Edge cases: Putting electronic warfare tactics into practice

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EW sensors for infantry

Dismounted land forces' EW at the tactical edge is a complex mission governed by a myriad of factors that must be considered to ensure success. In this article, Shephard looks at how these techniques are put into practice.

Plath provides a range of EW products supporting COMINT including backpack systems that can equip dismounted infantry. (Photo: Plath)

magine a conflict raging on the outskirts of London. For this article, the genteel county of Berkshire, to the west of the capital, has been plunged into a vicious civil war. The army has

been deployed to fight an insurgency violently advocating secession from the rest of the UK. Peace must be returned to the home of Windsor Castle, Eton College and Ascot Racecourse.

Rebel activity is particularly strong around the commuter town of Maidenhead. The town is a key rail junction for services into neighbouring Buckinghamshire and the government wants to keep control. Intelligence suggests insurgent action to the south of the town in the suburb of Braywick, astride a major road which reaches Maidenhead railway station.

The local commander wants to obtain COMINT from Braywick. Local insurgents use handheld VHF/UHF radios. A dismounted army COMINT squad is deployed, briefed to detect and locate the enemy using their radio transmissions. By pinpointing these, the squad can determine rebels' locations.

The squad's equipment has software which can demodulate their adversaries' radio traffic. The VHF/UHF devices have software to modulate outgoing transmissions and demodulate incoming traffic. The COMINT squad's electronic support measures (ESMs), meanwhile, can detect and locate transmissions but also decrypt this traffic, letting the army eavesdrop on communications.

For this scenario, our COMINT squad, codenamed Forsyth, is positioned on a small hill overlooking Braywick Sports Ground. They have an elevation about six metres above the surrounding area. From here, their ESM needs to detect the other side's radio signals, identify the device transmitting them and locate it. Find the radio, and the chances are you will ascertain the location of the insurgent operating it.

Tyranny of geography

By using MASS' BattleEye EW mission support tool, we immediately see the challenges our squad faces. Their six-metre elevation is heightened slightly by the ESM's two-metre antenna. This gives them a total height of 8.1m above the surrounding area. The antenna has a 240 LoS bearing, fanning out 45 on either side in a rough cone-like shape, as shown in Figure 2.

These parameters give the ESM an LoS range of just over 18km, and VHF/UHF radios have a 90% chance of being detected and located by it. This is shown in Figures 1 and 2 in green. Yellow areas show where the ESM would have a 50-90% chance of detecting and locating the radios, while red areas indicate a 10-50% probability.

Figure 1: This BattleEye screenshot shows that emissions in the vicinity of Maidenhead railway station have a 90% probability of detection and interception by the 'Forsyth' COMINT EW squad located in Braywick Park. Some areas directly to the north of the station may be less easy to cover with 50-90% chance of interception. (Image: author)

Maidenhead railway station, just over one kilometre from the squad, falls in the green area, although some small areas to the north are better shielded from ESM. Other approaches to the station from the west, south and east have good ESM coverage as Figure 2 depicts.

Systems like BattleEye can be particularly useful in helping to plan COMINT missions, which is key as our squad must be within LoS range of its targets. As Torsten Duesing, business case manager at EW specialists Plath, explained: 'This means you can be exposed to electronic countermeasures and kinetic fires.'

Planning also ensures the optimum spot is found for the team's deployment, added Mark Warman, CommsAudit's business development manager. Precisely defining mission goals is similarly important – Warman noted that limitations on the kit a dismounted team can physically carry results in trade-offs, traditionally between COMINT collection and jamming.

This factor is particularly relevant when the team is jamming IEDs, which can be initiated by radio systems like cellphones and even garage remote controls. 'A commander will normally and reasonably sacrifice intelligence collection over jamming. That does mean for some time spectrum situational awareness is reduced.'

