THALES
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# Information advantage for the dismounted soldier

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**"CONTACT. WAIT OUT."**
These words, in the Dismounted Close Combat (DCC) world, are charged with so much more importance than just correct voice procedure. Ultimately they mean that two commanders and their troops on the ground, 'in contact', are engaged in combat and gaining 'decisive advantage' is paramount to survival. This process of engagement, the 'OODA loop' in action, is an age-old challenge where stress, confusion, and lack of communication or up-to-date information all contribute to what is known as the 'fog of war'. But the commander who can 'observe', 'orientate', 'decide', and 'act' more quickly and precisely will start to tip the balance to their advantage.

Operating in the battlespace of the 21st century requires state of the art communications. In sub-threshold or grey-zone operations where the enemy avoids the conditions for a full-scale NATO coalition deployment under Article 5, it is likely that friendly forces will increasingly deploy in future on an expeditionary footing to face operations that are ever more complex. Non-kinetic and non-lethal forms of warfare will challenge our forces to respond in ever more ingenious ways. Forces deployed in these conditions need consistent assured communications. At one end of the spectrum of such operations permissible Electromagnetic Environments (EME) will exist, allowing the use of host nation telecoms infrastructure and commercially available off the shelf systems and applications to maintain situational awareness and monitor atmospherics. At other times, or when events dictate, forces will need to rapidly re-configure for high intensity conflict, with the need for secure communications and seamless connectivity between tactical and strategic assets on the move and in contact.

The C4I equipment for soldiers and commanders of the near future will need to cater to the most likely scenarios across the spectrum of conflict, with the minimum number of deployable systems and functionality optimised in those systems to match the demands of the mission at hand. Information advantage in the battlespace has never been so highly sought after by modern forces and therefore choosing the right type of systems with the right sorts of features is a critical and complex acquisition endeavour with which the customer is charged.

So what does the 'right sort of tactical radio system with the right sort of features' mean to the combat soldier and junior commander? To address that question it is helpful to consider the training and information lines of development. In terms of training and readiness, forces comprising recce, infantry and combat support elements will have readiness levels set to expeditionary requirements. Increasingly that will mean these forces having to be more self-sustaining, more resilient, less reliant on home base infrastructure. It will also mean the adoption of a train-as-you-fight mentality, using core deployable systems in both live and synthetic environments, often finishing training in theatre, utilising simple to use battle-ready capability.

From the force development perspective an expeditionary footing also means that the need to reduce soldier burden both physically and cognitively becomes an increasing priority: optimising expeditionary readiness and enhancing operational effectiveness. Reducing solider load with reductions in the size and weight of radio systems places an emphasis for good Size Weight and Power (SWaP) characteristics. Modern Software Defined Radios in near-miniature form and fit, capable of low power output, low probability of detection, high battery life and with secure architectures will cater to the combat soldier seeking to reduce physical load without compromising high range connectivity, stable networks for voice and data and good situational awareness, including blue force tracking. Commanders up to Company level will derive equal benefits with the same systems and depending on data requirements, with only small increases in size and weight, dismounted Coy to Coy and BG communications will trade detection and power efficiencies for richer data needs,

*Getting it right; the SquadNet software defined radio, balancing capability, range and SWaP for the dismounted soldier*

including mounted to dismounted and sensor to shooter connectivity benefits.

In terms of the information defence line of development, the need to reduce cognitive burden will also apply. Here ease of use, simplicity of training, and simplicity in re-configuring C2 for rapidly changing missions will be key. The look and feel of the systems will have to be intuitive to future generations of military recruits. The applications on the systems, whether they be for Health Usage and Monitoring (HUMS), GEO or Target data need to be as easy to use as they are on modern mobile phone devices, because that is how the next generation of recruit will expect how to operate and that is what an expeditionary information environment will demand from industry in its offerings for the next generation of soldier-commander tactical radios. Many modern radio systems can and will attain these demanding requirements, even with the significant performance trades that are involved in their design, but the best of them do it in a way that allows the infantry solider and junior commander to conduct his or her primary mission i.e. without distraction or lack of focus.

