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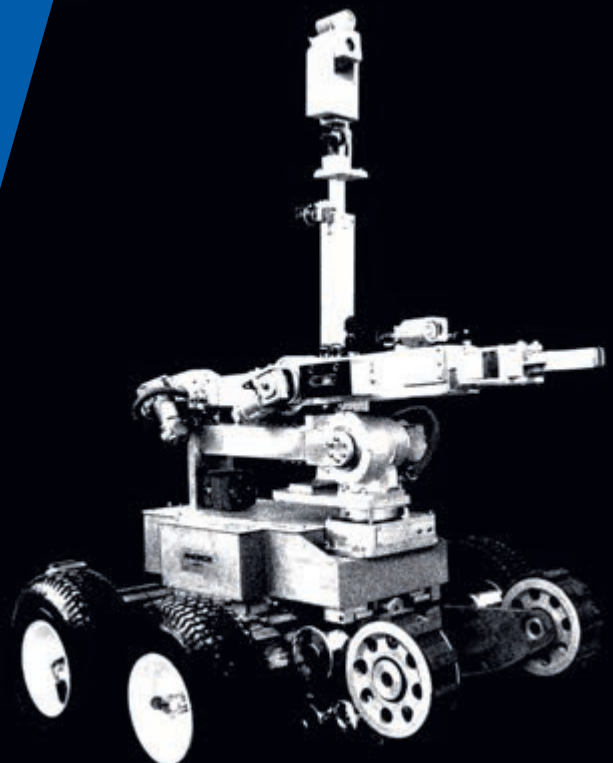
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3 Editorial Comment

Publicity stunt or not, Amazon's 'delivery by drones' announcement has raised some interesting points, argues Editor Andrew White.

News**4 Mixed fortunes for European MALE ambitions**

A review of the latest developments from around the unmanned systems industry.

10 Sea monsters

Moves to develop and field substantially larger AUV platforms than those currently in service could open up a whole new range of capabilities and missions. Andrew White assesses the state of the art.

15 Every second counts

The perennial problem of analysing UAS-gathered intelligence quickly enough to command an appropriate response by troops in contact is being tackled by some innovative software and network solutions, Peter Donaldson discovers.

22 The rise and fall

With fluctuating investment over the past few years, the future of unmanned lighter-than-air technology is in doubt. However, a number of programmes remain active and are providing valuable capability in-theatre, Beth Stevenson reports.

28 Wider focus

Maturing technologies such as SAR/GMTI and FOPEN radars are opening up new possibilities for UAV operations. Tom Withington rounds up recent developments in this field.

**33 Unfamiliar terrain**

Traditionally not seen as a primary market for UGVs, Southeast Asia could be a future source of big business for developers, argues Angus Batey.

39 Keep on running

As militaries look to transition more unmanned systems into their core equipment sets post-Afghanistan, Claire Apthorp looks at how OEMs will provide long-term support for those fleets in future.

44 Relocation package

Lt Col Bede Galvin of the Australian Army's 20th Surveillance and Target Acquisition Regiment talks to Andrew White about the role of the service's Shadow 200 fleet post-Afghanistan and its plans for future UAS procurements.

Front cover: LTA ISR platforms face an uncertain future. (Photo: US Army)

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Pie in the sky?

Whether it was a clever publicity stunt or not, Amazon's idea to deliver packages to customers by UAV has raised some interesting questions in the unmanned arena.

Dubbed 'Prime Air' by Amazon's next-generation R&D laboratory, the proposed solution would use VTOL aircraft, similar to those sold on its website, to pick up packages from a distribution warehouse and deliver to a customer address.

'It looks like science fiction, but it's real,' Amazon brazenly admitted, before adding: 'From a technology point of view, we'll be ready to enter commercial operations as soon as the necessary regulations are in place. The FAA is actively working on rules for unmanned aerial vehicles.'

A company statement continued: 'Yes. One day, Prime Air vehicles will be as normal as seeing mail trucks on the road today... safety will be our top priority, and our vehicles will be built with multiple redundancies and designed to commercial aviation standards.'

Responding to these far-fetched ideas was the UK's CAA, which remains reasonably open-minded about the proposals, with a source telling *Unmanned Vehicles*: 'I suppose you can never say never. As always though, provided that an operator can provide us with sufficient proof that the intended operation is safe, then there is no reason to say no.'

In 2012, it was reported that Amazon was making 306 online sales per second at its peak. Imagine the number of VTOL UAVs that would litter the skies should any sizeable proportion of these orders be delivered by Prime Air. Would there be VTOL superhighways in the sky? What altitudes would they operate at to deconflict with

military users, first responders and civilian traffic? Would they be compulsorily equipped with collision avoidance technology? The list of questions is endless.

As the CAA source added: 'There is still a long way to go before this could be a reality, particularly on the more practical sides – battery endurance, reliability, control, collision avoidance, the safety of the people you are delivering to, what happens if you are out when it arrives. What do you do about returns?'

'Basically, it was a good publicity gimmick which was timed perfectly to coincide with what is apparently the busiest online shopping day in the year and they got a massive amount of free advertising from it from all of the broadcasters.'

However, is this idea really so implausible? A medical specialist company called Transplant and Transportation Services (TTS) announced in December that it was involved in R&D to have unmanned aircraft deliver transplant organs to hospitals.

Currently, private aircraft are used to distribute such items. However, TTS stated: 'Reducing safety risks, increasing operating room utilisation through flexible timing, surgeon cooperation and collaboration, and significant cost savings are just the beginning of what we all have... to gain from the use of these machines... the benefits will change transplant and potentially the entire healthcare industry.'

As the unmanned sector continues to deflect criticism of so-called 'drone strikes' in the Middle East and south Central Asia, detractors of such technology would do well to consider its wider applications and the good it can bring across a variety of other sectors.

Andrew White, Editor

RESPONSE

Unmanned Vehicles' editorial team is always happy to receive comments on its articles and to hear readers' views on the issues raised in the magazine. Contact details can be found on p1.

IN THE NEXT ISSUE

- Asian UAV market
- UGV navigation
- Harbour protection
- Parapublic robots

Mixed fortunes for European MALE ambitions

The Dutch MoD is pushing ahead with plans to procure the MQ-9 Reaper, while German aspirations to acquire a similar capability remain questionable following recent coalition government negotiations.

Having cancelled a previous project to procure a MALE UAV in 2007, the Netherlands will acquire four air vehicles, according to information provided by the Dutch parliament on 21 November. A formal contract will be signed in early 2015 and procurement will be conducted through the US FMS programme.

The Dutch RfI stipulated that the new system should be able to conduct '24/7' surveillance over a six-month period while also calling for an individual UAV endurance exceeding 24 hours.

Manufacturer General Atomics teamed up with Fokker Technologies in the Netherlands to win the tender. IAI's Heron TP was also a contender.

Once in service, the MQ-9 will provide a wide range of ISR capabilities to the Dutch military, including target acquisition and battle damage assessment, while the aircraft will also be used to support national tasks in cooperation with civilian authorities. Destined to operate on behalf of the Netherlands Coastguard as well, the new system should reach initial operational capability in late 2016, while full operational capability will be achieved one year later. The platforms will be operated by 306 Squadron out of the Royal Netherlands Air Force base at Leeuwarden.

Meanwhile, Germany's largest political parties – the Christian Democrats (CDU/CSU) and the Social Democrats (SPD), who oppose the arming of UAVs – agreed to form a coalition on 27 November, after lengthy negotiations

following federal elections on 23 September. The new government is not expected to take office until mid-January.

Defence Minister Thomas de Maizière and the Chief of the German Air Force, Gen Karl Müllner, continue to defend plans aimed at procuring armed UAVs. The German MoD wants to acquire a total of 16 new MALE aircraft as part of its SAATEG or Long Range Theatre Reconnaissance programme. Original projections had envisaged the purchase of 22 UAVs.

However, defence sources in Germany are concerned that procurement of an armed UAV capability could be seriously threatened by the 'Shaping Germany's Future' document which the CDU/CSU and the SPD have agreed to sign.

Speaking in April at the Kooy UAS Symposium in Amsterdam, Col Jörg Dronia, branch chief of strategic planning (air, space, cyberspace) at the German MoD, confirmed that Berlin was looking at acquiring five military-off-the-shelf 'bridging' solutions, capable of entering service from 2016. However, these stop-gap platforms will not be weaponised in the short term before the remaining systems go operational by 2025.

The German Air Force is also said to favour the MQ-9 Reaper over the Heron TP due to its superior payload and growth potential, as well as high levels of interoperability with coalition partners.

The German and Dutch armed forces have recently been investigating pooling and sharing arrangements with regard to the joint acquisition and sustainment of UAVs, while also contemplating joint training and conduct of operations.

By Pieter Bastiaans, Breda



The MQ-8C reached an altitude of 500ft on its second flight. (Photo: USN)

MQ-8C makes first flight

The latest variant of the USN's Fire Scout UAV flew for the first time on 31 October, staying airborne for a total of 16 minutes across two test flights, service officials have revealed.

The VTOL MQ-8C is based on the Bell 407, a larger helicopter in comparison to the in-service MQ-8B, which utilises the Schweizer 333 airframe. The new model aims to provide additional endurance, payload and range for the navy and was also developed by Northrop Grumman.

Designed to fly for twice as long as its predecessor and with three times the payload, the 'C'-model will be capable of 12-hour endurance and will carry a 1,180kg payload during a 24-hour orbit.

The testing, which occurred at Naval Base Ventura County in California, was used to validate autonomous control systems and was operated by a ground-based military and industry team. The aircraft reached an altitude of 500ft during the second flight.

'First flight is a critical step in maturing the MQ-8C Fire Scout endurance upgrade before using the systems operationally next year,' Capt Patrick Smith, Fire Scout programme manager at Naval Air Systems Command, said in a statement.

The MQ-8C is expected to undergo a quick reaction assessment and the intent is to have a system that can be deployed in Q3 2014. The navy has a requirement for 30 aircraft, two of which will be used for the test programme.

By Beth Stevenson, London

Challengers emerge to Western UAV dominance

The sovereignty of Western UAV manufacturing has been challenged as details emerge regarding the latest developments in Chinese and Iranian systems.

Media reports coming out of Iran have pointed to the development of a new UAV which bears a striking resemblance to the Israeli IAI Heron aircraft. Elsewhere, it has been reported that China has conducted the first flight test of its Lijian ('Sharp Sword') UCAV.

According to the Islamic Republic News Agency (IRNA), Iranian Defence Minister Mohammad Dehghan unveiled Fotros – the country's largest indigenous strategic platform to date – on 19 November.

It is claimed that Fotros will be able to reach an altitude of 25,000ft with 16-30 hour endurance. It is also believed it has an operating radius of some 2,000km, while in addition to ISR taskings, the aircraft can be armed with missiles and surface-to-air rockets for combat missions.

IRNA said the vehicle had been successfully tested, demonstrating that 'sanctions are not an obstacle to the progress of the Iranian defence industry'.

'Whilst it is always sensible to be questioning Iranian announcements of new military hardware, the recent unveiling of the Fotros, as well as earlier activities, reflects a desire across the Middle East to acquire UAV technology,' George Lawrence, associate at Renaissance Strategic Advisors, commented.

Iran has been rapidly developing its UAV capabilities in recent years, most notably when it downed a US ScanEagle and reverse-engineered it to develop the Yasseer aircraft.

Elsewhere, according to Chinese media sites, the Sharp Sword conducted a 20-minute maiden flight from Nangchang on 20 November.

'In China, the emergence of the Sharp Sword and Soaring Dragon UAVs underscores that country's investment in aerospace technology and ISTAR assets,' Lawrence noted. 'In the future, these systems have the potential to compete with Russian and Western systems in specific regions.'

Notably, on 25 November, Beijing declared an 'air defence zone' over the Diaoyu Islands in the East China Sea – whose territory is disputed by China and Japan –



Fotros is Iran's largest indigenous strategic platform to date. (Photo: Iranian MoD)

which dictates that all aircraft passing over the area have to report to the Chinese authorities.

The Huanqiu news site claimed that China is looking to develop unmanned aircraft of all specifications to match US capabilities, including converting retired J-6 fighter aircraft into UAVs to monitor the Diaoyu Islands.

Huanqiu also claimed that although US MQ-9 Reapers are advanced, they also come with a price tag of \$30 million, while Chinese-developed UAVs sell for only \$1 million, which could make them appealing.

Larry Dickerson, unmanned systems analyst at Forecast International, told *Unmanned Vehicles*: 'Potential customers will not be falling over each other to purchase Chinese or Iranian UAVs. There could be export orders from countries that are allies of these nations and others that want an inexpensive system to meet moderate local requirements.'