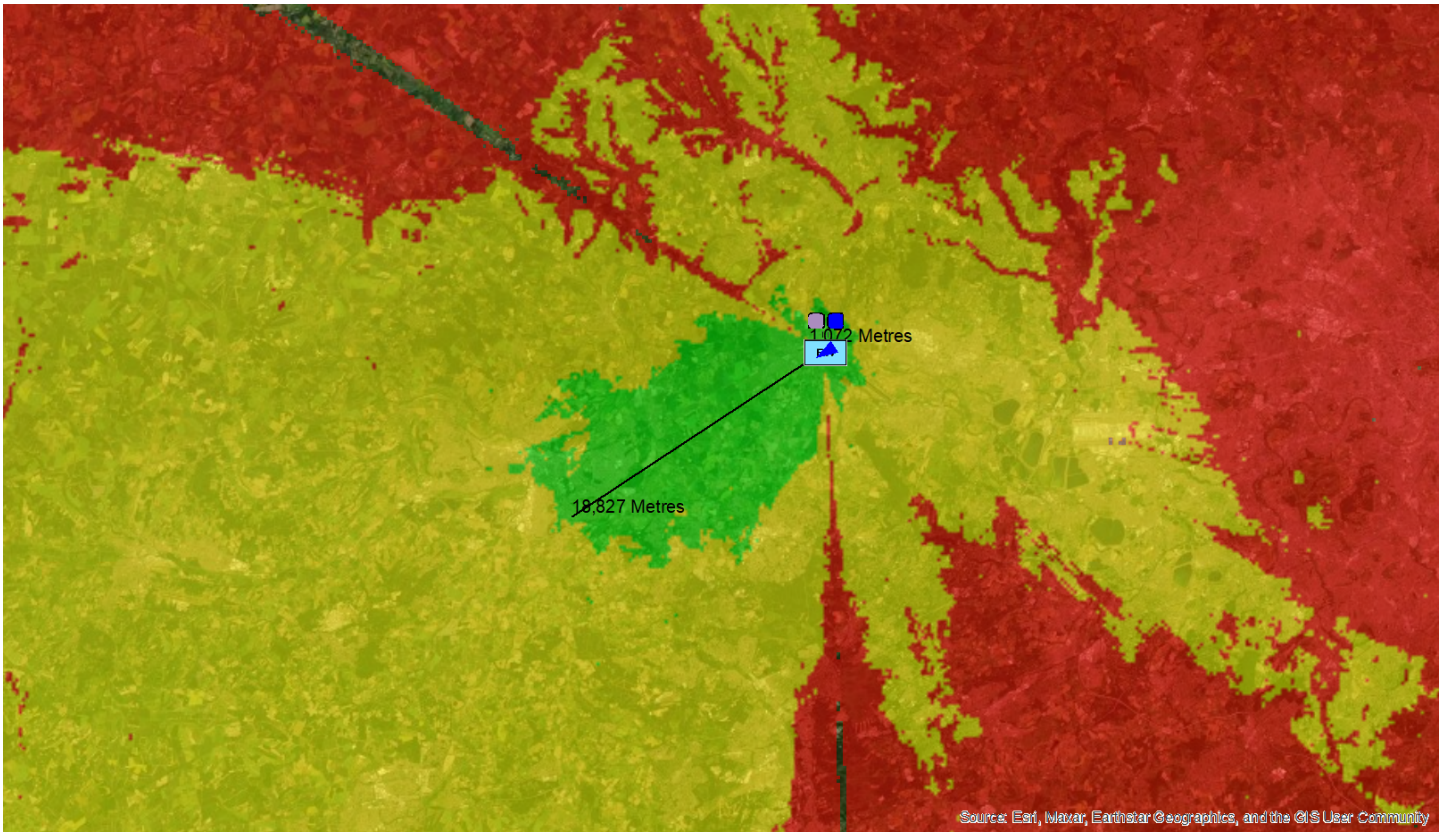


Figure 2: This second BattleEye screenshot illustrates the footprint of COMINT ESM coverage from the unit deployed to Braywick Park. As can be seen, the squad has a 90% chance of detecting and locating emitters up to 18km southwest of their position. (Image: author)

Physics and SWaP

As shown by our example, dismounted EW teams at the tactical edge are limited by how far their equipment can 'see' red force threats. 'The laws of physics heavily influence electronic warfare in general,' said Alan Blackwell, a land forces EW expert and director of ABAL Insight. 'The size and height of your antenna, for example, is directly proportional to the bearing and geolocation accuracy you can determine [for a hostile radio]. Design aspects to improve the performance of the antennas and other equipment can get you so far, but physics is physics".

