FUTURE VECTOR PROJECT

Air and Space Power in NATO

AIR & SPACE POWER IN NATO

FUTURE VECTOR

PART II

Joint Air Power Competence Centre

JAPCC

**Joint Air Power
Competence Centre**

Air and Space Power in NATO

Future Vector – Part II

AIR AND SPACE POWER IN NATO

FUTURE VECTOR

PART II

October 2014

**Joint Air Power
Competence Centre**

Disclaimer

This publication is a product of the JAPCC. The views expressed in this work are those of the authors. It does not represent the opinions or policies of the North Atlantic Treaty Organization (NATO), and is designed to provide an independent overview, analysis and food for thought regarding possible ways ahead on this subject.

Release

This document is approved for public release. Portions of the document may be quoted or reproduced without permission, provided a standard source credit is included.

Foreword

The precise application of combat power from the air has been of strategic importance to the Alliance since NATO's inception. Time and again, NATO and its Member Nations have turned to Joint Air Power as the first, and in some cases only, military response option. Air Power, now coupled with Space Power, continues to demonstrate its inherent ability to 'go over not through' with attributes of speed, reach, flexibility, and precision. These combined qualities provide NATO and National political leaders with a tool of unmatched responsiveness and flexibility, supporting the political-strategic objectives of both the Alliance and its Member Nations.

Despite Air and Space Power's undeniable contribution, NATO continues a drastic and increasing reduction of the very same capabilities. The current 'climate of austerity' will put investment in future Air and Space Power under further scrutiny, resulting most likely in further diminishing the minimum military Air and Space Power capabilities needed to support NATO's level of ambition. Our Alliance now faces the *increasingly dire risk* of not having the right capabilities and/or sufficient quantities of Air Power and access to Space capabilities to cope with the security challenges out-lined in NATO's forward looking Strategic Concept.

Therefore I directed the Joint Air Power Competence Centre to conduct the study 'Air and Space Power in NATO – Future Vector' to chart the path forward and guarantee Air and Space Power's contribution to the success of NATO and the security of Member Nations. I would like to reiterate that the Future Vector Study is Joint in nature. The study focuses on Air and Space Power from all domains and includes the capability and competency requirements of all Services.

The crisis in Ukraine quickly highlighted why collective security in Europe is still required. Our Alliance will be required to execute Collective Defence, Crisis Management and Cooperative Security crisis response in a rapidly changing and challenging world. NATO and political decision-makers must continue to act collectively to maintain our asymmetric advantage – Joint Air and Space Power.

I strongly encourage you to read this publication as it offers ideas and potential solutions to enhance NATO's Joint Air and Space Power and guarantees our collective security in the coming decades.

Frank Gorenc
General, USA AF
Director, JAPCC

Table of Contents

Table of Contents

Table of Contents

Executive Summary

Context of the Future Vector Project

For more than fifteen years now, NATO has been actively pursuing efforts to improve the operational capabilities and competences of the Alliance. Today, essential shortfalls still exist and the transatlantic capability gap has become even greater. Although this capability and competency gap in NATO is not new, it has been starkly highlighted by recent developments in the Ukraine and the changes in the relationship between Russia and NATO.

When addressing the priority deficits, the conclusion must be that this issue explicitly touches upon a broad and essential range of shortages in Joint Air and Space Power capabilities and competencies in NATO. In particular, the capability disparity between NATO/North America and NATO/Europe is a factor that must be considered. To this consideration must be added a number of political-military strategic issues like the pivot of the United States to Asia; the new United States 'win and deny' warfighting strategy; the existing arrangement in NATO that no single Ally should provide more that 50% of certain critical capabilities; and the fact that current capability development initiatives in NATO most probably will not solve or substantially mitigate the existing and widening capability gaps.

The conclusion of this all is that, should a crisis or conflict situation arise (non-Article V) in which the United States, because of domestic political reasons or other strategic interests, are not or not fully able to provide the needed Air and Space Power capabilities and competencies, the remaining portion of NATO might be unable to execute a full-spectrum air operation. Therefore in the future, NATO/Europe should possess the full spectrum

of Air Power capabilities and competencies and maintain assured access to space based information and data to conduct Crisis Management Operations independently at the periphery of NATO's geographical Area of Operational Responsibility (AOR).

This sense of urgency was well reflected at the 2012 Annual Joint Air Power Competence Centre (JAPCC) Conference when a key note speaker spoke about 'the future role of Air Power in NATO.' The main theses of the lecture was that 'from its beginning NATO has been an Air Power Alliance, which is now at risk.' Why? 'Because of the existing 'Air and Space Power Paradox.' 'On the one hand and since its inception, Air and Space Power has been pivotal for NATO's effectiveness and success.' 'On the other hand, there are continuing and drastic reductions in defence budgets and diminishing Air and Space Power capabilities in NATO.' Therefore, it was stated, the adage should be 'to cooperate and share, or decline.'

These deliberations and standpoints led to the decision to conduct a comprehensive Air and Space Power study towards 2040. As an initial step, the JAPCC delivered a paper in March 2014 titled 'Present Paradox – Future Challenge' in which the Air and Space Power Paradox is qualified with respect to future challenges. Put simply, the Air and Space Power Paradox is:

'The inceasing importance of Air and Space Power as the military tools of choice for NATO and political decison-makers to succesfully impose their collective will, yet these same decision-makers seemingly unwilling or unable to act collectively to maintain and evolve this executive tool necessary to effectively intervene'

'Present Paradox – Future Challenge' provided a broad range of recommendations for a comprehensive Air and Space Power study towards

2040. Early 2014, this led to the start of the 'Air and Space Power in NATO – Future Vector Project' with the overall aim:

'To identify viable options and solutions to guarantee that joint Air and Space Power continue to be key enablers for the security and success of NATO and its Allies.'

It is stressed that the 'Air and Space Power in NATO – Future Vector Project' is joint in nature. It focuses on Air and Space Power across the domain and does not exclude the Air and Space Power capability and competency requirements of any of the Services in the defence organizations of the respective Member States.

A Coherent Trinity

The Core Team executing the Future Vector Project decided to deliver a Compendium of essays consisting of two parts. Part One was published in July 2014 and focuses on the political-military aspects of the Air and Space Power Problem.

This is Part Two of the 'Air and Space Power in NATO – Future Vector Project' Compendium of essays. It consists of eight essays focusing on military- and operational-strategic aspects of the Air and Space Power Paradox in NATO. Although Part One contained some mention of the essays of Part Two of the Compendium, new insights have led to an adjustment of the titles and sequence of the essays in Part Two. All essays breathe the need for political- and military-strategic consideration and decisionmaking at the highest military and political levels.

Combined with the 'Present Paradox – Future Challenge' Study and Part I of the Future Vector Project Compendium of essays, this volume completes a coherent trinity providing an examination of the future of Air Power in NATO.

Key Messages

Each of the eight essays in this second Part of the Compendium of essays contains key messages, which are summarized here:

· **Air and Space Power in NATO 2020 – 2030**

'The defence budgets of most NATO member-states have fallen since the start of the economic crisis in 2008. At the same time, the costs of defence equipment have continued to rise. For Alliance operations to remain viable and capability to remain credible, investment will have to improve. Innovative approaches to procurement, including pooling and sharing initiatives, particularly in respect of new technologies, will help mitigate costs.'

· **Air and Space Power Force Structure – Towards a Right Balance**

'NATO/Europe must be ready, as a minimum, to face autonomously a Crisis Management Operation at the level of a Smaller Joint Operation – Air Heavy. Without the availability of a set of full spectrum Air and Space Power capabilities and competencies to cope with such a contingency', there is a fair chance that NATO and in particular NATO/Europe is not capable of adequately dealing with emerging security challenges at the peripehery of NATO's geographical Area of Operational Responsibility.'

· **Air and Space Power: the Need for Cyber Resilience**

'NATO has become extremely dependent on computers and information technologies and, hence, potentially vulnerable. As cyber attacks can ultimately not be prevented or deterred, achieving cyber resilience requires top leadership attention. Leadership attention must no longer only focus on higher, faster, further. It must also focus on secure, reliable, and effective – even under conditions of major disruption.'

- **Air and Space Command and Control (Air C2) in NATO –
  More Than Just a Technical Issue**

'Air Command and Control in the NATO Command Structure (NCS) has been reduced to a level incompatible with the requirements of its Level of Ambition (LoA). Key to a solution is the availability of sufficient numbers of trained operators, both in the NCS and in the nations which contribute to the NATO Force Strucure. This makes teaming with capable national Joint Force Air Component organizations an inevitable prerequisite. Responsibility for 'Air and Space' must be complemented by proper expertise and set tools in the Air C2 organization to enable the Air Commander to fill his role as 'Air and Space Power Advisor' for the JFC.'

- **Keeping up Preparedness, Readiness and Effectiveness of
  Air and Space Power in NATO**

'Keeping up preparedness, readiness and effectiveness of Air and Space Power in NATO is not so much about a radical transformation of the role of the Alliance.' 'It is about effective and efficient ways of educating, training and exercising and about making the Alliance more flexible in assisting Member States to maintain the superiority of Air and Space Power in NATO in a way that it is fit for purpose for the future.'

- **Space and Air Power in NATO**

'Space is an esential resource for Air Power in NATO. Assured and uninterrupted access to Space therefore is of paramount importance. To that end the Alliance must develop a comprehensive Space policy and foster bi- and multilateral sharing agreements among the Space fairing nations and with the European Union (EU) and the European Space Agency (ESA).'

- **Air and Space Power in Counter Insurgency Operations**

'Counter Insurgency Operations (COIN) are a key component of contemporary warfare and will remain so in the foreseeable future. 'NATO and its Member States need to calibrate their Armed Forces, and Air, Space and Cyber power specifically to their primary mission of national and collective defence, but they need also to master the art and science of COIN.'

- **Assured Air and Space Power Entry Capabilities in Denied Airspace Environments**

'Air and Space Power will remain of paramount importance to the conduct of NATO's current and future military operations. However, the freedom to deploy and employ this Power will be increasingly contested in the future. To maintain freedom of action NATO must address these challenges through an integrated joint/combined cross-domain concept within the military sphere as well as synchronisation and coordination outside it as part of a comprehensive approach'.

New Ground

Part Two of the Future Vector Project Compendium of essays provides a broad range of thoughts, ideas, and options, thereby carrying a number of key messages. Most of the essays contain new considerationss which are worthy to be further developed and researched in terms of useability. Some of the new thoughts and ideas are:

- The concept that NATO should serve as a clearing house for best practices and for sharing experiences related to human resources and education.
- The initiative that NATO should consider acquiring a commonly funded NATO 'responsive space capability' with small satellites.

- The theory that Air and space power can play a major role in COIN operations by capitalizing on traditional and non-traditional ISR and highly precise targeting. NATO can be considerably more effective and efficient in supporting indigenous forces if such operations encompass air-mindedness rather than remaining ground-centric and battlefield-oriented. Together with indigenous and special forces, aerospace power can form a trinity that challenges the old notion of deploying large numbers of troops into the theatre.
- The development of an integrated joint/combined cross-domain concept to ensure freedom to deploy Air and Space Power in contested and/or denied airspace environments.
- The realization that the proliferation of anti-aircraft systems to possible future adversaries must be countered by NATO through a comprehensive approach, which involves application of the other instruments of national power as well as military activity. This approach must be synchronized and coordinated both within and outside the Joint Operations Area (JOA) and it spans the spectrum of conflict from peace to war and back again via reconstruction/transition.
- The suggestion to consider earmarking personnel resources dealing with peacetime air issues in multinational staffs and headquarters as available to augment NATO's Air Command and Control system and train them for JFAC-functions.
- The concept to formal team NATO/AIRCOM with the USAF's capable standing 603rd Air Operations Centre on base in Ramstein.

For a complete list of ideas and options, the reader should refer to the recommendations in the various essays.

Finally

With the publication of Part Two of the 'Air and Space Power in NATO – Future Vector Project,' an important phase of the Project has been complet-

ed. The Future Vector Project trinity of publications not only shows that the Air and Space Power Paradox is real, it also shows that the future security environment includes a number of developments, challenges and threats that will directly impact Air and Space Power in NATO and in particular that of NATO's European Member States. This trinity provides NATO and its Member States with a broad range of viable options and ideas that also form the basis for an important new phase of this Project, a phase in which the thoughts and ideas must be further developed, validated and discussed at the highest political- and military-strategic levels in NATO and its Member States. It is the belief of the Future Vector Project Core Team that, should this discussion occur and decisions are taken by NATO and national leaders, Air and Space Power in NATO will be fit to address the security challenges of the 21st Century, thereby supporting the preservation of the credibility and success of our political-military Alliance.

Key Recommendations

'Air and Space Power in NATO – Future Vector Part Two' contains eight essays that contribute to the achievement of the overall objective of the 'Air and Space Power in NATO- Future Vector Project.' The essays show a broad range of recommendations aiming at the military- and operational-strategic level. This chapter deals with key recommendations, thereby identifying viable options, ideas and solutions to guarantee that Air and Space Power in NATO continue to be key enablers for the security and success of NATO and its Allies. The key recommendations are grouped under the respective titles of the essays. For a full list of recommendations, the reader is referred to the respective essays.

Air and Space Power in NATO 2020–2030

- To develop a baseline and set the conditions for a communications bandwidth that is a crucial feature for Alliance operations.
- Ensure that NATO's concept for the employment of Air Power is fit for purpose taking into account technological advancements in Air, Space and Cyber technologies.
- To synchronize, connect and control through adaptive means the existing and future Air and Space Power capabilities in NATO for 2030 onwards.
- To invest in developing leadership, training and high quality people and empower them to exploit available technologies and capabilities, in order to employ Air and Space Power effectively and intuitively throughout the spectrum of conflict.

Air and Space Power Force Structure – Towards a Right Balance

- To abandon legacy aircraft that are too costly to maintain.
- To plan for the realization of a NATO/European set of full spectrum Air

and Space Power capabilities and competencies that can effectively and efficiently deal with Smaller Joint Operations – Air Heavy at a minimum.
- To suggest to political decision makers a different and innovative apportionment of the overall Defence budget to favour that part dedicated to Air and Space Power.
- To rationalize and further consolidate where necessary and possible the European Defence Industry. This rationalization and consolidation process with a focus on better and more affordable defence products must be conducted in full coordination with the European Defence Industries and the European Defence Agency (EDA).
- To establish a close dialogue with EDA in order to further harmonize the defence capability planning and development activities of NATO and the EU in order to avoid duplication of efforts.
- To synchronize the respective roles between NATO and the EU and to further harmonize the defence capability planning and development activities of both organizations in order to reduce duplication, increase effectiveness and efficiency.

Air and Space Power: The Need for Cyber Resilience

- To address cyber resilience by recognizing that at least some essential networks should be decoupled from the Internet and that some systems and networks should have stand-alone capability. Once the problem is properly conceptualized, the proper military requirements and specifications need to be written.
- To better fund technologies in support of improved security and cyber resilience of networked and individual systems, including on-board computing and data storage (detailed 3-D model of the world), inertial and optical guidance, and passive radar.
- To strengthen the reliability controls for hardware and software supply-chains. Production design (based on military specifications) should reflect the need for built-in cyber resilience.

- To improve effective vetting of essential personnel. Specifications need to be drafted accordingly. Suppliers need to be security-checked and controlled to ensure they apply the highest standards of security and robustness in everything they do.
- To develop operational concepts for executing air operations in a true multi-spectrum stealth mode and without dependence on networked computing and data exchange. In all relevant areas, red teams should be employed to unveil weak points that need to be addressed.
- To prepare for the loss of satellites by expanding the capacity for emergency launch of replacement satellites another alternatives.

Air and Space Power Command and Control in NATO – More Than Just a Technical Issue

- To keep a record of personnel that fulfills the Air Command and Control (Air C2) training requirements in NATO and Member States to agree to make those people available as required.
- To train national Joint Force Air Component (JFAC) personnel to the same standards as the NATO Command Structure (NCS) personnel.
- To agree that nations which have considerable expertise in the field of Intelligence, Surveillance and Reconnaissance (ISR) partner with Air Command (AIRCOM) Ramstein and interested nations to train and maintain a pool of ISR specialists available for Air C2.
- Consider the development in NATO of a Space Doctrine in addition to its Cyber Strategy which should not be limited to defensive operations. Air C2 structure complemented with the required set of tools and expertise.
- To develop full interoperability between all Command and Control (C2) and to present all information available to decision makers and planners as required.
- To request the nations to commit to a disclosure policy that enables the full sharing of information in operations.
- To consider formally teaming NATO/AIRCOM with the capable standing USAF 603rd Air Operations Centre on base in Ramstein.

Keeping up Preparedness, Readiness and Effectiveness of Air and Space Power in NATO

- NATO to serve as a clearing house for best practices and for sharing experiences related to human resources and education.
- To offer niche training for rare Air and Space Power competencies as part of a multinational curriculum or as part of the program of relevant Centres of Excellence (COEs).
- To encourage bilateral or mini-lateral efforts to educate, train together, and move away from a 'one size fits all' approach at 28.
- To develop more opportunities for live exercises training for the entire air combat system (capabilities and competencies).
- To explore an expanded role for Allied Command Transformation (ACT) in training and education. If 'combatant commanders' under Allied Command for Operations should retain the prime responsibility of training and preparing ally forces, ACT could be more closely associated in evaluation and lessons learned processes.
- To exercise the full spectrum of Air Power in order to develop preparedness for multiple contingencies.
- To further develop association of like-minded partners, in particular non-NATO EU countries such as Sweden and Finland into its training activities.

Space and Air Power in NATO

- NATO to consider taking on a coordinating role in Space only.
- To include Space operations in all NATO exercises.
- To increase the number of Space specialists in NATO based on a dedicated space training program and to insert Space specialists as appropriate into the different levels of the NATO Command Structure.
- To equip all air assets so that they can operate in a degraded environment with reduced or even absent Space support.

- To define what might constitute an article V situation in the domain of Space.
- To closely monitor the latest commercial developments such as Space tourism, small satellites etc. that could affect fundamental changes in future Space operations.
- To pursue, through an arrangement of Memorandum of Understandings (MOUs) with the Space faring nations and entities, a NATO Space Situational Awareness (SSA) capability appropriate to its Level of Ambition (LoA).
- To consider acquiring a commonly funded NATO 'responsive Space capability' with small satellites.

Air and Space Power
in Counter Insurgency Operations (COIN)

- To establish Advisory and Assistance (A&A) teams in NATO for host nation Air and Space Power capability and competency building.
- To further invest in joint air-land integration in NATO and its Member States and to take advantage of the synergy found in accurate ISR and precision targeting.
- To conduct a series of studies by NATO and its Member States on the role of Air and Space Power in COIN operations, and develop a theory and doctrine for such operations that appreciates the asymmetrical advantage of aerospace power.

Assured Air and Space Power Entry Capabilities in
Denied Airspace Environments

- To consider the need and level of ambition for a NATO integrated joint/combined cross-domain concept within the military sphere, and how this might work with, or alongside, US capabilities. Synchronize this with a comprehensive approach outside the military sphere to ensure NATO

and its Member States can effectively deal with the challenges of Assured Access/Aerial Denial as well as asymmetric threats posed by the proliferation of anti-aircraft systems amongst non-state actors, terrorists and insurgent groups.

- To balance the ability of NATO Member States to afford new Air systems against other options that effectively contribute to overcoming the challenges of A2/AD.
- To plan, equip and train for the worst case environment, in particular ensuring that skills that have been forgotten or neglected over the past 10 to 15 years are retrained and refined for today's threats.
- To consider the urgent need for a NATO 'Air Sea Battle' (ASB) concept, the relevant level of ambition and how this might work with, or alongside, US capabilities.

Air and Space Power in NATO 2020–2030

1

By Air Marshal Graham Stacey

Taking into account current trends (declining defence budgets and reduced airpower mass), what will Air and Space Power, especially European Air and Space Power, in NATO need to look like in the timeframe 2020–2030? What will be available and what will be useable in relation to the emerging operating environment, threat and political context? How will we do what is required with less?

'In the development of air power, one has to look ahead and not backward and figure out what is going to happen, not too much what has happened.'

Brigadier General William 'Billy' Mitchell

Introduction

This paper addresses these questions from the NATO Joint Operational Commander's perspective. The Commander is given the mission and resources and is then required to build an operation to meet the military strategic end state and political intent. After a brief review of European defence spending in recent years and an examination of the costs of technology, it will discuss the characteristics of the likely future operating environment. Finally, it examines what Air Power elements are likely to be available, their utility in the likely future operating environment in order to

assess where investment and rational thinking will be required to get the best from the limited resources available.

Defence Spending

Across NATO, defence spending has suffered real-term cuts raising new questions about Alliance solidarity and burden-sharing. Since 2008, Europe and the rest of the world have been in the grip of a financial crisis and the limited recovery has not been without collateral effect. Nationally determined operating contexts and ambitions will continue to drive defence planning and thus defence spending. Consequentially, almost all NATO member and partner nations have had to constrain public spending; defence budgets have been granted little to no immunity. This represents one of the most difficult, immediate and enduring challenges faced by the Alliance.

Between 2010 and 2013, real defence spending decreased in 18 out of 28 NATO Member States[1]. Defence spending in Europe, though still significant, delivers less than it should because of inefficiencies. At the national level, defence industries are often monopolies or even oligopolies. As a result, they are fragmented and unable to exploit economies of scale at the European level. Member States have resisted consolidation and the creation of an effective single defence market for a variety of reasons. Primarily, despite the fact that most EU Member States are also NATO Allies, there is a lack of trust between them. Nations continue to procure nationally because they are concerned about security of supply in a crisis.[2] Indeed, 2013 saw some key defence adjustments continue to take place, with many nations planning further cuts out to 2020[3]. Few member nations meet the NATO 2% GDP defence spending target reiterated at the recent Summit in Wales choosing instead to pursue nationally focussed operating contexts and capability plans.

