/Armed Forces Joint Composite Capable Radio Equip-

Coming to a German Army vehicle near you! Rohde and Schwarz is forging ahead with the development of its SVFuA radio for the force which will include new, and legacy, waveforms.



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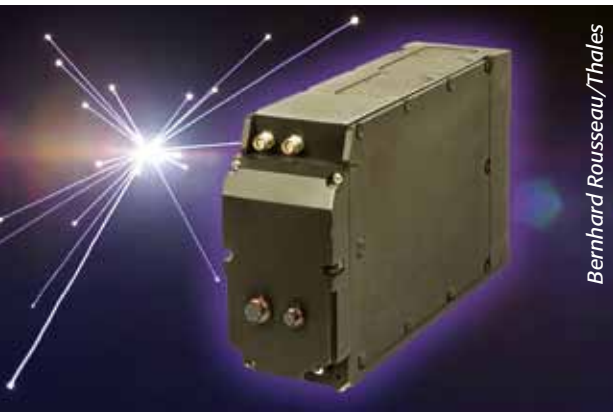
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Bernhard Rousseau/Thales

Thales' new SYNAPS family employs a significant quantity of technology developed for the French Army's CONTACT programme. The airborne member of the SYNAPS family, SYNAPS-A, is pictured here.

ment) tactical radio. The SVFuA programme is developing a new Software Defined Radio (SDR) which will cover a frequency range of 1.5MHz to three gigahertz for the German Army, and the company disclosed that the development work on this new radio has now been completed. The V/UHF radio uses a multi-channel architecture handling national communications at the German *GEHEIM* (Secret) level. Rohde and Schwarz are planning to also classify the radio to handle NATO (North Atlantic Treaty Organisation) Secret traffic, although it has not provided a timeline as to when this could occur.

The company continued that another important phase of the development to meet the SVFuA requirement has now been achieved with the porting of legacy waveforms, and waveforms from third parties, into the radio to allow its compatibility with transceivers already in service with the German Army. In terms of legacy waveforms these will include the HAVEQUICK-I/II air-to-ground/ground-to-air digital waveform used throughout NATO and the High Frequency (HF: three megahertz to 30MHz) Multiple Adaptive HF Radio System waveform and new waveforms such as COALWNW (see above). At present, the SVFuA radio is only capable of narrowband communications, although the firm has told *Armada* that the transceiver will require a wideband networking waveform in the future. One of the candidates to this end could be the company's HDR (High Data Rate Waveform) which can meet such needs. Furthermore, the ability of the radio to carry the Link-16 tactical data link protocol used by NATO and allied nations

for communications to support air operations is being explored. More details regarding the Link-16 data link can be found in the author's 'Let's Get Linky' article in the accompanying edition of *Armada*. The company added that the SVFuA radio will initially equip the German Army's Krauss-Maffei Wegmann/Rheinmetall Puma infantry fighting vehicle and Boxer armoured fighting vehicles produced by the same company.

THALES

While Rohde and Schwarz has been working hard on the new SVFuA radio, Thales has unveiled a new family of tactical radios developed as a spin-off from the CONTACT tactical radio programme that it is fulfilling for the *Armée de Terre* (AdA/French Army) to eventually replace the firm's PR4G radios currently used by the force. During the



Bernhard Rousseau/Thales

Thales has included a vehicular/manpack radio in the SYNAPS family with the SYNAPS-V product. All family members will run several new and legacy waveforms.



Bernhard Rousseau/Thales

Joining the airborne member of Thales' SYNAPS family is the SYNAPS-H, designed as a handheld radio, which the firm states could become available from circa 2018.

Eurosatory exhibition, the firm launched its new SYNAPS radio family which uses much of the technology already developed for CONTACT. The entire SYNAPS family includes airborne radios (SYNAPS-A), as well as a handheld (SYNAPS-H) and manpack/vehicular transceiver (SYNAPS-V).

The transceivers comprising the SYNAPS family share the same hardware as those being procured for the CONTACT programme, with the exception that they are bereft of the national proprietary encryption and security features which will equip the AdA's CONTACT radios. In terms of data throughput, the SYNAPS transceivers have an optimum data rate of up to five megabits-per-second, and are intended to provide a battalion-wide network. In terms of waveforms, the SYNAPS radios will be able to host the customers' sovereign waveforms, along with standard waveforms such as HAVEQUICK-I/II which is a UHF frequency-hopping waveform employed for air-to-air/ground-to-air communications and SATURN (Second-Generation Anti-Jam Tactical UHF Radio for NATO) which can carry data links such as the Link-11 and Link-22 protocols. Other waveforms which the SYNAPS family can host include the legacy PR4G waveforms already in use with these eponymous Thales radios. This will allow the SYNAPS family to be backwards-compatible with legacy radios using these waveforms. This is a particularly important consideration as there will be an overlapping transition within the French armed forces between the PR4G family and the advent of the new CONTACT radios.

Other waveforms which can be hosted by the SYNAPS family include ESSOR (see above) and COALWNW. Furthermore, Thales disclosed that the SYNAPS radio will include two new proprietary waveforms, namely the Manoeuvre waveform to be used for ground-to-ground voice and data communications, and the Airborne waveform for air-to-ground/ground-to-air voice and data communications. Thales told the author that it expects to complete field trials of the SYNAPS-H and SYNAPS-V transceivers by 2017, with production then commencing in 2018 which is analogous to the French CONTACT programme procurement timetable. The airborne radio should meanwhile complete testing in 2018, and be ready for production in 2019. Thales is currently awaiting customers for the SYNAPS family.

The Transmission Party

Away from Europe and North America, the tactical radio domain is a hive of activity with suppliers from Australia, Israel, Pakistan and South Africa releasing new transceivers and moving forward on domestic and export procurement programmes.

The Eurosatory defence exhibition held in Paris this June witnessed a number of new products being launched across the radio domain, both in terms of hardware and software. Australia's Barrett Communications is in the vanguard of High Frequency (three megahertz/MHz to 30MHz) tactical radio provision. The company told the author that the world of HF communications had been experiencing somewhat of a renaissance in recent years, which has been noted elsewhere in this compendium. This is primarily driven by the capabilities which HF can provide in terms of range. Unlike VHF (Very High Frequency: 30-300MHz) and UHF (Ultra High Frequency: 300MHz to three gigahertz/GHz) radio communications which essentially follow a line-of-sight range, HF uses the ionosphere; a section of the atmosphere at 60 kilometres/km (37 miles) to 1000km (620 miles) above the Earth's surface which acts as a natural 'dish' across which HF communications can bounce so as to achieve intercontinental ranges.

While HF does not necessarily offer the throughput in terms of bandwidth for still and video imagery communications, it can provide voice and data communications across such ranges, and avoids the need for a nation to purchase or lease a Satellite Communications (SATCOM) infrastructure to be able to achieve such distances. This is a particularly important consideration in Africa, where Barrett told the author the company enjoys an increasingly large percentage of the market share in terms of the military HF transceivers used on the continent. HF is in demand in Africa given that the distances across which militaries may need to communicate from forward-deployed troops back to headquarters may well eclipse the ranges offered by V/UHF, while SATCOM maybe unaffordable.

As a reflection of this renaissance, Barrett launched its latest HF transceiver, the 4050 HF software defined radio in May,

showcasing this new radio at Eurosatory. The new product has been designed from the outset to be easy to use with an intuitive touch screen display. In addition, the 4050 HF has its own built in WiFi adapter and Ethernet (Internet Protocol) connection which can allow it to be controlled and used remotely. This can be done using civilian devices such as smartphones equipped with either the Android, Windows or iOS (sic) operating system, the latter is used by Apple iPhone and iPad products. Frequency hopping and digital encryption options are available ensuring communications security, and despite this new product, Barrett will continue to support its legacy 2050 HF transceiver. Moreover, the company told *Armada* that new products are in the pipeline include a unique compact liquid-fuelled one kilowatt transmitter, known as the Barrett 4075.

ELBIT SYSTEMS

Also showcasing new products at Eurosatory was Israel's Elbit Systems displaying its E-Lynx tactical radio family. The company told *Armada* that it had already secured two major orders for its E-Lynx transceivers, one of which is for an undisclosed NATO (North Atlantic Treaty Organisation) member. The firm added that it expects to start shipping these radios to these two customers from 2017. The philosophy behind the E-Lynx family, Elbit stated, was to create a data as well as a voice network. The firm envisages these networks taking the form of a 'cloud' which can connect disembodied troops at the Forward Edge of the Battle Area (FEBA), their vehicles and their headquarters, with the intention of providing troops at the FEBA with as much information as possible regarding everything from the targets that they must prosecute to blue and red force locations. Regarding data rates, the company told the author that up to ten megabits-per-second (mbps) of data can be handled by the handheld and vehicular members of the E-Lynx family,



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Elbit's MCTR-7200HH is shown to the right of this picture. Part of the E-Lynx family, the radio can also work with the MCTR-7200MP to transform the MCTR-7200HH transceiver into a vehicular radio.



with the GRX-8000 radio and antenna which forms part of the E-Lynx family for use at the headquarters level, capable of handling in excess of 100mbps. Ranges of between 100 to 200 kilometres (62 miles to 124 miles) can be achieved with the Mobile *Ad Hoc* Networking capability of the E-Lynx radios.

