UK Long Range Offensive Air Power for 2020 and Beyond

By Air Commodore Tim Anderson

The Future Offensive Air System (FOAS) programme is a discrete acquisition programme intended to fulfil the UK's future long range strike capability requirements from the end of the next decade out to 2050, and quite possibly beyond. The programme has continued to evolve throughout the last four years of its Concept Phase as the context and nature of the operational requirement have become more clearly defined. At this stage in its genesis, FOAS is envisaged as providing a suite of capabilities that will complement and reinforce those which will be provided within the nearer term by the UK's aircraft carrier-capable Joint Combat Aircraft (JCA) Force comprising the Short Take-off and Vertical Landing Joint Strike Fighter and Typhoon.

The FOAS programme's Initial Gate is approaching and it is anticipated that it will be followed by an Assessment Phase designed to offer a detailed analysis of the broad range of candidate systems identified during the programme's Concept Phase

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and their inter-relationships, culminating in a nominal production Main Gate in 2009 and system In Service Date of 2017. While the UK MoD has identified these timescales for planning, it recognises that the both the nature of the requirement and the spread of possible contributors to fulfiling it are likely to manifest themselves in an incremental approach to acquiring the overall capability, with the obvious implications for a unitary Main Gate or ISD.

Meeting all the implicit core system requirements of *responsiveness*, *reach*, *sustainable weight of effort*, *ubiquity* and versatility simultaneously is only likely to be affordable through air and air vehicles. Without 'solutioneering' the requirement, the most promising candidate systems identified during the Concept Phase thus far include a mix of long-range stealthy manned aircraft, UCAVs, and highly developed cruise missiles launched from a variety of platforms. Nevertheless, the extent to which any or all of these candidates ultimately contribute to satisfying the core requirement will be determined during the Assessment Phase with the aim of having a reasonably well defined idea of the optimum system force mix by 2008. It is assumed that the capability of the overall system will be enabled and enhanced by an integral, but fully interoperable, C4ISR network that will form a key element of the UK's future Network Enabled Capability.

Aim

The aim of this essay is to explore developing thoughts on what the future might require of the UK's long range offensive air power capability and, in particular, to set the FOAS capability requirement in the overall context of the UK's evolving defence needs. I must stress, however, that I will be describing emerging themes, occasionally from a personal perspective, and not all of my comments should therefore be regarded as authoritative statements of endorsed UK defence policy. Nevertheless, in doing so, I will attempt to encapsulate the UK doctrinal context and policy drivers — to elaborate a little on the 'Why' of the FOAS requirement. A brief assessment of the global geo-political scene will hopefully point to the 'Where' and the 'Who', before I attempt to show how the evolving FOAS requirement has also been shaped, to a greater or lesser degree, by developments in warfighting and lessons identified from contemporary campaigns over the last decade or so.

Other forums and authors have provided their own insights into the nature and utility of offensive air power in the round and its relationship with Effects Based Operations (EBO). In the space available I will therefore touch only briefly on this area. However, this and what is already in the public domain with regard to our developing EB doctrine will, I hope, serve to underpin the rationale regarding some of the Key System Attributes I believe FOAS must possess if it is to help address both current and future UK capability gaps for long range precision strike. Finally, I will outline where I see the key challenges facing the FOAS programme — challenges that in many cases, of course, are not exclusive to the UK.

Timing and planning

As a prelude, it is perhaps worth pausing for a moment to consider the FOAS timeframe in a little

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more detail. The changed environments in which the system will be required to operate within the third decade of this century and beyond, and the threats it will have to contend with, are likely to be as polarised from now as those of the early 1960s. Then, surface-to-air and air-to-air missiles were in their infancy, surveillance and target acquisition sensors were relatively crude and 'stealth' was an arcane art confined to the annals of research. Contrast that with the US Patriot and Russian S-400 families of SAM systems; high-speed and super agile air-to-air missiles equipped with multi-spectral sensors that are effective over very long ranges; stealthy bomber and super-cruising fighter aircraft; and the advent of directed energy weapons operating at the speed of light, all of which offer demonstrated capabilities *today*.