**The Importance of Communications Range**

Range is the most important aspect of any communications solution and is an issue on every deployment. Ground to ground communications is one of the most challenging situations and reliable communications depends on maximising antenna height and power output together with minimising transmission bandwidth and ideally VHF or low band UHF frequencies for propagation. It is an operational necessity that combat troops operate low to the ground the varying terrain, antenna height, body shielding and ground propagation effects all hinder communications significantly for this user. Increasing radio output power to counter these disadvantages is limited on body worn equipment for safety reason but also increasing power reduces autonomy and the increased weight of spare battery is not welcome nor is the increased logistics support requirements to charge and resupply. Multiple body antennas, longer antennas or wearing antennas higher up the body all help but the soldier needs to retain maximum mobility to manoeuvre and fight so antenna locations are rarely optimum. Clearly, the dismounted soldier operations presents some inescapable challenges to achieving reliable communications to maximising range and freedom of movement.

MANET networking can help to improve range as communications services are rebroadcast from one radio to the next. However the implementation of a MANET network means the on air bandwidth is typically over 1MHz and such a wideband transmission will reduce point to point range. Consequentially this approach relies on a sufficient numbers of user, distributed evenly on the ground to relay messages from radio to radio rather than broadcasting directly to all radios. The MANET approach increases power consumption as several radios are required to transmit when relaying a single message throughout the net and this translates into additional weight for the user who needs to carry more batteries for the radio. The MANET solution is most useful in confined environments where there is no line of sight between users such as tunnels or in urban areas. In more open terrain a point to point broadcast solution is a more efficient and resilient way to communicate as it does not have the node density and user positioning restrictions that a MANET solution brings.

The ability for the dismounted soldier to remain concealed is an essential element for protection and mission success. Any soldier radio is a threat to this as RF transmissions can be detected at range and this can compromise a mission, as the element of surprise is lost and may even prompt the enemy to launch a counter operation whether that is surveillance or direct action. Commercial technology and proliferation means this detection threat exists across the spectrum of conflicts but the impact is more significant in a near peer operation where the adversary will have the means not only to detect the transmissions but also to act rapidly with a variety of responses.

Wideband, fixed frequency RF transmissions provide an obvious signature, and add to this multiple transmissions as it the case in a MANET network in which every node broadcasts then an adversary has plentiful opportunity for detection. At the very least, this negates any element of surprise and the adversary can choose to avoid the engagement. However, sampling an RF signature over time will yield more information, enabling an adversary to determine location, direction of travel, force size and from this information potentially mission intent. Low Probability of Detection (LPD) is key, as the enemy is unlikely to react if they are not aware of a presence. Techniques such as narrowband, low on air duty cycle, minimal nodes broadcasting and minimal power output will make detection more challenging although this will not be enough in near peer operations where more sophisticated techniques such as frequency hopping will be required.

If detected and the enemy takes action then the communications will need to support our counter response to maintain effectiveness whether that is dispersal over a wider area to minimise causalities in the event of a potential artillery barrage or employ an anti-Jam waveform to counter an attack on the RF spectrum.

The utility of the soldier radio has been well established in terms of co-ordination on the ground, stronger command structure, enabling higher tempo operations, safety and ultimately in mission success. However, in the modern integrated battle space an obvious and easily detectable soldier radio signature will quickly become a liability most notably in near peer conflicts and just as camouflage uniform was introduced to reduce the visual signature of the dismounted soldier it is necessary to ensure the soldier's RF signature is addressed equally well on the modern battlefield.