There is likely to be a market for Chinese UAVs, according to Lawrence, in particular in Southeast Asia, Africa, South America and parts of the Middle East, where they can compete with Russian and Western capabilities: 'China has the potential to take the part of the market that Russian aerospace firms have historically dominated.'

'The deployment of UAVs by Iran and China will force potential adversaries to modify their plans should a conflict arise,' Dickerson added. 'Whether UAVs will provide either nation with an advantage depends. Neither has much experience in the operational use of UAVs. Developing expertise and doctrine will take years.'

By Beth Stevenson, London

On the web

TAF Anka crashes during operational testing
12 December 2013

USN unveils submarine-launched UAV
11 December 2013

Cosair unveils generic UAS training system
4 December 2013

ASV C-Target 9 boats delivered to South Korea
25 November 2013

DHS assessing TCOM aerostats for border security
21 November 2013

AHammerHead demonstrator completes maiden flight
19 November 2013

Camero launches structure-penetrating ISR UAV
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Bat UAV integrated with electronic attack payload
15 November 2013

Saab's Skeldar UAS finds its wings
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Future UAV 'super satellite highway' makes progress
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US FAA plans to end segregation

The US FAA has released its first UAS roadmap aimed at facilitating and guiding the integration of civil platforms into the national airspace system (NAS).

The 'Integration of Civil UAS in the NAS Roadmap' was launched on 7 November, and will guide the 'transition from UAS accommodation to UAS integration', it reads.

The FAA's near-term focus will be to safely accommodate UAS utility, followed by a shift to integration, with a long-term focus on the refinement and updating of regulations, policy and standards.

'The end state is to implement streamlined processes for the continued integration of UAS into the NAS,' it notes. 'The safe integration of unmanned aircraft... is a significant challenge. The FAA is dedicated to developing the technical and regulatory standards, policy guidance and operational procedures on which successful UAS integration depends.'

The paper said that it will align procedures with the Congressional mandate that is included in the FAA Modernization and Reform Act of 2012, which outlined that six UAV test sites would be established, and that

small UAS – weighing less than 2kg – would be allowed to fly under certain restrictions.

The test site solicitation was originally slated for 2012, although delays have meant that no decisions have yet been made. It is understood that 25 bids from 24 states were submitted.

In August, Deputy Secretary of Transportation John Porcari told the AUVSI Unmanned Systems conference in Washington, DC, that the six UAV test sites for flight testing will be established by the end of the year.

By Beth Stevenson, London

UN urged to outlaw killer robots

A pressure group seeking to outlaw fully autonomous UAVs has secured a UN mandate to discuss the potential prohibition of such technology.

The Campaign to Stop Killer Robots stood before representatives of the signatory states to the UN's Convention on Conventional Weapons (CCW) in Geneva on 15 November to call for legislation that will ultimately prohibit the development and deployment of fully autonomous unmanned systems.

The parties to the CCW, whose purpose it is to ban or restrict weapons considered unjustifiable, agreed to convene between 13-16 May to discuss questions relating to 'lethal autonomous weapons systems'.

Although the relevant technology does not yet exist, and operators and designers of UAVs claim that there will always be a human 'in the loop', campaigners believe that development is 'moving rapidly' towards too much autonomous control in the systems.

'The Campaign to Stop Killer Robots believes that robotic weapons systems should not be making life-and-death decisions on the battlefield,' a statement from the organisation

explained. 'That would be inherently wrong, morally and ethically.'

'Fully autonomous weapons are likely to run afoul of international humanitarian law, and there are serious technical, proliferation, societal and other concerns that make a pre-emptive ban necessary.'

The International Committee for Robot Arms Control (ICRAC) supported the campaign, with chairman Noel Sharkey announcing: 'We are now on the first rung of the international ladder to fulfil our goal of stopping these morally obnoxious weapons from ever being deployed.'

In the UK, academic Sharkey is best known for his appearances on television programmes including *Robot Wars*, which pitted remote-controlled UGVs against each other.

The agreement comes seven months after the launch of the Campaign to Stop Killer Robots – a global coalition of 45 NGOs in 22 countries which calls for a pre-emptive and comprehensive ban on the development, production and use of fully autonomous weapons.

Supporters of the campaign have used the successful flight tests of the USN/Northrop Grumman X-47B UCAV demonstrator this



Opponents to development of UCAVs are happy to have the subject discussed at UN HQ in New York. (Photo: UN)

year as an example of a platform that has demonstrated fully autonomous operations.

Responding to the criticism, an industry source told *Unmanned Vehicles*: 'The mandate is on autonomous weapons, not autonomous systems. X-47B is an autonomous system... and it does not carry weapons. The X-47B doesn't even carry a sensor like EO/IR or SAR as it is a demonstrator for carrier integration.'

'Other UAS do carry sensors and based on the area of interest, these are "manned" to find, locate, track targets. [I] can't imagine there ever to be time when a weapon would be deployed without a decision-maker in the loop,' the source concluded.

By Beth Stevenson, London

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Sagitta enters integration phase



Sagitta is due to fly for the first time in 2015, and will be used to research a number of UAS technologies. (Image: Cassidian)

Cassidian's next-generation UAV design project, Sagitta, has entered into an integration phase ahead of its maiden flight in 2015, the company has revealed.

The move means integration of the first software and hardware components has started, which will enable the company to study the aerodynamic behaviour of the aircraft's blended wing configuration. Production of the first carbon fibre structural components started earlier this year.

Sagitta aims to bring the company together with research institutes to test technologies that are required for autonomous flight. It involves the development of a 1:4 scale demonstrator that will be used to research different areas of UAV technology.

'Sagitta was never intended to fly at full size because the demonstrator is much more cost-efficient, while the scientific results are the same,' a Cassidian spokesperson told *Unmanned Vehicles*. 'The focus is purely on a flying research demonstrator with a 3x3m configuration.'

Wind tunnel tests took place throughout 2013 to generate an aerodynamic data set, while 'more elaborative' studies are currently under way to further research the aerodynamic optimisation of leading edges and flaps, the spokesperson added.

'Major integration will have to finish at year-end [2014] to allow sufficient time for ground testing to achieve system acceptance readiness prior to summer 2015,' he noted, referring to the first flight of the demonstrator. 'The first flight campaign in 2015 will therefore explore the behaviour of the

overall system step by step without stretching the flight envelope too aggressively.'

The first flight test will mark the end of the initial phase, while potential further stages currently being negotiated may carry on until 2017.

Initial research areas will focus around task-based mission planning and execution using the integrated onboard sensors, before the demonstrator layout has to be upgraded for research areas that require structural adaptation of the aircraft, such as morphing and thrust vectoring, according to the spokesperson.

The demonstrator will be equipped with an EO/IR turret as well as stratospheric cameras, which are expected to be integrated once first flights have validated the stability and controllability of the system.

'The experience gained in such an R&T programme is an invaluable complement to our overall UAV know-how,' the spokesperson noted, adding there is currently no government funding or participation in Sagitta, although this is currently under negotiation.

By Beth Stevenson, London

Adcom unveils new HALE UAV

Abu Dhabi-based Adcom has expanded its UAV family by unveiling the Global Yabhon at the Dubai Airshow last month.

Described by Ali Al-Dhaheri, general designer and CEO of Adcom, as 'the ultimate HALE' UAV, it features the same twin-wing configuration as the United 40 MALE UAV, which was launched at the same event two years ago.

Al-Dhaheri told *Unmanned Vehicles* that the platform was two to three weeks away from entering wind tunnel tests and the first flight would be in about six months.

He added that because it features the same configuration as the United 40, which is

currently under a production contract with an undisclosed customer, it gave Adcom the confidence to meet this timetable.

The Global Yabhon features 18 hardpoints for weapons (4x300kg, 4x200kg and 10x100kg), allowing a variety of payloads to be carried on the same flight.

The two-wing configuration allows the company to keep the centre of gravity in the middle of the aircraft, which has a wingspan of 23m, an empty weight of 3.5t and a maximum take-off weight of 10t.

In terms of flight performance, the Global Yabhon has a stall speed of 54kt, cruise speed

of 270-400kt and a ceiling of 50,000ft. 'It can take off from paved and unpaved runways and has a very low landing and take-off speed, almost like a glider,' Al-Dhaheri said.

Like the United 40, the larger UAV features a retractable EO/IR sensor, which the company also plans to develop using COTS components.

Alongside the Global Yabhon, the company displayed a naval variant of the United 40, which is also designed to be armed and is capable of carrying up to eight Namrod air-to-ground missiles.

By Tony Skinner, Dubai

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Sea monsters

Moves to develop and field substantially larger AUV platforms than those currently in service could open up a whole new range of capabilities and missions. **Andrew White** assesses the state of the art.

First rising to prominence in the USN's 2004 'Unmanned Undersea Vehicle Master Plan', it appears that major steps are currently being undertaken to bring large displacement (LD) UUVs to fruition.

In 2013 alone, both the USN and DARPA launched projects designed to consider the development of such a capability, with industry days aimed at gauging the interest of primes and specialist companies.

Both organisations remain tight-lipped, with neither able to comment on the record. However, *Unmanned Vehicles* has gained perspective on both projects through various interested industry parties.

WEIGHT CATEGORIES

In the USN master plan, the LD 'mission-reconfigurable' UUV is defined as measuring over 20,000lb (9,070kg) in water displacement. This compares to 'man-portable' systems at 100lb (45kg) or less, 'lightweight' at around 500lb (225kg) and 'heavyweight' at approximately 3,000lb (1,360kg).

The only remaining detail in the master plan recommended that the 'large vehicle class' be compatible with both 'surface ship (Littoral Combat Ship (LCS)) and submarine (SSNs with hanger or "plug" and SSGN) use', the report reads.

Additionally, the USN highlighted nine 'sub-pillar' roles which all of its four UUV classes must be capable of performing. In order, these include: ISR; oceanography; communication/navigation network node; MCM; ASW; inspection/ID; payload delivery; information operations; and time-critical strike.

Run by the Naval Undersea Warfare Center's Newport Division, the LD UUV industry day defined requirements for such a system to be easily 'transported to/from worldwide port facilities or carried by/deployed from LCS, SSGN and SSN' platforms.

Additionally, official documents described demands for 'sufficient range and endurance to provide the fleet with a capability to autonomously complete missions in the current mission set and expected future missions under development', as previously mentioned under the navy's sub-pillars.

Conducted on 16 October, the 'SECRET'-level briefing is understood to have informed industry of the technical requirements and an assessment of technology maturity. It was led by the Unmanned Maritime Systems Program Office and the Program Executive Office for LCS. The navy was unavailable to officially comment on the briefing, but sources informed *UV* that it did not include an RfP.

However, it is understood that a solicitation will follow in a 'year or two', according to individuals present at the briefing.

FORCE MULTIPLIER

The other concept is DARPA's Hydra, which is aimed at developing a 'distributed undersea network of unmanned payloads and platforms to complement manned vessels', according to the organisation. 'The system would innovatively integrate existing and emerging technologies to deliver various capabilities above, on and below the ocean's surface. By separating capabilities from the traditional platforms that deliver them, Hydra would serve as a force multiplier, enabling faster, scalable

and more cost-effective deployment of assets wherever needed.'

Based on the navy's nine-pillar hit-list, Hydra will comprise a series of payload modules capable of being plugged into a 'standardised enclosure' which could securely 'transport, house and launch' them while sustaining payload functionality for 'weeks to months'.

'The Hydra system would emphasise scalability, rapid reconfiguration and maximisation of payload. Naval forces could deliver the Hydra system by ship, submarine or airplane to littoral ocean zones,' the agency added.

Benefits of such CONOPS would be the 'seamless' conduct of operations on, above and below the waves, with specifics including: an increased operational reach via beyond line-of-sight C2; enabling of new capabilities currently neglected on manned platforms (such as 'forward deployed airborne ISR with expendable platforms' and 'recharging hubs for ISR-capable undersea vehicles'); and an ability to integrate future payloads in years to come.

Both industry days attracted keen interest from primes and SMEs alike. *UV* understands that large companies including Lockheed Martin and Northrop Grumman are both interested, although neither was prepared to comment on either programme.

NICHE PRODUCTS

However, the smaller, niche AUV specialists are expected to provide the expertise necessary to develop such systems. Bluefin Robotics' president and CEO, David Kelly, explained to *UV* how the USN's industry day had been 'well attended, as you'd expect'.



The USN's Advanced SEAL Delivery System mounted on a submarine off the Hawaii coast prior to the programme's cancellation in 2006. (Photo: USN)



The Proteus UUV is driving Bluefin Robotics' push towards larger systems. (Photo: Bluefin Robotics)

'We were there. People were looking forward to what requirements and associated capabilities will be required to support [LD UUV],' he said. 'The programme is driving technology, especially in the desired endurance of the vehicle, which is much higher than current AUV platforms. This poses challenges in the areas of energy and levels of sophistication and autonomy to go with conducting multiple operations without human intervention. It is in the early phases of the programme to determine this.'