Moreover, since the advent of the industrial age, technological advance has only ever accelerated. Clearly, therefore, looking ahead to the FOAS timeframe, FOAS will be required to deliver a quantum leap in capability if it is to provide a meaningful contribution to our overall offensive air capability throughout its service life, and not just at its beginning.

An inherent strength of the UK's planned iterative approach to sustaining our offensive air power capability through acquisition of Typhoon, JCA and FOAS is that it minimises the risk of a cliff edge end to this pivotal capability as one system's effectiveness inevitably declines. Instead, it generates an enduring squad consisting of 'workhorses' capable of dealing with the more utilitarian end of the requirement spectrum, operating alongside 'thoroughbreds' that retain a qualitative edge over potential and real opponents.

Thus, in the nearer term, Typhoon will complement Tornado GR4 and will offer real capability operating in, and conditioning, hostile air environments populated by advanced combat aircraft systems; similarly, JCA's arrival at the end of this decade will complement Typhoon and will offer a distinct improvement in survivability in dense, high-threat IADS environments as they proliferate in the medium term; and further ahead, FOAS is our prudent investment in the future that will continue to ensure a sharp tip to the spear as JCA reaches middle age and beyond.

An unpalatable alternative to this overall approach would be to over-invest in today's leading-edge technology, only to risk finding that a decade or so later even significant upgrading of the extant fleet could offer nothing better than a stopgap capability in the second half of its useful life. In parallel, the essential groundwork that must underpin maintaining a sustained level of offensive air capability commensurate with UK defence and foreign policy, such as planning far enough ahead to take advantage of new technologies, react to emerging threats and allow for the timescales of subsequent system development and production, would be likely to atrophy.

Conceptual and doctrinal framework

Within the MoD's Equipment Capability Customer (ECC) area our work benefits from a considerable amount of informed strategic guidance and policy direction. Some of this resides in the public domain such as the Strategic Defence Review and SDR New Chapter, and some, for obvious reasons, remains on a more restricted circulation. However, the coherence throughout is striking. This strategic guidance, and supporting High Level Operational Analysis between them identify both enduring and emerging themes that underpin and inform British defence policy and thinking, and will undoubtedly continue to do so. At the heart of this thinking rests our philosophy of a 'Manoeuvrist' approach to operations. In itself, this is underpinned by a developing EB doctrine that appears set to place a significant emphasis on Deep Operations enabled by Knowledge Superiority and Information Operations.

Both the philosophy and the developing doctrine will of course have profound implications for force development in general, and offensive air power in particular, since it is this capability that lies at the heart of being able to reach out and influence an opponent quickly and in a manner that, when necessary, is capable of evoking acute Strategic Effect. Moreover, notwithstanding the developing tenets of EB doctrine, the core roles of offensive air power, such as Air Reconnaissance/Surveillance,

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Offensive Counter-Air Operations and Anti-Surface Force Air Operations are unlikely to diminish, particularly when focused against an opponent's fielded combat and fighting power. As such, it is likely to remain a premium value capability and one that we can assume with strong confidence will continue to feature highly on both our own list of essential capability requirements and those of our allies.

In considering our future capabilities today in the round, Swift Strategic Deployability, an EB Approach to operations, effective Information Operations and a greater emphasis on Deep Operations have already been identified as key criteria against which all new capabilities should be judged. Clearly, it is vital that FOAS is fully aligned to, and coherent with, such guidance as inevitably FOAS will have an important, and probably central, role to play in translating our doctrinal approach into future campaign success. It should come as no surprise, therefore, that FOAS' conceptual basis is coherent with the UK Joint Doctrine and Concepts Centre's emerging High Level Operational Concept (HLOC), which reiterates that reach and flexibility are essential to future capabilities.

