Layered defence systems for the drone and missile age 100925.wav

Rob Merryweather: [00:00:00] Hi there. Welcome, everybody. I'm going to spend the next few minutes talking about layered defence systems for the drone and the missile age. So, we've been talking about integrated air and missile defence. We've been talking about short range and medium range ground-based air defence. We started to talk about counter-uas systems, and what they bring is their specific challenges. What I'm going to just spend a few minutes talking around is how BAE Systems is approaching this as a spectrum of capability, and what that means in terms of our approaches, the equipment's we develop and the capabilities that they offer to the customers that we serve. So, we've all seen the evolution of the conflict in Ukraine particularly, we would have seen elements of this and shadows of this in earlier conflicts in Syria. But the effect of drones low cost uncrewed air systems on the modern battlefield is clear and is evident and is transformational. One of the biggest things that these assets have changed these kinds of weapon systems is the economics of warfare. So, we have systems/ we've had systems for tens of years that are capable of shooting down air targets, we've had them for air defence. But these systems or individual shots of these systems often cost hundreds of thousands of pounds. At the point where we're in a long scale, attritional conflict with drones that are 10 or 20 or £30,000, even the long-range versions at that kind of price point, that economics is not sustainable. So, we need to change our approach to how we provide defence against these kinds of threats, whilst also making sure we retain our ability to defend against the more exquisite threats that are still evident in a peer on peer conflict. So, if we think about that new approach and what does it drive? It drives us to a model of considering the detect the decide the effect cycle. And increasingly the decide element of that cycle becomes incredibly important. But we need to understand that from an end to end position in order to ensure that we don't only make the best decision about the thing we wish we could do, but that we have thought about what we will do, what effect systems we have in place to deliver that so we can inform how we detect, how we can affect and then what is the best decision to make given the tools that we have in the toolbox, the tools that we can provide to our customers. All of this then is underpinned by a rate of change that is pretty unprecedented. So, we could solve this problem for what we understand and know today. But the thing that we certainly know is that even within six

weeks or 12 weeks or ten weeks, that environment is going to be different. So how do we not only architect the systems to be able to evolve, but how do we have the intelligent systems that will inform that evolution and make sure that we are driving the right changes, the most effective changes to keep these systems agile and effective? So, if I start to bring some of these elements to life and talk in the, in the detect line. One of the effects that we see particularly in Ukraine is the survivability of active sensors. So, at the point where we are turning on an active beacon, an active radar to detect the survivability of that asset in that location is in a very small number of minutes, because there are systems now that can locate that that sensor and then can launch effect against that sensor. So, we're putting a lot of effort into passive detection capabilities. That's quite conventional in terms of cameras, electro optics, surveillance cameras. But how we build range on top of that, so you'll see some works that we've been experimenting with at the back of the stand around, really getting the AI of image classification really embedded tightly to the operation of the sensor. So, we're not just analysing a video feed, we're analysing the raw data that comes off the sensor, and then applying the AI to that raw data to give us much better ability to detect the anomalies and classify those anomalies within a, within a video feed.

Rob Merryweather: [00:04:30] We've also taken work around passive radar. 2D passive radar is relatively conventional, that's where you understand the emissions that are coming from the object. It's communications through its control loop, it's communications for broadcasting, it's ISR information and you get a bearing on that, that RF signal and you understand that bearing. We're moving beyond that now into 3D passive radar. So how can we understand or use the signals of opportunity in the battle space to actually Triangulate reflections of an object without ever having had to make an intentional transmission. So that gives us the ability to detect objects in 3D without disclosing the location from which we're sourcing. And while that technology might not be ready yet to give you a target grade track, it's certainly good enough to cue your camera sensor onto that location to then be able to identify the object, assess its threat, and continue to do that detect capability in the passive domain. The longer we can stay in the passive domain, the more survivable those systems become and remain. But again, in that layered capability, that passive domain is only going to give you a certain level of range, a certain level of detection. So that still integrates into the more exquisite radar sensors that we offer. And particularly when you bring it, come into the naval

domain. We can talk about signals of opportunity in land where the adversary is driving E-W. They're driving electronic countermeasures.

