



Photo courtesy Dvids/Lance Cpl. Sean Evans, III Marine Expeditionary Force

Evolving tactical communications systems ●●

Access to reliable communications are taken for granted by the general public today, as we have become so accustomed to being able to make a phone call or send an email at the drop of a hat that we don't even think about it anymore. However, when it comes to military operations, every single communication system must be closely scrutinised to ensure that the best-possible security is in place. Nowhere is this truer than on the battlefield, particularly the beachhead, where secure communications save lives and help achieve vital missions.

The original definition of a beachhead was 'A defended position on a beach taken from the enemy by landing forces, from which an attack can be launched,' but today the definition has been extended to any secure initial foothold in enemy territory. The formation of a beachhead is a vital early tactical step in any military operation, and having reliable, secure communications, both between soldiers and officers on site and with decision-makers at remote headquarters, can make all the difference in establishing and securing a strong foothold.

According to 'The Military Communications Market: 2015-2030 – Opportunities, Challenges, Strategies & Forecasts,' the trend towards network centric warfare and the unstable geopolitical landscape is continuing to drive military communications spending despite pressures on budget expenditure at organisations around the world. More than US\$40 billion of revenues in military communications are expected to be generated by the end of 2020. Meanwhile, more than 100 petabytes of data were routed for military communications systems every day in 2015, and this is only expected to grow in the years to come. The report cites the rise in wearable technology, M2M and sensor networks as a major source of growth during the time period, with augmented reality expected to play a key role.

Indeed, following six consecutive years of spending cuts, Western European governments increased their military spending by more than one percent in 2016 in light of the continually-developing threats to domestic security. According to Fenella McGerty, Principle Analyst at HIS, communication spending has become a key focus: "As the extent of Islamic State networks across Western Europe continues to reveal itself, coordination between European security agencies has become of paramount concern and the need to secure military

communications remains a key challenge."

Continuously evolving solutions

Battlefield communications have come a long way in the last hundred years, developing from hand signals and shouts, human messengers and basic radios, through to the highly-advanced networks we have in place today. Indeed, with secure communications such a vital part of all military operations, commercial and government entities alike are always working to improve the available solutions.

One of the most widely-used communications systems for battlefield operations today are VSAT networks. With only a small amount of on-site equipment required, VSAT networks enable mobile, secure, real-time information relays via satellite over commercial or government frequencies, or indeed a combination of both. As the technology has evolved over the years, satellite antennas, modems, and other related equipment have become smaller, more lightweight, and more mobile, meeting the ideal size, weight and power (SWaP) requirements to satisfy military user demands. Inmarsat Global Government, ViaSat, Hughes Government Solutions, Harris CapRock and Newtec are all major players in the field of VSAT service solutions, providing increasingly-high specification offerings to an extremely competitive and fast-moving market.

Cognitive radios are another vital component in many military operations, enabling soldiers to securely communicate under all kinds of battlefield conditions, such as when securing a beachhead. Unlike conventional military radios, and a step beyond software-defined radios (SDRs), cognitive radios are sufficiently computationally intelligent regarding radio resources and computer-to-computer communications to detect and act on user needs. Most cognitive radios on the market today can

identify potential interference, path loss, shadowing and multipath fading that might impair the use of a particular frequency. These capabilities enable highly secure and extremely efficient military communications, even under harsh conditions, or in contested and/or congested environments. xG Technology, ASELISAN and Per Vices are all working today to evolve cognitive radios to their next logical iteration.

New, ground-breaking solutions are always evolving. The US Army, in particular, has invested heavily in research for reliable, highly-secure communications options, while universities around the world continue to test what is possible within the realms of science.

Next-generation soldier-to-soldier communications

3D printing is one of the key emerging technologies today, and it has not gone unnoticed by the military sector. Various groups have explored 3D printing, or additive manufacturing, for the production of food, replacement limbs and bones, battle armour, antennas, drones and ballistic missiles. Only recently, however, has the concept of using 3D printing for communications, specifically for brain-to-computer interfaces, or synthetic telepathy, been raised by scientists.

Synthetic telepathy has been studied for several years now. In 2014, the US Army Research Office co-funded research at the University of Washington which successfully demonstrated the use of one person's brain signals to control the hand of another person. Electroencephalography (EEG) recorded the brain signals and transcranial magnetic stimulation (TMS) delivered those signals to the second subject's brain.

