Future Technology and International Cooperation
A UK perspective

In 2011, NATO’s Integrated Air Defence (NATINAD) and the supporting NATO Integrated Air Defence System (NATINADS) marked 50 years of safeguarding NATO’s skies. In order to successfully reach future milestones NATO must continue (and in many cases improve) its air defence interoperability across the strategic, operational and tactical domains. In order for this to become reality a combination of exploiting synergies and acknowledging that the whole is greater than the sum of its parts is required at all levels. Recent improvements and a greater focus on future capability within the UK’s Joint Ground Based Air Defence (Jt GBAD) will enable the Formation to deploy its units and sub-units in order to operate the latest air defence weapon systems, within a multinational environment, against a near-peer adversary or asymmetric threat, and win.

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This article will highlight the UK military’s strategic situation, perception and understanding of the air threat before explaining the new military structure to which the Formation is adapting. It will then describe future UK AD technologies prior to focusing on the UK’s essential cooperation with its partners and allies. There has been a significant change in the strategic direction of the British Armed Forces, and subsequently the operational level construct. As the new direction is towards Joint Force 2025 (JF2025) it is pragmatic for this paper to focus on the next 10 years. The purpose is to identify and highlight the pertinent capability enhancements and future vision of the UK’s Ground Based Air Defence Formation and its developing role within the NATO construct.

The UK’s Strategic Defence and Security Review 2015 (SDSR 2015) and the Defence Strategic Direction 2016 (DSD 2016) forms the UK Government’s latest review on all national security matters and provides high level direction to UK Defence out to 2025. SDSR15 stated that the MOD and Armed Forces were to be reformed, including the improvement of the
procurement process, to ensure that the UK could maximise investment in the front line. The Government pledged £178 billion over the next decade on equipment and equipment support. The requirement for a period of national austerity, combined with political reticence to investment has resulted in a limited procurement budget for the three services. To meet that increased level of Defence ambition as part of SDR15 the Secretary of State announced Joint Force 2025 – a resource-informed and time-bounded aiming mark to ensure Defence’s increased utility over the coming years.

Joint Force 2025

JF2025 aims for the ability to deploy a larger force more quickly than is currently the case. By 2025, it is planned this highly capable expeditionary force of around 50,000 will include a land division with three brigades (two Armoured Infantry (AI) and the new Strike Brigade, capable of assuming command of a fourth coalition brigade, and one of the UK’s Very High Readiness Air Assault or Littoral Manoeuvre Task Forces, supported by an air group of combat, transport and surveillance aircraft. JF2025 will be capable of deploying on an enduring medium-scale operation, often drawing mostly on just one Service, such as the current counter-ISIL mission in Iraq. This new policy demands that the UK is able to field a modernised division, capable of war fighting as the principal output of the Army. The Army’s ability to deliver a war-fighting division aimed at deterring or defeating a near-peer enemy has required refinement to the Army 2020 (A2020) force structure integrating an Army of Regular and Reserve components which will deliver the contribution to the JF2025.

United Kingdom Joint Ground Based Air Defence

The UK’s Air Defence (AD) capability, and within that the Ground Based Air Defence (GBAD) capability, is based on modern, high intensity manoeuvre warfare in conditions in which air supremacy or superiority cannot be guaranteed. The GBAD formation is commanded by a Royal Artillery Colonel and is under Operational Command (OPCOM) to 1 Group Royal Air Force (1 Gp RAF). The formation’s LAND coordinating and Budgetary Control (BUDCON) 2* HQ is Force Troops Command. This chain of command necessitates that any requirements for equipment capability must be staffed through the AIR chain of command. The UK’s current GBAD engagement capability consists of two systems. The VSHORAD High Velocity Missile (HVM) system with a range of approximately 5.5km (12 000ft ceiling) and 24hr capability which is deployed for route/vital point defence and protection to manoeuvre forces. It can be mounted on the Stormer CVR(T) self-propelled vehicles (SP) or employed in the Lightweight Multiple Launcher (LML) role. The SHORAD Rapier FSC capability with a range of 8.2km (16 000ft ceiling) has a 24hr capability and is employed as area air defence, route defence, vital point defence of base defence zone roles.

