BATTLESPACE

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COUNTER UNMANNED AIR SYSTEMS (CUAS)

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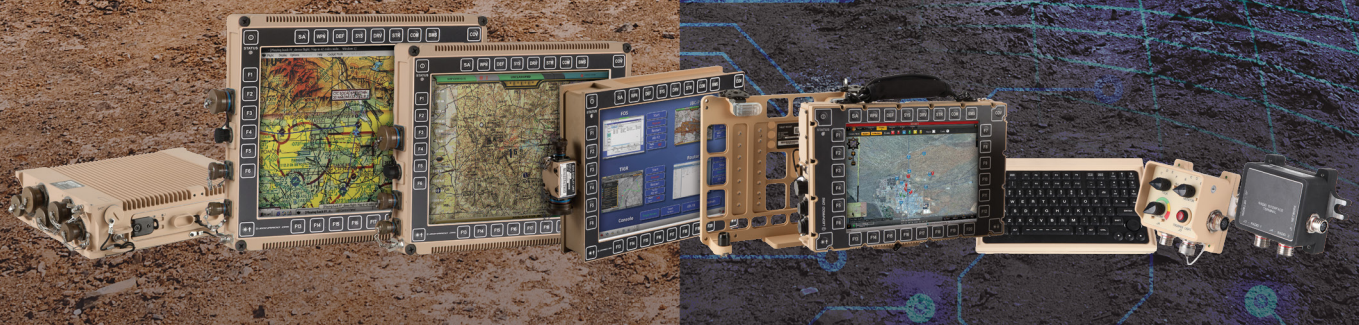

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Editor: Julian Nettlefold

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Contacts:
Julian Nettlefold
Mobile: +44 (0)77689 54766
Email: j.nettlefold@
battle-technology.com

Subscriptions:
www.battle-technology.com

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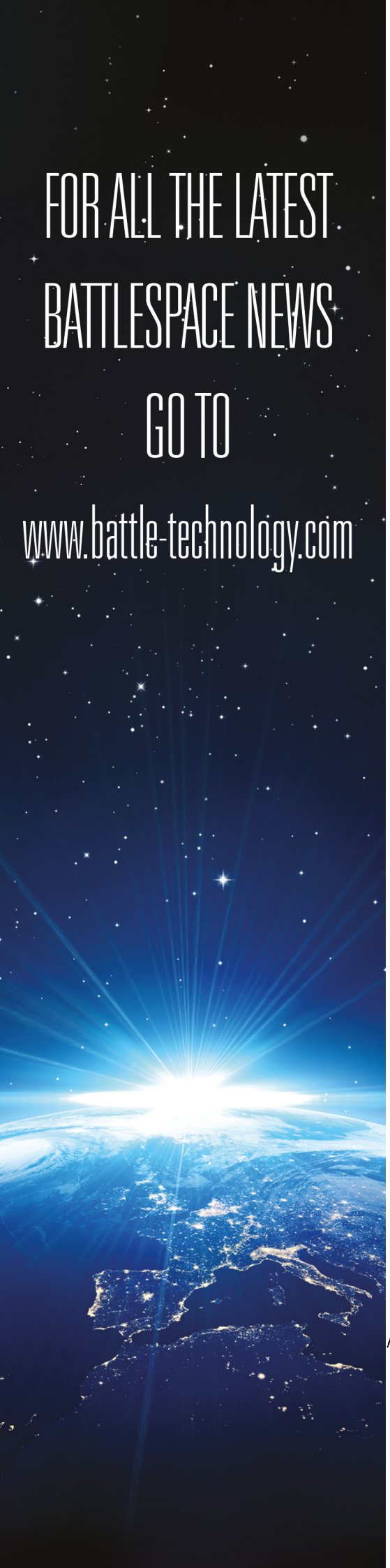

Letter from the editor

Dear Reader,

Welcome to the third issue of BATTLESPACE for 2023. We had originally slated this special C-UAS issue as a supplement to the September issue but due to the huge amount of news and comment on C-UAS issues, it is now a stand alone issue.

Hardly a day goes by without media coverage of UAV strikes across the world in the Middle East, Asia and now our screens and channels are jammed with details of UAV attacks on Kyiv and Moscow and how technology is evolving to defeat these armed, non-armed and surveillance UAVs. Safety in urban areas has spurned non-kinetic defeat systems whilst the battlefield requires concentrated kinetic systems to defeat swarms of armed UAVs small medium or large.

In the military domain, the war in Ukraine has become a war of attrition, where the onus is on deploying large numbers of affordable front-line tactical C-UAS systems to defeat early generation UAVS, rather than reacting to new drone threats which have suddenly appeared on the battlefield, such as autonomous swarming attacks. Although some commentators see the emergence of drone-on-drone combat in Ukraine as the start of a new era of air warfare, most government investment in new C-UAS capabilities – in the public domain at least – does not appear to be in intercept drones or net capture systems but in areas such as direct energy or C-UAS anti-swarm capabilities.

The world's armies are pouring billions into C-UAS technology and acquisition, thus, given the urgency to purchase the technology, new speedier acquisition processes, particularly in the USA are being developed. Running in parallel with this are the laws and processes required to deal with this new threat.

In due course we hope to announce a dedicated C-UAS Conference and Exhibition in the UK next year.

Your sincerely,

Julian Nettlefold
Editor, Battlespace

Front cover courtesy of Echodyne

British Army acquires SMARTSHOOTER's SMASH

The British Army's close combat soldiers will soon receive SMARTSHOOTER's SMASH Smart Weapon Sight Fire Control System, a cutting-edge weapon sight that will give them a tactical advantage countering uncrewed aerial vehicles (UAVs).

An initial order for SMASH sights has been agreed under the new five-year Framework Agreement, worth up to £20 million for delivery to Operational readiness units across the Dismounted Close Combat (DCC) community by the end of this year.

Providing dismounted soldiers with the ability to achieve a high probability of a hit against micro and mini UAVs, SMARTSHOOTER's SMASH technology enhances every mission's effectiveness through the ability to accurately engage and hit ground, aerial, and naval, either static or moving targets during both day and night operations. Employing AI, computer vision and machine learning, the SMASH family of fire control systems include handheld operated, remotely controlled, and robotic systems, e.g., UGV, UAS, mounted systems that ensure precise hit capabilities, enhance forces' situational awareness, and reduce costs – by significantly lowering training burden in both time and ammunition.

This kinetic Counter-Small Uncrewed Air Systems (C-sUAS) capability will initially be fitted to the SA80 A3 assault rifle and can also be fitted onto other in-service individual weapons. The contract Yorkshire-based Viking Arms Ltd, has the potential to allow further sights to be delivered over the next few years to dismounted close combat operators across the Army, Navy and RAF, based on operational and readiness commitments. This work contributes to sustaining the company workforce – supporting the Prime Minister's priority to grow the economy.

Michal Mor, SMARTSHOOTER CEO: *"We are delighted to cooperate with Viking Arms Ltd. for this significant project,. We are confident that the SMASH precision fire control systems that revolutionize the dismounted combatants' battlefield effectiveness, are an ideal fit for the cUAS operational requirements of the British Army, providing a pin-point accurate kinetic interception capability that is not dependent on the user's combat stress and in fact reduces their cognitive load."*

Drone attacks on UK critical infrastructure

Drone attacks on UK critical infrastructure *"relatively small but possibly significant."*

Drone attacks on UK critical infrastructure have been added to the UK's National Risk Register. The likelihood level is relatively small but the impact could be significant.

According to the text of the report: *"The use of drones has increased significantly in recent years, both for business and pleasure purposes. UK law now dictates that registration with the Civil Aviation Authority (CAA) is mandatory for operators of drones over 250 grams and all drones other than toys that are fitted with a camera. It is illegal to fly in an airport's flight restriction zone unless specific permissions have been granted. There are multiple ways in which a drone could be used maliciously."*

"In 2018 a sighting of a drone at Gatwick airport resulted in significant disruption to flights. Work is ongoing between various government departments, the CAA, industry, and police to maintain risk analysis and continually strengthen mitigations against future malicious drone incidents."

Scenario

"One planning scenario is based on the malicious use of a drone at an airport, which could cause disruption and safety concerns. It should be noted that drones are a novel vector to commit crimes and attacks. We actively plan for all types of potential disruption and threat that may result from negligent, criminal, or terrorist use of drones, not just that of airport disruption."

Key assumptions for this scenario

"Assumptions vary by scenario, however for the airport disruption scenario described above: It is assumed for the purposes of the assessment that the airport is operating at pre-COVID levels. The risk would not concur at the same time as another major event and the perpetrator is assumed to have malicious intent."

Response capability requirements

"Relevant capabilities will vary by scenario. For the airport disruption scenario described above: Specialised police counter-drones capabilities would be required to respond to the incident. Police work, alongside further investigative methods (for example forensic scrutiny of a downed drone), would be used to identify and apprehend malicious users."

For more information
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1175834/2023_NATIONAL_RISK_REGISTER_NRR.pdf

(Source: www.unmannedairspace.info)

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SMARTSHOOTER delivers a tactical edge to the dismounted soldier against the C-sUAS battle by employing a ballistically calculated coincident shot release to significantly increase the probability of hit.

Counter C-UAS Lessons Learnt from the Ukraine War

By Brig (Retd) Ian Cameron-Mowat Former Head of Force Protection UK Defence Equipment and Support

Before 2022, a piece on Counter-UAS Lessons would have highlighted the use of drones – both military and improvised – by the likes of Islamic State, Azerbaijan, Turkey in northern Syria, and of course by Russia in various theatres. Now the focus is much sharper. The drone war centred around Ukraine is at a level of intensity – indeed, ferocity – simply never seen before. That is why it is right at this time to ponder on C-UAS lessons from this major war in Europe. What's happening there now affects us all.

An important disclaimer! I've taken the material for this piece from open sources, including Russian and Ukrainian ones. I've pointed out systems produced by a number of different companies, and I have no commercial or professional links to any of them. Especially Kalashnikov.

Threat

First off, we need to define the drone threat. I won't deal here with the likes of the Kinzhal (or Dagger) hypersonic ballistic missiles used by Moscow with varying degrees of success; it's not a drone, and neither are the long-range high-speed cruise missiles launched primarily by air and naval platforms. That's a problem for conventional air defence and that's not what we're addressing here.

Drones are primarily used for surveillance, intelligence gathering, propaganda, and strikes.

Additionally, drones are used to help direct and conduct strikes. At the beginning of the war, Ukrainian forces used armed military drones such as the Bayraktar TB2 to target the Russian column headed for Kyiv. A TB2 drone may also have been used to distract the defences of the Russian flagship Moskva while naval missiles attacked and ultimately sank it. Intelligence gathered by drones is also used to direct artillery.

The most remarkable aspect of drone use in this war is the large number of civilian drones.

Quadcopters and other rotor drones are mainly produced by commercial firms such as the Chinese DJI and are among the most common. Armed systems, such as the TB2, or on the Russian side, the Orion drone, carry missiles which can be used

Above: *The Iranian Shahed class UAV.*

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BATTLESPACE is delighted to announce in association with Marksman PR a Counter Unmanned Air System (C-UAS) Conference & Exhibition 2024 at a date and location to be advised.