Bluefin has been working on such a 'theme' with Battelle and The Columbia Group. Their solution, named Proteus, comprises a 60in (150cm) diameter vehicle, based on a free-flooded manned platform that was automated in a period of nine months. As *UV* went to press, Kelly announced that the platform was undergoing integration testing.

Described as a test vehicle, Proteus is 7.8m in length and builds on Bluefin's existing range of AUVs which comprise 9, 12 and 21in diameter platforms. 'It is much larger in diameter and slightly longer than our platforms to date, and has a dual mode – manned and unmanned,' Kelly noted.

To date, Proteus has completed 100 hours of manned and 175 hours of unmanned testing. 'Proteus does have some additional capabilities, like vertical and horizontal thrusters, active trim capability, and can go at higher speeds than base vehicles. We are now moving into advanced behaviours to support potential mission needs,' Kelly said.

Highlighting additional CONOPS elements, he mentioned 'hovering capability, bottoming capability and working a way up to being able to have multi-day operations without human direct intervention'.

'The objectives of LD UUV are to have multi-week type endurances – most AUVs today are one to three days in endurance – and an ability to land on the [sea bed] and go dormant, then re-engage and continue.'

Bluefin describes Proteus as an extrapolation of 'next-generation free-flooded design' AUVs which are capable of carrying larger payloads. More specifically, payload capacity is 4.8m³, or 1,630kg in a dry cargo hold. However, as always there is a trade-off between energy and payload, Kelly pointed out.

ON THE DOCKS

Based on a potential design created for a swimmer delivery vehicle, Proteus has raised issues regarding logistics and handling. So far, the vehicle has been launched from a dock, but other 'host' systems such as larger submarines have been mentioned.

Meanwhile, Kongsberg subsidiary Hydroid told *UV* that it is currently testing an automated launch and recovery system for an undisclosed customer. The initiative involves underwater docking, which company marketing director Graham Lester said is of interest to both military and marine research users.

'AUVs can spend up to 120 days underwater at a time. By docking underwater, this could be extended to 240 days at a time and we could see vehicles "flying" between different [underwater] docks,' he explained. 'It can be applied to any size of AUV.'

Back at Bluefin, Kelly proclaimed: 'We will look at CONOPS and lessons around handling capabilities. The community doesn't have a lot of experience with large AUVs and [Proteus] gets us on the learning curve. ➤

'LD UUV will be mission/objective-driven and something greater than 21in in form factor,' he said, commenting on the 'mothership' idea which could see a 60in platform carrying smaller 9, 12 and 21in AUVs into an area of operations. 'We have done some conceptual work and are looking to move beyond that stage.'

Referring to DARPA's Hydra concept, he described the idea as complementary to LD UUV: 'It's a bigger platform and requires more energy for longer missions and endurance. It will generate different CONOPS, [carry] bigger payloads and drive autonomous development and command and control. This is a new arena of AUV development.'

'LD UUV is in the formative stages of looking at options and Proteus will continue independent of the large-diameter programme. In the next

five to ten years, the initial round of those larger AUVs will start to get into the market and see use. Looking at the time frame of LD UUV, there will be a fairly long timespan before IOC and fielding of the first generation of vehicles,' he concluded.

■ GETTING INVOLVED

Hydroid is also interested in both the USN and DARPA concepts. Describing them as 'commercially sensitive', Lester explained to *UV* how his company was considering involvement in both programmes.

'Kongsberg has the largest number of AUVs fielded with any navy [in the world], with medium and small vehicles operational. We are looking to larger vehicle programmes,' he said.

Referring to a growing trend towards larger systems, Lester added: 'We are seeing increased

adoption of this concept with more equipment and higher-end persistent presence. There is increasing use of AUVs based on the success of initial applications in the last few years.

'There has been growth in confidence. This year, we started delivering medium-sized Remus AUVs to the USN's Fifth Fleet. There is slow adoption but it is increasing, based on increased confidence, and large-diameter vehicles are a progression of that with an increase in tasks.'

According to Lester, the fate of the USN's Advanced SEAL Delivery System (ASDS) – a combatant submersible design to infiltrate/exfiltrate special forces – proved something of a stumbling block for larger AUV programmes.

Companies including Northrop Grumman had been considering replacements for the navy's Mk 8 wet-flooded SEAL delivery vehicle

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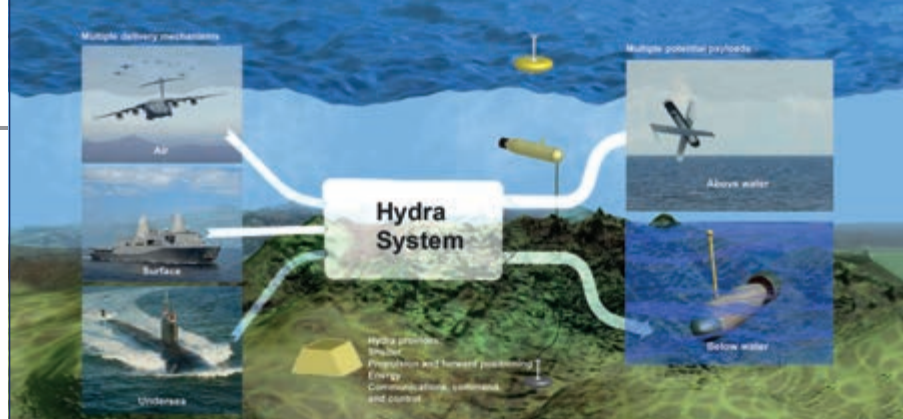
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DARPA's Hydra concept focuses on a large UUV mothership as the centre point. (Image: DARPA)

(SDV). A dry-dock submersible was looked at, which meant submariners took control of the programme. 'Programme costs went up and up and it was decided that this wasn't making sense any more,' Lester said.

ASDS was capable of transporting SEALs in a 'dry' environment, as well as carriage of EO/IR sensors and other payloads. Operated by two personnel, a single system was capable of carrying an additional 16 operators.

SEAL-ED FATE

According to information from the USN, ASDS had been planned to 'provide a new

level of undersea situation awareness to the embarked SEAL team, allowing them to conduct short surveillance prior to landing. Those who pilot the vehicle are forging new directions in undersea capabilities and redefining what may soon be the "norm" for submarine-based SOF operations for the next 20 to 30 years.'

According to Lester, there are similarities between SDVs and AUVs. 'Can you automate it? Yes you can, but that doesn't necessarily mean you should,' he questioned.

However, lessons learned from the ASDS programme do not bode well for the LD UUV

concept. ASDS was cancelled in 2006 following damage to the single test vehicle. The following year, US Special Operations Command elected not to repair it, and in 2010, the follow-on Joint Multi-Mission Submersible programme was also shelved due to cost concerns.

In conclusion, Bluefin's COO Jeff Smith told *UV*: 'From a logistics perspective of understanding how to transport, maintain, launch and recover these vehicles, we believe it makes a great deal of sense to automate this class of vehicle to provide an initial testbed capability. They can use the vehicle to gain valuable lessons which can then shape requirements for when they actually decide move on to full-on procurement.' **uv**

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Every second counts

The perennial problem of analysing UAS-gathered intelligence quickly enough to command an appropriate response by troops in contact is being tackled by some innovative software and network solutions, **Peter Donaldson** discovers.

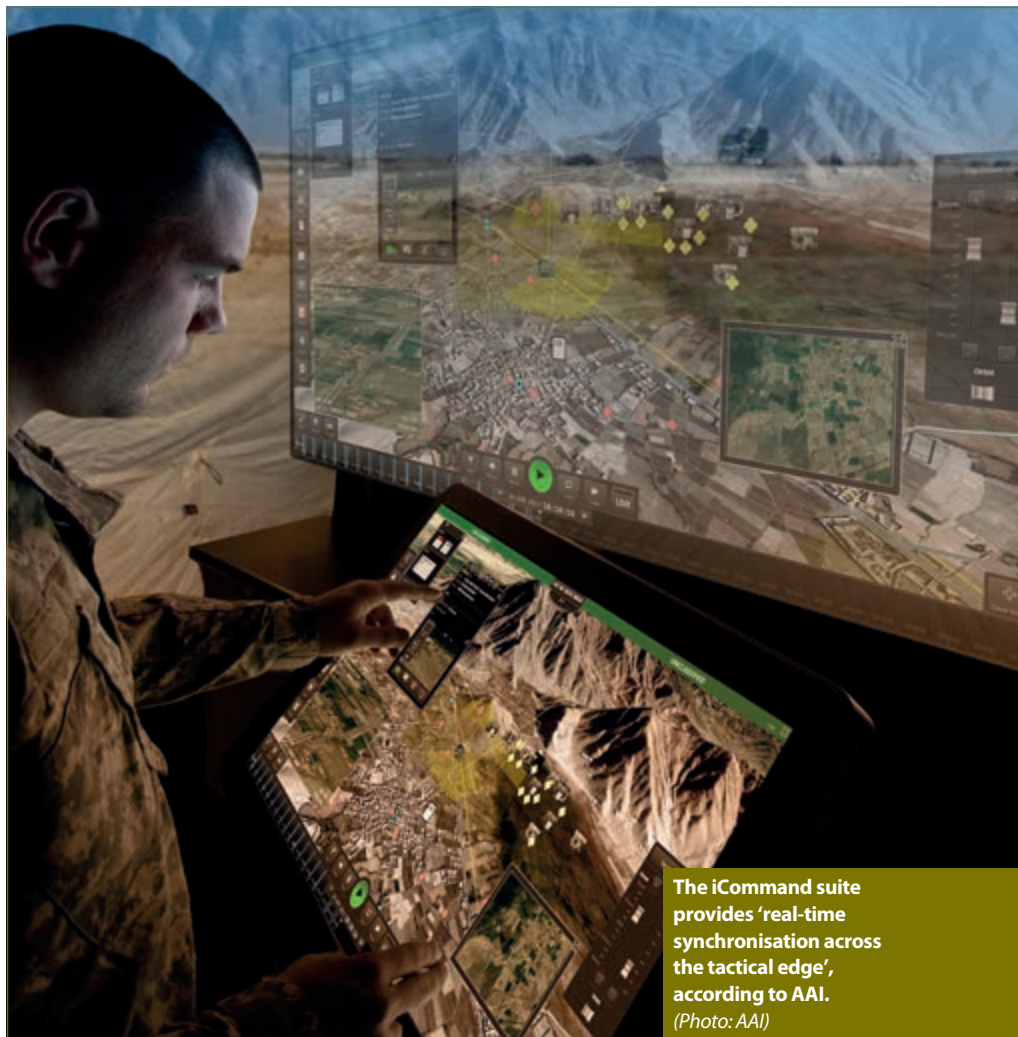
In 2008, a US Intelligence Science Board (ISB) study neatly encapsulated the problem facing small military units operating at the tactical edge, with a requirement to make the right decisions in time frames that might span hours, minutes or even seconds:

'While small units may not require large quantities of ISR data, their needs are focused, immediate and critical when engaged with the enemy,' the report reads.

INCREASING EFFICIENCY

UAS of all kinds are making increasingly valuable contributions in the contemporary operating environment, and the smaller hand-launched vehicles under the immediate authority of small unit commanders owe their genesis to the recognition of this need. While the immediate availability of live video has proven invaluable, such feeds remain as raw data. Turning them into actionable intelligence makes them far more valuable, both for immediate tactical use and for more preparatory and forensic applications.

Making this transformation depends on the rapidly developing field of processing, exploitation and dissemination (PED), for which global defence systems integrators, UAS manufacturers and image analysis companies



The iCommand suite provides 'real-time synchronisation across the tactical edge', according to AAI. (Photo: AAI)

are providing an expanding range of software products with the flexibility to work on a wide variety of devices, including handheld computers at the bandwidth-poor tactical edge. *Unmanned Vehicles* sought the views of a cross-section of interested parties to gauge how the technology has evolved since the ISB report, in view of future developments.

Although PED capabilities at the tactical edge are growing, nourished by the familiar

magic of Moore's Law, heavy dependence on reachback to nodes at higher levels of command persists. Such links are likely to remain important, because where PED is best carried out depends on the needs of the mission.

Elbit Systems argues that organic capability for the forward unit and centralised services with dissemination are complementary, with the latter being assigned tasks that require ➤

more expensive and heavier payloads or where 'massive exploitation effort' is required.

Elbit's Skylark 1LE is typical of the small, hand-launched UAVs designed for small tactical units, with remote viewing terminals enabling commanders and troops to see live imagery directly from the aircraft without having to rely on any C4I infrastructure.