The Current State of UK GBAD

The UK’s GBAD capability has reduced by 84% since 2004. UK SHORAD capability is primarily focused on the GBAD protection in the Falkland Islands (FI). Contingent SHORAD capability can only be achieved at ‘best effort’ and is not resourced in equipment or structural terms. UK SHORAD (Rapier FSC) holdings are now 14 platforms following a saving measure in 2011.
improved Air Surveillance (AS) and provided early indications and warnings for other systems, whilst providing organic Link-16 capable Situational Awareness (SA) to Land HQs, through dissemination of the Recognised Air Picture (RAP). LEAPP provides a 150km surveillance coverage and IFF Mod 5 capability.

UK GBAD BMC4I capability is currently limited; neither VSHORAD nor SHORAD systems are Link-16 (L16) enabled, cross-tell (by choice) remaining the means of passing situational awareness derived from the LEAPP SIAP/RAP, or from external sources. The Battlefield Communications and Information System (BatCIS) remains the battlefield communication system, using HF and VHF; it is the bearer for GBAD Battlefield Information System Application (BISA), a planning tool which enables site recce and consolidation. It currently lacks Shared Situational Awareness (SSA) and the capacity to plug all capabilities into a common (networked) architecture.

The UK’s Headquarters Jt GBAD transformation vision is given below:
Contemporary and future air-enabled threats pose a severe risk that we are currently ill-prepared to counter. Jt GBAD will therefore transform and adapt over the next 3 years in order to ensure the supported arms can operate effectively even when our adversaries are able to make use of the air environment. This will be done through refining BMC4I to enable effective engagement decisions, reconstituting operational C2 and by reorganising structures to make better use of scarce resources. Jt GBAD aims to harness NATO operations and becoming the recognised Defence experts in PASSIVE AIR DEFENCE MEASURES, develop Defence’s understanding of ACTIVE AIR DEFENCE MEASURES in operational design; and pioneer the integration of Air Surveillance (AS) and GBAD into OFFENSIVE ACTION through timely support to full spectrum targeting.\(^{11}\)

This Jt GBAD direction highlights the importance of regaining its previous high level of expertise on three of the key areas of ground based air defence:

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The platforms are manned by a single Regiment who are permanently committed to providing persistent GBAD to the Joint Prioritised Defended Asset List (JPDL) in the Falkland Islands (FI). The Rapier Out of Service Date (OSD) is 2020 when it is due to be replaced by SKY SABRE, a Beyond Visual Range (BVR) MRSAM system, procured to replace Rapier FSC in The Falklands. UK VSHORAD (High Velocity Missile (HVM)) numbers have reduced from just under 400 platforms in the early 2000s to 82 (44 Self Propelled (SP) and 38 Lightweight Multiple Launchers (LML)). The correct ‘unit of measure’ for VSHORAD is the Fire Group\(^{10}\) (F Gp), and it is more informative to describe UK capability now as 6 x SP and 4 x LML F Gps.

The introduction of Land Environment Air Picture Provision (LEAPP) has enhanced the detection range for some categories of hostiles,

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\(^{10}\) A F Gp consists of 6 x Fire units, or weapon platforms, deployed in mutually supporting and overlapping arcs.

\(^{11}\) Colonel N.T. Sawyer (Late RA), Commander Jt GBAD, JT GBAD DIRECTIVE 2016 dated 14 May 2016, 1.
There are several transformation work streams (WS) that will deliver this vision. The key workstreams are:

- Developing Passive Air Defence (PAD) Expertise.
- Developing Air Observers.
- Converting 16 Regt RA to SKY SABRE.
- Reconstituting NATO and Higher HQ GBAD Cells.
- GBAD support to Offensive Action.

**The Air Breathing Threat**

The current fixed and rotary wing threat from a near-peer adversary remains extant. British Army doctrine states that the potential air threat also includes Space Operations, Theatre Ballistic Missiles (TBMs), Tactical Aerodynamic Missiles (TAMs) (including Cruise Missiles (CMs)), aerial surveillance platforms (including Unmanned Aerial Vehicles (UAVs)), Stand-off Systems, Electronic Warfare and a Suppression of Enemy Air Defence (SEAD) capability.\(^\text{12}\)

In an analysis undertaken by the Think-Tank RAND, in which six potential future worlds were characterized, ranging from US unipolarity to anarchy, in order to ascertain how different political situations would affect the air threat, CMs were the only threat present in every scenario.\(^\text{13}\)

The only nation that has an effective cruise missile capability is Russia.\(^\text{14}\)

CMs present a significant threat to access to Airports of Disembarkation (APODs). Whatever the type of operation, military forces will require early access to airports, which are easily threatened by even unsophisticated CMs. Thus, the requirement for GBAD to be able to defend against the CM threat is of a particularly high priority. Furthermore, there is an ever increasing risk of swarm attacks – an attack of sufficiently large number of CMs or UAVs designed to overwhelm air defences – which currently very few countries have the ability to counter.