Readers are probably wondering which of Elbit's radios comprise the E-Lynx family? Alongside the GRX-8000 product discussed above, the family includes the PNR-1000. This is a UHF (300 megahertz to three gigahertz) transceiver carrying a narrowband waveform capable of handling around ten megabits-per-second of voice and data, or voice and video traffic. The PNR-1000 also carries a wideband waveform (Elbit Soldier Radio Waveform/ESRW) which can carry up to ten megabits-per-second of data. So far, Chile and Finland have both ordered the PNR-1000, and the radio is undergoing testing as part of a requirement for a new handheld tactical radio from the BENELUX (Belgium, Netherlands and

Luxembourg) countries. Production of the radio for the BENELUX customers is expected to commence over the next year.

Joining the PNR-1000 is the MCTR-7200 series. The company told *Armada* that it can run three waveforms simultaneously across the MCTR-7200 family. This can include two tactical narrowband waveforms occupying 25 kilohertz/KHz of bandwidth; one of these can carry 115 kilobits-per-second (kbps) of data, while the second carries up to 150kbps of simultaneous voice and data traffic. The third waveform occupies 1.2MHz of bandwidth and can carry between 600kbps to one megabit-per-second of traffic. The firm also has plans to port the ESRW which is currently handled by the PNR-1000 (*see above*) into the MCTR-7200 family. This will provide simultaneous voice and data communications using 200KHz of channel bandwidth. The MCTR-7200 family includes the handheld MCTR-7200HH. Meanwhile, the MCTR-7200MP contains two 50 Watt channels and has the same waveform composition of the MCTR-

7200HH and PNR-1000. However, a key difference is that the battery of the MCTR-7200HH can be removed to enable the transceiver to be installed on the MCTR-7200MP thus enabling a handheld radio to become a vehicular radio, and also to provide the L-band (one gigahertz to two gigahertz) communications which can be achieved by the MCTR-7200HH. Although not confirmed by the company, confidential sources have informed *Armada* that the Israeli Army is procuring the MCTR-7200 radio family.

While the radios described thus far cover the V/UHF band, High Frequency (HF: three megahertz to 30MHz) communications have not been neglected by Elbit's E-Lynx family. HF communications are currently experiencing something of a renaissance as noted above. Aware of this renaissance, Elbit has added the HF-8000 radio to the E-Lynx family to offer users a long range HF capability. The firm told the author that this radio can carry voice and data communications at a rate of circa 20kbps, and added that the firm is working to develop a wideband capability for the HF-8000 which could provide 24KHz of bandwidth potentially increasing data rates to between 120kbps and 140kbps. The firm added that it expects to commence serial production of the HF-8000 by the end of the year.

■ NRTC

Looking towards Asia, Pakistan's National Radio and Telecom Corporation (NRTC) updated *Armada* regarding the status of its SDR-96X family of V/UHF tactical radios that the company is providing to a number of domestic and international users. Three radios comprise the family: a multiband handheld transceiver, manpack multiband radio and a vehicular multiband transceiver. Each offer data rates of up to 64 kilobits-per-second and accommodate six waveforms, notably the Combat Net Radio (CNR), ACNR (Airborne CNR), WBNR (Wideband Networking Radio), NBNR (Narrowband Networking Radio), air-to-ground and ground-to-air waveforms, in addition to a waveform that allows users to communicate with public safety officials such as civilian first responders.

Deliveries to the Pakistan armed forces, which include the country's navy, army, air force, marines and paramilitary forces are currently ongoing. NRTC was unable to provide precise figures regarding how many of these specific radios it was delivering, although it did disclose that deliveries had



Thomas Withington

Elbit's HF-8000 high frequency radio could benefit from the renaissance being witnessed in the field of HF communications. This radio forms part of the company's E-Lynx radio family.

commenced in 2011, and are expected to conclude in 2020. Regarding export customers, these radios have been delivered to the Nigerian and Saudi Arabian armies, with deliveries commencing in the next two years to the Egyptian Army.

RAFAEL

Joining their Israeli colleagues in tactical radio provision is Rafael Advanced Defence Systems. The company is continuing to develop its flagship BNET tactical radio family. Family members include the BNET-HH which is designed as a platoon leader's radio, although it can serve lower echelons. This radio is currently finishing field trials which should be completed by the end of the year, with deliveries ready to commence in 2017. The BNET-AR is the airborne element which has been acquired by both the Brazilian and Colombian air forces. In Brazilian service, the BNET-AR will carry the air force's proprietary Link-BR2 airborne data link. This radio will also be acquired by the Israeli Air Force (IAF) with deliveries commencing in 2017. The force is thought to currently use Rafael's RAVNET-300 V/UHF airborne radios, and the RAVNET waveforms used by these legacy transceivers will be ported into the BNET-AR radios that the IAF will acquire. Other BNET family members include the BNET-V vehicular radio, with the Israeli Army understood to be receiving this radio as of 2016 for air-to-ground/ground-to-air communications.

In conversation with the author at this year's Eurosatory exhibition, the firm revealed that it is working towards demonstrating to existing and potential customers the ability of a single BNET network to accommodate up to 400 members. The *rationale* behind this, the company disclosed, is to have a

large brigade-sized network with gateways between the different users and echelons on that network, such as infantry, armour and aviation. This is to ensure that the same users have access to the same broadband capability offered by BNET regardless of the transceivers they are using. This can include transmit data rates of up to two megabits-per-second and ten megabits-per-second transmit for the BNET-HH and BNET-V/AR radios, and reception speeds of 100mbps and 500mbps for these respective radios. The firm told *Armada* that it currently offers a network which can accommodate a battalion-sized deployment, with the brigade network capability discussed above expected to debut in 2017.

REUTECH

Finally, South African military communications specialists Reutech disclosed that the company will begin to deliver a new selection of tactical radios to all branches of the South African armed forces (army, air force and navy) during this year. The company declined to disclose the number of radios that it will deliver, but did mention that these will replace existing Reutech transceivers which have been in service with the South African armed forces for the past 25 years. The company added that it will supply HF and V/UHF transceivers, the latter being used for ground-to-air/air-to-ground communications. Although the nomenclature of these radios has not been disclosed, the firm adds that all of these radios will be offered in manpack, vehicular and fixed configurations. Regarding waveforms, the radios will support voice and data networking with communications security and electronic counter-countermeasure protection.



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Radio Programmes

The erstwhile Joint Tactical Radio System (JTRS) programme continues to dominate tactical radio procurement for the United States armed forces, with new waveforms and hardware being spun out of these initiatives for export customers.



Thomas Withington

Harris showcased its RF-7850S radio at this year's Eurosatory exhibition. This radio also carries the firm's new STNW waveform, and is being supplied to nine undisclosed customers around the world.

General Dynamics is working on a next generation manpack radio to fulfil this requirement. The firm is concentrating on reducing the size, weight and power consumption of its existing AN/PRC-155 manpack design, adding that adapting and procuring an improvement on an existing design may be more cost-effective for the US Army than purchasing a completely new radio. One of the attractions of the AN/PRC-155, the company told the author, was that the radio already possessed the MUOS (Mobile User Objective System) waveform which allows it to communicate with the US Navy's UHF (Ultra High Frequency: 300MHz to three gigahertz) MUOS satellite constellation which is entering service to replace the US Navy's UFO (UHF Follow-On) satellite constellation.

Meanwhile, in early September 2015, the United States Army awarded General Dynamics a contract worth \$20 million for a two-channel, vehicle-mounted version of the force's AN/PRC-154/A(V)1/B(V)1 UHF (225-450 megahertz/MHz) and L-band (one gigahertz to two gigahertz/GHz) Rifleman Radio. The AN/PRC-154 is currently being procured via the Low Rate Initial Production (LRIP) phase for the handheld dimension of the HMS requirement (*see above*). As a result of this contract, General Dynamics subcontracted Thales to provide a total of 1100 AN/VRC-121 VIPER (Vehicle Integrated Power Enhanced Rifleman) radios which will begin deployment in early 2016 with the US Army's 82nd and 101st Airborne Divisions. In terms of architecture, the AN/VRC-121 design effectively acts as an adaptor to provide a two-channel radio. The transceiver accommodates an AN/PRC-154/A handheld radio which in turn carries the Soldier Radio Waveform (SRW) developed for use by the US Army for dismounted troops. The AN/PRC-154/A fits into the AN/VRC-121 transceiver which provides 20 Watts of amplification. This increases the transmit power of the AN/PRC-154, usually circa five watts, allowing longer-range communications.

Joining Harris and Rockwell Collins (*see below*), General Dynamics is one of the companies answering the call to provide the FRP (Full Rate Production) segment of the manpack requirement for the US Army's ongoing HMS (Handheld, Manpack, Small Form Factor) tactical radio requirement. The HMS programme was spun out of the erstwhile Joint Tactical Radio System (JTRS) initiative. Under the JTRS programme, the US Department of Defence (DoD) planned to replace all of the tactical radios in the United States armed forces with a range of new systems until JTRS was dissolved in 2011, following concerns over cost overruns. Nevertheless, the programme was then resurrected, but with individual services given the responsibility of acquiring various tactical

radios, hence the army being given the responsibility of procuring the HMS component which will also equip the army's sister services (United States Air Force/USAF, United States Marine Corps/USMC and United States Navy/USN).