EYE IN THE SKY

'Some missions are real-time support of troops in contact, where the analyst is providing an "eye in the sky" during a live operation,' pronounced Jon Damush, CEO of video processing house 2d3 Sensing.

'Other missions are battlefield preparation, surveying an area prior to action to provide better planning data to the deployed warfighter. Then other missions are forensic in nature, looking for clues that can be pieced together with data from other operations to form a complete picture of a specific high-value target or pattern of life. Each CONOPS requires a different view of the data and different skill sets to process,' he told *UV*.

The company has created a modular framework designed to allow its customers to add capabilities rapidly by writing new plugins, rather than embarking on large software development projects. This framework and what Damush describes as 'an almost fanatical commitment to using and influencing the standards used to move data around networks,' enables the company to provide tactical users with software including situation awareness, battlefield preparation, real-time screening and imagery and metadata improvement among its PED capabilities.

Australian company Sentient Vision's Kestrel moving target detection software enables operators of small UAVs to extract actionable intelligence from raw video data in real time and automatically removes detections that do not fit mission criteria.

According to Simon Olsen, its director of business development, strategy and partnerships, the company is also making progress towards integrating Kestrel into the aircraft. 'The processing and exploitation of



Kestrel software allows UAV operators to extract actionable data in real time. (Image: Sentient Vision)

imagery will be done on board, enabling the operator to only receive relevant mission-specific information without having to interpret raw imagery,' he explained.

Connectivity Enhancement for Gray Eagle (CEGE, pronounced 'siege') is a General Atomics Aeronautical Systems (GA-ASI) internal R&D project that enables the MQ-1C to disseminate digital information over the last tactical mile using warfighters' existing radios, networks and waveforms. Through incremental changes to Gray Eagle, CEGE incorporates data guards to ensure that the aircraft sends only essential data to soldiers' Nett Warrior equipment, simultaneously allowing it to act as an airborne communications node, says the company.

AUSTERE COMMS

Small tactical units typically have both the most immediate need for intelligence and the most austere communications and processing capabilities, points out Mike Worden, director of integrated intelligence solutions for Lockheed Martin Information Systems & Global Solutions, which is working in a number of areas to support them.

'First, we are working on communications efforts to support small units with bandwidth-aware content, which is essentially messages and other material that have been optimised

for low-bandwidth communications,' he explained to *UV*.

The company has also done much to optimise the data layer of the US DoD's Distributed Common Ground System (DCGS) Integration Backbone and its core component, the Distributed Data Framework. This work has focused on ensuring that the data layer supports modularity and scalability, so a system can integrate many different vendor and government applications or services, as well as work with various levels of processing and communications capabilities at a site.'

In efforts to make mission-relevant data more accessible at the tactical edge, Lockheed Martin is using data conditioning software to push the highest priority data first. The company is also using its own intranet to test a distributed and modular environment. Multi-intelligence processing and exploitation capabilities are deployed at several Lockheed Martin 'nodes', said Worden, simulating various ways of updating battlefield awareness for mobile forces.

Although technology has moved far and fast since the 2008 ISB report, PED has not had as much attention from defence departments as it deserves, Damush believes, citing the gap between the people flying the aircraft and managing the sensors and the PED community. He points out that most attention to date has been paid to detecting what he refers to as 'nouns' – people, vehicles and buildings. 'More attention needs to be paid to the "verbs" of the scene. What are the people doing? Is it a meeting? Are they running? If they are running, are they running to or from the same spot?'

By investing in more image interpretation capabilities and the infrastructure to support more onboard processing, 2d3 Sensing

'PED has not had as much attention from defence departments as it deserves.'



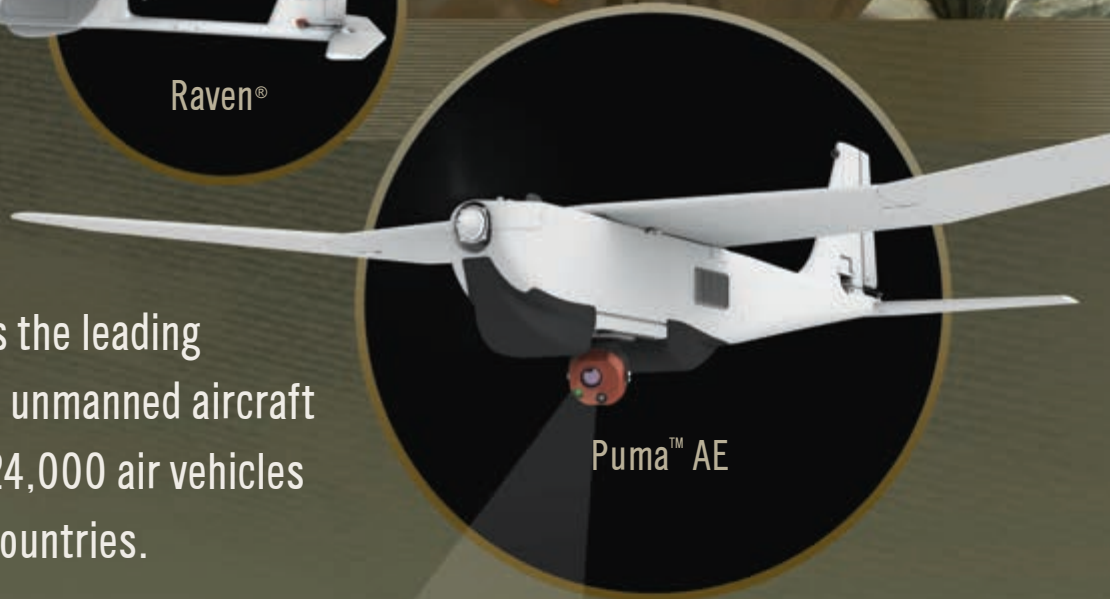
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aims to be able to send summary information to point analysts towards the important data in a 'collect', enabling them to choose the available bandwidth to watch the feed live, tag it for analysis or store for forensic correlation. The company's Catalina software is essentially a

modular and automated set of plugin-based services that can run on a small computing platform directly connected to the sensors on an aircraft. 'As new algorithmic capabilities come to light, either through our own internal R&D or other commercial or academic work, it is an easy

piece of work for us to convert that algorithm into a plugin for our software architecture and deploy it,' said Damush.

DETECTION DEVICES

Elbit cites the combination of high-quality detectors and tools for processing and exploitation in its Large Area Scanning System Operation (LASSO) and new SkEye wide-area airborne persistent surveillance systems as key developments.

LASSO, according to the company, enables any Hermes UAV working through a Universal Ground Control Station to carry out multi-spectral photography with automatic mapping and exploitation of very large areas in near-real-time. LASSO also includes a truck-mounted mobile centre for 'real-time high-level' exploitation and dissemination.

SkEye provides multiple independent high-resolution video 'straws' within a wide area of interest for real-time and past events. It supports the execution and management of several missions simultaneously, each of which might be carried out by a small tactical unit.

The adoption of transaction-based tasking standards has proved very important in providing a common way for ISR systems to understand and incorporate customers' needs into their plans, as Worden explained: 'The edge node collection systems have as their primary requirement timely collection, specialised data processing and dissemination of intelligence products to the right consumer. This process is facilitated by managing tasking as a dynamic and discreet set of instructions that can be tactically morphed during a mission rather than as a one-time pre-mission database dump. This makes the end-to-end collect-to-exploit chain more efficient, responsive and reliable.'

Through its operating units Overwatch and AAI Unmanned Aircraft Systems, Textron provides solutions that enable small units to exploit ISR feeds from UAVs including the company's Shadow and Aerosonde platforms, transmitting them into devices such as the One System Remote Video Terminal, for both mobile and dismounted forces.

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The Skylark I LE allows dismantled troops to utilise live feeds without relying on any C4I infrastructure, says Elbit. (Photo: Elbit Systems)

Overwatch programme director Chester Husk highlighted the use of automation to stare at live ISR video streams and mark moving targets. 'This assists small units when they are prosecuting an objective to identify targets fleeing the objective area,' he told *UV*. 'Additionally, the ability to remotely manage a UAV and re-task instantaneously has become a valuable tool.'

GA-ASI points to the creation of shared ISR databases and better analysis tools as key developments since the ISB study and has been

working with the USAF and industry partners on technologies that enable analysts to focus on the right information at the right time.

'Our System for Tactical Archival, Retrieval and Exploitation (STARE) combines several of these technologies to database and federate (or share) ISR information across the connected enterprise', Robert Walker, programme director for mission systems and electronic payloads in the Reconnaissance Systems Group of the company, told *UV*.

STARE correlates internal and external ISR feeds and integrates them into a 3D map that interfaces with the raw data and intelligence products on a server to create a common intelligence picture. The fusion of data from multiple sensors, access to reports and intelligence through DCGS and an intuitive

interface are intended to reduce the time the analyst needs to get from data to decisions.

'We don't believe in replacing the analyst, but rather providing him or her with processed and prioritised data,' said Walker. 'Our aim is to reduce the burden by having the machines do as much of the work as possible and let the analysts do what they do best.'

COMMERCIAL CONTRIBUTIONS

Saab marketing director Anders Wennström emphasised the importance of change detection and geo-referencing in the advancement of image PED in general, describing how the commercial sector was setting the pace. 'What we can do today compared not with ten years ago but year by year – the development is astonishing.' ➤



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General Atomics' STARE technology stores and distributes ISR information across the 'connected enterprise'. (Photo: General Atomics)

Saab has provided Sweden's army and air force with a system known as the Single-Source Intelligence Cell. This container-based solution takes feeds from the Shadow UAV and the Gripen fighter jet and has seen action in Afghanistan.

Despite rapid advances in computer hardware and software, there remain significant hurdles to overcome, some of them very familiar. 'From a practical view, I think the biggest challenge still is a good data link network to spread the information to your forces,' said Wennström. 'Still, we work a lot with compressing information just to get it out into the network.'

Damush has a similar view: 'Frankly, it is getting all of the collateral data required for the PED task to the tactical edge. Map data, terrain data, real-time comms for friendly force tracking, bandwidth to get imagery flowing in both directions are all challenges today that preclude the tactical edge analyst from seeing the whole picture.'

Elbit points out that small forward-deployed units do not have the time, expertise or manpower for the full range of PED tasks, which is why they must be provided with processed data as much as possible.

This lack of human resources is cited by Lockheed Martin as a key reason why the exploitation function in particular relies heavily on reachback to resources such as the DCGS to provide near-real-time analysis to help with minute-by-minute tactical decisions.

'The biggest challenge still is a good data link network to spread the information to your forces.'

'This model can work as long as the dissemination feedback loop is timely and responsive,' said Worden.

'DCGS analysts do not have to be specialists with respect to a platform as long as the sensor and product type fit within the skill set that they can staff. Those at the edge executing the mission do not need to be ISR analysts, but can be specialists with regard to the unique aspects of the platform they are controlling.'

In terms of future progress, Damush anticipates more cloud deployments, with processing and storage on remote servers. He also expects more processing aboard UAVs, using intelligent algorithms to minimise the amount of data flowing around the network, along with more transparency in C2 between the analyst – or even the tactical warfighter – and the collection platform, 'ensuring that the system is collecting the data that is needed, when it is needed'.

OPEN SOURCE

Worden looks to the open source community continuing to develop new technologies and techniques that address both military and commercial requirements at low cost. 'Already, innovative real-time technologies such as Storm streams and Hadoop batch processing are in government and industry R&D integration labs testing with analytic TCPED [tasking, collection, processing, exploitation and dissemination] frameworks with open architectures,' he said.

Storm is described as a free and open-source distributed real-time computation system developed to process streams of data, 'doing for real-time processing what Hadoop did for batch processing', according to the Storm community.

Hadoop is a project of the Apache Software Foundation (ASF), developed to provide an

open-source software framework for reliable, scalable distributed computing. The ASF describes it as a foundation of cloud computing and says that it is at the epicentre of big data computing. 'Apache Hadoop enables data-intensive distributed applications to work with thousands of nodes and exabytes of data,' said the foundation, which launched Hadoop 2 on 16 October.

'Semantic knowledge engines have been in experimental labs for years, but are now emerging as more mainstream in searching federated data sources in multiple data centres or clouds for key data sets that otherwise may be unknown to the PED analysts. Finally, operating systems will become less important as more robust services are deployed and browser use becomes the norm to access cloud email, data and applications.'

Olsen sees an expanding role for automation in aiding the decision-making process. 'We believe automation – especially in the air – will be a key feature in the foreseeable future. Most of the advancement to date has been on the ground. However, it is actually at the data collection point where PED processing could be of far more use.'