Rob Merryweather: [00:06:07] If you're in a blue ocean scenario, there are not a lot of signals of opportunity. So, the ability to still have that active radar, that active capability is critically important. Then we move beyond that into the strategic surveillance. So, capabilities in over-the-horizon radar our Australia business and Australia as a nation is a real leading country in over-the-horizon radar capabilities. This is using HF radio waves that we can propagate and bend through the atmosphere so we can see thousands of miles offshore. In the context of defence against hypersonic weapons, long range strike on homeland security, that's the kind of detection ranges that we need to be able to see, to understand the threats, and then have the time to be able to position for the counter. So hopefully what you can see him trying to describe here is how we can move from passive detection, passive 3D multistatic radars in the tactical land domain up into active radars that are relevant in the land domain. Also, highly relevant in the maritime domain over tens of kilometres out into the over-the-horizon radar capabilities to give us that strategic intelligence, all of which can start to inform that that decision, that decision tree. Then on top of all of that, now you have the closest thing that you get to effectively, you know, I'm a physicist and a scientist, I do not believe in a flat Earth, but a Leo capability gives you as close to a flat Earth as you are ever going to practically see the ability to ubiquitously see vertically down what's happening over the land gives you that capability. And again, you'll see with our US business, where we've been awarded contracts for space-based detection of hypersonic missile launches in the US. So, through this end to end detect capability, you can pick the right detection capability for the threat that you need and feed that into the decision making. If I then move into just talk about the decide capability. The thing that I would really want to bring home about the decide is it's one thing to be able to run AI algorithms around what's an optimization of asset allocation to, to threat. But that allocation and that AI will only be as good as your understanding of the capability of the effector that you're delivering and your understanding of the threat that you're trying to address. So what we bring into this decide function is a real deep understanding of the probability of accuracy of the detection and the classification that we've managed to achieve through the sensors, the probability of kill or effect of the effectors that are in the portfolio and feeding that depth of understanding of the military capability of those systems into the desired algorithms, so you really do have confidence that the decisions

that are being recommended to the mission operators are going to be as effective as they can possibly be.

[00:09:15] This is an example of the systems MCAT, C2 product, which is really focused around electromagnetic countering, so the EAW countering effects. And in here the red areas and the blue areas represent the propagation areas of those spectrums. So, we need to understand the terrain that we're operating over. We need to understand how that EM will propagate and then we can understand the best locations to perform that jamming that countermeasures from, to have the optimal effect. So, it's really bringing that deep understanding of the mission equipment into the desired function but then using the AI and ML to accelerate the pace of that desired function, accelerate the complexity of the situation that can be dealt with in any period in time. So, if I move beyond the decide, we then get into the range of effectors. We have electronic electromagnetic effectors as simple as jammers, which can work against very low-cost drones. But jamming won't work when you move into fibre optic controlled drones. It won't work into you know, some of the more exquisite capabilities which are heavily, heavily hardened against those capabilities. So, whilst in the while we're still in the EM domain, we start to move beyond simple jamming into how to deliver effectively hard kill through electromagnetics.

Rob Merryweather: [00:10:44] And there's some systems that you'll see like Dragonfire - laser directed energy weapons. But actually, you can bring things much more focused down into the RF domain that disrupt the signals within platforms that cause them to fail, cause aircraft to fall out of the sky. So that kind of semi low power directed energy can become really, really effective and really capable in the in the battle space. We then start to move forward into your kinetic effectors. You'll see some of the guns that we have on the on the stand, the CV 90 with a 30-millimetre cannon on the CV 90. You know, these cannons can deliver airburst munitions. It's an evolution of World War Two technology of anti-aircraft guns you know, putting explosions up in the atmosphere, but with a whole different level of accuracy and agility now. So, the CV 90 is demonstrated taking out an uncrewed air target whilst the CV 90 was on the move at about 50km an hour. The accuracy that you need to assess the position of the vehicle, the angle of your turret, the position of the drone with all of that movement and trigger your airburst munition in the vicinity of the drone to take it out. That's really where you get to some of the expert engineering in terms of making what is a simple concept, a highly effective

operational capability. We can take the same the same kind of capabilities, the same kind of cannons, move them into bespoke counter-uas systems.