The geo-political scene

If strategic guidance, policy direction and developed doctrine provide us with the 'Why' for effective future offensive air power, assessment of the global geo-political environment gives insight into 'Where' we might need to deploy and employ military capability, and 'Who' we could find ourselves operating alongside, and against. The geographical breadth of the UK's responsibilities is unlikely to diminish in the foreseeable future. Our historical ties, partnerships and associated influence across the globe, economic status, intimacy with a burgeoning Europe and transatlantic relationship will all continue to serve to generate dynamic obligations for the UK on a near-global canvas.

British military involvement over the last 13 years in the Gulf Region, the Balkans, Africa, Afghanistan and even as far afield as South East Asia is testament to this. However, our capacity to act over a large part of the globe is unlikely to be able to rely on sustained forward presence, such as that seen in Europe in the Cold War, or even today with US forces on the Korean peninsula, as it is likely to be neither desirable politically, nor affordable. The availability of access, basing and over-flight rights in support of any surface force required to deploy into a theatre, not forgetting its enabling capabilities, will also be highly situation dependent.

Moreover, the nature of the threat to UK interests abroad and at home has changed and will undoubtedly continue to do so. Although the incidence of conflict will remain certain, the causes, timing, location and nature of that conflict will remain as uncertain. Failing and rogue states are likely to affect regional stability. State support for terrorist organisations — be that overt or covert – will continue to fuel terrorist activity and attacks across the globe. The non-linear threat posed by non-state actors, especially those in the future with access to weapons of mass effect, will call for novel, probably time sensitive, and certainly decisive, countermeasures.

Therefore, the ability to act quickly and effectively in response to developing situations, possibly at considerable distance from friendly territory, will be paramount. A capability to create early and decisive effects, where and when we need to, whether opposed or not, and not just when we are afforded the time to build up to an event, will be an increasingly critical element of our ability to face down, and ultimately remove, acute threats to

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our security, and that of our allies. We should not forget too that, throughout, the requirement to retain public support and obey international law will ensure that we shall wish and need to maintain the moral high ground, even against enemies who have little or no interest in its occupation.

Developments in warfighting

We in the ECC area are always mindful of the dangers of planning to fight the last war when seeking to identify lessons from recent operations that might guide our definition of future capability requirements. However, there are some clearly identifiable themes shaping the continuing development of offensive air power that FOAS will wish to reflect. Firstly, the ever-increasing need for precision, both in munitions themselves and in the targeting process. In the 1991 Gulf War, the RAF's ratio of precision-guided munitions to 'dumb' weapons was 1:9.

During recent operations in Iraq, that ratio was reversed. The MoD's Strike Capability Manager's weapons strategy to 2020 is predicted on an inventory of almost entirely precision guided and precise munitions that will offer a range of effects against fixed, movable and moving targets be they soft or hardened, and unconstrained by light levels or weather. Fuelling this drive towards precision is more efficient use of resources, allied to the accelerating demand for ever lower levels of collateral damage, and interestingly, an ability to reduce the attrition caused to our enemies' fielded forces, where that is deemed desirable. In conflicts where the regime/leadership is identified as the focus of our military operations, public opinion at home and, crucially for post-conflict settlement within the regimes homeland, may be best influenced by just such a precisely orchestrated effects-based campaign.

Secondly, our forces will need to be configured for expeditionary operations. In Anthony Cordesman's initial assessment of the lessons to be learned from Operation IRAQI FREEDOM , it is gratifying to note his acknowledgement of the positive changes in RAF operating posture between 1991 and 2003 and the Service's ability to rapidly relocate its air power platforms in the light of a rapidly, and unexpectedly, changing political situation. In 1991, with some notable exceptions, the RAF fast jet fleets were tied to Main Operating Bases with a well-founded, but similarly well-rooted and inflexible, support infrastructure.