The key data requirements for the dismounted commander are to support the battlefield management application including Blue force tracking, enemy report, navigation, point of interest, CASEVAC, chat, text, file transfer etc. Other data services apply to all dismounted users such as HUMS and stores management. Soldiers deployed in the field have limited bandwidth, processing, access to advisors, security nor the time to scrutinise, process or analyse intelligence feeds. For the most part dismounted soldiers need clear information to plan and act on rather than data to process. The integration of wideband video services from surveillance assets into the dismounted soldier net will not only burden the network but also the soldier so it is generally considered these intelligence feeds are passed to HQ to be processed and a coordinated response is disseminated to the dismounted commanders on the Battlefield Management Application (BMA).

In the future we are likely to see a more integrated soldier platform and experimentation in this area has been progressing in recent years to identify not only the technology to do this but what is beneficial. This will inevitably mean a soldier radio and architecture solution to support collection of information from each soldier. Sensors on the soldier and local data processing can be employed to alert commanders when a soldier has become unconscious, suffered a blast or come under fire. Additionally, passive monitoring of stores from each soldier can also be reported on the net to help logistic plan their resupply activities.

**Communications Architectures for Dismounted Soldiers**

In addition to the radio technology options and trade-offs, it is important to consider the architecture of the solution to support the services across the dismounted user groups - typically a company of 120 users with 3 tiers – section, platoon and company. Architectural decisions are driven by operational scenarios, doctrine and wider integration or interoperability considerations. For example, some users will typically deploy a company size group with dedicated support vehicles so the architecture design needs a tightly coupled communications solution between dismounted commanders and vehicles. Other users may place less emphasis on co-operation between mounted and dismounted operations such as expeditionary forces including paratroopers or other specialist unit like jungle or mountain warfare where vehicles are not a feature.

The architecture design needs to deliver the appropriate services required for the company structure. These main services, summarised below, need to be provided simultaneously so voice does not interrupt data and vice versa.

(1) A number of independent voice nets – typically 9 sections, 3 platoons, 2 company plus nets for attached specialist
(2) A shared Blue Force Tracking (BFT) picture for all members of the company
(3) A data net to distribute intelligence for dismounted Battlefield Management Applications
(4) A data net to collect information from soldiers or supporting UAVs including HUMS, stores or sensor feeds to inform the wider intelligence picture and logistics planning.

Several architectures, employing different radio and waveform features, are available as shown in the diagram below. For example, these services can be delivered with a single company-wide flat network partitioned to support each service. This is a single radio type, single waveform approach but requires a wideband waveform with the various drawbacks that brings. Alternatively, these services can be provided through a mix of radios/waveforms for each tier. This enables optimisation for the different users and crucially this approach is not dependent on the wideband waveforms so is potentially a better solution for near peer conflicts.