GA-ASI also emphasises efforts to tag metadata closer to the sensor and the use of better analysis tools to refine the data and feed information to the tactical user. The company is also developing software and hardware architectures, such as its next-generation mission control module, an internally funded project to separate sensor management from flight critical control to allow faster GCS and sensor software updates, ease the addition of new sensors and provide more efficient sensor communication.

'As Lt Gen Deptula stated a few years ago, we are drowning in data and starving for information,' remarked Walker. 'Metadata tagging and rapid correlation or fusion of data needs to improve. Multi-source intelligence will continue to grow. GA-ASI is researching an all-source intelligent data fusion capability, powered by inference engines to filter the massive amounts of data flowing in to the PED process and reduce the data to the relevant pieces.' **uw**

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The rise and fall

With fluctuating investment over the past few years, the future of lighter-than-air unmanned technology is in doubt. However, a number of programmes remain active and are providing valuable capability in-theatre, **Beth Stevenson** reports.

The US Army was leading the charge with its LEMV programme before cancellation in February 2013. (Photo: Northrop Grumman)

Unmanned lighter-than-air (LTA) technology is arguably the mother of unmanned airborne surveillance, having been around in a variety of different forms for over 100 years.

Goodyear blimps and Zeppelin airships – in particular the *Hindenburg* famed for its crash in 1937 – are well known historical systems. However, far from remaining in the history books, revivals over the years have occurred, particularly in support of operations in Afghanistan and Iraq.

During these campaigns, FOBs have been protected by LTA systems, providing persistent surveillance of on-site and off-site activity, with arguably little cost and logistical burden.

‘There has not so much been a revival, but a surge with the conflicts in Iraq and Afghanistan,’ Ron Bendlin, president of TCOM, told *Unmanned Vehicles*. ‘The demand for that period was due to the fact that aerostats are really the ideal application for persistent surveillance over these FOBs. It really was the right technology for that situation where you had to be stationary over a specific location for extended periods of time.’

According to an October 2012 Government Accountability Office (GAO) paper, US investment in aerostat and airship development ranged from \$339 million in 2007 to \$2.2 billion in 2010 and \$1.3 billion in 2012.

MAJOR PROGRAMMES

Specific aerostat-related investment was \$5.8 billion over the period 2007-2012, which accounted for more than 80% of the total. Over 90% of this investment, worth almost \$5.4 billion, is attributed to the development and procurement of three US Army aerostat programmes: the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS); the Persistent Ground Surveillance System (PGSS); and the Persistent Threat Detection System (PTDS). All three are successfully operating or on track to do so in the near future.

On the airship side of LTA development, the GAO stated that in the same period most of the \$1.1 billion investment was for R&D, again with 90% of it focused on three main programmes, namely: the USAF Blue Devil II; DARPA’s Integrated Sensor Structure (ISIS); and the



US Army's Long Endurance Multi-Intelligence Vehicle (LEMV).

The difference with the airship development is that Blue Devil II and LEMV have both been cancelled since the report, while DARPA told UV that it is only focusing on the radar development for ISIS, with the airship element no longer a priority.

TCOM was contracted to develop the airship for the Blue Devil II programme, for which it provided the hull. Meanwhile, the LEMV hybrid air vehicle programme, which was cancelled by the US Army, was due to see a Northrop Grumman-led team develop the system.

Lockheed Martin also failed in its endeavour to keep its Hybrid Airship for the Missile Defense Agency airborne, a platform that was supposed to operate above the jetstream.

A DoD representative confirmed to UV that the High Altitude Long Endurance – Demonstrator (HALE-D) that derived from the Hybrid Airship flew on 27 July 2011, but encountered a problem at altitude and had to be brought down with a controlled descent. There are currently no plans to proceed with the programme any further, and Lockheed Martin was unable to comment.

CLOSING TIME

Other cancellations include the CargoLifter CL160 heavy-lift airship programme, which ended in 2002 when the company went into liquidation, as well as DARPA's experimental Walrus Hybrid Ultra Large Aircraft project that was cancelled in 2010 and would have been a heavier-than-air vehicle producing lift through a combination of aerodynamics, thrust vectoring and gas buoyancy generation/management.

However, despite an apparent surge using tethered aerostats during recent operations, it has not been the same for airship development, as the technology struggles to remain relevant.

'The DoD is maintaining status quo for the foreseeable future,' George Bye, CEO of Bye Aerospace, and Ron Oholendt, executive VP for business development at Near Space Systems, told UV. 'With sequestration, 2013 R&D dollars were greatly reduced... and 2014 will see further retraction for R&D. The reduction in funding

coupled with the drawdown [from Afghanistan] will severely limit R&D available.'

Bye Aerospace and Near Space Systems teamed up to develop the Naval Air Systems Command (NAVAIR) solar-powered StarLight stratospheric airship, designed to operate at an altitude of 85,000ft and made of an upper and lower stage, thus creating a new LTA category.

However, this again proved to be another airship programme that faced problems, this time due to funding issues.

'Our programme was deemed highly successful by NAVAIR, but funds were provided by a "Congressional plus-up" in 2010 and the moratorium in the House precluded any additional funding,' the pair explained. 'The navy did not have a programme of record to provide any follow-on funding.'

The airship was taken through critical design review and then the lower stage of the system was manufactured and integrated with subsystems, such as propulsion, power, manoeuvring and payload, before the programme was cancelled.

POSITIVE OUTLOOK

However, the two companies remain positive about the potential of such a system and claim it could replace HALE UAVs and satellites in the future. 'LEMV... and a number of other cancelled military programmes were airships, not tethered aerostats,' clarified Bendlin. 'These were very large-scale developments performed to aggressive schedules.'

He said that tethered aerostats are 'mission-critical assets' for different operations internationally, and the value for money is unmatched.

'While future military airship requirements are not defined, we continue to believe that there is military interest in providing persistent surveillance with the flexibility of an airship,' he added.

While admitting that the demand has peaked so far as Afghanistan is concerned, Bendlin said that his company is now looking to sustain business across a variety of areas.

'Before these conflicts came along, our business was fairly consistent in providing border surveillance products,' he noted.

'For the 12M in particular [a small tactical aerostat], where we see that going is in policing activities [and] disaster recovery. We've seen some trials go on with that for re-establishing communications; tactical applications where you want line-of-sight coverage with a camera; and also wanting a communications platform – we see commercial applications there as well.'

CONCEPT OF OPERATIONS

The 12M is the newest addition to the company's portfolio. It is a tactical aerostat system that has been delivered for test and evaluation to the US military, which is currently working out its CONOPS with the system, according to Bendlin.

'If you look at trends, we've gone smaller, with the 12M being our smallest to date,' said Matt McNeil, VP of business development at TCOM. 'This capability is more digestible and understood in the next series of combat operations, if you will, as militaries reset themselves from what's been the ongoing campaigns in Iraq and Afghanistan and take a look at things in new potential trouble hotspots in Sudan, the Horn of Africa and Southeast Asia.'

'A focus towards a more mobile capability is probably going to continue to develop, and that is going to drive towards a smaller system, we think.'

LEMV, meanwhile, was designed to operate on-station for 21 days in order to cover a 3,000km radius. It was flown for the first time in 2012 with a crew on board, setting it up for deployment to Afghanistan in 2013. ➤

Reasons for the cancellation were given as performance and technical problems, as well as tight financial resources.

However the airship, developed by a Northrop Grumman-led team, including British company Hybrid Air Vehicles (HAV), has been bought back by the latter from the army. 'We've bought the vehicle and are planning to ship it back to the UK and will continue to develop it here,' Chris Daniels, head of partnerships and communications at HAV, told *UV*. 'We've agreed with the US Army that we'll share all development data with them free of charge.'

Daniels said that timelines are not yet set, but expects the airship will be transported to Cardington in the UK and inflated 'early next year'.

It is currently in a manned configuration – in line with the testing that took place in 2012 – and HAV will possibly look to make it unmanned-capable in the future, as originally planned. Keeping it in a manned configuration would initially aid in the certification of it in UK airspace.

'They certainly haven't closed the door on this yet,' Daniels said of the army's endeavour to procure a platform of this type.

TRIED AND TESTED

According to Bob Boyd, hybrid airships programme manager at Lockheed Martin, which lost out on the bid for LEMV: 'We believe wholeheartedly that it is not the technology [that led to the LEMV cancellation] – the technology is available and it will work.'

Boyd expects that the US Army will eventually regenerate the programme as it sees the cost benefits of using buoyancy systems.

'I think they [the army] are going to wait and see if somebody develops a commercial one like we're trying to do, and if it's working then they'll look at adapting instead of inventing from scratch like they did in LEMV,' he said. 'The concept of LEMV was that the sensor carrier users could develop a platform and then you could transition this to cargo. Well that didn't work out so well, so they're probably going to do it the other way round, with cargo first and then transition it back to ISR.'

The company is still developing a hybrid platform based on its P-791 offering, and is

looking to develop a small, medium and large cargo-carrying airship. They will have a load-carrying capability ranging from 20-500t, initially focusing on the commercial market. It aims to have a system ready within three years.

FUTURE OPPORTUNITIES

Boyd explained that the unmanned, military and ISR markets will all be opportunities for it eventually.



Lockheed says that the P-791 proves the technology will work. (Image: Lockheed Martin)

'I'm sure as we get these out in operations we're going to get a phone call from many of the departments and the DoD who are interested in sensor carrying,' he continued. 'So we'll have some variants focused on that, probably at a much higher altitude than the cargo carriers will go, and probably with a much longer endurance, so they'll be unmanned.'

'Right now, the cargo carriers are envisioned to be manned because of current FAA regulations, but you can make them unmanned relatively easily... [although] there's [currently] no legal way to make an unmanned commercial airplane.'

He said if the military was to become interested in the vehicle, making it unmanned would not be an issue and would open up that operating spectrum.

'Of course for the military you can conduct unmanned operations, so it may be that you go

unmanned for military purposes first, and then eventually bring it back into the commercial market,' he said. '[We] could easily see an unmanned version of this in five years or so if the interest was there.'

'When you get into the buoyant systems or the LTA market, anything negative would tend to be a bit of a "black eye" for the industry, but on the other hand with LEMV it was a completely different mission – it was an airship,' Ken Throne, director of persistent surveillance at Lockheed Martin Information Systems & Global Solutions, told *UV*. 'It is not a type of aerostat. I think if you look at the performance of tethered aerostats across the industry... the record for all of those systems is pretty incredible.'

PERSISTENT SUCCESS

One aerostat success story is the company's Persistent Threat Detection System (PTDS), which continues to be used in Afghanistan by the US Army.

It was first deployed in 2004, and some 37 systems remain in operational use, although the company could be asked to provide up to 65 platforms under the terms of its most recent contract. On 21 October, Lockheed Martin announced that PTDS will continue to be operated and supported by the company under a \$345 million contract.

Throne explained that the US Army decided to complete the logistics and operator work being conducted in-theatre, which resulted in Lockheed Martin being awarded a one-year contract with a one-year option to provide up to 65 PTDS through to Q3 2015.

'However, we all know that we will not be operating 65 systems for the full two years, so we are supporting as the troops withdraw in Afghanistan,' noted Throne. 'That need to have systems on-site to provide that overwatch for the sites is declining, so we have fewer systems than the 65 that we bid.'

At least 36 systems are expected to still be operated by the end of 2013.

'What we've been told by our customer, the US Army, is that as long as there are troops in Afghanistan, whether they are US troops or US coalition forces, the PTDS will be there,'



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UTC Aerospace Systems

The Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System, or JLENS, is expected to start operational evaluation in 2014.
(Photo: Raytheon)



added Throne. 'If there are still troops out there beyond that time [2015], I expect there will be a follow-on contract, and it will remain there as long as there are troops.'

PROTOTYPE PROGRAMME

PTDS started out as a prototype programme to support US operations in Iraq, and has only just been awarded programme of record status. 'Last month, we were informed by the army that the PTDS programme was approved as an official programme of record for the army, and so we have built 65 systems, flown 51, and we're down to 37 now, and the army's plan is to designate 29 of those systems for the programme of record going forward,' explained Throne.

'So that means beyond the conflict in Afghanistan, these systems would be used by

the army to pop up at whatever the next hotspot is worldwide.'

Lockheed Martin is currently in the process of returning the 29 designated systems to the US, where they will be reset to a standard configuration and go into storage until they are required.

'In addition to the 29 systems that we'll be bringing back and retrofitting/resetting for future use, we're going to have 21 systems back in Afghanistan that are referred to as the "enduring systems", and these will continue to support in Afghanistan,' added Throne.

A PTDS typically operates at 5,000ft, while surveying a 24km radius. In addition to its day/night camera, a second camera or radar can also be integrated, notably the Northrop Grumman StarLite radar.

'It gives the army a pretty incredible capability in that we can detect motion in a wide area with the radar, then immediately fly the camera to the location to get "eyes on";' said Throne.