BATTLESPACE will publish a special dedicated C-UAS issue for distribution at the event

Topics include:

- C-UAS Radar Systems
- C-UAS EO/IR Optical Systems
- C-UAS Jammers
- C-UAS Kinetic Defeat Systems
- Specialist C-UAS Ammunition
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Contact: Julian Nettlefold
Tel: +44 (0)7768 954 766 **Email:** j.nettlefold@battle-technology.com
Web: www.battle-technology.com

Contact: Craig Lloyd Taylor – Director
Tel: +44 (0)7827 831 519 **Email:** craig.taylor@marksmanpr.com
Web: www.marksmanpr.com

Above: *The AtlasPRO system.*

to attack troops on the ground. So-called kamikaze drones, or loitering munitions, single-use drones, which hover above a target before diving into it and exploding on it, are also used extensively, especially by Russia but more recently for the attacks on Moscow.

For the Russians, most of that capability is now bought in from Iran, although measures are in place to enable manufacture in Russia itself. These are the Shahed 136 / 131[1] systems, or Geran in Russian service, prop-driven slow-speed drones with a 1000+ km range which in some respects remind me of the V1 weapons of the Second World War. I remember my parents describing what it was like to live under the threat of the *'doodlebugs'* in London in the 1940s; I don't think many of us expected to see or hear that threat again in Europe in the 21st century. But now, with an Iridium-powered comms unit, an inertial back-up navigation system and success against Saudi oil installations and almost strategic reach, time to think again?

Ukraine, of course, has not been idle. A drone industry was already developing before the 2022 invasion, but with Government, private and crowd-funding initiatives creating a whole domestic ecosystem, systems such as the Bober (Beaver), looking much like the Shahed, appear to have caused problems as far away as Moscow.

Systems such as the Shahed / Geran or the Bober are used to strike beyond the front line and into the depth of the enemy. These *'Low and slow'* can be a problem for conventional air defence systems, but facing the threat, the switch of surveillance, EW and even kinetic air defence systems from the front line to major population centres may dissipate C-UAS deployments along the front lines in Ukraine.

Other drones are of course deployed: they include the Russian Orlan 10 artillery spotting system and the Turkish Bayraktar in use by Ukraine. And that's before you take into account a range of loitering munitions, such as Kalashnikov's Lancet and Kub.

Ukraine is also receiving drones from abroad, whether commercial or specifically defence systems. Shorter range, purely tactical systems can take the form of purely commercial quadcopter systems such as the Chinese DJI range, especially the Mavic. Closer to the war, Latvia-based Atlas Dynamics provide the more robust and jam-resistant AtlasPRO system, and have opened an R&D office in Ukraine itself.

These quadcopter or (in the case of the AtlasPRO) tricopter systems are routinely used for surveillance, artillery spotting, grenade attacks or full suicide missions; the internet is full of videos of the last in particular.

Right down at the micro level, Teledyne FLIR's Black Hornet has also been procured in large numbers for Ukraine.

Countermeasures

An assessment of the effectiveness of countermeasures swiftly runs into the obstacles of deception, propaganda, operational security and national sensitivities. Some facts are known, however.

Electronic Warfare

Russia's investment in EW over the years has given it powerful capabilities for the C-UAS fight. Earlier this year, Russia claimed that it was able to bring down about 90% of Ukrainian drones through jamming; life in Ukraine is becoming difficult for commercial drones in particular. RUSI also estimates that Ukraine is losing 10,000 drones per month; this shows how many are in use and being procured.

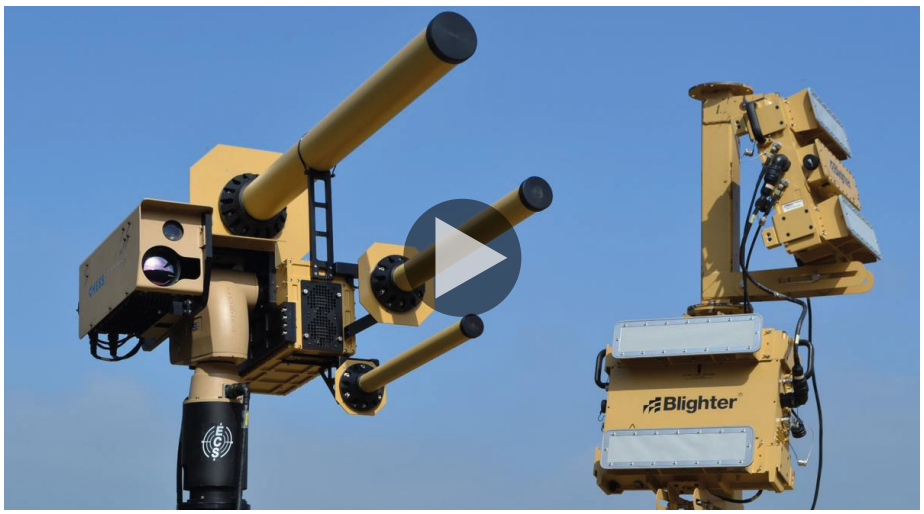
Hence the emphasis on the robustness of systems such as the frequency-scanning, frequency-hopping AtlasPRO; and hence the queasiness in some parts of NATO at the West's EW shortfalls as part of the wishful thinking of the *'peace dividend'* at the end of the Cold War.

C-UAS EW systems with a useful range come at a cost, but some of this is also being supplied to Ukraine. Blighter's Anti-UAV Defence System (AUDS) is an example; its provision to Ukraine was announced this summer.

Manpack counter-drone equipment is mostly repurposed or further tuned Counter-IED equipment; it can have some protective effect through disrupting drone communications or navigation at short ranges. Some systems aim to take control of the drone, but that's a more specialist operation.

Innovation doesn't stop at conventional EW; the Russian arsenal includes counter-drone rifles such as the multi-frequency PARS-S Stepashka, introduced this year. In the early months of the war, a RUSI report stated that quadcopters on the

Below: *AUDS; detection at out to 10km, and countermeasures.*



[1] *https://rusi.org/explore-our-research/publications/commentary/russias-iranian-made-uavs-technical-profile*

Above: *SteelRock's Nightfighter with the Royal Marines (MoD Crown).*

Above: *The L3Harris VAMPIRE system.*

front line only lasted three flights on average before jamming defeated them.

As an example of capability on the Ukrainian side, the British firm SteelRock is providing its Nightfighter system through Norway for Ukraine.

But EW is not the classic *'silver bullet'*; systems with inertial navigation capabilities, sophisticated communications links and pre-programmed strike systems can be highly resistant.

Kinetic Responses

Ukraine has formed mobile air-defence teams equipped with a variety of short-range and portable weapons, including self-propelled anti-aircraft guns such as the Soviet-era Shilka and the German-made Gepard, shoulder-fired missiles like the US-made Stinger, and even Soviet-designed DShK heavy machine guns paired with searchlights and mounted on pick-up trucks.

Note that Shahed drones are highly susceptible even to conventional, old-school anti-aircraft guns – that is, if they are detected in time to engage them. But, made of light materials and flying close to the ground, they are difficult to acquire on radar.

Another system which proved highly effective from early on is the Gepard, the old stalwart of Cold War air defence. In particular it dealt serious damage to Shahed swarm attacks on Kiev. The problem, though, became the ammunition – Swiss legislation prevented export and a work-around had to be found.

Echoing the pick-up theme, L3Harris is under a US Government contract to deliver 14 VAMPIRE laser-guided rocket systems by the end of 2023.

The International Fund for Ukraine – administered by the UK but working with Northern European partners – funds equipment and training programmes for Ukraine. As part of its C-UAS drive, £56M has been spend on acquiring CORTEX Typhon counter-drone systems, where the Teledyne FLIR and Kongsberg RWS systems are mounted on Dingo 2 vehicles.

Systems like the Orlan 10, however, fly too high for anti-aircraft guns to engage, so a radar-guided surface to air missile capability is still required.

Other Stuff

There's a lot of other *'stuff'* in the works or already deployed, though not necessarily yet in Ukraine. This ranges from hawks with Kevlar mittens, through counter-drone drones, through close-in net guns from the likes of the UK's Openworks Engineering, to lasers. Some of it will in the end prove to be highly effective.

So for C-UAS, what can we say?

- We need to detect drones as far as possible from the target
- We still need *'classic'* and expensive air defence to defeat some high-flying targets
- Electronic warfare is extremely powerful, but is not a complete answer
- Closer to the ground, missiles and guns are essential. And given the pervasiveness of the threat everywhere in Ukraine, that capability needs to be… pretty much everywhere
- The C-UAS battle is not a field just for air defence specialists. These capabilities also need to be in the hands of every unit, because every unit is under threat.

But most importantly, success relies on the human mind. Again and again we see Ukrainian versatility and speed of adaptation; but never forget that the enemy has a vote, and the Russians are not slow to adapt either in this C-UAS battle.

In many ways, to many of us, this doesn't really feel like air defence; this feels like the counter-IED fight all over again. A different threat, some different technology, but fast-changing, deadly, and critical to the success of operations.

Below: *Gepard - old, but highly effective against the right target set.*

Layers of CUAS Create Symmetry

By Leo McCloskey, VP Marketing, Echodyne

Growing up some distance from the equator, the same admonishment echoed in my head every year as the weather turned cold: *"Remember your layers! You never know where you will be, so be prepared!"* The wisdom of being responsive to conditions through different layers is well learned, and in cases like my own, well taught.

Layers of Ground-Based Air Defence (GBAD) are as doctrine as layers of defensive fortifications. Layers of requirements and procurement procedures are as cumbersome as layers of bureaucratic approvals. Some layers are necessary; Some are cumbersome. Each layer needs to be considered anew in the context of detecting and defeating Uncrewed Aircraft Systems (UAS), also known simply as drones.

The Drone Revolution

It should be noted that the focus here is airborne, though drones are equally effective submersed, on water surfaces, and on the ground. The arrival of UAS is heralding a range of changes in long-horizon strategic plans. While drones can be crudely thought of as inexpensive missiles, long range flight capabilities at very low altitude with high maneuverability and quiet operation create an inexpensive airborne weapons platform of varying sizes that challenges all existing doctrine.

It is straightforward to purchase a high-performance, fully equipped reconnaissance drone for a few thousand dollars. Easy retail accessibility of drone components, like GPUs, other advanced processing platforms, stabilized night optics, cutting-edge electronics, and numerous YouTube video guides for building a custom drone all indicate a genie that is well outside its bottle. This revolution in tactics and technology is being televised.

The use of drones in Ukraine each day represents not just another piece of war materiel, nor even another delivery vehicle. These highly attritable aircraft are nothing short of revolutionary across every aspect of the battlespace. The Counter-UAS (CUAS) revolution should be at least equal, if not greater across every aspect of planning, preparation, deployment, and operation.

Cost Asymmetry

Defensive postures started with concepts related to countering fast, high altitude objects like jets, bombers, and missiles. These systems bristle with technologies, networks, and weapons to defeat traditional threats. Systems like SHORAD

Above: *EchoGuard – The leading 4D radar for high performance ground and air surveillance of defense, government, and critical infrastructure assets (Echodyne).*

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Contact: Julian Nettlefold
Tel: +44 (0)7768 954 766 **Email:** j.nettlefold@battle-technology.com
Web: www.battle-technology.com

have gone through rapid adaptation, adding very short range and mobility as key solution attributes.

Unlike the state financing required to design, test, and deploy missile systems, each drone used by Houthi rebels in the Aramco 2021 attack cost less than a cheap used car. Activity in the Middle East and Ukraine demonstrates the risk of fast (›200 m/s) larger UAS at low altitude. Aircraft such as the Shahed-136 or ZALA Lancet demonstrate missile-like destructive and lethal capabilities and cost $20k and $35k, respectively. The defensive side is designed to counter surface-to-air and cruise missiles and has adapted its multi-million-dollar system, distributed command, expensive sensors infrastructure, and $400k per missile costs to the counter-UAS need. As history demonstrates, though, expensive victories can be pyrrhic.