One's passport was dusted off for a major US exercise, and perhaps a NATO Squadron Exchange every year. Twelve years later, our squadrons can expect to spend up to five months a year away on operational duties or other detachments, with the capability to deploy measured in hours not weeks. This systemic expeditionary capability serves to underline offensive airpower's unparalleled responsiveness and reach, and its utility across the widest range of military tasks, but we must become even more agile. If we are to divest ourselves fully of monolithic force structures, rooted face-to-face with the threat of the day, we must be certain that thereafter we can get combat power to where we need it whenever it is required and for however long it is required, and that it is capable of creating the desired effects irrespective of the benignity or otherwise of the environment. In future, the ability to deploy quickly to, operate within, and to condition for follow-on forces what our US colleagues term 'anti-access' environments is likely to be key.

Together, this emphasis on precision effect delivered by forces organised and equipped for

Boeing's UCAR concept UAV

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expeditionary warfare underpins the third clear theme — the move towards smaller, lighter forces able to employ decisive combat power when required. The MoD Deep Target Attack Equipment Capability Directorates vision is, by 2020, to field 10 times the effect of long range strike weapons systems, with one-tenth the deployed logistical tail, 50% of the manpower and at half the cost of ownership compared to 2002. Advances in technology, structures and affordability will see offensive air power in the vanguard of realising this challenging vision.

Enabling technologies

New technologies will offer the UK the potential to achieve its politico-military objectives in different ways and may indeed provide the means to conduct traditional military tasks and roles in previously unimagined ways. Most obviously, UCAVs and UAVs offer the potential for transformational change in the way that offensive air power is organised, sustained and delivered; it will come as no surprise, therefore, that the UK continues to be actively engaged in research and analysis in this nascent area. Given the ever-present pressures on defence expenditure, UCAVs and UAVs will before long have to demonstrate clear operational and cost advantages across a variety of roles if they are to secure places for themselves in the earlier iterations of the FOAS Force Mix.

Advances in enabling capabilities such as C4ISR and the supporting sensors and data networks, particularly in the deep battlespace where third party ISR information may be limited at best, will also be critical. However, to what extent these overarching capabilities enable, or are enabled by, potentially complex component systems such as FOAS is a balance we have yet to define fully: in all probability they will prove to be dynamic. We may also find ourselves undertaking military action in the future against adversaries who have not been rigorously analysed and modelled during the decade preceding conflict. We will therefore need the capability to model or predict the battlespace prior to our attempts to shape it — knowledge superiority is after all a *sine qua non* for unleashing the potential of EBO. It is axiomatic that without it, our warfighting will in all probability be incoherent and certainly reduced in effectiveness.

Advances in computing power and in propulsion, fuels, materials and aerodynamics will all contribute to our ability to extend air power's reach and increase its speed of response even further. Evolution of passive stealth techniques and the fielding of active techniques will underpin acceptable levels of survivability, whilst facilitating access to an opponent's most closely guarded vulnerabilities, or his systems that pose us the highest threat. FOAS will call upon all of these advances and, moreover, technological advances in design and manufacturing will have a part to play too if our aspirations are to be converted into affordable capability. Percolating through all of this adaptable, advanced synthetic environments and the fidelity of training and mission rehearsal they will enable, will serve to maximise the effectiveness of the physical and moral components of our offensive air power capability and are likely to be key capability enablers in the FOAS timeframe.

FOAS will give the UK the ability to engage adversaries on their own doorsteps and — coupled with responsiveness — at a time of our choosing

FOAS key system attributes

So how then might the doctrinal context, emerging and enduring trends in warfighting, and advances in technology shape our view of offensive air power's future utility and nature, and in turn help us to define the capabilities the UK might require of FOAS? I would like to answer this by outlining the key system attributes (KSAs) that I currently believe FOAS must possess as a system in order to offer us the insurance of a qualitative edge over potential adversaries through the medium of long-range offensive air power. Clearly, defining these KSAs as attributes that the overall system should possess is not to say that a sub-system possessing some of them is necessarily a suitable candidate component. Moreover, whilst I will discuss each attribute in turn, in reality they will be closely inter-linked and inter-dependent as befits a system of systems. Nevertheless, if nothing else, I hope identifying them in this manner will help illuminate the envelope of the required FOAS capability and perhaps stimulate thought and debate.