Generally, the increasing amount of UAVs presents a threat beyond that of a swarm attack. In order to effectively defend against the UAV threat, the defensive capability needs to be long range. This would deny UAVs the ability to collect information from range and would prevent the adversary with the ability to strike effectively. Therefore, the most likely threats to the UK, at home or on operations, are the propagation of cruise missiles and the globally increasing amount of UAVs.\(^\text{15}\)

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The advances in UAV technology and usage represent the biggest shift in recent threat development. Class 1 UAS and below (Mini, Micro and Nano) are considered Difficult Aerial Targets.

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12 Director General Joint Doctrine and Concepts, Ground Based Air Defence, 1-3.
13 Frances Lussier et al., Army Air and Missile Defenses: Future Challenges (Santa Monica: RAND, 2001), vii.
15 Lt M. Dalgarno RA, Duncan Essay Submission: In a congested air operating environment is this approach still valid compared to the use of cheaper MANPADs in greater numbers?, 2016, 2-3.
The result of a capable mini-UAS threat can be catastrophic. In the summer of 2014, at least two Ukrainian Battalion Taskgroups were destroyed (in under 15 minutes) by surface-to-surface rockets. The Ukrainian forces were detected by mini-UAS and the fires were directed by mini-UAS. Larger Tactical UAS (similar to the UK’s Watchkeeper and Reaper, and the US’ Predator) are also being used by non-state actors, often enabled through a ‘sponsoring state’. Whilst open war with a near-peer enemy is considered possible, conflict with a foe indirectly supported by a non-friendly nation, is almost a certainty. In Nov 2016 Kurdish forces fighting the Daesh in northern Iraq shot down a small drone the size of a model airplane. They believed it was like the dozens of drones the terrorist organization had been flying for reconnaissance in the area, and they transported it back to their outpost to examine it. But as they were taking it apart, it blew up; killing two Kurdish fighters in what is believed to be one of the first times the Daesh has successfully used a drone with explosives to kill troops on the battlefield.

Lt General (Retd) Naresh Chand, Ex-Director General of Corps of Indian Army Air Defence, suggests that the Future Trends in Air Threat will encounter a variety of airborne dangers focused on the increased use of UAVs, armed UAVs and micro/mini-UAVs. There will be an ever increasing missile threat with a proliferation of precision guided munitions (PGMs) and a more effective use of electronic warfare capability for jamming air defence systems by future adversaries. All of the above will result in multi-platform, silent and stand-off threats. As at January 2017 the British Army recognises the latest significant potential threats to the UK are from Russia and Daesh (in addition to Boko Haram and Cyber Warfare).

**Future Technologies – High Tech**

The UK Government has stated that it will ensure that the Armed Forces will project power, be able to deploy more quickly and for longer periods, and make best use of new technology. Future technologies may also include Electro-Magnetic (EM) guns, Directed Energy Weapons (DEW) and Surface-to-Air Missile (SAM) Systems but all of these require one common capability; a Fire Control System working within a Universal Battlefield Management Command, Control, Communications, Computers and Information (BMC4I) network. A BMC4I system enables effective and timely engagement decision making. To maximise the capability it must integrate all the sensors and all the effectors available on the battlefield. Along with AD sensors this is the most vital element of AD on the battlefield and, arguably, one of the most difficult to achieve. The vast array of capability within NATO nations’ AD systems combined with differing complexity creates a less than ideal platform for integration.