The answer to CUAS cost asymmetry is COTS technology. If the cost of one high Tx/Rx ESA radar could acquire one hundred COTS radars of equivalent performance, if at shorter ranges, networked to provide the same coverage, the only obstacle is the unchanging nature of the acquisition process. The asymmetry in CUAS cost requires different thinking, eschewing strict requirements and gold-plated solutions delivered across years for innovative ideas and solutions that can be deployed tomorrow and replaced the day after.

Times Have Changed

The separation of capabilities for GBAD or ground fortifications are paired with different choices in systems and technologies, fitting nicely into long-standing divisions of responsibility with laborious procurement cycles built on precise requirements developed over years. These are layers to shed and reconsider.

While the recent mantra has focused on Change! in procurement, especially rapid procurement, slight change has come into practice. The common procurement activity remains a prolonged, multi-year program to meet requirements established in prior years. Large, fixed programs have proven ill-suited for the drone threat, yet few programmatic pivots are evident.

A RAND article from 2000 titled *"Understanding the Extraordinary Cost of Missile Defense"* remains the template for programmatic development within rigid, hierarchical Ministry of Defence (MoD) – Supplier relationships. The twenty-three-year interval since publication is unique to the decades preceding it, though, in one important way – the growth in technological capabilities across the private sector.

The large programs even today resemble a world where traditional suppliers are thought to be the only ones capable. Much of that may be true, but it can be changed. In fact, the mix of technologies and suppliers must become more dynamic. Private companies today possess hardware and software expertise and capabilities that rival and surpass those of traditional Suppliers.

The goal of rapid innovation, as often heard at conferences and expositions, necessitates a faster procurement cycle based on agile requirements of capabilities. As recently described by Gen. James Rainey of the U.S. Army Futures Command:

"The amount of disruption and the character of warfare right now is unprecedented, so inside two years we need to do a better job of seeing something that's happening on the battlefield, in technology, out in the Pacific, and turn that into no-kidding capability in a formation … It's my responsibility to write a clear requirement document, not for a specific piece of material but a requirement for a capability, and then work with [Army] acquisition guys, work with the contracting guys, work with industry to be able to get inside of two years."

(Defense News, Aug 8, by Jen Judson)

To achieve the goals of rapid turns from requirement to capability, innovative solutions built on commercial-off-the-shelf (COTS) hardware and software must become a key element of a rapid,

Layers of CUAS Create Symmetry

low-friction procurement practice. Such cycles create layers that can added and attritted and added again, maintaining tactical and financial pace with enemy actions.

The Testing Layer

The idea of COTS has been around for some time. The words in support of COTS are often warmly given while the actions following remain rooted in schedules across months and quarters. Change is difficult but essential.

There has been genuine change in considering novel technologies from private companies. The doors are open wider than normal. Interactions with large Suppliers looking to add to their portfolios are mirrored by MoDs taking meetings with private sector companies. These are positive signs and more focused interaction should be encouraged.

The men and women in uniform that focus on understanding the needs of their fellow warfighters do want what is best. The process, end to end, is built for bespoke manufacturing, restraint, and zero tolerance of inadequate performance. This makes sense when programs require hundreds of millions and billions of capital investment in bespoke manufacturing, training, operational support, and maintenance. But does it make sense when your adversary requires quite small, even tiny fractions of capital and time to build offensive capabilities?

In a 2022 Blog, Peter Modi from MITRE Corporation introduced a graphic in the context of Disrupting Acquisition. It has become known as DoD's Valley of Death but is localized easily enough. It remains a singular view of the challenge of matriculating from Interesting to Actioned.

Field testing in multiple scenarios and environments is obviously critical to evaluation. Consistency and reliability are attributes to be emphasized and rewarded when found. When private companies clearly demonstrate capabilities or innovation that meets need, layers of bureaucracy must be shed to enable speed. A further challenge with drones is they fly across every swim lane of responsibility and authority, further delaying acquisition activities with inter-branch and inter-agency procedures.

Simultaneously a Low Airspace and a High Ground Problem

Drones conflate ground and air, merging disparate streams of safety and security. The drone challenge is as much about inter-organizational data sharing as it is about technology and cost. The activity underway promises increasingly effective solutions over the coming years. How do we increase velocity and reduce time from years to months? These solution sets will include modifying existing programs, creating new programs, and new acquisition paths to accelerate COTS evaluation that create layers of detection and effector systems, each with its own role to play, in the CUAS toolkit.

The Achilles heel of the current drone platforms is its communications medium. A design choice to use unlicensed spectrum to enable industry growth created the current detection and defeat capabilities in radio frequency (RF) tools. This is a fleeting drone weakness. Use of multiple media such as low earth orbit satellites, ad hoc networking capabilities, unusual spectrum, or just a mobile SIM all change and reduce the drone's digital attack surface. Maturing video analytics and high-resolution maps combine with rapid capability growth in AI autopilots enables autonomous flight, without need for communications to reveal itself. Such drones will be impervious to electronic warfare (EW) tactics, techniques, or platforms. The RF tools of today will always remain a layer, just a less and less effective one.

Even as UAS technology matures, one sensor delivers dependable and comprehensive detection of all things moving in the sky. Radar remains the most effective sensor for detecting, tracking, identifying, and targeting all movement in the airspace, and

electronically scanned array (ESA) radars with high Tx/Rx module counts remain the gold standard for performance. Radar data creates the baseline for situational awareness, scanning large volumes of space for movement, slewing secondary sensors for eyes-on-object identification, and training sensors for targeting and mitigation of intruding drones.

But not all radars are equal. What separates wheat from chaff is the fidelity of the data acquired.

Actionable Data

Data increases knowledge. Knowledge is a decisive advantage. Sensors are only as good as the data acquired and transmitted to systems of systems. The better the data, the better the system. Information architectures are becoming more distributed and layered, aligning with command structures and deployed capabilities. Sensors must follow a similar path and, as with information systems, commercial companies have intriguing offerings.

To be effective, deployed radar systems must excel at detecting, tracking, identifying, and targeting drones and integrating with complementary sensors, targeting systems, and remote weapons stations and other weapons platforms for mitigation. Mobile sensor and effector platforms challenge enemy counterfires, contribute local details to command-level situational awareness, and protect forces in operating areas.

The industry challenge has been data fidelity in a small radar format. Large radar systems will deliver fidelity but remain far removed from active areas, creating gaps in coverage. If ESA radar were the size and weight of a paperback book with a small energy footprint and produced actionable data, it would be used everywhere.

Industry has produced, delivered, and thoroughly tested low-SWaP radar systems with equal or greater data fidelity, but lack a program anchor and become lost in yesterday's radar requirements and acquisition processes.

Range Inflation

In every conversation with operators and integrators, the instinct is to deploy more capable systems with greater and greater range for maximum response times against incoming enemy UAS. This is a well-taught response but eschews layers for the conventional choice. Large radar systems built on their own transportation platform offer key advantages in detecting and tracking objects at long range but cannot by themselves solve the challenge.

In Ukraine, reports of counter-UAS success caused by the data sourced from radar platforms like Hensoldt's TRML-4D, and the focus by Ukraine on disabling similar Russian platforms all point to the high value placed on these large radar systems and the data they generate. With significant range and excellent performance, these radars are important data acquisition elements in the situational awareness puzzle that must be protected from the same inexpensive drones they seek.

Losing one or more of these large radar systems creates a knowledge gap that is not easily or cheaply replaced. Consequently, large radar systems are placed further and further from harm, which in turn requires greater and greater range – an endless cycle of range requirement escalation that leads to greater and greater capital requirements.

The obvious answer is a distributed, attritable network of sensors fielded by forces of varying sizes and capabilities. ESA radar has proven highly resistant to efforts to reduce cost, size, weight, and power without impacting performance. Defence agencies have expended significant capital and labor in search of rapidly deployable, high-performance radar, without much success in miniaturizing ESA designs.

Echodyne's metamaterials ESA (MESA®) technology creates the only compact, high Tx/Rx module count, true beamsteering radar. This patented platform offers breakthrough size, weight, and power (SWaP) formats, simple manufacturability, and commercial

pricing. With short- and medium-range options, Echodyne radars fill coverage gaps, are portable, mobile, and easily integrated into higher-level systems, and generate reliable, consistent data of exceptional fidelity.

COTS, Attritability, and Resilient CUAS Systems

The addition of COTS radar adds resilience to every layer of the CUAS system. COTS radar generates data accurate enough for effector systems, such as Northrop Grumman's M230LF Bushmaster Chain Gun, to eliminate UAS targets with extraordinary efficiency. Large ESA radars, like the TRML-4D, will always have their role in battlespace but need complementary layers for resilient operation.

Deploying data acquisition assets, like sensors, must consider COTS to achieve attritability while maintaining performance. A large ESA radar combined with hundreds of low-SWaP ESA radars creates a powerful sensor network that matches remarkable airspace acuity with high attritability. High-performance radars, such as Echodyne's EchoShield pulse-Doppler MESA® radar, offer comparable to often much better data fidelity at a tiny fraction of the cost.

While edge cases will always require pinnacle systems, the benefits of layered redundancy, layered commands, and layered systems of systems remain clear. Adding COTS to the formula creates capital symmetry for the MoD and properly equips warfighters with adaptive layers of CUAS protection.

CUAS and the importance of an Integrated System

By David Eldridge, Chess Dynamics

Intro

Effective C-UAS relies on early detection, accurate situational awareness combined with information regarding range, classification and declared intent all seamlessly passed to the operator for action. This demands that all system sensors and effectors are working together and reporting the required correct data for timely and confident decision making.

A key component of a C-UAS system is the Radar. With an ability to Detect, Track, and Classify, it's important to select a radar solution that is capable of both delivering against end user needs and integration into the wider system infrastructure.

To help mitigate risks, the more advanced C-UAS radars are equipped for the drone problem out of the box but require significant post-sale integration for seamless operation. Ultimately, these radars are great, but they do rely on an integrator to make them work properly. So, what can you keep in mind at the point of integration to make the most of your investment?

Location, Alignment, Synchronisation

A state-of-the-art C-UAS system can extract precise information for evidential purposes. Next generation technology can also provide full spectrum air defence – from long range aircraft to close vicinity drones, but if the equipment within the system isn't installed effectively, it may fail against objectives, however much you've invested.

The first stage is to determine the correct geographic location/placement of the equipment. Surveying where it is going and where it needs to be for it to be fully effective. There is no point trying to hide it away if in by doing so its coverage and range are compromised. And as location can affect sensitivity, full site surveys, power requirements, and network requirements should be considered.

In addition, some passive elements of detection, such as the RF/DF (radio frequency direction finding) rely on separation and triangulation to locate the UAV by scanning a wide range of frequencies to locate the presence and bearing of a UAV. Positioning the detection nodes at least 1.5 km apart will also provide a far more accurate point at which they intersect to be able to decipher bearing and range.

The sensors and effectors then need to be synchronised and in the right place for integrating. Standardisation and orientation / alignment is necessary for them to report accurate data back to the user – aligned, synchronised and time stamped.

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Automation of Sensors and 3D Mapping

You'd be surprised how often sensors are set up but not tested for seamless automation, but it's crucial to make sure the software is integrated, and that all sensors are working correctly. On their own they will just *'report'*, so they need to be brought together in a unified way. And even with the sensors aligned, integrated, and automated, how the data is received by the operator needs to be considered. We ultimately need to support a distracted user and reduce operator burden.

