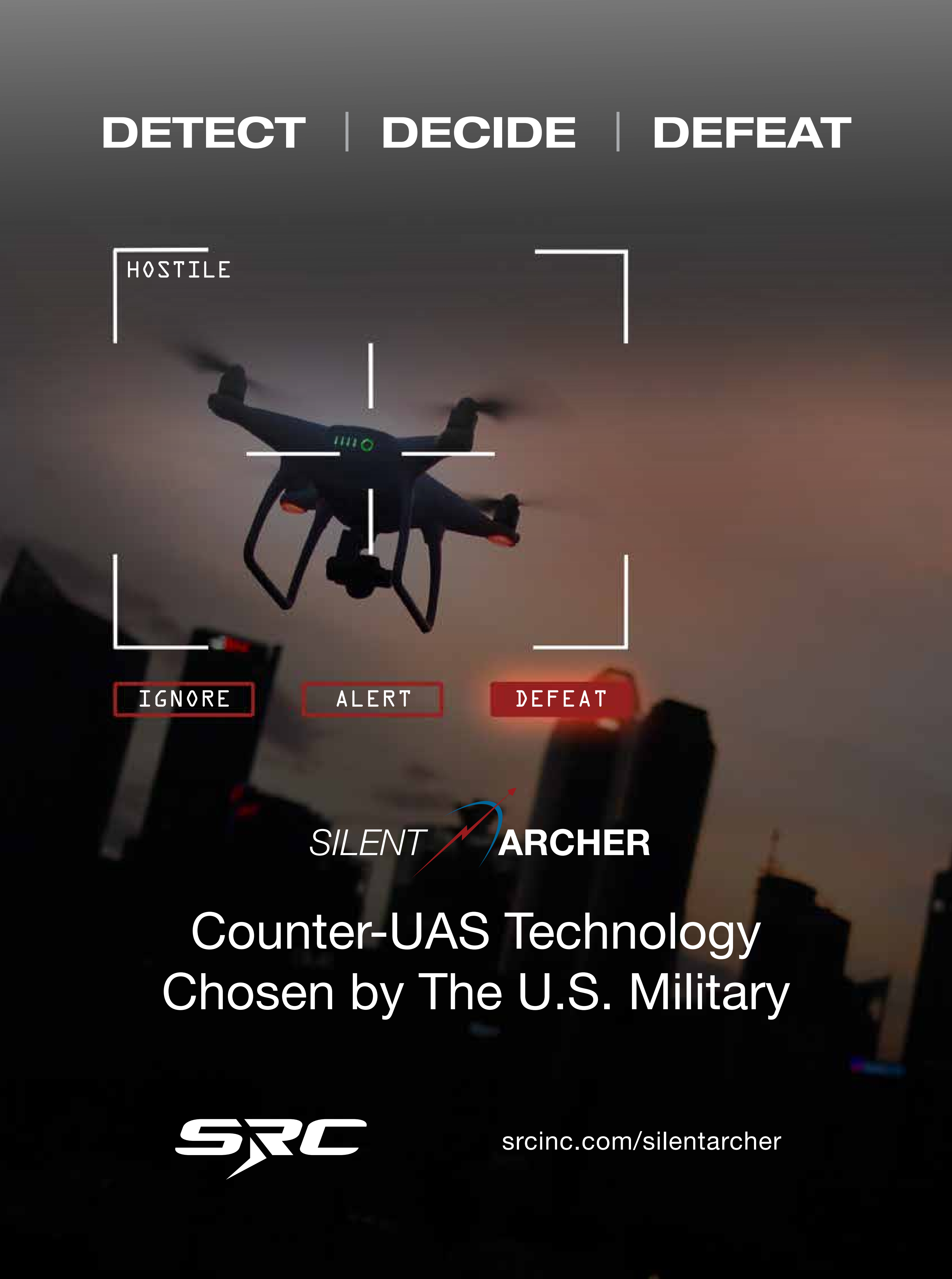
THE TRUSTED SOURCE FOR DEFENCE TECHNOLOGY ANALYSIS

ARMADA INTERNATIONAL

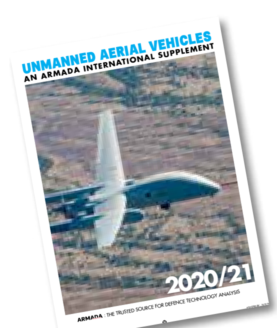
JUNE/JULY 2020. Issue 03.

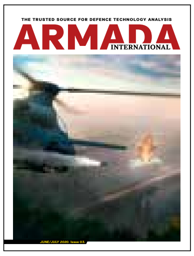

DETECT | DECIDE | DEFEAT
HOSTILE
IGNORE
ALERT
DEFEAT
SILENT ARCHER
Counter-UAS Technology
Chosen by The U.S. Military
SRC
srcinc.com/silentarcher

JUNE-JULY 2020

CONTENTS

www.armadainternational.com





ON THE COVER:
The Bell 360 Invictus (cover photo) has been selected along with Sikorsky's Raider-X to compete for the final contract to build FARA, the US Army's Next Generation attack helicopter.

THE TRUSTED SOURCE FOR DEFENCE TECHNOLOGY ANALYSIS

ARMADA INTERNATIONAL

Volume 44, **Issue No.3**, JUNE/JULY 2020

Published bi-monthly by Media Transasia Ltd.
Copyright 2012 by Media Transasia Ltd.
Publishing Office: Media Transasia Ltd., 1603, 16/F, Island PL Tower, 510 Kings Road, Hong Kong

Editor-in-Chief: Andrew Drwiega
General Manager: Jakhongir Djalmetov
International Marketing Manager: Roman Durksen
Digital Manager: David Siriphonphutakun
Sales & Marketing Coordinator: Wajiraprakan Punyajai
Art Director: Hatsada Tirawutsakul
Production Executive: Wanlaya Thiangrungreung
Circulation Officer: Yupadee Seabea
Chairman: J.S. Uberoi
President: Egasith Chotpakditrakul
Chief Financial Officer: Gaurav Kumar

Advertising Sales Offices

FRANCE/SPAIN
Stephane de Remusat, REM International
Tel: (33) 5 3427 0130
E-Mail: sremusat@rem-intl.com

GERMANY
Sam Baird, Whitehill Media
Tel: (44-1883) 715 697 Mobile: (44-7770) 237 646
E-Mail: sam@whitehillmedia.com

UK
Zena Coupé
Tel: +44 1923 852537, zena@expomedia.biz

NORDIC COUNTRIES/ITALY/SWITZERLAND
Emanuela Castagnetti-Gillberg
Tel: (46) 31 799 9028
E-Mail: emanuela.armada@gmail.com

RUSSIA
Alla Butova, NOVO-Media Ltd,
Tel/Fax: (7 3832) 180 885 Mobile : (7 960) 783 6653
Email :alla@mediatransasia.com

USA (EAST/SOUTH EAST)/CANADA (EAST)
Margie Brown, Blessall Media, LLC.
Tel : (+1 540) 341 7581
Email: margiespub@rcn.com

USA (WEST/SOUTH WEST)/BRAZIL/CANADA (WEST)
Diane Obright, Blackrock Media Inc
Tel : (+1 858) 759 3557
Email: blackrockmediainc@icloud.com

INDIA
Sanjay Seth
Global Exposures
Tel: +91 11 466 96566 Mob: +91 9818 697279
Email: sseth.globex@gmail.com

TURKEY
Zeynep Özlem Baş
Mob: +90 532 375 0046
Email: media@oz-ist.com

ALL OTHER COUNTRIES
Jakhongir Djalmetov
Media Transasia Limited
Tel: +66 2204 2370, Mobile: +66 81 6455654
Email: joha@mediatransasia.com

Roman Durksen
Media Transasia Limited
Tel: +66 2204 2370, Mobile +66 83 6037989
E-Mail: roman@mediatransasia.com

ABC

Controlled circulation: 26,050 (average per issue) certified by ABC Hong Kong, for the period 1st January 2018 to 31st December 2018.
Printed by Media Transasia Ltd., 75/8, 14th Floor, Ocean Tower II, Soi Sukhumvit 19, Sukhumvit Road, Bangkok 10110, Thailand.
Tel: 66 (0)-2204 2370, Fax: 66 (0)-2204 2390 -1

Annual subscription rates:
Europe: CHF 222 (including postage)
Rest of the World: USD 222 (including postage)

Subscription Information: Readers should contact the following address: Subscription Department, Media Transasia Ltd., 75/8, 14th Floor, Ocean Tower II, Soi Sukhumvit 19, Sukhumvit Road, Bangkok 10110, Thailand.
Tel +66 2204 2370 Fax: +66 2204 2387
Email: accounts@mediatransasia.com

INDEX TO ADVERTISERS

THIS MONTH ON ARMADAINTERNATIONAL.COM

IRANIAN NAVY FRIENDLY FIRE INCIDENT

The Islamic Republic of Iran Navy frigate Jamaran opened fire on one of its own warships, the Konarak on 10 May causing numerous casualties. The IRIN naval vessel was accidentally hit by a missile fired during naval exercises in the Gulf of Oman, killing 19 sailors and wounding 15 others. The Islamic Revolutionary Guard Corps quoted that the vessel has been towed to port.

NEW TOOLS FOR NEW THREATS

The US Marine Corps is reorienting its focus to near-peer rivalries in the Asia-Pacific. Its electronic warfare capabilities will need to follow suit. Published this March the US Marine Corps' (USMC) Force Design 2030 study details how the corps will reorient its posture from focusing on violent extremism in the Middle East and Central Asia, a core mission since the attacks on New York and Washington DC on 11th September 2001, towards its increase emphasis on near-peer competition and the Asia-Pacific. As the document states, the USMC is returning to its core role of projecting power in the littoral.

FIRST GLOBALEYE ARRIVES INTO UAE ON SCHEDULE

On Wednesday 29 April the UAE Air Force took delivery of its first Saab GlobalEye Swing Role Surveillance System aircraft which had been flown from Sweden the previous day. The GlobalEye is based on a Bombardier Global 6000 business jet airframe with Saab's new Erieye Extended Range Radar incorporated.

UK GOVERNMENT DELAYS INTEGRATED SECURITY, DEFENCE AND FOREIGN POLICY REVIEW

During the Queen's Speech on 19 December 2019, the Government announced plans to conduct an Integrated Security, Defence and Foreign Policy Review. Heralded as "the most radical reassessment of the UK's place in the world since the end of the Cold War", the review promised to "cover all aspects of international policy from defence to diplomacy and development".

Editorial

THE VIRTUAL GLOBETROTTER

As a defence journalist, one of the main frustrations of this COVID-19 blight on the world is not being able to attend a variety of briefings, conferences, exhibitions and airshows, at home and abroad, and the networking that goes with it.

I realise that this sentiment probably applies to the vast majority of those reading this, but it is during these trips that new technologies are seen and explained, new trends are observed and discussions take place with people who know a heck of a lot more about their individual subjects than I ever will. Some talk on the record, some off, but it is this continual chatter from one location to the next that allows the media to keep pushing forward their knowledge and understanding of defence in all of its forms.

That said, one of the (few) good things about lockdown has been the rise of virtual conferences hosted by the organisers of the regular conferences that have now been cancelled. This has meant that I have been able to dial into a range of defence topics that were not on my original travel plan, or budget, to cover. This has been convenient for the speakers as well, for having planned their specialised subjects in advance, they too can dial in and make a full presentation from the comfort of their home or office.

As the Editor-in-Chief of *Armada International* and its sister publication *Asian Military Review*, I have to take a 60,000 foot view across all of defence, trying to make sure that I know a little of what is going on in most sectors. That usually means attending the big defence shows that often cover several areas - such as DSEI in London, Eurosatory in France and AUSA in the United States - balanced with some international airshows such as those in Dubai in the UAE, Singapore and others on an ad hoc basis when there is a compelling reason to attend.

The strength of the magazines main content lies in its subject matter expert writers who focus on their particular areas of interest, whether land or naval warfare, aviation, special forces or some who have a deeper understanding of technology. These specialists often see their own peers at specialist sector defence events, although naval experts tend not to go to airshows, and aviation gurus would shy away from land warfare expos.

So back to my point, in the last month I have virtually attended a wide range of special forces presentations hosted by the organisers of SOFIC, an event set to be held in Florida; a comprehensive run-down of US Army and US Navy Program Executive Officer presentations on the development and acquisition of rotorcraft for both of those services, organised by the Vertical Flight Society and destined for Montreal, Canada; and today's foray took me into the world of Future Armoured Vehicles Weapon Systems. an SMI event which would have been staged in the UK. The key was that I virtually dipped in and out of those that took my interest, and did not have to invest time that I did not have and money beyond my budget travelling to each location.

My ultimate point is, pre-coronavirus the volume of similar events being staged around the world was reaching unsustainable levels. Every country wanted its own 'me too' event. The lockdown and collapse of international travel has hit 'pause' on this event merry-go-round. Looking ahead, travel will take time to recover to early 2019 levels - and not nearly as convenient as before. National COVID-19 breakouts may also suddenly affect countries preparing to host an event.

Defence event organisers, especially the smaller ones, may only be able to stay in the game for the next few years if they embrace virtual participation. But the speakers will have to be good, and the entry price for virtual delegates reasonable.

ANDREW DRWIEGA,
Editor-in-Chief

TRANSFORMING THE ROYAL AIR FORCE

Air Marshal Andrew Turner, Deputy Commander Capability provides an insight into the intellectually driven ASTRA - the plan to transform the Royal Air Force by 2040

By Andrew Drwiega

ASTRA will transition the Royal Air Force into an organisation as modern and as adaptable as its F-35B Lightning IIs.

How do you transform an institution like the Royal Air Force (RAF), steeped in history and awash with legends - both in terms of aircraft and those who flew them?

Honouring the past is an important responsibility for any organisation, especially one that is actually credited with saving the nation from invasion during 1940. In the immortal words of Winston Churchill: "Never was so much owed by so many to so few."

The danger however, is remaining anchored in tradition at the expense of transformation. Air Marshal Andrew Turner, Deputy Commander, Capability, leads on energizing and delivering the Next Generation Royal Air Force through 'ASTRA' – not a project, but more a journey than anything else. "ASTRA envisages the world around 2040 - beyond current financial planning and policy time frames – where our thinking can be unconstrained, we can be genuinely creative and we can design from origin the likely nature of the environment and types of operation we might be asked to act in. When seen through a series of five year stepping stones back to today, and the realities of the world and warfare we face every day, we can chart a clear path to follow" he explains.

As commander of capability, Air Mshl Turner has a strategic vision that breaks away from how the development of the RAF has traditionally been managed, and instead will modernise it along civil corporate lines. What this means is bringing its philosophy into the 21st Century.

Air Marshal Andrew Turner is Deputy Commander (Capability) in the Royal Air Force and fully behind the delivery of the Next Generation of his service.

To date, he says, the RAF has generally followed a path of "strategic planning by replication, primarily orientated around equipment. Essentially we have adapted whilst in contact, often with the enemy. For much of my career this has largely led to the replacement of old stuff with slightly newer and invariably more expensive and therefore slightly less stuff than before."

CHANGE OF EMPHASIS

"Astra is not focused on equipment, but the world and the challenges we will face," explains Air Mshl Turner. He comments that the increasingly complex environment that the RAF must operate in could lead to "satellite dogfights" (as an increasing number of nations can launch their own satellites), biological threats (now made more real by the current experience with coronavirus - but also including deliberate acts such as that in Salisbury), and the rapid march of technological development.

He identifies five different impetuses for change:

1. Warfare is changing the future of which will be increasingly less kinetic: "traditional norms –laws, are being circumvented for advantage by our adversaries. We are facing a very threatening re-orientation of the world and it is important for us to move as it changes.
2. As ever, government wants more capability from the Defence budget - a persistent requirement to get more capability – more from our equipment, not more equipment.
3. The public will want more from us – more presence in more places.
4. Our Service people naturally and reasonably want more, not only modern equipment, but also different terms of service, modernized support arrangements and a focus on the NetZero agenda.
5. And we must harness the fast-moving technological advances for our benefit.

The Global Strategic Trends, a document that describes a strategic context for the UK government to allow it to develop long term plans, strategies, policies and capabilities, is one example of rapid change. "This is its 17th year and it is already on Edition 6," says Air Mshl Turner. "We have been unable to predict the rate of technology change in the world." He adds that traditional budget horizons (and mechanisms such as the *Strategic Defence and Security Review*) have been set in five year timeframes, but such is the pace of emerging technology that it emerges and is accessible well within these timelines.

ASTRA will get after all of this, not through doing the impossible and predicting the future, but through a persistent journey of looking well ahead, drawing on widely developed insights and plotting a pathway of concepts, people needs, equipment modernisation, as well as support and infrastructure over time. The challenge is considerable says Air Mshl Turner, with around 233 different projects already identified, aggregated into 30 programmes of work. "The real challenge is what do you do first," he notes.

CEREBRAL RESTRUCTURING

"The conceptual journey is about rebuilding the Air Force 'brain'. We need to confront questions to inform choice before the answers are needed," says Air Mshl Turner. The plan is to ensure all of the places where that deep intellectual reflection and thought is conducted are joined together and that we draw on the mass to develop more, which is where the sum will be

greater than the parts. He sees the RAF reaching out not only to its own academic base in staff colleges, but also to Fellows in Oxford and other universities, as well as Defence institutes and think tanks such as the Royal United Services Institute (RUSI) and International Institute for Defence Studies (IISS).

An understanding needs to be formulated and frequently revised on matters such as the future way that warfare will be fought, the development of new command structures, and the change in what modern deterrent measures will work. "How do we defeat an enemy without shooting; how agile is the force to new threats, particularly to the home base; how do we view our approach to warfare through the information advantage lens; how do we defeat and win in space without effecting the UK's infrastructure and way of life." Around 70 big, hard questions have been identified so far, he says.

But ASTRA is intended to turn reaction into preparation: to plan where the RAF needs to go rather than reacting to what is demanded. To this end, Air Mshl Turner says that an academic board has been formed, will meet several times each year and, with a prioritised list of subjects, will drive the academic analytical development of the RAF into the future. This work will feed the four main focus areas that will drive ASTRA forward: people, equipment, training and support.

The whole way in which service personnel are treated and developed needs a new construct, states Air Mshl Turner. It is multi-directional: "We want to reset our offer, getting out of the 1930s environment where we have 68 branches and trades, and move those into something like 10 professions. There needs to be more opportunity for people to move around the organisation without leaving."

He notes that the flexibility and remuneration offered by industry needs to be matched if people are to be attracted to the service and retained over the long term. He adds that there also needs to be "a more flexible relationship with industry to allow personnel to move in and out of the organisation, as they will be civil qualified which will make transitions easier. We have called this developing the 'zig-zag' career."

PROFESSIONAL RECOGNITION

"For a long time our people have not been 'tradesmen' with all of the historical connotations of that word, and nor do we need a separate term for officers from the other ranks. Instead, we want to refer to all of our people through the lexicon of a profession; it's what they deserve" he states. "Basically this means grouping previous trades and branches together under one profession, adjusting training to allow people to re-skill more quickly and then adjust their terms of service to generate the real fluidity/liquidity in workforce that we need to confront adversaries long into the future". In this way he describes a specialist computer operator who could be controlling a satellite, running battlespace, driving the sensors on a drone, analysing intelligence images or running air traffic control, all of whom would come under one 'umbrella' profession. According to Air Mshl Turner, "there are currently around 14 branches/trades that currently cover those activities and it is really difficult to move between each one."

There is also scope to significantly change the working structure for RAF employees, with similarities to the civil employment contract, which would include more flexible working conditions. "People may want a career break or time off for paternity; I am very interested in allowing people to be more flexibly employed and move towards a more Full Time Equivalent approach," says Air Mshl Turner. "We want to aim at having two categories of people - regular and reserve (which would replace the eight titles that describe those two functions at present."

"We also want to treat people more as individuals, as in the civilian world, not as cohorts. We are not a huge organization - around 30,000 people – so this should not be difficult". Air Mshl Turner cites the considerable benefits of serving in the forces: in addition to the basic salary (which may initially seem lower than in the civil world), there is accommodation, pension, access to medical services, food, and a wide variety of activities, all of which would carry their own costs in civvy street. However certain areas are in need of improvement, especially basics such as regular hot water and heating, and wifi.

He admits that some of our personnel systems are in need of significant improvement: "We need to move into personnel applications on phones to manage our personal business, we have 90 different allowances where we should have 3, and many more things besides".

EQUIPMENT

New technology, as ever, is on the way. But this is not the type of replacement churn mentioned earlier. Unmanned continues to expand into new areas with the advent of loyal wingman and cloaking UAVs; cognitive warfare and the control of information and further expansion into space based

Old RAF trades/branches will become professions, such as computer based systems operators from air traffic controllers to UAV sensor operators.

"We need to move away from rote learning towards more learning at the front line and more skills taught on-the-job," states Air Marshal Turner.

systems. The challenge now is not to have volume, but to have data and intelligence led strategies.

As Air Mshl Turner recalls: "When I joined the AF we had 38 fleets of aircraft - Vulcan, Victor, Domini, Bulldog, etc – each fleet of which had roughly 100 aircraft, today we have 48 fleets on average around 10 aircraft or so. By way of example – we have 18 different helicopter types, 14 different ISR platforms and eight different airlift platforms. The capital invested in synthetics, training, logistics, management, airworthiness as so on across each fleet is significant, but when aggregated is enormous. So we need to rationalise our fleets, become more multi-roled in those that we retain and drive up the availability of each. Through this approach, we will be able to deliver more from the equipment we have got. This is essential if we are to meet the challenges I set out at the beginning". He is calling for a reduction in the number of fleets, but with an emphasis on those that remain will have greater utility and versatility. "If we go from 48 to let's say 20 fleets and we double front line availability, from the current 40-50 per cent to 80-90 percent, we will increase our capacity and capability in every area". If we connect this to more and better synthetics for training, better through-life support (like Chinook TLCS or TyTAN), we will be in a completely new place and fit and ready for the rigours and challenges of contemporary operations".

TRAINING AND ESTATE

"This needs an absolute revolution," states Air Mshl Turner. With over 5,500 people in some form of school, college or academy, we need to move away from rote learning towards more learning at the front line and more skills taught on-the-job. "We need to move from our current 17.4 percent of our people in some type of training institution to around seven percent."

In terms of the RAF's main base facilities, Air Mshl Turner considers that there is much to recapitalise and change. More secure employment would allow more people to own their own homes, with spouses being able to hold down employment without the worry of continual displacement.

Finally, Air Mshl Turner is thinking about Net Zero, and the RAF's contribution towards global warming. While some may doubt how a fighting force can achieve this, he points to daily achievements that could be made outside of conflict. The use of anaerobic digesters, solar panels on hangers, wind generation (obviously away from runways), and an examination of offsetting JetA1 aviation fuel, or even working towards an alternative eco-friendly fuel. There is a clear path towards a NetZero RAF, but we just need the right academic underpinning, partnerships and investment and we can play our part in this important national and Global endeavour.

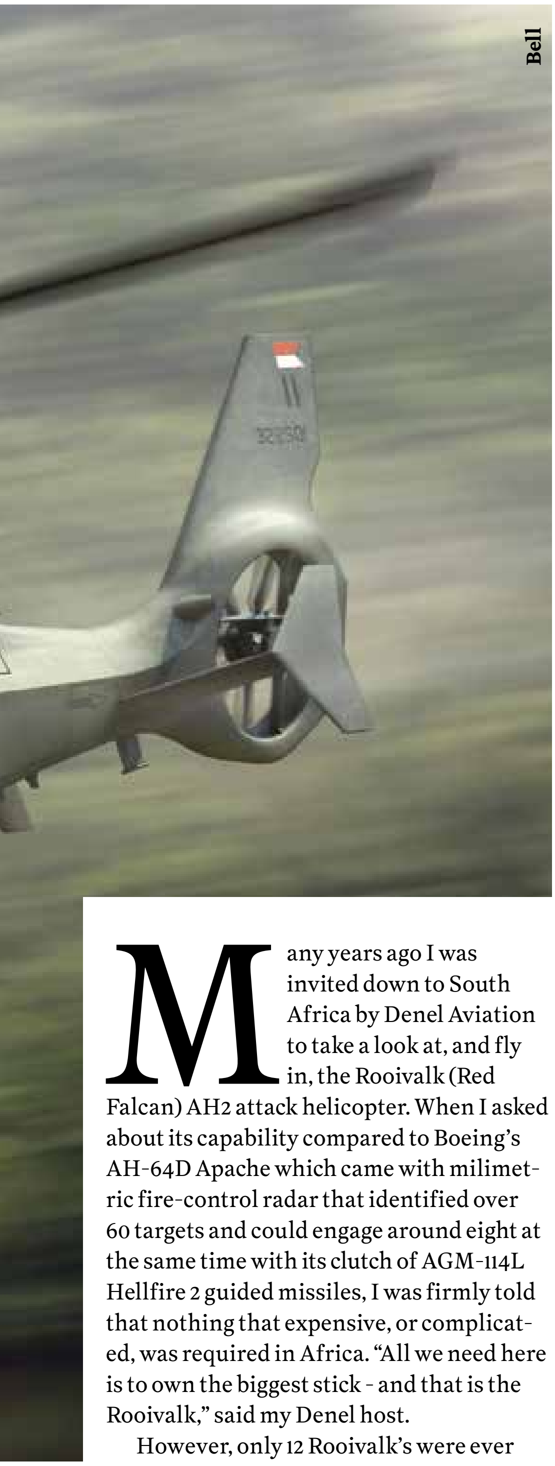
As Air Mshl Turner embarks on the Astra journey it appears that the all-encompassing scope of the challenge is daunting. But it one that needs to be done. Norms in all walks of life are changing. We have only to recall how the coronavirus has changed the world in a few short months. The world is revolving around data and technology - and the management of both which requires smart, informed and well-motivated people. *Per ardua ad astra* never had a better literal meaning.