Speaking during the May 2016 SOFIC (Special Operations Forces Industry Conference) exhibition held in Tampa, Florida, General Dynamics officials updated *Armada* regarding the work that the firm is performing on the manpack component of HMS. Currently the firm is delivering AN/PRC-155 two-channel, manpack tactical radios to the force which have been delivered to the army as part of the Low Rate Initial Production (LRIP) phase of the manpack segment of HMS. The programme is now moving towards Full Rate Production (FRP: *see below*) and



US DoD

General Dynamics is in the running for the FRP phase of the manpack requirement for the US Army's HMS programme. The firm is already supplying its AN/PRC-155 manpack transceiver as part of the LRIP element of this initiative.

The AN/VRC-121 enables the AN/PRC-154 to be both a handheld and a vehicular radio using the same transceiver. To ease installation, the AN/VRC-121 can be accommodated in any vehicle with either a Single Channel Ground and Airborne Radio System (SINCGARS) radio vehicle adapter amplifier, or SINGCARS base tray. The AN/VRC-121 can act as a conduit carrying the SRW between dismounted troops using the SRW on their AN/PRC-154 family radios, vehicles, and higher echelons of command. It answers the US Army's requirement for a vehicle-mounted radio carrying the SRW.

I HARRIS

At this year's Eurosatory defence exhibition held in Paris this June, Harris showcased its new RF-7850S UHF (300MHz to three gigahertz/GHz) handheld radio. Intended for platoon-wide communications of up to four kilometres/km (2.4 miles) range, the radio hosts a number of waveforms including the proprietary Soldier Time Division Multiple Access Waveform (STNW) which was launched alongside

this new product. The STNW is designed as a point-to-point waveform to support MANET (Mobile Ad Hoc Networking) communications and provides full voice communications, simultaneous voice and data communications and location information using the Global Positioning System (GPS) satellite constellation. Harris officials told the author that the STNW can host six dedicated voice channels with each individual having their own GPS slot on the waveform. Six talk groups with up to 48 users can be hosted using the STNW which handles up to 1.4 megabits-per-second of data. For now, the STNW is only available for the RF-7850S, although the firm is confident that this waveform could, in the future, be ported into other members of Harris' RF-7850 Falcon-III tactical radio family.

In July the firm told *Armada* that it had shipped 2090 RF-7850S transceivers since the radio was launched this May, with nine undisclosed customers in the Asia-Pacific, Europe and the

Middle East making purchases. Another interesting feature regarding the RF-7850S is that it has been designed to be easily exportable. While the radio does fall under the strictures of the US government's International Traffic in Arms Regulations legislation, it does not employ the National Security Agency's (NSA) Type-1 level of encryption relating to securing classified US government information. Instead, the radios are secured using Harris' Citadel-I/II and the US National Institute of Standards and Technology's AES-256 (Advanced Encryption Standard-256) levels of encryption.

Beyond the STNW, the RF-7850S can accommodate the firms' TNW (TDMA Networking Waveform) which is a narrowband waveform offering ranges of up to 15km (9.3 miles), but with a data throughput of 16kbps (kilobits-per-second) with the waveform typically being used to handle text messages. The TNW is interoperable with other RF-7850 family radios, and can host up to 64 users on a network, the company told *Armada*. These users can be organised into six different

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Harris' AN/PRC-117G radio is being outfitted with new waveforms such as the US Army's WNW, which will include the Over The Air Management capability to allow the easy update of the radio across deployed networks.

talk groups each of which absorbs 25 kilohertz of bandwidth, with the waveform also offering GPS-based location reporting. The firm's ULOS (UHF Line-of-Sight) waveform is also hosted on the RF-7850S which it states is a 'last ditch' waveform to carry simple voice and minimal data communications. The ULOS is a fixed frequency waveform occupying three kilohertz of bandwidth.

The firm also shared with the author that in February 2017 it would launch a new waveform called WPAN (Wireless Personal Area Network). Designed to be retrofitted across Harris' RF-7850 family, the waveform can be used by these radios following a simple retrofit which includes a small circuit board being installed in the transceiver to allow the WPAN software to be used. Once installed, this will allow these radios to use wireless connectivity across WiFi or Bluetooth networks allowing the radio to communicate with a cellphone, tablet or a laptop and *vice-versa*. This should be of particular use when RF-7850 family radios are being employed in an environment where non-military personnel may be present and may need to liaise and communicate with one another, such as in the wake of natural disasters or during humanitarian work.

Beyond new products such as the RF-7850S, Harris is heavily involved in a number of programmes for the United

States armed forces. For example, the company has ported the MUOS waveform onto its AN/PRC-117G V/UHF multiband manpack radio. Used throughout the US armed forces, and the United States Special Operations Command (USSOCOM), the radio already hosts the Single Channel Ground and Airborne Radio System (SINGARS) and HAVEQUICK-I/II legacy air-to-ground/ground-to-air and ground-to-ground analogue and digital waveforms. The addition of the MUOS

waveform will let the radio be used for UHF satellite communications across the MUOS constellation. Harris told *Armada* that it had already begun to receive orders for AN/PRC-117G radios to be retrofitted with the MUOS waveform, and hopes to start delivering upgraded radios in the third quarter of 2016.

Furthermore, the company disclosed that it is outfitting the AN/PRC-117G with the Wideband Networking Waveform (WNW). The WNW facilitates



Harris is providing the AN/VRC-118(V) mid-tier networking radio to the US Army. This is designed to facilitate communications from brigade and battalion levels to company- and platoon-sized formations.

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Per Vices Corporations' Crimson SDRs continue their development with the company adding yet more functionality to this family of tactical radios, which will no doubt benefit customers in Europe and North America.

communications at the mounted infantry level, with the Soldier Radio Waveform (SRW) being subordinate to the WNW and being used for dismounted communications at platoon/squad level. A further enhancement to the AN/PRC-117G is the addition of the OTAM (Over The Air Management) capability. Much like the civilian smartphone world, OTAM enables AN/PRC-117G users to download new enhancements to their radios in the field across their radio nets. This could be particularly useful if new encryption parameters need to be uploaded during a specific mission, or should new frequencies need to be employed. Both the SRW (which also outfits the AN/PRC-117G) and the WNW both have the OTAM function.

Other Harris radios have received similar modifications. For example, the AN/PRC-152A handheld V/UHF multiband radio which is in service with the US Army, USMC and USAF is being retrofitted to handle Project-25 (APCO-25) communications. Tactical radios equipped with APCO-25 can communicate in the United States with civilian first responders given that the APCO-25 communication standard is used at the federal and state level in the US by local public safety organisations. This work commenced in 2015, and the company believes that APCO-25 functionality will prove particularly useful to US National Guard units equipped with the radio which may be called upon to assist domestically in the wake of natural disasters or civil unrest, and hence benefit from this level of interoperability with local civilian organisations.

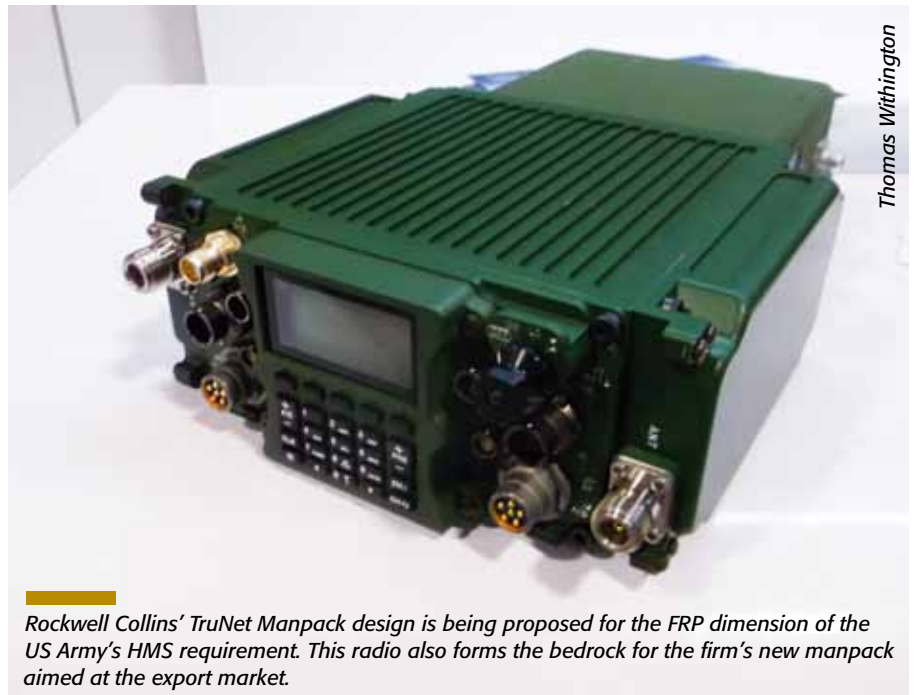
Harris is also the contractor providing the AN/VRC-118(V) Mid-tier Networking Vehicular Radio (MNVR), having been selected to provide this transceiver to the US Army in September 2013. The AN/VRC-118(V) is, as its acronym suggests, a vehicular radio designed to carry voice, data and imagery traffic from brigade and battalion levels to companies and platoons. Certified to US NSA Type-1 encryption standards, the AN/VRC-118(V) carries legacy waveforms such as SINCGARS and HAVEQUICK-I/II, while also carrying

WNW and SRW forming the junction where dismounted communications using the SRW connect to the next tactical echelon using the WNW. The OTAM capability discussed above for the AN/PRC-117G will be included in the next software release planned for the AN/VFC-118(V) in the third quarter of 2016.