Given the decreasing acquisition numbers driven by lower defence budgets, it is likely that in the future air components may be deficient in combat

mass[4] and nations will likely place an increased reliance on partnerships and alliances.[5] That said, following the Russian intervention in Ukraine, many Baltic and Central European nations have reviewed their defence spending plans and have announced significant nationally focussed equipment programmes which might provide a short-term reprieve in some capability areas. Capability plans under the aegis of the NATO Defence Planning Process (NDPP), which acknowledges national affordability, need to be integrated at Alliance level whilst taking into account individual nations' aspirations and global responsibilities. However, whether nations spend in a nationally focussed manner or integrate spending under the NDPP, real term defence spending as a proportion of GDP will have to increase or novel solutions to deliver capability will have to be found if Alliance operations are to continue and remain viable.

The Cost of The Technological Edge

There is arguably a trend to build in greater utility into new capability requirements. Indeed, fewer high-cost conventional aircraft projects are being undertaken with just a single role in mind; Typhoon, Rafale, Gripen, F22 and JSF are all multi and/or swing role aircraft which offer the customer greater utility for their investment. That said, complex projects with long lead times are increasingly vulnerable to the short-term fiscal climate and adjusted operating contexts. Many nations appear to opt for continuous development and upgrades to existing platforms in order to save costs.

The need to maintain the technological edge, or at the very least equality, is self-evident, as is the desire for nations to protect their indigenous defence industries. However, at a time when these industries are competing in an ever tighter market, arguably few nations can afford independent procurement activity. Whilst open competition amongst defence industries benefit the customers and should be maintained, there is merit in a greater number of open partnership programmes, allied to an integrated

Alliance capability plan. Partnership and multinational programmes under NATO's Smart Defence Initiative could have the potential to offer Alliance members economies of scale and the attainment of greater capabilities whilst also ensuring that upgrades are to a common NATO integrated standard. Pooling and sharing should, therefore, be further explored in light of increased platform commonality. Given the rising costs of new technology, reduced capital spending and the fact that 2020 is, in reality only 5 years away, there is unlikely to be a significant technological revolution surrounding aircraft capability and design, although advances in the use of the EM spectrum, fuels and engines remain likely. [6]

The Distribution of Global Power and The Operating Environment

The Commander will likely have to plan and execute future operations with the same general capabilities he has today, albeit likely with fewer assets. What will be important is the operational context within which these capabilities may have to be employed. Out to 2045, the focus of global power will move away from the United States (US) and Europe towards Asia, as the global system shifts from a unipolar towards a multipolar distribution of power. This shift, coupled with the global challenges of climate change, resource scarcity and population growth, is likely to result in a period of instability in international relations, accompanied by the possibility of intense competition between major powers[7].

The nature, scope, scale and location of future conflicts are uncertain. As more people live in cities, it is likely that some future adversaries may be found in larger, more complex urban environments, possessing a greater level of information and better access to technology than they do today. Geographically, Sub- Saharan Africa remains a volatile region as does the Middle East; the BRICS[8] group of nations is becoming increasingly resource hungry. The poles, the disputed ownership of sub-Arctic and Antarctic

continental shelves, under which lie vast carbon fuel deposits, may become a planning factor for the Alliance further compounding the destabilizing influence of this uncertainty. Moreover, wide-spread and challenging implications for defence and security will almost certainly be generated in an increasingly connected world, with its rapidly advancing technology and evolving societies. The face of some armed forces may change, with an increasing use of unmanned systems. Militaries and security forces may be asked to meet the challenges of more humanitarian disasters and attacks by non-state actors and cyber-criminals may increase.[9]

Although it is not possible to determine with certainty the region of any conflict, it is fair to assume that the future operating environment is likely to be congested (physical, urban, EM Spectrum), cluttered, contested, connected (networked systems) and constrained (bandwidth, legal considerations).[10] This is, to a certain extent, supported by NATO's 2013 Strategic Foresight Analysis report which states that *'urbanisation will increase the likelihood that the Alliance may need to conduct … operations in condensed urban environments'[11] and that 'globalisation and increasing resource scarcity will directly influence international security.'[12]* It is against this background that the Commander must consider Air and Space Power within a broader spectrum of conflict. This will require engagement and interactions outside the traditional military sphere as part of a comprehensive approach. Indeed, the Afghanistan conflict has forced NATO to start to look beyond its historical preoccupation with force-on-force conventional war, which is the form of conflict which underpins the Alliance's being. As Russia has shown quite recently and the Taliban have sought to prove, any future opponent is likely to employ overlapping, simultaneous and mutually supportive modes of war.

In the future, the most capable opponents may *'seek to combine truly disruptive capacity with traditional, irregular, or catastrophic forms of warfare.'[13]* NATO is, therefore, not likely to face a widening number of distinct chal-

lenges but the potential convergence of challenges into hybrid wars. In these hybrid wars, future opponents (states, state sponsored groups and non-state actors) will exploit access to modern military capabilities, including encrypted command systems and modern lethal systems, as well as promoting the use of protracted insurgencies and other coercive techniques such as economic degradation. This may also include states blending high tech capabilities such as anti-satellite weapons with terrorism and cyber warfare.[14] Future opponents may also be highly likely to use multiple means to justify instigation of either conflict or an overt military standoff. Given the uncertain but likely complex operational future, there is a need to develop flexibility in the use of existing capabilities and in the mindset of operators and planners to ensure NATO forces remain capable of meeting these future challenges.

Air Power – Core Roles of a Default Component

The manoeuvrist approach to operations offers the Commander the potential of achieving results that may far outweigh the level of resources and capability applied[15]. Ingenuity and rapid decision making are the tenets of this methodology, which is underpinned by the need to maintain momentum, tempo and agility[16]. This manoeuvrist approach to operations is likely to remain valid in both complex and hybrid scenarios through the 2020–2030 timeframe. Air and Space Power will remain fundamental to its application but the key element to their continued utility and relevance lies in their ability to provide the Commander with the tools to take timely, appropriate and assured decisions; in essence, to the ability to turn exquisite intelligence into precision effect.

It is not a given that the Commander will default to Air and Space Power as his tool of first intervention. Air Power has however, since the 1990's, become the 'go to' asset for initial action and response. In some respects, Air Power is a victim of its own apparent success[17]. There are circumstances

in which Air Power is seen as the only viable, or at least the most attractive military option open to governments owing to its ability to deliver precision effects, often at distance, without the politically unpalatable requirement to put boots on the ground. This was the case in OPERATION UNIFIED PROTECTOR and forms the backbone of the US pivot to Asia[18]. In this respect, one must ask whether undeliverable expectations of Air Power have been raised or, conversely, whether the argument for further investment in Air Power capability has been eroded?

In order to remain relevant to the Commander, Air Power must deliver real added value, rapid speed of response, high resource availability, timely precision effect, versatility and reach. Above all, it must complement his operational goals as part of a comprehensive approach to operations in which the ability to deliver kinetic effect may or may not be required. The 4 fundamental Air and Space Power roles (Control of the air and space, air mobility and lift, intelligence and situational awareness, and attack) are likely to endure at least until 2030, although probably not without considerable refinement to their conceptual basis. Whether it is shattering an opponent's will or shifting their perception of risk and consequence, the ability to achieve effect is likely to present the Commander with a complex problem.

As tools for coercive diplomacy, Air and Space Power will remain entirely relevant. Significant operational effect may be achieved through ISR assets revealing the 'truth' about an adversary's actions, by use of airlift assets in support of humanitarian and reconstruction efforts or through some other air domain delivered effect. Whatever the case, the air-minded operational commander should seek to use Air Power intelligently as a bridge between diplomatic effort and application of force in delivering effect.

Offensive and defensive actions may increasingly occur in both the electromagnetic sphere and in the public media arena. That said, individual na-

tions are likely to continue to wish to retain significant kinetic effectors[19] in their arsenals in order to prove beyond doubt their will and intent, which is a key component in any defence strategy. In this case, access to timely intelligence provided by persistent situational awareness assets such as satellites and long-loiter unmanned aerial systems may prove more useful across a comprehensive approach. Such assets allow the Commander to prove violation of treaties, war crimes and incursions, but more importantly may allow him to attribute events to a particular opponent. Assets which provide situational awareness or strategic warning are in themselves a potentially strong deterrent and may cause the opponent to either invest considerable time and effort in countering them or to regard the aggregated cost of action as too high to bear. Such assets also afford the Commander a vital capability when conducting operations at extreme reach (for example in the High North). The use of such assets to increase warning time and thus pre-empt an opponent's activity in order to cue timely effects across the spectrum, especially kinetic, operating at extreme range and using numerous force multipliers, is a key skill to be developed. Once developed, the capability shall then have to be maintained; arguably at the expense of other Air Power capabilities. What is required for the Commander to get the best out of such systems is the ability to focus the asset appropriately having interpreted the data presented in a timely manner. Timely analysis of all data especially within the electromagnetic spectrum and the cyber domain is also a niche capability that requires sustained development by highly trained specialists over many years; a core NATO cadre is an obvious solution. Ultimately, a balance of investment must be struck between the operational commander's desire for an 'unblinking eye'[20] and the provision of indicators and warnings at the strategic level.

Constrained and Congested

The Commander is likely to have access to a broad spectrum of the projected potential capabilities within the timeframe under discussion, pro-

vided that nations are willing to contribute. He is, however, likely to struggle to obtain timely intelligence from some nationally held strategic ISR assets, most notably satellites and traditional electronic intelligence gathering platforms. This is likely to present some challenges when seeking to gain detailed, real-time intelligence at reach, especially through the assignment of assets on a semi-permanent basis. Another constraint facing the Commander will likely be the high reliance on the electromagnetic spectrum. Congestion, bandwidth limitations and the need to rent 'satellite space' are all now operational realities. UAV and other systems are increasingly bandwidth-hungry due to the proliferation of real time data[21]. Having a realistic baseline for bandwidth in future NATO operations is a crucial enduring feature of coalition operations; it is what underpins connected and integrated capabilities.

The role of international law is becoming increasingly important in the regulation of armed conflict, yet defining it and ensuring that it is fit for purpose will prove to be two of the greatest challenges. The twentieth century witnessed the signing of many international treaties, to include those at the Geneva Conventions. The intention was to largely codify that which already existed, but also to ensure that the horrors of World War Two would be mitigated in future conflicts. The Geneva laws drafted in the 1940s and subsequently supplemented by additional protocols later in the century were aimed at regulating conflict between belligerent nations. They foresaw conflicts between nations and conflicts arising from a desire to break free from colonialism. It is arguable that these laws, which are still in effect today, do present challenges often related to technological advancements in air, space and cyber technologies; especially in conflicts that are increasingly pushed out with traditional sovereign boundaries.

The use of Remotely Piloted Aircraft System(s) (RPAS), whilst perfectly in order, is, according to some, contrary to the ancient military principle of

chivalry. To the minority, that makes such weaponry immoral if used to take life. It could be argued that this position is largely academic whilst there is still a 'man in the loop', but we can still expect enemies and protest movements to seek to discredit their use. The Alliance potentially enjoys a marginal technological advantage over potential adversaries but it is unlikely to maintain that position indefinitely without investment and against potential adversaries like China. Systems should, where possible, be designed to operate within the diplomatic space that is likely to be morally contested.

Indeed, ambiguity will reign in the legal domain – the days of the nations of the world coming together as one to refresh international law are arguably over. Whilst the 'first' Cold War is over, events in the Ukraine and Syria have exposed continued division within the permanent members of the UN Security Council, making closer cooperation unlikely. Collateral effects caused by the exploitation of RPAS are unlikely to be tolerated and, therefore, any joint operational action will have to be carefully controlled to maintain the moral high ground.

Future conflicts involving Air Power cannot afford to adversely impact upon the economic potential of member nation airspace. Disruption of airways and other trade routes (including emerging sea lanes in the high north) from which NATO allies draw revenues and economic strength will result in significant pressure upon the political apparatus to alter the mode and nature of the Commander's operational design. However the tragic events surrounding the downing of Malaysian Airways flight MH17 over Ukraine reminds us that there is a significant cost if we do not safeguard airspace for civilian use.

The role of Strategic Communications (STRATCOM) in the future will be critical in countering the multitude of challenges presented by a globally connected world and the constrained and congested operating environment. Awareness of the STRACOM implications must become an inherent

factor in the planning and employment of Air Power, particularly as effective STRATCOM will enhance maintenance of the moral high ground. In the words of General David Petraeus, there will be a constant need to 'Fight the information war relentlessly' and 'Be first with the truth'[22].

Momentum and Initiative

As in all operations to date, there will be a certain amount of discretionary and non-discretionary air activity to be undertaken. In this case there can be no disputing the requirement for a certain mass of assets to achieve the tasks. As has been identified, numbers of assets are likely to reduce in line with shrinking defence budgets. Whilst capabilities of individual platforms might increase as they are able to undertake a greater number of simultaneous roles, the reduced number of assets may limit the ability to provide simultaneous effect over wide or dislocated geographic areas. Whilst cross-domain effects will be increasingly integrated, it is acknowledged that Air Power has always been a finite resource. Therefore, there may be a place in the future operating environment for a certain amount of low tech mass, if only to allow simultaneous action and effect across a broad geographical area.

To ensure that he may maintain momentum and initiative, and thus the coercive edge, the future Commander will need flexibility. Flexibility may be achieved in many ways, including through having sufficient assets to support and apportion to tactical commanders. The Commander will need the flexibility to assign the correct capabilities to have a timely effect in both pre-determined and reactionary situations. He may also require the ability to allow his tactical commanders freedom of action in the manner in which they achieve their objectives. With a potential shortage of certain platforms vice capabilities, the Commander may be forced into a position where he has to ration or overly govern his subordinate commanders' activity, and enforce the supported/supporting relationship amongst components.

Holding key assets at the joint operational level might be an answer but the definition of 'key' when describing assets is not only temporal but might depend upon their relative availability, scarcity or importance to the mission. Another avenue which the Commander might seek to pursue could be redefined Air Command and Control (Air C2) protocols. Much has been learnt from past conflicts and current protocols have evolved through time and the changing face and nature of conflict. It is the innovative and bold air commander (JFACC) who understands Air Power's inherent flexibility who can, and should, make the difference by harmonizing effects and integrating air assets. The future paucity of certain assets will probably determine the maintenance of the centralized control and decentralized execution system which we are so used to seeing today. Command and control of space assets is unlikely to be delegated below the (national) strategic level, not only because of national sensitivities, but also due to the global reach of the capabilities involved. For Air Power, if adaptive control measures are to be adopted or integrated within the established C2 model, it will be the Commander's challenge to ensure that not only his JFACC fully understands the mission and its parameters but also that all of his subordinate headquarters fully understand the mission boundaries and how to use Air Power intelligently to achieve effect.

If subordinate headquarters are to be given what amounts to progressive mission command over assets, then the same challenges of timely intelligence gathering, assimilation and targeting will apply throughout the command chain. This will require continual investment in robust C2 systems and training and exercising that speed up decision making by removing uncertainty. Only then might the benefits such as an increased tempo and the shortening of the decision cycle be realized. Of singular importance, however, will be the ability of both national and NATO systems to communicate via a single command network. This is vital if we are to ensure the continued ability of commanders to make

speedy and informed decisions at the lower tactical levels that may have strategic impacts, the importance of which has been demonstrated in Afghanistan.

In the past, it was the platforms which defined the available missions and tasks and, to a certain degree, the effect. In the period 2020–2030, it will be the effectors. Certainly, platforms will govern how the effectors may be employed (range, height, speed, lethality, CDE, etc.) but having access to sufficient, integrated effectors will be key. Effectors and platforms are of no use without a system. Potentially crucial will be future technology which must grant the NATO commander interoperability between unsophisticated platforms and sophisticated systems. Indeed, there are likely to be future challenges in integrating 'legacy' platforms and capabilities, especially where nationally focussed projects, often constrained by financial resource, are aimed at retaining and upgrading older platforms vice the purchase of new ones.

Air and Space Power itself will likely become part of a larger targeting system. This will likely comprise both traditional and non-traditional product and effect, synthesized with more advanced technologies such as cyber attack as well as more subtle technologies such as strategic messaging and the likely increased exploitation of social media (our actual and potential opponents are already exploiting social media). Unmanned and other innovative technologies are flourishing with some potentially offering reasonably persistent ISR capabilities. All systems, both terrestrial and space, based will be dependent on an increasingly cluttered electromagnetic domain for their control, transmission of products, and potential ability to attack. They will therefore become increasingly susceptible to cyber-attack, electronic attack and bandwidth limitations. NATO and member nations will have to work now to build the experience and tools necessary to protect Air and Space Power in the future.

Conclusions

The defence budgets of EU member-states have fallen since the start of the economic crisis in 2008 from approximately €200 billion to €170 billion. At the same time, the cost of defence equipment has continued to rise. For Alliance operations to remain viable and deterrent capability to remain credible, investment will have to improve. Innovative approaches to procurement, including pooling and sharing initiatives, particularly in respect of new technologies, will help mitigate costs.

There will be no revolution in capabilities in the next 15 years, but there are likely to be limited advances in the use of the EM spectrum, fuels and engines. In essence, NATO will have to fight with what it has today, but maybe less of it.

The future operating environment is likely to be congested (physical, urban, EM Spectrum), cluttered, contested, connected (networked systems) and constrained (bandwidth, legal considerations). Air and Space Power will need to be employed within a broad spectrum of conflict. This will require greater cross-domain, joint and combined integration within the military sphere as well as synchronisation and coordination outside it as part of a comprehensive approach. Ever increasing legal constraints will require greater care in delivering kinetic effects and innovative use of effectors to maximize the contribution of legacy platforms. The implications of global connectivity will demand greater understanding and employment of Strategic Communications (STRATCOM). ISR capabilities will be critical not only to guarantee precision across the targeting spectrum, but also to contribute to the STRATCOM challenge and maintain the moral high ground, especially in 'being first with the truth.'

In the future, when operating within a complex battlespace against an adaptable and resilient opponent, the multitude of effects provided by Air and Space Power are unlikely to defeat an opponent on their own but may

prove invaluable when employed as part of a comprehensive, synchronized and connected approach to warfare. The use of Air Power will only be limited by the flexibility of thought from the strategic to the tactical level. The prime purpose of Air and Space Power must be to affect the opponent's cohesion and will to continue his chosen strategy. The Commander's ability to direct and control scarce air and space resources to achieve his stated aims and requirements will depend increasingly on a flexible and robust C2 network. This implies not only the ability to withstand the impact of physical and cyber-attacks, but also an inherent understanding of the tenets of mission command.

NATO's technological edge will be countered asymmetrically by potential adversaries or equalled by states like China. Leadership, high quality people, initiative and empowerment will be crucial to win wars.

The competent opponent will likely resort to a version of hybrid warfare to exploit Alliance and member state weakness and dependencies; this may be especially true in the electromagnetic, cyber and economic spheres. To counter this, combat mass and credible deterrence will remain important to the Alliance, but this is equally true of any potential opponent. As advanced threats multiply, the potentially small number of aircraft available to the Commander means that even the lowest attrition rates may render a campaign unsustainable. What is important to NATO is, as a matter of priority, to synchronize, connect and control through adaptive means the Air and Space Power we have and that which is to come. NATO should, in dialogue with member states, set out now agreed plans, structures, partnerships and capabilities for 2030 onwards. These should be supported by adequate strategies and/or common training standards to guarantee a stated understanding of air and space warfighting and capability employment.

With one obvious exception, no member nation can, or is likely to, afford the full panoply of capabilities required to defeat the future threat. The

Director General of the International military Staff (DGIMS) at HQ NATO recently opined that, *'If NATO is to satisfy its level of collective ambition then it, and the nations that it comprises, must either work more closely together to do more with less – or simply accept that they will only be able to do less.'[23]* From a Joint Operational Commander's perspective, he will have to do the right thing with what he's got.

Endnotes

1. Taylor and Francis, *The Military Balance, Chapter 4: Europe* (London: Routledge, 2014), p. 59–74.
2. Ian Bond, *The EU and Defence Procurement,* (London: Centre for European Reform, 2014), p. 1
3. Taylor and Francis, p. 59–64
4. Mass may be defined as: *'an effect that air and space forces achieve through effectiveness of attack, not just overwhelming numbers.'*
5. DCDC, *Future Air and Space Operating Concept: JCN 3/12* (Ministry of Defence: 2012),VII
6. Hagel, Chuck. 'Secretary of Defence Speech.' Pentagon: 24 Feb. 14.
7. Defence Concepts & Doctrine Centre (DCDC) Strategic Trends Programme, *Global Strategic Trends – Out to 2045* (London: 2014).
8. BRICS nations comprise: Brazil; Russia; India; China and South Africa
9. (DCDC) Strategic Trends Programme, *Global Strategic Trends – Out to 2045 (London: 2014),* XIV.
10. DCDC Strategic Trends Programme, *Global Strategic Trends – Out to 2040* (Ministry of Defence, 2010), p. 88–90
11. ACT, *Strategic Foresight Analysis, 2013 Report* (Norfolk VA: 2013), 1
12. Ibid, p. 2
13. Department of Defence, *National Defence Strategy* (Washington, DC: 2005), p. 4.
14. Frank G Hoffman, *Hybrid Warfare and Challenges,* JFQ: Issue 52, 1st quarter 2009, p. 37.
15. JDP0–01, *British Defence Doctrine 4th Edition* (Ministry of Defence, 2011), p. 5–9.
16. ibid.
17. Chief of Air Force: Air Marshal Geoff Brown AO – Introductory Speech, Air Power Conference 2012, 'Air Power's Role in Coercive Diplomacy' Thursday 10 May 2012.
18. Robert H Dorff, Strategy *in NATO: Preparing for an Imperfect World* (New York: Palgrave Macmillan 2014), p. 50.
19. Effectors include: air-to-air and air-to-ground weapons; cameras; data pods; data collections pods; and other ISR or kinetic weaponry devices.
20. Military UAVs: Up in the Sky, an Unblinking Eye, Newsweek 31 May 2008.
21. Mehta, Aaron, *Pentagon Seeks Solutions To UAV Bandwidth Crunch,* Defence Weekly?, 31 Mar. 2013
22. General David H Petraeus, 'Counterinsurgency Guidance', issued to all US and NATO forces in Afghanistan Aug. 2010.
23. Air Marshall Sir Christopher Harper at the Lord Trenchard Memorial Lecture 2013, *NATO Air Power: Learning from the Past-Looking to the Future,* (RUSI 10 Dec. 2013).