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16 Hezbollah currently operates more UAS that the British Army and RAF combined.
20 The Army Knowledge eXchange Newsletter (Jan 17 – Issue 8), http://akxportal.landforces.snl.uk/sites/akx/operations/threats.
Whilst the SKY SABRE is a very different capability to Rapier, the Regiment has the benefit of already being equipped with the G-AMB Radar system. The familiarity and experience that 49 (Inkerman) Battery RA has developed whilst bringing the Giraffe radar into use, in the Recognised Air Picture (RAP) role, should stand the Regiment in good stead during the transition to SKY SABRE. SKY SABRE will be a paradigm shift in terms of capability, effectiveness and complexity.

A key point is the importance of integration and communications in enabling the maximum possible effectiveness of SKY SABRE. Airspace coordination and control measures will become commensurately more complicated for SKY SABRE operators than they were for Rapier. With the through-life design of SKY SABRE there is significant potential to continue integration and development, with the use of Link 16, and the future Network Enabled Airspace Defence and Surveillance (NEADS) project among others.

The Lightweight Multirole Missile (LMM) is a low cost, lightweight, precision strike missile for use on existing Starstreak HVM platforms (it can also be integrated onto some UK helicop-

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23 Lt H.D.S. Blanshard RA, Duncan Essay Submission: What lessons can be drawn from 36 Regiment’s conversion from 3.7 inch guns to Thunderbird after WW2, 2016, 7-8.
24 Lt H.D.S. Blanshard RA, Duncan Essay Submission: What lessons can be drawn from 36 Regiment’s conversion from 3.7 inch guns to Thunderbird after WW2, 8.
UK AD doctrine, AAAD has not been at the forefront of GBAD’s training objectives, or practised, over the last decade. As part of GBAD’s transformation AAAD has been recently practised by sub-units. It is, by its very name, designed to be a procedure that is utilised as a capability (up to 1000m) by all ground forces although preferably coordinated by AD or Artillery advisors.

Developing Air Observers

As one of Jt GBAD’s transformation workstreams, developing air observers is key to countering Low, Slow, Small, Stealthy and Swarming (LS4) targets. With mini-UAS prevalent on the modern battlefield, and the likelihood of a stringent EMCON environment that only allows GBAD radars to operate on an ‘radiate then vacate’ basis, we are re-learning the role of Air Observer.

Technology has changed dramatically, but the requirement for a single air picture and a timely and effective response has not. The modern day Air Observer will take recent lessons learned during Op OLYMPICS to develop the skills required for the modern GBAD battle. Air Observer CONOPS are being developed by HQ Jt GBAD.

International Cooperation – NATO and the Strategic Level

‘Thus, no matter how much Brexit changes other aspects of British life, I predict the impact so far as our Armed Forces are concerned will be negligible.’

The security and stability of the UK has long depended on its strong partnerships in the Euro-Atlantic area, including NATO. The UK Government wishes to deepen its security, intelligence and defence relationships in particular with the US, France and Germany. The USA is likely to remain the world’s leading military power in 2035, although its military advantage is likely to be challenged increasingly by China. Working within international organisations, or with allies and partners, is likely to remain the preferred method of
international engagement for the UK in 2035. The EU is also likely to continue to play a greater defence and security role. Interoperability and adaptability will be key as bespoke alliances and partnerships are formed, both between nations and with non-state actors.\textsuperscript{29} The mission of NATO Air Defence – to achieve and maintain air superiority to protect NATO territory in peace, crisis and conflict – remains as relevant today as when it was established in 1961.\textsuperscript{30}

In 1961, US President John F. Kennedy described America’s commitment to support European countries vulnerable to Soviet domination as “our central and most important defensive alliance”. Since his victory, President Trump has been more emollient; General Richards described Mr Trump as a ‘pragmatic man, who wants to see a stable relationship with Russia and with Mr Putin that is in the interests of all NATO members.’\textsuperscript{31} The UK aims to intensify its security and defence relationship with Germany whilst keeping open the possibility of cooperation with Russia.\textsuperscript{32} The UK will continue to seek to engage with Russia on global security, including international efforts to tackle the ISIL threat, building on the successful cooperation that we shared in negotiations on Iran’s nuclear programme. While our Armed Forces can and will whenever necessary deploy on their own, we would normally expect them to deploy with allies such as the US and France, through NATO, or as part of a broader coalition.\textsuperscript{33}

The UK Government aims to further strengthen the UK-France defence and security relationship.\textsuperscript{34} Building on the Lancaster House Treaty signed in 2010, the agreements further the security and prosperity of the two nations through commitments to jointly invest in the procurement of defence equipment, the joint training of armed forces and the continued development of the Anglo-French Combined Joint Expeditionary Force.