Meanwhile, development of the AN/VRC-188(V) is continuing with the radio having performed tests with the US Army in 2015. That said, reports emerged this July that Michael Gilmour, director of operational test and evaluation for the US Department of Defence, had expressed concerns regarding the suitability of the AN/PRC-118(V)1 to meet the US Army's requirement for mid-tier networking. This followed the US Army's Networking Integration Evaluation (NIE) exercise conducted at Fort Bliss, Texas in May and a previous NIE held in 2015. Media reports have noted that the US Army's Brigade Modernisation Command (BMC), which performs the NIE exercises, had received varied feedback regarding the radio by commanders who had used the transceiver during these exercises. In particular, the

feedback from the most recent NIE stated that the vast majority of commanders who attend the exercise and used the AN/VRC-118(V) would use the radio if it is fielded by the US Army. A decision on whether the US Army will move towards the low-rate initial production of the AN/VRC-118(V) is expected towards the end of this year.

Finally, like other companies discussed in this compendium, Harris is increasing its activities in the High Frequency (HF: three megahertz to 30MHz) domain. HF radios provide intercontinental distances thanks to the ability of HF transmissions to 'bounce' off the ionosphere, a level of the atmosphere at an altitude of 60 kilometres/km (37 miles) to 1000km (620 miles) above the Earth's surface. The attractions of HF is that it is less expensive to procure HF transceivers, compared to SATCOM terminals, which also require an accompanying satellite and ground-based infrastructure which is either leased or owned by the government of the armed forces in question. However, HF communications are hampered in terms of bandwidth and cannot necessarily handle still and video imagery traffic.



Rockwell Collins' TruNet Manpack design is being proposed for the FRP dimension of the US Army's HMS requirement. This radio also forms the bedrock for the firm's new manpack aimed at the export market.

Harris told the author that it plans to launch its new RF-300H HF radio in February 2017. This will be a smaller and lighter transceiver compared to the firm's legacy AN/PRC-150 HF manpack radio currently in service with the US Army, USMC and USSOCOM, and a number of so-called 'five eyes' nations (Australia, Canada, New Zealand, the United Kingdom and the United States). One attraction of the RF-300H is that the existing AN/PRC-150 accessories will be compatible with this new transceiver. Although no orders exist as yet for the new radio, the firm told *Armada* that the US Navy and USAF have shown great interest in the RF-300H, and that the USMC is planning on modernising its HF communications in the near future with the new radio being a possible solution to this end.

Elsewhere, Harris has been awarded an indefinite-delivery/indefinite-quantity contract from the US Army to supply AN/PRC-158 manpack radios. The contract has a ceiling of 65000 AN/PRC-158s and includes a five-year base, plus an additional five-year option. According to a Harris

press release published in late-February, full production of these radios is expected to commence by the fourth quarter of 2017. The V/UHF AN/PRC-158 carries a wide array of waveforms including SINCGARS and HAVEQUICK-I/II. These are in addition to Harris' HPW (High Performance Waveform) and ANW2 (Adaptive Radio Networking Wideband Waveform), and the SRW.

Staying with Harris, this February, it was reported that the TSM-X waveform developed by TrellisWare will be included in the next generation handheld radio to equip the USSOCOM which is being provided by Harris. To this end, the TSM-X MANET waveform will handle voice, data, imagery (still and video), plus Internet Protocol (IP) and geolocation information across a single network. In early October 2015, Harris announced that it had received a contract from the USSOCOM for the provision of a new handheld radio under the terms of a \$390 million indefinite delivery/indefinite supply contract across a five-year period, with the option to extend this by one year and

deliveries to commence in 18 months from the reception of the contract. The radio will be developed in two versions for urban and maritime operations with the latter being water-submersible to a depth of 20 metres (65 feet) for two hours, carrying two channels, one for broadband and one for narrowband communications.

PER VICES

Unlike Harris, Per Vices Corporation is not directly involved in the US Army's HMS programme. Nevertheless, it is forging ahead with new products. Following their discussion in 2015's *Tactical Radios Compendium*, the Canadian communications specialists have shared more details regarding their Crimson family of software defined radios with *Armada*. Over the past twelve months, the firm disclosed that it has continued the development of the Crimson TNG which it says is its newest SDR, that in turn builds upon the capabilities of its Crimson Classic product which possesses four, fully-integrated transmit and receive channels each offering 322MHz

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2110M		Codan	
	1.6 to 30 MHz Power: 5 or 25 Watts Waveforms: Mil-STD-188-110A/B and Stanag-4539 Encryption: Wideband and band-limited frequency hopping and voice encoding Notes: Supplied to Afghan Border Police and Kyrgyz Republic.	2.9kgs.	


AN/PRC-159		Harris	
	225-450MHz/L-band Power: Selectable up to 3.2W SRW and software upgradeable to support additional and future waveforms. Waveforms: SRW and software upgradeable to support additional and future waveforms. SW programmable security architecture Suite B. Encryption: Suite B. Notes: Alongside its accommodation of the Soldier Radio Waveform, this radio will be able to access the WIN-T network.	0.78kgs.	


SYNAPS-V		Thales	
	30MHz-3GHz Power: Unpublished Waveforms: Robust COMSEC, TRANSEC and frequency hopping Encryption: Proprietary waveforms and legacy PR4G waveforms, plus third party NATO and national waveforms. Notes: Launched in 2016, developed as the exportable component of the transceivers being developed for the French Army CONTACT programme.	Unpublished Weight	


HF-6000 HDR		Elbit Systems	
	1.5 to 30 MHz Power: 20 Watts manpack/125 vehicular Waveforms: Voice/data, CW Encryption: Digital/analogue encryption Notes: Selective calling, digital squelch, proprietary orthogonal and synchronous networks w/o master station, data up to 9.6 kbps, adaptive data algorithm, frequency hopping ECCM.	3.9kgs.	


PR4G F@stnet		Thales	
	30 to 88 MHz Power: 2 Watts hand-held (see notes) Waveforms: F@stnet, isochronous TDMA Encryption: ECCM against narrow- and broadband jammers Notes: Radio family uses Mux mode, continuous voice and data, 10 Watts manpack 50 vehicle.	0.87kgs.	


AN/PRC-117G		Harris	
	30 MHz to 2 GHz Power: 10 or 25 Watts (20 in Satcom mode) Waveforms: SINCGARS, HAVEQUICK-I/II, VHF, UHF, AM, HPW, Dama, ANW2, 181B Tacsat Sierra II NSA-certified Type I Encryption: IP-based wideband networking radio, transmits 5 Mbps over tactical Internet, Over 50000 radios delivered to the USMC to date. Notes:	5.4kgs.	


PRC-710		Elbit Systems	
	30 to 88 MHz Power: 5 Watts (20 w/amp) Waveforms: Mil-STD-188-110A/B and Stanag-4539 Encryption: Frequency hopping and voice Notes: Up to 16 kbps data with adaptive algorithm, orthogonal network, full frequency band.	0.7kgs.	


PRC1099A		Datron	
	1.6 to 30 MHz Power: 5, 20, 100 and 400 Watts Waveforms: Simplex or half-duplex USB, LSB, CW, and Ame Encryption: Embedded ECCM and COMSEC Notes: 100 programmable channels, Fed-Std-1054 ALE, built-in test, 5 Watts continuous duty.	5.1kgs.	


RF-310M-HH		Harris	
	30 to 512 MHz Power: 0.25 to 5 Watts Waveforms: VHF, UHF, AM, FM (Type 1 AES) Encryption: Type 1 Suite B AES, Type 3 AES, Des-OFB Notes: First tactical radio to receive NSA certification for Type 1 Suite B.	1.2kgs.	


RF40		DICOM	
	30-512 megahertz Power: 5W with 10W Burst Waveforms: LOS FM/AM, WM40, HW20 Encryption: AES based key length up to 384 bits Notes: Launched in 2015, DICOM's RF40 Thoroughbred V/UHF handheld radio can achieve a data throughput of 270kbps. The addition of a Mission Module can extend this to 40mbps.	0.9kgs.	


Soldier ISR Receiver		L-3	
	Ku/C/S/L-bands Power: 3.5 Watts Waveforms: FM, FSK, BPSK, O-QPSK Encryption: Triple DES, AES Notes: IP-based secure, digital/analogue data/video ISR receiver/SDR designed for modular soldier systems.	0.9kgs.	


Soldier Radio M		Harris/Exelis	
	30 to 88 MHz Power: Variable wattage Waveforms: Soldier Radio Waveform, JTRS Bowman (JBW), capable of hosting others Encryption: Programmable crypto subsystem Notes: VHF 30-88MHz 5 W, UHF 225-450 MHz 2 W, L-band 1250 - 1390/1710-1850 MHz 2 W.	0.73kgs.	