Rob Merryweather: [00:12:09] So you don't have to have an armoured personnel carrier or an infantry fighting vehicle on hand. We can just take the weapon system out as part of a county UAS system, which you see with the Trident Mk2, and we can take the same capabilities and we can put them on the front of a naval vessel to allow a naval vessel to defend itself against swarms of incoming UAVs, which is a real threat that we've seen in the Red sea and in the Straits of Hormuz. If we move beyond that, we've had successful firings of our advanced precision kill weapon system. So again, this is a very low-cost precision guided munition. It takes a Hydra rocket, puts a precision guidance laser guided precision guidance kit on the front and it gives you a precision guided weapon capability for $30,000 to $50,000 a shot, as opposed to the hundreds of thousands that you might see from other laser guided weapons. On this capability we mounted that successfully on one of our or modified versions of one of our Malloy drones in the US earlier this year. And we're able to conduct three live firings. One was an air to ground. Two of those were air to air engagements, which we believe are the first air to air engagements of a counter drone missile from another drone of this class.

Rob Merryweather: [00:13:29] So, again, the ability to understand how to put the right weapon system in the right place and to get through the military capability necessary to deliver a credible military effect. That might deal with the threat as we see it today. But what do we do, particularly in the EM domain, to understand what signals our adversaries are using, how we can counter those, how they are using those to counter our systems and continue to drive that forwards. The two elements here is one is the enormous amount of work that government does within government organizations to understand this threat, and how we're working much more closely with government now to understand the feedback from the operational environments, to inform the capabilities that we deliver, and also the software defined nature of much of the hardware that we're putting out there now. So, when there is a change, it isn't a hardware change that's needed. It can be changed in the software configuration files, which means the systems can evolve massively more quickly than historically they have been able to. Then we look at open architectures and that integrated capability. We need to be able to link our tactical defence, the sensors that we have available at the tactical level to the sensors

that we have available at the operational, the strategic levels across the domains of maritime and land, bringing in the future capabilities of air defence.

Rob Merryweather: [00:15:05] So we can build this layered capability. And this really is at the heart of what the MoD have been talking about in the Strategic Defence Review about the digital targeting web. That will not be a single thing that is created and deployed on mass as a single capability. It will be an amalgamation of sensors with open architectures and C2 systems that can talk to each other. So, the observations and the detections from each can be shared and the decision making can be optimized across a disaggregated system. And we fully understand that we have the ability and we've done integration trials to show how what we detect in the ground domain can be shared with the naval ships for the air defence in Type 45 and how as a next generation that can spread into disaggregated mission systems. So, across all of this I'm hoping I've given in what's still, I hope, a reasonably short period of time of your interest. A view as to what's changed in the current warfare situation. The threat has changed, but many of the existing threats have remained the same. So, we need to evolve our capability to address the new threats without degrading our ability to defend against the ones that we already knew about.

Rob Merryweather: [00:16:23] And we need to evolve our design approaches to be more open architecture, more software defined, more enabled by enhanced decision making, to allow that evolution to be really fast and really effective. But the thing that I would probably like to leave you with more than anything else is whilst AI and decision making is critical, it is only as effective as your understanding of the threat that you're addressing and the effect that you're deploying. And we really need to bring that knowledge of those two elements together. If we're going to really deliver the capabilities that our servicemen and women are going to need as they seek to, to defend us and our freedoms over, over the over the years to come. Or more hopefully for us to put forward the credible deterrence to our adversaries that mean it is not wise to take on the defence mechanism because we have the capabilities to undertake these defences, which is ultimately what we're working for as the deterrence mechanism to keep the world the safe place that we want to live in. So hopefully that has been an interesting relatively short. The plan was relatively short insight into our thinking around layered defence and the impact that has on the effectors and the sensors and the decide tools that we're, that we're delivering. But hopefully I have a few minutes left for

questions. If there is anything from the floor that people like to have microphones available.