The Bell 360 Invictus is the company's offer to meet the US Army's Future Attack Reconnaissance Aircraft (FARA) competitive prototype programme.

A NEW, DATA DRIVEN BIG STICK

Manned attack helicopters still have a future thanks to their ability to network. But will this tranche of new and updated machines be the last of their line?

By Andrew Drwiega


Bell

Many years ago I was invited down to South Africa by Denel Aviation to take a look at, and fly in, the Rooivalk (Red Falcan) AH2 attack helicopter. When I asked about its capability compared to Boeing's AH-64D Apache which came with milimetric fire-control radar that identified over 60 targets and could engage around eight at the same time with its clutch of AGM-114L Hellfire 2 guided missiles, I was firmly told that nothing that expensive, or complicated, was required in Africa. "All we need here is to own the biggest stick - and that is the Rooivalk," said my Denel host.

However, only 12 Rooivalk's were ever delivered to the South African Air Force (SAAF) and their main claim to fame was the deployment of three Rooivalk's to support United Nations operations in the Democratic Republic of Congo in 2013. They seldom were called on to wield that stick.

Today's in service 'big sticks' are all well known, ranging from modern versions of American-made helicopters that first cut their teeth during the Vietnam War including Boeing's perennial AH-64 attack helicopter and Bell's AH-1 family, through to Russia's ubiquitous Mi-24/35s and more modern Ka-52s and Mi-28s. In terms of the modern era, Europe got in on the act with the Airbus Tiger, Leonardo AW129 Mangusta and not forgetting the Asian Hindustan Aeronautics' Light Combat Helicopter and China's AVIC Z-10.

Despite the plethora of unmanned aerial vehicles muscling their way onto the aerial stage, and the changing expectation that warfare will be more 'peer-to-peer' next time, manned attack helicopters look set to remain for the next few decades, although they will be increasingly absorbed into the battlefield network 'of things', and are increasingly standing-off targets so that their manned-unmanned teaming (MUM-T) buddies can press home the attack in high threat areas.

The success of manned attack helicopters dominating the battlefield during the asymmetric wars in Iraq and Afghanistan may have been the high point in this type of warfare. During the Cold War, helicopters armed to attack then Soviet tank formations that would have been coming over the forward line of defence (FLOP) were thought to have a one-way mission, such were the low expectations for their survival. What should be expected from the attack rotorcraft of the future?

THE FUTURE IS FARA

The US Army's search for two Next Generation helicopters, the Future Attack Reconnaissance Aircraft (FARA) and Future Long Range Assault Aircraft (FLRAA), has reached another milestone, which is looking beyond the prototyping of two flying technology demonstrators.

Dan Bailey, Program Manager for the FARA Competitive Prototype, said that the US Army's goal has been "to fly before we buy." Speaking during the Vertical Flight Society's virtual Forum76 on Wednesday 20 May, Bailey said that the focus has been on developing the air platform prototypes and open systems digital backbone, and feed that work into the establishment of a programme of record.

In terms of what the FARA will be expected to deliver, the Army's Future Vertical Lift Cross Functional Team divided performance and operational characteristics into what was 'required' and what was 'desirable.'

Highlights in the former category include the General Electric T901 Improved Turbine Engine (ITE) which will deliver more power that existing engines, limiting the size of the rotor diameter and aircraft width, limiting gross weight, speed matched with the reach that is required, and a Modular Open Systems Approach (MOSA) to the integration of sub-systems.

Bailey said that the process was in a final design phase which will lead into "a go/no-go decision later this year at final design point will be reached at the end of the year with the intention to built the air vehicle sometime in 2022."

There was an evaluation at the beginning of the year and two contenders emerged. Bell's Invictus 360 is a single main rotor with a ducted tail rotor and is visually conventional but it is a compounded aircraft with a wing. Said Bailey: "They are focusing on simplicity and low drag and have learned a lot of lessons from the Bell 525 Relentless commercial aircraft. All the aircraft are fly-by-wire. They are past a sub- and full up-system PDR [Design Review] level and on the way to the final design and on schedule."

Sikorsky/Lockheed Martin has produced the RaiderX, a fourth generation design. "They have worked on the Raider S-97 and through JMR-TD there was the flying aircraft called the SD.1 Defiant. The RaiderX is the scaled up version of the S-97 but has lessons learned from earlier co-axial prototypes that are being incorporated into the design enhancements. The RaiderX is again based on a compound design, has a six-bladed rotor system and has passed PDR level design and is on track for flight test in November 2022."

Colonel Gregory Fortier, the FARA Program Manager's first comment was that FARA "it not your grandfather's acquisition programme. New military helicopters, and fighters for that matter, have a history of laborious development with escalating costs, whereas FARA has had an aggressive development timeline. Given previous slow development times for rotorcraft, the intention with FARA is to conduct the down-select in 2024, reach Milestone C (the end of Engineering and Manufacturing Development (EMD) and begin initial production) by 2028 and have the first unit equipped (FUE) by 2030.

APACHE NOT READY FOR SUNSET

For the foreseeable future, and well past the proposed FARA FUE date, that old war horse Boeing's Apache AH-64s will still be flying. The latest version is the AH-64E

Boeing's stalwart AH-64 Apache will further future proof with the E model, Version 6 upgrade.

Guardian Software Version 6 upgrade and Boeing's TJ Jamison, an retired Army Apache pilot and now director, Vertical Lift International Sales, believes that this will continue to helping Apaches keep flying through continual modernisation until around 2060.

During a briefing on 12 May, Jamison stated that in the AH-64E V6, the fire control radar (FCR) has been improved which has doubled its range from eight kilometres to 16km. Although the current weapons onboard cannot range out that far, by using its Manned-Unmanned Teaming-Extended (MUMT-X) range capability it would be able to vector other armed UAVs - or fighters - onto any target at range with a non-line of sight remote shot.

The software updates now mean that Apache V6 will operate more effectively in the maritime by detecting smaller targets at greater range, and can eliminate some of the surface clutter that can give false readings, as it can do with smaller UAVs.

Jamison stated that the Apache E is the only attack helicopter in the world with the Link 16 secure data link which allows it to integrate with any other Link 16 holding asset allowing it to share targets and data to all within the same Joint Fires Network. It can also exchange data over Soldier Radio Waveform (SRW) allowing direct comms and date with soldiers on the ground.

The Apache is also the only attack helicopter with both Modernised Target Acquisition Designation Sight/Pilot Night Vision Sensor (PNVIS/MTADS), with each crew member being able to use either crew member to fly or conduct target acquisition and prosecution. With a new ITE engine and improved resilliance, the Apache has a secure future with the US Army as well as an impressive collection of foreign customers.

TIGER PADS ON

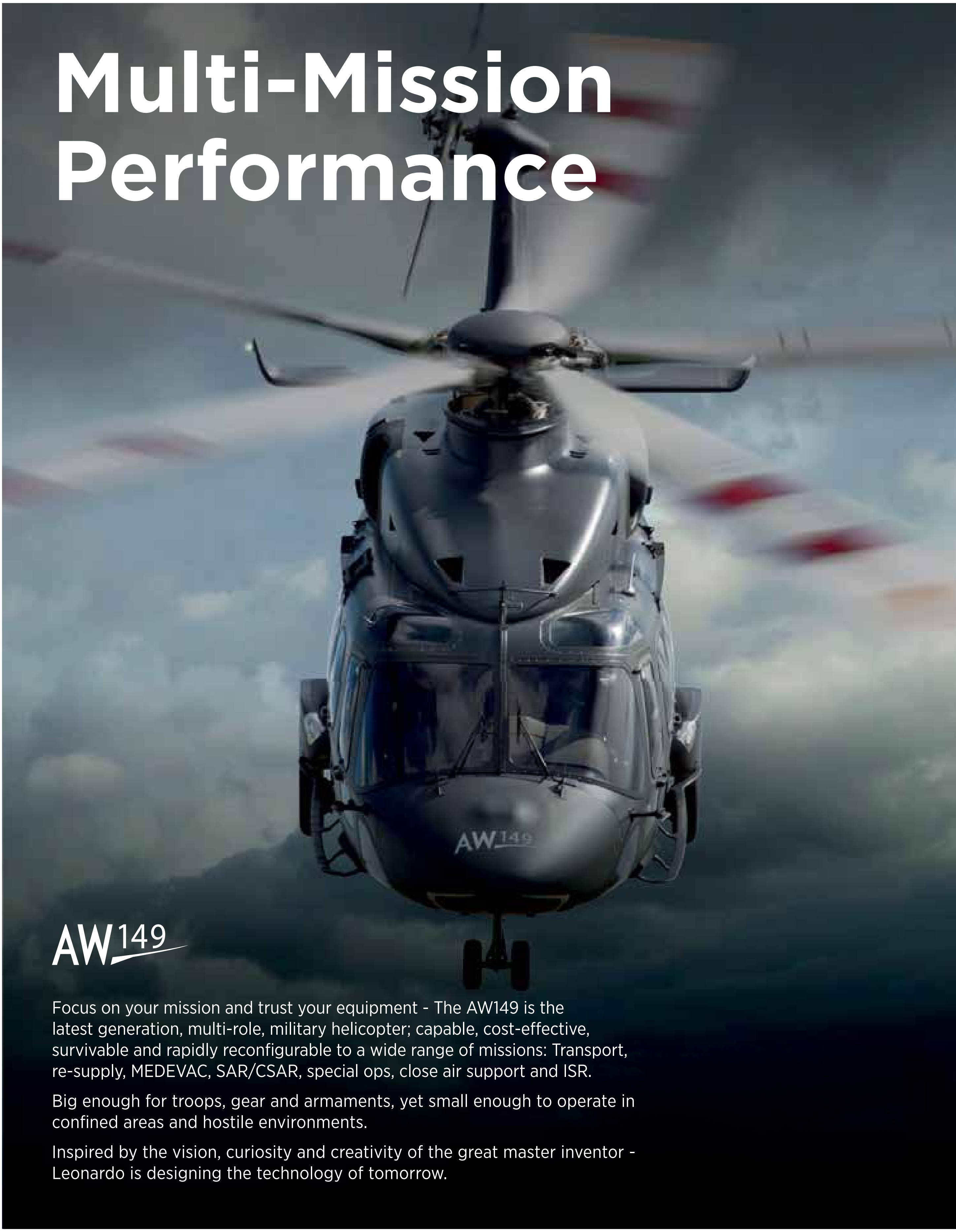
In December 2019, the Airbus Tiger attack helicopters in service with the French German and Spanish armed forces jointly benefited from a long term support agreement signed by Airbus Helicopters and European intergovernmental OCCAR (Organisation for Joint Armament Co-operation).

An Airbus statement revealed that the contract "covers critical items such as continuous improvement and obsolescence treatment as well as securing repair and spares capabilities with all vendors involved."

A Tiger Mk3 upgrade is in the making, with OCCAR examining new developments and upgrades to the helicopter's avionics, mission, and weapon systems. Thales and MBDA are contributing to these studies.

Airbus states that 183 Tigers are in service with the three European nations as well as Australia, although the latter is currently in the process of deciding whether to replace its fleet of Tiger Armed Reconnaissance Helicopters (ARH) with an alternative attack helicopter. The Australian Army is looking at its military rotorcraft fleet long term and particularly at the developments of FARA/FLRAA in the US. The question of whether to upgrade the existing ARH or acquire a new attack helicopter will depend on the result of the process triggered by the Commonwealth of Australia's (CoA) Request for Information (RFI) for the Project LAND4503 Armed Reconnaissance Capability. The CoA will judge whether a Tiger upgrade offered by Airbus is better than buying a new helicopter type, and how long the in-service life of the ARH capability will be until its replacement by a Next Generation aircraft begins around 2035-2040.

Andrew Mathewson, Airbus Australia Pacific managing director told Armada that improvements to the supply chain and the way that the ARH is embedded in defence and local industry will be a cost effective bridge for the 22 aircraft towards a


Multi-Mission Performance
AW149
AW149
Focus on your mission and trust your equipment - The AW149 is the latest generation, multi-role, military helicopter; capable, cost-effective, survivable and rapidly reconfigurable to a wide range of missions: Transport, re-supply, MEDEVAC, SAR/CSAR, special ops, close air support and ISR.
Big enough for troops, gear and armaments, yet small enough to operate in confined areas and hostile environments.
Inspired by the vision, curiosity and creativity of the great master inventor - Leonardo is designing the technology of tomorrow.

new aircraft. "We can save the Government more than $2.1 billion (AUS$3 billion) by retaining Tiger in service and extending its life out to 2040," said Mathewson. He added that the Australian Army were now much more satisfied with the Tiger, now that it is reaching typically a 93 percent of planned missions achieved rate.

However, Airbus has been hit hard as a corporate entity over the last few years and this, together with the impact of the coronavirus on business may well temper plans to fully modernise a relatively small fleet of helicopters, and prospects for further international customers for Tiger have not looked positive for many years

Russian Helicopters

The Kamov Ka-52 is a relatively new attack helicopter from Russian Helicopters. The Russian Defence Ministry reportedly requires 114 Ka-52Ms by the end of 2022.

TAKING IT FORWARD

The development of a successor to Leonardo's AW129 Mangusta attack helicopter was triggered in 2017 by the Italian Army. Although Leonardo offered the option of a new airframe at that time as option, the Army opted for an upgrade to take it through to the type's out-of-service date expected around 2025.

The Army has made use of its attack helicopter operationally, deploying the AW129 to a variety of countries including Iraq and Afghanistan as part of a multinational force on both occasions, and as an element of United Nations missions to countries including the Republic of Macedonia, Somalia and Angola.

From the initial fleet of 60 A129s, 45 are still in service. The current Italian Army fleet is coming to the end of an upgrade programme which will deliver an improvement to the type's endurance, speed, situational awareness, and information-handling capabilities. This upgraded version has been designated the AH-129D which will remain in service until its successor is ready. This upgrade saw the integration of the PCO Toplite electro-optical system with Rafael's Spike air-to-surface missiles (which are also incorporated into the 'make'do' upgrade of Poland's current Mil Mi-24 fleet until the Kruk requirement is fulfilled.

The AW249 will not be a newer version of the AW129, but will be "a completely new design leveraging lessons learnt designing, developing, producing and introducing into service the AW129 and its entire life-cycle and operational experience in Italy and abroad," according to a Leonardo spokesperson.

The AW249 will be a heavier aircraft, up to eight tonnes, three tonnes heavier than the AW129. This will allow it to deploy with a wider range of mission systems, fuel and weapons. it will also feature open architecture which should lead to greater potential for collaboration between avionics and mission systems suppliers.

In July 2018 a joint announcement was made between Leonardo and Polish company PGZ (Polska Grupa Zbrojeniowa) over the intent for both to potentially collaborate over the design, manufacture, final assembly and through-life support for the AW249. The Polish angle is particularly important as the Polish Ministry of Defence could be a potential customer for its Kruk attack helicopter requirement of 32 new helicopters to replace its legacy Mil Mi-24s.

"The collaboration between Leonardo and PGZ, particularly through PZL-Swidnik, would allow Polish industry to access up to 40 percent of the contractual

Leonardo

Leonardo is developing the AW249 to succeed the AW129 in the Italian Army, as well as offering it for Poland's Kruk attack helicopter requirement.

value," said the Leonardo source. If the company can keep the development costs low with an uncomplicated specification the new AW249 may have a market among countries who want medium complexity at an affordable price.

SYRIAN LESSONS LEARNED

Russian Helicopters will always have its main customer, the Russian Federation to rely upon for orders. The company has made headway in trying to 'internationalise' its appeal and modernisation matched with trade deals woven by state corporation Rostec that are made financially appealing to foreign customers.

In December 2019, Russian Helicopters announced that it had delivered "over 20 attack helicopters" to the Russian Defence Ministry which met the contracted number for that year.

On 26 December, Aviation Cluster Industrial director of the Rostec State Corporation Anatoly Serdyukov stated: "This year, the [Russian] forces have received Ka-52 Alligator reconnaissance and strike helicopters, transport and combat helicopters Mi-35M and combat helicopters Mi-28N and Mi-28UB. In addition, we completed the delivery of the first modern Mi-28NM Night Hunter combat helicopters and by 2027 we will produce 98 such machines for the Defense Ministry."

Lessons have been learned from the international deployment of Russian forces into Syria and that experience is now being inserted back into helicopter modernisation programmes.

The latest version of the Kamov Design Bureau Ka-52 Alligator is the Ka-52M. Manufacturer Progress Arsenyev Aviation Company (AAC) is currently conducting experimental design work to further modify the helicopter to improve target location and identification. According to Russian media reports, the Defence Ministry has a requirement for 114 modernised Ka-52Ms to be delivered by the end of 2022. Although the Russian involvement in Afghanistan taught lessons in hot and high operations, that experience ended in 1989. A quarter of a century later and the Syrian deployment will have fed back much needed information regarding operational capability in a modern environment, and a significant amount of data gained from operating in proximity to NATO forces.

Russian Helicopters says that


Russian Helicopters

The Mil Mi-28MN made its first flight in October 2016 and is also being procured by the Russian Defence Ministry up to 2027.

modernisation is focusing on EO/IR technology, together with target classification and identification. Range is also under review, to provide the latest upgrades with longer endurance and weapons with improved range to engage targets on land and in the air. "Increasing the armour of the machine and updating the energy supply system are being studied cooperatively [as well as studying the] unification of aviation weapons with attack helicopters of the Mi brand."

The Mi-35P, an international version of the Mi-24P which has seen longstanding service with the Russian Army, has been in deep modernisation over the last couple of years. According to a Russian Helicopters spokesperson, testing at the Russian Helicopters' Rostvertol factory in Rostov-on-Don continues on the Mi-35P, which made its debut at the MAKS-2019 Aviation and Space Salon in Moscow.

The Mi-35P features the Shvabe OPS-24N-1L observation-sight system which provides the crew with 360-degree targeting surveillance by using four, stabilised, short-wave infrared cameras (this can also be found on the Mi-35M and and Mi-8AMTSh). Images and data are presented to the crew through four screens inside the cockpit. According to the company, the system was developed following lessons learned while Russian forces were operating in Syria. Other improvements extend to an updated piloting system which adds a greater level of control and stability, and improved target tracking capabilities.

Russian Helicopters declares that the modernisation of the Mi-35P gives it improved performance in 'hot and high' conditions, while there has also been a reduction in the complexity of maintenance. It also features the 30mm GSh-30-2K twin-barrel auto cannon.

Following a later delivery timetable comes the order from the Russian Defence Ministry for 98 of the modernised Mi-28NM Night Hunter attack helicopters by the end of 2027. The Mi-28NM first flew in 2016 and is different to the standard Mi-28N.

"The Mi-28NM has acquired a new fuselage shape, modernised engines and an auxiliary power unit, a new avionics system, advanced weapons capability, and can be operated in conjunction with unmanned aerial vehicles and ground command posts," stated Boginsky. He added that its development continued to be one of the companies priorities.

Recent customers for Russian attack helicopters include the Serbian Government who received four out of a requirement for seven Mi-35Ms in December 2019.

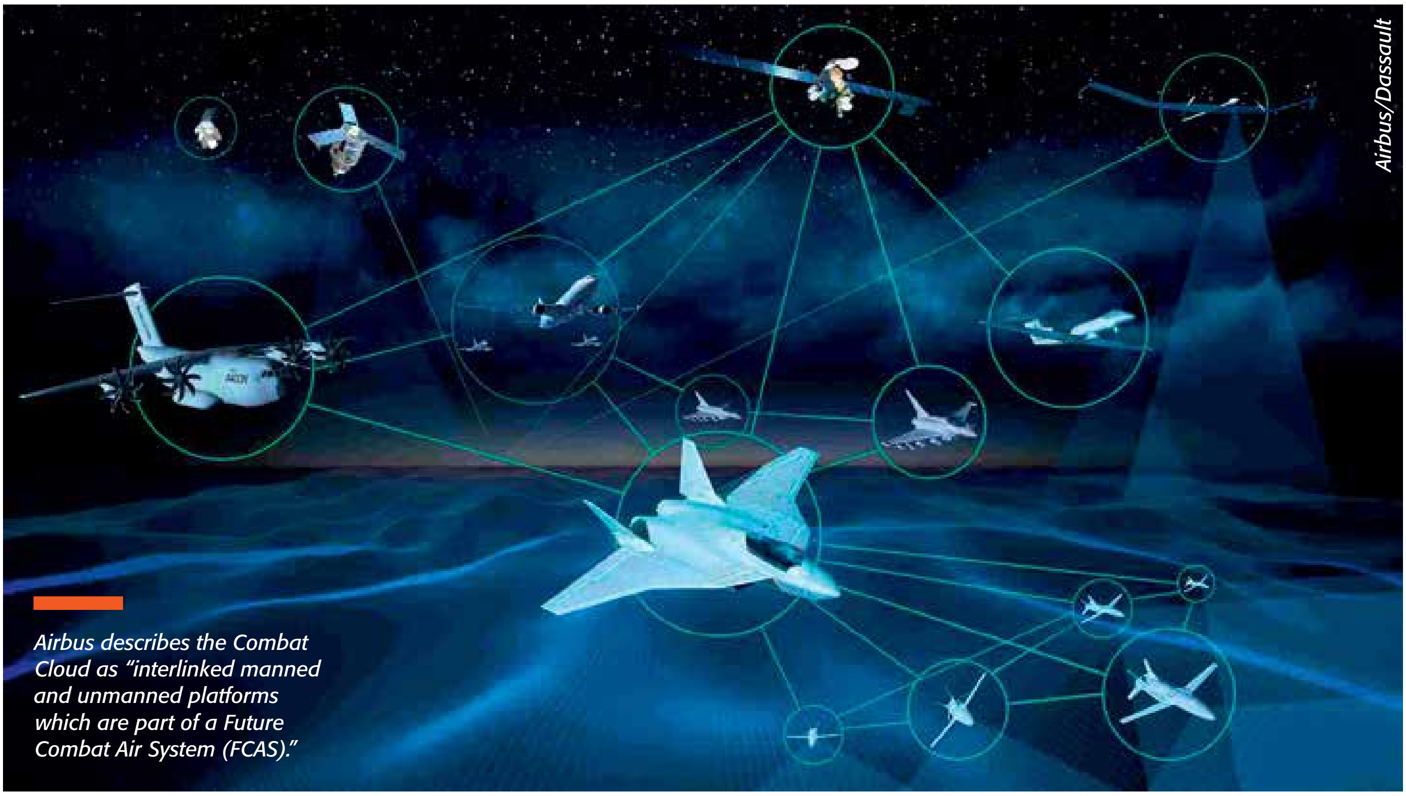
Designing new bespoke military helicopters is usually an expensive and time consuming activity, and with the world counting the cost of the COVID-19 virus - matched with the march of unmanned platforms, will this be the final crop of manned attack helicopters? 🅰

UNMANNED AERIAL VEHICLES

AN ARMADA INTERNATIONAL SUPPLEMENT

2020/21

ARMADA INTERNATIONAL : THE TRUSTED SOURCE FOR DEFENCE TECHNOLOGY ANALYSIS



Airbus/Dassault

Airbus describes the Combat Cloud as "interlinked manned and unmanned platforms which are part of a Future Combat Air System (FCAS)."

LOYAL, UNAFRAID AND UNMANNED

The role of networked unmanned wingmen closely supporting manned jet aircraft is a vision that is now being realised.

Peter Donaldson

Manned-unmanned teaming (MUM-T) is major theme of big ticket development programmes on both sides of the Atlantic among the Five Eyes (FVEY) group of countries, with the European Future Combat Air System (FCAS) and US/Australian Airpower Teaming System (ATS) taking significant steps forward in recent months.

Phase 1A of the overarching FCAS demonstration programme launched earlier this year on 12 February has Dassault as prime contractor for the manned New Generation Fighter (NGF) with Airbus as its main partner, and Airbus acting as prime for the unmanned Remote Carrier (RC) element with missile specialist MBDA as main partner.

Naturally, robust and secure networked communications are considered crucial to the concept of operations in which the manned platform will manage a diverse package of UAVs that will do the dull, dirty and dangerous work inside the engagement zone of modern Integrated Air Defence Systems (IADS).

Airbus is also serving as prime on the Air Combat Cloud (ACC) that is to provide the airborne infrastructure with reachback to home networks that will serve up tactically relevant and timely information to reconnaissance and strike packages. Thales is taking on the role of main parter on ACC.

All the companies involved in FCAS are committed to cooperation on a common simulation environment to ensure consistency between demonstrators.

REMOTE CARRIERS

As prime on the RC element, Airbus is addressing the entire scope and additionally focusing on artificial intelligence (AI) as it applies to teaming, and will also develop the medium-to-large platforms. The company has extensive experience with platforms from small to large and with teaming, having operated the Barracuda demonstrator since 2006. This vehicle has acted as a testbed for technologies and procedures to be used by the next generation of UAVs in fast reconnaissance, surveillance, targeting and Battle Damage Assessment (BDA) missions. Missile specialist MBDA is to develop the small and medium RC platforms.

As force multipliers, RCs will take on specific roles in high-risk environments and provide new capabilities in conjunction with, and coordinated by, manned air assets including but not limited to the NGF.