Reach

As I intimated above, analysis of the geo-political landscape provides us with pointers as to where FOAS may be required to operate and underpins the attribute of '*reach*'. Not that the requirement for air power reach is some new invention, as evidenced by strategic operations in both World Wars through to, more recently, the 3,500 nm round-trip missions conducted by RAF Tornados operating from Germany during Operation ALLIED FORCE in the Balkans. To help safeguard the UK's vital interests, FOAS will require the capability to hold at risk targets wherever they may reside within the UK's area of strategic regard. This FOAS attribute will give the UK the ability to engage adversaries on their own doorsteps and — coupled with *responsiveness* — at a time of our choosing.

Nor will this ability be limited to the prosecution of 'terrorist' targets. Long-range offensive air power will be an essential element of any integrated campaign in anti-access environments. It must be assumed that our future opponents will also have learnt lessons from recent conflicts and, therefore, enhancements can be expected in their surveillance capabilities (including space-based), air and maritime defences and accurate long range strike capabilities. Intuitively, this in turn will generate a requirement to shape and condition the battlespace whilst standing off by significant distance; to be able to provide a counter-force suppression and/or disruption capability that will permit the subsequent deployment and employment of friendly surface forces adjacent to and within the theatre of operations, and to be capable of achieving this from a posture that is beyond the initial area of vulnerability.

A B1-B delivers its weapon

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This important element of what can be described as a 'Day One' capability must address the application of effect against the most demanding of targets, probably at extended range from the UK, Sovereign or allies' territories, and in the highest of threat environments. In doing so, we will clearly wish to watch closely evolving US concepts for timely effect at range to enable, where possible, the UK to meet its desired level and extent of commitment to coalition operations. It would also seem sensible to assume that, in order to turn aspiration into reality, some level of organic ISR capability will be required within elements of the FOAS force mix; some of the targets we may be required to prosecute could quite possibly be beyond the range of detailed third party-supplied battlespace information.

Effect

Traditionally, offensive air power has visited lethal kinetic weapon effects on an adversary and, even in the EBO era, this is likely to remain its *raison d'être* for the foreseeable future. Whether employed in direct military action for strategic effect, focused on an opponent's strategic centre of gravity, in support of the other instruments of power marshalled in pursuit of an indirect effect, or when applied in support of friendly forces directly against an enemy's combat power, the requirement to harass, disrupt and destroy by application of '*precise kinetic effect*' is likely to endure.

Historically, imprecise munitions and delivery techniques generated an often substantial *over target* requirement in terms of aircraft needed to ensure target destruction. Recent advances in weapons and their targeting have reversed this paradigm — we are now coming to expect one platform to be able to create multiple effects against a range of targets in one mission iteration, shown most graphically in Iraq recently with the use of multiple JDAMs from USAF B-52 and B-1 bombers. In the future, weapons such as the Small Diameter Bomb will extend an element of this capability to smaller platforms such as JSF. FOAS will wish to continue and exploit this trend.

However, we should be wary of assuming that this shift will be matched by a directly proportional reduction in the overall *number of sorties*, and therefore platforms, required to prosecute an air campaign, even with the increased serviceability offered by modern systems. Our growing ability to

find and strike precisely targets of increasing granularity, whilst minimising collateral damage in the target's environs will make possible and increasingly desirable the capability to write down an opponent's fielded forces to an extent not achievable before.

Notwithstanding EBO, we must assume that the future will still feature adversaries equipped with large standing forces matched with a willingness to commit them to initiating, or sustaining, their aggression. Leading on from today's casualty-averse political environment, our willingness to commit sizeable formations of our own surface forces into discretionary engagements with a competent and stubborn opponent will inevitably be conditional upon prior battlespace preparation by long-range strike systems, and escort of friendly surface forces by air power through a coordinated air/land battle and joint manoeuvre.