JLENS, the US Army's new missile defence tethered aerostat developed by Raytheon Integrated Defense Systems, meanwhile, is expected to complete engineering and manufacturing development at the end of 2013 and undergo operational evaluation at Aberdeen Proving Ground in mid/late 2014.

Keith McNamara, business development executive for global integrated sensors at the company, suggested that weight constraints on an airship might have something to do with the lack of success.

'Aerostats and airships have a finite weight limit, and by keeping the processing equipment

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Lockheed Martin's PTDS is supporting US forces currently operating in Afghanistan.
(Photo: Lockheed Martin)

and power generator on the ground, you maximise the system's payload because the only thing the blimp is carrying is the radar,' he said.

He noted that with a tether, the power runs up to the radar operated on board the platform, and then the data runs back down. This means that the power and processing systems can be grounded, saving weight.

'The capability is mission-dependant and based on the threat,' continued McNamara. 'The threat will always drive requirements, but the solution has to make economic sense. This is one of the reasons Raytheon sees so much promise in JLENS – the cruise missile and unmanned aircraft threat is growing, and JLENS offers a defensive capability in a cost-effective manner.'

With regards to UAV technology competing with LTA, he said that they are complementary,

not competitive technologies. 'Early on in the [Afghan conflict], commanders were using UAVs to protect FOBs, but that was not the best use of that resource, and it didn't offer persistence.'

He continued that affordability will remain a factor for operators in the future, so the more capability that one system has, the better.

WIDER OPPORTUNITIES

'JLENS was first envisioned in the 1990s as a surveillance platform to support cruise missile defence,' he said. 'It does cruise missile defence quite well, but the threat has evolved and so has JLENS. In the past 18 months, it has demonstrated the capability to detect and track swarming boats and unmanned aircraft, and detect and discriminate a short-range ballistic missile in the boost phase.'

Internationally, South Korea is expected to deploy an aerostat system, believed to be worth some \$22 million, to oversee the border between itself and North Korea. Details surrounding the acquisition have remained relatively scarce, although it is understood that it will be developed locally. China, meanwhile, is believed to have used aerostats during natural disasters in recent years.

The US appears to be leading both the success and failure of operations of this type of technology. However, with other nations such as South Korea and China – which is considering LTA for humanitarian assistance/disaster relief, homeland security and construction missions – seeking capabilities of this type, there may yet be another momentum shift in the future of LTA technology. [uv](#)

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GA-ASI and Selex ES flew the latter's Seaspray 7500E AESA surveillance radar on the former's Predator B UAV in front of an international audience in May 2012. (Photo: Selex ES)

Wider focus

Maturing technologies such as SAR/GMTI and FOPEN radars are opening up new possibilities for UAV operations.

Tom Withington rounds up recent developments in this field.

Horror struck Italy's normally idyllic island of Lampedusa on 3 October 2013 when a boat carrying hundreds of migrants from Eritrea, Ghana, Libya and Somalia sank with the loss of 360 lives, less than 400m from the island. Although the Italian Coast Guard did manage to rescue around 150 people from the boat which had departed the Libyan port of Misrata, the death toll caused profound shock across Italy and around the world.

The disaster highlighted not only the dangers that migrants face in taking such voyages, but also the criminal nature of the trade, with the traffickers who organised the crossing accused of raping and torturing passengers unable to pay for their trip.

SEARCH FUNCTION

The Lampedusa tragedy and the dangerous underworld of people trafficking have underscored the need for persistent radar surveillance of the high seas to spot illegal activity and activate search and rescue operations in a timely manner. It is little surprise then that General Atomics Aeronautical Systems (GA-ASI), the US company well known for its production of UAVs, has turned its attentions towards sharpening the gaze of its Lynx family of multi-mode radars.

John Fanelle, director of the radar business area within the firm's Reconnaissance Systems

Group, said GA-ASI is currently upgrading the Lynx Block 30 radars which equip the six MQ-9 UAVs supplied to the Italian Air Force (IAF): 'The Italians have an urgent need to perform the search and rescue of migrants in the Mediterranean. We are upgrading the radars used by their MQ-9s with a software-only change which will enhance their maritime surveillance performance,' he told *Unmanned Vehicles*.

At present, the radar can be coupled to the optronics, with the former spotting a target of interest and the latter then being slewed to take a closer look. The software change that Fanelle and his colleagues are rolling out across the Italian MQ-9 fleet will enable the radar to perform broad-area maritime surveillance, scanning the ocean at 30°. This translates to the surveillance of up to 40,000 sq km per hour.

In particular, this mode will be effective for detecting precisely the kind of small vessels involved in the Lampedusa tragedy, a task



GA-ASI is performing a software upgrade of its Lynx Block 20A radar to improve the maritime patrol capabilities of the Italian Air Force's MQ-9 fleet. (Photo: GA-ASI)

variety of offerings in this respect including its Gabbiano X-band (8.5-10.68GHz) product which has a range of around 400km for maritime surveillance.

In February, the firm completed flight trials of its new Gabbiano T20 radar mounted on a Selex Falco UAV. The tests evaluated the radar's strip and spot synthetic aperture performance, its track-while-scan function, and its maritime surveillance and ground mapping capabilities.

Offering a range of up to 407km, the Gabbiano family includes the T20 and T200. The T20 uses a 360° belly-mounted and a 90° nose-mounted antenna and weighs 43kg, transmitting an average power of 20W. The belly-mounted antenna for the T200 weighs 62kg, with the nose-mounted antenna weighing 56kg.

Other SARs in the Selex ES stable include the 10kg PicoSAR, which completed a foreign comparative testing programme with the USMC on the Boeing/Insitu RQ-21A Blackjack tactical UAV in September, and the larger multi-mode Seaspray 5000E, 7000E and 7500E radars. The principle discriminating factors between these is their maximum detection range, which is a function of the power aperture, with the radars weighing between 50-115kg.

According to Steve Marlow, head of radar sales at the company, Selex ES is currently involved in a number of delivery programmes: 'We currently have contracts for all of these systems and are delivering them for fixed- and rotary-wing manned and unmanned applications. PicoSAR has flown on a range of platform types, including Selex's Falco, Insitu's Blackjack [Integrator] and Schiebel's S-100 Camcopter.'

Cost effectiveness is one attraction of Selex ES's UAV radars, with Marlow adding that 'size and weight are also key attractions. Radars aren't cheap, but we have a good position from a price perspective. Moreover, all of our radars are X-band, which helps to penetrate bad weather.'

He continued: 'They are unique in the context of UAV radar in that they have active

electronically scanned arrays [AESA] that provide performance benefits against small targets at sea and from higher altitude.'

INTERCHANGABLE SENSORS

Another major European name in UAV SAR provision is Thales. The firm spent much of 2013 promoting its I-Master radar, which is outfitting the WK450 Watchkeeper UAVs that the company is providing to the British Army, and can also be installed on a range of manned aircraft. In a statement provided to *UV*, Thales noted that I-Master has been designed to fit into a standard 15in sensor payload space. This is unique among UAV radars and means the system is interchangeable with other payloads depending on the mission.

New SAR products are also entering the market place from other European suppliers. In May, defence electronics specialist Cassidian announced that it had developed a new airborne SAR/GMTI (ground moving target indicator) known as SMART (Scalable Modular Aerospace Radar Technology). The firm is confident that SMART could outfit a range of conventional aircraft and UAVs, with testing having been performed in Canada last year. The pod-mounted radar uses an AESA antenna.

IAI Elta took advantage of the Seoul Aerospace and Defence Exhibition in October to showcase a number of its UAV SAR radar products. Systems on display included the Ku-band EL/M-2055, which provides real-time SAR/GMTI imagery in a package weighing between 36-66kg according to the configuration. Smaller UAVs, meanwhile, can use the EL/M-2054 which falls in the 12kg weight class, while offering a range of circa 10km and the ability to collect up to 350 sq km of SAR imagery per hour. Other UAV-specific products in the Elta portfolio include the EL/M-2022U which performs target detection at up to 370km, and can track up to 256 targets simultaneously.

US manufacturers have taken similarly important strides during 2013 as regards UAV SAR/GMTI payloads. A Northrop Grumman RQ-4B Block 40 Global Hawk demonstrated

which the IAF is keen to employ its MQ-9s for. The company is on track to have this capability ready for the Italians in the first three months of 2014.

During the same timeframe, Fanelle said the company will have a similar search mode, again taking the form of a software upgrade, available for the Lynx Block 30's sister product, the Block 20A. The principle difference between Block 20A and Block 30 is that the latter has a smaller size of 37kg as opposed to the 52kg of the former. Both offer a range of 100km for maritime search. All Lynx radars, including the version fitted to the company's Predator XP export model UAS ordered by the UAE, have a common architecture.

SYNTHETIC SUCCESS

Much like GA-ASI, Italy's Selex ES has carved a niche as a supplier of specialist UAV synthetic aperture radar (SAR) systems. The firm has a



Selex ES's Falco UAV has flown with the company's PicoSAR AESA radar. (Photo: Selex ES)

its ability to transmit streaming GMTI imagery to offboard users in May. Using its AN/ZPY-2 AESA radar, the RQ-4B transmitted its imagery to a USAF E-8C Joint Surveillance and Target Attack Radar System (JSTARS) ground surveillance aircraft. The ability of the E-8C to observe radar imagery transmitted by the RQ-4B potentially greatly enlarges the surface area that can be viewed by operators on board the aircraft by federating their two radar pictures together.

Similarly, during 2013 Northrop Grumman has been pressing ahead with its Vehicle and Dismount Exploitation Radar (VADER) for the US Army. The company has designed VADER to give UAVs a SAR/GMTI package capable of tracking pedestrians and vehicles. Among other platforms, VADER has been designed to equip the MQ-1C Gray Eagle. Two VADER systems are currently deployed to Afghanistan where they are flying on board manned aircraft. The programme is sponsored by the army Intelligence and Information Warfare Directorate's Defense Microelectronics Activity, and DARPA's Joint Improvised Explosive Device Defeat Organization.

THROUGH THE TREES

The next major advance in UAV radar will probably be the in the foliage penetration (FOPEN) domain. The contribution which SAR makes to the detection of moving targets such as vehicles and increasingly individuals moving at slow speeds on foot via GMTI technology has been well documented. However UAV users have a corresponding need to see through dense forest or jungle canopy, at present off limits to SAR which has its gaze blocked by such vegetation.

FOPEN radar has a particular niche in combating narcotics producers and traffickers in Latin America who can perform their work below the trees with relative confidence that their activities will not be detected by radar.

Whereas the traditional SAR/GMTI radars surveyed in this article typically transmit in the upper end of the radar segment of the electromagnetic spectrum (the X-, Ka- and Ku-band regions), FOPEN radars such as Lockheed Martin's TRACER (Tactical Reconnaissance and Counter-Concealment Enabled Radar) is a UHF system.

During its development, Lockheed Martin has continually improved the capabilities of TRACER, including the addition of a GMTI and dismount detection function which commenced testing in 2012 on board a Sikorsky UH-60 Black Hawk utility helicopter.



IAI Elta brought several UAV SAR products to this year's Seoul Aerospace and Defence Exhibition, including the EL/M-2055.

(Photo: author)

Lockheed Martin is not alone in its FOPEN endeavours. DARPA has developed the FOPEN Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER). The agency joined forces with US Special Operations Command and the US Army to sponsor FORESTER's development by US-based radar specialists SRC. Transmitting in the UHF range, FORESTER can penetrate forest canopy from an

altitude of 15,000ft. The radar includes a GMTI and can see through vegetation across an area of 145 sq km.

Given that FORESTER can be mounted on a rotorcraft, which enables it to maintain a 'near zero ground speed', according to official SRC literature, the GMTI is able to detect slow-moving targets such as dismounts in real time. The radar can scan a 90° swathe or a 360° field of view. In terms of UAVs, FORESTER has already been tested on board the Boeing A160 Hummingbird (now cancelled).

IMPORTANT ADVANCE

European FOPEN efforts include Saab's Carabas initiative. Saab's Swedish home has its fair share of thick forest canopy, and Carabas uses VHF SAR technology, with a low-frequency mode transmitting in the 20-90Mhz range also included. Carabas is designed to equip a manned helicopter, but the technology could almost certainly be adapted in the future to outfit UAVs.

Currently in technology demonstrator form, Carabas has an operating altitude of circa 6,500ft and a stand-off range of 6km. This allows the scanning of a swathe of ground 3km wide with 5 sq km of territory per second being surveyed. The entire Carabas package including the antenna, radar electronics and mounting weighs 72kg.