One particularly crucial aspect of teaming will be cross-platform mission management, allocating and reallocating tasks to different vehicles, both individually and in groups, as mission phases unfold. The idea is for the RCs

Boeing

Boeing Australia first fuselage was completed at the beginning of the year. The Loyal Wingman concept feeds into Boeing's manned-unmanned Airpower Teaming System (ATS).

to complement and augment the manned fighters, cooperating closely but with enough autonomy to improve performance in high-intensity conflicts and increase combat mass to compensate for the small numbers of sophisticated manned fighters that defence spending plans are expected to fund.

It is likely to be the RC vehicles that benefit from more radical designs, as it is easier to adopt and develop new technologies quickly with unmanned platforms than with manned ones, and types being studied include some that can be employed in expendable swarms, as well as more sophisticated groups that can take on more demanding missions with a high degree of autonomy and task sharing, prioritisation and reallocation. The scope here is broad, but one of the high level goals is to enable safer penetration of hostile airspace by manned aircraft. That is a tall order today, as Russian and Chinese IADS technology is generally believed to have the upper hand.

AIR COMBAT CLOUD

On 20 February it was announced that Airbus and Thales had joined forces to develop the ACC, and the companies are set to work together on the structural design of the communications system needed to support collaborative national and multi-national air operations and that will link the manned and unmanned assets. ACC's purpose is to connect and synchronise all the platforms and enable the processing and distribution of information to enhance situational awareness and collaborative operation, the companies explain.

The agreement represents the ACC pillar within Phase 1A of the FCAS demonstration effort, is to lead up to the early technology demonstrations intended to showcase ACC capabilities in a real world environment. Covering a period extending 18 months from signature date, it is also regarded as the starting point for further demonstrations and technology development.

Airbus has extensive experience in the development of sophisticated military aircraft for both combat and supporting roles, along with the development and integration of mission systems and weapon. The company will also bring its expertise in space systems and collaborative digital C5ISR (Command, Control, Communication, Computers,

The US Defense Advanced Research Projects Agency (DARPA) is experimenting with using a swarm of autonomous drones and ground robots to support military missions.

Cybersecurity, Intelligence, Surveillance & Reconnaissance) technologies to bear.

Design and implementation of ACC's first instantiation will be within the framework of Franco-German FCAS cooperation. Subsequently, the intention is to enlarge its scope to include national air forces at European level, should member nations decide to join the programme. Further, incremental inclusion of existing platforms and related collaborative combat capabilities is expected to combine with the NGF and RC unmanned vehicles as they come on stream to that full FCAS capability is anticipated by 2040.

LOYAL WINGMAN

February also saw Boeing Australia announce that it had completed the first fuselage for a Loyal Wingman unmanned aircraft, a concept demonstration vehicle that is to form a key element of Boeing's manned-unmanned Airpower Teaming System (ATS) effort.

Loyal Wingman is an advanced development programme being pursued jointly by Boeing and the Royal Australian Air Force (RAAF) along with an Australian industrial team. The aircraft measures 38 foot (11.7m) in its largest dimension, and digital engineering and advanced composite materials have been used by the Australian team to achieve their goals for low cost and high agility.

Team member BAE Systems Australia provided hardware kits including flight control computers and navigation equipment, while RUAG Australia provided the landing gear, AME Systems wiring looms, and Ferra Engineering various precision-machined components and sub-assemblies.

Following on from construction of this first major structural assembly, the next major milestone that must be achieve is to install the undercarriage so that the fuselage can come out of its assembly jig to continue systems installation and functional testing. Before COVID-19, the aircraft had been expected to fly for the first time this year.

This first prototype is intended to provide lessons that will feed into the development of ATS, which is what Boeing Australia is currently calling the operational aircraft it will offer to the global defence market. Boeing says that this aircraft represents its biggest investment in a new UAV outside the US and that it will provide fighter-like performance and a range of more than 2,000 nautical miles. It is also to carry integrated sensor packages to support ISR and EW missions and also to exploit artificial intelligence to operate independently or in support of manned aircraft while maintaining safe separation.

DARPA WANTS SWARMS

Other advanced capabilities under investigation include swarms of dissimilar unmanned systems, both airborne and ground based, capable of conducting military operations in urban environments. This is the subject of the US Defence Advanced Research Agency's OFFensive Swarm-Enabled Tactics (OFFSET) initiative. Under OFFSET, nine contractors are to start work on what DARPA describes as the 'fifth swarm sprint' for the programme, which envisions up to 250 collaborative autonomous systems providing insights to ground troops operating in dense, crowded towns and cities.

Key areas to be investigated under OFFSET include swarm tactics, swarm autonomy, human-swarm teaming, virtual environments and physical testbeds. As the "sprint" label implies, the intention is to foster rapid innovation and continuous incorporation of new technologies.

The fifth swarm sprint is focused on the physical testbed and swarm tactics. Organisations selected for the first include Michigan Technological University/Michigan Tech Research Institute, the Johns Hopkins University Applied Physics Laboratory, HDT Expeditionary Systems, Sentien Robotics and Texas A&M University. They are to focus on speeding up integration of hardware and enhancements to reduce swarm deployment time, introducing new navigation and perception sensors, employing fixed-wing aircraft into swarm operations, and enhancing the mobility of wheeled vehicles.

In addition to Michigan Tech, Charles River Analytics, Soar Technology, and Northwestern University are working on the swarm tactics area and are to focus on the design and implementation of new tactics using a swarm of air and ground robots, and addressing mission objectives such as to seize key urban terrain within eight square city blocks over a mission duration of four-to-six hours. According to DARPA, proposed tactics include disrupting enemy decision making, obfuscating the swarms intent, updating maps of a dynamic environment, and maintaining the swarm's communications inside buildings.

In other developments, Elbit announced $20 million worth of contracts in April to upgrade Hermes 900 MALE UAVs for Latin American customers, integrating satcom and automatic take-off and landing systems into aircraft already in service.

In April, the US Ambassador to South Korea revealed the delivery of a Global Hawk HALE UAV system to an undisclosed location, with more expected. South Korea bought four Block 30 RQ-4s in 2011.

CHINA RISING

Illustrating China's growing prowess in the UAV arena, a Chinese military website published a brief analysis of the popularity of the Predator-like Wing Loong system, which it called China's best selling armament. The 30ft (9m) long, one tonne aircraft has a 46ft (14m) wingspan and can carry two missiles under the fuselage at once. Wing Loong has been exported to more than a dozen countries in recent years, *China Military Online* said. It also expressed the opinion that the Wing Loong's competitive price of around $1 million for a single air vehicle, rising to about $3 million with the GCS, was a major reason for its success. Other Chinese UAVs, big and small, have a growing presence in the world military market.

AERONAUTICS

ORBITER 4

Span: 5.4m
Maximum take-off weight: 50kg
Range: Line of sight up to 150km comms range
Speed: 70kts
Endurance: up to 24hr
Altitude: 18,000ft
Payload capacity: Two payloads, up to 12kg. Stabilised pod with day, night (cooled IR) sensors, laser designator, COMINT, ELINT, VISINT, photogrammetric mapping (HDLite), synthetic aperture radar, maritime patrol radar, LiDAR, Automatic Identification System
Powerplant: Spark ignition multi-fuel engine
Launch/Recovery: Catapult and compact, foldable net
Remarks: Designed for shipboard and land-based applications including ISTAR, fire control electronic warfare, comms relay & ship self-defence.

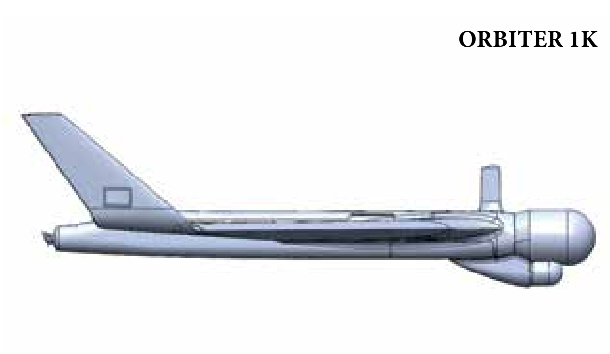
ORBITER 3

Span: 4.4m
Maximum take-off weight: 30kg
Range: line of sight up to 150km
Speed: 70kts
Endurance: 7hr (up to 100km from base)
Altitude: 18,000ft
Payload capacity: 5.5kg. Controp T-STAMP tri-sensor EO (Day/Night), cooled, laser pointer. D-STAMP: day (CCD) EO. UZ-STAMP: Night (uncooled IR). M-STAMP: Dual Day (CCD) and Night (Uncooled IR) EO. Rafael HD-Lite: Photogrammetric mapping, 3D modelling.
Powerplant: Propeller driven by an electric motor
Launch/Recovery: Cat/net
Remarks: In service with domestic & export customers. Can complete missions without GPS or datalink.

ORBITER 2

Length: 1m (estimated)
Span: 3m
Maximum take-off weight: 10.3kg
Range: 40-50km
Speed: 50kts
Endurance: up to 4hrs
Altitude: 18,000ft
Payload capacity: 1.5kg. Controp stabilised payloads including EO/IR/laser, laser designator, EO HD, Rafael HD-Lite photogrammetric mapping & 3D modelling sensor, Netline Woodpecker comms jammer, Aeronautics K-munition warhead, L3Harris comms relay.
Powerplant: Electric motor driving pusher propeller
Launch/Recovery: cat/para
Remarks: In service with domestic and export customers inc Finland.

ORBITER 1K



Length: 1m approx
Span: 2.9m
Maximum take-off weight: 13kg
Range: 100km
Speed: 30 to 70kts
Endurance: 2.5hrs
Altitude: 8,000ft AGL
Payload capacity: 3kg.
Stabilised mini dual EO\IR camera.
Powerplant: Electric motor driving pusher propeller
Launch/Recovery: cat/precision net or expendable
Remarks: Loitering munition based on Orbiter 2 MUAS.

AEROSTAR

Length: 4.5m
Span: 8.7m
Maximum take-off weight: 230kg
Range: 250km
Speed: 110kts max
Endurance: >12hrs
Altitude: 18,000ft
Payload capacity: 50kg. Options include stabilised EO/IR sensors, laser designation, synthetic aperture radars with ground moving target indication, ELINT and COMINT systems. Customers include: Israel, General Dynamics, CIS, the Netherlands & Poland.
Powerplant: Zanzottera 498i fuel injected 2-str twin, 38 hp
Launch/Recovery: conv/conv
Remarks: Tactical UAS with over 250,000 operational flight hours logged.

DOMINATOR

Length: 8.6m Span: 13.5m
Maximum take-off weight: 1,910kg
Range: LOS 300km, BLOS satcom unlimited
Speed: 150kts max Endurance: > 20hrs
Altitude:>27,000ft
Payload capacity: 373kg. Options include EO/IR and hyper-spectral sensors with laser pointer and designator, maritime radar, SAR\GMTI radars, communications relays, COMINT, ELINT, MAD etc.
Powerplant: 2 x 170hp Austro AE300 jet fuel piston engines
Launch/Recovery: conv/conv
Remarks: Operators include Mexico & Turkey. Operational in GPS-denied environments.

AEROVIRONMENT

PUMA 3AE

Length: 1.4m Span: 2.8m
Maximum take-off weight: 6.8kg
Range: 20km or 60km with long range comms antenna
Speed: 25-45kts
Endurance: 2.5hrs with an LE battery Altitude: 300-500ft AGL
Payload capacity: > 0.85kg. Mantis i45 Gimbaled payload with dual 15mp EO cameras, 50xf zoom, IR camera and low light camera for night operations, and high-power illuminator
Poweplant: battery electric
Launch/recovery: hand or rail/autonomous or manual deep stall landing
Remarks: All-environment 3rd generation Puma mini-UAS with new propulsion system making hand launch easier, enhanced sensor suite.

RAVEN

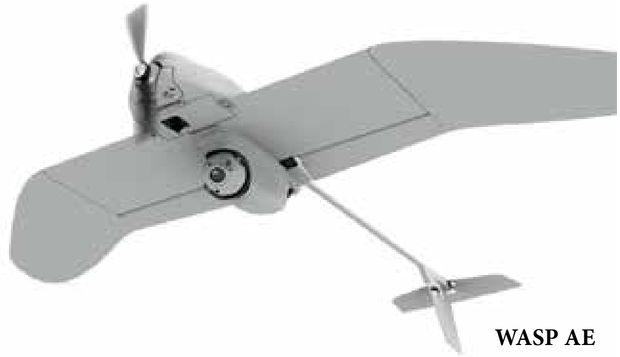
Length: 0.91m Span: 1.37m
Maximum take-off weight: 1.9kg Range: 10km comms range
Speed: 17-44kts Endurance: Up to 1.5hrs.
Altitude: 500ft AGL, 14,000ft MSL launch
Poweplant: battery electric
Payload capacity: 0.17kg. Dual forward and side-looking EO or IR camera nose with electronic pan-tilt-zoom & stabilisation.
Launch/recovery: hand/deep stall landing
Remarks: Most are operated by the US, but foreign customers have included Australia, Estonia, Italy, Denmark, Spain and the Czech Republic.

SWITCHBLADE LOITERING MUNITION

Length: <0.6m estimate Span: <0.9m estimate
Maximum take-off weight: < 2.5 kg Range: 10 km
Endurance: 15min Speed: 55 to 85kts
Altitude: < 500ft AGL, > 15,000ft MSL
Payloads: Dual front and side look EO cameras and IR nose camera. Stabilised electronic pan-tilt-zoom, Orbital ATK advanced munition warhead.
Powerplant: battery electric
Launch/recovery: tube/NA
Remarks: US Army and USMC are the primary users.

BLACKWING

Length: 45.5cm Span: 69cm
Maximum take-off weight: 1.8kg Range: 10-45km
Speed: 87kts Endurance: 1hr estimate
Altitude: < 500ft AGL
Payloads: Modular. Includes Front and side look day/night cameras, tactical data relay.
Powerplant: battery electric
Launch/recovery: Underwater-to-air delivery canister, multi-pack
Remarks: Submarine-launched ISR UAV in service with the US Navy.



WASP AE

Length: 0.76m Span: 1.02m
Maximum take-off weight: 1.3kg
Range: 5km LOS, more with DDL relay
Speed: 20-45kts Endurance: 50min
Altitude: 500ft AGL
Payloads: Gimbaled payload with pan and tilt stabilised high resolution EO & IR camera in a compact aerodynamic modular payload.
Powerplant: battery electric
Launch/recovery: hand, remote/deep stall landing in confined area
Remarks: Serves with US Army and export customers including Australia.

VAPOR 55

Length: 1.9m Span: 2.3m rotor diameter
Maximum take-off weight: 24.9kg Range: 56km
Speed: 15m/sec (speed-over-ground limit)
Endurance: 60 mins cruise, 45 minute hover
Altitude: 0-12,000ft MSL
Payload capacity: 4.5kg. Options include EO/IR sensor, lidar, hyperspectral imager, PPK mapping, drop deployment mechanism
Powerplant: electric motor powered by high-energy-density lithium polymer batteries
Launch/recovery: automated VTOL
Remarks: All-electric helicopter UAS build with military grade components.

VAPOR 35

Length: 1.941m Span: 1.7m rotor diameter
Maximum take-off weight: 14.5kg Range: 56km
Speed: 15m/sec (speed-over-ground limit)
Endurance: 1hr cruise, 45 minute hover
Altitude: 0-12,000ft MSL
Payload capacity: 2.27kg. Options include EO/IR sensor, lidar, hyperspectral imager, PPK mapping
Powerplant: electric motor powered by high-energy-density lithium polymer batteries
Launch/recovery: automated VTOL
Remarks: All-electric helicopter UAS build with military grade components.

AIRBUS

HARFANG

Length: 9.3m Span: 16.6m
Maximum take-off weight: 1,250kg Range: 1,000km
Speed: 110kts
Endurance: 12hr at 550nm from base Altitude: 25,000ft
Payload capacity: 250kg. Synthetic aperture radar with 1 m resolution, Wide-Area Surveillance (WAS) & spot modes, EO/IR turret also with WAS & spot modes, NATO-STANAG-3875-compliant laser designator, panoramic pilot assistance camera.
Powerplant: 115 hp turbocharged Rotax 914 piston engine
Launch/recovery: conv/conv
Remarks: Retired French systems acquired by Royal Moroccan Air Force.

ATLANTE

Length: 5.47m Span: 8.0m
Maximum take-off weight: 570kg Range: 200km on datalink
Speed: 108kts max, 73kts cruise Endurance: > 10hrs
Altitude: 20,000ft
Payload capacity: 100kg. Retractable HD EO/IR turret as standard, SAR/GMTI, maritime radar, environmental sensors including releasable types are options.
Powerplant: 1 x internal combustion engine
Launch/recovery: conv/conv or cat/para
Remarks: Tactical UAS certifiable to operate in segregated air space.

Length: 2.25m
Span: 3.42m
Maximum take-off weight: 161kg
Range: > 140km (on data link)
Speed: 118.8kts
Endurance: 5.5hrs
Altitude: 11,500ft
Payload capacity: 35kg. Thermal imager system (8–12 µm or 3–5 µm), 3 x fixed-focus TV cameras (6 FoV), all 3-axis stabilised. Principal operator is the German Army.
Powerplant: 24kW 2-str engine
Launch/recovery: rato, cat/para
Remarks: Tactical UAS optimised for high speed reconnaissance missions.

Length: 6.2m
Span: 7.2m rotor diameter
Maximum take-off weight: 700kg
Speed: 100kts
Endurance: 8hrs with full tactical payload 80nm from ship
Altitude: 19,600ft
Payload capacity: 100kg. Naval-grade EO system, naval tactical radar, AIS, deck finder autoland system.
Powerplant: 155hp diesel and jet fuel engine
Launch/recovery: Automated VTOL
Remarks: Shipborne unmanned helicopter designed to operate alongside other shipborne naval assets.

ZEPHYR S

Length: 7.5m estimate
Span: 25m
Maximum take-off weight: <75kg
Range: >18,500km
Speed: approx 30kts
Endurance: > 30 days
Altitude: > 65,000ft
Payload capacity: 5kg. HD Optical / IR Video, AIS, Narrowband mobile comms (e.g. Tetra), 100Mpbs broadcast
Powerplant: Solar powered electric motors
Launch/recovery: conv/conv
Remarks: Solar-electric long-endurance UAV intended as a high-altitude pseudo satellite with the persistence of a satellite and the flexibility of a UAV

ZEPHYR T

Length: 6m estimate
Span: > 32m
Maximum take-off weight: 140kg
Range: > 18,500km estimate
Speed: approx 30kts
Endurance: > 45 days
Altitude: > 65,000ft
Payload capacity: 20kg. RADAR, LIDAR, ESM/ELINT, Broadband Comms
Powerplant: solar powered electric motors
Launch/recovery: conv/conv
Remarks: Larger variant of Zephyr with greater payload & endurance.

ARCTURUS

T-20

Length: 2.87m
Span: 5.33m
Maximum take-off weight: 84kg
Range: NA
Speed: 75kts
Endurance: 20hr
Altitude: 15,000ft rated, 25,000ft proven
Payload capacity: 34kg inc fuel. Cloud Cap Technologies 200 and 400 Series EO/IR are standard options. 3-D mapping, SAR, LIDAR, communications relay, COMINT, and SIGINT systems are available. Operators include the US & Mexican navies & reportedly the Turkish government.
Powerplant: 1 x 190cc fuel-injected Honda 4-str petrol
Launch/recovery: cat/belly
Remarks: UAV with CFRP monocoque fuselage that accepts oversized payloads, wing hard points.

JUMP 20

Length: 5.64m
Span: 2.87m
Maximum take-off weight: 95.25kg
Range: 125km
Speed: 72kts
Endurance: nine to 16hrs
Altitude: 15,000ft
Payload capacity: 27.2kg inc fuel. Cloud Cap Technologies 200 and 400 Series EO/IR are standard options. 3-D mapping, SAR, LIDAR, comms relay, COMINT, SIGINT systems available.
Poweplant: 1 x 190cc 4-str engine & 4 x electric motors, props for VTOL
Launch/recovery: VTOL, cat launch option
Remarks: Arcturus aircraft family are operated by US SOCOM under the Mid-Endurance Unmanned Aircraft Systems III contract. Jump 15 is smaller variant.

ARMENIAN ARMED FORCES

KRUNK

Length: 3.8m
Span: 5m
Maximum take-off weight: 214kg estimated based on approx payload fraction of 0.28
Speed: 82kts
Endurance: 5hrs
Altitude: 15,770ft
Payload: 60kg. Operators include the Armenian armed forces, the Republic of Artsakh
Powerplant: Internal combustion engine driving pusher propeller
Launch/recovery: conv/conv
Remarks: Intended for close reconnaissance, real-time visual or IR video transmission and capturing higher resolution stills.

BAYKAR

BAYRAKTAR AKINCI

Length: 12.2m
Wingspan: 20m
Maximum Take-Off Weight: 5,500kg
Range: LOS – BLOS (Global)
Endurance: +24hrs
Cruise - Max Speed: 130- 195knots
Altitude: 20,000ft - 40,000ft
Payload Capacity: 1,350kg
Payload - ISR: EO/IR/LD, Multi-Mode AESA Radar & SIGINT
Payload - Weapons: Laser Guided Smart Munitions, Missiles & Stand Off Weapons
Powerplant: 2x450 or 2x750 hp – Twin Turboprop Engine
Launch/Recovery: Autonomous
Remarks: The Bayraktar Akinci is a strategic class platform whose unique aerodynamic design provides less drag, more stability and lower fuel consumption.

BAYRAKTAR TB2

Length: 6.5m
Wingspan: 12m
Maximum Take-Off Weight: 650kg
Range: LOS - BLOS
Endurance: Up to 27hrs
Cruise - Max Speed: 70 - 120knots
Altitude: 18,000ft - 27,000ft
Payload Capacity: 150kg
Payload - ISR: Interchangeable EO/IR/LD or Multi Mode AESA Radar
Payload - Weapons: 4 Laser Guided Smart Munitions
Powerplant: 100 hp – Internal Combustion Engine
Launch/Recovery: Autonomous
Remarks: More than 120 in service with Presidency of Defence Industries, Turkish Land Forces, Turkish Gendarmerie, Turkish Navy, Turkish Police, National Intelligence Agency and numerous foreign customers.

BAYRAKTAR VTOL UAV

Length: 1.5m
Wingspan: 5m
Maximum Take-Off Weight: 30kg
Range: 150km
Endurance: 12hours
Cruise - Max Speed: 50 - 80knots
Altitude: 15,000ft
Payload - ISR: Multi Sensor Day, Night Cameras and Lasers
Powerplant: 4x electric engine & 6 hp internal combustion engine
Launch/Recovery: Autonomous
Remarks: Bayraktar Vertical Landing Unmanned Aerial Vehicle (VTOL) is a Mini Tactical UAV class aircraft capable of land or shipborne reconnaissance and intelligence missions.

BAYRAKTAR MINI

Length: 1.2m
Wingspan: 2m
Range: 15km
Endurance: 60min
Cruise - Max Speed: 30 - 40knots
Altitude: 2000ft
Payload – ISR: Interchangeable Day & Night Cameras
Powerplant: Electric
Weight: 5kg
Launch/Recovery: Hand Launched / Parachute or Belly
Remarks: More than 300 in operational with Turkish Land Forces, Turkish Gendarmerie, Turkish Police and a foreign customer.

BLUEBIRD AERO SYSTEMS

MICROB

Length: 1.02m
Span: 1.7m
Maximum take-off weight: 2.2kg
Communication range: 10km
Speed: 40.5kts cruise, 75kts max
Endurance: up to 2hrs
Best Operational Altitude: up to 3,281ft AGL
Ceiling: over 16,000ft ASL
Payload capacity: up to 0.3kg. Dual sensor (CCD / Uncooled IR) Gimbaled and stabilised surveillance payload
Powerplant: brushless electric motor, rechargeable battery
Launch/recovery: shoulder-fired launcher/para
Remarks: Micro UAS designed to provide similar capabilities to a mini UAV in a smaller, more affordable package.

SPYLITE

Length: 1.35m
Span: 2.75m
Maximum take-off weight: 9.5kg
Communication range: 50km (standard), 80km (extended)
Speed: 32-65kts
Endurance: 4hrs
Best Operational Altitude: up to 3,281ft AGL
Ceiling: over 30,000ft ASL
Max Launch altitude: Over 16,400ft ASL
Payload capacity: up to 1.5kg. Single HD, dual or triple CCD IR and optional laser pointer gimbaled and stabilised payloads and/or optional high resolution, proprietary RGB/ multi-spectral/radiometric photogrammetric payloads for mapping.
Powerplant: brushless electric motor, rechargeable battery
Launch/recovery: auto cat/para, airbag
Remarks: Operational in Israel and by numerous international Defence, HLS and civilian customers.

WANDERB VTOL

Length: 1.79m
Span: 3.1m
Maximum take-off weight: 13kg
Communication range: 50-80km
Speed: 65kts
Endurance: 2.5hours
Best Operational Altitude: up to 3,281ft AGL
Ceiling: 22,000ft ASL
Payload: 1.35kg. Day and IR stabilised cameras, photogrammetric, multi-spectral or radiometric mapping cameras for airborne ISR or Mapping on Demand.
Poweplant: Four battery driven VTOL electric motors and one electric pusher motor for level flight
Launch/recovery: VTOL
Remarks: Mini UAS optimised to facilitate covert, over-the-hill operations or extensive, day-and-night ISR.