Other considerations focus on SWaP. Dismounted EW equipment must be sufficiently ergonomic to be carried by soldiers sometimes for hours on end and must be designed 'to fit in with these constraints' Blackwell emphasised.

This has implications for ECM. The jamming power such devices generate will be constrained by their amplifiers and the size of batteries, in turn, influenced by their practical weight for use by dismounts. Here, SWaP impacts the individual soldier who 'will carry normal issue kit, rations, water, ammunition and a sleeping bag etc' noted Warman. This is in addition to EW kit plus batteries and 'results in a large amount of weight per person'. While 'not particularly unique, this does impact on manoeuvre and needs consideration'.

Short-term goals

Infantry squads performing EW are primarily doing so in order to influence the tactical battle. 'You don't necessarily have dismounted EW at the tactical edge to collect intelligence supporting longer-term pattern-of-life analysis', said Blackwell. 'You are striving to get immediate, actionable intelligence that will help save lives in the short term and achieve mission success.'

CommsAudit's dismounted EW systems include the Spectra Go tactical DF unit which covers a 30MHz to 6GHz waveband. (Photo: CommsAudit)

He adds that soldiers carrying EW equipment do not have the luxury of the deep analytical tools found in higher headquarters. Even if they had these capabilities, force protection may be their primary role during an operational phase and thus disrupt sustained collection. Zachary George, CRFS's international market development manager, added that 'because [dismounted EW] is human-operated, it is subject to human ills, such as human fatigue', unlike an unattended 'drop kit' system (see below).

Allied to this is the need for tactically relevant information to be easily discernible. The pace of combat makes it imperative that the data is 'very easy to interpret and clearly presented, not saturated with too much extraneous information', said Duesing. From the electronic attack perspective, EW cadres at the tactical edge have several options available to them.

'They may choose to interfere with only a selected communications node to distract from friendly forces conducting reconnaissance nearby', explained Jim Kilgallen, president and CEO of COMINT Consulting. Alternatively, they could masquerade as a trusted member of a network long enough to extract that network's callsigns for the day, current unit locations or even a