However, the capacity to set the conditions for success and minimise friendly casualties comes at a price. Firstly, as ever, air superiority must be established (possibly from a standing start, as opposed to over a period of years as witnessed recently in Iraq) and maintained and, secondly, sufficient weapons (notwithstanding precision, in the order of many hundreds as a minimum, and much more probably thousands) must be brought to bear across the full breadth and depth of the battlespace. Add to this counter-force air operations and, even with the coming promise of a wholly multi-role FJ force and the contribution from long range surface systems, this is likely to translate into a potentially large overall sortie requirement.

Nevertheless, increasing precision will obviously be a facilitator of our ability to shape the battlespace surgically. It will permit reductions in warhead and weapon size — for the routine, we will be able to achieve the required effects with less. This will have significant additional macro benefits, both in enhancing our ability to fight efficiently from a logistical perspective, and from the point of view of minimising any parasitic drag on the tempo of other components of the operation as a result of diffuse destructive effects. We are also re-learning that conflicts with an end state of regime change are likely to carry a high additional tariff for post-conflict reconstruction, as we are witnessing in post-Saddam Iraq. Clearly, this would be eased and accelerated by limiting physical destruction to the minimum necessary.

Moreover, it may well be that the coming years see an increase in the use of non-lethal effects, using various novel warheads and damage mechanisms, especially when one factors in the asymmetric advantage this could provide. In the UK, we would obviously be interested in any developments in this area that would give clear warfighting benefits and, where and when available, would expect to field these capabilities as part of an integrated FOAS solution. Nevertheless, perhaps the existence of the USAF's Massive Ordnance Air Blast weapon suggests that the day of the 'big bang' is not completely over.

Responsiveness

However, being able to deliver a kinetic or non-lethal effect is irrelevant if we are unable to also create it at the desired time. For FOAS, this attribute is likely to encapsulate a number of complementary requirements. For example, SDR New Chapter specifically identified that '*New elements and capabilities are needed to seize what may be fleeting opportunities to engage terrorists (and) to deal with them in remote areas*'. FOAS' emphasis on '*speed of response*' embraces this notion but develops it further to include recognition of the different contexts we may be required to operate within. Thus, the ability to apply precise effect, constrained by the bounds of proportionality and legality, perhaps within *hours* of any non-prescient political decision to act, coupled with the more general ability to detect and attack the most stressing time sensitive targets located within a hostile environment, are key goals that will be pursued in attempting to deliver a suitably responsive long-range offensive air capability through FOAS.

Moreover, a highly important incidental benefit of speed of response is the inherent and unique ability to sustain weight of effort at considerable range that it conveys upon air systems, by virtue of their ability to support rapid task/replenishment cycles.

Tornado F3s patrolling the no-fly-zone over iraq

FOAS must therefore exercise 'presence' as well. Historically, 'presence' has not been regarded as one of air power's strengths

Overarching all of this, achieving the correct balance between 'hunter-killer' and cued operations, whether from manned aircraft, or even air-launched armed UAVs, will be critical to delivering a truly responsive capability in the FOAS timeframes. Within the MoD's Deep Target Attack Directorate, significant work is being done to identify a holistic way forward in this area – how we can minimise the 'sense – decide – effect' timeline — through our Kill Chain Development Initiative.

Presence

Ultimately, extended reach and speed of response will satisfy only part of the wider system requirement. The system must also be capable of enduring for prolonged periods, to hold the enemy's target set at risk, or provide the time to build an operating picture, identify significant events and react to them appropriately. FOAS must therefore exercise 'presence' as well. Historically, '*presence*' has not been regarded as one of air power's strengths.