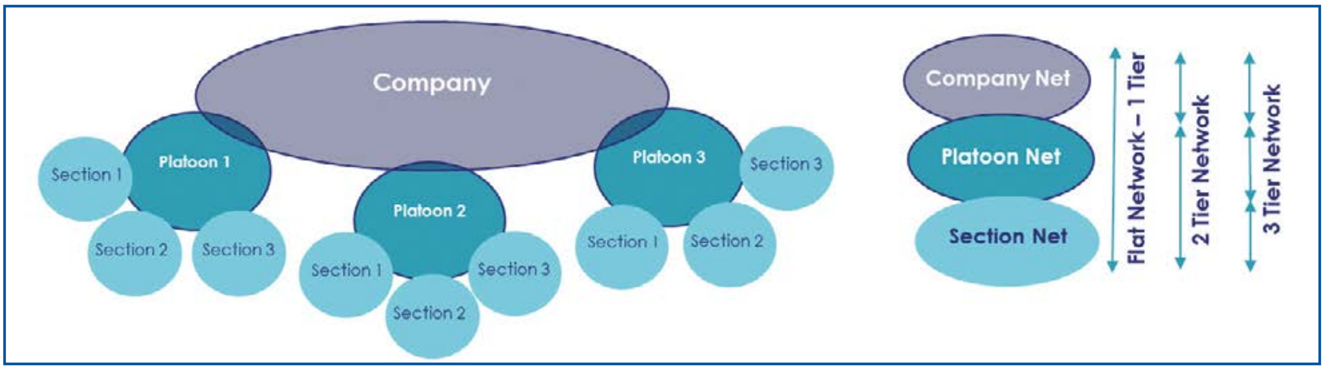


***Figure 1 – Hierarchy and Tiers and for a Dismounted Company***

With spectrum demand growing and dedicated military spectrum reducing to make way for commercial applications the world over, there is increasing spectrum planning issues and mutual interference in the traditional military bands. In particular mismatches in power output between vehicle systems and soldier carried systems makes soldier systems less effective especially when operating near these vehicle. Using bands outside the traditional military bands can overcome these problems. It makes sense to explore moving the lower power military systems out of the military bands as they are less likely to cause interference with the other users in band. Frequency is a key parameter in achieving range for the dismounted soldier. VHF and lower UHF bands are best for achieving ground to ground range but these bands are in demand so new approaches to deliver more efficient services and flexible spectrum planning are developing. TDMA waveforms inherently support multiple services but combined with bands sharing techniques (narrowband, low power, low duty cycle waveforms), frequency hopping to increase spectrum usage and techniques to specifically correct any transmissions clashes the available frequencies can be used more productively.

**What does Thales Contribute?**

Thales is the largest supplier of military communication systems outside of the US and works across a number of communications technologies to provide customers solutions across the full spectrum of potential conflicts. Solutions range from ruggedized commercial bearers and waveforms suitable for low intensity or national operations to military hardware and waveforms that can be relied on to deliver at the other end of the conflict spectrum. Our latest SDR dismounted radios provide simultaneous services even in narrowband and frequency hopping modes so all services can be maintained throughout the mission even in a hostile RF environment. Solutions can be configured to support various multi-tiered architectural approaches with different bearer types or as a flat network with a single radio type and waveform. Thales has carried out various company level tests on representative terrain with the different architectural configurations describes. In all cases location and HUMS data for every soldier in the company is available to all the commanders on their display device. Company-wide update rates are typically 10-15 seconds. For the tiered network, update rates for the lower tiers are typically 3 seconds as these need to be aggregated for distribution across and up the rest of the network. Our tests with 120 SquadNet radios configured to a flat network achieved coverage over an area of 20km2 (4x5kms). A three tiered network with 104 radios using the SquadNet radio in each tier achieved coverage over an area of 42km2 (6x7kms) on similar terrain and only employed 1 network rebroadcast hop per tier leaving 2 rebroadcast hops per tier to provide further range extension or resilience. A two tiered approach with the SYNAPS V/UHF handheld radio for the company tier and a SquadNet radio providing the platoon and section levels has been demonstrated and although not tested to maximum range this approach will provide a further significant benefit in coverage. The use of the V/UHF SYNAPS radio for the company net can provide the dismounted commander with direct interoperability with vehicle and air asset nets so is a key architectural driver for many customers. The tiered approach provides more flexibility to configure networks as desired as there is no constraints in the number of users or communities of interest that can be established. The tiered network also lends itself better to the 'golf bag approach' as integration is at the network boundary rather than within a waveform and likewise the 'ever-greening' concept can be more readily applied as upgrades can be applied tier by tier or even unit by unit rather than a complete system or waveform change.

As sensors and effectors become more sophisticated, integrated and automated in the future battlefield the speed of response will increase on both sides. The ability to avoid detection along with the increased manoeuvrability will be critical to avoid fixed or mobile battlefield surveillance assets. Freedom to manoeuvre at range will also be important to keep troops dispersed to avoid mass causalities if engaged. Communications range for the dismounted soldier is never sufficient and it likely to become even more of an issue as the battlefield becomes more lethal particularly in near peer engagements. The importance of range and LPD cannot be overstated for dismounted users but this need not be to the detriment of our digital battlefield and collaborative combat aspirations. SDRs, waveforms and architectural choices can enable dismounted soldier to play their part in the digitisation of the battlespace and take benefit without compromising their freedom to manoeuvre or exposure to the adversary. ■