© US Air Force, Staff Sgt. Jonathan Fowler

Air and Space Power Force Structure – Towards a Right Balance

<div style="text-align:right">**11**</div>

By Lieutenant General (ret.) S. Panato

Executive Summary

Deficiencies in capability in NATO/Europe became a hot issue as the Alliance progressively moved toward an expeditionary posture. It is widely believed that in absence of corrective actions, especially in the airspace domain, the future credibility of the Alliance is at stake. Rationalization of the existing is a necessary measure, especially in NATO Europe, together with the dismissal of obsolete legacy assets, whose sustainment drains precious resources and inhibits investments. Additional effort is also required to diminish the un-necessary duplication of assets and capabilities among Allies and between NATO and the EU.

The call for additional resources in airspace budgets is a consequent measure but, to be effective, has to be substantiated by a broad spectrum of considerations that covers among others the stimulus to the economy and the ensuing spill-over of technology to every aspect of society. In addition, European Airspace Industry should be rationalized and consolidated as necessary. EDA should be engaged by NATO in the exercise as a valuable partner.

All the measures to ameliorate the current deficiencies are political in nature and require time to produce effects. In the short term, remedial action

is necessary to allow NATO-Europe to mount autonomously a 'small scale joint operation-air heavy'. Considerable forces and capabilities are basically available in the continent provided that caveats and reservations are overcome by European Nations.

The solution to the issue of unequal distribution of capabilities across the Alliance is to find a satisfactory adjustment in the medium term at the political level. In the short term, a planning process should be initiated to start shaping airspace forces to the required quality. This implies, among other things, considering the trade-off between diverging attributes of the same airspace forces.

Introduction

Uneven distribution of military force and capabilities is a long-standing issue for the Alliance and affects all domains: land, maritime, air and space. During the Cold War era, the enduring asymmetry between both shores of the Atlantic Ocean was periodically stigmatized, but the compelling pressure of the Soviet threat caused the issue to be set aside. The general understanding was that in an Art V situation, solidarity within the Alliance would have prevailed over any other resentment.

The end of the Cold War and the emphasis placed on Crisis Management Operations (CMO) reinvigorated the issue of more balanced capabilities, specifically in the Air and Space domain, which has been the preferred military option in case of a CMO. At the same time, repeated engagements of the Alliance in CMO proved that solidarity amongst Allies should not be taken for granted.

Taking into account the trends and the political-military strategic developments as described in Compendium Part One of the 'Air and Space Power in NATO – Future Vector Project', it is clear that NATO, and more specifically

its European part, needs to take urgent corrective measures if it wants to limit the risks of being perceived as obsolete. For Air and Space Power in NATO/Europe and its related future Force Structure this means the availability of a set of full spectrum capabilities and competencies to conduct and sustain a Smaller Joint Operation – Air Heavy (SJO-AH).

This essay will assess the current Air and Space Force Structure from a qualitative point of view. It will look at what is needed for the future and what are the shortfalls. A set of balancing factors is presented that is of importance for shaping the future Air and Space Power Force Structure in NATO/Europe. The essay concludes with a set of recommendations.

Current Situation

Capability and competence development in NATO is the outcome of a rather technical planning process that does not always provide the necessary solutions. In fact, it is impossible to anticipate everything, particularly in the current security environment, which is characterized by volatility, unpredictability and complexity. Therefore, Joint Air and Space Power in NATO tend to have, as prerequisite, the flexibility and the ability to operate effectively along the whole spectrum of missions, from humanitarian assistance to heavy combat. Scalability, sustainability and usability are equally crucial attributes.

Furthermore, a number of trends and developments are impacting the availability and application of joint Air and Space Power. One of the key developments that directly affect the discussion in NATO on the composition and quality of joint Air and Space Power capabilities and competencies is the United States pivot to Asia. This pivot implies a significant shift of United States foreign and defence policy from Europe and the Middle East to the east and South-East of Asia. It means that it can no longer be assumed that under any circumstance that the United States will be

capable or willing to make substantial contributions in terms of capabilities and competencies to NATO/Europe. Therefore, NATO/Europe must take into account that, other than in an Article V situation, it has to be capable of independently securing its interests at the periphery of NATO's geographical Area of Operational Responsibility. For joint Air and Space Power in NATO/Europe this means the availability of a set of full spectrum capabilities to support and conduct CMO.

Precisely defining the optimum set of Air and Space capabilities and competencies, in term of quality as well in quantity, needed to address the future challenges of the Alliance is not an easy task. It depends on the political appraisal of the moment, where multiple factors such as resources available, perceived threat, differing national agendas, the degree of success of particular initiatives ('smart defence', 'pooling and sharing'), the effectiveness of NATO-EU cooperation and the availability of coalition partners all play a role. Those factors constantly change, influence each other and are the drivers of a continuously adaptive process.

With due consideration to the multitude of factors, a realistic and at the same time affordable level of ambition for NATO/Europe is the ability to conduct and sustain a SJO–AH with of duration of six months, for planning purposes. A set of joint Air and Space Power capabilities and competencies, equipped, trained and ready to conduct such an operation should therefore be assumed, as a minimum, as the objective for NATO/Europe.

So far, the problem is that NATO/Europe lacks a number of the required capabilities and competencies. The question, therefore, is 'what is needed?'

What is Needed and What are the Shortfalls?

It must be clear that a SJO-AH may vary in focus and objectives and, therefore, the emphasis on required capabilities may differ. For example, OPERATION

UNIFIED PROTECTOR (OUP) in Libya was primarily focussed on providing Intelligence, Surveillance and Reconnaissance and kinetic combat power to produce desired effects. In other types of SJO-AH, in which the focus is primarily Humanitarian Assistance or Disaster Response (HA/DR), the capability requirement will be different. In this case fixed-wing and rotary-wing airlift capabilities will play a crucial role to the success of the operation.

So, an initial conclusion is that NATO/Europe, from a qualitative perspective, needs to have the capabilities and competencies to cope with the whole spectrum of possible SJOs-AH. In essence, this means the capability and competencies to plan, task and execute the following roles and missions: Air Superiority; Mobility (strategic airlift and vertical lift); Intelligence, Surveillance and Reconnaissance (ISR); Precision Strike/Suppression of Enemy Air Defences (SEAD); Medical and Casualty Evacuation (MEDEVAC/CASEVAC), Electronic Warfare (EW) and Air Command and Control (Air C2).

The JAPCC publication 'Present Paradox – Future Challenge' made the deficiencies in NATO/Europe's capabilities clear. Persistency, ISR; Air to Air Refuelling; Strategic Airlift; Helicopters (transport and MEDEVAC/CASEVAC), EW; SEAD and Precision Guided Munitions (PGMs) are the predominant capabilities lacking in the NATO/European Air Power inventory. Other areas where NATO/European joint Air Power capabilities are lacking or where NATO/Europe is currently overly dependent on the contributions of the United States are: Ballistic Missile Defence, Maritime Patrol Aircraft, Special Operations Forces Aviation, Sea based power projection capabilities and space-based ISR assets.

Operations in the Former Republic of Yugoslavia, Afghanistan and Libya showed that space support was instrumental to the effectiveness of the operation. For the future, it is vital that NATO/Europe maintains assured access to space-sourced data and information for weather information, navigation, communications and targeting, etc. The best solution for

NATO/Europe to remedy its own shortcomings in space support could be through tailored Memorandum of Understanding (MOU) and binding agreements with selected providers, be they space fairing States or private companies. Other key areas of attention are the timely availability of qualified essential manpower to plan, task and conduct Air and Space Power Operations, timely availability of strategic, operational and tactical intelligence, improving interoperability and standardization and key weapons stockpile planning (PGM etc.). It also includes the need for a clear focus on the specific NATO European Air and Space Power requirements and continuous oversight, direction and guidance, and coordination throughout the capability development planning process.

As NATO operations in Afghanistan revealed, helicopters have a unique value for the achievement of stated objectives. In Afghanistan, helicopters' tactical-level actions generated strategic effects, safeguarded troops or individuals in distress and supported the electoral process with crucial influence on governance and security. It is for this reason that NATO and in particular NATO/Europe must ensure that helicopters form an integral part of NATO/Europe's joint Air Power inventory.

Finally, SJOs-AH must be continued for six months as a minimum for planning purposes; this asks for persistence in capabilities and competencies. NATO/Europe must have adequate resources not only to produce the desired effects but also to rotate assets and personnel into and out of theatre which will impact the overall quantity and quality of the requirements.

If NATO does not collectively address the Air and Space Power problem there is fair chance that in the future NATO/Europe will not be capable of adequately dealing with emerging security challenges that require focused action. It is for this reason that NATO is required to further assess the future force structure requirements for NATO/Europe as a matter of urgency.

Sliding Panels – Balancing Factors in Determining a Future Force Structure

A joint Air and Space Power future force structure in NATO/Europe needs to have a proper balance of qualities. This implies a trade-off process between diverging attributes, to include, although not exclusively the following ones:

Overall: Reinforced Coordination

The main instrument to carry out a trade-off process between diverging attributes of Air and Space capabilities is the NATO Defence Planning Process (NDPP), which establishes military requirement for NATO's Level of Ambition. The reality is that this top-down mechanism is not fully connected with bottom-up planning by the individual Nations.

National cuts in defence budgets and future force developments are hard to anticipate for NATO, but also for its Member States. The result is that Members States make choices that are focused to support primarily national interests. As a result of this uncoordinated execution, investments and defence budgets are spent on niche capabilities without a real 'check and balance' against what tools are needed in NATO's toolbox.

The fact is that NATO cannot demand that nations procure and contribute the required capabilities to meet NATO's Level of Ambition, nor is there a binding agreement for a nation to provide the capabilities needed. It is not likely that this situation will change in the foreseeable future.

It is therefore vital that NATO reinforces the coordinating/synchronization mechanism by calling for 'early consultation' on national cuts. At the same time, NATO should implement a procedure within the NDPP to track, manage and measure planned national defence spending.

Spectrum of Conflict: High End – Low End Capabilities

Since the end of the Cold War, which produced an enduring infatuation with 'high end' combat forces, the focus has been also on other types of engagements, such as CMO and Counter Insurgency Operations (COIN). These operations require mainly 'low end' capabilities and a seemingly ever-increasing demand for combat support and combat service support. The likelihood that these capabilities unduly prevail over conventional 'high end' capabilities exists and should be taken into account.

Conventional 'force on force' confrontation is not currently on the horizon but should not be totally excluded from consideration. Although unlikely, a conventional (Article V) confrontation is by far the most risky scenario for the security of the Alliance. Therefore, adequate consideration should be given to assure a NATO/European set of joint Air and Space Power capabilities and competencies suitable to meet the requirements for conducting operations effectively throughout the spectrum of conflict.

The challenge is to properly balance the future Force Structure of Air and Space Power capabilities and competencies in NATO/Europe. Cost-effectiveness will be an important factor in the assessment process. Air and Space Power in NATO/Europe should, in the first instance, be structured with the capabilities and the competencies required for Crisis Management Operations but the backbone should always be capable meeting the requirements of hi-end spectrum of conflict operations. The optimum would be a set of Joint Air and Space Power capabilities and competencies that can adequately cope with the requirements of the full spectrum of conflict.

Few or Many Assets

Technological progress so far has been an important driving factor behind the increase in operational capability for Air and Space Power assets. Indi-

cators suggest a further leap forward in in platform and system capabilities in the future. Therefore, it is fair to assume that future platforms will offer capabilities equating the sum of several legacy ones. Renewal of obsolete platforms, on a one by one basis, would make no sense and an overall reduction in the number of platforms is a predictable future trend.

Although quantity constitutes a quality in and of itself, there are obvious limits to the reduction in numbers of assets. The number of future assets should not be allowed to fall below the level of critical mass. Driving aspects in the sizing of an effective and efficient force structure for Air and Space Power capabilities are, for example, the capability to effectively execute operational concepts, Techniques, Tactics and Procedures (TTP's) and trade-offs in terms of cost-effectiveness like the 'tooth-to-tail' ratio.

Sustainability

In general, crisis operations after the Cold War have lasted longer than anticipated. In many occasions, governments had to extend their mandate in order to continue their contributions. Operations in Former Yugoslavia lasted from 1994 until 2010 and operations in Afghanistan have been on-going since 2002. NATO/Europe's future Air and Space Power should be tailored for sustained operations (six months as a minimum). This mainly applies for readiness of weapons systems, weapon stockpiles (e.g. during OPERATION UNIFIED PROTECTOR in Libya some European nations ran short of precision guided munitions after a few days in the operation), and logistics. But, the personnel factor should also be considered accordingly.

Multirole or Specialized

Multirole assets offer advantages in terms of flexibility, sustainability, training and reduction of overall costs. At the same time, savings are partially offset by acquisition and maintenance costs that are normally higher in comparison to

specialized assets. In addition, multirole assets cannot always efficiently cover all missions. Some specialized tasks and roles, such as persistent ISR and SEAD, are normally best executed by specialized assets. Therefore, specialized air assets are still needed in the inventory of the Alliance.

On the other end, a too-diversified fleet of platforms is difficult to sustain and poses problems in term of interoperability. Fundamental choices have to be made.

Given the pros and cons of multirole and specialized assets, NATO/Europe should primarily choose multi-role or even multi-mission aircraft, as long as new roles or missions are not detrimental to its performance. On this line, as a further measure, the creation of multinational and multirole units should be considered. This is a solution that could also address the present budgetary constraints.

Manned and Unmanned

An important factor for a balanced future Air and Space Power force structure is the manned versus unmanned issue. So far, manned aircraft maintain an edge in terms of speed, payload, flexibility, survivability and, most importantly, human awareness in the cockpit. At the same time, it is clear that the use of Unmanned Aerial Vehicles (UAV's) is becoming more and more attractive. They are persistent, are more difficult to detect either visually or with radar and do not expose aircrew to risks that could politically be exploited by adversaries. For these important attributes, unmanned assets are already operating beyond the traditional ISR mission set, well into the traditional combat aircraft domain.

It is anticipated that the use of UAV's and Unmanned Combat Aerial Vehicles (UCAV's) will further increase in the future despite the existence of a number of concerns. The lower costs that have so far made

unmanned so popular are rapidly rising for several reasons. First, attrition is generally higher than for manned assets. Second, there are still operational-technical and legal issues that must be resolved for the use of unmanned assets in shared airspace, both in peacetime and in times of conflict. For example, these issues are linked to peacetime airspace integration, the capability to comply with the principle of 'see and avoid' and the need for segregation in non-radar controlled airspace during crises and conflict. Third, a single unmanned mission requires a large ground crew – far larger than any manned assets. Fourth, the requirements related to the use of bandwidth for communication with ground stations and reach back are significant with high related costs. These are precious and finite resources. Finally, the ethical and legal issues connected with kinetic operations carried out by UCAV's are still debated.

The future Air and Space Power force structure will contain an appropriate mix of manned, unmanned and even hybrid aerial vehicles. The ultimate balance will be based primarily on considerations of cost- and operational effectiveness and the extent to which employability aspects can be definitely solved (e.g. legal, airspace integration).

Stand-off and Proximity

Stand-off operations are effective in term of surprise, survivability and flexibility and are therefore the favourite choice when conditions permit. However, for specific missions or targets, there is a need to operate at a relative proximity. While ISR or SEAD may be conducted from stand-off distance, Close Air Support (CAS) and Time Sensitive Targeting (TST) are examples of missions that often require human judgment and precise discrimination before prosecution. In these circumstances, manned assets are unavoidable due to the flexibility they offer in comparison to unmanned platforms

From the above it follows logically that a future NATO/Europe joint Air and Space Power force structure should see an appropriate balance between weapon systems designed to operate at stand-off distance and others aiming to operate at close proximity of targets, eventually with penetration capability into contested environment, thereby setting the conditions for assured access and the prevention of aerial denial.

Live and Synthetic Training and Exercises

Training and exercises are vital to the operational effectiveness of Air and Space Power in NATO. Technological advancement in computer power computation and in simulation – e.g. full motion mission simulators and distributed interactive simulation – leaves room for an efficient and effective way of training and exercising. Of course, live training should not be abandoned; it must be dedicated to those niches which cannot be covered by synthetic means. If, in the future, the operational possibilities of synthetic exercising and training can be further exploited, there is a real chance that options can be developed that have a cost-effective impact on a future Air and Space Power force structure. For example, if simulated flight hours can be characterized as effective, it will undoubtedly have an impact on the size of the fleet, in the number of related aircrew and ultimately in the operating costs.

Wealth and Scarcity of Data

The current operational environment is characterized by a wealth of data: intelligence data, geo-referential data or other. The enormous quantity of data available, combined with the processing capability of some aerial platforms, is at the root of the amazing performance displayed in recent operations. More and more data will be available in the future and computer power is predicted to increase in accordance with the Law of Moore. At the same time, all indicators are showing a growing importance of cy-

ber-threat that suggests that availability of data should not be taken for granted. One could deny their availability, corrupt them or simply delete them. In a cyber-contested scenario, the heavy reliance and dependence of present Air and Space platforms on availability of data is a serious source of vulnerability. Therefore, while exploiting the potentiality of cyberspace to the maximum extent, it is essential for future air platforms to be able to operate in adverse conditions in which scarcity or corruption of data has occurred. This will require self-reliance in terms of navigation and target acquisition and sufficient resilience in 'Electronic Warfare' contested environments to handle essential data, including Air Command and Control information and protocols.

What Needs to Happen: Remedial Action

As all measures which might be decided will have some kind of political influence, time will be required before they will be effectively implemented and start to produce effects. This further emphasizes the need not to delay all necessary decision processes.

While Alliance solidarity in the Collective Defence context remains so far undisputed, it is a fact that solidarity in expeditionary scenarios could be 'a la carte' and in no way is assured. The recent NATO operation over Libya is emblematic in this regard. While the political framework of the operation was unanimously approved, only fourteen Nations contributed militarily and, of those, only ten took part to the offensive missions over Libyan territory. Such a limited participation also puts the financial burden on a small number of NATO Member States in accordance with to the existing NATO adage that 'cost lie where they fall'.

The probability exists that the future geopolitics at the boundary of NATO/Europe would drive the international community to call NATO to lead a Crisis Management Operation in the region. Should it be impossible for NATO

without the substantial support from the USA to positively respond to that request, it would be disastrous for its credibility and for the security of Europe.

If NATO wants to minimize the risk of becoming obsolete, it must rapidly address the shortcomings in joint Air and Space Power capabilities and competencies shown during recent engagements.

The call for additional resources to supplement the European defence budgets is the first obvious measure one may think of. However, this is not new. It has happened from time to time in the past, with very limited success. Whether it will be different this time is unlikely. The truth is that the overall financial climate in Europe is such that this plea for resources risks again being unanswered, unless it is anticipated by other measures able to reassure a rather sceptical public opinion on further financial commitment on defence.

There is the need for the Alliance to demonstrate a genuine effort to better use existing capabilities. The overall NATO/European defence budget is the second largest in the world, exceeding by far the defence spending of any other superpower except the US. Additionally the inventory of fighter aircraft in Europe roughly equates that of the US.

Problems are caused by unnecessary duplication of structures, overlapping agendas between NATO/Europe and the Nations, equipment obsolescence and the lack of crucial assets. There is no doubt that the scope of military resources and capabilities potentially available to NATO/Europe is large. Therefore, concrete actions by the Alliance should be taken as soon as possible to better re-focus this set of resources towards the challenges of the future security environment.

First, the overall number of available fighters in Europe is relevant, but there is substantial legacy problem. Many NATO/European countries have legacy aircraft in their inventory. Although fighter aircraft, even if legacy,

are a symbol of might and sovereignty for many countries, they are too costly to maintain and should therefore be progressively abandoned. This will allow nations to focus scarce defence resources on the acquisition of other Air Power capabilities, less humble but more needed.

Second, the recognition that Air and Space Power will be, at least initially, the preferred option when considering a military operation could also suggest to political decision makers a different and innovative apportionment of the overall defence budget to favour that part dedicated to remedy NATO's capability shortfalls, especially in the Air and Space Power domain.

Third, as defence budgets have become very constrained, bi-national, multinational or common funded acquisition of capabilities is recommended. There are some good examples of instances in which such approaches have generated capabilities which would have been unaffordable for a single nation. NATO Airborne Early Warning is an example of Smart Defence. The C-17 Heavy Airlift Wing and NATO Alliance Ground Surveillance (AGS) are other examples. Other options are a multinational Joint ISR wing based on unmanned Joint ISR capabilities, Air-to-Air Refuelling, SEAD and GBAD to name just a few.

Fourth, the European defence industry should be fully involved in this rationalization process and encouraged to further consolidate in order to offer better and more affordable defence products. Common European requirements and a common set of rules for testing and certification of equipment is a further measure of rationalization. National and industrial interests have, so far, prevented this from happening. But market globalization and the need for critical mass in every field are opportunities not to be missed.