CNR-2000	LEONARDO/SELEX	
	1.6 to 60 MHz	3.7kgs.
Power:	10 to 25 Watts	
Waveforms:	CW (J2A), USB/LSB/FM voice, FSK, NPSK phase shift keying and NQAM	
Encryption:	Proprietary TRANSEC/COMSEC	
Notes:	ELOS/BLOS/LOS, embedded GPS; HF-to-HF/VHF-to-HF rebroadcast, Gen-3 ALE.	


CNR-9000	Elbit Systems	
	30 to 108 MHz	3kgs.
Power:	5 to 20 Watts	
Waveforms:	High data rate combat net radio	
Encryption:	Orthogonal frequency hopping and ECCM	
Notes:	32 kbps data transfer, optional vocoder, GPS, streaming on-the-move video.	


HH7700	Datron	
	1.5 to 30 MHz	3.9kgs.
Power:	0.5, 2 or 5 Watts	
Waveforms:	Simplex over FM	
Encryption:	Optional voice scrambler	
Notes:	Splash proof, alphanumeric LCD, 2320 or 4640 channels (300 Hz to 3 MHz FM), Vox and Whisper modes.	


MicroLight DH500	Raytheon	
	225 MHz to 2.0 GHz	0.76kgs.
Power:	0.1 to 4 Watts	
Waveforms:	Eight-hop relay, CPSPM with DSSS, TDMA, CDMA and FDMA	
Encryption:	AES for secure-but-unclassified trans mission	
Notes:	Web browser, VoIP, data, video and position info.	


AN/PRC-148	Thales	
	30 to 512 MHz	0.95kgs.
Power:	0.5 to 5 Watts	
Waveforms:	HAVEQUICK-I/II, SINGARS	
Encryption:	NSA Type 1, Type II DES	
Notes:	Supplied to the US Army in 2007. AN/PRC-148V3/V4 JEM upgrade makes it compatible with JTRS frequency range.	


AN/PRC-150	Harris	
	1.6 to 60 MHz	4.7kgs.
Power:	1, 5, 20 Watts	
Waveforms:	HF SSB, AM SSB, CW, VHF, FM, Melp, LPC-10	
Encryption:	NSA-certified Type 1, Melp vocoder, serial-tone ECCM, coalition Citadel	
Notes:	75 programmable presets, ALE and datalink protocols, wideband FSK data to 16 kbps.	


4050 HF	Barrett	
	1.6-30MHz	2.55kgs.
Power:	Up to 150W	
Waveforms:	Proprietary waveforms	
Encryption:	Frequency hopping at 5 to 25 hops per second	
Notes:	Includes an innovative touchscreen display, and can be controlled remotely	

PRC2100V	Datron	
	30 to 88 MHz	4.2kgs.
Power:	0.5 to 10 Watts *	
Waveforms:	VHF, voice, data, FM FF, simplex or half duplex	
Encryption:	full/partial freq hopping, digital encryption	
Notes:	12-chnl GPS, 16 Kbps data, * 0.5 to 75 W vehicle/fixed, selective calling, voice priority	


RF-7800M-MP	Harris	
	30 MHz to 2 GHz	3.6kgs.
Power:	20 Watts	
Waveforms:	Narrowband VHF low, VHF high, UHF low. Wideband UHF, ANW2	
Encryption:	AES 256-bit	
Notes:	Fixed, manpack or vehicular, embedded 12-channel GPS, 2400 bps Melp, ad hoc networking.	


RF-7800S-TR	Harris	
	350 to 450 MHz	0.30kgs.
Power:	0.25, 1 or 2 Watts	
Waveforms:	FSK or GMSK data/voice	
Encryption:	Selectable Citadel II Asic or AES	
Notes:	Full-duplex to six talkers, GPS position report, range to one kilometre in jungle, automatic whisper mode.	


Spearhead	Harris/Exelis	
	30 to 88 MHz	0.65kgs.
Power:	0.1, 1* or 5 Watts	
Waveforms:	NATO squelch, clear or secure voice, SINGARS, tactical Internet	
Encryption:	Secure orthogonal frequency hopping, country-specific crypto	
Notes:	Embedded OTA position reporting, 12-channel GPS receiver, *International version.	


RF-7850S	Harris	
	225MHz to 2GHz	775G
Power:	3.2W	
Waveforms:	TNW, VULOS	
Encryption:	256 bit Citadel, 256 bit AES	
Notes:	Launched in 2016, this radio is already being supplied to a number of customers around the world.	


A COMPENDIUM


Centaur		Harris/Exelis
	225 to 450 MHz	14kgs.
	Power:	adaptive up to 20 Watts
	Waveforms:	VHF/HF Centaur network data backbone
	Encryption:	AES 256-bit
	Notes:	Supply UK MoD's M-Dor in 2011 under \$15 million contract. Now four Mbps data.

EPLRS-XF-I		Raytheon
	225 to 450 MHz	8kgs.
	Power:	up to 50 Watts
	Waveforms:	Enhanced position, IP MANET
	Encryption:	AES Encryption
	Notes:	Sales to Canada and Australia, up to 32 simultaneous independent data paths, auto route establishment, man pack/vehicular/airborne.


MPT3A		Reutech
	118 to 400 MHz	0.76kgs.
	Power:	0.5 or 5 Watts
	Waveforms:	Analogue voice, CVSD, TDMA, CSMA
	Encryption:	Vocoder, frequency hopping, digital encryptor
	Notes:	Customisable encryption algorithms, GPS position reporting, 1 metre immersion/2 hours.


MR300xU		Rohde & Schwarz
	25 to 30 MHz	n/a
	Power:	10 to 150 Watts (see notes)
	Waveforms:	Ale 2/3G, AM/FM, SSB, Stanag 4285 and 4246, Secos, HAVEQUICK-I/II
	Encryption:	Secom-H/-V/-P and digital voice vocoders
	Notes:	Integrated GPS and position reporting, 72 kbps data, wide variety of waveforms.


AN/PRC-152		Harris
	30 to 512 MHz	1.1kgs.
	Power:	0.25 to 5 Watts (10 in Satcom mode)
	Waveforms:	SINGARS, VHF, UHF, AM, HAVEQUICK-I/II, SATCOM HPW, Dama, P25 option
	Encryption:	Sierra II programmable
	Notes:	Dagr, PLGR GPS interoperable, JTRS-approved, SCA-compliant SDR.


AN/PRC-154		GD-MS/Thales
	5 to 15 GHz	1.1kgs.
	Power:	2 Watts UHF, 5 L-band
	Waveforms:	Soldier Radio Waveform voice and data, UHF, L-band
	Encryption:	Programmable NSA Type II COMSEC/TRANSEC
	Notes:	Rifleman Radio, continuous location reporting. LRIP began 7 July 2011


PRC-9651		ASELSAN
	30 to 512 MHz	1.4kgs.
	Power:	0.5, 1, 2.5, 4 Watts
	Waveforms:	VHF/FM, UHF/WBNR, UHF AM/FM, A-CNR
	Encryption:	Frequency hopping for digital voice and data
	Notes:	Multi-mode multi-mission SDR.

PRC-9661		ASELSAN
	30 to 512 MHz	1.4kgs.
	Power:	1, 2, 5, 10 Watts
	Waveforms:	VHF/FM, UHF/WBNR, UHF AM/FM, A-CNR
	Encryption:	Frequency hopping for digital voice and data
	Notes:	Multi-mode multi-mission SDR, 50 W power amp available.


RO Tactical Radio		Harris/Exelis
	DTCS/Iridium SATCOM	0.5kgs.
	Power:	connects to PC
	Waveforms:	HF voice and data
	Encryption:	AES 256 voice/data
	Notes:	OTM over horizon secure voice, up to five unique networks (soon ten), <400 km range, pole-to-pole comms w/o need for geo sat link.


HF-8000		Elbit
	1.5-29MHz	Unpublished weight
	Power:	Up to 4000W depending on configuration
	Waveforms:	Proprietary waveforms
	Encryption:	AES 256, Digital and analogue encryption
	Notes:	Provides up to 2.4kbps of data communications, and up to 0.8kbps of voice communications, with options to increase this to 1.2kbps.


SR600		Kongsberg
	225 to 400 MHz	0.7kgs.
	Power:	0.1 to 1 Watts
	Waveforms:	Multi-hop IP-based voice & data
	Encryption:	Embedded AES 256-bit
	Notes:	Supports parallel voice networks, ad hoc IPv4 node (DHCP/routing), five voice nets.

St@r Mille-S		Thales
	325 to 470 MHz	0.37kgs.
	Power:	0.1 to 1 Watts
	Waveforms:	High data-rate UHF
	Encryption:	Embedded AES 256-bit
	Notes:	Also available in vehicular and intra-platoon versions, whisper mode, up to 1.5 km in open terrain; 500 metres urban.