Long-range synthetic telepathy could open up incredible new communications options for soldiers in the field, with applications ranging from securing a beachhead, to undertaking covert missions. The ability to communicate via thought would speed up decision-making and action-taking, improving the chance of mission success. It would also take some time for hostile groups to establish technology capable of hacking these synthetic telepathic communications, if it is possible at all.

In September 2016, at the Intelligence and National Security Alliance Summit, the potential for 3D printing for military purposes was a major topic of discussion. The Principle Investigator for Materials and Technology Development in Additive Manufacturing at the US Army Research Laboratory (ARL), Larry Holmes, raised the prospect that 3D printing might play a future role in advancing biometric communication.

Holmes cited a 2008, US\$4 million research project on synthetic telepathy at Carnegie Mellon University, the University of Maryland and UC Irvine. The researchers used a sensor to detect the brain's electromagnetic pulses and translate them into a base level of communication, which would then be sent to another person by TMS. According to Holmes, 3D printing could advance this research by producing helmets embedded with EEG technology.

"Imagine if I have a helmet. You can put it in this 3D printing machine, tell this machine to scan it, then go back and say, 'Oh, this mission requires some communication device I don't have.' I can tell the printer to rebuild this helmet and incorporate the device into this helmet as I'm building it, antennas, structured sensors, whatever," said Holmes.

Thus, not only would the military benefit from the enhanced communications capabilities, but it would also be able to produce such devices as needed in the field, in case of inadequate supply or damage to one or more units. While research to date on both 3D printing and synthetic telepathy is promising, it is challenging for 3D printed items to meet the rigorous military manufacturing specifications. As such, most 3D printing for military applications to date have been within the special operations community.

Hack-proof quantum communications

Quantum communications have recently grabbed the attention of the communications industry and the world's media thanks to the launch of the world's first satellite dedicated to quantum

experiments in August 2016, the Quantum Experiments at Space Scale (QUESS) satellite.

Quantum communications were formally restricted to the world of science fiction, but this is about to change. Quantum particles can be transmitted over reasonable distances on Earth, and, according to theory, much greater distances in space. Theory states that information encoded in a quantum particle is secure against any computerised hacking because the information would be destroyed as soon as it was measured. Indeed, the only way to observe the photon is for it to interact with an electron or an electromagnetic field, both of which would cause the photon to decohere, or interfere with it in a way that would only be apparent to the intended recipient in possession of the encryption key. The Co-Founder of ID Quantique, Gregor Ribordy, said that a quantum communication was like a bubble: "If someone tries to intercept it when it's being transmitted, by touching it, they make it burst."

The advantages that quantum communications could provide to the military are clear. Decision-makers at headquarters would be able to swiftly give orders to soldiers at the beachhead or on the battlefield with no concern about the information being accessed by unwanted personnel. Likewise, data from the field could be securely relayed back to headquarters for analysis, without enemy interference.

China's QUESS satellite, a first-of-its-kind craft that scientists hope will enable hack-proof quantum communications, was launched in August 2016. The spacecraft was developed by the Chinese Academy of Sciences and the Austrian Academy of Sciences. Its main payload is a Sagnac interferometer that generates two entangled infrared photons by shining a UV laser on a non-linear optical crystal.

QUESS will test quantum communications capabilities between Earth and space, and test quantum entanglement over unprecedented distances, during its two years of operation. While physicists have successfully separated entangled photons by distances up to 300km on Earth, because they scatter when they travel through optical fibres and are subject to atmospheric turbulence when sent between telescopes, it is challenging to send entangled photons longer distances. In space, however, these interferences are removed.

To test whether quantum communications could provide a viable, global communications option, a number of quantum communications transmissions will take place between QUESS and various Earth stations, including the Xinjiang Astronomical