Fifth, NATO should establish a close dialogue with EDA in order to assure best value for money invested in defence. The allocation of NATO research funds should be focused accordingly in order to become synergistic with

the efforts of EDA. In the end, the European aerospace industry will be in a position to produce more capable air assets. That, in turn, will induce a positive technological influence over other industrial sectors. Eventually, investments in defence in general, and in Air and Space Power capabilities in particular, may produce multiple cascade effects. If properly coordinated, they will serve as stimuli for employment, for economic growth and for innovation in the society in general.

Sixth, both NATO and EU are already trying to answer the demand for rationality within their respective organizations with particular initiatives such as 'Smart Defence' and 'Pooling and Sharing'. These initiatives require sincere support from the Nations, as their success depends on political understanding, on mutual confidence and, at the end, on reliance on other Allies. Cooperation is no longer optional but a necessity. However, the current status of the agreements between NATO and EU is far from being satisfactory. A better definition of the respective roles and a further harmonizing of the defence capability planning and development activities of both NATO and the EU would lead to reduced duplication and increased effectiveness and efficiency and consequently better serve the security of Europe and of NATO. It is not to be excluded that this could eventually lead to a division of responsibility between the two Organizations, based on the principle of geographic primacy.

Conclusion

Currently, NATO is confronted with a complex situation in which a number of issues such as geo-politics, fair distribution of capabilities and commonality of intent amongst Allies are all interrelated. The expeditionary character of NATO in its post-cold war posture gives a new emphasis to Air and Space roles and exacerbates deficiencies in capabilities.

In addition, geo-political developments are suggesting the US rebalance its military posture towards other areas of the globe. In this context, NATO

and in particular NATO/Europe, needs to solve, as a matter of urgency, shortages in certain Joint Air and Space Power capabilities and competencies. If this is not going to happen, there is the serious risk that NATO, and in particular NATO/Europe, will not be capable of adequately addressing its security interests in its own 'backyard'.

Three factors are imposing a pace to the renewal of capabilities that are a serious challenge for many Allies: the general draw-down of military expenditures, mainly but not exclusively on the European side of the Alliance; the extended NATO operation in Afghanistan that is producing a certain tiredness and is causing wear-out of equipment beyond expectation; and finally, the pervading technology that accelerates the obsolescence of equipment.

In the short term, concrete measures are necessary to strengthen NATO/European joint Air and Space Power capabilities in order to be capable of dealing with the broad range of possible CMOs. A realistic and at the same time affordable objective for a NATO-Europe level of ambition in a CMO situation is the ability to conduct, as a minimum, a six months long SJO-AH operation.

No NATO/European country will have the resources to develop the required set of full spectrum joint Air and Space Power capabilities for such an objective on its own. Therefore, the development of an adequate NATO/European future force structure, is in fact only possible if the political will exists to give further substance to extended options of bi- and multinational cooperation and agreements are made in the field of education, training, exercises and validation as well as in the area of availability and commitment.

Finally European Nations will have to overcome traditional caveats and reservations to optimally use existing joint Air and Space Power capabilities.

Recommendations

If NATO wants to minimize the risk of becoming obsolete, it must rapidly address the following points in joint Air and Space Power capabilities and competencies shown by its European arm during recent CMO's engagements:

- Legacy assets that are too costly to maintain should be progressively abandoned;
- The recognition that Air and Space Power will be, at least initially, the preferred option when considering a military operation could also suggest to political decision makers a different and innovative apportionment of the overall Defence budget to favour that part dedicated to Air and Space Power;
- NATO needs to have a clear focus on the specific NATO/European Air and Space Power requirements and establish continuous oversight, direction and guidance, and coordination throughout the subsequent capability development planning process.
- To search for extended cooperation (e.g. through NATO's Framework Nation approach) and possibilities to acquire capabilities that are bi-national, multinational or common funded;
- Rationalize and consolidate the European Defence Industry as necessary. The European Defence Industries should be fully involved in this rationalization process and encouraged to further consolidate in order to offer better and more affordable defence products;
- NATO should establish a tighter dialogue with the EDA;
- The need for a better definition of the respective roles between NATO and the EU. Harmonization of the defence capability planning and development activities of both NATO and the EU are measures which reduce duplication, increase effectiveness and efficiency, and in this way better serve the security of Europe and of NATO.

Air and Space Power: The Need for Cyber Resilience

111

Professor Dr. Phil. Holger H. Mey

Some Fundamental Points for Consideration

Air and Space Power today and tomorrow depends on computers ('microchips are everywhere'). Computers are, and will remain for some time to come, instruction-executing machines (Scott Borg). They are fundamentally multi-purpose, meaning one machine can do many things to a system depending on the program and the context. Instructions, however, can be changed, i.e. manipulated; wrong instructions produce unwanted results. Integrity, confidentiality, and continuity are the key criteria for assessing whether you can rely on a system or not. A system loses integrity when manipulated. A system loses confidentiality when security is breached. A system loses continuity when there is a disruption of service.

As the dependency on computers increases, so does the need for cyber resilience. Resilience implies that key elements of Air and Space Power continue to function even under conditions of disruption. While NATO's secret Command and Control (C2) structure is decoupled from the internet and any components are thoroughly tested before they are introduced into the system, NATO's Air and Space posture as a whole cannot be assumed to be cyber resilient. NATO must do much more to ensure the availability of uninterrupted and sustainable Air and Space Power in the

event a cyber-attack and resultant computer failure degrades standard procedures for planning, tasking, and execution of air operations.

According to the Oxford Dictionary, cyber space is the notional environment in which communication over computer networks occurs.'[1] Cyber attacks, according to the same source, represent an attempt by hackers to damage or destroy a computer network or system.'[2] Cyber attacks, however, do not have to come through a network. They can be initiated by the insertion of a USB stick or by a preinstalled logic bomb that goes off at a certain time or as a result of pushing a specific key or sequence of keys. Cyber attacks could potentially manipulate missions, take over operations and stop whole systems from working. Cyber attacks against a society (critical infrastructure, chemical industries, etc.) can reach an extremely high level of disruption, destruction and casualties. Cyber attacks, if well executed by competent hackers that do not want to be identified, cannot be attributed to any person, group or country and consequently can scarcely be prevented and deterred. As such, cyber resilience must become a foundation of Air and Space Power. Military requirements must be developed accordingly. Cyber resilience is important for Air and Space Power regardless of policy choices on offensive cyber capabilities like Stuxnet[3].

While command authorities need to do what is reasonably possible to protect Air and Space Power from the full range of cyber threats, they must also assume that they will not always be successful. Accordingly, the ability to mitigate the consequences of successful or partially successful cyber attacks becomes essential. In terms of Air and Space Power, cyber resilience is about the ability to maintain or quickly restore at least minimum functionality even under the condition of a cyber attack, network failure or computer malfunction. Assuring cyber resilience will be an issue of growing importance to NATO's political and military leadership.

While not wholly neglecting the potential benefits and utility of the offensive use of cyber operations or the useful contribution of hacker attacks in support of military missions, this essay focusses primarily on the defensive side of the cyber dimension or, more accurately, on measures that mitigate the effects of opponents' offensive cyber operations. This essay argues for doing more to ensure that NATO's Air and Space Power capabilities remain available when needed – even under the condition of massive cyber disruption. In line with the overall objective of this JAPCC project, this essay examines the prerequisites from a cyber perspective for ensuring the availability of one's own Air and Space Power in support of the intended military and political objectives.

Many decision-makers do not fully understand the need for resilience, while many experts carry vested (e.g. economic) interests that are focused on bigger, faster computers, complex software, and networks. Resilience is almost never the issue. Furthermore, focusing on resilience and the ability to decouple systems from the internet and dedicated networks runs largely counter to the fashionable idea of network-centric warfare or net-enabled operations. While 'traditional' Air and Space Power approaches of central control and decentralized execution sound good and remain valid, one has to counter the trend to micromanage missions just because technology allows one to do it. There is a dangerous temptation to direct any aircraft from the cabinet or coalition table.

To ask decision makers which network to protect by which sort of firewall is as useful as building a wall around a medieval city after the invention of artillery – not to mention the tunnel under the wall, the second key for the gate, and the agent within the city who opens the door at night. Decision makers also need Air and Space Power options when even priority networks fail. The essay argues that the ability to decouple is essential for ensuring at least a minimum functioning of Air and Space Power under the assumption of major disruption of networks and systems by competent adversaries.

However, decoupling is not enough if the respective systems and subsystems are already corrupted or infected. Hence, secure hardware produced under national or trusted cooperative control is essential. Tested and verified software, personnel with security clearances, and a competent counterintelligence service are among the many prerequisites for inherently secure equipment and structures. Resilience is based on the realization that certain central computer systems will need to have a high degree of security and quality control built into the whole design and production chain.

Options for Dealing with the Cyber Challenge

Prevention

The proliferation and dissemination of technology, including the skill set to conduct cyber-attacks, is unstoppable. At the same time, militaries increasingly look to Commercial Of-The-Shelf (COTS) technology, mainly for economic reasons. Convenience as well as military interest in commercial innovation cycles also motivates the move to COTS. Militaries seem to have subscribed to the five economic trends (Sandro Gaycken) that dominate commercial mass market thinking, which are:

- reduce costs;
- increase efficiency;
- ensure user-friendliness;
- move toward standardization and interoperability; and
- outsource.

Questions of security usually remain unasked. Security is, potentially and in most cases *de facto* (however not necessarily so if done right), in a trade-off relationship with these and other fashionable business trends. Commercial mass-market suppliers do not, and indeed cannot, meet the

highest security standards that the military should (!) require. Militaries, however, have not always spelled out comprehensive cyber (hacker) hardening, much less cyber resilience as a military specification (the same applies to EMP hardening; the Electromagnetic Pulse, generated by a nuclear or a non-nuclear device that will destroy all non-EMP protected electronics).

Governments purchase hardware in countries that are known to sell hardware that contains mistakes that, in turn, can be exploited. Software is being programmed in countries where software engineers have never gone through a comprehensive security check by counterintelligence services. Hence, 'logic bombs' could already be in our systems and we have no easy way of finding them.

Software has become so complex (also because of customer demands) that the resulting tens, if not hundreds, of millions of lines of code can no longer be verified. Hence, human error becomes a problem similar to intentional manipulation. Statistically, mistakes happen and, in turn, represent potential zero-day exploits for hackers and, hence, opportunities to penetrate our systems. Moreover, the second oldest profession in the world (espionage) as well as disloyal personnel and corruption mean that 'sleepers' are likely to be in our organizations and able to corrupt our processes (the so-called 'threat from within'). Big software houses often employ thousands of programmers whose reliability and loyalty is doubtful – even when military projects are involved. The Critical Infrastructure of a country is, of course, even more vulnerable than the military. Opponents will seek asymmetrical advantages, studying Western dependencies and vulnerabilities, attempting to exploit Western weaknesses.

In sum, prevention of cyber attack is extremely difficult and in many cases not possible at all. Bad things, even devastating things, will happen;

it is only a question of time. Public health officials work on this basis. They prepare for diseases and pandemics, knowing that not all of them can be prevented. New immunizations are important, but so is consequence management which will be the key for cyber security as well.

Deterrence

Deterrence has often been offered as a way to prevention. For deterrence to work, it must be credible. Credibility is a product of the capability and the will to execute the counter-attack. This requires knowing who to deter and how to deter. The problem with cyber-attacks, if carried out by competent hackers, is that they can be done in a way that is impossible to track back with any degree of confidence to the true origin or source of attack. As mentioned above, the key problem is being unable to attribute an attack to a particular perpetrator.

But even if one could identify, with a certain degree of likelihood, the opponent, another problem remains: 'after detection what?' (Fred Charles Iklé) Of course, according to Clausewitz, war is a means of imposing your will upon your enemy and any attack, we assume, should serve a political purpose. The objective of war, however, must not necessarily be to force the opponent to accept certain conditions by pain infliction or by convincing him to re-calculate his risks; the objective could be to just slowly weaken him (e.g. economically). In this field, strategies of erosion can be highly granular and tailored. Hence, 'deterrence by punishment' does not seem to be a plausible option, but 'deterrence by denial' (also in the sense of resilience) could convince the other side not to try an attack because it would not lead to success. In sum, deterrence, at least if related to punishment, is unlikely to work – and might be impossible because of the uncertainties involved in who to punish (and how).

Resilience

Policies focusing on consequence and disaster management, emergency preparedness, continuity of functioning (degraded and minimum functioning), work-arounds, quick recovery, reducing dependencies on single-point failures, decentralization, and the atomisation of sub-units are essential for societies (or organizations) to survive under attack. This is, for instance, why decentralized agricultural societies are so hard to destroy with bombing campaigns alone. As they say: 'Fighting dogs are not only dangerous because they can bite, they are dangerous because one can beat them almost to death and they still bite.' It is because they can absorb strikes. How many strikes can our modern societies absorb?

Authorities need to plan for disruption and, hence, prepare against it by implementing those measures mentioned above. This involves, among many other things, structural and procedural issues as well as, and in particular, the right mind-set. This includes the empowerment of people for the purpose of decentralization, which is so important to reducing the impact of things that might happen no matter how much effort one puts into preventing or deterring them. This kind of resilience also strengthens the prospects for 'deterrence by denial.' Aware of robustness and resilience, opponents may refrain from investing in an attack in the first place.

The more dependent Air and Space Power is on the cyber domain, the more important it is to be able to operate (almost) without it – or to make it really secure. True resilience means being able to achieve the desired results in many different ways. Cyber resilience involves reliability through a mixed portfolio of operational capabilities at multiple levels of connectivity from fully networked to completely autonomous. Resilience is about being able to absorb expected and unexpected attacks (internal or external) by allowing for the pursuit of objectives at many levels on multiple scales. Resilience is about assuring mission execution.

It needs to be kept in mind that the network as such is only one potential transmission belt for attacks. Additional emphasis has to be given to make sure that the individual system is secure in the first place. Rigorous controls and security checks, transparency and measures to verify codes and procedures, and inherently secure hardware and software are all measures that need to be implemented rather quickly.

Resilience involves thinking about immanent security in a more rigorous and holistic manner, but also involves thinking about the built-in bureaucratic obstacles to organizing resiliency that need to be overcome. Vested interests that reject resiliency in favour of efficiency, profitability, or next year's budget remain a challenge. Few planners are asked to put security and resiliency first. Decision-makers often lack the interest in looking into long-term security considerations, as those things rarely look attractive publicly.

Cyber Security and Cyber Resilience for Air and Space Power

Since modern Air and Space Power is, as stated previously, largely dependent on computers and networks, and since almost all those are more or less vulnerable, the first and most logical consequence is to reduce avenues of attack. At the same time, while these measures are necessary, they are not in themselves sufficient to create cyber resilience. That said, equipment should be tested by military-grade red teams. Decision makers should be informed of outcomes instead of keeping the outcomes hidden. Political leaders should be encouraged to improve the hardening, robustness, and reliability of critical infrastructure. The military should require courses in cyber resilience, raising general awareness while also training – and retaining – expert IT operators. Just as army commanders need to understand the basics of air operations and air force commanders need to understand the basics of ground operations (and the same applies to naval officers and operations), so too must all commanders under-

stand that cyber resilience is a part of cyber operations. Cyber security and resilience should be a key staff college course.

Strategies for cyber security include prioritizing networks and computer-based operations, and identifying those essential to Air and Space Power missions. Core networks and systems must be given appropriate protection or alternatives must be found. The same goes for critical data and information. Processes must be understood in terms of locating potential weaknesses and mitigating their consequences. Counterintelligence procedures must be improved, reducing the likelihood that sleepers do not go undetected. Reducing dependence on too many single points of failures will mean taking a meta-perspective to ensure alternatives also in terms of types of technologies and processes. Resilience means a diversified portfolio, not more examples of the same equipment or programs.

Procurement policy must reflect the true cost of cyber vulnerability. Lowest price is not always the best, in particular if cyber security requirements are not a part of formal military specifications. Commercial off-the-shelf hardware will be particularly vulnerable to cyber intrusion and should not be used for essential functions despite the pleas of lobbyists. Complexity increases vulnerability, also by increasing the probability of programming errors that can be exploited before protection is available (zero-day exploits). Reducing the lines of code to a number that can be verified, enforcing correct and documented coding – or using a programming language that doesn't allow for buffer overflows or digital misunderstandings while enforcing documentation and abstraction – should be part of future procurement policy.

Companies involved in system integration need to assure full control of their entire hardware and software supply chains. This needs to be defined as a Military Specification (MilSpec) and funded appropriately. All involved personnel will need security checks and monitoring provisions – even if

expensive and unpopular. At the moment, to be quite frank, NATO countries neither have the products available (since never demanded by military specifications) nor are sufficient human resources available to meet this demand.

Resilience requires metrics to measure functionality and reliability in support of system design, decision making and technology investment. Resilience and dependability metrics are best tested and improved with highly empowered red-team units. In the end, individuals, effectively cooperating and capable of quickly learning and adapting, are as important as any technology. There will be a premium on interface awareness. Concepts of quarantine, familiar from the world of medicine, apply to networked computing as well.

NATO should define the highest possible standards for ensuring interoperability and protecting networks and see that they are comprehensively applied while establishing labs and methodologies for the measurement and testing of security efficiency and cyber risk. Tactical Evaluations must, more than today, include cyber security checks; red-team exercises must be part of ongoing cyber-security training and evaluation. NATO should employ the recently introduced, highly competent cyber emergency-response teams. NATO should also support the systematic study of offensive cyber operations for red-team development that goes beyond traditional electronic warfare. The NATO Cooperative Cyber Defence Centre of Excellence (NATO CCD COE) should give particular emphasis to cyber resilience as a key doctrinal concept.

In the end, comprehensive and complete protection is impossible. All measures aimed at reducing vulnerability are of limited value if not accompanied by a major effort to enhance cyber resilience. Resilience is about the ability to maintain, or quickly restore, at least a minimum functioning of Air and Space Power, even under the condition of com-

petent, specifically targeted or comprehensive, and well-executed cyber attack, even during attempts at strategic disruption and/or taking over our systems.

Cyber Resilience and the Need for Autonomy

'Central control' remains essential to effective, efficient employment of Air and Space Power. In the cyber age, however, central control is potentially a major vulnerability if the network is not either decoupled from the internet (as the NATO secret-level network is) or built completely secure. The very idea of an open network made sense when the threat was nuclear decapitation and the destruction of many relay stations (which made the option to re-route a way to maintain control). The same networks make less sense in a 'responsibility-to-share' environment, in which open architecture can enable malicious code to nearly instantaneously infect all the users of an entire network.

True cyber resilience requires that at least some essential networks are decoupled from the Internet and that some systems and networks have reliable stand-alone capability. Decentralization and autonomy for units and sub-units becomes essential when the networks – of whatever size – are the source of the threat. Some networks work without a technical, physical network. One can be networked by ideas (or ideology), by good training and common procedures. Franchising organizations, like Al Qaida 'network' without necessarily being networked in a technical sense – despite their ability to use all modern networks and communication equipment.

Security in the cyber age challenges conventional wisdom and traditional business practices. Networked forces function well under benign circumstances, which require that opponents are either incompetent or cooperative or both. Aware of NATO reliance on networked operations, opponents will try to deny, disrupt or corrupt the data and computing power of the

network. Air and Space Power planners must account for this possibility and compensate accordingly. There will be a premium on the ability to execute air operations in a true multi-spectrum stealth mode and without dependence on networked computing and data exchange.

A centralized process for planning air campaigns and disseminating mission orders is always preferable, but not imminently guaranteed. The more dependent NATO is on centralized planning and command, the more important it will be to have contingency options for greater delegation and empowerment of operational units within the context of an overall campaign plan. There will be a premium on air assets that can maximize autonomous freedom of operation while continuing to pursue overarching mission objectives. The trend to network all forces and assets runs counter to this trend, if the network and the individual system or platform are not secure.

Revolutionary developments in information technology enable greater centralized control of military operations. Political leaders and military authorities have avidly sought greater centralization. This trend needs to be balanced by a more focused effort on endowing Air and Space Power with the capacity to operate under greater autonomy and less direct centralized control. Air operations will need to take place of at various levels of connectivity and computing power. Technologies like on-board computing and data storage (detailed 3-D model of the world), inertial and optical guidance, and passive radar will grow in importance. So will new kinds of decision-making authority and command organization. Air operations could well come to look a bit (and only a bit!) like submarine or special forces operations in regard to stealth, network autonomy and operations in total radio silence. There will be value in segmenting and fragmenting certain forces.

This is not to ignore the importance of computers and networks to current air and space operations; it is simply to say that this dependence is a vulnerability that requires more serious thinking, in particular about opera-

tions under conditions of degraded computers and networks. In the future, having the ability for truly decentralized, autonomous mission execution might make the difference between having Air and Space Power and not having it at all.

Monitoring centres that are able to detect an attack against an, or the corruption of, a system or network as early as possible are very important. It is always good to know when you are under attack. Monitoring, however, does not solve the basic problem outlined here, which is to be able to act even if and when under attack.

Cyber attacks are a serious threat to Air and Space Power. Cyber defences designed to protect against attack are necessary but not sufficient. If true resilience in the cyber age is to be achieved, established assumptions that have been central to Air and Space Power for decades must be seriously reconsidered. Organizations and systems must be able to fulfill their most import functions even when under serious cyber attack. The cyber domain can be an enabler, but undue dependence can make the cyber domain a dangerous disabler. Looking into the future, the more dependent Air and Space Power is on computers and networks, the more important it will be to have some residual capacity to function, at least to some useful extent, without them. Without action to increase cyber resilience and reliability, investment in network operations and cyber security will be misallocated. Assets invested now can assure that, even under conditions of network and computer failure, the Air and Space Power of NATO members will still have residual functionality.