**International Cooperation (Operational and Tactical Level)**

In a national context, the operational level is the responsibility of the Joint Commander. The tactical level of warfare is the level at which formations, units and individuals ultimately confront an opponent or situation within the joint operations area.\textsuperscript{35} Direction from HQ Jt GBAD states that a Future VSHORAD (FuVSHORAD) force must be Combined, Joint, Intra-governmental, Inter-agency and Multinational (CJIIM) by design, with priority

\textsuperscript{29} United Kingdom Government, *Future Operating Environment 2035*, 5.23.
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The Lightweight Multi-role Missile (LMM) aboard a Schiebel Camcopter S-100 UAV

given to US and FR interoperability; Effective Maritime and Air integration will require commitment to routine Jt readiness training, to include JEF FEs and Jt Enablers. The Principles of Joint Air Defence are the doctrinal guide for all UK GBAD FEs to exercise interoperability with NATO partners.

As US AD is composed of mainly air defense systems such as the PATRIOT Missile System, Terminal High Altitude Air Defence (THAAD) and Avenger, any future NATO or ‘ad hoc’ coalition deployment will more than likely depend on US involvement. In addition to the integration of capabilities it is essential to continue to understand US AD doctrine and operational/tactical procedures in order to be able and ready to link in for any future deployments.

The Netherlands Ground-based Air Defence Command operates various ground-based air defence systems including PATRIOT, National Advanced Surface to Air Missile System (NASAMS), Fennek Stinger Weapon Platform and the TRML system (airspace monitoring radar). Tactical deployments of Dutch and UK AD sub-units have demonstrated the benefit of a common understanding within a NATO setting. Ex JOINT WARRIOR 15/1 in Scotland witnessed the first combined AD CP that included a UK Rapier FSC sub-unit, Air Defence Troop Royal Marines (HVM), Dutch Stinger Platoon and a combined C2 element. Along with attached RAF TACP personnel it was the first time a tri-Service, multinational AD CP had deployed in support of this NATO exercise. Future deployments must continue in quick succession in order to develop confidence in common operating procedures. All NATO air defence capabilities differ in modernity, procedural function and complexity although each user nation should have the common goal of defending the skies from attack by many different potential adversaries. The key areas that will dictate whether the mission is achievable will be the C2 and BMC4I capability and capacity.

Future NATO AD Exercises will be vital to the readiness of all partnership forces. Exercise TOBRUQ LEGACY (TOLY) 2016 was visited by a UK contingent in order to assess the practicalities of deploying AD FUs and a command structure during future Exercise TOLY deployments. The exercise provided an excellent opportunity for multinational SBAD FEs to operate within a NATO environment in order to improve levels of training and interoperability for potential contingent deployments. Exercise TOLY presents an opportunity for FEs from Jt GBAD to operate alongside NATO counterparts. The training benefit is significant and is realistic in terms of potential operational deployments in a contingent capacity, especially given the increased focus on Trans-Atlantic Capability Enhancement Training (TACET) Initiative and Enhanced Forward Presence (eFP).

The Exercise will allow the UK to deploy assets in order to operate and practice procedures alongside other NATO SBAD sub-units. This will enable forces to exercise interoperability, interconnectivity, C2 and communications in a multinational SBAD environment (NATO SBAD)
targets and low flying rotary wing assets. Whether deploying as part of a multi-national Alliance (NATO) or an ad hoc coalition, the UK’s Jt GBAD units and supporting HQ element are currently reorganising in order to support these deployments. It is evident that interoperability at the tactical level is improving with the increased training opportunities that are available to NATO SBAD/GBAD units. Interoperability at the strategic level is a direct result of international cooperation and, as such, is required to shape itself in order to conform to political will and intent. Cultural challenges in terms of a common understanding of NATO AD doctrine and procedures (particularly ROE and WCS at the tactical level) remain. True interoperability at the tactical level will require heavy investment in exercising operational and tactical interoperability, C2 and live firing opportunities. The extent of NATO nations’ AD commitment to these deployments will indicate the true strength of NATO’s integrated and rehearsed AD capability. The exploitation of synergies and enhancing AD cooperation will ensure that the whole is greater than the sum of our parts.