Contemporary operations such as the policing of the Iraqi no-fly zones have energised the evolving concept of 'air presence'. Moreover, air-to-air refuelling and uninhabited air vehicles, coupled with recent advances in technology — from materials to power storage and propulsion — are already offering very significant advances in air platform persistence. FOAS must be able to attack targets around the clock without pause or interruption. This capability will allow us to exercise the spectrum of capability, from deterrence through to physical destruction if required, and must require the minimum possible logistic support. Accordingly, its systems will require significant operating periods without replenishment, servicing or support.

Robustness

'Presence' is insufficient in itself: it must be matched with '*robustness*'. We must assume that the threat environment within which FOAS Force Elements will be required to operate, extending out to 2050, will be multi-layered, highly complex and resilient. Whilst we have been fortunate in recent years not to have come face-to-face with them, advanced and highly capable air defence systems *already exist*, and are available to those with the desire and requisite means to acquire them. Moreover, their attractiveness can only increase in the light of recent operations. Proliferation of advanced SAM systems such as the S-300/400 family and their derivatives, advances in passive and active detection capabilities, and the air-to-air threat posed by fourth generation fighters armed with highly agile missiles will undoubtedly be the routes chosen by many potential adversaries over the coming decades in their attempts to blunt offensive air power's edge.

Developments in the field of Directed Energy Weapons and the potential threat they will pose to humans, sensors and other electronic systems, will provide a further complication. The continuing effectiveness of offensive air power will be reliant upon the development and adoption of survivable new systems, driven by technological advances and novel operating techniques. The introduction

of JCA in 2012 will provide the UK with its first Low Observable air platform, promising greatly enhanced survivability and mission effectiveness. Thereafter, as we project forward into the FOAS timescales, platform survivability across the FOAS candidate systems is likely to require an evolving combination of active and passive techniques, anchored around core characteristics such as Low Observability and speed.

Interoperability
Whilst the UK will wish to retain the capability to act autonomously at up to medium scale if our national interests are threatened, we are more likely to be called upon to operate within the framework of a coalition, be that with the US, other NATO nations, EU states or further afield.

'*Interoperability*' with our allies — and given their technological and military might, particularly the US – is a further key system attribute. The speed of response required may not allow for a staged build-up and we will need to be fully familiar with potential allies' modus operandi (and recognised as such) and capable of networking fully from the outset.

In broad terms, the ability of FOAS force elements to contribute to and receive the wider Joint Operating Picture, and to exchange sensor data with other FOAS and non-FOAS constituent systems, will be critically dependent on the realisation of the UK's Network Enabled Capability. But, within this, any organic FOAS C4ISR capability will also be a major component of the air element of NEC, and probably beyond. Moreover, we will wish to avoid building into the system more dependencies than are necessary if we are to retain free access to air power's inherent characteristics of flexibility, adaptability and ubiquity across the length and breadth of the battlespace.

Clearly, too, interoperability means more than just network-enabled. As I mentioned earlier with reference to the necessity of a 'Day One' capability, we will need to provide a credible and useful contribution to all stages and elements of a campaign, and resist the notion that someone else will look after the 'difficult stuff'. We will need FOAS to integrate seamlessly into Joint and Combined operations. Any shortfalls in the interoperability arena will almost certainly degrade overall system effectiveness and severely constrain the contribution FOAS will make to EBO.

Legality
Lastly, FOAS must operate at all times within the Rules of Engagement pertaining to a specific operational theatre and the overarching considerations and strictures of extant international law, including any future developments thereof. An integrated approach, extending from the development of multi-spectral and high fidelity sensors offering broad utility across the spectrum of battlespace terrain, through alignment with an effective C2 architecture, to ongoing legal review of the developing programme aims to ensure that FOAS will be compliant in this vital area.

Challenges
I offered to highlight briefly some of the challenges I foresee facing the future application of effective offensive air power and in particular the delivery of FOAS. Fundamentally, we will need to ensure that our C4ISR architecture is robust, has the potential to handle increasing data exchange demands and possesses both redundancy and graceful degradation to cater for the worst cases. It must also be capable of catering for increasingly complex, potentially non-linear, scenarios, including operations in urban terrain. Moreover, the amount of information available versus that required, or even useful, is likely to be substantial, placing a premium on automatic and man-in-the-loop data processing. In parallel, minimising the demands placed on information carriers and available bandwidth will be significant challenges in their own right.