THUNDERB

Length: 1.9m
Span: 4m
Maximum take-off weight: 32kg
Communication range: 150km
Speed: 32-72kts
Endurance: Up to 24hrs in standard configuration, up to 12hrs in cargo release configuration, up to 15hrs on station 150km from its ground control position carrying T-STAMP
Best Operational Altitude: 6,000ft
Ceiling: 16,000ft
Payload: up to 4kg nose mounted with full fuel and additional payload under the wings, examples include Controp T-STAMP triple sensor (CCD/cooled IR/laser)
Powerplant: Advanced two stroke engine with electronic fuel injection
Launch/recovery: auto cat/para airbag, VTOL version available
Remarks: Operational in Israel and by international Defence and HLS customers. Continues mission in GPS denied environment

BOEING

UNMANNED LITTLE BIRD H-6U

Length: 9.94m
Span: 8.38m (rotor diameter)
Maximum take-off weight: 1,497kg
Range: 430km
Speed: 145kts
Endurance: about 6hrs
Altitude: 20,000 ft
Payload capacity: 635kg unmanned, 544kg manned
Powerplant: Rolls-Royce model 250 turboshaft
Launch/recovery: VTOL
Remarks: Provides over-the-horizon search, re-supply and retrograde, communications relay and surveillance capabilities

BOEING INSITU

SCANEAGLE

Length: 1.6m
Span: 3.1m
Empty operating weight: 16kg
Range: > 100km LOS
Speed: 50 to 60kts cruse, 80kts max
Endurance: > 24hrs
Altitude: 19,500ft
Payload capacity: 3.4kg. EO, EO900 (EO camera and EO telescope), MWIR, Dual Imager (EO and MWIR)
Powerplant: Obital 2-str heavy fuel (JP-5 or JP 8) 2-str engine or C-10 gasoline engine
Launch/recovery: cat/SkyHook
Remarks: Operated by USAF, USMC, USN and numerous export customers.

Length: 1.71m Span: 3.11m
Maximum take-off weight: 26.5kg
Range: 900nm (estimated based on endurance & cruise speed)
Speed: 50 to 60kts cruise Endurance: 18hrs
Altitude: 19,500ft
Payload capacity: 5kg. Options include high resolution, day/night camera and thermal imager & many others. Up to 150W onboard power
Powerplant: Orbital Argon heavy fuel (JP-5 or JP-8) 2-str piston engine
Launch/recovery: cat/SkyHook vertical wire
Remarks: ScanEagle 2 offers more payload options, rapid integration, a purpose-built engine, architecture that maximises commonality with Insitu systems.

Length: 2.3-2.5m Span: 4m
Maximum take-off weight: 36.3kg
Range: 720nm (estimate based on cruise speed & endurance)
Speed: 40-50kts cruise, 80kts max Endurance: 18hrs
Altitude: 20,000ft
Payload capacity: 9.1kg. Turret houses EO, EO900 (EO camera and EO telescope), MWIR, Dual Image EO and MWIR), 170W onboard power
Powerplant: 1 x 2-str heavy fuel piston engine burning JP-5/JP-8
Launch/recovery: cat/SkyHook vertical wire
Remarks: ScanEagle3's design doubles the aircraft's payload capacity and is compatible with existing ScanEagle payloads.

Length: 2.5m Span: 4.9m
Maximum take-off weight: 61kg
Range: 960 nm (estimate based on endurance & cruise speed)
Speed: > 90kts max, 60kts cruise Endurance: > 16hrs
Altitude: > 20,000ft
Payload capacity: 17.7kg. EO imager with 1.1°–25° optical field of view & 4x digital zoom, mid-wave infrared imager with 2°–25° field of view, laser rangefinder, IR marker. Communications relay and AIS also integrated.
Powerplant: 8 HP reciprocating engine with EFI, burning JP-5, JP-8 heavy fuels
Launch/recovery: cat/SkyHook vertical wire
Remarks: Developed for a US Navy requirement for a small tactical unmanned aircraft system capable of operating from land and sea.

Length: 2.5m Span: 4.8m
Maximum take-off weight: 61.2kg
Range: 1,320nm (estimate based on endurance & cruise speed)
Speed:> 90kts max, 55kts cruise Endurance: > 24hr
Altitude: 19,500ft
Payload capacity: 18kg. Baseline package includes EO imager, mid-wave infrared imager, IR marker, laser rangefinder
Powerplant: 2-str heavy fuel piston engine burning JP-5/JP-8
Launch/recovery: cat/SkyHook vertical wire
Remarks: Designed as a modular & flexible multi-mission UAV for land and maritime operations.

CATIC

Length: 4.2m Span: 7.5m
Maximum take-off weight: 320kg Range: 200km
Endurance: 10hrs Speed: 97kts
Altitude: 16,000ft
Payload capacity: 50kg
Powerplant: Internal combustion engine driving pusher propeller
Launch/recovery: rocket booster/para
Remarks: Medium altitude/medium endurance multi-role UAV designed for ISTAR, BDA, artillery fire adjustment by day and night in real time.

WING LOONG I

Length: 9.05m
Span: 14m
Maximum take-off weight: 1,100kg
Range: 4,000km
Endurance: 20hrs
Speed: 150kts
Altitude: 16,000ft
Payload capacity: 200kg on pylons, 100kg for sensors. Reportedly capable of launching guided bombs including the FT-10, FT-9, FT-7, GB-7 and GB-4, and the BRM1 and AKD-10 guided missiles. In service with China and export customers inc Saudi Arabia and Egypt.
Powerplant: 1 x 100 hp Rotax 914 turbocharged piston engine, pusher propeller
Launch/recovery: conventional
Remarks: Export variant developed from Wing Loong is Known as Sky Saker

WING LOONG II

Length: 11m
Span: 20.5m
Maximum take-off weight: 4,200kg
Range: 4,500nm (estimate based on 140kts cruise & endurance)
Endurance: 32hrs
Speed: 200kts max, 81kts min
Altitude: 32,500ft
Payload capacity: 480kg on external stores. Reportedly capable of launching guided bombs including the FT-10, FT-9, FT-7, GB-7 and GB-4, and the BRM1, AKD-10 and BA-7 guided missiles.
Powerplant: turbocharged piston engine
Launch/recovery: conventional
Remarks: Operational in China, Pakistan, UAE & Egypt.

DENEL DYNAMICS

SEEKER 400

Length: 5.77m
Span: 10m
Maximum take-off weight: 450kg
Range: 250km
Speed: 81kts
Endurance: 16hrs
Altitude: 18,000ft
Payload: 100kg. S400 can carry dual imaging EO/IR payloads with gimbal diameters of up to 530mn with day TV, thermal imaging, colour/monochrome spotter camera, night spotter camera. Laser illuminator and LRF, electronic intelligence payload.
Powerplant: 1 x 85hp two-cylinder, air-cooled 4-str engine
Launch/recovery: conv/conv
Remarks: Seeker 400 is an evolution of the battle-proven Seeker II UAS. Seeker 200 is a smaller variant with a 40kg payload.

HUNGWE

Length: 2m
Span: 4m
Maximum take-off weight: 35kg
Range: 100km line of sight for comms
Endurance: 6hrs
Altitude: 12,000ft service ceiling
Payload capacity: 5kg
Powerplant: Internal combustion engine driving pusher propeller
Launch/recovery: catapult/skid or conventional runway
Remarks: Small UAV with an all-composite, low-drag blended wing design.

ELBIT

HERMES 45

Length: 1.25m (estimate)
Span: 5m
Maximum take-off weight: 70kg
Range: 100 to 200km (comms limited)
Endurance: 22hrs
Altitude: 18,000ft
Payload capacity: 20kg. Payloads include EO/IR cameras, radar, ELINT, COMINT, VHF/UHF communications relay etc in a multi-payload configuration
Powerplant: Internal combustion engine driving a pusher propeller
Launch/recovery: cat/net for point landing
Remarks: Multi-Mission small tactical USA for land and maritime operations. Supports higher tactical echelon with long endurance ISTAR missions.

HERMES 450

Length: 5.7m
Span: 10.5m
Maximum take-off weight: 550kg
Range: 250km
Speed: 95kts
Endurance: 17hrs
Altitude: 18,000ft
Payload capacity: 180kg. Options include EO/IR, SAR/GMTI & maritime patrol radars plus AIS, ELINT, EW, COMINT, COMJAM. Forms the basis of the UK/Thales WK450 Watchkeeper system.
Powerplant: 1 x 52 hp UAV Engines R802/902 rotary
Launch/recovery: conv/conv
Remarks: Multi-role, high-performance tactical UAS operational worldwide.

HERMES 900

Length: 8.3m
Span: 15m
Maximum take-off weight: 1,180kg
Range: 2,500km estimate
Speed: 119kts max, 60kts cruise
Endurance: 30-36hrs
Altitude: 30,000ft
Payload capacity: 350kg. Options include Leonardo Gabianno T-200 maritime & SAR/GMTI radar, AIS, Elbit D-CoMPASS EO/IR/Laser turret, AES 210 V – ESM/ELINT, Skyfix / Skyjam – COMINT/DF & optional COMJAM system and a communications relay. Users include the Israeli Air Force, with exports to Brazil and other Latin American countries.
Powerplant: 1 × 115hp Rotax 914 4-str engine
Launch/recovery: conv/conv
Remarks: Next-generation MALE UAS equipped with a variety of high-performance sensors to detect ground or maritime targets over a wide spectral range.

HERMES 900 STARLINER

Length: 8.8m
Span: 17m
Maximum take-off weight: 1,600kg
Range: 2,500km estimate
Speed: 119kts max, 60kts cruise
Endurance: 36hrs
Altitude: 30,000ft
Payload: 450kg
Options include Leonardo Gabianno T-200 maritime & SAR/GMTI radar, AIS, Elbit D-CoMPASS EO/IR/Laser turret, AES 210 V – ESM/ELINT, Skyfix / Skyjam – COMINT/DF & optional COMJAM system and a communications relay. Users include Switzerland reported. Designed to comply with civilian airspace regulations.
Powerplant: 1 × 115hp Rotax 914 4-str engine
Launch/recovery: conv/conv
Remarks: Next-generation MALE UAS qualified for flight in and transit through civilian air space.

SKYLARK I-LEX

Length: 1.5m
Span: 3m
Maximum take-off weight: 7.5kg
Range: 40km LOS
Speed: 27-50kts
Endurance: 3hrs
Altitude: 15,000ft
Payload: 1.2kg. Stabilised EO/IR turret, delivering high-quality day and night real-time video. Advanced image processing capabilities include tracker, moving target indicator, geo-registration, and mosaicking.
Powerplant: battery electric
Launch/recovery: hand/stall-airbag
Remarks: Stealthy portable mini UAS for backpack or vehicle-based operation. Serves with IDF, NATO and other international users.

SKYLARK 3

Length: 2.5m (estimate)
Span: 4.7m
Maximum take-off weight: 40kg
Range: 100km
Endurance: 5hrs
Speed: 45-70kts
Altitude: 15,000ft
Payload: Dual payload features high resolution EO/IR gimbal is standard, options include ELINT and COMINT
Powerplant: battery electric, two-blade pusher propeller
Launch/recovery: cat/stall, airbag
Remarks: Tactical mini UAS for dismounted or vehicle operation to support division, brigade and battalion command levels.

Maximum take-off weight: 12.5kg
Range: 10km radius
Endurance: 70min
Speed: 11.6kts
Altitude: 2,000ft
Payload: 3kg. Lightweight dual EO/IR stabilised camera turret. Folding, backpack portable multi-rotor UAS with camera-guided advanced convoy mode
Powerplant: battery & 4 x electric motors driving vertical props
Launch/recovery: VTOL
Remarks: Multi-rotor mini-UAS developed for military, para-military and special operations, particularly in urban environments.

Maximum take-off weight: 2.5kg
Range: 3km
Endurance: 30 minutes
Speed: 21.5kts
Altitude: 4,000ft ASL
Payload: 350g. Incorporates dual S-Band and LTE communications and coordinate tracking capabilities, MAGNI provides day/night, 3D intelligence to manoeuvring forces.
Powerplant: battery & 4 x electric motors driving vertical props
Launch/recovery: VTOL
Remarks: Multi-rotor mini UAS designed for surveillance and reconnaissance missions and deployable in a wide range of terrains and weathers.

Maximum take-off weight: 5kg
Range: 4km radius
Endurance: 55min
Speed: 27kts max, 21.6kts operational
Altitude: 1,500ft
Payload: 0.7kg. A a range of EO and high resolution cameras is available
Powerplant: battery & 3 x electric motors driving vertical props
Launch/recovery: VTOL 10 to 1,500ft
Remarks: Ultra-light drone designed to carry a range of EO and high resolution payloads that can be deployed rapidly by a single operator.

EMT PENZBERG

Length: 2.36m
Span: 4.17m
Maximum take-off weight: < 40 kg
Range: > 80km comms range
Endurance: 6 to 8hr
Speed: 38kt cruise
Altitude: 5,000m
Payload: 1 x colour video CCD pilot view camera; wing ice monitoring camera, 3-axis stabilized modular sensor platform, downward looking colour video CCD zoom camera and MWIR imager as standard. Transponder. Serves with the German Army.
Powerplant: 2 cylinder 2-str internal combustion engine, pusher propeller
Launch/recovery: cat/para or net
Remarks: Powered glider UAS with the ability to glide without engine power with no acoustic signature and to restart the engine at any time.

Length: 3.0m
Span: 5.3m
Maximum take-off weight: 110kg
Range: > 100km digital data link
Endurance: > 12hr
Speed: 60kt cruise
Altitude: 5,000m
Payload: Sensor turret with colour and IR zoom video, LRF, pilot colour video. Transponder. Optional sensors: SAR/GMTI, SIGINT-sensors, ESM, CBRN, Data link relay for BLOS operations, encryption, GCS hand-off function.
Powerplant: 1 x 11 kW, fuel-injected multi-fuel engine
Launch/recovery: cat/para or net
Remarks: Purchased by the German Army.

ALADIN

Length: 1.57m
Span: 1.46m
Maximum take-off weight: < 4kg
Range: > 15km
Endurance: > 1hr
Speed: 30kt cruise
Altitude: 30m AGL minimum, 150m typical, 3,000m density alt max
Payload: Daylight configuration: 4 x colour CCD video cameras: 1 pilot view, 2 x downward looking, 1 downward looking on left side used in circling mode, plus high-res forward looking zoom camera, 2 x daylight video cameras. Night configuration: 1 x IR video, 1 x colour video CCD camera
Powerplant: battery & electric motor driving tractor propeller
Launch/recovery: hand or cat/auto
Remarks: High performance mini UAV in operational service with several NATO countries.

ENICS

ELERON-3SV (T-28 AIR VEHICLE)

Length: 0.6m
Span: 1.47m
Maximum take-off weight: 5.5kg
Range: 25km with comms link, 50km off line
Endurance: 1hr 40min
Speed: 30-70kts
Altitude: 16,400ft
Payload: Option 1: 3-axis stabilised turret with a 10x optical magnification-enabled video camera and digital photo camera with minimum 10.2mpix resolution. Option 2: Stabilised turret with 10x thermal imaging and video camera. Digital camera with minimum 10.2Mp resolution.
Powerplant: battery & 1 x electric motor driving pusher propeller
Launch/recovery: cat/para
Remarks: Designed for round-the-clock aerial electro-optical surveillance. Can be supplied with Russian "Acceptance 5" quality standard certification.

ELERON-10SV (T-10 AIR VEHICLE)

Length: 0.9m
Span: 2.2m
Maximum take-off weight: 15.5kg
Range: Up to 60km
Endurance: 2hrs 30min
Speed: 30-70kts
Altitude: 13,100ft
Payload: Option 1: 3-axis stabilised turret with a 36x optical magnification video camera, plus a 10mpix digital camera. Option 2: 3-axis stabilised turret with an uncooled thermal imager and a video camera, plus a 10mpix digital camera, drop containers optional
Powerplant: battery & electric motor driving pusher propeller
Launch/recovery: cat/para
Remarks: Larger member of Eleron range. Designed for round-the-clock aerial electro-optical surveillance.

FLIR SYSTEMS (PROX DYNAMICS)

BLACK HORNET PRS/VRS

Length: 0.168m
Span: 0.123m
Maximum take-off weight: < 33g
Range: 2km
Endurance: 25min
Speed: 12kts (6 m/sec ground speed)
Altitude: > rooftop
Payload: Day: 2 x EO cameras, 1 video, 1 high-res snapshot. Night: fused thermal and EO.
Powerplant: battery & electric motor driving two-blade main and tail rotors
Launch/recovery: VTOL
Remarks: Personal/vehicle reconnaissance system. Vehicle launch unit mounts externally and fully integrates within vehicle.

SKYRANGER R70

Length: 80cm between motor mounts
Maximum take-off weight: 6.5kg
Range: 8km comms range with standard base station
Endurance: 50minutes with high-endurance propulsion system
Speed: 50kph max ground speed
Payload: 2kg. HDZoom 30, EO/IR MK-II, StormCaster-T, StormCaster-L, Osprey
Powerplant: battery powering 4 electrically driven rotors
Launch/recovery: VTOL
Remarks: Man-packable UAS designed to deliver a range of Group 2-3 payload capabilities with the agility and single-operator deployment footprint of a Group 1 UAS

R60 SKYRANGER

Length: 60cm between motor mounts
Maximum take-off weight: 3.07kg
Range: 10km comms range with directional antenna
Endurance: Up to 50minutes
Speed: 27kts ground speed
Payload: 670g. Day HDZoom 30, night EO/IR Mk-II
Powerplant: battery powering four electrically driven rotors
Launch/recovery: VTOL
Remarks: Stable in sustained 35kts winds and gusts up to 48.5kts. Deployed with over 20 militaries, in use with public safety and industrial operators

R80D SKYRAIDER

Length: 80cm between motor mounts
Maximum take-off weight: 6.5kg
Range: 8km comms range with standard base station
Endurance: 50 minutes with high-endurance propulsion system
Speed: 27kts max ground speed
Payload: 2kg. HDZoom 30, EO/IR MK-II, Forward EO/IR
Powerplant: battery powering 4 electrically driven rotors
Launch/recovery: VTOL
Remarks: Man-packable UAS designed to deliver a range of Group 2-3 payload capabilities with the agility and single-operator deployment footprint of a Group 1 UAS

GENERAL ATOMICS AERONAUTICAL SYSTEMS INC

REAPER BLOCK 5

Length: 11m
Span: 20m
Maximum take-off weight: 4,763kg
Range: LOS/global
Endurance: 27hrs
Speed: 240kts max
Altitude: 50,000ft MSL
Payload Capacity: 1,701kg (386kg internal, 1,361kg external, not simultaneous)
Payloads: MTS-B EO/IR, Lynx multi-mode radar, maritime radar, SIGINT/ESM system, Automatic Identification System (AIS), comms relay, dual ARC-210 UHF/VHF radios, other customer specific payloads.
Weapons: Hellfire missiles, GBU-12, GBU-38, GBU-49 smart bombs
Powerplant: Honeywell TPE331-10 turboprop 3-blade propeller
Launch/recovery: conv/conv
Remarks: Operated by: USAF, US Homeland Security, Australia, France, Italy, Netherlands, Spain, UK (to be replaced by Protector RG Mk1).

PREDATOR XP

Length: 8m
Span: 17m
Maximum take-off weight: 1,157kg
Range: LOS/global
Endurance: 35hrs @ 10,000ft
Speed: 120kts max
Altitude: 25,000ft
Payload Capacity: 147kg. EO/IR, Lynx multi-mode radar, comms relay
Features: auto takeoff and landing, optimised fuel mapping
Powerplant: Heavily Modified Rotax 914 Turbo piston engine
Launch/recovery: conv/conv
Remarks: Updated version of Predator licensed by US Government for sale to customers in the Middle East, North African, and South American regions.

GRAY EAGLE

Length: 9m
Span: 17m
Maximum take-off weight: 1,633kg
Range: LOS/global
Endurance: 25hrs
Speed: 167kts max
Altitude: 29,000ft
Payload Capacity: 261kg internal, 227kg external. EO/IR, SAR/GMTI radar, communications relay, 4 x Hellfire missiles.
Powerplant: 165hp Thielert HP heavy-fuel engine
Launch/recovery: conv/conv
Remarks: Persistent UAS dedicated to direct operational control by US Army field commanders. Features fault-tolerant control system, triple-redundant avionics.

GRAY EAGLE EXTENDED RANGE

Length: 9m
Span: 17m
Maximum take-off weight: 1,905kg
Range: LOS/global (comms)
Endurance: 42hrs
Speed: 167kts
Altitude: 29,000ft
Payload Capacity: 261kg internal, 227kg external. EO/IR, SAR/GMTI radar, communications relay.
Powerplant: HFE-180 HP heavy-fuel engine
Launch/recovery: conv/conv
Remarks: Open, modular architecture supports integration of three payloads simultaneously, with capacity for growth.

SEAGUARDIAN

Length: 11.7m
Span: 24m
Maximum take-off weight: 5,670kg
Range: > 5,500nm
Endurance: 35hrs
Speed: > 200kts
Altitude: > 40,000ft
Payload Capacity: 2,155kg across 9 hard points (8 wing & 1 centreline), 363kg internal. High definition EO/IR, multimode 360° maritime radar, Automatic Identification System, Lynx multimode radar, dual VHF/UHF certified radios
Features:
Powerplant: Honeywell TPE331-10 turboprop driving pusher propeller
Launch/recovery: conv/conv
Remarks: Variant of MQ-9B with maritime mission kit.

SKYGUARDIAN

Length: 11.7m
Span: 24m
Maximum take-off weight: 5,670kg
Range: LOS/global
Endurance: 40hrs
Speed: 210kts
Altitude: 40,000+ft
Payload Capacity: 363kg internal, 1814kg external. Raytheon MTS-B EO/IR, GA-ASI Lynx multi-mode radar, VHF/UHF certified radios
Powerplant: Honeywell TPE331-10 turboprop driving pusher propeller
Launch/recovery: conv/conv
Remarks: Selected by UK (Protector RG Mk1) and Belgium.

GUIZHOU AIRCRAFT INDUSTRY ASSOCIATION

WZ-7 SOAR DRAGON/SOAR EAGLE

(image attribution - By Baiweiflight - Picture drawn by Baiweiflight, CC BY-SA 3.0)

Length: 14.3m
Span: 25m
Maximum take-off weight: 10,000-12,000kg (estimate)
Range: 7,000km (estimate)
Endurance: 10hrs (estimate)
Speed: 405kts cruise
Altitude: 59,000ft
Payload Capacity: unknown
Payloads: Multi-sensor electro-optical system and maritime radar most likely
Powerplant: Single 43.1kN thrust Guizhou WP-13 turbojet
Launch/recovery: conventional from runway
Remarks: HALE UAV system broadly comparable with US Global Hawk in service in small numbers with Chinese People's Liberation Army Air Force

HARBIN

BZK-005 GIANT EAGLE/SEA EAGLE

Maximum take-off weight: 1,250kg
Range: 6,000km (estimate from cruise speed & endurance)
Endurance: 40hrs estimate
Speed: 150 to 180kph cruise
Altitude: 26,200ft estimate service ceiling
Payload Capacity: 150kg estimate
Payloads: Electro-optical sensor system under fuselage
Powerplant: Internal combustion engine driving single pusher propeller
Launch/recovery: conventional
Remarks: HALE UAV system in service with Chinese People's Liberation Army Air Force and Navy. Manufactured by Harbin Aircraft Industry Group.

IAI

HERON

Length: 8.5m | Span: 16.6m
Maximum take-off weight: 1,270kg | Range: 350km LOS, > 1000km BLOS
Endurance: 45hrs | Speed: 140kts
Altitude: > 30,000ft | Payload capacity: 470kg
Payloads: Multi Sensor Mission: EO/IR with LRF & designator, SAR, COMINT, ESM, comms relay etc
Remote operation: landing, takeoff and additional capabilities by Satellite Communication (SATCOM)
Powerplant: Certified electronic-controlled fuel injection engine
Launch/recovery: conv/conv, automatic takeoff and landing system (ATOL)
Remarks: MALE UAV with multi-sensor capabilities for strategic and tactical missions.

HERON MK2

Length: 8.5m | Span: 16.6m
Maximum take-off weight: 1,350kg | Range: > 1000km
Endurance: 45hrs | Speed: 140kts max, 60-80kts loiter
Altitude: > 35,000ft | Payload capacity: 470kg
Payloads: New configuration include long-range EO systems and radars plus a wide range of additional payloads: ELINT/COMINT/ESM, communication relay, special etc
Powerplant: Certified electronic-controlled fuel injection engine
Launch/recovery: conventional runway automatic take-off and landing system
Remarks: Updated version of Heron enabling new configurations with long-range observation sensors and radars.

MARITIME HERON

Length: 8.5m | Span: 16.6m
Maximum take-off weight: 1,350kg
Range: 350 km LOS, > 1,500km BLOS | Endurance: > 45hrs
Speed: 140kts | Altitude: 35,000ft
Payload: 470kg. Multi Sensor Mission: EO/IR with LRF & designator, MPR (Maritime Patrol Radar) / SAR, Sonobuoy (acoustic detector), MAD (Magnetic Anomaly Detector), COMINT, ESM, comms relay etc.
Remote operation: landing, takeoff and additional capabilities by Satellite communication (SATCOM)
Powerplant: Certified electronic-controlled fuel injection engine
Launch/recovery: conv/conv, automatic takeoff and landing system (ATOL)
Remarks: Multi-role MALE RPAS equipped for maritime operations.