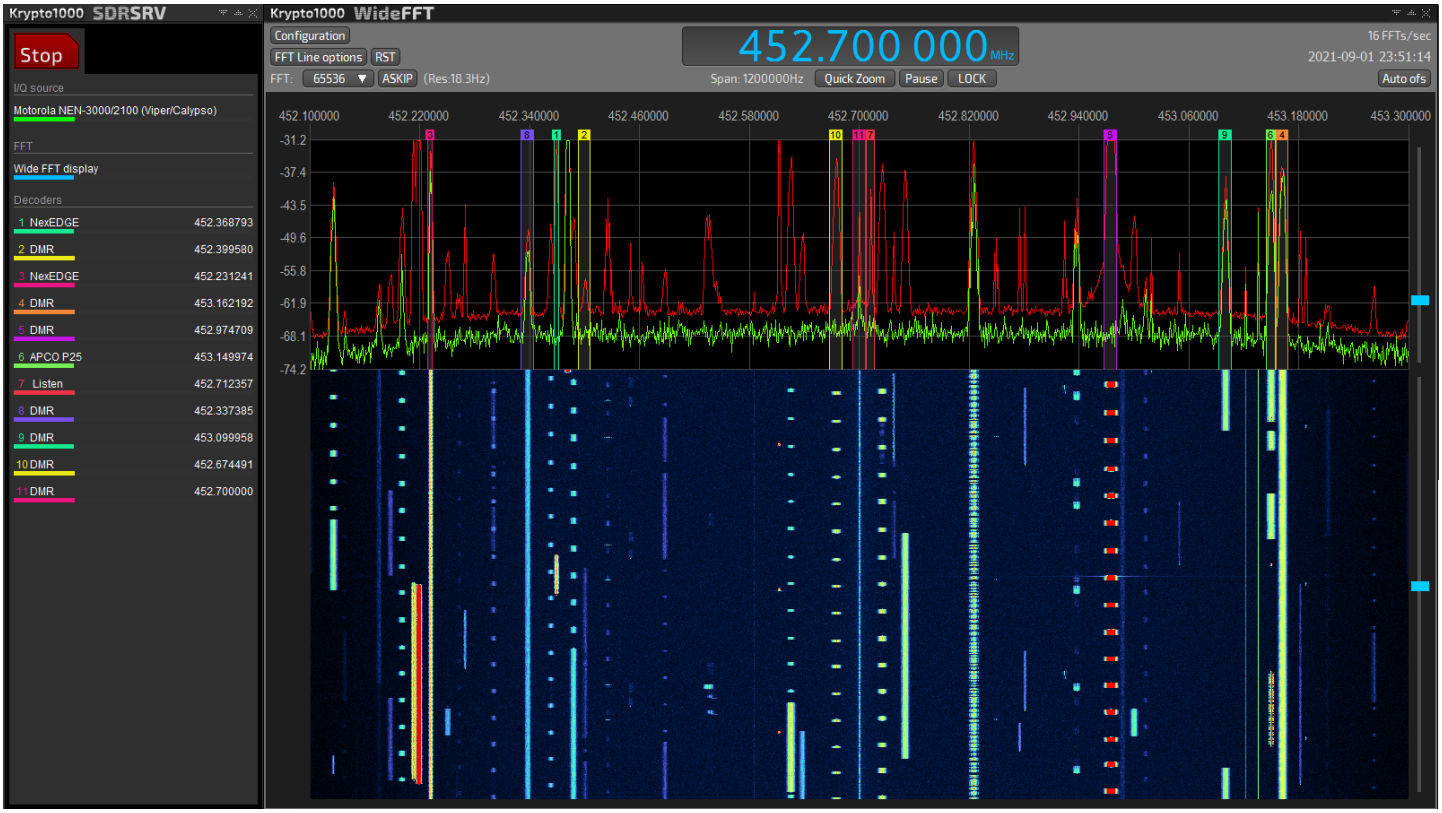
shared cypher key. 'This nuanced approach to tactical EW is what the most capable, most experienced tactical forces utilise.'

The speed of combat dictates that any EW system, particularly ECMs, must be responsive. 'If you use EW equipment at the front line, you must have a convenient mode of operation,' said Duesing. For example, electronic attacks may need to be activated quickly, with 'one or two clicks of the software'.

'Jamming, injecting noise or otherwise interfering with an enemy force's command and control can be effective', offered Kilgallen. Nonetheless, these techniques can have short-lived effectiveness because jamming could reveal the blue force's hand to the red force. Once revealed, these techniques 'can be countered quite easily through change of spectrum, implementation of radio silence, employment of new frequencies, or even the use of landlines or infrared communications systems' to outflank the jamming.

Staying undetected

Emissions control is another important factor. Jamming a hostile network potentially unmasks the squad for discovery by enemy COMINT ESMs, which may detect and locate the source of the jamming signal. Once located, the squad may find its position being shelled.



COMINT Consulting's Krypto-1000 software equips an array of PCs and laptops. The software can detect, identify, demodulate and decrypt an assortment of emitters. (Image: COMINT Consulting)

'As soon as you start jamming, you risk being spotted,' warned Duesing. 'You can jam on the move, but this can be tricky.' It may be safer to transmit a jamming signal against a target

and then rapidly change location to avoid retaliatory fire.