OF RADIOS


F@stnet Twin	Thales
	<p>30 to 88/225 to 512 MHz >1kgs.</p> <p>Power: 5 Watts UHF & VHF</p> <p>Waveforms: PR4G F@stnet, CNR, iMux, SuperMux, St@rmille, air-ground Nextwave</p> <p>Encryption: Full TRANSEC/COMSEC</p> <p>Notes: Simultaneous voice/data, dual-channel SDR, embedded GPS, 2D map facility.</p>


FlexNet One	Thales/Rockwell Collins
	<p>30 to 512 MHz in development</p> <p>Power: 50 Watts UHF and VHF</p> <p>Waveforms: Waveform customisation, supports Flexnet and PR4G F@stnet waveforms</p> <p>Encryption: Programmable INFOSEC, customer specific encryption</p> <p>Notes: SCA 2.2-compliant V/UHF narrow/wideband, multimedia to six mbps, first international SDR.</p>


MR3000P	Rohde & Schwarz
	<p>25 to 146 MHz n/a</p> <p>Power: 5 Watts</p> <p>Waveforms: VHF SECOM-P digital EPM jam-resistant waveform</p> <p>Encryption: frequency hopping and digital encryption</p> <p>Notes: M3TR family. Optional GPS receiver, remote control unit, nine network presets.</p>


MRC3005	Reutech
	<p>1.5 to 512 MHz 5.9kgs.</p> <p>Power: 0.01, 0.5, 1, 2, 3, 10, 20 Watts</p> <p>Waveforms: HF, VHF, V/UHF, HAVEQUICK-II, CNR, PRN, SCRA, IPoA, SECOM H/V, ALE 2/3G</p> <p>Encryption: Frequency hopping and voice</p> <p>Notes: Syllabic, tone, signal squelch, GPS mode, 72 kbps OFDM data rate, 20-hour autonomy.</p>


AN/PRC-155	GD-MS/Rockwell Collins
	<p>2 MHz to 2.5 GHz 6.5kgs.</p> <p>Power: 20 Watts</p> <p>Waveforms: Soldier Radio Waveform, MUOS/SINGARS, EPLRS, HF SSB w/ALE, SATCOM</p> <p>Encryption: Type 1 and 2 embedded COMSEC and TRANSEC</p> <p>Notes: Two-channel JTRS HMS manpack, four channels by networking. LRIP began 7 July 2011.</p>


RRC-9210	Radmor
	<p>30 to 88.975 MHz 3.4 kgs.</p> <p>Power: 0.5/5 Watts</p> <p>Waveforms: Interoperable with all Thales PR4G radios</p> <p>Encryption: High level of ECCM protection</p> <p>Notes: Has built-in GPS receiver, can perform simultaneous and independent voice and data communications.</p>


AN/PSC-5D	Raytheon
	<p>30 to 512 MHz 5.2kgs.</p> <p>Power: 10 or 20 Watts</p> <p>Waveforms: SINGARS, SATCOM, DAMA, HAVEQUICK I/II, AM, FM, FSK, B/SB/DESB/SOQ PSK</p> <p>Encryption: Wide variety of voice and data encryption capabilities, embedded COMSEC</p> <p>Notes: NSA/JITC certified, Melpe vocoder, embedded tactical Internet/joint range extension protocols, embedded IP stack.</p>

R3507 / R3509	Radmor
	<p>20 - 520MHz 1.0kgs.</p> <p>Power: 0.1 to 5 Watts</p> <p>Waveforms: multi waveform modem: VHF/UHF AM and FM, FH waveform / STANAG 4204, 4205, BMS IP WF</p> <p>Encryption: AES 256</p> <p>Notes: Built in data transmission, GPS, SCA interface, frequency hopping. Available in vehicular version / MANET, GPS, simultaneous voice and data transmission, frequency hopping</p>

RT-1702	Harris/Exelis
	<p>30 to 88 MHz 3.5kgs.</p> <p>Power: 0.1, 5, 10, 50 Watts</p> <p>Waveforms: SINGARS, secure voice, IP data</p> <p>Encryption: Default orthogonal hopsets/six presets</p> <p>Notes: International SINGARS radio. 12-channel GPS, voice/data retransmit, position reporting, waypoint management, four-km remote control.</p>

SDTR	Rohde & Schwarz
	<p>HF/VHF/UHF n/a</p> <p>Power: 50 Watts</p> <p>Waveforms: High Data Rate Waveform</p> <p>Encryption: Robust Rohde & Schwarz security and encryption.</p> <p>Notes: SDTR family radios are optimized to provide range, data and security performance depending on user requirements Waveforms enable mobile, IP-based tactical communications</p>

URC-200(V2)	GD-MS
	<p>30 to 420 MHz 4kgs.</p> <p>Power: 0.15, 1 or 5 Watts</p> <p>Waveforms: VHF/UHF/AM/FM, non-freq hopping</p> <p>Encryption: SINGARS connectivity</p> <p>Notes: AM/FM clear and cipher text with external COMSEC</p> <p>Notes: Frequency Enhancement version covers 30 to 90 MHz, range to 60 miles, debuted 1/2010.</p>

WM600	Kongsberg
	<p>225 to 400 MHz 4.1kgs.</p> <p>Power: 0.1 to 5 Watts</p> <p>Waveforms: IPv4 multi-hop data or voice and data</p> <p>Encryption: Embedded AES 256-bit, multi-hop voice</p> <p>Notes: Long-range C4ISR SDR comms, 2.5 Mbps data, provides DHCP routing.</p>



Raytheon's MR-150 tactical radio forms part of the company's offerings in this domain. Raytheon is currently supporting the US Army and USSOCOM with its Maingate tactical radios.

of bandwidth. The Crimson TNG, the company disclosed, will offer improved performance compared to the Crimson Classic. Although taciturn regarding its exact customers, Per Vices Corporation told *Armada* that its customers are located in Europe and North America.

| RAYTHEON

Although perhaps not immediately synonymous with the tactical radios domain, Raytheon does nevertheless provide a number of transceivers via its Maingate family. This family of transceivers has been designed to provide a high capacity backhaul radio for the US Army. In radio jargon, backhaul refers to the radio network which links the backbone network, or the main trunk communications running from the command level down to deployed headquarters, to the sub networks such as the platoon communications net or artillery communications net, for example. Raytheon released a statement to *Armada* discussing its recent activities in the tactical radios domain, although it was taciturn regarding the exact work it has performed for specific customers beyond sharing that its radio products are supporting US Army aviation and USSOCOM needs. Over the past year, Raytheon says that it has strengthened its products with enhanced encryption, and new waveforms

to allow digital, secure voice and tactical networking. It added that new MANET protocols have extended the Maingate family's operating ranges and allowed for the radios to support a comparatively larger tactical radio network.

| ROCKWELL COLLINS

Alongside Harris and General Dynamics, Rockwell Collins is participating in the US Army's HMS programme. In February, each firm was given two months to supply 30 radios to the US Army for qualification testing. Rockwell Collins has provided its TruNet Manpack design which, as stipulated in the US Army's requirements, is a two-channel multiband manpack radio. For now, testing of all the radios participating in the programme from all of the vendors is continuing. Once testing is completed, the US Army is expected to release the results therein. Rockwell Collins told *Armada* that they are quietly confident that they have met the US Army's requirements for the manpack.

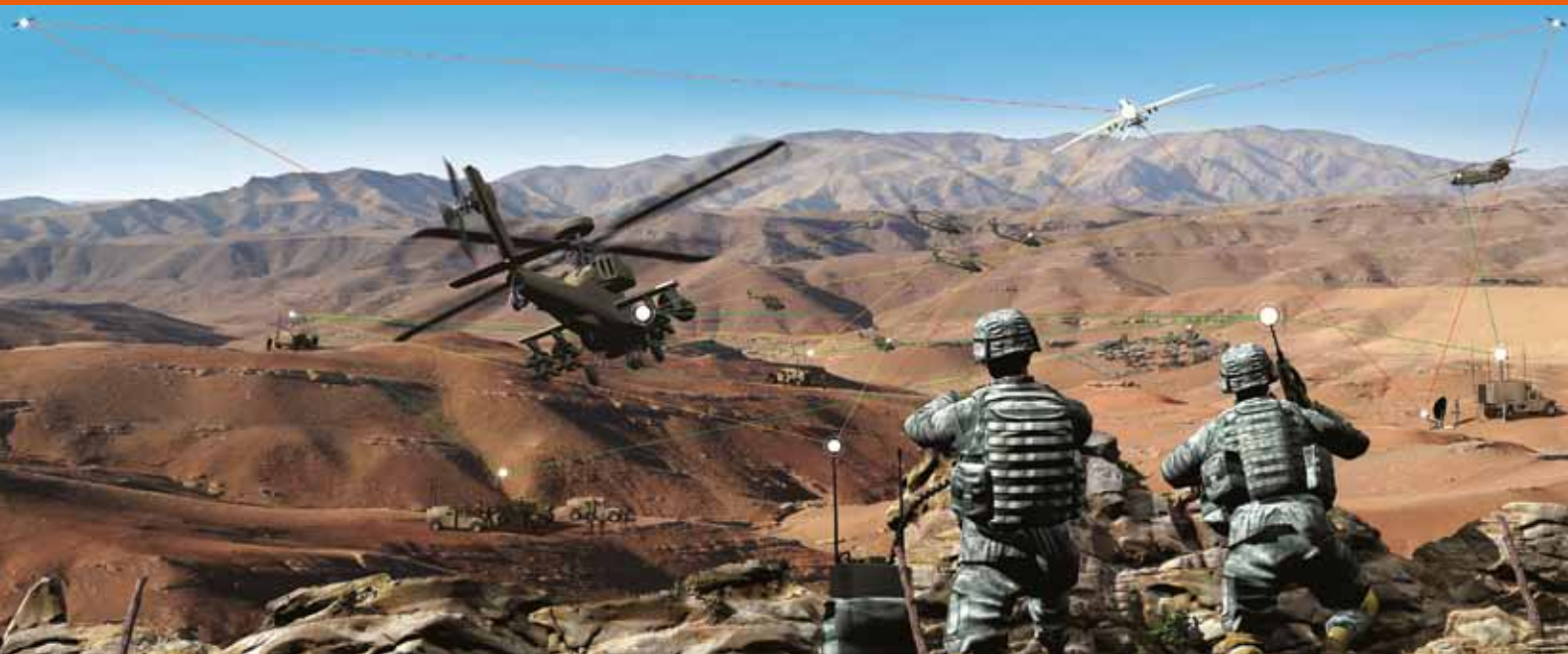
According to publicly-available reports, those manpack radios which successfully complete this first stage of testing will then receive a larger procurement of 60 radios from each of the successful vendors. These will be delivered in the fourth quarter of 2016, with the possibility of full rate production beginning in the fourth quarter