HERON TP

Length: 14m | Span: 26m
Maximum take-off weight: 5,670kg | Range: BLOS
Endurance: > 30hrs | Speed: 220kts
Altitude: 45,000ft
Payload: 2,700kg. EO/IR/LRF/LD, synthetic aperture and maritime patrol radar, ELINT/COMINT, ESM and additional capabilities of payloads.
Powerplant: 1,200hp Pratt & Whitney Canada PT6 Turboprop driving pusher propeller
Launch/recovery: conv/conv, automatic takeoff and landing system (ATOL)
Remarks: Turbine-powered MALE UAV with large internal volume for a variety of payloads, certified to STANAG 4671 and compatible with NATO standards.

TACTICAL HERON

Length: 7.3m | Span: 10.6m
Maximum take-off weight: 600kg
Range: 300 km LOS, > 1500km BLOS | Endurance: 24hrs
Speed: 120kts max, 60-80kts loiter | Altitude: 23,000ft
Payload: 180kg. Multi Sensor Mission: EO/IR with LRF & designator, maritime patrol radar (MPR)/ SAR, COMINT, ESM, comms relay etc. Up to 4 payloads simultaneously
Powerplant: Certified electronic-controlled fuel injection engine
Launch/recovery: conv/conv, automatic takeoff and landing system (ATOL)
Remarks: landing, takeoff and additional capabilities through SATCOM

SEARCHER MK III

Length: 5.85m
Span: 8.55m
Maximum take-off weight: 450kg
Range: 350km
Endurance: 20hrs
Speed: 110kts max, 60-80 kts loiter
Altitude: 21,000ft service ceiling
Payload: 120kg. EO/IR or SAR/GMTI or SIGINT, aerial data relay
Powerplant: Jabiru 4-str "silent" piston engine
Launch/recovery: conv/conv
Remarks: Offers multiple operational configurations, operates in extreme weather, fully redundant avionics.

BIRDEYE 650

Length: 1m
Span: 3m
Maximum take-off weight: 11kg
Range: 40km
Endurance: > 4hrs
Speed: 70kts max, 40kts loiter
Altitude: 1,500ft AGL
Payload capacity: 1.2kg. Wide coverage, stabilised day/night payload and moving target tracker
Powerplant: battery & electric motor, pusher propeller
Launch/recovery: cat/flip-over & parachute
Remarks: System capable of 12 hours of operation can be carried in three backpacks, run by two people.

BIRDEYE 650D

Length: 1.1m
Span: 4m
Maximum take-off weight: 30kg
Range: > 150km
Endurance: > 15hrs
Speed: 80kts max, 40kts loiter
Altitude: 15,000ft
Payload: 5.5kg. Wide coverage, stabilised day/night payload and moving target tracker
Powerplant: Gasoline fuelled reciprocating engine
Launch/recovery: cat/parachute, flip over & airbag
Remarks: Advanced, long-endurance small tactical UAV for urban operations and over-the-hill intelligence

IDS

IA-17

Length: 1.27m
Span: 2.8m
Maximum take-off weight: > 25kg
Range: 80km LOS
Endurance: > 5hrs
Speed: 86kts
Altitude: 14,764ft
Payload capacity: 2.5kg
Payloads: Gyro-Stabilised turret with 15x zoom CMOS day camera and 4x thermal imager for night operations
Powerplant: 2-str gasoline engine
Launch/recovery: cat/para
Remarks: Small UAV configured for surveillance, aerial observation and reconnaissance missions

INDRA

PELICANO

Length: 3.4m
Span: 3.3m rotor dia
Maximum take-off weight: 200kg
Range: 100km
Endurance: 4-6hrs
Speed: 100kts
Altitude: 11,811ft
Payload: 30kg
Gyro-Stabilised MMP EO/thermal camera, Automatic Identification System (AIS)
Powerplant: Heavy fuel engine burning JP5
Launch/recovery: VTOL
Remarks: Maritime unmanned helicopter designed to support surveillance and law enforcement tasks from a ship or a ground base.

KOREA AEROSPACE INDUSTRIES

RQ-101

Length: 4.7m
Span: 6.4m
Maximum take-off weight: 300kg
Range: 80km radius
Endurance: 6hrs
Speed: 100kts
Altitude: 14,764ft
Payload capacity: 85kg (inc fuel)
Payloads: Dual sensor day TV & thermal imaging turret
Powerplant: Rotary internal combustion engine driving pusher propeller
Launch/recovery: cat/para or conv
Remarks: Corps level UAV system in service with Republic of Korea Armed Forces

LEONARDO

AW HERO

Length: 3.7m
Span: 4m rotor diameter
Maximum take-off weight: 200 g class
Endurance: 6hrs with 35kg payload
Speed: 90kts max cruise
Altitude: 14,000ft service ceiling
Useful load: 85kg (payload + fuel)
Payloads: Options include EO/IR turret, maritime radar, synthetic aperture radar, ESM, ADS-B, IFF, LiDAR, AIS
Powerplant: Heavy fuel engine burning JP5, JP8, Jet A1
Launch/recovery: Automated TOL
Remarks: Maritime rotorcraft UAS that took part in a successful maritime surveillance capability demonstration in the European OCEAN 2020 initiative in the Mediterranean in late 2019

FALCO

Length: 5.25m
Span: 7.2m
Maximum take-off weight: 490kg
Range: > 200km
Endurance: 8-14hrs
Speed: 117kts
Altitude: > 16,404ft
Payload: 70kg. EO/IR turret with laser designator, SAR/GMTI radar, multi-mode surveillance radar, AIS, ESM/COMINT, comms relay, hyperspectral imager.
Delivered to Pakistan Air Force. 5 customers total, including deployment on behalf of the United Nations (UN) MONUSCO peacekeeping operations in the Democratic Republic of Congo (DRC).
Powerplant: 65hp gasoline engine
Launch/recovery: conv/conv
Remarks: Medium altitude, medium endurance tactical UAV intended for surveillance missions.

FALCO EVO

Length: 6.2m
Span: 12.5m
Maximum take-off weight: 650kg
Range: > 200km link range
Endurance: > 20hrs
Altitude: 19,685ft
Payload: > 100kg. EO/IR with laser designator, laser marker, SAR/GMTI radar, multi-mode surveillance radar, AIS, ESM, COMINT, comms relay, hyperspectral sensor.
Delivery to the first of two Middle-East/Gulf customers, thought to be Jordan and Saudi Arabia, in January 2018. Deployed as part of the European Frontex surveillance research programme.
Powerplant: 80hp gasoline engine
Launch/recovery: conv/conv
Remarks: Falco variant that adds multi-payload capability, mission endurance and range.

FALCO XPLORER

Length: 9m
Span: 18.5m
Maximum take-off weight: 1,300kg
Range: comms range unlimited (satcom)
Endurance: > 24hrs
Altitude: > 30,000ft service ceiling
Payload capacity: 350kg
Payloads: Gabbiano T80UL multimode synthetic aperture radar mapping, ground moving target indication. EO turret up to 20-in diameter, visual/IR/laser rangefinder, laser marker and optional laser designator, ELINT or COMINT suite, AIS
Launch/recovery: conv/conv
Remarks: Large UAV launched in June 2019, will be offered as both an integrated platform and as a fully-managed information-superiority service to military and civil customers, designed for civil certification

CREX-B

Length: 0.45m
Span: 1.7m
Maximum take-off weight: < 2.1kg (±5%)
Range: 10m Line of Sight (LOS)
Endurance: 75min at max take-off weight
Speed: 60kts (max), 20kts (cruise)
Altitude: 10,100ft ASL (99-1600ft (AGL) operational)
Payload: 3 stabilised payload modules for real-time monitoring: Two day colour TV modules, one IR module, digital links, built-in video enhancement features (stabilisation, visual tracking, mosaicing, target locking)
Powerplant: Battery driving tractor propeller
Launch/recovery: Hand release, automatic short landing
Remarks: In service with the Italian armed forces

SW4 SOLO

Length: 9.068m
Span: 9m (main rotor diameter)
Maximum take-off weight: 1,800kg
Range: 940km
Endurance: 6hrs
Speed: 111kts (max cruise)
Altitude: 17.000ft service ceiling
Payload: 470kg
Powerplant: 1 x 336kW Rolls-Royce 250-C20R/2 turboshaft engine
Launch/recovery: automated VTOL
Remarks: ISTAR, manned-unmanned teaming and data dissemination demonstrated in real operational environment in several sets of trials, including Ocean 2020

LOCKHEED MARTIN

CONDOR XEP

Length
Span: 3.6mft
Maximum take-off weight: 18.3lbs
Range:
Endurance: > 4hrs under ideal conditions, > 3hrs in tactical operations
Speed: 45kts max
Altitude: 17,000ft
Payload capacity: Up to 2.2kg. Standard 720p HD streaming video with 30x zoom, FLIR Boson 640x512 uncooled LWIR camera with 7.5um to 13.5um detector array
Powerplant: Battery & electric motor driving a tractor propeller
Launch/recovery: Hand launch, marinised for landings in water to sea state 3.
Remarks: Improvements to propulsion system and battery doubled endurance while keeping payload capacity for special ops missions

DESERT HAWK III

Span; 1.5m
Maximum take-off weight: 3.72kg
Range:
Endurance: 1.5hrs
Speed: 50kts
Altitude: 11,000ft
Payload: 0.9kg. Includes 360-degree colour EO and IR video camera systems, plus other interchangeable, snap-on "Plug and Playloads"
Powerplant: battery & electric motor driving tractor propeller
Launch/recovery: hand/conv skid
Remarks: Small UAS that provides day and night support to small unit ISTAR and related operations.

INDAGO 3

Length: 0.81m
Span: 0.81m
Maximum take-off weight: 2.05kg
Range: 10km line of sight comms
Endurance: 50-75min
Altitude: 500ft AGL
Payload capacity: 0.2kg. Multiple hot-swappable payload options for ISR, search & rescue etc
Powerplant: battery & 4 x electric motors driving vertical propellers
Launch/recovery: VTOL
Remarks: Developed by Lockheed Martin Procerus Technologies, Indago 3 is rucksack portable and deployed in support of military operations and covert missions globally.

STALKER XE

Span: 3.66m
Maximum take-off weight: 10.9kg
Range: 370km (aircraft), 93km comms
Endurance: > 8hrs
Speed: 30.4kts cruise, 39kts dash
Altitude: 12,000ft max launch alt
Payload capacity: 2.5kg. EO/IR with cursor-on-target, integrated tracker with scene lock moving target tracking, auto-track and follow navigation
Powerplant: solid oxide propane fuel cell & electric motor driving tractor propeller
Launch/recovery: cat/conv glide, VTOL option
Remarks: VTOL capability provided by four electric motors driving vertical propellers mounted in pairs mid-span

LUCH

SOKOL 2

Length: 1.39m (tube)
Tube diameter: 160mm
Maximum take-off weight: 5kg
Range: 20km
Endurance: 2hrs
Speed: 54-65kts cruise
Payload capacity: 1kg
Payloads: Video camera and radio link to send target imagery back to armoured vehicle
Powerplant: battery & electric motor driving pusher propeller
Launch/recovery: tube/NA
Remarks: Reconnaissance and targeting asset integrated into infantry combat vehicle or armoured personnel carrier

NORTHROP GRUMMAN

BAT

Length: 2m
Span: 3.65m or 4.3m depending on variant
Maximum take-off weight: 95kg or 159kg depending on variant
Endurance: 8hrs or 18hrs depending on variant
Speed: 166kph (max)
Altitude: 5,500m
Payload capacity: 34kg to 57kg depending on variant
Payloads: Still image and real time video cameras, EO/IR and SAR sensors, laser range finders & designators, IR cameras, comms relay equipment, chemical, biological, electronic warfare, and IED detection systems
Powerplant: Hirth electronic fuel-injection engine and heavy fuel-variant, which runs on a variant of JP-8
Launch/recovery: catapult/net
Remarks: Bat is a family of affordable, medium altitude, multi-mission unmanned aircraft systems. Can be configured with differently-sized fuel tanks and different sensor payloads.

FIREBIRD

Length: 10.5m
Span: 24.1m
Maximum take-off weight: 3,220kg
Endurance: > 30hrs
Speed: 135kts cruise at 6,000m altitude Altitude: 7,600m
Payload capacity: 771kg
Payloads: Multi-sensor, mission ready with 5 payloads operating at once
Powerplant: 400 HP Lycoming Engine
Launch/recovery: conventional/austere runway
Remarks: Optionally-piloted multi-INT aircraft. On-board/off-board processing, with network attached storage. Rapid payload integration and change in configuration from UAV to manned.

NATO AGS - RQ-4D

Length: 14.4m
Height: 4.7m
Span: 39.8m
Weight: 14,950lbs / 6,781kg
Maximum take-off weight: 14,628kg
Endurance: 32hours
Speed: 310knots
Altitude: 60,000ft
Thrust: 7,600lbs
Payloads: 1,360 kg
Powerplant: Rolls Royce-North American AE 3007H turbofan
Fuel capacity: 7,847kg
Range: 8,700 nautical miles
Remarks: Primary function: High-altitude, long-endurance intelligence, surveillance and reconnaissance. The AGS system consists of air, ground and support segments, performing all-weather, persistent wide-area terrestrial and maritime surveillance in near real-time. The AGS will provide in-theatre situational awareness to commanders and contribute to a range of missions such as protection of ground troops and civilian populations, border control and maritime safety, anti-terrorism, crisis management and humanitarian efforts in natural disasters.

GLOBAL HAWK

Length: 14.5m
Maximum take-off weight: 14,628kg
Endurance: 24hr at 2,222km
Altitude: 60,000ft
Span: 39.9m
Range: 22,780km (ferry)
Speed: 310kt loiter
Payload: 1,360kg
Remarks: All-weather synthetic aperture, radar/moving target indicator, high-resolution electro-optical (EO) digital camera, and a third-generation infrared (IR) sensor working through common signal processor. Wideband communications and signals collection and processing.
Powerplant: Rolls-Royce AE3007 turbofan generating 8,500lb thrust

MQ-8C FIRE SCOUT

Length: 12.6m
Span: 10.7m dia
Maximum take-off weight: 2,722kg
Range: 150nm radius from ship, 1,380nm estimate based on endurance & cruise speed
Endurance: 12hr
Speed: 135kts max, 115kts cruise
Altitude: 16,000ft
Payload capacity: 318kg
Payloads: EO/IR/LRF, comm relay, AIS, AN/ZPY-8 maritime radar, AMCM (future). Multiple payloads and configuration available
Powerplant: Rolls-Royce 250-C47E turboshaft engine driving main and tail rotors
Launch/recovery: automatic VTOL
Remarks: US Navy declared the MQ-8C initial operationally capable and it is scheduled to deploy in late 2021.

TRITON

Length: 14.5m
Span: 39.9m
Maximum take-off weight: 14,630kg
Range: 15,186km (ferry)
Endurance: 30hrs
Speed: 320kts
Altitude: 56,500ft
Payload capacity: 1,452kg max internal, 1,089 external
Payloads: Multi-Function Active Sensor Active Electronically Steered Array (MFAS AESA) radar, MTS-B multi-spectral targeting system
Powerplant: Rolls-Royce AE3007 turbofan generating up to 8,500 lbs thrust
Launch/recovery: conventional runway
Remarks: Developed under the US Navy's Broad Area Maritime Surveillance programme, Triton's role is to provide ISR over vast ocean and coastal regions, conduct search and rescue missions, and to complement the P-8 Poseidon MPA.

NOSTROMO DEFENSA

CARBURE III

Length: 1.2m
Span: 2.2m
Maximum take-off weight: 5kg
Range: 15km LOS comms range
Endurance: 90mins
Speed: 57kts max
Altitude: 13,100ft ceiling
Payloads: 10 x zoom CCD daylight camera, colour/low-light CCD camera, uncooled IR camera options
Powerplant: lithium polymer battery driving 450W brushless motor & two-blade propeller
Launch/recovery: catapult/belly landing
Remarks: Operated by the Argentine Marine Corps

YARARA

Length: 2.465m
Span: 3.98m
Maximum take-off weight: 35kg
Range: > 50km LOS link range
Endurance; 6hrs
Speed: 90kts max
Altitude: 9,843ft
Payload capacity: 5.5kg
Payloads: IAI MicroPOP EO/IR turret
Powerplant: 1 x 8hp Cubewano Sonic 35 multi-fuel rotary engine driving 3-blade pusher propeller mounted above the wing.
Launch/recovery: conventional, unprepared runway
Remarks: Operated by the Argentinian Air Force, system comprises three UAVs, GCS and support equipment in three boxes weighting less than 250 kg

ZONDA

Length: 1.7m Span: 2.8m, 3.2m and 3.6m versions available
Maximum take-off weight: 15kg
Range: 30km LOS Endurance: > 2hrs
Payload capacity: 3kg
Payloads: Interchangeable video and stills cameras, the latter including a CCD colour camera, long-wave IR camera, multispectral camera. All feed image processor and downlink
Powerplant: battery and electric motor driving a tractor propeller
Launch/recovery: catapult or trolley/parachute or belly
Remarks: Developed for image intelligence applications with real time and on board recording of still images in visible, NIR and IR bands

PIAGGIO AEROSPACE

HAMMERHEAD

Length: 14.4m Span: 15.6m
Maximum take-off weight: 6,600kg Range: 7,038km
Endurance: 15hrs max with 227kg payload, 9.5hrs 1,500km from base
Speed: 395kts max, 320kts cruise, 135kts loiter
Altitude: 45,000ft service ceiling Payload capacity: 227kg standard
Payloads: SkyISTAR mission system with sensors including FLIR Systems StarSafire 380HD EO/IR turret, Leonardo Seaspray 7300 E Radar. The Italian defence ministry has reportedly requested purchase of 20 aircraft.
Powerplant: 2 × 850shp Pratt & Whitney Canada PT6A-66B pusher turboprops
Launch/recovery: conventional runway
Remarks: Based on P180 Avanti manned business aircraft. UAE launch order cancelled. Italian government has pledged continued support for certification

SAFRAN

SPERWER MK II

Length: 3.5m Span: 4.2m
Maximum take-off weight: Range: 200km
Endurance: > 6hr Speed: 90kts
Altitude: 15,000ft Payload capacity: 50kg
Payloads: Safran Euroflir 350 day/night gyrostabilised optronic sensor (EO/IR). Principal operator is the French Army.
Powerplant: 1 x 70 hp Rotax 582 2-str engine
Launch/recovery: cat/para
Remarks:

PATROLLER

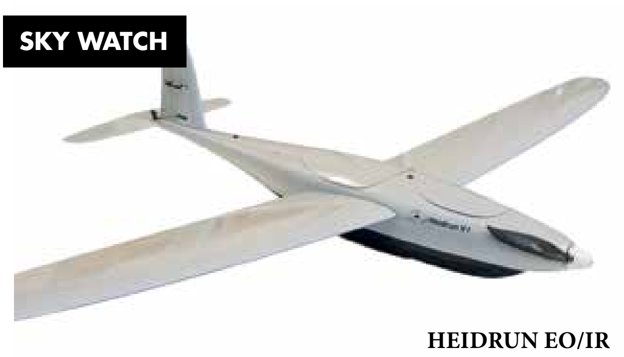
Length: 8.5m Span: 18m
Maximum take-off weight Range: 200m LOS
Endurance: 20hr Speed: 110kts max
Altitude: 20,000ft Payload capacity: 250kg
Payloads: Safran Euroflir 410 EO/IR turret plus COMINT, SIGINT, radar and other sensors.
Powerplant: 1 x 115hp Rotax 914F 4-cyl turbocharged liquid cooled engine
Launch/recovery: conv/conv
Remarks: The French Army has 14 on order, was due to receive the first 5 at the end of 2019, 14 in 2020 and two more in 2024. No deliveries yet reported.

SCHIEBEL

CAMCOPTER® S-100

Length: 3.11m Span: 3.4m rotor diameter
Maximum take-off weight: 200kg Range: up to 200km data link range
Endurance: > 6 with 34kg payload, > 10hr with external fuel tank
Speed: 120kt dash, 55kt best endurance
Altitude: 18,000ft Payload capacity: 50kg
Payloads: EO/IR, wide area opticas, Ground- and Maritime Moving Target Indication (GMTI + MMTIs, Signal Intelligence (SIGINT) & Communication Intelligence (COMINT), High-Frequency Direction Finder (HFDF), drop box and underslung load cargo carrying.
Powerplant: 50hp rotary engine
Launch/recovery: VTOL
Remarks: Initial substantial ordes came from the UAs, currentlnd Schiebeerhas more than 33 customers worldwid

SKY WATCH



HEIDRUN EO/IR

Length: 1.07m | Span: 1.65m
Maximum take-off weight: 2.3kg
Range: approx 46nm based on cruise speed & endurance
Endurance: 90min | Speed: 31kts cruise
Altitude: 11,500ft service ceiling
Payloads: 2-axis stabilised turret with EO/IR sensors
Powerplant: battery & electric motor driving a tractor propeller
Launch/recovery: Hand launch/deep stall landing
Remarks: battle proven, fixed wing, mini drone for low-altitude video surveillance and reconnaissance missions

SURVEY COPTER

ALIACA

Length: 1.85m | Span: 3m
Maximum take-off weight: 12kg | Range: 50km
Speed: 52kts | Endurance: 3hrs
Altitude: 9,843ft | Payload capacity: 1.1kg
Payload: T120 gyrostabilised EO/IR turret
Powerplant: battery & 1 electric motor driving a single tractor propeller
Launch/recovery: cat/belly
Remarks: Developed for ISR, protection & monitoring missions in military and civil applications. Currently deployed by the French army, foreign land & naval forces, SOF, police & gendarmerie.

TRACKER 120

Length: 1.54m | Span: 3.3m
Maximum take-off weight: 8.7kg | Range: 25km
Speed: 17 to 25m/sec | Endurance: 90mins
Altitude: 985ft cruise, 8,200ft max | Payload capacity: 1.1kg
Payloads: T120 gyrostabilised EO/IR turret
Powerplant: battery & 2 x electric motors driving twin tractor propellers
Launch/recovery: hand/belly landing
Remarks: Designed for ISR, coastal surveillance, convoy protection, monitoring of sensitive areas

DFV 2000 ER

Length: 2.27m | Span: 3.3m
Maximum take-off weight: 22.5kg | Range: > 50km
Speed: 65kts | Endurance: 7hrs
Altitude: 32,300ft | Payload capacity: 2kg
Payload: Survey-Copter's own T120 gyrostabilised EO/IR turret
Powerplant: 1 x fuel-injected 2-str engine
Launch/recovery: cat/conv
Remarks: Designed for military and civilian intelligence, surveillance and inspection missions

TAI

ANKA

Length: 8.6m | Span: 17.5m
Maximum take-off weight: 1,600kg | Range: 200km comms link range
Endurance: 24hrs | Speed: 117kts
Altitude: 30,000ft
Payload capacity: 200kg for 24hrs endurance
Payloads: EO/IR laser designator and rangefinder, plus SAR/ISAR/GMTI sensors
Powerplant: 1 x 155hp Tusaş Engine Industries PD-170 heavy fuel engine
Launch/recovery: conv/conv
Remarks: In service with Turkish Air Force, National Intelligence Organisation and Navy. Ordered by Tunisia in march 2020

ANKA AKSUNGUR

Length: 11.6m Span: 24m
Maximum take-off weight: 3,300kg Range: 6,500km estimate
Endurance: Ground attack/maritime mission 12hrs at 25,000ft with 750kg, SIGINT mission 24 hours at 35,000ft with 150kg payload
Speed: 135kts cruise Altitude: 40,000ft service ceiling
Payload capacity: 750kg
Payloads: IMINT, SIGINT, maritime patrol and comms relay packages.
Weapons options: three hard points on each wing with 500, 300 and 150kg capacities for a range of precision guided weapons
Powerplant: 2 x PD-170 dual turbo diesels rated at 170hp (SL, ISA)
Launch/recovery: conventional runway
Remarks: MALE UAV system with ISTAR and strike capabilities

TEXTRON UNMANNED SYSTEMS

AEROSONDE SMALL UNMANNED AIRCRAFT SYSTEM

Length: 2.1m Span: 3.6m
Maximum take-off weight: 36.3kg Range: 140km comms range
Endurance: > 14hrs Speed: 40–65kts
Altitude: 15,000ft service ceiling, 7,000ft max take-off elevation
Payload capacity: 9.1kg
Payloads: Carries day/night full-motion video, communications relay, signals intelligence and/or a customer-selected payload simultaneously
Powerplant: Lycoming EL-005 two-stroke Heavy Fuel Engine
Launch/recovery: cat/net
Remarks: Field-proven small UAS over more than 300,000 flight hours, offers up to 200watts of payload power

AEROSONDE HYBRID QUADROTOR (HQ)

Length: 2.1m Span: 3.6m
Maximum take-off weight: 47kg Range: 140km comms range
Endurance: 10hrs with multi-INT payload
Speed: 65kts
Altitude: 10,500ft density altitude with multi-INT payload
Payload capacity: 6.8kg
Payloads: Can carry Cloudcap TASE 400 two-axis stabilised turret with EO/MWIR with continuous zoom optics with multiple 3rd bay and laser options, integrated GPS/INS, onboard video processing
Powerplant: Lycoming EL-005 two-stroke Heavy Fuel Engine plus 4 electric vertical rotors
Launch/recovery: VTOL
Remarks: Runway independent development of Aerosonde

NIGHTWARDEN

Length: 3.9m Span: 7m
Maximum take-off weight: 340kg
Range: (comms limited) 125km LOS, > 1,000km) satcom
Endurance: 15hrs Speed: 85kts max, 60-72kts cruise
Altitude: up to 18,000ft Payload capacity: > 59kg
Payloads: EO/IR turret with laser designator, synthetic aperture radar, weapons, special purpose equipment
Powerplant: water-cooled rotary engine driving pusher propeller
Launch/recovery: conventional
Remarks: Group 3 UAS developed from Shadow family to provide cost-effective MALE capabilities usually associated with larger vehicles