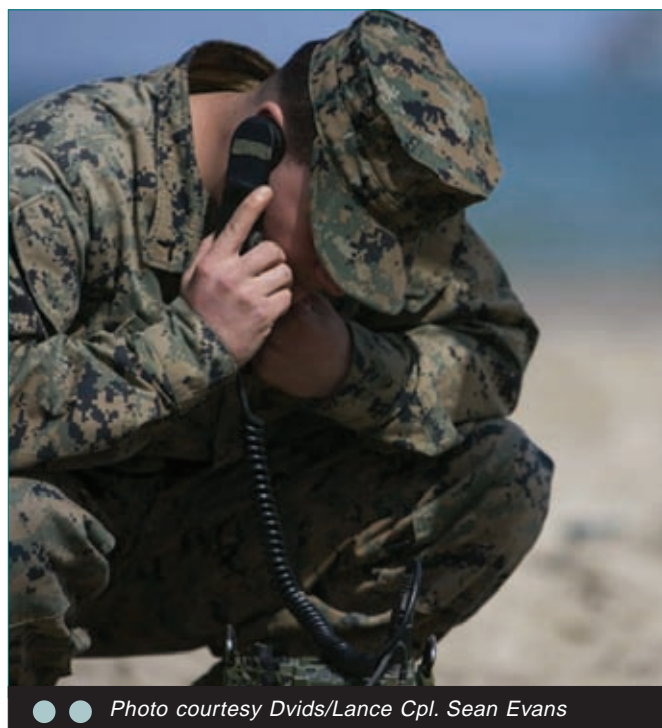


Photo courtesy Dvids/Lance Cpl. Sean Evans

Observatory in western China, the Xinglong Observatory in Yanshan, and, eventually, a site in Vienna. QUESS will also quantum teleport a photon state from the Ali Observatory in Tibet to the satellite.

According to Jianwei Pan, QUESS's Chief Scientist at the University of Science and Technology of China, the ability of the ground stations to perfectly track the satellite, which is travelling at 8km/s, is a major challenge. "It's very challenging to create a perfect quantum channel between the satellite and the ground station," said Pan. "We have developed a high-frequency and high-accuracy acquiring, pointing and tracking technique to do that."

If the experiments are successful, China plans to launch a number of similar satellites to form a quantum communications network by 2030.

The future is here

It's obvious that today's battlefield communications systems are in a major state of flux. The new generation of high throughput satellites (HTS) are making it increasingly affordable for military groups to take full advantage of satellite communications options, while advancements in technology are making innovative new ideas a possibility.

GMC



● ● Photo courtesy Dvids/Lance Cpl. Sean Evans

Germany receives first tactical standard Airbus A400M airlifter

Airbus Defence and Space has delivered to the German Air Force its first A400M transport aircraft qualified for tactical operations and able to fly in areas subject to military threats.

The aircraft is the sixth A400M in German service and the first with the new capabilities in addition to the world-leading performance of all A400Ms as strategic transports. All aircraft will be retrofitted to the new standard and receive subsequent enhancements as those are certified.

Key aspects of the aircraft's latest capabilities are improvements in its self-defence systems, ability to air-drop cargo loads, and paratrooping. Additionally it can operate on unprepared runways, fly as low as 150ft above the ground, refuel other aircraft as a tanker, and safely take-off and land in extremely high temperatures.

Airbus Defence and Space A400M Programme Manager, Kurt Rossner, said: "The A400M programme has made enormous progress this year in implementing these critical capabilities on the aircraft. In addition to having twice the payload-range of the legacy transports like the C-160 and C-130 that it is replacing, it can now also operate from any runway that those older aircraft could use. There is no other aircraft in the market with the A400M's combination of tactical and strategic capabilities and it is going to transform Germany's air mobility force."

The new aircraft is fitted with a Defensive Aids Sub-System (DASS) incorporating a Missile Warning System, Radar Warning Receiver, and an Expendables Dispensing System to eject flares and radar-confusing chaff. The DASS for all A400Ms is integrated by Airbus Defence and Space at Ulm.

Military and humanitarian loads of up to eight tonnes each, including for example 24 x 1 tonne pallets, are fully certified for air-dropping from the aircraft's ramp and further loads are being continually qualified in flight test.

Paratroops can be dropped from the ramp or side paratroop doors in sticks of up to 20, and sticks of 30 have already been successfully demonstrated with certification to follow. Flight testing continues to build the numbers next to 40 and then 58 in a single pass.

The A400M is certified to operate from grass runways and has successfully completed testing of operations from gravel and sandy soil with certification in process. Low-level flight in mountainous terrain is cleared down to 150ft above ground by day and 300ft by night under the pilot's manual control. Development of automatic low-level flight is well advanced.