For example, the new EchoShield radar from Echodyne includes the four primary data elements (azimuth, elevation, range, velocity) with extraordinary accuracy (‹0.5 degrees in both azimuth and elevation). Operating in Search While Track mode, EchoShield tracks hundreds of targets, delivering precise airspace coordinates at a high data rate (10 Hz) for smooth optical tracking and targeting of effector systems.

Accessing this data from the various sensors and taking it beyond just reporting without having to visit different screens is a must. Being able to display all the data being reported into a single, easy to use screen which includes a 3D map is incredibly useful and preferably in a way that can also be mobile. This enables them to pinpoint with accuracy what and where the target is for improved decision making and speedy action.

Integrating with a Legacy System / Prevention of Security Compromise

It's also necessary to consider whether the user already has an existing systems or even a complete Battle Management System into which this needs to be integrated, as this may cause several security concerns. For example, it is possible that integrating a new sensor component may compromise the integrity of a network and increase the risk of sophisticated hacking. What are the cyber security restraints for example?

This has nothing to do with any particular sensor but the process of integration itself. Before integration, the network needs to be tested for robustness. Working with an experienced integrator can help here.

Deployment, Operation and Update

As with a lot of technology, sensors often have software updates available. It is imperative to make sure there is a contract in place to enable these updates are made throughout their lifetime for improvement and optimum performance.

In addition, it's human nature that teams experience *'skill fade'* – where people get blasé from working with equipment over time. To prevent this, and to also keep skills fresh, Chess Dynamics includes an in-built simulator for weekly drills and assessment to practice what will be required in a real-time situation.

Getting the Most from your Sensors

A great system includes great components, but a great component does not create a great system. It's the system the customer buys and so it's important to make sure it's the best it can be.

Leo McCloskey, VP of Marketing at Echodyne comments, *"We often see C2 systems that are built on the least amount of integration required, organized for specific sensors and releases. Chess Dynamics has built an active C2 that integrates and manages the component sensor lifecycle. Software-defined radars, such as Echodyne's, require a steady diet of upgrades for continuous improvement and operation, and Chess delivers this for its customers."*

Conclusion

As we look at current trends, the C-UAS system needs to be both highly accurate and increasingly mobile. The C-UAS system may require several fixed sensor installations and then have any gaps filled by vehicles that may rotate around an area of security. Quick to deploy capability for situations such as needing to move forward in a battlefield or cover a high-profile security event with additional surveillance comes to mind here.

If you are considering a mobile C-UAS that is easily moveable and networked, the robustness of the system needs to be tested first. Mobility introduces a host of challenges for systems and sensors operating in cooperative networks, in addition to stark differences in performance on paved and unpaved surfaces and truly off road. The equipment also needs to be capable of rapid updates to the map – and in a way that isn't draining the battery on your vehicle. And the C2 needs to securely and flexibly manage it all.

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RF inhibition: Countering the evolving UAS threat in the modern battlespace

By Graeme Forsyth, Counter-UAS Product Manager, SPX CommTech

Global defence has been on high alert since early 2022 with the Russia-Ukraine war and heightened tensions worldwide. Electronic warfare is evolving, and we see more frequent and increasingly sophisticated threats. While there are positive use cases for Unmanned Aerial Systems (UASs) – like rescue and search missions – their hostile use is growing due to their flexibility, low cost and capacity to be updated.

Today, unmanned systems such as drones are considered one of the biggest threats to military coalition forces, and their use is only intensifying. Radio Controlled Improvised Explosive Devices (RCIEDs) account for most military and civilian casualties in asymmetric warfare environments.

It's not just defence teams that are acutely aware of new threats. Security and policing are seeing more incursions across borders and threats to critical national infrastructure, where billions of dollars of services are at risk. In this context, successfully defeating any danger posed by errant, illegal or malicious UASs is becoming ever more critical for an increasingly wide range of domestic and international military and security forces.

The ability to counter threats and provide communication security is now considered among the highest global priorities, and this is where Radio Frequency (RF) plays a vital role.

Innovation in technology capabilities

UAS threats are RF-enabled, resulting in mounting demand for RF inhibitors and continued innovation in the space since the Iraq and Afghanistan conflicts onwards. Technology is keeping teams ahead by offering significant defeat capabilities and sophisticated analysis, adapting at the same rapid pace as the threats themselves.

Guided by the highest industry standards, the most sophisticated RF inhibition solutions are designed for safety and reliability and are currently deployed to counter defence aircraft and unmanned systems worldwide.

Above: *Soldiers in field communicating to BLACKTALON 2 operator (SPX CommTech).*

Considerations to stay one step ahead

Defence and security teams need to consider if their RF inhibition technology will deliver efficient *"kills"* even as rapid development continues and the landscape changes. To do so, there are several considerations for defeating a hostile UAS, including mobility and range.

The threat/counter-threat cycle is speeding up as each side of the conflict iterates to thwart the other. Therefore, defence and security teams prioritise methods that help shorten the threat evolution loop and keep them one step ahead of their adversaries. Enabling updates to control mechanisms and protocol change via a controllable source helps keep pace with evading threats as they develop. For example, a UAS's protocols are constantly changing as they hop within and across RF bands, making it harder for counter technology to track and defeat them.

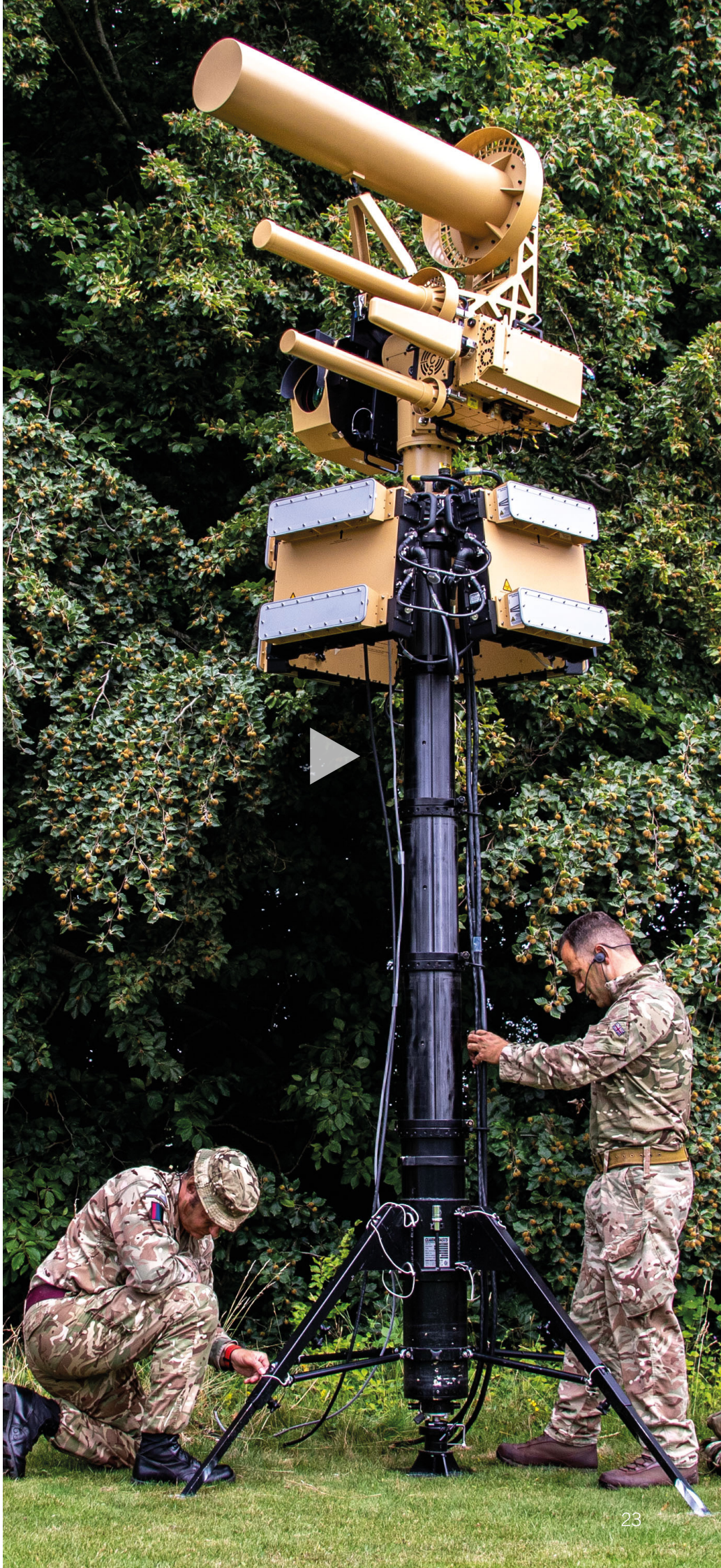
A growing concern for some defence and security teams is that RF defeat can result in RF leakage, which can take out emergency services or friendly force unmanned systems and the threat itself. This *"all down"* strategy is increasingly risky, so they want to ensure a more targeted kill. Rather than downing everything in the sky, having directional technology ensures a clean kill of just the hostile UAS, minimising collateral impacts in complex RF operating environments.

With increasing mobility, speed and distance capabilities of unmanned devices, countermeasures require longer-range, specific frequencies, high spectral purity and directional beams to increase chances of defeat. During peacetime (before 2022), a three-kilometre range was generally sufficient to keep threats at bay. This has changed, and defence and security teams need double-digit range capabilities in every direction to succeed. They require low power consumption while still delivering extended-range performance.

RF countermeasure inhibition techniques have evolved to Software Defined Radio (SDR) technology. SDR sources enable countermeasure systems to keep pace with and defeat the ever-evolving specialised command, control and communications (C3) links in the unmanned systems domain. An advanced SDR-based technique coupled with the directional inhibition beam is the key to defeating the most advanced frequency agile and band-agile C3 links at the range required to protect against today's long-range, fast-moving unmanned threats.

Perhaps more than ever, defence and security organisations must consider cost efficiencies, productivity and efficiency of

Right: *Soldiers setting-up Mast of BLACKTALON 2 System (SPX CommTech).*



all kit to ensure assets are maximally used. This is why multi-layered and network-enabled technologies are essential to enabling assets to appear in multiple places via multiple capabilities. For example, these organisations could seamlessly harmonise their RF inhibition system with third-party multisensory drone detection and kinetic systems, to provide ultimate operational flexibility.

Claw is critical for today's battlespace

SPX CommTech's Claw RF inhibitor system, developed by Enterprise Control Systems (ECS), offers a significant defeat capability to current and emerging threats and has capabilities that specifically address the above considerations. Drawing on 35 years of expertise in the defence and security space, ECS's RF Inhibitors use software fills, which can be generic or based on a specific sophisticated threat analysis for operations in multiple electronic threat environments.

The last two years have seen a dramatic shift in the protocols used to communicate and control threats. Gone are the standard spread of bands once seen in commercial systems during peacetime. As such, and in order to have the best chance of success, jamming systems need to keep pace in matching the focused energy of the signals of interest. A simple chip change can affect this subtly or dramatically. These *"software fills"* ensure specific counters to threats can be optimised, but may also require conscious decision-making to be made around priorities and expected threat set. Beyond this, technology is allowing increasingly complex control and communication signals to be developed that in turn generate the need for further details to be taken into account.