SHADOW V2

Length: 3.66m Span: 26.2m
Maximum take-off weight: 212kg Range: 125km LOS
Endurance: 9hrs
Speed: 62-65kts / Max 98kts dependent on mission profile
Altitude: 18,000ft ceiling, 10,000ft max take-off elevation
Payload capacity: 43kg
Payloads: EO/IR, communications relay, optional laser designation, etc.
Powerplant: UAV Engines model 741 rotary engine
Launch/recovery: cat/conv, arrested
Remarks: Operators of this and earlier versions include the US Army, US Marine Corps, the Australian Army, the Italian Army, the and the Swedish Army

THALES

TACTICAL (WATCHKEEPER)

Length: approx 5.7m
Span: 10.5m
Maximum take-off weight: 550kg
Range: 200km
Endurance: 16hrs
Speed: 95kts
Altitude: 16,000ft
Payload capacity: 150kg
Payloads: Elbit Compass turret with visual, Infra-Red (IR) laser rangefinder and designator, Thales I-Master SAR/GMTI radar, radio relay, COMINT. Principal operator is the British Army.
Powerplant: Powerplant: 1 x 52hp UAV Engines R802/902 rotary
Launch/recovery: conv/conv
Remarks: Based on Elbit Hermes 450, Watchkeeper is British Army tactical UAV system, latest version offered for export by Thales is Watchkeeper X

SPY'RANGER

Length: 1.76m (estimate)
Span: 3.9m
Maximum take-off weight: 14kg
Range: 30km (comms limited)
Endurance: 3hrs
Speed: 49kts
Altitude: 14,764ft (t/o)
Payload: 1.2kg
Powerplant: battery & DC brushless electric motor
Launch/recovery: cat/belly
Remarks: French Army acquired a fleet of 210 Spy'Rangers for reconnaissance and observation missions

FULMAR X

Length: 1.2m
Span: 3m
Maximum take-off weight: 20kg
Range: 800km
Endurance: 6-12hrs
Speed: 54kts cruise, 81kts max
Altitude: 9,843ft
Payload capacity: 8kg
Payloads: EO/IR camera turret with fusion capability
Powerplant: 1 x gasoline & heavy fuel engine
Launch/recovery: cat/net
Remarks: Intended for border surveillance, ISR, emergency management, monitoring illegal traffic, infrastructure security etc

UMS SKELDAR

V-150

Length: 3.2m
Span: 3.5m rotor diameter
Maximum take-off weight: 150kg (330.7lb)
Endurance: > 4hrs
Speed: 65kts
Altitude: 10,000ft service ceiling
Payload capacity: 42kg (12kg in the nose, 30+kg in the main bay)
Payloads: Land ops, main bay: SIGINT/GMTI, WAMI, LiDAR, hyperspectral & multispectral cameras, custom mission pods; maritime ops: SAR pods, tactical multi-INT/MTI radar; nose bay: Wescam MX8, i2Tech i2AX
Powerplant: heavy fuel engine running on Jet A1, JP8
Launch/recovery: VTOL
Remarks: Automated rotorcraft designed to support tactical operations for surveillance, emergency response, homeland security and defence

V-200

Length: 4.031m
Span: 4.6m (diameter)
Maximum take-off weight: 235kg
Endurance: > 5hr with 20kg payload at ISA
Speed: 150km/h (81kts)
Altitude: 12,000ft
Payloads: Optional payloads: advanced EO/IR turrets, Sentient Vision ViDAR, SAR/GMTI radar, hyper-spectral and multi-spectral cameras, comms relay systems
Powerplant: 1 x 54hp Hirth heavy fuel engine running on Jet A1, JP5 & JP8
Launch/recovery: VTOL
Remarks: Maritime unmanned helicopter with open interface to battlefield management and C4ISR systems, STANAG 4586 compliance for ease of integration into ships

Stingray air vehicle T1 positioned with the forward launch and aft holdback bars lowered over the imitation catapult's shuttle track.

STINGRAY: NO BARB OR VENOM FOR NOW

US Naval Air Systems Command is developing the world's first non-experimental air vehicle designed for carrier-based operations and autonomous aerial refuelling.

Mark Ayton

A team of aerospace specialists led by Naval Air Systems Command (NAVAIR) and Boeing's Phantom Works is currently developing a new weapon system, one that's set to change many of the established cultures of military aviation. Designated the MQ-25A and named Stingray, this 15.5 metre (51 foot) long non-experimental unmanned air vehicle (UAV) is the world's first designed for carrier-based operations. In addition to catapult launch and arrested landing capabilities, the Stingray will perform autonomous aerial refuelling (AAR) in support of all fixed wing aircraft assigned to the Carrier Air Wing (CVW).

Secondary to that, the MQ-25A has an intelligence, surveillance and reconnaissance (ISR) role afforded by an electro-optical and infrared (EO/IR) sensor. Data will be transmitted at appropriate classification levels to other aircraft, naval vessels, ground forces, and to exploitation nodes afloat and ashore, specifically the Navy's Distributed Common Ground System.

In official Department of Defense (DoD) parlance, the MQ-25 extends CVW mission effectiveness range, partially reduces the current Carrier Strike Group (CSG) organic ISR shortfall and fills the future CVW-tanker gap, mitigating strike fighter deficit and preserving F/A-18 Super Hornet fatigue life for fleet defence and strike missions.

As the first carrier-based, Group 5 unmanned aircraft system (UAS), the MQ-25 will pioneer the integration of manned and unmanned flight operations, demonstrate mature sea-based UAS command, control, communications, computers, and intelligence (C4I) technologies, and pave the way for future multifaceted multi-mission unmanned air vehicles to keep pace with emerging threats.

The latter is a pointer to follow-on roles for the MQ-25. Certainly the air vehicle's low-observable stealthy configuration points to the air vehicle being used to drag aircraft in CVW strike packages further from the carrier than ever before: most importantly supporting F-35C Lightning IIs into non-permissive environments.

A likelihood not denied by Captain Chad Reed, MQ-25 programme manager, Unmanned Carrier Aviation with PMA-268 who said: "Right now, even though its configuration is stealthy, there is no low-observable requirement for the MQ-25. Our requirement was for Boeing to use mature technologies in accordance with the accelerated programme goals. It is designed to operate in permissive environments when it enters the fleet, while concepts of operation are explored, and it's meshed with manned operations. Manned-unmanned teaming is a notable aspect of the

Boeing Phantom Works

T1 N234MQ (s/n 00001) on its first wheels-up flight from MidAmerica Airport. The shadow cast shows the air vehicle's chine, the longitudinal line of sharp change in the cross-section profile of the fuselage.

programme, one that's on the cutting-edge simply because other aircraft are not designed to operate in such close proximity to and with manned aircraft: Stingray has a configuration and a new capability unmatched in a current air wing."

UCLASS AND NGAD

MQ-25 requirements are aligned with the initial capability documents for the Unmanned Carrier Launched Airborne Surveillance and Strike (UCLASS) programme, and the Next Generation Air Dominance (NGAD) family of systems. Both documents highlighted the need for carrier-based refuelling and persistent ISR capabilities.

The Joint Requirements Oversight Council's (JROC's) guidance set out a requirement for a versatile platform that supports a myriad of organic naval missions such as aerial refuelling and ISR to support the CSG. On 21 July 2017, the JROC validated the capability development document for the MQ-25 Carrier Based Aerial Refueling System (CBARS).

Designed to be sustainable on board an aircraft carrier and from shore bases, the MQ-25 system is comprised of three major architectural segments:

- the air segment includes the MQ-25A air vehicle and associated support and handling equipment including the deck handling system, spares and repair materials.

- the control system and connectivity (CS&C) segment includes the Unmanned carrier aviation Mission Control System (UMCS) and its associated communication equipment; mission support functionality of the Distributed Common Ground Station-Navy (DCGS-N), the Navy's primary intelligence, surveillance, reconnaissance and targeting system; all network based interfaces and routing equipment required to control the Stingray; and all required modifications to existing networks and C4I system infrastructure.

- the CVN (aircraft carrier) segment comprises the ships' spaces allocated to unmanned carrier aviation, installed ship systems and modifications necessary for interface with the air and CS&C segments. CVN systems important to the MQ-25 include aircraft launch and recovery systems, data dissemination systems (including radio terminals and antennas), and deck operations systems. Ship installation requires considerable work to re-model nearly $900ft^2$ ($84m^2$) of space on board the carrier to house the UMCS.

As Lead Systems Integrator (LSI), PMA-268 manages all three.

In terms of its operating envelope, the MQ-25 adequately meets the fleet's current operational needs and achieves the two primary roles. Driving that performance is a relatively low air vehicle empty weight and the fuel-efficiency of the Rolls-Royce AE3007N engine.

Components integrated on the air vehicle to meet mission requirements include a long wingspan for flight stability and endurance; a Héroux-Devtek landing gear system; redundancy systems for safety of flight; Raytheon ALR-69A(V) all-digital radar warning receivers providing 360 degree coverage; a Raytheon AAS-52 MTS-A multi-sensor imaging system equipped with infrared and CCDTV sensors, laser rangefinder, designator and illuminator; and one Rolls-Royce AE3007N turbofan engine rated at 9,000lb (40kN).

Systems specific to carrier flight deck operations include a tail hook for arrested landings; foldable wings to minimise the air vehicle's parking footprint on the flight deck; design features that ease maintenance; and on-deck control systems that integrate with systems currently used on Nimitz and Ford-class carriers.

CBARS COMPETITION

Based on the US government's acquisition strategy approved in April 2017, the MQ-25 programme is an evolution from the previous UCLASS programme.

Concepts for the now defunct UCLASS programme were deemed too difficult and challenging given the number of new technologies involved, all of which required evaluation. Consequently, NAVAIR's PMA-268 implemented a restart to evaluate the art of the possible for introducing something so new as the MQ-25, and to explore concepts of operation.

In 2016 Congress appropriated PMA-268 a congressional plus-up award for four contractors each capable of developing an UAS suitable for the CBARS requirements; Boeing, General Atomics, Lockheed Martin and Northrop Grumman.

Each contractor presented PMA-268 with ideas about how they were to mature their own technologies and concepts prior to receiving their share of the congressional plus-up award; a means of funding their respective concept development programmes through mid-2018. At that point with details, including the giveaway fuel load and ranges of each of the concepts submitted, PMA-268 conducted a tanker trade study which help conclude its requirements for the CBARS programme.

PMA-268 released the draft air system Engineering, Manufacturing, and Development (EMD) Request for Proposal (RFP) in July 2017 and released the final EMD RFP in early October 2017. Shortly after, Northrop Grumman dropped out of the competition citing an inability to meet the Navy's specification and deliver a profit.

Less than eight months after receiving qualified proposals, PMA-268 awarded the EMD contract to Boeing Company in August 2018. This was the fastest Acquisition Category 1 (ACAT-1) EMD award of the past ten years.

Under the EMD contract, the first seven aircraft procured by the Navy are four Engineering Development Model (EDM, not EMD) test air vehicles (AV-1, AV-2, AV-3 and AV-4), and three System Demonstration Test

Boeing Phantom Works

Touch down at MidAmerica St Louis Airport, Illinois at the end of T1's maiden flight on 19 September, 2019.

Articles (SDTA). In addition, Boeing will also build two more airframes – one for fatigue testing and one for static loads testing.

Part of the requirement was to have a considerable amount of the design already complete prior to contract award; each company had either a prototype or a developmental article ready.

PMA-268 staff conducted a thorough review of each proposal over the next eight months. Boeing's bid was determined to offer the best value for the government, first and foremost because of its ability to meet the schedule, and the ability to meet the key performance parameters (KPPs). It's notable that the MQ-25 had just two KPPs. This a consequence of a pilot programme launched by the Chief of Naval Operations, Admiral John Richardson in 2017 that sought to limit the number of KPPs for a new weapon system to no more than three. PMA-268 opted for two; the capability to give away a set amount of fuel to a CVW strike package hundreds of miles away from the carrier, and full integration with Nimitz and Ford-class carriers as they currently operate.

MQ-25 is designated a maritime accelerated acquisition programme because the Chief of Naval Operations, Admiral John Richardson and the Assistant Secretary of the Navy for research, development and acquisition, James Geurts saw the importance of getting the system to the fleet quickly. More specifically to reduce the amount of flight time used up by F/A-18 Super Hornets when conducting the aerial refuelling role. The 6,000-hour Super Hornet service life is being depleted at much faster rates than anticipated. This has forced the Navy to devise and develop a new weapon system to conduct its tanker mission and save Super Hornet service life. This is a primary reason why the Navy switched its plan for a carrier-borne UAS from one programme, UCLASS, to another; CBARS (see below).

The CBARS concept also addresses other tactical aspects of carrier aviation; it helps to counter emerging threats now fielded by potential adversaries. That capability almost certainly points to a need for the MQ-25's stealthy, low-observable configuration.

T1 AND PHASE ONE TESTING

Phantom Works, Boeing's advanced prototyping division, started building air vehicle T1 in 2012.

The design features a blended wing-body-tail air foil with folding, high-aspect-ratio wings and a V-tail. Its configuration reflects the long-endurance mission requirements of the UCLASS programme, particularly the long thin wings. Phantom Works finished the first iteration in 2014 as part of its design proposal for the UCLASS programme.

Air vehicle T1 has the same outer mould line and the same engine to nascent production standard MQ-25s. Consequently, some aspects of testing already undertaken with T1 will not require repeating with a production standard air vehicle.

The objective of the MQ-25 test programme is to evaluate system maturity and technical performance of the aerial refuelling role; both mission and recovery tanking.

Initial ground testing with T1, including communications integration, towing, combined system and taxi, began almost immediately following contract award at Boeing's facilities in St Louis, Missouri. In April 2019, Boeing trucked T1 to MidAmerica St. Louis Airport in Illinois to conduct the first phases of flight testing. T1's maiden flight took place there on 19 September 2019. The company chose MidAmerica (the commercial side of Scott Air Force Base) because of hangar, runway, taxiway and air space availability.

As of 20 March, T1 had flown 12 flights and amassed nearly 30 hours during which the team worked through test points designed to evaluate the aerodynamic performance of the air vehicle, altitudes and air speeds, and the performance of the engine. T1 is fully instrumented for capturing flight test data used to evaluate flight and aerodynamic performance.

T1 is currently undergoing a planned modification for the installation of an aerial refuelling store underneath the left wing, specifically a Cobham 31-301-7 buddy store. The modification is required because T1 was originally developed without pylons to carry stores; that was not a requirement of UCLASS. The first series of aerial refuelling flight tests will follow later this year.

Testing with T1 will continue over the next few years to include envelope expansion, engine testing, aerial refuelling store operations, and Joint Precision Approach Landing System (JPALS) functionality testing.

The latter will require T1 to undergo a second modification period to enable the air vehicle to land using the JPALS, a differential, GPS-based precision landing system that guides aircraft onto carriers in all weather and surface conditions up to the rough waters of Sea State 5.

An important mod to evaluate functionality and identify any issue with JPALS before the FY2021 delivery to Naval Air Station Patuxent River of the first EDM test configured air vehicle AV-1.

T1's involvement in the test programme will culminate with its hoisting aboard an aircraft carrier to test the deck handling and control station systems.

RISK REDUCER / LATER TEST PHASES

T1 has already proven beneficial as a risk reducer during initial ground and flight testing. According to PMA-268, T1 is performing as the models projected to give the programme confidence as it moves to EDM standard air vehicle production and test.

Having T1 available for testing years before the first EDM comes off Boeing's St Louis production line supports early learning and the discovery of any issues much earlier than is typical. Lessons learned and any issues identified can be applied and corrected during the development of the EDM air vehicles. For example, an icing susceptibility issue with the air data probe system has already been identified. To correct the issue, a different air data probe has been designed and will be fitted to all four EDM air vehicles AV-1, AV-2, AV-3 and AV-4, during their production.

Without T1, the test team would not have been able to identify the air data probe problem for several years.

Initial testing of each EDM air vehicle will take place at Boeing's MidAmerica St Louis Airport facility by an integrated Navy-Boeing test team before delivery to Naval Air Station Patuxent River, Maryland. The Air Test and Evaluation Squadron 23 (VX-23) 'Salty Dogs' will lead testing of MQ-25.

Part of the air vehicle's catapult launch and arrested landing equipment testing will take place at Naval Air Engineering Station Lakehurst, New Jersey, followed by cold soak trials in the McKinley climatic laboratory at Eglin Air Force Base, Florida.

AV-1 will undergo all aspects of a standard flight test programme followed by catapult launches and arrested landings at both Patuxent River and Lakehurst.

Boeing is conducting T1 flights in partnership with PMA-268, whereas EDM flight testing will be conducted by an integrated Navy-Boeing test team led by VX-23.

PMA-268 is overseeing all preparations for the MQ-25's test programme at Patuxent River. A hangar and laboratory facility are under construction, support equipment is being acquired, and personnel recruited.

AV-1 and AV-2 will be dedicated to flight sciences testing and fitted with similar instrumentation to T1. AV-3 and AV-4 will be dedicated to mission systems and carrier suitability testing, and the air vehicle's effectiveness to the aerial refuelling role, all planned for the second phase.

The air vehicle's all-up weight is an incredibly important design parameter for carrier suitability. The MQ-25 must be capable of fulfilling its tanking role despite the constraints imposed by maximum catapult shot weights and arrested recoveries from Nimitz- and Ford-class carriers. All-up weight was also constrained by the requirement for a fuel giveaway of 16,000lb (7,257kg) at 500 nautical miles (925km) from the carrier. By comparison, a Super Hornet holds a giveaway fuel load of 12,000lb (5,443kg) on a two-hour cycle, 15,000lb (6,803kg) on a normal cycle and 25,000lb (11,339kg) on a short cycle.

The MQ-25 will also be tasked with recovery tanking, which involves having a tanker airborne in orbit close to the carrier while aircraft recover. A critical capability at night or when the weather conditions are bad with a pitching deck in heavy seas, such that pilots need to top up the tanks to afford further attempts to land on the flight deck.

Initial Operational Test and Evaluation (IOT&E) is the final phase.

CONTROL SYSTEM

Designated the MD-5 A/B (ship/shore), the Unmanned Carrier Aviation Mission Control System (UMCS). An MD-5 A/B control station comprises open architecture software, six OJ-845 common display systems, two UYQ-122 common processing systems, one network processing group, one integrated communication system, and network connectivity.

Both the MD-5 and its operating software are being developed by PMA-268, which is also responsible for all modifications required to shore-based and CVN infrastructure. The latter includes integration of NAVAIR-developed software with Boeing's air vehicle OFP, the network, and the command, control and communication systems that will enable both CVN and shore-based control of the air vehicle.

A PMA-268 team demonstrated the first build of the UMCS using representative shipboard equipment and a simulated air vehicle at Patuxent River on April 11, 2017.

During the demo, the UMCS communicated with a Surface Mobile Aviation Interoperability Lab truck, simulating an air vehicle, and verifying command and control. Connectivity between the UMCS and shipboard network systems was tested and voice trunking (internet protocol to serial) between the air vehicle operator (AVO) and the simulated UAV was verified.

Limited control and data dissemination between the UMCS and simulated air vehicle to include automatic identification system detection, electro-optical/infrared camera operation, and full motion video, pre-planned and dynamic mission re-planning, was also performed.

UMCS 1.0 demonstrated that third party software can coexist with the common control system (CCS) framework, thereby proving the architecture is viable.

This demonstration was the first of a series to demonstrate UMCS capabilities as development of the system progresses.

Integration testing is ongoing at Patuxent

Combined system and taxi testing at Boeing's St Louis facility. This shot shows the fuselage cross section form, the bulges of the wing joints housing the actuators and hydraulically-actuated pins that lock the wings in place, and the pitch of the tail surfaces of the V-tail.

An artist impression of the Lockheed Martin proposal for the CBARS programme, shown on a catapult ready for launch.

River as part of the programme's first test phase.

UMCS hardware builds on Naval Sea Systems Command's common display and processing systems from the DDG-1000 Zumwalt-class destroyer and other Aegis-equipped ships.

It also incorporates the Navy's CCS, a software architecture that features a common framework, user interface, and components designed for use with a variety of unmanned systems.

US Navy documentation lists a requirement for 12 UMCS sub-systems for assembly and delivery to installation sites between September 2020 and October 2027.

AIR VEHICLE CONTROL I

Using mouse and keyboard controls, the AVO commands the air vehicle where it needs to go and what it's required to do: the system determines how to get there in the most safe and efficient way.

Typical operation involves the AVO maintaining positive control of the air vehicle, including the ability to change speed, direction and altitude, and continuously monitor the machine while in flight.

Flight control software is designed to handle unexpected events such as bad weather or when a change to altitude or the position of its tanking pattern is required.

The AVO, a warrant officer, will use the MD-5 control station housed within the carrier's Unmanned Carrier Aviation Warfare Center throughout all stages of the mission from the catapult launch to the arrested landing.

Prior to launch and landing, a deck handling operator will use a deck control device to taxi the Stingray around the flight deck. Once the air vehicle is on the catapult, at some point the deck handling operator will hand-off to the AVO. After landing, the deck handling operator will assume control to taxi the air vehicle to its parking spot. This is a similar method to the one used for the Northrop Grumman X-47B demonstrator.

During aerial refuelling ops, the AVO will have the ability to communicate with the receiver aircraft's pilot. PMA-268 is currently developing a concept of operations for aerial refuelling which will follow the same procedures as currently used by Super Hornets.

MILESTONE C AND BEYOND

Since contract award to Boeing, PMA-268 is following a non-standard version of the rigorous Systems Engineering and Technical Review (SETR) process to finalise the design. The DoD tasked PMA-268 to tailor out elements of the standard SETR process as part of the MQ-25's Military Airworthiness Authority distinction in order to achieve a six-year schedule. MQ-25 milestone names and requirements differ from the traditional convention because of the focus on accelerating development and delivery to the fleet. Work will continue through to the MQ-25 system design review (SDR) later this year to set its baseline design. This will allow production of the EDM air vehicles to begin. SDR is similar to a critical design review used by other DoD programmes.

PMA-268 is pursuing a Milestone C decision for low rate initial production in FY2023 to procure up to 12 MQ-25A air vehicles. Following successful IOT&E, PMA-268 will pursue a full rate production decision for an estimated total of 76 air vehicles. Stingray is expected to achieve its initial operational capability with the fleet in 2024. A

MQ-25 STINGRAY CHARACTERISTICS

Wingspan: 22.86m (75ft)
Wingspan folded: 9.54m (31ft 3in)
Length: 15.54m (51ft)
Height : 4.78m (15ft 8in)
Flight deck footprint - no greater than a Super Hornet

ON THE COVER:
Northrop Grumman's Firebird is designed to provide ISR payload and cockpit flexibility through open architecture and plug-and-play payload integration. The system's hardware- and software enable users to carry out a wide range of ISR missions for 30 plus hours at approximately 25,000 feet.
(Northrop Grumman)

Unmanned Aerial Vehicles
Supplement to ARMADA Issue 3/2020
Volume 43, Issue 3, June/July 2020

ARMADA
is published bi-monthly by Media Transasia Ltd.