of 2017, and the radios being fielded with the US Army from 2018. Up to 1470 transceivers could eventually be procured for circa \$114.9 million under the manpack dimension of HMS, with the entire procurement being worth \$229.9 million, according to the 2017 President's budget request. The balance of \$115 million will be devoted to non-recurring engineering and fielding costs related to the programme.

In terms of the waveforms which the manpack radio is expected to handle, Rockwell Collins told the author that these would include line-of-sight waveforms like SINCGARS to enable communications with legacy radios operating this waveform, a networking waveform in the guise of the SRW to allow communications with dismounted troops, and beyond line-of-sight waveforms such as MUOS to enable SATCOM. Meanwhile, the radio will carry the WNW to permit communications with higher echelons of command. Currently, the US Army is thought to be deciding where in echelon terms the manpack radio could fit. As noted above, the MNVR component of the erstwhile JTRS programme, which is being provided by Harris, has been subjected to some criticism, with some sources close to the US Army informing *Armada* that the force may choose to stop the procurement of the MNVR if it does not meet army requirements and instead procure the new manpack radio selected for the HMS FRP in a vehicular, as well as a manpack, configuration.

The work which Rockwell Collins has completed regarding its TruNet Manpack design has allowed the firm to 'spin out' the radio's hardware into the GR-2500 manpack which is intended for export, and which forms part of the firm's TruNet radio family. Launched in March 2015, the TruNet family features the ARC-210/RT-2036 single channel networked airborne radio, the single channel AR-1500 airborne radio, the dual channel AR-2000/2500 airborne radio and the single-channel TIGR (Tactical International Ground Radio). Moreover, the GR-2500 will be focused on customer-specific waveforms, which could comprise the pan-European Secure Software Defined Radio (ESSOR) and the international COALWNW (Coalition Wideband Networking Waveform), more details of which can be found in the *Radio Days* article in this compendium. The timelines for the availability of the GR-2500, Rockwell Collins informs *Armada*, are roughly following those for the US Army manpack programme.

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Time to Accessorize

Often neglected in the world of tactical radios, but as vital as the transceivers themselves, are the accessories which enable the radios to be used in the most efficient way possible. These can include everything from amplifiers to antennae.



Thomas Withington

Elno's new Hoplite headset is comfortable to wear and provides the user with hearing protection in addition to excellent audio functions. The headset is being procured widely throughout the French armed forces and law enforcement organisations.

As well as representing an excellent opportunity to cogitate on the latest developments in the world of transceivers, the Eurosatory exhibition held in Paris this June witnessed a showcasing of tactical radio accessories. With a handsome stand on their home turf, French company Elno took the author through its Hoplite headset which was making its debut at the show. The company stated that all of the production work for this headset is performed in France, and that the headset is largely 'radio agnostic' being able to work with a diverse array of systems including Thales PR4G radios in widespread service with

the French armed forces, and Harris' AN/PRC-117 and AN/PRC-152 families of tactical radios, plus Safran's RIF and RIF-NG squad radios which form a vital part of the French Army's FELIN (*Fantassin à Équipement et Liaisons Intégrés*/Infantry Integrated Liaison Equipment) infantry soldier *ensemble*. The Hoplite will replace the company's legacy VH-590 headset which is in use on board French Army vehicles. The headset, the company told *Armada*, will also enter service with French special forces and the paramilitary GIGN (*Groupe d'Intervention de la Gendarmerie Nationale*/National Gendarmerie Intervention Group) and RAID (*Recherche, Assistance, Intervention,*

Dissuasion/Search, Assist, Intervene, Dissuade) national police organisations.

INVISIO

Denmark's Invisio was also present at Eurosatory showcasing their tactical radio accessories, notably launching the firm's new V20 radio controller which is not only 'radio agnostic' but which can work with a range of cellphones and vehicle intercoms, as well as military transceivers. They told the author that they have expanded their personnel base over the last twelve months, and that the firm has won several large tenders in 2016, which it says were the result of the firm's ability to employ commercial-off-



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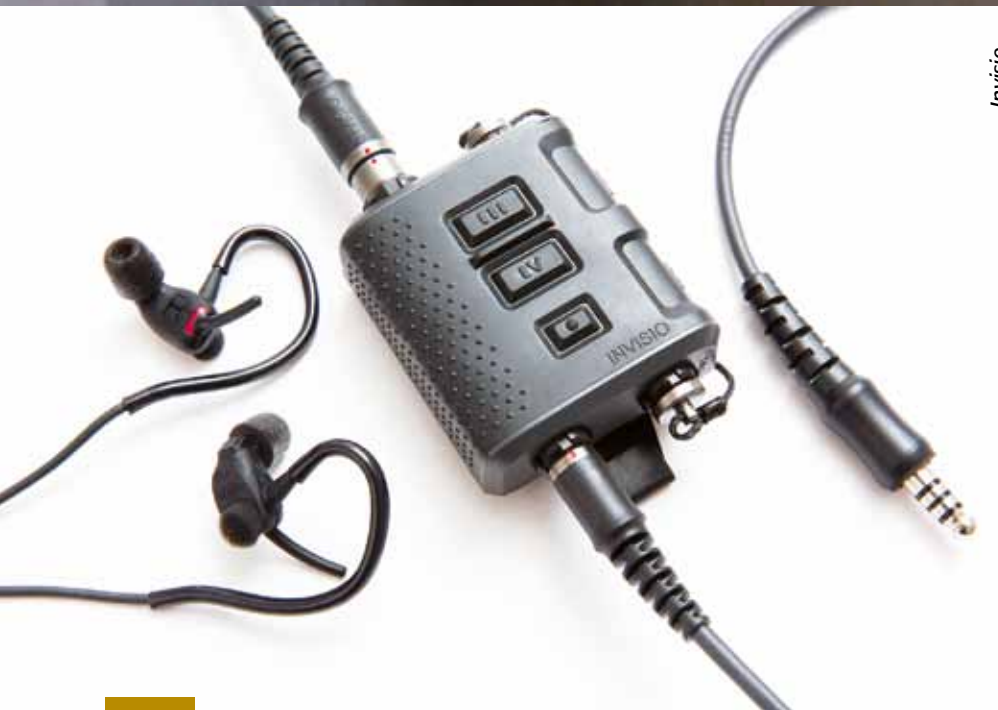
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Thomas Withington

New products showcased by Invisio during the Eurosatory exhibition include its V20 Control Unit which boasts a small size, and is currently undergoing numerous customer evaluations.



Invisio

Invisio's V60 product will supplement its S10 hearing protection which it is supplying to the Australian Army as part of the Land 125 soldier modernisation programme.

the-shelf technology, where possible, to deliver the most reliable and cost-effective tactical communications products to its customers. Invisio has debuted new products such as its V20 Control Unit which has a very small size and is currently being tested and evaluated by customers around the world, according to the firm.

The company is fulfilling a number of contracts which it has won in the last few years. These include the US Army's

TCAPS (Tactical Communications and Protective System) which provides soldiers with hearing protection, alongside the ability to continue to use their tactical communications. Media reports state that around 20000 TCAPS units have been provided to the force thus far. Similarly, the company is meeting the United Kingdom's Tactical Hearing Protection System requirement with the award of a contract worth \$15 million in 2015 alongside its partner Marlborough Communications

to deliver Invisio's S10 hearing protection across the UK armed forces, as part of a contract to run for four years, with the option to extend this by a further three years. Other successes for the company include the Canadian Army's Integrated Soldier System initiative which is an infantry soldier modernisation programme led by Rheinmetall, that also includes Invisio's communication and hearing protection. Other contracts forthcoming for Invisio announced in 2015 include the supply of combat hearing protection for the Australian Army as part of that force's Land 125 soldier modernisation programme. Deliveries are to continue to the Australian programme for five years, with the option to increase this by four years. Invisio will provide its S10 and V60 hearing protection to meet this order.