Claw is designed to disrupt and neutralise the threat posed by a UAS engaged in weaponised, hostile surveillance, and other malicious acts by jamming signals. It disrupts the control, navigation, and telemetry a UAS uses and can be customised for end-user requirements. It is a secure, fully self-contained, compact system that inhibits five individually selectable command and control links between the target UAS and its operator. It requires no external signal processing or power amplification modules and is insulated from third-party interference.

Claw is accredited with over 2,000 UAS defeats in multiple conflicts, including by the US Department of Defence, since its deployment in the 2017 Battle of Mosul. Furthermore, it is currently used worldwide to counter UAS threats in conflicts and other zones.

Key features supporting teams

Due to heightened global threats, defence and security teams are using more of the Claw RF inhibitor's capabilities, which means it can operate to even higher potential. Its key features supporting teams around the world in increasingly complex environments include:

- More range, accuracy, and agility than any other RF Inhibiting system,

defeating drone attacks over greater distances, keeping critical infrastructure and people safe.

- Intelligent RF Inhibition ensures spectral cleanliness limiting collateral damage and unparalleled record for long-range drone defeat. This is partly because Claw is powered by SDR, ensuring real-time, reactive and targeted power allocation within 400MHz to 6GHz frequency range. As the RF spectrum becomes ever busier and the effects of spectrum leakage risks become ever greater, Claw inhibits waveforms in a controlled manner, with no unwanted transmissions outside of the desired target band.
- The RF inhibitor uses open technology to quickly become an effector of choice and fit within multiple architectures or deployment modes. The Claw RF inhibitor can be easily integrated into multi-layered air defence systems delivering a comprehensive RF defeat capability.
- It exists in the sweet spot as a soft kill effect, offering range over and above a lot of other solutions – for instance gun systems, cannons, or Very Short Range Air Defence System (VSHORAD). Claw's cost per shot, or cost per kill, is cheaper and more beneficial than hard kill solutions.
- It is built explicitly for top-end, power and range. Due to heightened global threats, however, defence and security teams today use more capabilities, which means the inhibitor delivers a higher operational level to protect people, critical national infrastructure and borders.
- Recent trials confirm Claw as being ahead of many rivals as one of the most efficient directional high-powered jammers available on the market.
- It's also easy to integrate and can be typical 240V AC or 24V DC (standard vehicle supply) and the user interface needs can be loaded onto standard available PC's or for a deeper Command and Control (C2) integration. We see UAS utilised now in all aspects of conflict, from pure ISR missions through to complicated redirection of live fire missions to devastating effect. As such, the information including imagery gathered from the countering of these activities is of interest at every level of command and this requires linkage with multiple C2 systems to facilitate.

Extending Claw's capabilities

SPX CommTech can integrate the Claw RF inhibitor system into multiple Counter Unmanned Aerial System (Counter-UAS) detect and track systems, such as BLACKTALON. The solution was jointly developed by SPX CommTech's TCI and ECS, providing an effective way to integrate passive and active RF detection to locate, identify, track and defeat drones, allowing for flexibility in deployment in an ever-changing and evolving threat environment. Proven in active conflict, its SDR source generation delivers an inhibition waveform best suited for Counter-UAS. High-gain, directional antennas transmit the inhibition waveforms, ensuring the antennas illuminate the target. Furthermore, the antennas have a nominal 20° beamwidth providing the power density required at the target UAS, which allows mitigating collateral impact upon other systems and is without a doubt a key factor for using RF.

BLACKTALON is an open architecture Counter-UAS solution that also enables users to integrate their legacy or preferred sensors and to interface the system to their C2 system of choice. This allows the capability to be scaled in response to an emerging and evolving Concept of Operations (ConOps), to the Operational Environment and to the available budget. This flexibility allows for a custom solution approach that embraces established Technology Readiness Level 9 (TRL9) components into a solution for immediate operational impact whilst providing the ability to scale the sensor and effector solution in response to changing threats and ConOps in the future. The outcome is early and reliable detection, pinpoint tracking, and selective defeat options to mitigate the UAS of concern.

Looking to the future

While threats continue to evolve at high speed, so must the tools that provide teams with critical protection well before the potential threat materialises into reality. Going forward, as UAS and other unmanned attacks continue to evolve, the effectiveness of countermeasure solutions will depend to a large extent upon the ability to understand and foresee the next generation technology that is likely to be deployed to adapt countermeasure solutions rapidly on the battlefield.

Counter unmanned systems must ultimately form part of every country's overall strategic defence capability. To ensure defence and security organisations remain ahead, SPX CommTech continues to review the threats and innovates to solve the challenges customers often don't yet know they face. Claw will continue to become a more prevalent networked remote weapon system.

As solutions manufacturers, at SPX CommTech, our primary goal is focused on innovation and progress, but more broadly, we must continue to deliver technology like our Claw and BLACKTALON solutions that ensure a smarter, more secure future for us all.

For more information on our SPX CommTech Battlespace solutions, visit www.tcibr.com and www.enterprisecontrol.co.uk or our stand at DSEI (H2-874) from 12-15 September 2023 at ExCel London.

***Background image:** Soldiers in field setting-up 953 System as part of BLACTALON 2 (SPX CommTech).*

Israeli C-UAS Systems

By Arie Egozi

Israel Identified the threat posed by armed UAV's and drones in an early stage and that has resulted in the development of many defense systems against this growing threat. The use of Iranian made armed drones by the Russian forces in Ukraine , is according to Israeli experts another anticipated development in the growing phenomena of using armed UAV and armed drones in war.

The Houthi rebels attack on the oil facilities in Saud Arabia in 2019 was performed by a mix of cruise missiles and armed drones. Supplied by Iran.

In the very recent clash between Israel and the Hamas terror organization in Gaza, attempts were made to hit targets in Israel with armed drones.

While all this happened , the Israeli ministry of defense and the Israeli defense companies , were already deep in the effort to find the best solutions.

Swarms of armed UAV's and armed drones is a threat taken very seriously by Israel and other countries. But now a new threat is emerging very fast – attacks by swarms of armed UAV.

The threat was exposed in 2018, when the Russian Ministry of Defense claimed its forces in Syria were attacked by a swarm of home-made drones – the first time such a coordinated assault has been reported in a military action.

According to the Russian Ministry of Defense, Russian, forces at the Khmeimim air base and Tartus naval facility, have foiled the attack.

The official spokesman added that at nigh fall, the Russian air defense units detected 13 unidentified small-size air targets at a significant distance approaching the Russian military bases.

The growing threats and especially the numerous attempts to cause casualties in Israel by using armed UAV' and armed drones, has taken Israel to an across the board effort.

So the threat is real and growing , and that brought a host of Israeli companies to develop defense systems they say can detect, neutralize or destroy incoming UAV's and drones.

UAV's and especially drones, present unique challenges that set them apart from traditional airborne threats, such as missiles or warplanes.

Elta , the electronics group of IAI, has developed the Drone Guard that addresses this threat. It detects and blocks its communication capability without compromising the communication capabilities of nearby civilian infrastructures. In this way, the operation of the hostile UAV or drone is disrupted and neutralized.

Drone Guard is based on a combination of 3D radars that trace the air targets, electro-optical and COMINT means, and a dedicated UAV flight disruption system.

The company says that Drone Guard is used successfully against a range of UAV and drones and in other scenarios including forays or multiple-target.

The Drone Guard system features an integrated multi-layered sensor system that includes: 3D X-band radar that detects and tracks all types of drones; dedicated COMINT system that classifies the drone by its transmission (using the information to verify the target and reduce false detection rates); an EO/

IR camera used to classify the detected object; and a Jammer that neutralizes and intercepts the object.

Elta says that all the sensors are managed by a unified command and control unit. The key advantage of the layered configuration is that it provides added protection should one layer fail.

According to ELTA , the system is capable of *"closing the cycle"* very fast, to neutralize a threat. This by Using a variety of sensors that supply very accurate detection, identification and precise location for the different active systems that are used to neutralize the threat.

Rafael Advanced Defense Systems, one of Israel's major defense companies, has also joined the effort to cope with the growing diversified threat and developed the Drone Dome – a radar and laser-beam system for detecting and destroying drones, with the company adapting its existing laser systems to handle the threat. Once the system's radar identifies targets, its laser system destroys them. Drone Dome also features a jamming system for disrupting communications between the drone and its operator. Drone Dome's range reaches several miles, but causes minimal interruptions to other systems in nearby urban areas. The drone threat is neutralized by activation of directional GPS/GNSS and radio-frequency inhibitor/jammer devices. A laser weapon is optional.

The drone threat is neutralized by activation of directional GPS/GNSS and radio-frequency inhibitor/jammer devices. The laser weapon is optional.

In a recent demo conducted in Israel, Rafael's Drone Dome system performed interceptions of multiple drones, including maneuvering targets, using its hard-kill Laser beam.

According to the company this version achieved 100% success in all test scenarios. The stages of the interceptions included target detection, identification, and interception with a high-power Laser beam.

Elbit Systems, also developed an anti-drone system, the Redrone .According to the company this systems can detect, identify, locate and neutralize commercial drone threats in real-time, delivering exceptionally effective countermeasures for civilian, HLS, military and paramilitary defense.

The company says that the ReDrone system has been developed using sophisticated, field-proven SIGINT and EW technologies to create a two-level solution that provides options for both short and long-range protection, making it ideal for use in multiple scenarios, including the defense of borders, airports, strategic facilities, public events, convoys and VIPs.

The ReDrone has a 360° coverage and can detect and defeat single or multiple drones simultaneously. As a passive system with reactive jamming, the system transmits only when a drone is detected. Once detected, an automatic alert is sent, and the process of neutralizing the drone's navigation and communication capabilities begins.

According to Elbit , ReDrone is designed to detect, identify, track and neutralize different types of drones that are flown within a range of radio frequency communication protocols.

The evolution of the anti UAV/drone systems will be affected directly by the power of laser systems. The currently used laser systems can kill a drone or a small UAV from a relatively short range and altitude.

The effort now is to find ways to integrate more powerful lasers in these systems. The detection and verification phases are performed now almost flawlessly by many sensors and in most cases by integrating their capabilities. The aim now is to achieve positive kill of drones and relatively big UAV's.

In a video recently released by Elbit, the company presented the concept of the system: installing a powerful laser on the fore section of a UAV. According to Elbit, the company was selected by the ministry of defense to provide a laser-based solution that will protect Israel from missiles and rockets. This in addition to the operational Iron Dome systems manufactured by Rafael.

Elbit estimates that this technology is expected to be one of its growth engines in the coming year.

An Elbit source said that the company has achieved a technological breakthrough which enables it to build an operational system if the defense ministry funds the project.

The threat is spreading and South Korea is considering the purchase of Israeli made anti-drone systems .This, after North Korean drones entered the nation's air space recently.

The first system to be evaluated is the Rafael Sky Spotter that is capable of detecting small drones.

Utilizing a network of sophisticated optical sensors, Sky Spotter can use radar countermeasures to find small targets or aircraft. In order to prevent false alerts, the system uses AI to separate, classify, and identify objects.

The Sky Spotter is a cutting-edge passive early warning electro optical (EO) system sensor for accurate tracking of aerial objects, such as drones, airplanes, and UAVs.

According to Rafael it uses sophisticated artificial intelligence, image processing, and automation algorithms. The company says that the Sky Spotter is an essential part of standalone AS&W for force protection, air situational awareness, and support for C-UAS/GBAD systems.

Sky Spotter has a wide-field-of-view staring sensor that keeps continual watch, and its imagery is processed to lock-and-track numerous targets at once and to automatically give a sense-and-warn function. In a networked system, the quantity of staring sensors can be expanded to guarantee complete coverage.