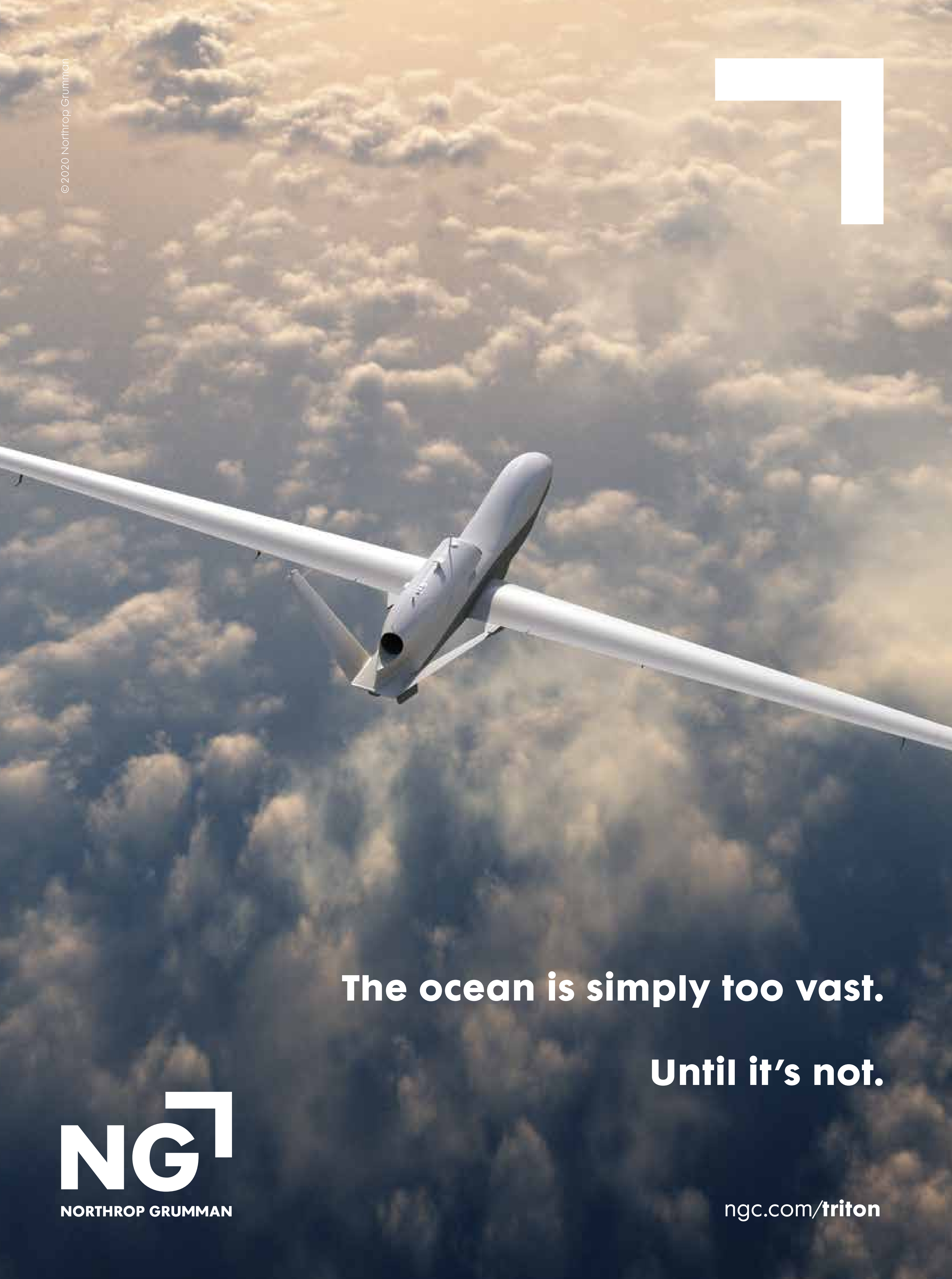
Publishing Office: Media Transasia Ltd.,
1603, 16/F, Island Place Tower, 510 King's Road, Hong Kong

Editor-in-Chief: Andrew Drwiega
Chairman: J.S. Uberoi
President: Egasith Chotpakditrakul
Chief Financial Officer: Gaurav Kumar
General Manager: Jakhongir Djalmetov
International Marketing Manager: Roman Durksen
Digital Manager: David Siriphonphutakun
Sales & Marketing Coordinator: Wajiraprakan Punyajai
Art Director: Hatsada Tirawutsakul
Production Executive: Wanlaya Thiangrungreung
Circulation Assistant: Yupadee Seabea

Advertising Sales Offices
■ FRANCE/SPAIN
Stephane de Remusat, REM International
Tel: (33) 5 3427 0130
E-Mail: sremusat@rem-intl.com
■ GERMANY
Sam Baird, Whitehill Media
Tel: (44-1883) 715 697, Mob: (44-7770) 237 646
E-Mail: sam@whitehillmedia.com
■ UK
Zena Coupé
Tel: +44 1923 852537, zena@expomedia.biz
■ NORDIC COUNTRIES/ITALY/SWITZERLAND
Emanuela Castagnetti-Gillberg
Tel: (46) 31 799 9028
E-Mail: emanuela.armada@gmail.com
■ RUSSIA
Alla Butova, NOVO-Media Ltd,
Tel/Fax: (7 3832) 180 885, Mob: (7 960) 783 6653
Email :alla@mediatransasia.com
■ USA (EAST/SOUTH EAST)/CANADA (EAST)
Margie Brown, Blessall Media, LLC.
Tel : (+1 540) 341 7581
Email: margiespub@rcn.com
■ USA (WEST/SOUTH WEST)/BRAZIL/CANADA (WEST)
Diane Obright, Blackrock Media Inc
Tel : (+1 858) 759 3557
Email: blackrockmediainc@icloud.com
■ INDIA
Sanjay Seth
Global Exposures
Tel: +91 11 466 96566 Mob: +91 9818 697279
Email: sseth.globex@gmail.com
■ TURKEY
Zeynep Özlem Baş
Mob: +90 532 375 0046
Email: media@oz-ist.com
■ ALL OTHER COUNTRIES
Jakhongir Djalmetov
Tel: +66 2204 2370, Mob: +66 81 6455654
Email: joha@mediatransasia.com
Roman Durksen, Tel: +66 2204 2370, Mob: +66 83603 7989
E-Mail: roman@mediatransasia.com

Annual subscription rates:
Europe: CHF 222 (including postage)
Rest of the World: USD 222 (including postage)
Controlled circulation: 26,050 (average per issue)
ABC certified by ABC Hong Kong, for the period 1st January 2018 to 31st December 2018.
Printed by Media Transasia Ltd., 75/8, 14th Floor, Ocean Tower II, Soi Sukhumvit 19, Sukhumvit Road, Bangkok 10110, Thailand.
Tel: 66 (0)-2204 2370, Fax: 66 (0)-2204 2390 -1

Subscription Information: Readers should contact the following address: Subscription Department, Media Transasia Ltd., 75/8, 14th Floor, Ocean Tower II, Soi Sukhumvit 19, Sukhumvit Road, Bangkok 10110, Thailand.
Tel +66 2204 2370 Fax: +66 2204 2387
Email: accounts@mediatransasia.com
www.armadainternational.com


©2020 Northrop Grumman
The ocean is simply too vast.
Until it’s not.
NG
NORTHROP GRUMMAN
ngc.com/triton

One of the test firings of the new Saab Lightweight Torpedo (Torpedo 47) from a Swedish Royal Navy Visby-class Corvette earlier this year.

SWEDISH NAVY TRIALS NEXT GENERATION TORPEDO

Both the Swedish Royal Navy and the Finnish Navy are anticipating the arrival of a new generational torpedo designed for the challenging waters of the Baltic Sea.

By Andrew Drwiega

The Swedish Defence Procurement agency FMV and the Swedish Royal Navy (RSwN) have just assisted Saab in trailing its new Saab Lightweight Torpedo (SLWT) from a Gotland-class submarine and from a Visby-class corvette. The tests were conducted during February and March 2020 at sea ranges outside Karlskrona, on Sweden's east coast in the Baltic Sea.

Both the Swedish Royal Navy and the first foreign customer, the Finnish Navy, have contracted Saab to provide them with a modern, digital homing and wire guided torpedo. The RSwN needs a replacement for its Torpedo 45 currently in service, while the Finnish Navy made a decision to bring back torpedoes as weapons for its four upgraded Hamina-class fast attack craft as well as the new Pohjanmaa-class corvettes of the Squadron 2020 Programme. These ships are due to be constructed between 2022-2025 with first sea trials beginning in 2024. The full Squadron is scheduled to be operational by 2028. The RSwN's two A26 submarines are scheduled for delivery by 2025.

Magnus Lind, project manager NLT (TS47), Swedish Defence Materiel Administration (Försvarets materielverk/ FMV) said that work had begun on the new Torpedo 47 back in 2014. Although the RSwN is a proficient operator of anti-submarine warfare (ASW), Lind said that research and technology studies were still conducted on how the new Torpedo 47 would be integrated onboard a surface vessel, a submarine as well as being dropped from a helicopter.

Anne-Marie Vösu, vice president and head of Business Unit Underwater Systems, Saab, said that these first test conducted during exercise conditions from a corvette and a submarine were a major milestone in the development of this next generation torpedo. It is a littoral weapon, specifically designed for the shallow Baltic Sea and to be used with an Integrated Total Engagement Control (ITEC) system. The torpedo then uses an active/passive homing system to detect, classify, track and engage its target.

Lind revealed that the trails were basically proof of concept tests where the torpedo had been launched successfully both from on top of, and under, the sea. "We got a lot of data from exercise and we are now in the last stages of the development

Both the current Swedish Royal Navy Gotland-class submarines and the new Blekinge class submarines (A26) will deploy with the new lightweight torpedo.

Saab's Lightweight Torpedo incorporates a digital homing system, which offers both fire-and-forget and wire-guided operation to locate and destroy the target.

programme. Earlier land based trails have already been conducted to ensure that the customer's requirements were being met and progress was on schedule. In addition to the actual weapon, other elements of the total system design include the interface with the host vessel, the launch unit and the communications through which the torpedo will be wire-guided to its target.

Lind said that the tests conducted in these final phases of the development would lead into production with the weapons ready for operational deployment on the corvettes by late 2022 and in submarines early the following year. Before then however, there will be more sea trials which will be conducted from naval vessels, operational and maintenance training, and finally acceptance from the customer. Once in service, the RSwN intends to use the Torpedo 47 onboard the modified Gotland class submarines, the new coming Blekinge class submarines (A26) and the Visby-class corvettes.

Lieutenant Commander (LtCdr) Anders Hecker, Commanding Officer of HSwMS Helsingborg (K32, a Visby-class corvette) said that good sensors and torpedo guidance were crucial in the difficult waters of the Baltic Sea. He said that the Torpedo 47 represented a "continuation of a concept , modern but based on what we currently use." Crucially it will have a wider speed range, better endurance and therefore longer range, he added. The RSwN has conducted over 2,000 shots of Torpedo 45, with operational knowledge gained being fed back into Saab's Next Generation weapon.

According to Lind, two of the most important challenges in developing the torpedo was the challenging environment in which it will operate, as well as the safety concerns specific to the different surface and sub-surface platforms.

Feasibility studies were conducted during 2015-16 into the use of the Torpedo 45 from a helicopter, but a requirement and integration plan still needs to be formulated. A

The Raytheon Coyote expendable tube launched high speed missile combined with the KRFS radar is adaptable to multiple platforms and can be employed as stationary or mobile system to intercept maneuvering aerial targets. Shown here firing from a 4x4 tactical vehicle.

C-UAS STRIKES BACK

Air defence on the battlefield has returned, particularly to counter unmanned aerial systems.

By Stephen W. Miller

For decades the functions of forward tactical air defence have taken a back seat in many of western militaries. This was particularly pronounced with United States ground forces which had 26 battalions dedicated to the mission in 2004 but deactivated all but nine with seven of those being Army National Guard units. However, the US was not the only military to relegate local air defence to the 'not a concern' column. The German Bundeswehr phased out both its Krauss-Maffei Wegmann (KMW) Gepard 35mm self propelled anti-aircraft gun system and its Roland Marder based anti-air missile systems by mid-2010.

However, two international developments brought air defence back into the spotlight – first, was the appearance of inexpensive small unmanned aerial vehicles (UAS) and their use by insurgents as in Mosul, Iraq in 2016. Second was their deployment during the Russian military incursion into the Crimea and subsequent conflict with Ukraine.

The introduction of the small UAS challenges the security of a wide range of facilities and activities including military, public, industrial, and government sites. Military concerns such as airfields and bases are suited to commercial 'soft kill' Counter-UAS (C-UAS) systems like DroneShield's handheld DroneGun or stationary fixed DroneSentinel or tripod Drone Sentry. Bill Kramer assistant vice president C-UAS programs at SRC pointed out; "Larger UAS platforms have adopted these improvements significantly increasing the threat they pose .... The most recent example of this was the Abqaiq-Khurais oil refinery attack where large UAS platforms were used to strike oil processing facilities." This demonstrates the clear erasure of any practical difference between the UAS and tactical aircraft.

However, the UAS has made protecting forward combat manoeuvre elements from aerial threats substantially more difficult. It must address the small UAS, larger more capable UAS, remote piloted aircraft (RPA) and tactical air. These targets range from lone or 'swarm' low signature VTOL UAS operating locally in dense ground clutter to a low and fast strike aircraft or tactical missiles delivering precision ordnance in a coordinated attack. Though the 'detect, decide, and defeat' criteria for each may differ, it also is questionable if particularly forward tactical forces can afford to have unique systems to address each of these threats.

FIRST STEP C-UAS

The reaction to the somewhat belated recognition of the threat presented by the small UAS drove particularly the Unite States military to initiate a number of accelerated efforts to get CUAS capabilities fielded. The emphasis was largely focused on defeating these UAS despite a parallel concern over the similar inadequacies in short range tactical air defence in general. A notable and almost coincidental exception was the introduction in 2018 of a new proximity fuse warhead upgrade and introduction of in-flight guidance for the General Dynamics/Raytheon Stinger missile. This new fusing not only enhances the missiles effectiveness against aircraft and helicopter targets but also can be used against the UAS/drone. Threat detection for the Avenger/Stinger SHORADS relies on the AN/MPQ-64 Enhanced Sentinel X-band radar from Raytheon/Thales. Although it has a range of 74km, being trailer mounted it must be set up and operates only stationary. This limits it effectiveness covering fast moving manoeuvre units leaving Avenger/Stinger teams reliant on visual search.

MADIS AND TACTICAL SOFT KILL

The US Marines moved smartly in introducing a true tactical CUAS capability that could be deployed. The Light Marine Air Defence Integrated System (LMADIS) uses a pair of Polaris MRZR light vehicles and can detect, locate, identify, assess, and neutralise a range of UAS platforms. Lee Dingman, president and COO at Ascent Vision, the MADIS provider explained: "It combines radar, electro-optics, and electronic warfare technologies to reliably provide an umbrella surveillance coverage out to 5-6 km both while stationary and on-the-move. It then can conduct a 'soft kill' of the radio frequency controlled or GPS navigation reliant UAS often by jamming

GDLS - DRS

IM-SHORAD uses the Stryker 8x8 platform mounting the MOOG RlwP turret with a 30mm auto-cannon, Stinger ground-to-air missiles, and Longbow Hellfire antitank missiles. RADA Multi-mission Hemispherical Radar and a Wescam panoramic sight provide detection and fire control.

these signals. With a loss of control the UAS may crash or be forced to abort its mission." LMADIS gained significant attention when it was revealed that it had successfully deterred a hostile UAS on 17 July 2019 while operating from a US warship in the Persian Gulf.

SRC also offers its Silent Archer counter-UAS system. Bill Kramer assistant vice president C-UAS Programs describes it as "a tailorable system-of-systems providing a layered sensor and mitigation capability to effectively 'detect, decide, and defeat' each of the five groups of unmanned airborne threats." They use multi-dimensional detection, tracking, classifying, identifying, and disrupting using EO/IR, RF and radar with non-kinetic electronic warfare responses. The Army, in January 2019, contracted SRC to provide a mobile system to counter small, slow and low flying drones. The US Air Force followed in June with a sole source bid to SRC as part of its Medusa system.

USMC GBAD

Building off its MADIS, US Marines GBAD (Ground Based Air Defence) is an initiative bringing drone, aircraft and cruise missile detection, alerting, and tracking together on a single mobile platform. Funds are budgeted for 28 Joint Light Tactical Vehicle (JLTV) mounted systems with a 2022 initial fielding. The first GBAD iteration, MADIS 1, consisting of a Mark 1 system focused on counter-fixed, rotary wing and non-kinetic UAS defeat while the Mark 2 appears strictly focused on detection and both kinetic and non-kinetic defeat of the UAS. A Marine Corp 26 March 2020 Request for Information (RfI) calls for an effective range at least 4km in a mature non-development system. Systems are required for testing by mid-2021 and low rate production in mid-2022. The RfI seeks solutions "that can be integrated into the MADIS".

The MARCORSYSCOM PEO Land System PM-GBAD also lays out a MADIS Future Weapon System that reflects these two vehicles improved to provide a turret launching for Stinger, direct fire weapon (calibre unstated), multi-functional EW, and EO/IR optics. The Mk 2 substitutes a 360 degree radar for the missiles. The Marines have also experimented with a directed energy weapon, the Compact Laser Weapons System CLaWS as an additional option for counter UAS. A prototype is undergoing evaluation. Based on results it could be considered for incorporation into future GBADs.

US ARMY M-LID TO E-LIDS

Leonardo DRS and SRC were solicited in

One of the first C-UAS systems operationally deployed was the LMADIS from Ascent Vision. Fit to Polaris MRZR light vehicles it integrates radar, electro-optics, electronic warfare, and Operator Assist (CUAS-OA) to detect, locate, track, classify, identify and neutralise small UAS.

March 2019 by the US Army to provide the Expeditionary Low, Slow Small Unmanned Aerial Vehicle Defeat system (E-LIDS) which is targeted against Group 1, 2 and low-end Group 3 threats. This is an extension of its early M-LIDS (Mobile-LIDS) mounted on the MATV 4x4 vehicle. Filling an urgent requirement, M-LIDS included two platforms with a .50 machine gun MOOG unmanned weapon station. One is equipped with a telescoping mast electro-optic sight with thermal and day cameras, zoom imaging, and laser ranging to identify a threat. The second uses a radar to detect and track with electronic jamming leading to a 'soft kill'. As it prepared to deliver these first systems for testing, DRS was already looking to enhance the capabilities of the initial designs. Edward House, business development manager Land Systems suggested that "improvements could include up-gunning to a 30mm auto-cannon which would not only better address kill effect against the UAS but expand its ability to engage other aerial and ground targets." The 30mm effectiveness is increased with Northrop Grumman's new programmable fused warhead that offers air-burst, point detonate, and delay allowing effective engagement of a wide range of targets. House continued: "The vehicles could even incorporate 'carry and launch' of its own UAS designed to attack and neutralise, destroy or capture a threat UAS."

IM-SHORAD

To fill its short range air defence (SHORAD) gap in its manoeuvre forces, the US Army is looking to a new system that integrates existing, non-development sensors and weapons on to the Styker A1 8x8 armoured vehicle. Leonardo DRS's solution was selected in mid-2018 and delivered test prototypes in around 12 months. The IM-SHORAD will be capable of addressing fixed and rotary wing aircraft and Groups 1-3 UAS threats. It is configured with the RADA Multi-mission Hemispherical Radar (essentially the same radar used in the MADIS) with AESA (active electronically scanned array) antenna positioned on each corner of the vehicle for detection, locating and tracking threats. Armament consists of a MOOG RlwP turret with a 30mm auto-cannon and 7.62mm coaxial machine gun plus a quad-launcher for Stinger missiles and a dual Lockheed Martin Longbow Hellfire missile launcher. A L3 WESCAM MX-GCS independent panoramic EO/IR stabilised sight with laser ranging and designator provides hunter/killer search and engagement. Identification Friend or Foe IFF interrogator is positioned forward on the turret to eliminate fratricide engagements.

IM-SHORAD is intended as an "interim" solution to provide 144 systems for four air defence battalions. Testing is underway with a production decision the end of 2020. This said, the US Army requirement for SHORAD capability is significantly higher with its air defence battalions currently equipped with the 1990's Avenger. The Army defines the current system as 'interim', however, DRS and MOOG are using the inherent adaptability of the RlwP, open system architecture and capacity of the A1 Stryker to explore enhancements to sensors and weapons anticipating technology advances and updated tactical requirements. Doug White business development manager at MOOG Space and Defence Group indicated that "upgunning is forward. Change out of different missiles is simply basic mechanical and software/electrical fire control interface. Reconfiguring with simple modification kits has already been demonstrated."

HOWLER AND COYOTE

Raytheon's Coyote is the latest CUAS fielding but also one with potential for other mission applications. An early version was used by the US Marines in 2018 to provide UAS hard kill in conjunction with its initial GBAD. Subsequently the company developed a Block 1B version with an RF seeker and proximity warhead for the Army. It uses Ku band radio frequency radar (KRFS) for drone detection and interception. Concurrently it developed an improved Coyote Block 2 with a turbine jet engine, improved sensors and a blast fragmentation warhead with air speed increased to 200 knots (370 kmph), extended loiter time, greater 10-15 km range, and enhanced lethality. This system called Howler couple to its KRFS achieved IOC (initial operational capability) in June 2019 addressing a Joint Urgent Operational Need Statement (JUONS). In March 2020 the Coyote was approved for international sale.

John Hobday, Coyote business development lead explained that "the KRFS high fidelity volumetric properties make it ideally suited for detecting and discriminating aerial targets including those operating extremely low near ground clutter. It, thus, can address a wide range of targets and threat scenarios. In addition, the Coyote operator maintains positive control via a two way data link allowing it to be retargeted or even aborted even after launch." The system is adaptable to a variety of platforms addressing fixed site defence or mobile use. It has been demonstrated with KRFS and launcher integrated onto a single carrier like a


US Army

The Avenger is the current US Army mobile SHORADS asset. The missile uses a heat seeking sensor with a new proximity detonating warhead that is more lethal including against the UAS.

medium tactical truck providing a mobile relocatable system or on a JLTV or other armoured tactical vehicle, and on a transportable "pallet" for stationary fixed site defence.

Hobday emphasised: "Coyote's inherent design adaptability, modularity and low cost lend itself to potential application to other missions and targets. For example a Block 3 version with greater loiter capability is being explored." This adaptability could allow a pod launcher to be loaded with a mix of Coyote missile versions each configured for different roles and targets, like other air threats, armoured vehicles, command and communications nodes, and even opposing air defence systems. With such a configuration the system expands its combat utility and a multi-mission capability on a single platform.

BLADE

The Ballistic Low Altitude Drone Engagement system (BLADE) is another US Army CUAS effort. It is directed toward providing the ability to detect, track, identify and engage small UAS threats using the existing CROWS remote operated weapon system. CROWS with .50 calibre machine gun is currently mounted on tactical vehicles ranging from the MATV and JLTV to the Stryker and M1A2 MBT. BLADE adds a radar and fire control software facilitating hitting the moving target to the existing thermal and day video sighting. Technology prototypes have been tested and the Army has begun to reach out to industry to begin move toward future production systems. BLADE could provide a capability to individual tactical vehicles to defeat the small UAS (sUAS). Whether this addition will also potentially also enhance CROWS primary capability of engaging ground or other non-UAS threats nor the cost and complexity implications remain unclear.

Another piece of the US Army's anticipated future tactical air defence system is the Low-cost Extended Range Air Defence which is intended to provide a smaller more tactical interceptor missile system to address subsonic cruise missiles, unmanned aerial systems and, one may assume, also threat aircraft. This air defence tier between the SHORAD and Patriot High/Medium air defence missile is a critical area and one without a US solution. A Multi-Mission Launcher (MML) has been an internal development by Army research labs since 2012 for the role. MML provided a truck mounted fifteen tube launcher that would accept a number interceptor missiles types. By 2018 in had demonstrated its ability to fire the AIM-9X air-to-air missile, AGM-114 Hellfire, a Lockheed-Martin Miniature Hit-to-Kill (MHTK) kinetic kill missile, and Raytheon/ Rafael Tamir missiles. However, in October 2019 BG Brian Gibson in charge of the Army's air and missile defence modernisation indicated MML would not be further pursued and the interceptor developments were 'paused'. What direction efforts to fill these deficiencies remain unclear.

LESSONS FROM THE .50 CAL

The realisation that the UAS arose as a serious tactical and operational threat has sparked a variety of initiatives by various agencies across all of the services. These tended single mission systems focused solely on countering the UAS, and only Groups 1, 2 and 3 at that. However, at least at the tactical level, the UAS is merely an additional aspect of broader aerial threats. Particularly given the ever increasing interconnection of various aspects of today's battlefields, countering the UAS is viewed as an additional, albeit new element facing SHORAD. It has brought the need to equip and train for self air defence back to the ground force.

The original purpose of M2 .50 calibre machine guns on tactical and combat vehicles was to provide organic unit, local anti-aircraft defence. This was lost in western armies thanks to the guarantee of air superiority and the seeming shift to specialised high technologies. The UAS has back that aerial threat. A

TRIANGULATE TO ACCUMULATE

NATO's CESMO initiative promises a step change in how the alliance collects electronic intelligence offering tactical, operational and strategic advantages.

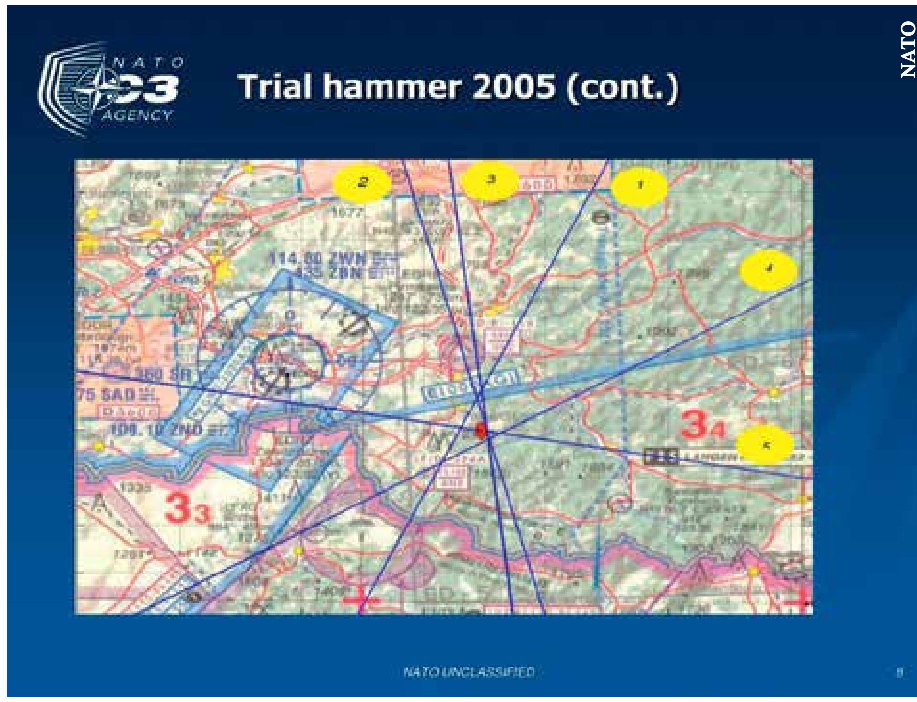
By Thomas Withington

L3Harris

Naval ESMs like the ES-3701 are important tools for collecting ELINT which not only helps to enhance vessel protection, but which can also feed intelligence into the NEDB system.