Key Recommendations

- Achieving cyber resilience requires top leadership attention. Leadership attention must no longer only focus on higher, faster, further. It must also focus on secure, reliable, and effective – even under conditions of major disruption.

67

- Planners should address cyber resilience by recognizing that at least some essential networks should be decoupled from the Internet, just as NATO's secret network is, and that more systems and networks should have stand-alone capability. Once the problem is properly conceptualized, the proper military requirements and specifications will need to be written.
- Technologies in support of resilience should be much better funded, including on-board computing and data storage (detailed 3-D model of the world), inertial and optical guidance, and passive radar.
- As important as the question of networked and autonomous forces is the issue of the security of individual systems. Reliability controls for hardware and software supply-chains should be more stringent; production design should reflect the need for built-in cyber resilience. There will be a premium on effective vetting of essential personnel. Specifications need to be drafted accordingly; suppliers need to be security-checked and controlled to ensure they apply the highest standards of security and robustness in everything they do. All these requirements need to be militarily specified and adequately funded.
- Planners should develop operational concepts for executing air operations in a true multi-spectrum stealth mode and without dependence on networked computing and data exchange. In all relevant areas, red teams should be employed to unveil weak points that need to be addressed.
- NATO's Cooperative Cyber Defence Centre of Excellence in Tallinn, Estonia, should be tasked to analyse in depth the issue of cyber resilience, including procedural and secure supply chain aspects. Monitoring, defence, offense, redundancies, all this is important, but resilience is something else…
- Air and Space Power planners should prepare for the loss of satellites by expanding the capacity for emergency launch of replacement satellites or other alternatives.

Endnotes

1. See: http://www.oxforddictionaries.com/us/definition/american_english/cyberspace
2. See: http://www.oxforddictionaries.com/us/definition/american_english/cyberattack?q=cyber+attack
3. Stuxnet is an advanced computer virus that targets systems running specific software and hardware. It is thought to have been designed to target Iranian nuclear enrichment equipment, as the great proportion of computers infected were in Iran.

Air and Space Power Command and Control in NATO

IV

More Than Just a Technical Issue

By Lieutenant General (ret.) Ralph J. Jodice and
Lieutenant General (ret.) Friedrich W. Ploeger

T*he effective application of Air and Space Power requires modern, agile and responsive Command and Control (C2) which is mainly dependent on dedicated, trained and skilled personnel, an effective and efficient organization, and robust C2-Systems support. Air C2 in NATO's Command Structure (NCS) has been reduced to a level incompatible with the requirements of its Level of Ambition (LoA). Key to a solution is the availability of trained operators in sufficient numbers in the NCS and in the nations which make up the NATO Force Structure (NFS), making the teaming with capable national Joint Force Air Component (JFAC) staffs an inevitable prerequisite. The quick realization of modern, interoperable C2-systems is a further must to improving NATO's Air C2. The issues presented by the essential enabling cyber and space domains need to be addressed both doctrinally and operationally.*

Introduction

Since its inception, NATO has been an Air Power (and Sea Power) Alliance. Air Power provided the Alliance with the operational edge it needed during the Cold War to be able to cope with an adversary who had an arsenal of forces outnumbering NATO's Forces by three to four times. That ratio

existed for air forces also, but was compensated for by superior doctrine, superb equipment, excellent training and skilled leadership executed through a well-developed, multi-layered command and control system, thereby characterizing this key pillar of the Alliance's deterrent.

As it is a defensive Alliance and vis-à-vis the threat from the overwhelming forces of the Warsaw Pact, command and control for NATO's Air Defence at the tactical level was more advanced, with an integrated system of sensors, operation centres, and weapon systems, whereas offensive forces were primarily procedurally controlled and coordinated with the air defence. This deficit was recognized in the 1970s and ideas of how to overcome it were developed under the Air Command and Control System (ACCS) program. ACCS was a program which described structures, organization and functionalities of an effective and all-encompassing integrated Air C2 system for tactical air operations.

Realization of the program, however, was delayed due to various factors, leaving NATO waiting to see ACCS in operation. Therefore, NATO Nations decided to develop some of the structural elements earlier, and, in the beginning of the nineties, tactical command and control of offensive and defensive air were fused in Combined Air Operation Centres (CAOCs). It took even longer to develop the doctrine, the training and the systems for better air and surface integration, which was perfected in Afghanistan in support of OPERATION ENDURING FREEDOM (OEF) and the International Security Assistance Force (ISAF)

Since the end of the Cold War, NATO has undertaken two air operations in the Western Balkans which created the conditions for the ensuing peace support operation: OPERATION DELIBERATE FORCE in 1995, preceding the Dayton Peace Agreement and IFOR/SFOR, and OPERATION ALLIED FORCE in 1999, preceding KFOR. Both operations were run by an especially set up CAOC at Vicenza (Italy). Command and control for ISAF-Air is executed by

the USA-CAOC at Qatar. Therefore, one can say OPERATION UNIFIED PROTECTOR (OUP) was basically the first NATO operation completely commanded through the NCS under the lead of JFC Naples (Italy). Air Command Izmir (Turkey), with its CAOC at Poggio Renatico (Italy), ran the Air Component while the Maritime Component was led by Maritime Command Naples. From the beginning, this Operation revealed the weaknesses of NATO's Air C2 structure.

Analyzing the most recent NATO Air Operation from the Air C2 perspective, this essay will assess NATO's current Air and Space Power Command and Control (Air C2) capability. It will also determine if NATO still has the comparative edge and if the Alliance can meet the requirements of its current LoA. Recommendations are developed suggesting ways how to mitigate shortfalls in order to re-establish and maintain the agile and flexible Air C2 the Alliance needs.

In order to better understand the processes of Air C2 in operations, the following diagram illustrates schematically the interaction between the divisions inside an Air Component and higher level headquarters. Until the recent changes in the NCS, NATO's Air C2 doctrine suggested a distribution of C2 responsibilities inside the Air C2 structure: Command functions executed by the Air Command, and Control functions executed by geographically separated Memorandum of Understanding (MoU) CAOCs following the command guidance of the Air Operations Directive (AOD) by the parent Air Command. In Air C2, the operational and the tactical level of command are connected; in a JFAC with embedded AOC they are integrated.

Air Command Ramstein had already adopted the widely accepted 'Joint Force Air Component (JFAC) with embedded Air Operations Centre (AOC)' construct. Ramstein relied on personnel from the MoU CAOCs Finderup and Uedem to man the AOC floor.
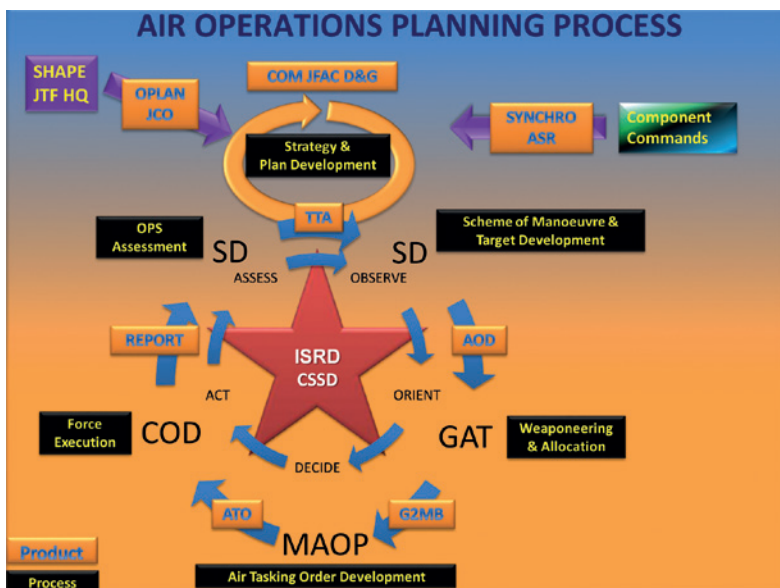
The planning cycle begins 48 hours before execution. Therefore, there are always three planning cycles running concurrently. So if it is day 5 of the operation then the Combat Operations Division (COD) is executing day 5 while the strategic planners are assessing day 4 and feeding information to the combat planners to adjust the Air Tasking Order (ATO) for day 6 at the same time that those are piecing together day 7. This is why so many people are required to run a JFAC around the clock.

OPERATION UNIFIED PROTECTOR (OUP) – A Smaller Joint Operation Air Heavy from the Air C2 Perspective

Background

In early February 2011, the people of Libya saw what was occurring in Egypt and Tunisia. The fervor of the Arab Spring was appealing. Libyans

were tired of the heavy hand and dictatorship of Gaddafi. They wanted freedom. Clashes started to occur between the Libyan civilians and the conventional military forces of Gaddafi. Confrontations became more violent with Gaddafi and his military forces attacking the civilian population. The international community demanded Gaddafi to stop his aggressive actions. However, the Libyan ruler continued to oppress the civilian population using his regular military ground and air forces. By the end of February 2011, some nations even called for a No-Fly-Zone. Discussions occurred in the international community about NATO possibly playing a role to help stop the deteriorating situation. On 28 February 2011, United Nations Security Council Resolution (UNSCR) 1970 went into effect, imposing sanctions on Libya and Gaddafi. During the first two weeks of March, the situation continued to deteriorate while a coalition started to form for potential military action. On 17 March 2011, UNSCR 1973 went into effect as the legal mandate to protect civilians. Two days later on 19 March, OPERATION ODYSSEY DAWN (OOD) started. This coalition, led by the United States with France and the United Kingdom close behind, also included other NATO nations acting as an independent coalition of nations, not as the Alliance.

A few days later, NATO agreed to participate in the arms embargo mission. This was rapidly followed by NATO agreement to eventually take on the No-Fly-Zone mission, too. However, political consensus by all 28 nations concerning the civilian protect mission, and how to conduct such a mission, had not yet been achieved. Not until around 24 March 2011 was consensus reached. Finally, NATO agreed to monitor the arms embargo, enforce the No-Fly-Zone, protect civilians and to take over OOD. The handover was originally planned for 30 March. However, that slipped one day, with NATO starting OUP on 31 March 2011.

This short summary is important because it demonstrates the challenges a quickly deteriorating situation can present and how quickly the Alliance

can be called upon to act. It all boiled down to days and weeks. Once final consensus was met, there were only days to finish planning and to stand up OUP. Now, imagine if this was an Article 5 operation: Consensus criteria must still be met. However, Alliance and treaty obligations to all 28 members would dictate an even quicker response. This all points to the importance of having a proven, rapidly adaptable, agile, and even deployable Air C2 structure already in place for the Alliance.

Transition Plans Are Important

As the Alliance reached consensus, the Combined Forces Air Component (CFAC) at Air Command Izmir, Turkey recognized the requirement to develop an Air C2 transition plan. This Concept of Operations (CONOPS) needed to ensure all the functions being accomplished by the OOD JFAC at Ramstein Air Base, Germany, were successfully transitioned to the OUP CFAC planned to be at Izmir. In order to have a smooth, seamless transition from one Air C2 entity to another, there needed to be a well-thought-out plan. However, there were only 6 days in which to develop and execute such a plan. That Air C2 transition CONOPS needed to address all the guidance products: the airspace control plan, Special Instructions (SPINs), AOD and ATO production, the Master Air Operations Plan (MAOP), Battle Damage Assessment (BDA), strategic plans and overall execution, just to name a few. The units executing the day-to-day missions were going to be essentially the same. A few additional NATO nations and partner nations eventually joined OUP. The main operational change was who commanded the operation and the Air C2 structure in use. By the actual transition date of 31 March, most of those units had been flying together for 12 days.

During that time period, SACEUR requested the CFAC to fly more NATO AWACS missions under the OPERATION ACTIVE ENDEAVOR (OAE) plan aimed at monitoring the Libya situation and gaining valuable situational

awareness of OOD's execution. This was easier said than done. It required a unique arrangement between the OOD JFAC and AC Izmir. Air and Space Power doctrine calls for a single Joint Forces Air Component Commander (JFACC), with centralized control and decentralized execution. The requirement to fly NATO's Airborne Early Warning and Control (NAEW) under operational control of a NATO Commander in the middle of the OOD coalition's JFAC's airspace flew in the face of Air Power doctrine. However, SACEUR said 'go do' and a viable C2 arrangement had to be developed. The OOD JFAC and AC Izmir developed a plan centred on primacy. This dictated the OOD JFACC had primary responsibility inside the Joint Operations Area (JOA) and, if required, could tell NATO assigned assets to depart the airspace. This arrangement lasted until NATO took responsibility for the JOA on 31 March 2011.

The transition plan proved to be extremely valuable for the OUP CFAC and the OOD JFAC. By developing a CONOPS, both entities forced themselves to think through all the permutations, potential show-stoppers, pitfalls, challenges, and successes. AC Izmir identified a few Air C2 experts and sent them to Ramstein to observe their operation. Daily VTCs were conducted between the OOD JFAC and AC Izmir. The development of stoplight style charts allowed both Air Components to see the progress as AC Izmir developed processes. Timelines initially had AC Izmir monitoring and shadowing OOD JFAC functions. Then, AC Izmir would take the lead through the transition date with OOD shadowing AC Izmir after the transition. One thing AC Izmir wanted was backup. What would have happened if NATO fell flat on its face after the transition for whatever reason, and the coalition had to take the lead again? Those challenges were real, requiring an agile approach to Air C2 founded in Air Power doctrine yet flexible enough to adjust in a dynamic environment.

Air C2 entities will not always transition from one Air Component to another one under a different Joint Task Force Commander as discussed

above. However, the dynamics of any current or future operation will be fast paced, requiring the Air Component to rapidly move from one phase to another. In many operations, the Air Component tends to be the supporting commander. However, with the reluctance to put 'boots on the ground', Air Components will find themselves more and more being the supported commander. In either case, supporting or supported, agile, flexible Air C2 will be required.

Air C2 in Single-Digit Seconds

For OUP, the plan was for the Commander and his key-long term planning and advisory team (strategy, targeting, AOD, LEGAD, POLAD, and PAO) to be at AC Izmir. ATO production and execution was to be done by the AOC which was carved out of the CAOC at Poggio Renatico and to remain there. Some entities of the Air Component would be in Izmir, and some entities would be at Poggio Renatico.

The air operations team at Izmir would provide the situational awareness to the Commander by close coordination with the AOC while the AOC was to reach back to AC Izmir for guidance and coordination. There was confidence this would work because this is how it was done during all of AC Izmir's NATO Response Force (NRF) training, exercises and certifications. The fallacy was all those exercises and the NRF certifications were based on a Humanitarian Assistance/Disaster Relief (HA/DR) scenario, not on a full-up kinetic operation. As the last days of March 2011 occurred, it became clearer what was required of the OOD JFAC organization and its Commander and what would be required of the OUP CFAC organization and it is Commander. Concerns developed about the C2 structure, its geographic separation and the overall ability to execute the C2 required in a rapidly changing, dynamic kinetic operation. Operating from two geographic locations led to a lack of the overall situation awareness required for the Commander and his staff to make timely and accurate decisions.

Therefore, the decision was made to consolidate all CFAC operations in one location at Poggio Renatico.

A JFAC/CFAC organization operates at the operational level of war. However, there are elements of it, which operate at the tactical level while others span both the operational and tactical levels of war. For example, the units flying the missions are at the tactical level of war while certain divisions within the CFAC (e.g. Combat Plans and Combat Operations) span both the operational and tactical levels of war. Therefore, the Air Commander and his HQ have to be able to connect strategy to task and task back to strategy, at times in single digit seconds. Today's operations demand it. The flow of information and the means to deliver that information is in real time, and it comes in from multiple directions. The CFAC organization has to be able to interpret the strategic guidance issued by the JTF Commander and translate it into an AOD. Within the Air Component HQ, that AOD is developed by the strategy division in close consultation with the Air Commander, providing detailed direction and guidance. That AOD is then interpreted by the Combat Plans Division (CPD) which develops and produces the ATO. The COD within the AOC executes the ATO. Once executed the Information, Surveillance and Reconnaissance (ISR) Division does BDA. That assessment is interpreted within the larger CFAC, and the AOD adjusted as required. The assessment is also fed back to the JTF allowing that staff and the JTF Commander to make adjustments to the strategy. This all feeds into the Joint Coordination Board (JCB) process led by the JTF.

Personal Engagement by the Air Commander Matters

As was seen in the opening days of OUP, the Air Component, and specifically the Air Commander, cannot execute properly as a CFAC and CFACC when conducting split operations. The entire organization needs to be together. It does not matter the location. What does matter at the location

is does it have all the C2, CIS, communication lines, equipment and work spaces required for today's fast-paced and dynamic operations? Once at Poggio Renatico, and especially during those first two weeks of OUP, the Commander spent a lot of time on the AOC floor, at the tactical level most of that time. However, the AC Commander needed that time to fully understand the dynamics of what was taking place over Libya and what was taking place on the AOC floor. The Commander needed to ensure processes were being developed to address the Air Components needs. The Air Commander needed the personal interaction with the planners to provide operational level direction and guidance which they could then translate into tactical action. At the same time, the planners needed direct contact with the Commander, advising him on what was feasible and not feasible and testing innovative ideas in the employment of limited air assets across the full spectrum of Air Power operations. The Commander needed to be able to talk with the CJTF/Commander at the strategic level, detailing what was working and not working at the operational and tactical levels. Concurrently, the CJTF/Commander had to tell the Air Commander what adjustments were required to meet the strategic end state as defined by the NATO Council. As time went on and the CFAC's processes and Tactics Techniques and Procedures (TTPs) matured, the CFACC spent less and less time on the AOC floor. Instead, the CFACC was thinking and acting at the operational and strategic levels like an Air Commander should. However, those occasional walks onto the AOC floor and face-to-face discussions with planners in their offices and during meetings proved invaluable, not only to the CFACC, but to the planners, too. The key lesson is that it does not make any difference where the CFAC team is, as long as the entire team is together. Air Commanders should become very nervous when they hear 'that will be done via reach-back'. So how is such an agile Air C2 structure built? First, start with a proven organizational model which can be adapted for any potential operation be it Humanitarian Assistance/Disaster Relief or full-up kinetic. That Air C2 organization has to have established processes which can

work in a 'plug and play' format and it must know where the people required to execute those process will come from. It must know those people are trained and ready.

Lack of Trained and Ready Airmen

Nearing the start of OUP and during those first few days of execution, one of the Air Component's primary challenges was putting the right personnel in the right seats. An Air Component requires an Air Power expert appropriately trained and ready for that particular task / function to sit in that right chair within the CFAC organization. A major issue at the OUP CFAC was a lack of appropriately trained and ready Airmen in many of the CFAC positions. Part of the reason the Air Component lacked the right people was the nations did not want to give some of them up. Another reason was that the Alliance failed to identify and train the people required for those particular functions. As discussed previously, the run-up to OUP happened fast. Literally, it occurred within weeks.

In the preparation for any operation, the Joint Task Force must conduct an Intelligence Preparation of the Operational Environment (IPOE). This IPOE allows the entire joint team to study the adversary, examine the political guidance, and assess how the JTF and its components must be structured and prepared to execute the mission. In the case of OUP, Libya had not been a concern for many years. Therefore, trained and ready Airmen who understood the dynamics of Gaddafi and of Libya were nonexistent. Consequently, the IPOE for the OUP CFAC occurred during the first 3 months of OUP. During the months of April, May and June, the CFAC was determining just what could be accomplished based on the mission and guidance given while determining what the pro- and anti-Gaddafi forces were capable of doing. The Air Component was putting the right person in the seat, and if not the right person, the person was trained to become the right person. Within the CFAC, processes (TTPs)

were being developed and adjusted to fit into the mission set which had to be executed. All this occurred while conducting the mission set of monitoring the arms embargo, enforcing the No-Fly-Zone and protecting civilians from attack or the threat of attack by belligerent actors.

Deliberate and Dynamic Targeting

Deliberate targeting requires a large amount of ISR. Many recent operations (not OUP) relied on space based assets to provide the majority of that ISR. However, in the case of OUP, the CFAC did not have space based assets available and therefore had a heavy reliance on national air breathing platforms assigned to the CFAC. The nations that owned those platforms at times were reluctant to release information to all the nations, including the non-NATO partners. This resulted in nations throwing down 'red cards' indicating they were not willing to take a target because that nation did not know how or why the target had been selected and developed. However, when conducting alliance operations, all nations need to know from where the information is coming and how targets are being developed. During OUP, once those CFAC processes matured, the Air Component was able to develop target sets on its own and share that intelligence information and target development with the nations from square one, those 'red cards' became 'green cards' and nations were much more willing to engage even the toughest and most contentious targets.

Without organic NATO targeting production capability, the CFAC had to again rely on a certain few nations. This placed increased burden on those nations and made some of the other nations feel like they were 'not in the club.' An insufficient number of trained analysts meant the CFAC could not complete BDA beyond Phase 1. This lead to unnecessary restrikes, inefficient target development and a lack of ability to adequately portray exactly what the CFAC accomplished. Thorough assessments are a must for an efficient and successful operation.

On the dynamic targeting side, pro-Gaddafi forces were able to quickly adapt from OOD to OUP. They changed their tactics knowing the political and military limits of NATO along with public perceptions. The use of civilian vehicles and urban cover (mosques, hospitals, schools, etc.) all presented challenges to the CFAC.

For dynamic targeting, Remotely Piloted Aircraft (RPA) with Full Motion Video (FMV) were of low density but of high demand. RPAs were critical for battle-space situational awareness. RPAs were a force multiplier, providing 'buddy laser' first run attack options, Search and Rescue (SAR) on-scene Commander (never required but trained and exercised), and most importantly, in the Strike Control and Reconnaissance Command (SCAR-C) role.