These sensors automatically detect suspicious objects, and when they do, the system alerts an investigating sensor with a considerably smaller field of view that is capable of giving an active defense systems the accurate point of it that will ensure a kill of the incoming threat.

Israeli sources said that in addition to evaluating this passive detection systems, South Korea may soon evaluate some Israel systems that are designed to kill hostile UAV's and drones.

European countries are showing great interest in the Israel Drone Dome system that protects against threats posed by armed drones. This peak interest is explained by the heavy use of armed UAV performed by the Russians in Ukraine.

Israeli company Rafael is upgrading its anti-drone system to meet the growing threats. The company has upgraded its Drone Dome system and claims that it is now capable of intercepting in longer ranges and in a variety of soft and hard kill means.According to a company source, the upgrades that were introduced are game changing.

He added, that the Drone Dome now features a maximum detection range of 150 km when using the SIGINT sensor. Jamming can be performed in ranges of 50 km.

He pointed to the fact that the upgraded system is capable of detecting possible threats from over 150 km away. *"These unique features bring this combat-proven system to the next level, delivering state-of-the-art performance from long distances."*

The source pointed to the fact that Drone Dome's new capabilities include diverse jamming techniques allowing the system to deliver comprehensive defense against attacks from varying distances and altitudes.

And new smaller companies are joining the effort to develop ant UAV system. One of them is Regulus that has developed the Ring C-UAS. According to the company this system uniquely and effectively uses GNSS manipulation techniques against intrusive threats – may they be attacking from the air, at sea or on the ground – replacing the need to jam several channels or to cyber-hack data links.

Ring uses very low-power smart RF transmission, only on the GNSS channel, to take control of threats and manipulate them – effectively and simply, without interfering with other communications. Ring is more effective than other C-UAS soft-kill solutions – affordable, compact, faster to deploy & easier to operate.

Israeli company SMARTSHOOTER, has developed the SMASH HOPPER a light-weight Remote Controlled Weapon Station (RCWS) using SMASH Fire Control technology. SMASH HOPPER provides operators the remote capability to engage ground targets and small unmanned aircraft systems (UAS).

The combination of lightweight and compact size of the SMASH HOPPER makes the system perfectly suited for complex urban areas, borders, and sensitive infrastructure and situations where a low signature is required. The HOPPER can be mounted in several configurations, including a tripod, fixed mast, surface vessel, and vehicles. The SMASH Fire Control tracking and locking capability enables the system to maintain its lock while maneuvering on land or sea.

The SMASH HOPPER can also be integrated into an existing Command-and-Control (C2) system, providing operators with the ability to hand-off or receive targets across existing communications networks.

Force Protection on AI Steroids

By Robert Hipwell, Brigadier General (R) US Army

In an increasingly uncertain world with emerging threats, the importance of robust force protection for military personnel and assets cannot be overstated. One technology stands out as the best option to counter the newest threat from drones and bolster security in these turbulent times and the foreseeable future: advanced AI radar systems.

Unparalleled Drone Detection and Mitigation: As the menace of drones continues to grow, military forces need to stay ahead of these agile and evasive threats. Advanced AI radar systems offer unparalleled drone detection and mitigation capabilities. Their sophisticated algorithms can discern between friendly and hostile drones, minimizing false positives and enhancing response precision. By thwarting drone attacks, these radar systems safeguard troops, installations, and critical infrastructure.

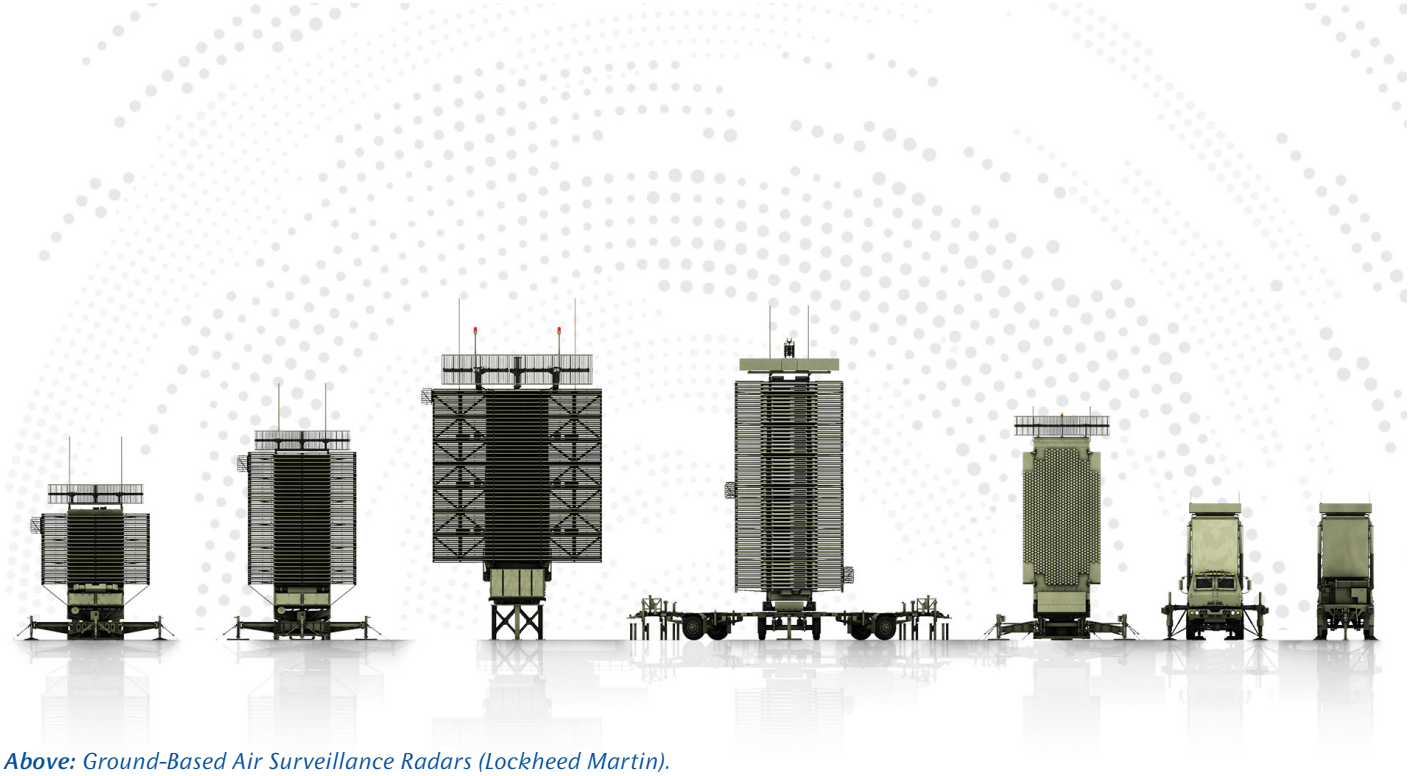
Real-Time Decision Support: Swift decision-making is imperative in today's rapidly evolving battlefield. AI-enhanced radar systems process vast amounts of data in real-time, providing actionable insights for military personnel. With precise threat analysis and target tracking, commanders can make informed decisions promptly, enabling effective force protection strategies.

Versatility and Adaptability: Modern military operations span land, sea, and air domains, demanding versatile solutions. AI radar systems excel in their adaptability, functioning seamlessly across various environments. Whether deployed on land-based stations, naval vessels, or aircraft, these systems offer consistent and reliable performance, protecting military assets across all domains.

Stealth and Evasion Detection: Sophisticated adversaries employ stealth and evasion tactics to circumvent traditional radar systems. AI-enhanced radar systems, with their advanced signal processing capabilities, can detect and track even the most elusive threats. This ability to pierce through enemy attempts at concealment ensures an impenetrable protective shield for military forces.

Integration and Cost-Effectiveness: Upgrading and integrating new technologies can be a daunting task for military organizations. AI radar systems alleviate this concern by offering seamless integration with existing defense infrastructure. Their modular design and scalability enable cost-effective implementation, optimizing resource allocation and minimizing maintenance expenses in the long run.

In these uncertain times and beyond, the newest threat from drones demands innovative solutions for military force protection. Advanced AI radar systems emerge as the optimal choice, thanks to their unparalleled drone detection and mitigation capabilities, real-time decision support, versatility, stealth detection, and cost-effectiveness.



Above: *Ground-Based Air Surveillance Radars (Lockheed Martin).*

As we face evolving security challenges, investing in cutting-edge AI radar systems is an imperative step towards fortifying military force protection. By harnessing the power of AI and advanced radar technology, our armed forces can confidently navigate the dynamic modern battlefield, ensuring the safety and success of their missions, personnel, and assets.

To learn more visit https://matrixspace.com/defense-solutions/

Robert Hipwell, Ph.D. is on the advisory board of MatrixSpace, which develops real-time AI edge-based sensing with the ability to detect and track multiple types of objects in any situation. He is a retired Brigadier General of the US Army, and served in the Army, the Army Reserves, and National Guard. Robert deployed to many remote locations throughout his military career while still handling civilian work responsibilities at both Cisco and Lockheed in addition to completing his Ph.D. After being promoted to Brigadier General he was selected to command a Military Police Brigade and served many tours in support of OEF and OIF. He is a strong advocate for our military, veterans and first responders, working with those organizations across the United States on effective teamwork and leadership, and how to increase profitability and success while inspiring each other, sponsors and their respective communities.

https://www.linkedin.com/in/robert-hipwell-8957041a/

C-UAS Systems – A Year In Perspective

By Julian Nettlefold

In this Feature, we give a snapshot of new developments in C-UAS technology, legislation and procurement across the world.

Sponsored by ECHODYNE

Introduction

Hardly a day goes by without media coverage of UAV strikes across the word in the Middle East, Asia and now our screens and channels are jammed with details of UAV attacks on Kyiv and Moscow and how technology is evolving to defeat these armed, non-armed and surveillance UAVs. Safety in urban areas has spurned non-kinetic defeat systems whilst the battlefield requires concentrated kinetic systems to defeat swarms of armed UAVs small medium or large.

In the military domain, the war in Ukraine has become a war of attrition, where the onus is on deploying large numbers of affordable front-line tactical C-UAS systems to defeat early generation UAVS, rather than reacting to new drone threats which have suddenly appeared on the battlefield, such as autonomous swarming attacks. Although some commentators see the emergence of drone-on-drone combat in Ukraine as the start of a new era of air warfare, most government investment in new C-UAS capabilities – in the public domain at least – does not appear to be in intercept drones or net capture systems but in areas such as direct energy or C-UAS anti-swarm capabilities.

The world armies are pouring billions into C-UAS technology and acquisition, thus, given the urgency to purchase the technology, new speedier acquisition processes, particularly in the USA are being developed. Running in parallel with this are the laws and processes required to deal with this new threat.

As small Unmanned Aircraft Systems (sUAS) or drones become easier to acquire, automate and fly, these are increasingly being harnessed by bad actors intent on using them for nefarious purposes. Compact, discreet and remote-controlled, drones can be a powerful tool for illegal surveillance, smuggling contraband or attaching dangerous payloads, making them a significant threat to public safety. Such proliferating threats pose a difficult challenge for military, security and law enforcement personnel. The ability to detect, track and identify drones is imperative to help operators regulate and manage these threats, determine intent and respond appropriately.