An accurate, timely electronic order-of-battle detailing the identity of hostile ground-based air surveillance and fire control/ground-controlled interception radars is to the Offensive Counter Air (OCA) battle what Mozzarella cheese and tomato is to pizza. Quite simply the success of Suppression of Enemy Air Defence (SEAD) efforts, a key element of the Offensive Counter-Air battle, is dependent on the SEAD force possessing the most accurate Electronic Intelligence (ELINT) possible. This not only helps the SEAD force ascertain where to direct its kinetic and electronic effects against such targets, but also allows other aircraft to plan their sorties in such a way as to avoid, or reduce, the chance of detection by these radars.

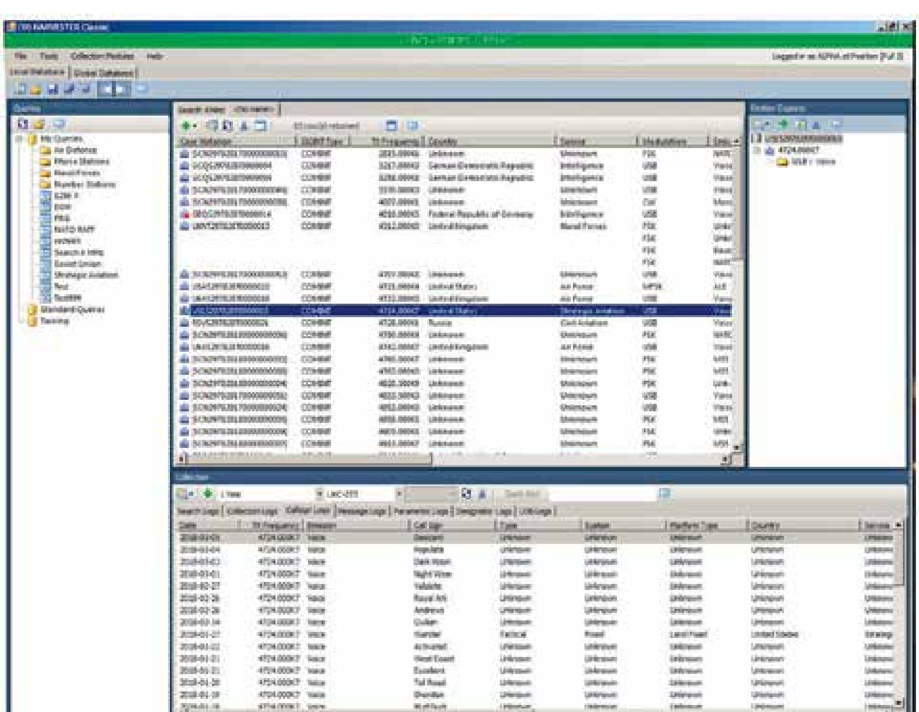
Link-16 remains the standard track and tactical information Tactical Data Link (TDL) used by the North Atlantic Treaty Organisation (NATO) and allied nations during air operations. Few would argue with Link-16's positive influence on air operations. One paper it can support data rates of up to one megabit-per-second, although in practice, data rates tend to be noticeably lower across the 960 megahertz/MHz to 1.215 gigahertz/GHz frequencies



NATO

NATO's Trial Hammer 2005 exercise represented an opportunity to trial the CESMO architecture which is now in service with a number of alliance members.

SIGINT Systems



EW databases are vital tools in the electromagnetic battle as a means of storing and sharing emitter information. The CESMO initiative will help populate these important resources; a process which will be eased by CESMO's use of IP messaging.

it uses, typically hovering around the 115 kilobits-per-second/kbps mark.

The TDL can handle tactical traffic concerning Electronic Warfare (EW), typically the J14 and J14.0 series messages it handles which relate to emitter parametric information and EW control coordination respectively. Parametric information relates to the characteristics of radar emissions in the locale of the operation. Analysing this information will often help to betray the identity of those radars. Once this is known, it is possible to decide which countermeasures will be most effective in neutralising them.

As the TDL is not designed exclusively to handle EW information, with just two albeit important categories of electronic warfare data handled by Link-16, another means of handling EW information in the air environment has emerged known as CESMO (Cooperative ESM Operations). NATO's CESMO initiative performs an elegantly simple function: It detects and locates electromagnetic threats, notably radar, by gathering ELINT collected by several disparate aircraft and federating

Northrop Grumman and Raytheon's AN/ALR-67(V) series of RWRs equipping platforms like the McDonnell Douglas/Boeing F/A-18 Hornet series combat aircraft could share the ELINT they collect across the CESMO network.

this to provide an accurate picture of where hostile radars maybe located at any particular time.

TRIANGULATION

Radars are located using two methods; Angle-Of-Arrival (AOA) and Time of Arrival (TOA). AOA determines the Line-of-Bearing (LOB) from on point to another, in this case an aircraft and a hostile radar. Imagine that three aircraft are flying in the vicinity of a ground-based air surveillance radar. One aircraft is flying towards the radar on a north-south bearing. The second is flying on an east-west radial away from it. The third is flying on a south-north bearing towards the radar. Each aircraft is equipped with a Radar Warning Receiver (RWR). The RWR will detect and identify a radar transmission and determine its LOB relative to the aircraft. All three of our aircraft detect the same radar transmission. The RWR on the first aircraft determines a southern LOB to the radar. The RWR on the second determines a westerly LOB to the radar while the RWR on the third aircraft determines a northerly LOB. By using this information, it is possible to determine the radar's position as the point where all three of these bearings meet. CESMO will compute this point using the ELINT derived from these aircraft's RWRs, and fusing this with the aircraft's positions as derived from their transmitted GNSS (Global Navigation Satellite System) coordinates to determine the radar's location.

TOA works in a slightly different fashion. Sticking with our three aircraft, all of which are continuing to fly the same courses in the vicinity of the hostile radar. One aircraft is 100 nautical miles/nm (185.2 kilometres/km) away from the radar flying on north-south bearing towards it. The second is 150nm (277.8km) from the radar, flying on an east-west radial away from it, and the third is 50nm (92.6km) away from the radar flying on a south-north bearing towards it. Triangulation relies on the fact that radar transmissions travel at the speed of light; 161,595 nautical miles-per-second (299,274 kilometres-per-second). The radar transmissions will take a different amount of time to reach each aircraft's RWR. For the first aircraft it will take the radar transmissions 0.6 milliseconds to reach the plane, for the second it will take 0.9 milliseconds and for the third it will take 0.1 milliseconds. As radar transmissions move at the speed of light, by calculating the difference in time it takes the radar transmissions to reach each of these aircraft relative to the aircraft's position itis possible to calculate where the radar is located.

The presence of noise in the electromagnetic spectrum and the possibility of RF error propagation will mean that the AOA approach will present the location of the hostile emitter as an ellipse around a central point rather than an 'x marks the spot' location. The more measurements that can be obtained vis-à-vis this radar from more platforms the better the location accuracy of the radar becomes. Once a radar is located it can be avoided with aircraft flying outside its detection range. Alternatively, the radar can be engaged kinetically or electronically as part of the SEAD fight. The cool thing about CESMO is that it can employ ELINT sent from the standard RWRs used by combat aircraft for self-protection and from warships equipped with Electronic Support Measures (ESMs) which maybe supporting the operation.

INFORMATION FLOW

At the tactical level, an ESM or RWR will detect a hostile emitter. This information will flow to the Electronic Warfare Coordination Centre (EWOC) supporting a specific air operation which will usually comprise part of the CAOC (Combined

Air Operations Centre). At the EWOC the ELINT sent by these platforms will be analysed and the radar's parameters analysed. As Jonathan Burton, a specialist engineer at 3SDL notes: "This information would then be transmitted back out on the CESMO network as well as provided to the headquarters to support situational awareness." 3SDL is heavily involved in the CESMO initiative, providing consultancy and software support to the UK's Defence Science and Technology Laboratory which is playing a leading role in the realisation of the overall CESMO concept including the CESMO Hub software which implements NATO's Standardisation Agreement 4658 (STANAG-4658). STANAG-4658 governs the CESMO specifications. Within NATO, CESMO is the responsibility of the alliance's Signals Intelligence and Electronic Warfare Working Group. It has been under development since 1995. 3SDL is offering the CESMO Hub as an operational product, Mr. Burton continues. As well as collecting ELINT, CESMO can be used to hoover up Communications Intelligence (COMINT) regarding hostile radios and communications networks.

CESMO uses IP (Internet Protocol) messaging to share SIGINT. For all intents and purposes, CESMO is a message standard used to convey the information discussed above, says Mr. Burton: "CESMO is designed to be bearer agnostic. As such it can use any bearer that supports an IP network," he notes. These IP messages can occupy under 16kbps of bandwidth and sent across existing communications protocols. Furthermore, CESMO is a node-less network as there is no single, central point of control. Should one platform sharing SIGINT be lost, this will not cause the loss of the network. Neither does CESMO handle ELINT in a single direction. As well as sharing SIGINT with the network, platforms can receive timely intelligence in their cockpits giving them an instant view of the location and behaviour of a hostile radar. Mr. Burton continues that the CESMO messaging standard is now in service with several NATO nations. The technology's application is not limited to air platforms: The bearer agnostic nature of the network means that any platform with a radio capable of handling IP data could share and receive CESMO information: "CESMO is designed to support integration into air, land and maritime platforms. A CESMO operation can be conducted with platforms from any and all domains so there is great flexibility to support any individual mission."

NEDB

CESMO has dual benefits in that it can enhance operational and tactical ELINT, while also enhancing ELINT at the strategic level. The alliance uses the NEDB (NATO Emitter Database) as the repository of electronic intelligence which is stored and shared amongst its membership. The NEDB has been in use since the early 1990s as a means by which member nations can share ELINT. For example, the L3Harris ES-3701 ESM equipping a 'Iver Huitfeldt' class frigate of the Søværnet (Royal Danish Navy) may discover a new radar waveform during a routine patrol. This intelligence maybe analysed by the ES-3701 or by ELINT analysts back at base after the mission if the detected emissions fall outside the ESM's threat library. Once analysed, the transmission's details and characteristics can be sent to the NEDB. Alliance members can view this information and load these parameters into their own ESMs and RWR threat libraries so that similar transmissions can be recognised and recorded in the future. CESMO represents an important milestone in the reinforcement of the alliance's overall electromagnetic situational awareness, and that of its member nations. A

DVIDS

UK Minister for the Armed Forces, James Heappey: "There's a responsibility to win the information battle. It's no longer enough to have highly complex systems..."

WINNING THE FIGHT WITH DATA ANALYSIS

The analysis of data, who to distribute it to and how it will be used will be key to winning future conflicts.

By Andrew White

On 18 February, the UK Ministry of Defence (MoD) announced moves to modernise the capabilities of the armed forces thereby allowing them to better operate throughout the 'Information Age'.

Addressing delegates at the Royal United Services Institute's (RUSI) inaugural Strategic Command conference in London, Minister for the Armed Forces, James Heappey described a series of challenges across both contemporary and future operating environments.

"It's no longer enough to have a battle-winning edge in terms of fire power," he warned. "There's a responsibility to win the information battle. It's no longer enough to have highly complex systems; you need all of the data that comes from that system in order to get a better understanding of what the enemy is doing and what the opportunities are to exploit and win the battle."

Supported by key service leaders from the Royal Navy as well as industry, the minister also discussed how the MoD could "counter adversaries in the so-called 'grey zone' through special operations harnessing disruptive technologies such as artificial intelligence (AI) and big data in the cyber domain".

Also speaking at the event was General Sir Patrick Sanders, Commander of the Strategic Command which comprises a rebranding of Forces Command. Sanders explained his intention to "strengthen the foundations of integration within the current force and experiment and develop the capabilities and structures required for the 2030s and beyond".

"This will be achieved in three priority areas: cyber, special forces and multi-domain integration, all are transformative, all are essential," he suggested.

As a result, the development and employment of AI and Machine Learning (ML) algorithms continues to be explored by Special Operations Forces (SOF) not only in the UK but around the world with commanders seeking to optimise the technology to support a range of mission sets including Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) and Situation Awareness (SA).

One of the leading global entities investing deeply in such efforts is the US Special Operations Command (USSOCOM) which in October 2019 conducted its first ever Artificial Intelligence Symposium at MacDill Air Force Base to discuss emerging technologies, trends and capabilities.

The effort was the first tri-service meeting of the Command which was tasked with envisaging an 'AI-enabled future' for the USSOCOM.

The symposium followed a similar event conducted by the US Army Special Operations Command as well as the opening of USSOCOM's Data Engineering Laboratory (DEL) at the SOFWERX facility in Tampa, Florida on 25 September.

At a ribbon-cutting, USSOCOM's Commander General Richard Clarke discussed how 'data' will impact operations and investment in the future before outlining how the Command must move forward in attracting leading data scientists, architects, software developers and system integrators from around the world to "...improve the efficiency and capability of special operations forces".

According to an official statement from USSOCOM, the DEL will also connect to the wider US Department of Defense (DoD) to focus on the "design and development of advanced data techniques including AI, machine learning, and robotic process automation".

"SOF, along with the Department of Defense, is dedicated to advancing our data architecture and analytical tools. We believe this DEL is one of many that will emerge in the future ecosystem across the DoD, the broader US government, and foreign partners," Clarke suggested at the event while USSOCOM's Chief Data Officer, David Spirk highlighted how DEL 'production' will be aligned with USSOCOM AI goals. "This has been a huge, huge capability improvement for us and this is a realisation of what this future is for us," he said..

Specifically, the DEL will support a series of USSOCOM AI/ML projects including preventative maintenance measures in support of the 160th Special Operations Aviation Regiment (SOAR). These aim to predict component failure to optimise flying hours and maintain operational readiness and efficiency.

Additionally, the DEL is also expected to support USSOCOM's Hyper Enabled Operator (HEO) concept which was launched in 2019 to provide enhanced SA, lethality, connectivity, mobility and survivability to SOF operators working in austere environments.

However, arguably one of the most critical SOF-specific mission areas likely to immediately benefit from the application of AI and ML remains intelligence, surveillance, target acquisition and reconnaissance (ISTAR) with programmes including USSOCOM's Joint Geospatial Analytic Support Services (JGASS) II programme which is seeking to enhance geospatial imagery analysis in support of special operations.

According to the publication of a pre-solicitation on 13 February 2020 (USSOCOM is expected to publish a request for proposals by the third quarter of 2020), the JGASS II aims to "support enterprise level Processing, Exploitation, and Dissemination (PED) of imagery related intelligence utilising a variety of advanced geospatial analysis techniques through the development and operation of an enterprise geospatial architecture that includes multiple GEOINT systems and data sets".

DVIDS

US Special Operations Command Chief Data Officer David Spirk, USSOCOM Commander General Richard D. Clarke, and USSOCOM Senior Enlisted Leader Chief Master Sgt Gregory Smith cut the ribbon to officially open the USSOCOM Data Engineering Lab in Tampa.

"Analysts will be expected to produce regional and/or extremely detailed analytical products to support special operations 'Find, Fix, Finish, Exploit, and Analyse' [F3EA] targeting methodology using full motion video; imagery; and geospatial analysis from air, space, ground, and maritime Intelligence, Surveillance, and Reconnaissance assets.

"Analysts will also be expected to perform traditional and advanced PED on electro-optical, infrared, radar, and still frame imagery. Further, Analysts will be expected to work with Measurement and Signature Intelligence and datasets tailored to support Special Operations," official documents highlighted before suggesting this be achieved through AI, ML and 'other emerging technologies'.

INDUSTRY SUPPORT

One industry partner already working with SOF partners across the DoD, as well as partner forces and governments around the world, is Earth Intelligence (EI) specialist Maxar Technologies which is already starting to exploit AI and ML to support a limited number of ISTAR-related mission sets.

In 2021, Maxar Technologies launches its latest six-strong EI satellite constellation-WorldView Legion - which will significantly enhance the ability of SOF to observe image intelligence (IMINT) in 'high demand areas of interest' (AOIs) anywhere in the world up to 15 times in a single 24 hour period. Today, in-service EI satellites including Maxar Technologies' own legacy constellations, retain capacity to revisit AOIs several times in the same period of time.

Speaking to *Armada International*, a Maxar Technologies official described how end users would benefit not only from the rapid increase in revisit times over AOIs but also 30cm resolution and 8-Band VNIR multispectral imaging.

"WorldView Legion will dramatically enhance the operational effectiveness of end users as they seek to streamline decision-making processes," the spokesperson explained before confirming how the combination of commercial technology and innovation including AI/ML, computer vision and data science, would "transform the ever-increasing volume of data into more manageable, valuable, and consumable products and analysis for more timely, meaningful decision-making".

"We're evolving our analytic capabilities and GEOINT solutions to empower customers to go beyond simply describing and diagnosing situations to begin predicting incidents and prescribing intervention," the spokesperson continued before explaining how WorldView Legion will be able to support a range of special operations including 'military mapping for mission support' and 'maritime domain awareness'.

"Planning special operations in remote regions or poorly mapped environments presents unique challenges and risks. It is critical that operators and allies have the

Maxar Technologies' WorldView Legion satellite constellation will benefit from AI/ML algorithms allowing SOF commanders to more rapidly PED image intelligence to plan direct action and special reconnaissance missions.

latest geospatial information, including maps and visualisation tools, to plan, rehearse and execute missions. Maxar's three-dimensional elevation datasets, mosaics and other mapping products will help enhance situational awareness and minimise risks in mission planning," the spokesperson continued.

Defence sources described to *Armada* how IMINT with frequent revisit times and high resolution would assist SOF commanders in the planning and preparation of direct action and special reconnaissance operations anywhere in the world, similar to the US Joint Special Operations Command's Operation Kayla Mueller to capture of kill ISIS founder Abu Bakr Al Baghdadi on 27 October 2019.

"A detailed understanding of the ground as well as pattern of life of a target compound and its surrounding area is absolutely critical to the successful execution of any special operation, particularly hostage rescue operations," one defence source highlighted.

Another SOF-specific special operations support provided by WorldView Legion's increased revisit and resolution rates including Maritime Domain Awareness where SOF units can be tasked to conduct counter-terrorism, counter-piracy, counter-narcotics and (combat) search and rescue missions.

As the Maxar Technologies' spokesperson continued to explain to AI, "nations with offshore territory need to focus their patrolling and security efforts for challenges including illegal fishing, maritime pollution, piracy, smuggling, human and drug trafficking to name a few.

"With WorldView Legion, coordination across our radar and optical satellite, and existing VDS [vessel detection system] capabilities Maxar will help maritime agencies address the myriad of challenges across the maritime domain. By helping focus resources through systematically detecting and identifying suspicious maritime activities, SOF will be able to enhance their ability to evaluate, prioritise, and respond faster than ever before.

Despite promoting AI/ML support in these types of special operations mission sets, the spokesperson also warned how the community was not fully trusting of AI/ML capabilities.

"It is operationally effective today but not yet fully trusted," he highlighted. "EI must bring back the data and form conclusions, leveraging ML in a time frame with WorldView Legion fast enough to react to something seen with one sensor that could be rapidly updated with a second sensor.

"AI processing is getting faster and faster, largely because of advances in Cloud technology, better hardware and algorithms. The time taken to extract valuable and actionable information from IMINT is getting impressively short," the spokesperson added.

As a result, the international SOF community continues to push companies like Maxar Technologies to 'shorten timelines' associated with data processing and exploitation.

"WorldView Legion will push data into the Cloud to run algorithms at scale against the content and deliver out an end product to end users with additional capabilities included 'Automated Change Detection'- another application which could act as a trigger for special operations."

Elsewhere, Booz Allen Hamilton is also pressing ahead with the support of special operations with the continued development of its Modzy AI solution which has applications for special operations with rapid access, evaluation, deployment, embedding and management of AI models at scale.

Launched in November, Modzy provides customers with a platform and model marketplace for the upload, management and re-use of AI models to reduce risk in operations. Applications could include the exploitation of Open Source Intelligence (OSINT) to identify high value targets and military equipment in addition to 'Overhead Building Detection' and facial recognition- two more SOF-specific mission areas which Dr Josh Sullivan, senior vice president at Booz Allen Hamilton highlighted to *Armada*.

Sullivan described Modzy as an "open architecture software solution available to customers on-premise, in the cloud, or via custom deployments" providing API access, built-in governance, adversarial defense, and explainability, the latter of which is described as one of the "toughest challenges related to scaling trustworthy AI".

"The Modzy platform can be used to govern and manage customers' own models for special operations applications, with customers interested in its ability to solve the last-mile challenges of AI at scale. Some of the use cases we've heard from defence clients include unique models that provide computer vision capability, including an aerial building segmentation model that can detect, mask, label and return information about buildings found in satellite imagery in order to assess building damage more quickly and with better accuracy more to aid in disaster relief efforts.

"Or, a military equipment classification model that can analyse JPEG images and classify the images into one of 87 military equipment classes, making it easier for analysts to process large set of images into different military equipment categories," Sullivan concluded.

CONCLUSION

Although the potential for AI/ML support of special operations remains strong in potential, much work must be undertaken by the international SOF community in terms of not only better understanding the technology but also providing the means for operators to truly trust it moving forward. 🅰

DEFENCE INDUSTRY AND SIGNALS OF THE NEW NORM

Andrew Hunter

COVID-19 is changing the world at an unprecedented pace. The disease spreads with amazing speed and terrible consequences in terms of health and lives. Within the space of a few weeks, the world economy went from healthy, to devastated. Industries as varied as aviation, energy, entertainment, and retail experienced sudden stops that are likely to drive a huge number of businesses out of the market permanently. Associated job losses have eclipsed all historical precedents, including even the pace of job losses at the start of the Great Depression. The rapidity of the pandemic's impact gives rise to the question of how long the downturn will last and how quick a recovery might be. In other words, which of the changes the virus has wrought will be enduring, and which are simply artefacts of the crisis to be forgotten shortly after the crisis abates?

The defence industry offers an interesting case study. In many ways it has been sheltered from the worst of the crisis. While demand for defence goods has dropped more in some countries than in others, defence is an inherently slow-moving business everywhere where contracts are typically long-lived and often pre-funded, meaning that work can continue for months or even years after funding concerns develop. The defence industry was designated as critical infrastructure by the US government, as well as many other nations, meaning that few defence facilities closed while much of the rest of the economy was shuttered. US defence spending actually increased in the near term as a result of stimulus efforts that included purchasing medical equipment through defence contracts. The US government also accelerated payments on its defence contracts which has increased cash flow to industry's coffers. As a result, many defence companies have reported steady or even increased earnings in the first quarter of 2020.

But despite the sheltered nature of defence industry, the impacts of the pandemic remain notable. While military orders have not decreased, industry has struggled in many areas to keep work on track and keep deliveries on schedule. While industry operations have continued, they have had to be modified for social distancing requirements and supply chain disruptions. This is particularly challenging in industry facilities like shipyards, where significant work has to be done in confined spaces, and in facilities for classified work that can't be done from home. In these facilities, social distancing has required a change to shift work to control the number of people working together at one time. Absenteeism as result of either illness or lack of childcare resulting from school closures has also impacted production. Lockheed Martin has indicated that it will see reduced deliveries of F-35s in 2020, and the US Department of Defense (DoD) has indicated that billions of dollars of work is likely to slip from 2020 to later years, driving cost increases.

For much of the white-collar side of the defence industry, working from home has quickly become the norm, and travel has also been sharply reduced. Industry has actually seen cost savings from these shifts. Increased work from home has already led industry to scale back leases of office space that isn't being used, and likely won't be used in the year ahead. Travel has been largely replaced by video conferencing; whose moment has unequivocally arrived. Video conferencing as a replacement for face-to-face meetings and conferences has proven surprisingly productive. Already CFOs throughout industry are making plans to harvest these savings for the long term. Because the shifts in defence industry are being driven by the more mundane impacts of the virus, rather than the economic sudden stop the virus generated, it is likely that the changes will endure even as the crisis eases and the economy begins to move towards a new normal. In this way, the defence industry is giving us a signal of where this new normal is likely to settle.

Before lighting any cigars in celebration of how the defence industry survived the crisis largely unscathed, keep in mind that two major hurdles remain. The first is imminent, and it is the equivalent of a looming fiscal cliff. In the US, the world's largest defence market, the reason why disruptions have been mostly minimal so far is that the US government has agreed to pay industry for COVID-related leave and has issued trillions of dollars in loans to businesses to keep them operating though economic shutdowns. Unemployment insurance has propped up incomes to keep consumer demand from collapsing despite the rampant job losses. However, much of this assistance is slated to be sharply scaled back in the next month. If this fiscal cliff isn't pushed back by new legislation, the economy would likely experience a second nosedive, and key sectors related to the defence industry will pay a heavy price. These include the aviation and automotive sectors, where there are strong overlaps with the defence supply chain, especially among smaller suppliers who are uniquely vulnerable. If these suppliers go under, the delays in defence deliveries will likely be significantly more pronounced, suppressing industry revenues. Longer term, the huge scale of government expenditures to fight the health and economic crises from COVID are likely to serve as a significant constraint on defence spending going forward. This is likely to be a world-wide trend, limiting the extent to which industry can turn to other markets to replace the revenue they lose domestically. To succeed in a market of slow to non-existent growth, internal cost-cutting measures in government and in industry may once again compete forcefully for leadership attention against investing in long term growth and strategic competition. A


MANPACK
SENTRY-H 6110-MP
One of the smallest and lightest manpack radios on the market.
• 30W power, up to 79 hours, less than 4.7kg
• Software Defined Radio (SDR)
• Secure Digital Capability
• Customisable to your mission
• Global service and support
CODAN
COMMUNICATIONS
CODANCOMMS.COM
BE HEARD
ON THE FRONT LINE
TACTICAL COMMUNICATIONS SOLUTIONS