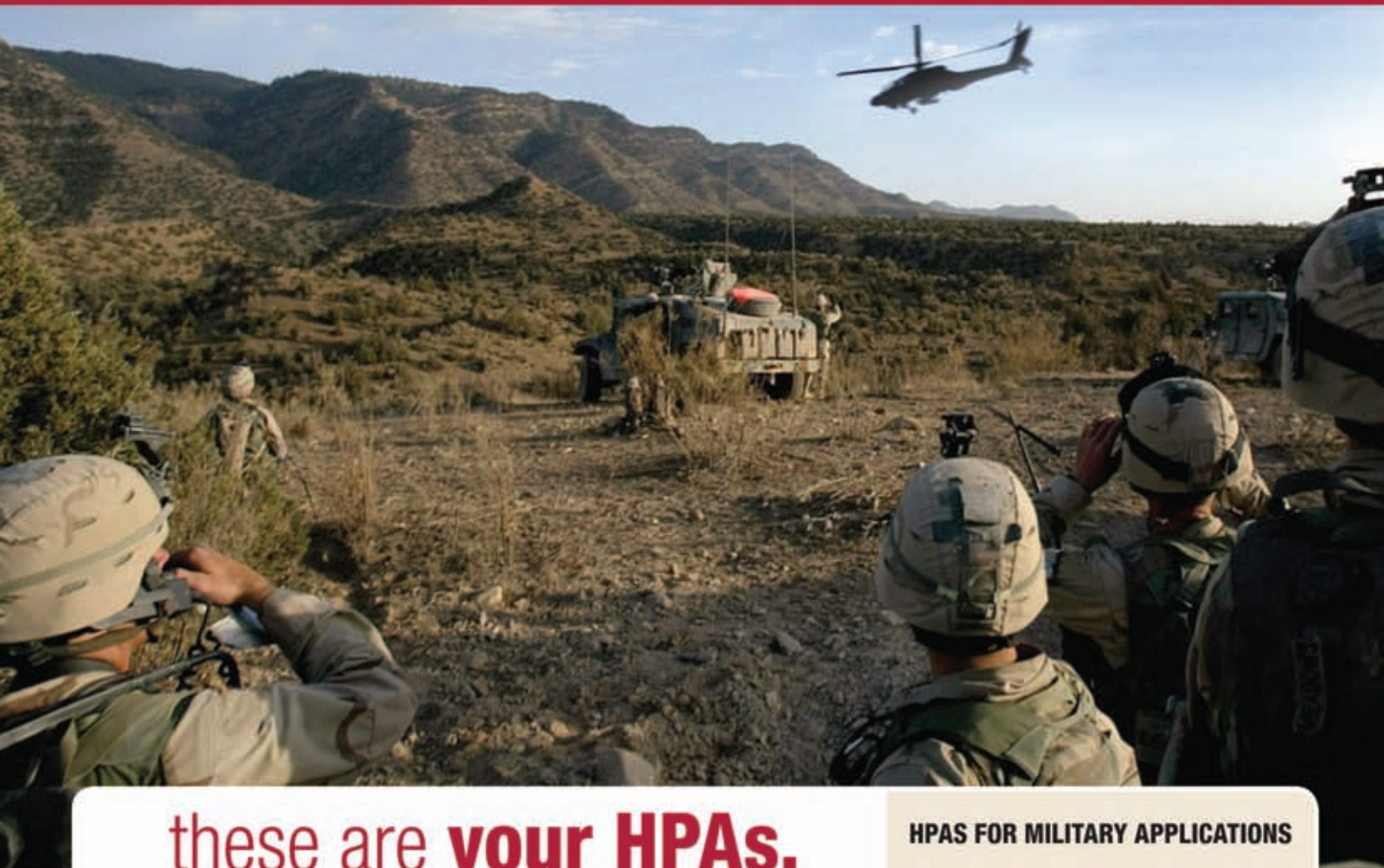
The aircraft is certified to receive fuel in-flight from a tanker, and as a tactical tanker itself to refuel fighters and other large aircraft by day, with night operations demonstrated and close to certification.

In this latest configuration the A400M is certified to operate in temperatures up to 55°C at sea level, ensuring excellent "hot and high" performance at operationally challenging airfields around the world. And it is approved to take-off and fly on only three of its four powerful engines in the event of a mechanical problem or battle damage, adding to its outstanding level of operating autonomy.

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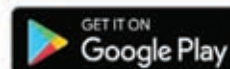
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