This US DDS quote sums up the current situation well, *"Small UAS (sUAS) are a threat both domestically and overseas. The global sUAS industry is rapidly evolving and introducing new sUAS into the market daily. Enabling the warfighter to utilize this cutting edge technology in the field and in support of base-defense is essential to DoD operations and countering this threat. Performance of this development requires unique labor, tools, parts, and software; often solutions need to be urgently fielded to meet the needs of the warfighter."*

The US DoD expressed similar concerns, *"However, DOD has long noted a gap – sometimes called "the valley of death" – between its development and its acquisition communities that impede technology transition. For example, the acquisition community may require a higher level of technology maturity than the development community is able to produce. For prototypes that a military department expects to eventually transition to a new or existing acquisition program, it needs to identify a transition partner that can support the further development of the new technology. To support transition, the Army developed a detailed plan describing schedules and stakeholder roles to build supporting activities around the use of directed energy weapons and early capabilities documents. However, while the Navy fielded several directed energy weapon prototypes and identified a potential transition partner, it does not have documented transition agreements for the directed energy programs that GAO reviewed. The Air Force has not consistently prioritized establishing transition partners, which makes planning for future transition even more challenging. Without these transition planning steps, the Navy and Air Force risk developing directed energy weapons that may be misaligned with operational needs."*

In this Feature, we take a snapshot of international developments in C-UAS policy, strategies and technologies over the past year to demonstrate the ongoing and growing threat of small and large Unmanned Air Systems.

International Policies, Laws, Industry Collaborations, and Research

December Developments

- South Korea to spend $440m until 2027 to counter North Korea drones.
- Threat posed by drone swarms highlighted in recent national defence act passed by Congress.

February Developments

- US Army seeks C-UAS industry whitepapers to support Technology Gateway event

- US Army seeks C-UAS capability as part of its PGS personal weapon system

March Developments
- EUROCAE, RTCA meet to align standards for non-cooperative counter-UAS detection systems
- UK moves to next stage in delivering Project Synergia C-UAS systems to military bases
- Market Forecast publishes counter drone market and technology forecast to 2030
- Securiton Germany and D-Fend Solutions collaborate to deliver drone detection in Germany
- Authorities in Israel permitted to close lower airspace for drone operations accompanied by UTM services
- Thales and French start-up Drone XTR link to offer C-UAS and UTM services
- European Commission requests industry feedback to a drone threat communication
- Dubai Police & RAFAEL Collaborating on C-UAS Security
- US STRIKEWERX held industry workshop in May to address counter small UAS challenges
- What is the Best Drone Defeat Technique?
- North Dakota announces additional BVLOS waivers, promotes C-UAS research
- European security agencies developing common methodologies for C-UAS protection of U-space/critical infrastructure

April Developments
- Japan expands counter drone capability with new electronic warfare unit
- The U.S. Department of Homeland Security (DHS), Office of Procurement Operations (OPO) issued a Request for Information (RFI) on behalf of the DHS Science and Technology Directorate (S&T), Office of Mission and Capability Support (MCS)
- US DHS Security Secretary raises concerns over UAS threat, calls for greater oversight
- The RAF is currently considering developing a centre of excellence for C-UAS expertise
- The Dubai Civil Aviation Authority (DCAA) has issued a new law
- The European Commission's Counter-UAS package is taking shape
- The Office of the US Under Secretary of Defense – Defense Digital Service (DDS) issued a request for information on supporting counter-UAS systems acquisition. Deadline for responses in May 3, 2023

May Developments
- The FAA announced members of its UAS Detection and Mitigation Aviation Rulemaking Committee

June Developments
- Germany's DLR aerospace centre launches C-UAS Demonstrator r
- CEN workshop COURAGEOUS
- Germany's DLR aerospace centre launches C-UAS Demonstrator research project, tests neutralisation
- On June 5th the US Senate Commerce, Science, Transportation committee considered widening C-UAS mitigation authority

White Papers and Research
- Counter-drone laser weapons still limited compared to other C-UAS systems
- Counter drone market predicted to rise by USD1.6bn at a CAGR of 25% from 2023-2028
- The Blighter Surveillance white paper, Multi-Mode Radar
- US GAO report: directed energy weapon technical maturity levels still lagging
- Lack of drone detection equipment contributes to rise in prison drug deliveries

July Developments
- C-sUAS Demo Returns to Yuma Proving Ground
- Counter drone market report details technology and systems
- CEN workshop to develop standardised test methodology
- Colombian Defence Ministry seeks C-UAS systems
- EASA adopts M2 Means of Compliance
- UK CAA invites feedback on proposal for remote pilot competency
- DGCA India and EASA to cooperate on AAM
- European ECHO project delivers ConOps for higher airspace ready for validation
- RoK to Introduce Anti-Drone Defense System at Key Military, Gov't Facilities
- Germany's bi-annual market study identifies growth in drone detection and commercial drone usage
- USAF hosts multi-national C-UAS exercise in Qatar
- India's border with Pakistan sees over 50 drone incursions in first six months. Counter-UAS systems and policies
- Robin Radar collaborates with Marduk Technologies
- USAF C-UAS branch seeks industry information on small UAS common operating picture
- European Parliament wants more regulation of emerging drone sector
- ICAO invites states to link enacted UAS regulations to ICAO UAS Toolkit

Kinetic and Laser C-UAS Defeat Solutions

January Developments
- Epirus wins $66m Army contract for drone-frying Leonidas microwave kit

March Developments
- Airobotics completes acquisition of Iron-Drone and launches new counter drone system
- Kawasaki Heavy Industries unveils high-energy laser C-UAS

April Developments
- *"Russian airships could play an important counter-UAS role in future conflicts"*
- Finnish study simulates use of drone swarms as effective counter measure against hostile swarms

May Developments
- Electro Optic Systems (EOS) has launched its Australian made counter-drone capability, named the "Slinger", at its manufacturing facility in Canberra

April Developments
- RI&S' HELWS taps NASAMS air defence system to destroy drones
- Japanese firms release prototype counter drone high-energy laser weapons
- US Army to Mount High-Energy Laser on Infantry Squad Vehicles to Destroy Drones
- US Army short-range air defense laser prototypes take down drones at Yuma

May Developments
- In May Diehl Defence reported that it has demonstrated the interoperability of its IRIS-T SLM ground-based air defence system – including a counter drone capability – in NATO's recent Joint Project Optic Windmill (JPOW) exercise
- EOS gave more information on how its Slinger counter-UAS ammunition can work in an urban environment

June Developments
- USMC want $200m for powerful drone-killing machines
- Northrop Grumman is continuing its partnership with the U.S. Army
- Non-Kinetic C-UAS Defeat Solutions

May Developments
- L3Harris launched its Operationally Deployed Counter-sUAS Capability
- Dedrone launches cloud-based City-Wide Drone detection system for remote C-UAS
- AI-driven: Autonomous C2 threat prioritization on one screen

June Developments
- Dedrone Defense Launched DedroneTactical

Radars, Thermal Imagers, Displays Software and Sensors

February Developments
- Operational Solutions Ltd reports release of a new Drone Alert Service (DAS) product
- Milanion combines Skylock C-UAS with Agema UGV amphibious vehicle for mobile solution
- SIGN4L unveils new mobile C-UAS solution
- DroneShield and Pierce Aerospace Partner, Integrating Advanced Remote ID and C-UAS Technologies

- T. Radar Pro launched a lightweight, cost-effective and with very high performance

March Developments

- Operational Solutions: New Drone Alert Service enables cost-effective situational intelligence
- Blighter Surveillance Systems was awarded a contract to supply its Multi-Mode A800 3D e-scan radars to Raytheon UK
- Aerial Defence announces small, lightweight counter drone detector with ATAK integration
- Toshiba unveils long-range detection radar
- Bluvec Technologies launches ADS-B based detection and tracking system. Canadian C-UAS company Bluvec Technologies has announced the launch of a new feature to the RF Blusensor
- Aerial Defence announces small, lightweight counter drone detector with ATAK integration

April Developments

- Rheinmetall unveils its new AMMR: a state-of-the-art radar for C-UAS, SHORAD and VSHORAD applications
- BAE Breaks New Ground With Successful Test of its Multiple Object Tracking Radar
- Teledyne FLIR, part of Teledyne Technologies Incorporated, has announced continued momentum within its Thermal by FLIR
- MARSS completes experiments with UK MoD
- Teledyne FLIR helps to keep airspace surrounding Swedish critical infrastructure free of drones
- Observation Without Limits' new GA7360 3D radar *"can detect Phantom 4 drones at 2.25-2.5 km."*

May Developments

- ANRA Technologies has integrated Echodyne's radar data
- Echodyne and Supernal Partner on Next-Generation Radar Solutions
- ESG Elektroniksystem- und Logistik-GmbH and CONTROP Precision Technologies integrated CONTROP's EO/IR camera systems in ESG's ELYSION
- DroneShield began the rollout of a major update to the DroneSentry-C2 platform
- OpenWorks demonstrated it optical sensor SkyTrack is compatible with Robin Radar's drone detection radar IRIS
- UAVOS launches new AI software for automated object recognition and tracking
- Singaporean company TRD unveiled its new Orion-Ship system at IMDEX 2023
- UAS Denmark International Test Center announced the acquisition of a XENTA surveillance radar from Weibel Scientific
- German Defence Ministry the Bundeswehr is procuring counter-UAS (C-UAS) SMASH fire control sights for the G27P
- Through new partnerships with Echodyne, Squarehead and CommTech (TCIIECS), Chess Dynamics has added Electronically Steered Array (ESA) 4D radar
- Hidden Level Inc. was selected by the US Department of Defense (DOD) to receive USD10m in funding
- MARSS completed the second Site Acceptance Test (SAT) for its flagship 5-year, $50m multi-site programme
- Poland's Chopin Airport to implement Advanced Protection Systems' counter drone solution

June Developments

- Laser Anti-Drone Weapon Successfully Tested on French Air-Defense Frigate
- Leonardo presents its Kronos Grand Mobile High Power radar
- Elbit Systems unveils new electronic warfare capability to counter drone threats
- US Marine Corps to add L-MADIS counter drone system
- MARSS moved into Canada, as Federal Fleet Services obtains NiDAR Command and Control and counter drone systems for installation on Asterix
- Anduril Industries partnered with Japanese firms to advance APAC
- European defence companies conclude successful TALOS laser trials
- SMARTSHOOTER to present its SMASH Hopper LRCWS integrated with RPS-42 MHR Radar at MDM
- Thales and Robin Radar announce multi-year global framework agreement
- USMC to add L-MADIS counter drone system
- Elbit Systems unveils new electronic warfare capability to counter drone threats
- British Army to Get New C-UAS Capability

July Developments

- *"Cheap resin adhesive can protect drones/missiles from laser air defences"*
- Laser Weapon System from Raytheon UK to include Cambridge Pixel technology
- DroneShield Ltd (ASX:DRO) (DroneShield or the Company) is has commenced the release of a major firmware update applied to its global fleet of counterdrone (C-UAS) devices
- European defence companies conclude successful TALOS laser trials
- US Army takes out one-way attack drones in desert demonstration
- Spain's TRC launches updated Cervus III C-UAS
- HYUNDAI WIA *"successfully trials non-lethal air burst C-UAS munition technology"*
- Private equity firm Artemis buys C-UAS company SightLine
- MyDefence introduces wearable direction finding mode
- US defence department tests MITRE-developed counter drone phone app CARPE Dronvm
- Robin Radar collaborates with Marduk Technologies
- Singapore to install 50 AeroSentry Zero remote ID sensors
- High Lander collaborates with Robotican

(Sources: C4ISR & Networks; Armada; airforce-technology.com; AMR; Emirates News Agency, Middle East AI News; www.unmannedairspace.info; BUSINESS WIRE; PR Newswire; UAS VISION/ Defense News Early Bird/https://www.thedefensepost.com/ C4ISR & Networks).