Likewise, a radio link with higher echelons carrying the captured COMINT in real time can point the opposing force to the location of the dismounted EW squad. Instead, the unit might only make flash transmissions of compressed data when necessary. This underscores the importance of thoroughly briefing a mission so the team knows exactly what it must collect.

Residual intelligence gathered during the mission, but not directly relevant to it, may be useful, even if not immediately. ESM deployed with a dismounted squad may collect COMINT to use elsewhere.

Our hypothetical squad is collecting intelligence germane to the fictitious insurgents' plans to capture Maidenhead railway station. Unbeknownst to that squad, an insurgent leader is visiting local rebels as the COMINT mission is underway. While recording the insurgents' communications, the ESM collects details of the insurgent leader's cellphone conversations.

This is not relevant to the squad's mission at that moment, but when the data recorded is downloaded during the mission debrief, the platoon intelligence officer takes a strong interest. The COMINT is then sent up the chain of command to the brigade level for further analysis.

Unattended sensors

The relatively small SWaP demands of modern SDRs opens other possibilities for dismounted EW troops. SDRs are at the heart of COMINT ESMs, and systems can now be deployed onboard hand-launched UAVs and UGVs. They can even be packaged into compact unattended ESMs.

These unattended ESMs can be deposited around the battlefield and even behind enemy lines. There, they continuously collect COMINT for as long as their battery lasts. This raw data can be sent via radio links up the chain of command for analysis.

Dismounted EW is potentially stymied by the height and size of deployable antennas. This may restrict the area a COMINT ESM can cover. (Photo: CRFS)

In our scenario, the EW squad may choose instead to position several unattended COMINT sensors around Braywick Park. This would allow them to perform other missions only achievable by a dismounted team. These ESM drop kits 'can help supplement the tactical COMINT take', George said. 'They are passive and can potentially be connected to one another and to the headquarters via fibre optics links.' Unattended systems may not be transmitting any radio signals but rather passively listening to the spectrum and sending data across non-radio links, making them almost impossible to detect by a hostile COMINT system.

One area where George believes dismounted COMINT will need improvement in coming years is incorporating civilian use of the spectrum, as collection in this domain can be controversial. Intelligence agencies can be uneasy about spying on civilian populations, particularly during out-of-area operations where relations between local inhabitants and a deployed force may be delicate.

Another problem is that the COMINT team might not have the correct software to feed data from military/civilian spectrum managers into their ESM for deconfliction and interference resolution. 'Are COMINT forces incorporating civilian spectrum management tools like decoders?' George asked.

For example, decoding software could indicate in which country a TETRA (terrestrial trunked radio) is registered. TETRAs are used widely in Europe for first responders, public transport and some military communications, so COMINT could determine if an unlicensed radio is operating in a given area without needing to decrypt voice data, forming a less intrusive approach.

CRFS's RFEye Stormcase spectrum monitoring and geolocation system is designed for dismounted troops. The product can be used unattended if desired and covers a 9kHz to 18GHz waveband. (Photo: CRFS)

Duesing is similarly concerned. He said troops often lack the means to gather COMINT on cellular and wireless communications at the tactical edge. 'Armies may have these COMINT capabilities, but they are not usually deployed on the front line and are not in the hands of soldiers.' If blue force COMINT cannot detect and decode red force cellphones, the former is, in effect, deaf and blind.

In summary, dismounted EW can be a complex mission influenced by a range of factors. Mission planning is vital to exploit geography to make good potential equipment shortcomings, and equipment like ECM and jammers must be optimised for portable SWaP.

The right questions also need to be asked. Is the team performing a dedicated EW task, or is it part of a larger kinetic mission? What risks are associated with the mission particularly if jamming is performed or the team needs a radio link to higher echelons? Is the team permitted to collect COMINT on civilian communications? And does it have the means to do so?

And, writ large, what role can emerging technologies like unattended sensors and ESM systems mounted on UAVs and UGVs play in supporting this mission? Expect further refinement of this highly nuanced mission set in the coming years.

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