FOPEN may well herald the most important advance in airborne radar surveillance technology since SAR began to be used militarily in the early 1990s on platforms such as the E-8C JSTARS. At the same time, work continues in making conventional SAR/GMTI radars both more affordable and more capable, while at the same time reducing their size, weight and power consumption. Enhancing the maritime surveillance capabilities of products such as GA-ASI's Lynx radar family could also help to prevent a repeat of the October 2013 Lampedusa tragedy. **uv**



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Unfamiliar terrain

Southeast Asia's typical jungle environments and porous land borders could lend themselves to a range of UGV operations.

(Photo: Adam Wakeling)

Traditionally not seen as a primary market for UGVs, Southeast Asia could be a future source of big business for developers, argues **Angus Batey**.

To Westerners whose insight and awareness is gleaned from news reports and a lifetime's stereotyping, the concept of a Southeast Asian market for unmanned ground systems presents something of a challenge.

First, a cursory glance at the map suggests that many of the applications most widely touted as suitable for UGVs may not apply in Southeast Asia. The border security role, for one, would seem to be a comparatively difficult task for ground vehicles to tackle, given that many of the nations in the region have longer coastlines than land borders to patrol and secure.

Secondly, the region is synonymous with high-technology innovation and low-cost manufacturing. This is where Western consumer electronics companies tend to outsource their production to, and even in technology sectors where the West

has traditionally held sway – such as automobile manufacture – Southeast Asian companies now command large slices of the global market.

Surely any need for UGVs will be easily met by indigenous suppliers, who will be able to produce systems more cheaply, making the region something of a non-starter for Western companies looking to do business there? However, the opposite is the case.

FINDING A NEED

'I can't discuss names of countries,' said Yoav Hirsh Bar-Gai, general manager of G-Nius, the joint venture formed by Israeli defence contractors Elbit and IAI which has been supplying the IDF with unmanned ground systems since 2007. 'I can say that in many of the countries in the region I can find requirements and I can find budgets, and I can find a need for such systems.'

'Countries such as Vietnam, Thailand and Cambodia have very long and often uncontested borders that are notorious for smuggling and other criminal activities,' said George Lawrence, an associate at Renaissance Strategic Advisors. 'UGVs for patrol – assuming sufficient development – could offer a solution.'

'Southeast Asian manufacturing industry is relatively high-tech, though not "Western",' added an expert industry source, speaking to *Unmanned Vehicles* on condition of anonymity. 'But with the exception of Singapore, its defence industry could not be described as high-tech. It is highly unlikely – with the possible exception of Singapore – that Southeast Asian industry will develop a UGV capability in the near to medium term that matches what can be offered by US and Israeli firms.'



The Guardium Mk III is described as a 'wrap-around' solution that can be applied to existing vehicle fleets. (Photo: G-Nius)

None of the UGV manufacturers contacted by UV were willing to confirm sales to users in the region, nor to discuss specific opportunities they may be pursuing or requirements that

may be extant. And the one company in the region which has UGVs in the marketplace – Singapore's ST Kinetics – refused to comment. Nevertheless, a reasonable picture can be

'Many Southeast Asian countries have a range of security concerns, including long and porous borders.'

drawn of the types of applications potential users in the region are asking UGVs to carry out, and which underscores the vibrancy and viability of the market.

'Many Southeast Asian countries have a range of security concerns, including long and porous borders and ongoing internal security issues, for which UGVs are well suited to meet the key requirements of patrol, reconnaissance and counter-IED,' said Lawrence. 'These countries are also experiencing a rapid increase in defence and security spending, which is driving force modernisation – suggesting demand for such systems is likely to be high across the region in the next ten years.'

'We are seeing a lot of interest from Southeast Asia in the systems and in the capabilities,' said Alan Bignall, president and CEO

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of ReconRobotics, the US-based manufacturer of the Throwbot – a surveillance UGV designed to be thrown over walls or into buildings.

‘Just like in years past in Europe and the US, our technology is game-changing. It’s different to most people’s ground capability, which tends to be big robots with some sort of armaments or tracks. But the interest is clearly there, especially as they see military and security teams in Europe and the US using it so well. We are actively selling it and showing it in pretty much all the countries in Southeast Asia. It’s very active business for us.’

ASSESSMENT CRITERIA

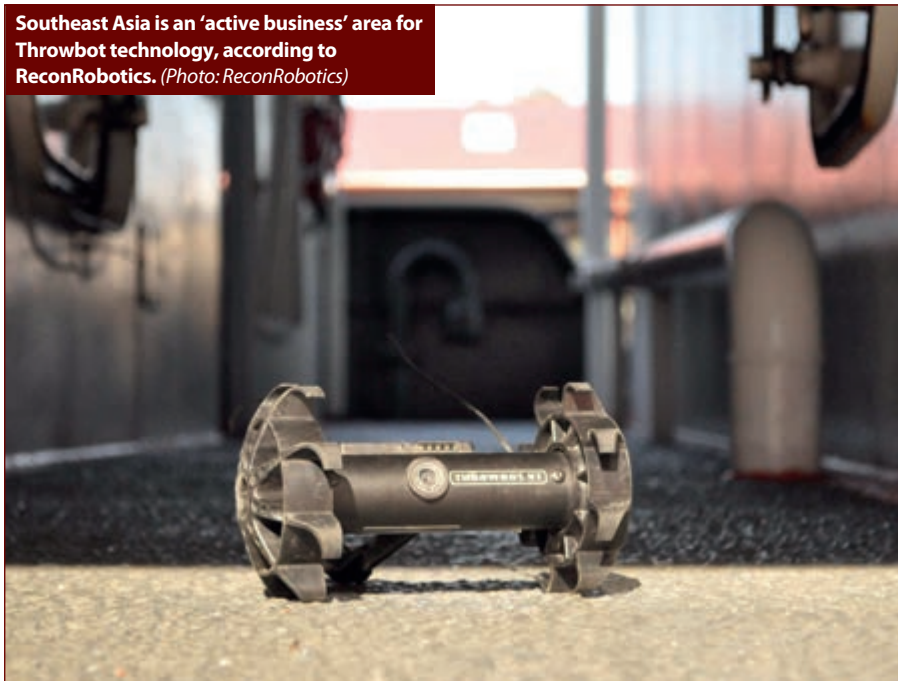
In assessing the region’s potential requirements, interesting issues emerge. First, the geographic location of the end user makes little difference if the customer is a military organisation likely to be engaged in coalition or alliance operations in the same theatres as Western allies. Also, domestic security applications such as border patrol and surveillance will require much the same platforms and technologies, regardless of specific location.

‘There is no doubt that most of our activity is for the IDF,’ Bar-Gai explained. ‘But we have a lot of connections and interest all over the world, and what we are trying to do in the company is to take the requirement that the IDF has, to study the requirements that other countries have, and to try to put all of that together so that our systems will be able to provide solutions to all of the different requirements.’

‘But from what I have seen, most of the requirements are the same – and if they’re not the same they’re really similar. Countries in the Far East who are sending soldiers to the Gulf [of Oman] are having the same problems as countries from Europe who are sending soldiers to the Gulf. And any country that has a problem on her border, that’s the same problem that we have on our border. So at the end of the day, most of the requirements are the same.’

The point was echoed in a short statement released to *UV* by Lockheed Martin, whose

Southeast Asia is an ‘active business’ area for Throwbot technology, according to ReconRobotics. (Photo: ReconRobotics)



Squad Mission Support System (SMSS) has been trialled in Afghanistan by the US military and is now being marketed internationally by the company. (Lockheed Martin has also signed

a memorandum of understanding with ST Kinetics, whereby both companies work to identify and develop opportunities for their manned and unmanned ground systems.) ➤

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'Several countries have smaller ground robots... but they're clearly understanding that robotics is here to stay.'

'We have received significant interest in SMSS and its capabilities from potential customers around the world,' the statement reads. 'The SMSS technology is mature and has proven itself to be extremely useful, having been deployed with US forces in Afghanistan. We continue to explore the many opportunities for SMSS and our other unmanned systems with potential customers not only in the US, but around the world.'

G-Nius's products – the Guardium and Avantguard families – are based on normal-sized vehicles, and the latest development, the Guardium Mk III, is essentially a wrap-around solution that can be applied to existing vehicle fleets. This gives the company an advantage over other UGV suppliers in that a customer can

retrofit legacy fleets to acquire an unmanned ground capability. Although this is a benefit that is not limited to the Southeast Asian market, Bar-Gai argued that it gives G-Nius an advantage in the region.

'The issue is what kind of platform you are using,' he said. 'One of the big advantages we have is that, in the last two years we have developed our system so that we can put our robotic suite on any kind of platform the user chooses – so, in other words, he can use the platform that he already has and we will put the robotic capability on it. At the moment the user is operating the right platform, so he will be able to operate it as a robotic system and meet his requirement in his terrain and his area in the way that he used to do it before he used the robotic solution.'

■ EDUCATING THE CLIENT

For smaller systems, such as ReconRobotics' Throwbot, the main issue limiting take-up of the technology is educating the potential user base about its existence and capabilities. Once achieved, this introduces the potential for new requirements to develop, with UGV capabilities

permitting missions to be undertaken which would not otherwise have been considered.

'Once [potential users] are exposed to our capability, then they're saying: "Wow – this changes the way we could do things,"' Bignall said. 'It's a change of tactics, it's a change of thinking. It's a case of: "We should rethink the way we're planning to use robotics or technology going forward, when things like this are available." Several countries have smaller ground robots – nothing of the size of ours – but they're clearly understanding that robotics is here to stay, and it's making a difference.'

Another factor that may influence regional requirements is the development of new CONOPS, especially those integrating UGVs with other systems, such as unmanned aircraft. A lengthy land border may pose patrolling problems that cannot be solved by a UGV alone, either for terrain reasons or because the distances involved are challenging as regards range and endurance. Combining air and ground systems could provide a more comprehensive answer.

'We develop all kinds of operational concepts, combining UAV and UGV – and this is something we've done with both Elbit and IAI UAVs,' Bar-Gai confirmed. 'As a concept, we have demonstrated it in Israel several different times. We are working very closely with our owners, and together with them we are marketing a full solution using UAVs and UGVs on the one hand. On the other hand, when we are going to meet potential users outside Israel, we can offer them just the UGV, or to combine it with UAVs that they already have. So we're working in a very wide way to promote our capabilities on the ground and in the air.'

■ OFFSET ARRANGEMENTS

One further key question is that of industrial capability and cooperation. The region is home to a vast array of businesses with extensive expertise and experience in high-technology production and manufacture, even if in the majority of cases that experience has not been in the defence and security sectors. With offset an established feature of most military procurement programmes, it is likely that deals



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SMSS is now being marketed internationally. (Photo: Lockheed Martin)

And we definitely see that question raised as we go to Southeast Asian countries.'

For a company with a product like the Throwbot, the issue prompts a different set of questions. 'It's not like we don't get components from South Korea or Japan or wherever,' Bignall pointed out. 'We get components from our robot from all over the world. But I think where it's a niche product like this, in its current state it's less likely to be manufactured in volumes in other countries.'

However, this is not proving an impediment to ReconRobotics' marketing strategies. Indeed, the fact that the product is manufactured in the company's host nation has become one of its key selling points.

'In the security world, there's something about "Made in America" that's important,' Bignall said. 'I'm not saying that out of pride of anything – it's more about the perceived quality, I think. But as robots become more and more ubiquitous, not just in the police and security worlds but maybe in the home or in factories or commercial businesses, then I can definitely see it shifting that way. And we're ready to do that as it makes sense.' **UV**

struck by western UGV manufacturers will include customer-nation workshare. This presents opportunities for established suppliers, but also challenges.

'There is an offset issue so we need to provide a solution,' agreed Bar-Gai. 'And we welcome discussion with companies for all kinds of cooperation. We are very open to move some of the production line from Israel if we have an agreement and an order from these countries.'

'When we go to each country we do business with, we always partner with someone internally as a distributor or service point,' said Bignall. 'We believe in generating internal economic value for the countries we're dealing with. Right now we only manufacture the product in the US. But it is a relatively niche product, and it's not a significantly high-volume manufacturing business. We remain open to any of those kinds of agreements, with the right deal of the right size and with the right economics.'

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As militaries look to transition more unmanned systems into their core equipment sets post-Afghanistan, **Claire Apthorp** looks at how OEMs will provide long-term support for those fleets in future.

Keep on running

Unmanned vehicles (UVs) and the capabilities they bring to warfighters are revolutionising the way that 'dirty, dull and dangerous' tasks are performed in-theatre. From providing ISR overwatch for ground operations, to connecting soldiers to their forward operating bases with communications payloads, and delivering equipment into theatre, unmanned technology enables more personnel to be kept out of harm's way in today's battlefield than ever before.