Below is a synopsis of the Feature which can be found in full

https://battle-updates.com/c-uas-systems-a-year-in-perspective-by-julian-nettlefold/

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The Pelican Effect

By Julian Nettlefold

Visitors and Exhibitors to this year's IDEX Exhibition in Abu Dhabi, may have noticed subtle changes in the traffic, parking and transport arrangements, taking the taxi and bus stations away from the Exhibition area.

In addition, as we understand, the whole IDEX Exhibition area was ringed with Counter-UAS systems including Patriot. Sources suggest that a Royal Palace was hit by a sUAS last year with no casualties reported. Another source suggested that the sUAS penetrated the C-UAS defence as the operator his the sUAS in a flock of Pelicans.

This development in the ability of all types of UAS systems, which we discuss in this special issue of BATTLESPACE, puts the spotlight on an issue we have discussed over the past years, that is the requirement for high-definition displays to allow operators to locate and destroy targets at long range. The current range of militarised civil 8 bit displays do not have the required definition to locate these targets once the video of the target is compressed. Several companies such as MARSS and Anduril are using AI systems linked to the C-sUAS systems to give better target recognition and range to track the target.

In 2019, to demonstrate the benefit of the 10 bit display, which although more expensive to buy, are in fact the equivalent cost to an 8 bit display if the initial higher costs are amortised over the period of the contract, American Panel, now part of Mercury Communications, paid on a sensor capability trial at the British Army's Armoured Trials and Development Unit (ATDU) at Bovington, Dorset, UK.

The UK MoD's DE&S initial reaction was to say that the current war plans are based on a target range of 5kms based on the North German Plain model, that was before the advent of the sUAS threat and the requirement for detection at least 12kms. There is also the sunlight readable requirements required for operators in hot climates such as the Middle East and Asia.

In June 2019, American Panel completed the sensor capability trial at ATDU, following a month long trial of its advanced vehicle display at the British Army's Armoured Trials and Development Unit (ATDU) at Bovington, Dorset, UK.

The results showed a clear benefit of the 12 bit display Vs. 8 bit.

A next generation of thermal imaging sensor to display capability was successfully trialled at ATDU over the period 10-28 Jun 19. This new capability included a latest generation 10-bit capable Thermal imaging sensor from TECNOBIT (TNB) that streamed live 10-bit video feed with a specific gamma rate correction setting to a 10-bit capable (American Panel Corporation (APC) and Kent Modular Electronics (KME) display. This capability not only transforms the user experience by furnishing the commander with feed that is easier to interpret; but crucially also enabling the commander to Detect, Recognise and Identify (DRI) targets and objects at far greater ranges than with the legacy, 6 or 8-bit capability on the in-service Remote Weapon Station (RWS).

By using these enhanced capabilities, the commander will be able to effect at greater ranges too – particularly in the new era of vehicles and weapon load modularity. This capability will enable simpler and faster changes of weapons systems (both direct and indirect) on a single multi-weapon mount, giving

commanders true variety and choice to their tactical capability.

Aim

4. The aim of the trial was to:

a. Determine the Detection, Recognition, Identification (DRI) capabilities of a 10-bit video input display.

b. Undertake comparative testing against a current in-service Remote Weapons System (RWS) 6›8-bit based thermal imaging sensor and matched video viewing/control screen.

c. Understand the benefits of the TNB HD sensor (10-bit) when used in conjunction with the APC / KME screen display (10-bit).

d. Showcase the combined capability to key UK MoD and Defence Industry personnel.

Jamie Boulet of American Panel, now DRS, said, *"The development of longer range EO/IR sensors has required MoDs and industry alike to look at a range of advanced displays to accommodate the images displayed at longer range. This is particularly important to avoid collateral damage involving civilians and blue-on-blue strikes. Our unique 10 bit technology, which has already been chosen by General Dynamics on the M1A2 Sep V3 main Battle Tank, provides this solution. The ATDU trail was undertaken on the basis of an 8 bit Vs. American Panel's 10 bit display. The results exceeded even our expectations."*

Conclusions

American Panel believed that the trial was successful in proving that in comparison to the legacy in-service RWS, the trialled system appears to have exceeded existing crew DRI capability and provides a much clearer picture at all distances. This new DRI capability is believed to surpass anything in current service with UK Land Forces. As a result, this step change means that crews should no longer have to rely on additional assets to DRI, at greater ranges. It is worth noting that while the appetite for collateral damage remains very low, the increased detail afforded by these enhanced capabilities, allows the operator to make better informed decisions on engagements, and in so doing reduces the risk of using imperfect identification information, especially in time-critical situations.

The Local Situational Awareness enhancement afforded by this system will aid operations across the whole mounted fleet; and will undoubtedly reduce the risk of fratricide on own, friendly or civilian elements by increasing Positive Identification ranges and certainty, thereby enabling greater (and more certain) prosecution of targets in low and no light.

It should be noted that this alignment display of thermal imaging and 10-bit video systems was only a first step in determining what is possible today. It is recommended that further testing both in controlled lab conditions and in an operational context could provide valuable information and further insight into delivering more precise identification and the potential for engagement.

IEE Displays

IEE displays are a key component in a Counter-UAS security strategy of detection, identification, tracking, and defeat. Modern advanced sensors, radars and other detection technologies enable the early warning and accurate identification of potential drone threats. IEE provides a line of operator console displays with resolutions of Full-HD, Ultra-HD and 4K that match the latest high resolution sensors and cameras, while still being able to operate in harsh outdoor fielded environments. For example, IEE's 13.3 inch Full-HD display is fit for use in both airborne and military ground vehicle applications with it's rugged sealed enclosure.

"High-resolution displays in combination with artificial intelligence algorithms can be used to analyze data from sensors, cameras and other sources to accurately differentiate between an actual threat and other flying objects," remarked Steve Motter, V.P. of Business Development for IEE. *"These detection algorithms, combined with object recognition, and high resolution imaging, allow the operator to quickly review and validate the detected potential UAS threat – leading to effective, informed Counter-UAS responses. IEE has continued the development of several new high resolution, rugged displays. We are actively aligning our design efforts with the (worldwide) MoD/DOD objectives of Modular Open Systems Approaches for next generation vehicle system architectures. This includes open standards for digital video streaming, high speed (secure) digital communications/ networking, and low-latency configurable video processing."*

13.3-inch FHD Display Description

This full-HD display (1920 x 1080) is LCD bonded with high-strength cover glass, including EMI shield, heater and anti-reflective/glare treatments. The LED backlight enables both sunlight readable and night (NVIS compatible) modes. The narrow bezel has eight backlit soft keys, and is optimized for side-by-side mounting to provide a panoramic view. The video interface includes 2x Composite NTSC/PAL and 1x 3G-SDI.

Below: *IEE 13.3 Inch HD Video Display 2022 (IEE).*

"We are seeing increased requirements for replaceable bezels," said Steve Motter, V.P. of Business Development for IEE. *"There are many benefits for this feature, but mostly, repairable bezels reduce disruptive and expensive downtime, and reduce the need for the costly replacement of the entire display."*

Repairable bezels for rugged displays are important for durability, cost-effectiveness, longevity, flexibility and maintainability. Below are two IEE displays with replaceable bezels.

10.1-inch WUXGA Multi-Function Display (MFD)

The 10.1" MFD utilizes of a high performance, heavy-duty, full color, very high bright WUXGA AMLCD. Designed for fixed and rotary wing airborne applications, this very wide viewing angle display features a selectable dual-mode LED backlight for sunlight readable daytime operation and NVIS-compatible operation for night. A programmable 8-way joystick and encoder knobs complement the bezel keys to provide a full-featured operator interface supporting the control of a wide range of applications.

Product Features:

- 10.1" WUXGA, (1920x1200) color TFT LCD display
- Brightness: 1,100 cd/m2 typical
- Contrast Ratio: 800:1
- Video Interface: 2 x DVI-D, 2 x HD-SDI (loop-through)
- Communication Interface: RS-422
- 13 programmable bezel push-buttons, with tactile feedback and NVIS filtered backlight
- Replaceable Bezel
- On-screen display (OSD) functions controlled using Bezel Keys
- 3-way rotary switch for OFF/NIGHT/DAY, one brightness encoder, two programmable dual-concentric encoders and one 8-way joystick

6"x8" Rotorcraft Multi-Function Display (MFD)

This dual-mode, high-bright and NVIS 10.4" LCD display is lightweight, and has a rugged sealed enclosure fit for airborne applications. With its redundant digital video and ARINC-429 communication interfaces, along with its extensive built-in test, this display provides the rugged performance necessary for demanding environments. The field-replaceable bezel assists the warfighter in maximizing operational availability for improved readiness.

Product Features:

- Enhanced, High Bright 10.4" XGA (1024x768) LCD Display
- Chemically strengthened cover glass with EMI Filter and anti-reflective/glare (AR/AG) treatments
- Dual-mode LED backlight with selectable high-bright day (sunlight readable) and night (NVIS compliant) modes
- Sealed NVIS Backlit Bezel with 24 Push Buttons and 4 Rocker Switches
- Replaceable bezel
- Video Inputs: 2x DVI-D
- Control Interface: 3x ARINC-429, RS-232/422

ScioTeq's Family Of Displays

A counter-UAS system operator may be operating remotely in a command centre or they may be co-located with the sensor in support of deployed operations; either way it is important to provide them with equipment that will function reliably in their environment. This may mean that a ruggedized display for use inside a vehicle or within a mobile command centre is the best solution. ScioTeq is a leading manufacturer and supplier of commercial-off-the-shelf (COTS) trailblazing displays to the international defense and aerospace markets. For over 30 years ScioTeq has led the introduction of new technologies in defence display development and manufacturing.

ScioTeq's latest entrant into the rugged display market is the Thinlite 4K family of displays. This family of products offer field deployable, survivable 4K low latency displays, which provide a critical advantage in counter-UAS identification. With sensor packages, such as cameras, incorporating much higher resolution capabilities in order to take advantage of the data they capture, higher pixel displays are needed, and thus the move to 4K. 4K displays (UltraHD 3840 x 2160 resolution) have more pixels per centimeter than 2K or standard displays, so their images contain more identifiable data, especially on smaller detected targets.

The Thinlite 4K displays provide pixel perfect clarity in an MIL qualified package and the highest level of clarity and sharpness, ensuring minimal delay between the instrument and the operator's eyeball.

The resulting low latency brings the displayed images into real time more realistically. This can allow an operator to positively identify a detected object earlier and at a greater range. Earlier identification provides a longer window of opportunity to interdict the UAS if required to do so, as does utilizing a sensor to display line with minimum latency.

Additionally ScioTeq displays allow *"picture within picture"* images which are tiled within the master image but, on a ThinLite 4K, these sub-pictures are of higher resolution than traditional displays. This greatly improves operator awareness.

The introduction of Thinlite 4K UltraHD displays provides a field deployable display that matches or exceeds the resolution of other sensors deployed to counter UAS.

"We have seen increasing growth in the utilization of high definition displays in aiding the detection & identification of aggressor autonomous systems and ScioTeq has responded, as we always do, to our Customer's needs." Said Klaas Peerlinck, Vice President of the ATC, Defence & Security Business Unit of ScioTeq bv.

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