Space precludes me discussing mission planning in any great detail, but we may need access to a fully interoperable mission planning and support architecture that hosts almost instantaneous re-routing and re-targeting functionality to enhance survivability, and enable delivery of effect against emerging and unplanned high value targets. Alternatively, the evolving HLOC is pointing in the direction of shared situational awareness lead-

ing to fewer requirements for traditional structured planning and which enables combat power at the tactical interface. Either way, there will be significant challenges here too.

We also face the challenge of de-risking some cutting edge technologies to ensure that they deliver on the promise already identified. UCAVs and air-launched UAVs figure highly here, and within the FOAS programme the mechanism of the Integrated Technology Acquisition Plan aims to ensure that these risks are properly understood and a road map to the higher Technology Readiness Levels is established. The integration of unmanned systems with manned platforms, and the necessary associated C2 structures, is also imperfectly understood currently, and we will need to assess soon where the possibilities and limitations of our various candidate systems really lie.

Finally, and crucially, offensive air power must be affordable. UK defence faces similar budgetary pressures to every other developed nation, and any system or capability that now attempts to justify itself on grounds of anything less than 'essential' will not stand scrutiny at the highest levels. We need to ensure that every pound we spend is spent wisely and the rigour we are applying to our associated research programme funding is testament to this. Our overriding challenge will be to deliver the critical capability required of FOAS against a backdrop of finite financial resources and competing claims of equally strong provenance. Squaring this circle will not be an easy task but it promises to be an incredibly stimulating one for those involved.

Conclusion

By its very nature, the unique ability of long range offensive air power to reach quickly and, if necessary, disrupt or destroy elements of an opponent's ability, will and means to sustain his aggression, potentially up to and including his strategic centre of gravity, will ensure that the maintenance of such a capability is likely to attract a very high priority for the UK for the foreseeable future. Moreover, air power's inherent flexibility and versatility should promote high confidence that investment in this agile capability will deliver significant dividends across the full spectrum of conflict.

Nevertheless, an unstable global security environment and the pace of technological advance, allied to the employment of non-linear strategies by both state and non-state actors, mandates that we must look increasingly far ahead if we are to continue to rely on our air power qualitative advantage as a central pillar of our defence capability. Inevitably, as resources become scarcer, this will be an increasingly hard discipline to maintain. Employment of astute balance of investment decisions that maximise our return by adopting innovative and synergistic systems of systems to deliver required capability is the only viable way ahead.

In doing so we must be careful to *build on* and *enhance* the core characteristics of air power and avoid the seductive trap of neutering them on the altar of programming savings. The FOAS programme has a flagship role to play in this new era. Continuing sensible and prudent investment in the pivotal military capability FOAS is being designed to deliver will ensure that long range offensive air power can continue to fulfil its essential roles and responsibilities in effects-based joint manoeuvre warfare well into the middle of the century. There is a clear risk that doing otherwise might subsequently come to be regarded as having been 'penny wise and pound foolish', and could invite a critical core capability gap for our successors that may one day leave them fatally exposed.

Notes:

[1] "The user requires a system of systems that provides the capability to create a range of effects on a balanced target set in the deep, including time sensitive targets, from extended reach, in all weather and light conditions, all terrain, in the highest threat environment and at a time of his choosing…." *Draft FOAS Initial Gate Business Case Single Statement of User Need, 08 Aug 03*.

[2] "The operational framework can be described in terms of *Deep*, *Close* and *Rear* operations, and is relevant in all categories of operations. It is a *conceptual framework*, used to describe how Deep, Close and Rear operations interrelate by *function* (what they are intended to achieve), within the battlespace (where they are to achieve it), and by time