ATLANTIC SIGNAL

US-based tactical radio accessories specialist Atlantic Signal provided *Armada* with some details regarding their tactical radio headsets during this year's Special Operations Forces Industry Conference (SOFIC) event held in Tampa, Florida this May. For example, the firm adapts 3M Peltor's COMTAC-III tactical headset for use in water. This is submersible in up to ten metres (33.3 feet) of water for up to ten hours and can be procured in both in single and dual channel communications versions. Known as the Below H20, this headset has been supplied to the United States Special Operations Command (USSOCOM), being approved to this end in the third quarter of 2015. The company is currently in the process of supplying 9500 Below H20 headsets to the USSOCOM, and has made the product available for worldwide procurement as of mid-2016. In addition, the company provides its Dominator headset which was used in Operation NEPTUNE SPEER; the 1/2 May 2011 US Navy Sea, Air, Land commando operation which killed the *Al Qaeda* insurgent organisation leader Osama bin Laden. The Dominator headset commenced deliveries to USSOCOM in 2011 and employs both an osteophone, by which the skull is vibrated enabling the user to hear communications traffic, and earpieces which offer hearing protection as well an additional audio source. The company stresses that its products can be exported free from the restrictions incumbent in the US International Traffic in Arms Regulation legislation, and are completely 'radio agnostic' enabling them to be used with a wide variety of transceivers.

The Day Without Satellite

Software approaches look set to increase in importance regarding tactical radio design, while threats in terms of anti-satellite weapons and electronic jamming will also influence tactical radio engineers. In terms of hardware, the need to improve hearing protection and battery safety will continue.

A number of future trends have been identified by experts in the tactical radio domain. In a written statement provided to *Armada* by Rohde and Schwarz, the company stated that it expects Internet Protocol (IP) approaches to handling all information moving around the battlefield including voice, data and imagery to be increasingly adopted. An approach which the company dubs EoIP could see such protocols becoming increasingly *de rigueur*. From an operator's perspective such an approach would make sense. Today's soldiers are thoroughly familiar with the IP approach, using smart phones and the internet as an indispensable part of their

daily lives. Adopting increasing levels of IP technology on the battlefield represents an intuitive approach to communications, promoting familiarity and simplicity.

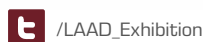
Allied to the increasing adoption of IP approaches, the firm adds that it sees much potential being offered by the Software Communications Architecture (SCA) standards increasingly being used by Software Defined Radios (SDRs). The SCA approach creates an open architecture for SDRs to use. Most notably, the US armed forces' erstwhile Joint Tactical Radio System (*please see preceding articles in this compendium*) uses SCA at its foundation. In simple terms, SCA provides a common open architecture software standard

enabling the new tactical radios being procured across the US armed forces to easily accept new waveforms and software-based capabilities so as to reduce costs when compared to adding new hardware to a radio each time it requires a new waveform or capability. An analogy in the civilian world would be the ease with which a smartphone directly downloads new features as and when they become available.

Crucially, the SCA approach will allow SDRs to accept waveforms already used by legacy radios to promote interoperability between new and old transceivers so as to enhance interoperability as one model of radio is being phased out, while a new



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Software defined radios, such as this Harris RF-335M, are constantly improving in terms of being able to easily accept software updates to enhance their capabilities, much like the world of civilian communications and computing.

model is introduced. Rockwell Collins is in agreement that the software approach will revolutionise tactical communications. The hardware of the radio will increasingly become the box into which new software, and hence new capabilities are added as and when they become available. Should a soldier need to change the parameters of their radio, such as its waveforms or its

frequencies, they need to be able to do this in an instantaneous fashion over the air while deployed, and software will assist no end in providing this capability.

OFFENSIVE ACTION

There are two other major considerations for tactical radio engineers in terms of offensive action. 'The Day without Satellite' is a term increasingly being heard throughout the tactical communications industry, and refers to the impact which offensive action against communications satellites could have for US and allied militaries. In May Russia tested its Nudol anti-satellite surface-to-air missile, the second such test following the first in November 2015, with the launch occurring from the Plesetsk Cosmodrome north of Moscow. Meanwhile, in January 2007, the People's Republic of China (PRC) destroyed the failed weather satellite FY-1C using an SC-19 anti-satellite missile carrying a kinetic warhead, with further flight tests continuing in 2010 and 2013.

Such tests indicate that it may only be a matter of time before so-called 'near peer' adversaries such as Russia and the PRC have the capability to destroy the satellites, military and civilian, upon which the US and her allies depend, such as the US Department of Defence's Navstar satellite constellation which enables the Global Positioning System to operate. In fact, the 1996 science fiction film *Independence Day* included the interruption of satellite communications prior to the invasion of Earth by extraterrestrials.

As this compendium has illustrated, the work ongoing among the world's providers of High Frequency (HF: three megahertz/MHz to 30MHz) tactical radios at least illustrates that such concerns are being addressed with advancements in the bandwidth which can be handled by HF communications. This illustrates that, while perhaps not yet there, HF is moving towards emulating the type of capabilities routinely available with SATCOM.

Closely related to the denial of SATCOM are concerns regarding the capabilities of Russia and the PRC to successfully jam military communications. The first decade of the 21st century largely witnessed conflicts involving the US and her allies against insurgent organisations and basic militaries in Iraq and Afghanistan. The capabilities of such adversaries to jam US and allied communications ranged from non-existent to rudimentary at best. Russia's involvement in Ukraine's civil war

since 2014 and its subsequent annexation of Crimea, a formerly Ukrainian province on the Black Sea in March that same year, has underscored the capabilities of the Russian armed forces regarding electronic warfare.

Put crudely, since the 1991 Persian Gulf War during which the US led the expulsion of Iraq from Kuwait, the Iraq's armed forces being predominately furnished by Soviet-supplied equipment, to an extent following Soviet military doctrine, the Russian armed forces have followed a doctrine which has stressed kinetically destroying one third of an opposing force, jamming one third thus causing the remaining forces to collapse. Russia had played close attention to the importance that the US and her allies placed on electronics during this conflict, particularly military communications and radar. Although difficult to confirm, several reports have reached *Armada* of Russia using high powered jamming systems to disrupt Ukrainian military communications. Such jamming has been effective against military communications systems supplied to the Ukrainian armed forces by Western nations such as France and the United States. Clearly, the relatively benign electronic warfare environment enjoyed by the US and her allies in Iraq and Afghanistan must now be seen in context, and radio engineers will have to ensure that their current and future wares are robust enough to withstand the worst jamming that potential adversaries can throw at them.

HARDWARE

At the hardware level, battery design continues to be a concern for tactical radio users. Batteries have weight and this can restrict a soldier's mobility. Barrett Communications told the author that pressure will continue to ensure that batteries are as light as possible without sacrificing performance. A second issue, the firm continued, relates to battery safety. Airlines and air cargo carriers can be sensitive about carrying tactical radio batteries amid concerns that such products could be unsafe either by representing a fire risk, or by containing dangerous chemicals. In the civilian domain, recent concerns have been reported around the world regarding the safety of lithium-ion batteries and the danger that these can overheat and catch fire, a particular concern where aircraft are concerned. Battery safety can thus have implications for the 'deployability' of the tactical radios which troops must take with them when on expeditionary operations. This could






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Invisio

The need for robust hearing protection for soldiers continues. A need which has to be balanced with the importance of ensuring that soldiers can retain their audible situational awareness.

cause problems in the logistics chain if certain air charters are reluctant to move a large number of tactical radio batteries that maybe required to support an operation.

Staying with hardware, Thales told *Armada* that the reduction in the number of radios used by military vehicles is becoming a major consideration. Radios can absorb space and power inside a vehicle, hence reducing the number of transceivers carried translates into more space for ammunition, weaponry, sensors and/or equipment, all of which improve the vehicles' lethality. Allied to this, reducing the number of radios also reduces power demands and hence improves' fuel consumption, and decreases engine wear and tear. High power demands on a

vehicle's engine can also cause its thermal signature to increase, hence making the vehicle potentially more visible to thermal optronics.

Finally, in terms of tactical radio accessories, headsets and hearing protection continue to play a major role in tactical radio procurement. Invisio shared with *Armada* that, at the NATO (North Atlantic Treaty Organisation) level, tactical radios are now rarely being procured without headsets which also provide hearing protection. Such headsets need to provide a high quality audio feed to ensure that the soldiers' situational awareness is not impeded. Thus a balance is needed between ensuring that the soldier can hear their communications, and sounds from their surrounding environment, such as one of their comrades calling for help, while at the same time, having their hearing protected. Hearing loss is a serious concern for the world's militaries. Battlefields are loud places, not only from gunfire and explosions, but from other sources such as loud vehicle engines, field generators and helicopters, to name just three.

According to a report published in 2013 in a US Army veteran's publication, 414,000 US personnel who had been deployed in combat since 2001 had returned with some sort of hearing damage. Cost-wise this saw the US Department of Defence spend circa \$216 million on hearing equipment for veterans in 2010 alone. Clearly the governmental bill for hearing loss is considerable. Moreover, should a soldier lose their hearing, they may have to leave the armed forces, meaning that the services may lose a soldier who is physically able with the exception of their hearing, thus losing the time, money and effort spent training and equipping them. Essentially, spending early on robust and capable hearing protection which does not degrade situational awareness can pay handsome dividends later. ☐



ON THE COVER: Barrett Communications are known around the world as providing robust High Frequency tactical radios, with HF technology experiencing a renaissance © Barrett Communications

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