Finally, the dynamic targeting environment had to adapt as the situation on the ground changed. But one thing which did not change was the CFAC's process to strike a dynamic target. The sequence of: Positive Identification (PID) of a target; does it comply with the Rules of Engagement (ROE); what is the Collateral Damage Estimate (CDE); who is the engagement authority; does it have national approval; and finally, engaging the target had to be strictly followed every time. Sometimes, the OUP CFAC did this in single digit minutes. Sometimes it took hours. What is important here is the process and working through that process in a logical sequence each and every time.

Major Air C2 Lessons Identified

The previous paragraphs identified some of the challenges and lessons learned. In the following paragraphs the 6 primary lessons identified by the OUP CFAC to the CJTF will be discussed. More than a few of these lessons are timeless. They have been seen before. They will be seen again. However, as stated above, more often than not, the Alliance will not have the luxury of months for preparation. NATO's Air C2 must be correctly

structured today in order to execute the operation the Alliance needs its Airmen to conduct tomorrow.

- NRF Preparation & CIS – The NRF preparation and certification process did not effectively train the CFAC for a Smaller Joint Operation (SJO) Air Heavy kinetic operation. Focus on HA/DR or peace support operations did not readily translate to the mission, especially the civilian protect mission. The Communication and Information Systems (CIS) infrastructure was lacking and required an all-out effort throughout the entire operation to maintain. CIS connectivity was difficult to establish and maintain not only among the allies, but also with the partner nations.
- ISR Division – The CFAC was initially unable to stand-up an ISR Division (ISRD) competent in executing the Intelligence Production/Exploitation/Dissemination (PED) process and supporting the ATO cycle in a dynamic kinetic operation. There was a lack of trained leadership at the mid-to-upper levels in the ISRD. Only two nations were able to fill the division chief position. After only a few days, it was very evident there was a lack of trained and experienced targeteers and analysts. Only one country had significantly experienced targeteers and analysts. Nearly all of those individuals were not available. The CFAC attempted to do some of that work via reach back. However, not having trained and ready NATO Airmen for that role created a big challenge for the CFAC.
- Manning Requirements – Across the board, the NATO nations did not provide sufficient and sufficiently trained personnel to fill CFAC manning requirements. The personnel who came from the NCS at AC Izmir, AC Ramstein, and NATO CAOCs were well trained. However, the CFAC required additional manning from the NFS; i.e. from the nations. Those personnel were difficult to obtain. When a nation did provide from their NFS, many times those individuals, although very hard working and dedicated, where not sufficiently trained for operating in a NATO operation. Consequently, on the job training was required for many positions while simultaneously conducting kinetic operations. Finally, whether

from the NCS or NFS, national caveats, especially concerning length of stay / deployment, adversely effected stability and continuity.

- Critical Enablers – Critical enablers were essential to the success of OUP. Many believe critical enablers only come in the form of capability such as SEAD, EW, AAR and ISR. However, critical enablers also come in the form of capacity. AAR is both a capability and a capacity. For example, more than a few NATO nations have AAR capability. However, the United States was the only nation which could provide the capacity (nearly 70% of all OUP AAR sorties) required even for this SJO. Precision Guided Munitions (PGM) are another example of a critical enabler in the form of capacity. Again, the US was the only nation capable of providing those PGMs at the numbers required; especially when 100% of the munitions dropped from fix winged aircraft during OUP were PGM. ISR is no longer an enabler but a driver. This does not mean ISR drives the CJTF to a target. However, ISR is required for nearly everything required of a CFAC. Finally, NATO's Response Force Unit Roster (the Combined Joint Statement of Requirements (CJSOR)) should be capabilities-based and not quantity based. For the Air Component, this means the CJSOR must specify the sortie rates required, and not just a simple number of certain types of aircraft for a certain type of mission.

- National Elements and Liaison Officers (LNOs) – Integration into the CFAC of national elements, LNOs and National Intelligence Centres (NICs) was absolutely critical to success. Since the nations were not willing to place sufficient people into the NCS of the CFAC, the CFAC had to rely on over 220 personnel in their national hats to achieve success. Those personnel were integrated into the CFAC as if they were part of the NCS. The CFAC's overall numbers of LNOs, people from national elements and assigned CFAC personnel totaled approximately 500. Therefore, for the next SJO Air Heavy operation NATO should have a minimum of 500 trained and ready personnel in the NCS, and far more when considering the requirements of concurrent operations or for a Major Joint Operation (MJO).

- Non-Kinetic – The CFAC did not have the required expertise to generate and / or assess non-kinetic effects. In any future operation, non-kinetics will play just as an important role as kinetics, and at times, non-kinetics must be more important. However, what is really important is the synchronization of non-kinetics and kinetics. Even though much of the non-kinetic planning is conducted at the JTF level, the components must have sufficient expertise at their level to do some planning, generation and then assessment of their own non-kinetic operations.

People

The OUP CFAC was successful for one simple reason … people! Challenges such as: operating from insufficient facilities; a quick response with minimum planning time; lack of guidance; neither enough nor fully trained people; lack of assets; national caveats; and no ground Component Commander, just to name a few, prevailed throughout the entire operation. However, the people at the CFAC were dedicated to the mission, committed to excellence, innovative, and supported one another. An Air Component can have the newest facilities and all the latest in technology, but in the end, it is the people who make the difference. The CFAC OUP people did make the difference.

Air C2 in NATO Today – An Assessment

Air C2 for operations as described in NATO's LoA is covered by the HQs of the NCS and Air C2 elements provided by some nations inside the NFS. Most of the NFS JFACs, however, are not readily available and only consist of a core element – about 10% to 20% of a 'medium size standard JFAC' – requiring massive augmentation and making them available for operation only after a longer lead time. Only the USA disposes of a standing AOC with each numbered Air Force (603rd AOC with 3rd Air Force at Ramstein) and can be considered as having a readily available Air C2 capability. Ger-

many beefed up the manning for its AOC to about 50% and thus reduced its reliance on augmentation. NFS JFACs are the primary NRF Air C2 elements and rotate into higher readiness according to the agreed NRF rotation plan.

The following assessment will focus on the NCS Air C2 organization. It is the commonly owned capability that is readily available for flexible reaction to a crisis affecting NATO in and around Europe. Furthermore, NATO's Air C2 organization is the only portion of the whole NCS that has Peacetime Standing Tasks: Safeguarding the integrity of NATO Airspace by Air Policing and – since the Lisbon Summit 2010 – Ballistic Missile Defence of NATO European Territory, Population and Forces. In performing these missions Allied Air Command (AIRCOM), Ramstein is directly reporting to the Supreme Allied Commander Europe (SACEUR).

At this Summit, with the changed security environment of that time in mind, NATO's Heads of State and Government also decided the New NCS – a flat and much leaner structure with SACEUR disposing of two Joint Force Commands, a MARCOM, and an AIRCOM with two CAOCs and a deployable CRC (the 'DARS'), comprising a total manpower of 900 posts for Air C2. It was also envisioned that both NAEW and AGS should become subordinate to the new single Air Command HQ. The Summit, however, did not decide about the footprint (the locations of the HQs). They left it for the Secretary General to propose and Defence Ministers to decide. As part of his footprint proposal, the Secretary General introduced a LANDCOM as an additional element, partly to achieve acceptance of his proposal. The footprint decision was taken while OUP was running at full speed and the major deficits in NATO's (former) Air C2 structure had become evident. These were: a doctrinal flaw, a capacity (manpower) problem, a training issue and systems interoperability problems. Some of them were addressed in the footprint decision.

Manpower

The manpower ceiling for Air C2 was raised by 250 to 1150 comprising the AIRCOM at Ramstein (500), two CAOCs (Uedem and Torrejon, at 185 each) and a new element that did not exist before, the Deployable Air Command and Control Centre (DACCC) at Poggio Renatico (280). The static elements of the CAOCs, the Standing Air Defence Centres (SADCs), are to execute the Air Policing Mission under the Command of AIRCOM. Their AOC-elements are supposed to man the Combat Plans and Combat Operations Division in a Ramstein JFAC. AIRCOM Ramstein is structured in a 'hybrid' way to enable it to accomplish the staff functions needed to support the Commander in his Air Advisor Role, to execute the standing peacetime tasks, i.e. the Ballistic Missile Defence Mission and supervising the CAOCs executing the Air Policing Mission, and to be able to rapidly stand up a JFAC organization whenever called upon. In the JFAC structure, AIRCOM Ramstein mainly mans the ISR-, Strat-/GAT- and support divisions. Looking at the manning requirements for a robust kinetic 'Smaller Joint Operation – Air Heavy JFAC' which was used as the design benchmark, this new structure generates just enough manpower to execute operations. However, critical shortages remain for the ISR division and some other specialties, e.g. Air-to-Air Refueling. From this perspective, it is questionable whether putting all Intelligence PED-functions into NATO's Air-Ground-Surveillance wing at Sigonella is helpful to close the ISR-capability gap in Air C2.

Deficits also continue to exist in AIRCOM's Space and Cyber expertise. Although those two domains are considered to be essential enabling domains, AIRCOM does not have the personnel billets required to advise the Commander about space and/ or Cyber issues unless those functions are picked up voluntarily by a nation (most probably USA).

Meeting sustainability requirements and filling the joint functions are further issues. It is evident therefore, that although NCS Air C2 was

beefed up by 250 personnel, its capacities and capabilities are still not enough to meet the challenges of NATO's LoA in concurrent operations or in a MJO which appears to be less a remote planning factor now after the Ukrainian Crisis.

Training and Exercises

A three-level training concept was developed to generate the required qualified personnel: All operator personnel of NATO's Air C2 structure receive their initial functional training at the DACCC in Poggio Renatico. They will then conduct team training in their home organizations, i.e. the AOCs of the CAOCs/ DACCC and at AIRCOM. Exercises in a fully developed JFAC-structure at Ramstein are supposed to top the training off and validate the whole system. In addition, a new training and reinforcement relationship has to be established with the nationally provided JFAC structures in order to get access to a wider pool of personnel able to fill specialists' billets, and certainly for sustainability. Currently, France, Germany, Italy, and the United Kingdom offer national JFACs for Air C2 in the NRF unit roster (CJSOR). Spain and Turkey are intending to offer similar capabilities to NATO in the near future. To transform the JFAC into a 'Joint Task Force (JTF)-Air HQ' and to fill the joint functions during an 'SJO-Air Heavy,' liaison with other command structure HQs is an obvious precondition. NATO's training and exercise schedules and priorities, however, do not reflect this variety of challenges that is unique for the single service commands in the new NCS.

NATO's exercise scenarios also lack the kinetic challenge a JFAC must receive to hone all its divisions to wartime perfection. For several years stabilization missions had been the focus of Alliance exercises. As discussed with the lessons learned from OUP, those exercises left a misleading impression concerning the capabilities of the NATO Command structure. Although a new scenario was developed to better reflect an Art. 5 situation,

it is still not giving AIRCOM the required kinetic challenge, though exercise fidelity has steadily improved since the end of OUP. A major effort is needed to include the elements which are necessary to fully train AIRCOM's JFAC Structure in a challenging kinetic scenario, including the ISR division and the joint targeting processes.

Doctrine

Although Defence Ministers acknowledged that the former NATO Air C2 Concept, with its distributed command and control, had to be corrected and an integrated JFAC structure with an embedded AOC was to be adopted to cope with the demands of a complex and highly kinetic air operation, nations still attach importance to a 'stand-alone' role of the CAOCs and the DACCC. AIRCOM Ramstein played this notion down in the Air C2 CONOPS, but it is still an open issue, as is the question of 'deployability'. Because connectivity is key to successful command and control, AIRCOM Ramstein intends to fight from its garrison location. Ramstein's infrastructure, however, needs major adaptation to better accommodate an SJO-JFAC. Deployable elements (and CIS) are primarily required for Ramstein's liaison at the JFC's location. One set of deployable C2-equipment (ACCS) is located at the DACCC in Poggio Renatico. Further equipment (tents etc.) is stored as CP 156 in Southern Italy. There is, however, only a single kit available for all deployable NATO Command Structure entities. The deployability requirement continues to exist for the NFS JFACs, which are NATO's primary option if expeditionary operations require a deployable JFAC. However, their availability is limited to their NRF stand-by periods.

Not yet sufficiently solved are doctrinal issues concerning the proper delineation of responsibilities with regard to the execution of the peacetime standing tasks (BMD and Air Policing) in a European JOA when transiting into the operational command structure during an Art. 5 crisis. Another

doctrinal gap exists for Space. Space is an extremely important enabling domain for NATO operations, but NATO still does not have a Space Policy nor a coherent Air and Space power doctrine.

Resilience

The drastic reduction in Air C2-entities took away all redundancy, making the structure vulnerable to technical outages, other failures, or attack. A longer outage of a CAOC, e.g. due to technical reasons or a fire, can only be covered by the AIRCOM HQ itself. A similar outage at AIRCOM cannot be covered inside NATO's Air C2-structure.

A holistic view of NATO's Air C2 capabilities must include the elements below the AIRCOM/ CAOC level, i.e. the CRCs and the capabilities of NATO's Airborne Early Warning and Control (NAEW/C). After the end of the Cold War, NATO nations reduced the number of CRCs in line with the reduction of their aircraft fleets to a minimum level just able to cope with the requirements of safeguarding the integrity of the airspace (the Air Policing function). This was made possible by the dynamic technical advances in C2 systems including the networking of a multitude of radars and radios.

The effect was two-fold: Capabilities to deal with a major crisis in Europe and to support a larger amount of combat aircraft with control services were lost and the remaining operators barely receive the training required to safely handle more complex air battle situations, as was shown in recent live air exercises. In nations with smaller or no 'own' air forces, aircraft controllers just receive the minimum live training to maintain the skills required for the air policing mission. Even though simulators have become more powerful and have gained in importance, simulation cannot compensate for everything learned in live training. Parallel to this concentration on the air policing mission, the drastic reduction and

withdrawal of Ground Based Air Defence (GBAD) systems from the integrated air defence contributed to the CRCs losing their capability to execute tactical control functions and manage the integrated air battle as was standard during the Cold War. The SADCs of the CAOCs are not designed to pick up this part of the Integrated Air Defence mission, leaving the earlier described doctrinal gap. Redundancy was also lost because of the drastic reduction in CRCs, making it sometimes difficult to organize back-up solutions.

C2-Systems

Last but not least, the C2-systems issue must be addressed: ACCS and Air-C2IS are considered to be the CIS backbone for Air command and control both below AIRCOM level (ACCS) and above it (AirC2IS). Both systems, however, are not yet in operation. Therefore, Air C2 in NATO has to rely on a multitude of C2-systems, making life very complicated for operators and the CIS-specialists who are to maintain these systems. The complex situation is exacerbated by a great variety of national systems, which are not all interoperable with the NATO systems even though they are more often than not the key source of vital information. Information and data exchange are quite often hindered or further complicated by National disclosure policies.

In sum: NATO's current Air C2 structure appears to be able to cope with its benchmark mission, the SJO-AH, although it still lacks capability in some critical specialist fields, especially ISR. To close the manpower gaps, a sophisticated training, augmentation and reinforcement scheme was developed. The capability gap to NATO's LoA with regard to concurrent operations or a MJO, however, is still not yet closed. Robustness and capability to control the integrated air battle was lost in the Air C2 structure of the nations at the CRC level because of the concentration on the air policing function. All levels of Air C2 in NATO need training in challenging live and

simulated exercises presenting the full spectrum of air activities, including Art. 5. This is not properly supported by NATO's current exercise priorities and scenarios. Air C2 systems interoperability is a must and national disclosure policies should not present a hurdle in operations. Space and Cyber are not yet sufficiently covered doctrinally and operationally.

Overcoming Deficits – Considerations and Proposals

Doctrine

There are some people who argue that standard JFAC organization and processes are too manpower intensive and do not recognize the highly qualified individuals in the subordinate units, mainly because of the principle of 'Centralized Command and Control with Decentralized Execution'. They believe that modern Air C2 should also adopt the principle of 'Mission Command'. Responsibility could be delegated to subordinate Commanders because most of current conflicts focus on air support in stabilization operations. Therefore, commanders at wing and squadron levels, rather than just marshalling their forces in accordance with the ATO, should have a chance to use their intellect and experience.

Mission Command is a Prussian idea from the 19th century, 'invented' by von Moltke to overcome the 'Fog of War'. If subordinate commanders knew and understood the Commander's intent, they could, within certain limits, continue to operate in absence of further orders as long as what they did was in accordance with the Commander's intent. If Network Enabling can lead to Shared Situational Awareness – where subordinate commanders have the same 'big picture' as the JFAC – then the benefits of Mission Command could be realised in the 21st century. In an 'Effects Based Approach to Operations,' subordinate commanders would become 'effects champions', responsible to the JFACC (and ultimately the JFC) for effects within their own sphere of influence and expertise.

One example of this, from the joint effects sphere, could be (perhaps) an Italian Tornado Squadron Commander. He would be the local 'expert' in providing CAS for Troops in Contact (TIC) and could therefore be the effects champion for a joint effort.

'Mission Command' may indeed be a solution for some stabilization operations and reduce manpower requirements at the JFAC-level, e.g. in Africa where coordination and prioritization can be exercised at lower levels. We also apply it today when we assign a 'Mission Commander' in some complex air attack missions for the detailed execution planning. But even in stabilization operations like Afghanistan, 'Mission Command' quickly reaches its limits because of the dimensions of the theatre and the complex coordination requirements of scarce air resources, enablers, EW- and Air to Ground capabilities. Furthermore, air's capability to deliver strategic and operational effects through tactical action calls for an integrated approach, as was shown in OUP. There still needs to be a single focal point for the effective employment of Air C2 across the full spectrum of Air and Space Power Operations. That single point is the Air Commander. Finally, a fully functioning 'NATO Network Enabled Capability' has not yet been achieved.

Mission Command and the JTF-Concept

The JTF-Concept is being developed to solve the mismatch between NCS capabilities and NATO's LoA at the joint level. The idea is to use GRF HQs (Land) as JTF HQs for low-intensity follow-on stabilization operations, thus freeing up a JFC. It is, however, not yet solved how to organize Air C2: whether it should be integrated, handled by the AOCC or by a dedicated small Air Component. If the air contribution in such follow-on operations, e.g. KFOR, consists mainly of rotary wing and fixed wing air transport, some non-organic ISR and probably a few dedicated air attack capabilities for support in extremis, a small Air Component applying 'Mission Command' principles under the auspices of AIRCOM could be the right solution.

The BMD Issue

Doctrine for NATO's new Ballistic Missile Defence (BMD) mission, executed by AIRCOM Ramstein, has not yet been fully developed. While Theatre BMD (TBMD) in expeditionary operations beyond NATO territory does not pose a problem from the C2-perspective, the standing BMD-mission in NATO Europe and an Art. 5 crisis in Europe raise questions about the delineation of responsibilities between the JFC dealing with the crisis, probably supported by an NFS Air Component, and AIRCOM Ramstein's responsibility to SACEUR for the conduct of the overarching BMD-mission. It is suggested that AIRCOM always stands up the JFAC in such a situation, thereby easing the air coordination portion; the NFS JFAC could serve as AIRCOM's liaison at the JFC-level. A similar conflict arises when transiting from air policing to air defence including GBAD, as discussed earlier. In both cases, a doctrinal solution must be found earlier rather than later.

Manpower

Solving the manpower issue continues to be the first priority. The AIRCOM training concept correctly addresses this challenge. Sustaining an operational JFAC-structure over a longer period, however, requires a considerable amount of trained Air C2 specialists readily available. Keeping a record of personnel that fulfill the training requirements and nations agreeing to make those people available are the only solutions to enable the new NATO Air C2 structure to fulfill its mission. It is also paramount that national JFAC personnel are trained to the same standards as the NCS personnel.

Alliance nations invest a lot of scarce specialist personnel resources in multinational staffs and HQs dealing with peacetime Air issues. Role and output of those staffs and HQs are sometimes doubtful, e.g. the 'European Air

Group – EAG,' which was founded to assist in the re-integration of the French Air Force into NATO. In any case, nations should consider earmarking these people as available for Air C2 and train them for JFAC-functions. An example is set by the DEU/ NLD Extended Air Defence Task Force (EADTF) at Ramstein.

Because of the importance of ISR as a key enabler and driver, the nations who have considerable expertise in this field should agree to partner with AIRCOM and interested nations to train and maintain a pool of ISR specialists available for Air C2. Furthermore, for ISR specialists, as well as for NAEW/C personnel and for some other highly specialized fields, the standard tour of duty should be extended to four years. Similarly, space and cyber expertise should be made available.

Cyber and Space

Because of the importance of these domains, NATO should consider developing a Space Policy in addition to its Cyber Strategy; the latter should not be limited to defensive operations. If the Air Commander claims responsibility for 'Air and Space,' he also must have the expertise and tools in his organization to fill the role as 'Air and Space Power Advisor' for the JFC. He should also know the impact Cyber activities can have on his operation, whether his C2 system are probably compromised and where Air and Space Power capabilities can contribute to the joint fight. A directly available 'cyber monitoring capability' could provide him with early warning in case of system attacks. The Cyber domain also opens new opportunities to achieve non-kinetic effects of strategic importance. Examples are: EW to deny access to communication systems, injection of false signals into communication systems, information operations using airborne platforms etc. Relevant NATO doctrine should be analyzed and adapted where necessary to reflect the contribution of the new domains.

Interoperability of C2-Systems

First of all, ACCS and AirC2IS should be brought into operation as soon as possible. Furthermore, all C2 systems should be interoperable and present all information available to decision makers and planners as required. National JFACs should consider using ACCS/ AirC2IS as their standard equipment to advance 'operator interoperability', reducing the need to get accustomed to a new HMI when augmenting a NATO JFAC.

Technically, interoperability should no longer be an issue when existing agreed to standards are adhered to. NATO's concept of 'Federated Mission Networks' (FMN) is the right approach. It needs to be followed up by the political willingness of nations to share information which sometimes is a bigger hurdle ('Cross Domain Solutions'!). It should also be a rule that no new C2 system in any NATO nation is developed without 'interoperability' being a key design requirement.