For military forces operating in Iraq and Afghanistan over the past decade, the UAVs providing these services have been acquired under a range of procurement methods, all of which have different support implications in-theatre. While some systems have been developed through programmes of record (PORs) to meet long-term requirements of armed forces, others have been supplied under UORs to fill short-term capability gaps. Yet others have been provided under

contractor-owned, contractor-operated (COCO) service agreements.

Now, with the drawdown of troops and equipment from Afghanistan well under way, coalition forces are taking the opportunity to look closely at their UAV fleets and decide what will be brought into their core equipment set, and how those platforms will be serviced and supported going forward.

SUPPORTING CAPABILITY

Lockheed Martin, which supplies its Desert Hawk III UAV to the British Army, and the Persistent Threat Detection System (PTDS) aerostat and K-Max VTOL to US forces, is one company considering how to take the support of these systems into the next phase.

'UVs and robotics in general provide a huge opportunity for us to do things in a different way, save lives and continue to execute the mission at reduced cost and risk to human life – and new missions across air, ground and sea

will only continue to emerge as we go forward,' Jay McConville, director of business development at Lockheed Martin Unmanned Integrated Systems, told *Unmanned Vehicles*. 'And as those missions come into play, there will be a natural growth of the systems, their capabilities, and the support services that we will provide to our customers.'

The British Army initially ordered Desert Hawk in 2006, which was followed by additional contracts in 2007 and 2010 for the lightweight, hand-launched, ruggedised air vehicle. The company runs a full-time contractor logistics support (CLS) programme for Desert Hawk, under which it provides spare parts and repair services for more than 20 >

AeroVironment UAS, including Raven, account for 85% of US DoD UAVs, but only 5% of spending, it is claimed. (Photo: AV)

vehicles a month, as well as technical publications, flight and maintenance training.

'This is a fairly typical support arrangement, but as the UV market is very diverse, the way we support the systems really depends on how the customer wants to use them,' McConville said. 'If you look at systems like the Fury 1500 UAV or the Squad Mission Support System UGV, those systems are newer so they will have new deployment scenarios. But what we do find consistent is that our customers need the back-stop of the logistics support operation to do the "sparing and repairing" while still continuing to develop and expand the technology.'

Key to providing successful support is the flexibility to meet changing user requirements, particularly for more complex systems that are designed to fly at higher altitudes for longer periods, such as the still-in-development Fury 1500.

Service provision arrangements, exemplified by Lockheed Martin's work with the US Army on in-theatre operation and sustainment of PTDS to provide 24/7 ISR in Afghanistan – a contract renewed in October 2013 – have also proven successful for customers seeking the flexibility of acquiring a service rather than investing in the complexities and expense of direct procurement.

'As unmanned systems become more prevalent in use, there will be a mix of ownership and service-based GOCO [government-owned, contractor-operated] support, and we are preparing to respond to that market dynamic right now,' McConville said. 'We've tried to remain flexible in how we provide that, whether it be on site with our own people flying and maintaining the system, or through a training programme to get the customer doing the same, or some hybrid of the two.'

FINDING A BALANCE

Insitu has used its experience from providing COCO UAV services for design programmes to support customers acquiring their ScanEagle systems under PORs.

'When we started, our first appointments involved providing ISR services through COCO



The Fury 1500 will have its own set of logistics requirements. (Image: Lockheed Martin)

systems, so in effect we became our own customer for the sustainment and support of those systems,' Ryan Hartman, senior VP for Insitu programmes, told *UV*. 'So we had to put into place a logistics and sustainment programme that enabled us to support those systems in the field while developing infrastructure for engineering support, reliability analysis and the provision of spares and maintenance.'

There are many aspects to the support of UAVs outside the hard spare/repair line. New customers, particularly those for whom unmanned systems are an unfamiliar technology, often seek guidance from systems providers on how to shape their programmes.

'A lot of customers start with a philosophy informed by manned aviation, because that is what they are most familiar with, and what we have to do is help them tailor that philosophy and sustainment approach so that they are balancing acquisition and sustainment costs,' Hartman said. 'After all, the true value proposition of unmanned systems comes from the sustainment of the system itself, and we want to ensure that value stays relevant.'

Similarly, companies such as Insitu are looked to by their customers to help evolve requirements over time – a key example of this will be seen as armed forces

complete the withdrawal of their equipment from Afghanistan.

'There is an absolute difference in terms of supporting a system in a wartime environment compared to a peacetime environment,' Hartman explained. 'In wartime, the priorities are mission reliability rates, and system availability is much more critical, whereas in peacetime, you're working with a customer who is focused on training and sustaining their competencies as they relate to unmanned systems – and to be successful you must be able to do both.'

DYNAMIC MARKETPLACE

The company now sees a balance of COCO and PORs among its customers, offering a 'one stop shop' for support of its UAVs. It expects a transition from CLS programmes to performance-based logistics (PBL) arrangements for those customers seeking PORs in the future.

'I think what we'll see will be similar to what happens in the manned aviation sector, where companies exist whose only business activity is to support the equipment supplied to their customers by other organisations,' Hartman said. 'I think unmanned systems is going the same way – as more systems enter use through more PORs it will drive a competitive



'Companies exist whose only business activity is to support the equipment supplied to their customers by other organisations.'

produces the equipment, and the company that is repairing or providing training for the equipment, there can be a loss of effectiveness and efficiency in that transaction,' he said. 'Clearly the intent in some cases is to gain economic advantage there, but our experience has been quite positive from a customer perspective when we are providing the complete solution – and in some cases it may end up even more cost-effective to provide that complete solution.'

For this reason AeroVironment's support philosophy is to try to stay as close to its customers as possible, with the objective of ensuring their success.

AeroVironment currently acts under an indefinite delivery/indefinite quantity contract awarded to it in January 2013 along with four other companies – Altavian, Innovative Automation Technologies, Lockheed Martin

and Elbit Systems of America – for the provision of small UAS and related support to the US military.

The company's Raven, Puma and Wasp systems make up a significant portion of the US DoD's UAV fleet, accounting for as much as 85%. This in itself provides additional impetus for AeroVironment to provide support to those systems with as cost-effective a solution as possible, in order to ensure that their uptake and usage continues. It is doing so successfully. In August 2013, figures published by the company reported that, despite the large size of the US military fleet, AeroVironment's small UAS account for less than five percent of total reported DoD UAS spending since 2004.

'We are able to provide 360° support to our customers, so we've learned a lot about the use of our products, and it's a continuous process because customer needs are not static. Nor is the operating environment – the enemy always has a vote, so to speak,' Gitlin said. 'And we will adapt to whatever the changing requirement may be. If that means training someone at a base in the US, or sending one of our personnel down to a base in Afghanistan to bunk with the customer and train them on site, that's what we'll do.'

market place opening up, and you'll find that many companies are already positioning themselves to take advantage of that.'

However, this potential split between platform provider and supporter does present a risk to the customer, Steve Gitlin, VP for marketing strategy and communications at AeroVironment, believes.

'If you break apart the supply chain between the company that develops, designs and

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FACING THE FUTURE

Part of the success of small UAS among military users has been their low logistics footprint, which is achievable due to the fact that keeping the equipment in good operating condition – or resetting the hardware to maintain the capabilities of the fighting force on drawdown – can be achieved much more quickly and cheaply than for conventional manned ISR assets.

The aviation paradigm is that early on in the adoption of unmanned aircraft, customers realised that although SUAVs *are* aircraft, they are really more equivalent to equipment such as rifles, infrared cameras or goggles, in that they're in a pack on the back of an infantryman or marine, and as a result they can be maintained by that operator to a certain extent,' Gitlin said. 'You don't need a large team of people, a hangar or sophisticated logistics control systems in the field to do that, so operating and maintaining smaller UAVs is quite a bit easier and faster than other typical aviation assets.'

But for UAVs with support requirements that approach those of manned aircraft, such as MALE and HALE systems with sophisticated operating envelopes and support structures, the picture is somewhat more complex.

In November, General Atomics entered into an enterprise-level, public-private agreement with the US Air Force Sustainment Centre (AFSC) for maintenance of UAS including the USAF's Predator/Reaper and



An engineer repairs a Shadow UAV at Evans Army Airfield in Georgia. (Photo: US Army)

the US Army's Gray Eagle fleets. This is the first centre-wide UAV partnership agreement implemented since AFSC was stood-up in 2012, and will see work performed by General Atomics and air force personnel at three AFSC logistics complexes in Georgia, Oklahoma and Utah.

It is expected that work on aircraft batteries will be performed at Warner Robins Air Logistics Complex (ALC), Georgia, landing gear at Ogden ALC in Utah and small engines will be covered at Oklahoma City ALC.

Such large-scale logistical support is reflective of the significantly more complex

requirements of larger UAVs, but this partnership agreement shows that the USAF is seeking more streamlined and efficient ways to manage its fleet. Before this arrangement, each ALC entered into individual partnerships depending on requirements, which could take up to 16 months to complete. Now, the bases will be able to execute implementation agreements with General Atomics to manage workloads in shorter timescales – saving as much as ten months for each partnering agreement.

As armed forces look to implement new ways to support their UAV fleets for the long term, such improved coherency of purpose will be required between military and industrial organisations to ensure efficiency at every stage of the logistics process. And as equipment returns from current operational theatres, now is a good time for users to reconsider the best way to maintain their fleets, and for industry to develop new and innovative options to do so. **uv**

'SUAVs are more equivalent to equipment such as rifles, IR cameras or goggles... and as a result they can be maintained by that operator.'



Insitu has used the COCO model to support customers under programmes of record. (Photo: Australian DoD)

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Lt Col Bede Galvin of the Australian Army's 20th Surveillance and Target Acquisition Regiment talks to Andrew White about the role of the service's Shadow 200 fleet post-Afghanistan and its plans for future UAS procurements.

Following November's drawdown of Shadow 200 UAVs from Afghanistan, the Australian Army has begun the process of 'realignment' to support multi-role combat brigades.

Speaking to *Unmanned Vehicles*, Lt Col Bede Galvin, commanding officer of the army's 20th Surveillance and Target Acquisition (STA) Regiment, outlined unit objectives in line with 'Plan Beersheba' – a phased programme designed to adjust the army's force structure to generate optimal capability.

'The army is undergoing a realignment of brigades and is using Shadow 200 to support it. This involves the reallocation of combat power for the multi-role combat brigade,' he explained.

BRIGADE SUPPORT

Describing how the army first deployed Shadow 200 to the Australian/US forward operating base in Tarin Kowt, Uruzgan, Afghanistan in March 2012, Galvin explained how the UAS would continue to support brigade operations at home in much the same way.

'Now, it is about how we support manoeuvring brigades. There is no issue for us and we are currently developing TTPs [tactics, techniques and procedures] to this end.'

Shadows were first mounted on HMMWVs by the US Army and USMC, and modification work to provide a mobile capability for Australian aircraft from Mercedes Unimog vehicles is currently under way, Galvin explained.

The STA regiment currently operates two Shadow systems, each consisting of five air vehicles. Galvin added that this capability is 'satisfactory to our need'. Combined with the

upcoming purchase of attrition replacements, the fleet will be adequate for the lifespan of the Shadow's capability.

Australian Shadows were brought in by the army following the utilisation of Skylark and ScanEagle systems in Afghanistan, East Timor and Iraq. However, Galvin said he anticipates the introduction of a smaller UAS, similar to the Puma or Raven, over the next three to five years.

'I expect to see a small UAV in the army, allowing us to take a leading role in UAV/ISR coordination for the multi-role brigades,' he added.

Referring to how lessons learned from operations in Afghanistan could be applied to future taskings, Galvin said: 'We learnt the flight behaviour of UAVs and what Shadow can do, and we are taking this into future training. So we are focusing on the next phase of our organisation and getting out of supporting current operations and looking at the next contingency operations.'

'Our focus is on enabling the system to fly and to support manoeuvre multi-role combat brigades. Key points are airmanship and focusing on dissemination of information, ISR and other tasks to support this. We are focused on learning to fly in the environment that is Australia which is very different to Afghanistan,' Galvin stated.

The army is undergoing a realignment of brigades and is using Shadow 200 to support it.'



Changing topics, he said there were no plans to replace IAI's POP200 EO/IR payload as used in Afghanistan, confirming that the Australian Army would retain the same growth plan as the US military.

'There is no plan for any further development other than EO/IR and the laser. POP300 will be staying for a while and we are likely to have Shadow for another ten years,' Galvin said. Additionally, he scotched any intent to weaponise the platform.

CAPABLE PLATFORM

According to manufacturer AAI, the Shadow 200 is capable of observing targets up to 125km away and spotting vehicles from an altitude of 8,000ft and a 3.5km slant range. Galvin said that operations in Afghanistan supported the wider Australian task force, which included the Special Operations Task Group.

Regarding networking capability, he offered: 'We can communicate with other platforms and that continues to be trained for and done.' **uw**



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