Foster Resilience

Because of its limitations in infrastructure, workstations and personnel, NATO/ AIRCOM should consider formally teaming with the USAF's capable standing 603rd AOC on Ramstein Air Base. An 'Alliance AOC' formed by AIRCOM Ramstein and the 603rd AOC would present NATO with a capability that it is lacking: a quickly available MJO Air C2 capability. It would also give AIRCOM better resilience in case of outages or failures, something which was lost as a result of the last NCS reform. This construct should be tested and assessed during one of the future USA 'AUSTERE CHALLENGE' Exercises.

Lifting 'Cross Border Constraints' would render NATO's Air Policing and Air Defence more effective and efficient and could contribute to mitigating redundancy problems at the level of the CRCs.

At all levels, resilience against cyber-attacks should be fostered by main-taining the highest cyber security standards and preparing mitigation/back-up measures in case of system outages.

Conclusions

Modern Air and Space Power, with its capability to deliver kinetic and non-kinetic effects across the operational spectrum, needs responsive, agile and adaptable Command and Control. Following the lessons from OUP, NATO partially corrected the economically-driven drastic reduc-tion in Air C2 manpower. Thus, AIRCOM was at least enabled to basi-cally meet the challenges of a 'Smaller Joint Operation – Air Heavy'. Nev-ertheless, a huge training effort is still necessary, and specialist gaps (especially ISR) need to be filled, for which NATO's Air C2 structure con-tinues to be critically dependent on USA contributions. Further training and commitment of nations are required to generate the manpower pool for AIRCOM for a 'Major Joint Operation' or concurrent operations. The availability of sufficient skilled and trained personnel remains the key. NATO's training and exercise scenarios, as well its priorities, should reflect this.

Adopting 'Mission Command' rather than the predominant 'Centralized Command and Control with Decentralized Execution' may be a solution for some air activities, but not as a general change in doctrine, and espe-cially not in highly kinetic and complex operations. Space and Cyber should both be covered by proper NATO policy. Air aspects of Space and Cyber need to be addressed doctrinally and operationally. 'Cyber early warning' is especially important for Air C2. Interoperability issues could be overcome by the next generation of C2 systems, which should, therefore, be introduced quickly. Fitting national disclosure policies must enable the sharing of vital information in operations. Capacity and redundancy lost can only be mitigated by teaming with nationally-provided capabilities.

Intensified cross border cooperation in Air Policing and Air Defence should be made possible wherever politically feasible.

Even though shortfalls exist in NATO's Air C2 capability, we are confident that the Airmen in the Air C2 structure will do their best to achieve success in operations and master any challenge ahead when the Alliance, through the nations, provides the resources. However, it is the responsibility of Commanders at all levels to provide them with a solid foundation through proper training. The personal engagement of the Air Commander with his JFAC staff and his subordinate commanders in preparing his organization as well as during operations makes the difference!

Keeping up Preparedness

Readiness and Effectiveness of Air and Space Power in NATO

By Camille Grand

Air and Space Power have been critical assets for the Atlantic Alliance and NATO nations over the last 25 years. Air and space dominance played a central role in the engagements and successes of Western Allies on multiple battlefields from the Gulf to the Balkans, from Afghanistan to Libya. While the Alliance was in almost all cases confronted with less capable adversaries, air dominance was not only achieved through technological superiority but was the by-product of a long-term effort by many NATO air forces to keep up a high level of preparedness, readiness and effectiveness through high standards of education and training.

Preserving the hedge provided by air and space dominance in the 21st century is one the most challenging tasks for the Alliance in order to preserve its military effectiveness and strategic superiority. In order to achieve this demanding objective, NATO needs to address multiple challenges in a rapidly changing security environment. Education and training, as well as the management of human resources, play critical roles, as technological leadership without appropriate and qualified human resources has only a limited value. This re-enforces that Western technological leadership

might not be taken for granted in the long term, as developments in the cyber field already demonstrate.

Enhanced training will be an important element of the 'Readiness Action Plan' proposed by the Secretary General of NATO and adopted by the Alliance's leaders at the Wales Summit in September 2014. This emphasis on training from the highest political level is yet another demonstration of the importance of renewed efforts to keep up preparedness, readiness and effectiveness.

Addressing the New Challenges for Air Power of a Transformed and Rapidly Evolving Security Environment

In the past two decades, NATO operations have given a critical role to Air Power and, in spite of their varied nature, each has benefited from Western air superiority. They have covered a wide spectrum of operations, from major joint operations in the Balkans and Afghanistan to purely air operations, including no-fly zones over Bosnia (operations SKY MONITOR and DENY FLIGHT over Bosnia-Herzegovina in 1992–1995), air campaigns involving strikes (operations DELIBERATE FORCE in Bosnia 1995, ALLIED FORCE in Kosovo and Serbia 1999, UNIFIED PROTECTOR in Libya 2011) and even strategic airlift for humanitarian relief in Pakistan (2005–2006).

All these operations share an essential point: NATO air superiority was overwhelming and control of air space was established very early in the crisis. It is also important to note that NATO forces have had almost no opportunities to engage in air combat with peer adversaries.

Moreover, the last two decades have led NATO to put the emphasis on out-of-area operations, sometimes at the expenses of the more traditional air defence missions aimed at preserving NATO air space, which appeared as less central. Until recently, the assessment was that the threat to NATO

airspace had become limited. Violations of the Baltic and Icelandic air spaces by Russian aircraft have led to a review of this optimistic assessment, and the collective engagement in the Baltic air policing mission since 2004 and Icelandic air policing since 2008 have tried to respond to that changing environment.

Now that NATO's involvement in Afghanistan is changing from a combat posture into a more training-focused posture, it might be opportune to review the training requirements for NATO forces. In an evolving security environment and in order to preserve its superiority, NATO needs to prepare for the full-spectrum of conflict, including the need to meet Article V contingencies.

There is in this context a specific challenge for European Allies, which have tended to rely heavily on US assets when it comes to air and space power. Only a couple of European Allies (France and UK) are capable of conducting operations without US support, even in limited air operations (Small Joint Operations to use NATO terminology) and in terms of both capabilities and competencies.

This is an extremely demanding challenge for European Allies, but as Libya demonstrated, US large-scale commitment cannot be taken for granted in all circumstances due to various political and military reasons. This also has a long term impact in terms of interoperability, as US Air and Space Power is engaged in the development of Air-Sea Battle. It is important to assess how NATO will fit into the picture and what are the requirements for training and exercising European forces.

Within the Alliance, the situation is challenging for multiple reasons:

- Several Allies do not operate fighter aircraft and, therefore, rely on other Allies to simply protect their airspace. This is the case for Luxembourg,

Albania and Slovenia in Western and Southern Europe, and, with more immediate consequences given tensions with the Russian Federation on the Northern and Eastern flanks of the Alliance, for the Baltic States and Iceland.

- Many Allies operate aging fleets, with serious consequences to readiness, interoperability and a distinct risk to soon join those already unable to protect their airspace or take an active part in demanding operations or missions.
- Fiscal and budgetary constraints combined with increased costs of the latest generations of platforms have also led to shrinking air forces operating fewer aircraft (and personnel) and less able and willing to take part in operations or to provide assistance and support to other Allies or to contribute even modestly to NATO's Joint Air and Space Power.
- Domestic political constraints have also led to more reluctance on the part of some Allies to take an active role in past operations (for OPERATION UNIFIED PROTECTOR (OUP) in Libya only 14 out of 28 Allies took part in the operation and a mere 8 took part in air-to-ground strikes and missions, together with 4 partners: Jordan, UAE, Qatar and Sweden); not all Allies have taken part in the reassurance measures in the Baltic region following the crisis in Ukraine. Going beyond politics, this trend can also lead to a two-tier Alliance, in which many Allies play no active military role in some of the most demanding missions and operations. This also has a long-term effect on the requirements of interoperability.
- All these developments take place in a degraded security environment, not only on the Alliance Eastern flank, which is affected by the crisis in Ukraine and assertive Russian policies, but also on its South Eastern and Southern borders, as instability and turmoil tend to characterize both the Levant and parts of North Africa.

In this gloomy context, it might also be important to note some positive developments.

- The lessons learned of Afghanistan and other operations ought to be preserved, including the fact that many NATO air forces have acquired combat experience and developed interoperability.
- Cooperation with partner countries of NATO has achieved significant progress transforming some partners, such as Sweden and Finland, into more interoperable air forces capable to fight with NATO forces and eager to train with them. During OUP and due to limited assets provided by the Alliance, the presence of the four very different contributing partners provided not only legitimacy, but some very useful capabilities. Additionally, the four nations were pleased with the interoperability and experience they obtained as a NATO partner. Politically and operationally, those four partners developed a closer relationship with NATO, and vice-versa, through their active participation to OUP. Australia falls, to certain extent, into same category, even though it has its own interoperability requirements with US PACOM in Asia-Pacific making interoperability with NATO a less central objective.
- Overarching political-military initiatives, such as the Connected Forces Initiatives, offer a useful setting to develop training and exercises amongst Allies and partners

Altogether, and in this transformed environment, exercises and training need to achieve multiple and sometimes conflicting objectives:

- Learn the lessons of past engagements in order to retain the level of proficiency acquired in those operations.
- Preserve the high readiness and multitask abilities of the most able air forces, which need to be able to, among others things, conduct demanding air policing missions to preserve the integrity NATO airspace against all potential adversaries AND to wage an air campaign outside NATO air space.
- Preserve interoperability, as it is a unique NATO asset.

Given the constraints and challenges described above, preserving and developing education, training and exercising have become all the more critical. NATO has always played a specific role in enhancing interoperability and has traditionally offered to Nations many opportunities for shared education, training and exercising in the context that many Allies have fallen below agreed standards in terms of training (specific and/or core) capabilities. Most European nations no longer meet the NATO-required flying hours for pilots. This might, however, no longer be the only, or most relevant, criteria as Nations are developing smarter training curricula using multiple benchmarks.

The core issue is whether NATO can further develop its role in education, training and exercising when they remain under the prime responsibility of Nations. Considering that it is, in fact, a shared responsibility, this paper examines seven key priorities in the field of education, training and exercising for the Allies and concludes with seven connected policy recommendations for NATO.

1. Train the Entire Air and Space System Live

A particular emphasis should be given to live exercises (LIVEX), as many air forces lack opportunities to train in large scale exercises offering situations close to combat. Such exercises offer political benefits, such as demonstrating NATO's abilities and political will or offering opportunities to engage NATO partners. The Iceland Air Meet 2014 exercise (3–21 February 2014) was an excellent example of these benefits, as it involved non-NATO Nordic nations, with significant Finnish and Swedish participation. Moreover and in spite of technological progresses, simulation is no substitute for live exercise as a tool to test and train key capabilities.

Such live exercises should, as much as possible, train the entire air combat system in order to allow, in particular, the entire C4ISR structure to be

trained as well as flying crews. As a recent example, Exercise Unified Vision 2014 ('UV14') was NATO's 'biggest ever trial' for Joint Intelligence, Surveillance and Reconnaissance (JISR) systems, which is one of the priority capabilities for the alliance's Connected Forces Initiative (CFI). UV14, which ran from 18–28 May 2014 and was mostly run in Norway, brought together satellites, aircraft, Remotely Piloted Aircraft (RPAs), navy ships, ground sensors, and human intelligence assets from 18 NATO members.

The point of such exercises is to train the whole network, monitoring the entire future air combat system – all sensors and all shooters. Exercising is not only about training aircraft pilots and crews, but also RPA operations, mission control, ISR, targeting and battle damage assessment. This is essential for preserving a high state of readiness and the appropriate level of mission preparedness. Without properly trained mission command, information management and intelligence officers, the skills of highly trained pilots or other combat operators might prove of limited value.

Beyond Air Power training, joint training is critical. Training air and space capabilities together with land and naval assets is demanding. The NATO Response Force (NRF) offers from that perspective a unique tool for the Alliance to practice joint full-spectrum operations at the appropriate level.

2. Train for All Potential Missions

One of the lessons of recent events is that security challenges and future missions are unpredictable. Based on operations in Afghanistan, many would have assumed that air power was primarily about supporting ground operations (through air transport, CAS, ISR and space campaigns), while OUP in Libya was an air campaign. Most analysts assumed air superiority and control of air space could be taken for granted out-of-area when debates about a potential air campaign in Syria focused on a major surface-to-air threat involving modern systems such as S-300 missiles. The

possibility that NATO could face a peer adversary was assumed to be highly unlikely; however, recent tensions with Russia have led NATO to not to rule out such a risk and to re-emphasize the capability to protect its airspace.

In such a geopolitical context, including the resurging challenges on NATO's Eastern borders, it is important to train for the full-spectrum of missions, including long-range bombing, CAS, air policing, air-to-air combat, Suppression of Enemy Air Defence and nuclear deterrence. Too many air forces in the Alliance have simply renounced appropriate training for some of these missions, and simply rely on other Allies (the US and a handful of Allies) to carry some missions. It is essential that all allied air forces continue to prepare for high-intensity air warfare.

As air-land battle offered in the old days a framing concept for demanding joint operations, it might be appropriate for NATO to offer more opportunities for joint training involving all services in large scale joint training (the Air-Sea Battle concept does offer such a framework to the US Air Force and the Navy).

3. Preserve Interoperability Achieved in Operations

Interoperability has always been both a challenge and a unique feature of NATO. Interoperability is not only about standards for communication, it is also about preserving the ability to work together. The coexistence of multiple generations of platforms requires specific training in order to allow different fleets to execute within one network.

From that perspective, the F-35's entry into service with several air forces of the Alliance offers a particular challenge that will have to be addressed collectively by Allies, as the inclusion of this new generation aircraft is likely to be more difficult than previous similar experiences. Joint train-

ing will be critical from that perspective, as other modern platforms such as the Typhoon, the Rafale and the Gripen will remain in the inventories for decades.

4. Differentiate Training Requirements

In order to go beyond existing frameworks which, of course, need to be preserved and enhanced when appropriate, new paths and innovative ideas could be explored and tested in order to maintain and train proficient air and space power operators.

Traditionally, NATO was about bringing all Allies to the same standards through a standardization process which tested and validated specific capacities and skills. Given the current disparity amongst air forces, both in terms of platforms (with several generations coexisting) but also in terms of operational experience, practices and political constraints, this 'one size fits all' approach does require a review. NATO could also develop advising teams able to assist and support Allies and partners with lesser developed capabilities and competencies through a tailored approach taking into account existing vast discrepancies in Allied Air and Space Power.

In a nutshell, it might be appropriate to better differentiate training amongst air forces and within some air forces. In times of severe budgetary constraints, does NATO need one hundred percent of its air capability to be available on high readiness? Is it necessary to train the entire force to wage the first day of an air campaign as an entry force, when some allies are unlikely to take part in the first days of a conflict for military or political reasons?

If, in theory, it would be better to preserve such a full-spectrum capability force through a standardized training, it should not happen at the expense of the number of platforms and trained crews because of the growing cost

of training. It might, under the current circumstances, be wiser to preserve formats and a capacity to conduct air operations over an extended period of time. This approach would differentiate better between those fully trained and capable including of serving as entry force on Day 1, and those, *inter alia* flying less training hours, who would immediately be able to perform less demanding missions and to gain or regain competences over a short period of time if and when required.

5. Develop Small Groups of Countries Activities

Increasingly, cooperation projects are developed amongst small groups, on a bilateral or 'mini-lateral' basis, instead of NATO-wide 'at 28'. Nordic Defence Cooperation (NORDEFCO), Visegrad or Franco-British cooperation, for example, has sometimes proven more effective and allowed development of successful and cost-effective education or training projects. Such cooperation amongst countries sharing similar technical and cultural backgrounds should be encouraged by NATO. Smart defence and smart training often work better amongst small groupings of countries. Such groupings are not only about 'users clubs' for specific platforms but can be developed around specific tasks, such as training ISR specialists.

This approach can also be applied to education as more and more air organizations cannot sustain national education and training facilities. There are already several cases of parts of the pilot training curriculum taking place in an allies' facility as part of a bilateral agreement (e.g. Belgian jet pilots training in France).

A 'smart education' initiative could involve further opening of schools and more sharing of education facilities. In the logic of smart defence, an effort to develop joint curricula and opening schools to allied participation, could prove cost effective and useful, as many Allies are not able or willing to sustain a full education for airmen in all required specialties.

6. Further Develop Joint Training with some Close Partners

NATO partnership has been, for two decades, a political tool to engage non-NATO countries in the Euro-Atlantic area and beyond, but has in the last few years developed also into a military tool. Some partners (Sweden, Finland, Australia immediately come to mind) have regularly been engaged alongside NATO forces in combat operations and have often provided substantially more significant forces than many Allies. Furthermore, Sweden and Finland now take part in exercises and activities which have direct connection with collective defence, such as Icelandic Air Policing.

In this context, it might be appropriate, as the Connected Force Initiative already envisions, to further associate such partners in NATO training activities and also to benefit, when feasible, from the large and relatively free Nordic air space for training purposes.

Amongst partners, the EU has a special role and, even if the EU does not operate air assets per se, it could be interesting to explore further opportunities for cooperation (for example in the field of simulation).

7. Addressing the Human Resources Challenge

Human resources for joint Air and Space Power in NATO have always been a challenge for allied air forces, as they need to attract qualified personnel and are, therefore, in competition with other potential employers. In the field of technology, civilian positions often offer more attractive salaries and career opportunities. Personnel also need to acquire unique sets of skills during their career and, in order to do so, must benefit from constant education and training. As Air Power organizations become smaller and smaller, this does reduce their attractiveness, as they are not always able to offer careers. As air forces become small organizations, they need to examine ways to preserve their human capital and to educate and train personnel at an acceptable cost.

If the situation differs very much from one NATO country to another, depending on national traditions and on the domestic job market, most European (and the Canadian) air forces face a common human resources challenge: how to maintain a correct knowledge base and preserve skills in smaller organizations.

This challenge may limit the further downsizing of organizations, as many air forces have reached a point where the continuous reduction to the number of platforms and downsizing of staffs creates unprecedented tensions and jeopardizes future organizational validity.

Human resources managers also need to manage new career paths, as they need to offer (short or long) attractive careers to enlisted airmen, NCOs and officers. Air forces are traditionally very focused on technology and structures. A renewed thinking on competencies might be needed to meet the challenges of 21st century air forces.

These multiple challenges lead to three basic recommendations:

- Take into account the preservation of skills and knowledge base when downsizing organizations;
- Small is not always beautiful;
- Examine ways to further explore information exchanges, mutualisation of education and training in ad hoc bilateral, 'mini-lateral', or Alliance arrangements.

Conclusion and Key Recommendations: What Role for NATO?

In this constrained environment, the role of NATO remains unclear as human resources, education and training are primarily the responsibility of Nations. The Alliance could move beyond its current role, focused on standardization, certification and joint training, by exploring new roles based on some of the above set of objectives.

In order to implement this general objective, the following ideas could be further tested and examined by NATO.

1. NATO could serve as a clearing house for best practices and for sharing experiences related to human resources and education. NATO could offer niche training for rare competencies as part of a multinational curriculum or through its centres of excellence.
2. NATO should encourage bilateral or mini-lateral efforts to educate, train together, and move away from the 'one size fits all' approach of 28 nations. Rather than insisting on a set of unique requirements for all allied air forces, NATO could better differentiate the training of different forces and provide more tailored support and assistance than a unique set of standards.
3. NATO should offer more opportunities for live exercises, training the entire air combat system, as most Nations have more difficulty and less opportunity to train live on a large scale because of budgetary constraints.
4. NATO needs, in particular, to exercise the full-spectrum of air power in order to develop preparedness for multiple contingencies. Training of the NATO Response Force offers opportunities to meet these two objectives.
5. NATO should put the emphasis on preserving interoperability (amongst Allies and with key partners), as different generations of platforms are likely to co-exist as well as multiple elements of the air combat system.
6. NATO needs to further develop association of like-minded partners with its training activities, in particular non-NATO EU countries such as Sweden and Finland.
7. NATO could explore an expanded role for the Allied Command for Transformation (ACT) in training and education. If 'combatant commanders' under Allied Command for Operations should retain the prime responsibility of training and preparing ally forces including the NRF, ACT could be more closely associated in evaluation and lessons learned processes.

In a rapidly evolving and challenging security environment, the Air and Space Power component of the new 'Readiness Action Plan' will heavily rely on educating, training and exercising better, more jointly. Air and Space Power will continue to be on high demand and needs to continue to adapt to the 21st century challenges.

In summary, the point is not so much about a radical transformation of the role of the Alliance, but about making the Alliance smarter, more flexible and more efficient in assisting allies' efforts to maintain in the long term the superiority of NATO air and space power in a way that is fit for purpose and able to confront multiple and different contingencies.

Space and Air Power in NATO

VI

By Lieutenant General (ret.) S. Panato

Executive Summary

Space is an essential enabling domain for NATO Air Power, but the space system is inherently fragile, in particular the on-orbit space craft and the up-down links. Provision should be made to further exploit space support in support of air operations and to mitigate shortfalls.

On-orbit active space craft are nationally owned and will therefore remain outside the control of the Alliance. The Alliance, however, should play a coordinating role. Subject to specific MoUs with Nations, a certain level of control of payloads could be obtained by NATO.

The issue of assured access to space by NATO Air Power is of paramount importance. In this regard, the Alliance is to develop a comprehensive space policy and to foster bilateral and multilateral sharing agreements among the space faring nations and with EU and European Space Agency (ESA).

NATO training and exercises should encompass space operations. Positions for space specialists should be inserted as appropriate into the command structure.

A high level of protection should be provided to the entire space system, in particular to the ground segment. The Alliance Air Power could be the most ap-

propriate means of deterrence in this regard. To cater for any contingency, NATO air assets should be capable to operate in situations of degraded or absent space services.

Incidents in space may constitute a case for triggering a self-defence reaction (Art. 51 UN-Charter). Space Situational Awareness, as well as closely monitoring technological developments that could change the fundamental nature of space operations and, as a consequence, air operations of the Alliance are required.

Introduction

Over the years, space has permeated our daily life far more than is widely known or that people, other than specialists, are aware of. Space capabilities that were once primarily developed for military purposes in the areas of Intelligence, Surveillance, and Reconnaissance (ISR), Communications and Positioning/Navigation and Timing (PNT) have found their way into civilian and commercial use such that they today contribute essentially to nearly all sectors of civilian life, e.g. earth observation for weather forecasts, climate monitoring, natural disaster control, agricultural and economic purposes, communications (which enable some 80% of the global financial transactions) and PNT satellites, which not only aid navigation, but more importantly give critical timing signals to the energy sector or ensure availability of ATM financial services in remote areas. Therefore, NATO, as a whole, depends on the availability of space services and all NATO military operations of the last decades depended critically on this enabling domain. The Alliance operated satellites in Space (NATO I, II, III and IV communication satellites) and did so until their service life expired in 2010. At present, the Alliance owns and operates two large Satellite Ground Stations along with several high capacity Transportable Satellite Ground Terminals and a host of small Deployable Satellite Ground Terminals. Regarding SATCOM, NATO today relies on national and commercial space services.

ISR, Geospatial, Weather and Early Warning information are also provided to NATO both by Nations and by commercial entities. This is an arrangement that is likely to be continued for the foreseeable future.

Air operations by NATO forces depend on the strategic advantage that space capabilities provide to NATO-led operations. Among NATO members, there are several of the most advanced space-faring nations in the world, which constitutes a considerable advantage. Thanks to space capabilities, some Air Power gaps have been overcome when new capabilities were made available. An example is persistency, which has been a problem since the inception of Air Power and is now greatly mitigated. Due to new capabilities, Remotely Piloted Aircraft (RPAs) have become a reality due in part to space navigation aids and satellite communications.

Challenges

Space is a precious enabler, but at the same time, unfortunately, is inherently fragile. The latter is primarily a result of the high-end technology which is used in spacecraft and is susceptible to hazards associated with launch to orbit, but could also be the result of other accidents and intentional acts. Some examples are:

- Hardware and, to a certain extent, software failures are important reasons for failure of on-orbit spacecraft and payload. These events are unpredictable by nature and difficult to restore.
- Collision with space debris constitutes a very serious and growing concern. Today, space debris is 'into' the billions at the sub millimeter size. Space-faring nations are mainly concerned about those larger than 1 cm that can cause heavy damage and even destroy spacecraft. Current technology permits the tracking of more than 20,000 of the most dangerous pieces of debris. In the future, the number of space debris will continue to grow unless internationally agreed countermeasures

become effective (moving Geostationary (GEO) satellites out of orbit at the end of lifetime, and similarly bringing Low Earth orbit (LEO) satellites to descent for destruction in the atmosphere).

- Radio frequency interference. Nearly 10 thousand satellite transponders are already in orbit. The management of the frequency spectrum is becoming critical.
- Space weather. Purely a physical phenomenon originated by the sun. Not avoidable but predictable and detectable with a reasonable rate of success.
- Jamming and spoofing. Technology to disable/disrupt GPS is available at relatively low costs. It can be used in the entire Electro Magnetic (EM) spectrum against space systems.
- Cyber-attack. A new threat, much advertised, still needing to be fully understood, but already sufficiently worrying.
- Predictability of satellites orbits. Due to the physics orbit, spacecraft there are vulnerable to attack, be it cyber-attack, anti-satellite attack or from Electromagnetic Pulse. For the same reason, adversaries could limit detection of their activities from space by proper timing of their exposure.
- Limited maneuverability of satellites. Changes in orbits and in the orbital plane cannot be effected immediately and consume precious fuel. Fuel expenditure is a factor that influences considerably the usable lifetime of satellites.
- Kinetic attack. Possible against satellites and against the ground segment of the space system.

Opportunities

Despite its relevance to NATO's mission, space is not well understood across the Alliance. In fact, only a limited number of personnel are tasked with guidance and oversight of space activities. Furthermore, because NATO reduced its footprint, NATO no longer owns and operates satellites. As described before, on-orbit capabilities are provided by nations or purchased

from commercial entities and this will probably be the rule for the future since NATO Member States will remain reluctant to cede any control over their sovereign assets or accept any constrains on their use.

Therefore, the possibility for NATO to have its own on-orbit capabilities in the future is highly unlikely, due to the costs involved and to the fundamental changes that technology is introducing to the entire space business. The number of space-faring nations and civilian entities is increasing rapidly because of rapid advances in technology and miniaturization. Space services are offered by a wide spectrum of providers and their number is increasing. The few satellites the Alliance is able to afford by common funding, however, will not be sufficient with regard to NATO's operational needs and cannot compare with the wide array of offers coming from the space industry. It should be examined whether NATO should be given some control of payloads, e.g. through tailored MoUs with the nations or commercial entities, thus reducing costs involved.

Therefore, the Alliance should generally continue to rely on space services provided by on-orbit spacecraft owned by others. The vested interest of the Alliance will be in coordinating the effort of the Nations. This will aid Alliance operations, and also will enable nations to best allocate their resources to national tasking and NATO support.

Policy Considerations

Space is a 'global common'. The operational land, maritime, air and cyber domains have a high level of interdependency. Space is the essential enabler for all. Therefore cross-domain integration is a must in any future planning or employment. This requires a solid base of common knowledge. Appropriate procedures should be developed in order to best exploit this finite resource. Training is a crucial factor to spread space knowledge and awareness among operators and planners. In addition, space specialists

should be in proper positions at all levels of the NATO Command Structure. All this points to the conclusion that the development of a comprehensive NATO Space Policy is necessary as soon as possible in order to guarantee guidance and coherency of effort among the many involved.

The policy document should address the following issues:

- Legal. Definition of boundaries and limitations. The definition of where the atmosphere ends and where outer space starts is not purely an academic exercise. It is necessary to clarify the role of the Air Service, both in respect of policing the portion of sovereign airspace and in terms of resource investment. Space by its nature is a common domain, free from any national attribute. The atmosphere, however, is a national domain. Physics could help in addressing this controversial issue. In fact, an altitude exists above which the speed necessary for a flying vehicle to generate sufficient lift equals the orbital velocity. Such altitude could be the boundary between atmosphere and outer space. Theodor von Karman suggested this altitude to be 100 km. As a consequence, the air domain up to the 'Karman Line' should be the competence of the national Air Services.
- A definition is needed reference the difference between militarization and weaponization of space. Militarization of space is already a fact. Nowadays space support to operations is widely accepted and considered compliant with treaties. Placing weapons of mass destruction in space, however, is a violation of current treaties (e.g. UN Outer Space Treaty of 1967 (initiated by Resolution 2222 XXI)) and would be a dangerous move with un-foreseeable political consequences.
- Incidents in space may trigger a self-defence reaction (Art. 51 UN-Charter) and call for Art. 5 consultations. A NATO Space Situational Awareness capability could contribute to a better assessment of the situation.
- Assured access to Space. The Alliance does not own on-orbit spacecraft and relies on those of its members nations and of commercial providers.

Multilateral and bilateral agreements are therefore essential. Redundancy of space services will contribute to making space capabilities more robust and resilient against failure or unavailability (e.g. GPS and GALILEO). This seems to be a paradox, but duplication of space capabilities among providers may indeed be a viable measure to ensure access for the Alliance.

- Sharing information. Space assets must be protected against debris and the adverse effects of space weather. Detection, tracking, cataloguing and identifying debris and the prediction of space weather effects – in a word having the so called Space Awareness – has to be a cooperative effort of all space-faring nations. Corrective actions to avoid consequences – even to people and territories – are very time sensitive. Therefore sharing of information is a key necessity for the Alliance to be pursued bilaterally and multilaterally. Finally, as stated before, NATO should have its own Space Situational Awareness Capability.

- Responsiveness. Operations in space are conducted at a velocity of several km/s. Correcting actions to avoid collision with debris and to mitigate consequences of unfortunate events require swift decisions.

- Protection. Space systems should be made resilient and redundant as much as possible. However, there are obvious limits to the endeavor. Protection should be addressed in a comprehensive way. This means that the protection should cover the space segment, the ground segment and the user element, including the up-down links. The ground segment in particular is the weakest link. Therefore the greatest level of security should be devoted to ground stations, power supply etc. Threat could be both kinetic and cyber. Cyber, in many ways, is similar to space and deserves utmost attention.

- Deterrence. Security could be enhanced by deterrence and by retaliation in kind to off-set any gains potentially obtained by an attack. However, retaliation in kind within the space domain could prove to be ill advised, both for technical and political reasons. Furthermore, the mechanics of escalation in space are not fully understood yet and, there-

fore, escalation should not be contemplated as a first reaction. Air Power, instead, could be a viable means to deter attack on our own space infrastructure. Its inherent characteristics of reach, speed, precision could be exploited for swift kinetic response against an adversary's targets, e.g. the ground segment of the adversary's space infrastructure or against other valuable targets. Cyber could also offer retaliatory options, but technical as well as operational aspects of such a course of action still need further examination.

- Back up. Space support is so important for Air Power in the accomplishment of various missions that the consequences of degradation, corruption or even switching off signals from space have to be seriously contemplated and catered for. Today's technology offers alternatives and viable solutions for crucial functions such positioning, navigating and targeting. It is essential that the totality of future air platforms be equipped to operate in a degraded mode to cater for possible lack of space support.

- Responsive Space. The Alliance should consider acquiring a commonly funded 'responsive space capability' with small micro and nano-satellites, capable enough to back-up single space services, e.g. surveillance in the optical and non-optical fields and communications. Satellites of micro or nano-size are cheaper, faster to produce and easier launch. Micro and nano-satellites have a limited lifetime and do pose a problem at the end of their life because they orbit fairly low. Nonetheless they appear to constitute a viable back-up solution to bridge a gap until the full space capability is restored.

- Cooperation with international organizations. The large majority of NATO Member States are also members of EU and ESA. These European organizations own significant space infrastructures and have developed a body of policies from which NATO could benefit.

- Research. The space domain is rapidly evolving, with commercial interest driving significant changes. The technology behind space tourism could be exploited to enhance air power in several ways, ranging from

ISR to the displacement of personnel around the globe at space veloc-
ity. Small satellite technology could drive a fundamental change in the
nature of future space operations. Large and high technology satel-
lites will continue to be present, but these will be probably part of a
larger network that is complemented by a constellation of small satel-
lites. Small satellites will be affordable to more nations and entities,
thus providing tactical advantages, not only for NATO but also for its
possible adversaries.

Recommendations

Space is an essential enabler for NATO Air Power but also intrinsically
fragile. To fully exploit the potential of space, an Alliance space policy is
necessary as soon as possible. This overarching document must address
the following issues:

- Assured access. Duplication of space systems among NATO Member
  States is welcome. Strong bilateral and multilateral agreements on shar-
  ing are supported. Intensive and close dialogue with EU and ESA is ad-
  vantageous for NATO in order to learn best from the experience of the
  European organizations.
- Protection of space systems must be provided at the appropriate level,
  in particular to the ground segment. Air power with its deterrent capa-
  bilities could contribute to that security. Define the scope. NATO should
  consider taking on only a coordinating role in space.
- Space operations must be included into all NATO exercises.
- Space specialist positions must be inserted as appropriate into the
  NATO command structure.
- The number of space specialists must be increased by an adequate
  space training program.
- All air assets must be equipped to operate in a degraded environment,
  with reduced or even absent space support.

- Technology. The Alliance should closely monitor the latest commercial developments, such as space tourism and small satellites, that could affect fundamental changes in future space operations.
- The Alliance should consider acquiring a commonly funded 'responsive space capability' with small satellites.
- Space situational awareness and information sharing. A NATO Space Situational Awareness capability appropriate to its level of ambition should be pursued through an arrangement of MoUs with the space faring nations and entities.

Air and Space Power in Counter Insurgency Operations

VII

By Colonel Professor John Andreas Olsen and
Air Commodore Professor Dr. Frans Osinga

Introduction: Irregular Warfare

Intra-state conflicts marked by irregular warfare have been the dominant context for western military operations during the past two decades. In Afghanistan (2001–2014) and Iraq (2003–2014), the objective was counter-terrorism, counter-insurgency and stabilization, in Libya the mission focused on the protection of civilians, while in Mali operations supported the government in fighting transnational insurgents. Despite different objectives, these missions share at least five important features: strategic distance, a vast operational theatre, a complex local and international socio-political environment, high media exposure and opponents that employ irregular warfare tactics. Other nations, from Israel to Colombia, have also fought or are fighting insurgents variously labelled as guerrillas, bandits, terrorists, patriots, freedom fighters or partisans. Developments in the Middle-East, Africa and Asia indicate that 'war amongst the people' and 'war without fronts' will become more rather than less important in the decades to come.[1] NATO Member States and Partners must be able to master the art and science of Counter Insurgency (COIN) in addition to their primary mission of national and collective defence.[2]

The key lesson from centuries of Western-led COIN operations is that the military cannot by itself defeat insurgents and win the war; armed forces can at best help local actors to initiate desired political processes and structures. Insurgencies are profoundly political in nature; consequently, victory requires at least as much political *will* as it does *military* might.[3] The task for NATO Member States then, is to find the best possible way of contributing to joint, combined and inter-agency campaigns aimed at countering insurgents or recalcitrant regimes long enough to allow positive local political developments to take hold.

A review of the literature on the role and relevance of Air Power in COIN over the last century suggests that it has mainly been a facilitator for operations on the ground. Air Power has repeatedly demonstrated its utility in a supporting and enhancing role, such as gaining and maintaining control of the air, providing Intelligence, Surveillance and Reconnaissance (ISR) and transporting troops, supplies and equipment. Many analysts have concluded that Air Power should restrict itself to such auxiliary purposes, suggesting that direct attack, especially in the form air interdiction, is of limited value and that it can be counterproductive in the form of strategic targeting.[4]

It is perhaps in the arena of irregular warfare that Air and Space Power has made the most progress lately. Some of its significant limitations have been overcome by improved air-to-ground communication, increased capacity to loiter over the battlefield, upgrades in ability to carry and aim ordnance, and advances in technology for operations at night and in bad weather. The combination of modern high-tech ISR, coupled with precise air-to-ground strikes, can be a game-changer if applied with thorough knowledge of the nature and character of the conflict at hand.

This essay suggests that Air and Space Power can provide significant political and military-strategic leverage in contemporary and future COIN opera-

tions. It submits that NATO should place a high priority on developing a concept and investing in a system that can provide COIN-focused 'advice and support' to host nations in Air and Space Power capability, interoperability and competency, so that local forces can defeat insurgents. The essence of COIN 'advise and support' is to help the host nation win its own war. If NATO Member States decide to engage in the actual combat, they should optimize the advantage gained from combining modern ISR and precision strikes. With current Air and Space Power, one can gather ever-more accurate and timely intelligence and act 'on-target' effectively. Together with indigenous and special forces, Aerospace Power forms a trinity that challenges the old notion of deploying large numbers of troops into the theatre.

However, to become effective, NATO Member States must undertake comprehensive and in-depth studies of how Air and Space Power can contribute to COIN operations. The advantage of new technology can only be realized if NATO Member States fully comprehend the strengths and limitations of Air and Space Power relative to other military tools and have a good understanding of political and societal wrongs they want to right. Air and Space Power can contribute to improving political, social and economic conditions – winning 'hearts and minds' (soft power) – while concurrently executing 'search and destroy' missions through precision targeting (hard power). The precondition for effective use of this tool is to acknowledge the primacy of politics and the nature of irregular warfare. As Professor Colin S. Gray reminds us: 'Even when it is tactically well conducted, COIN is not an effective super-hammer when the problem happens not to be a nail in need of hammering.'[5]

Counter Insurgency Operations: The Need for Air-Mindedness

Traditionally, irregular warfare is defined as the use of violence by sub-state actors or groups within states to achieve power, control and legitimacy. Insurgents use unorthodox or unconventional approaches to warfare in

order to compensate for fundamental weaknesses in resources or capabilities.[6] However, following Frank Hoffman's notion of Hybrid Warfare, in contemporary wars the definition of irregular warfare needs to be amended, firstly, in the sense that state actors too can employ irregular warfare tactics, and, secondly, that sub-state actors in turn may have capabilities that allow them to combine regular with irregular modes of warfare (hybridity). What remains constant is that their goal is political, economic, social and/or religious change. According to Dr. James Kiras:

> … *some groups conduct irregular warfare to weaken the existing order and destroy it (anarchist), or profit from chaos (commercialist) or prefer to break away from the existing order and establish their own (secessionist). Others believe the existing order can be saved (reformist) or changed to serve traditional norms (traditionalists) or privileges (preservationists) better. Still others believe a more just and equitable society (egalitarian) can be created, while some believe that they are anointed to mete out religious rewards or punishments (apocalyptic-utopian). Groups can espouse a single cause, blend together one or more of the above or shift from one to another over time. Almost all groups seek to change the existing system, whether on national, regional or global scale.[7]*

This common definition assumes there is an existing order. What operations in Iraq and Afghanistan suggest, however, is that sometimes sub-state actors are engaged in a vicious struggle precisely because there is an absence of government and/or society is fragmented along ethnic and/or religious lines and the actors subsequently fight over the form of government and for political dominance. The traditional notion of a struggle between an established government and a single insurgent group needs to be expanded.

Also in terms of methods, the generic concept of an insurgency needs adjustment. Insurgents adopt methods of irregular warfare to offset their

military and organizational weakness. They rarely possess a capital city, a formal government infrastructure, an industrial base and regular armed forces. Insurgents are often organized as guerrilla forces that disperse, choosing when and where to attack and hide. They tend to fight in small units to exploit their advantages in 'hit-and-run' tactics. COIN is not about a fair fight, as David Galula taught us half a century ago: 'the insurgent, having no responsibility, is free to use every trick if necessary, he can lie, cheat, exaggerate. He is not obligated to prove; he is judged by what he promises, not what he does.'[8] The leaders commonly operate underground or have sanctuary in other countries. Insurgents typically seek to mobilize popular support from the citizens and carry out paramilitary actions as part of a larger political strategy. This can lead to confusing the method or tactics of irregular warfare for its strategy or purpose.[9] The main point is that, at least until insurgents gain strength and can control territory; wars against non-state entities are carried out in a fundamentally different manner than wars against conventional nation states. And, as Islamic State in Iraq and the Levant recently have demonstrated, even when insurgents hold territory, they may opt to employ irregular warfare methods.

In principle, there is a difference between terrorism and insurgency. Terrorism is characterized by the use of tactics to generate fear among civilian populations and coerce state governments. An insurgency requires popular support, which translates into greater resources and therefore requires a civil and military-like structure designed to challenge a state for territorial control. Countering terrorism is in the realm of aid to civil power – the police and intelligence services, among others – and is to a lesser extent relevant to NATO in the context of COIN. On the other hand, in intra-state conflicts the boundaries are not always so neat. As the civil wars in Iraq and Afghanistan show, terrorist groups may become part of the ecology of such wars. Militias or religious fundamentalist factions may turn into terrorist groups and insurgents often use terrorism as a part of their repertoire of tactics. Here too hybridity seems to have become the new norm.[10]

If the nature of irregular warfare is evolving, so too must one of the key associated doctrinal concepts. To state the obvious, COIN doctrines suggest approaches to counter insurgents, a term that encapsulates a variety of sub-state actors. To defeat insurgents more effectively than in the past, NATO Member States must challenge the prevailing thought that COIN operations have to be ground-centric and battlefield-oriented. The dominating doctrine in the United States, Field Manual (FM) 3–24, *Counterinsurgency*, written by the US Army and US Marines and published in December 2006, largely dismisses the use of Air and Space Power.[11] The 2011 Allied Joint Doctrine for COIN, AJP-3.4.4 dedicates three of its 156 pages to Air Power, and establishes up front that 'AJP-3.2 'Allied Joint Doctrine for Land Operations' provides the doctrinal underpinning for the COIN campaign theme and its relationship to the conduct of operations across the full range of military activities'.[12] Despite the quality of both doctrines and a series of other joint publications printed since, most NATO Member States still lack a concept and doctrine that convey fully the relevance and role of Air and Space Power in COIN operations. There are thousands of books and articles on irregular warfare, but Air and Space Power gets very little attention, and often more in the negative sense than in the positive.

This is unfortunate, particularly as sending large numbers of ground troops into a foreign country is problematic, and at times counterproductive. History shows that local populations often distrust or actively detest foreign troops. The more visible the intervening forces, the easier it is for the insurgents to use their presence to discredit the indigenous government. Insurgents can influence the local population in ways that foreigners cannot. Large expeditionary armies are also expensive and hard to maintain. Such deployments lead to close combat and consequently large numbers of casualties. The more troops there are on the ground, the more likely it is that they will be subjected to 'fog and friction.' The longer the war lasts, the more difficult it will be for expeditionary armed forces to sustain force protection and for the intervening countries to maintain international com-

mitment and popular support. It is a vicious spiral and, as Paris and Sisk have observed, it is part and parcel of the inherent contradictions and paradoxes of such comprehensive interventions.[13] Although drone strikes in Pakistan and elsewhere have led to unfortunate collateral damage, most unintended casualties result from ground forces engaging an opponent closely, under stress in the heat of combat. The new concepts for COIN operations should seek to avoid deploying large formations into theatre: the old concept is extraordinarily expensive in lives and treasure, and strategic success has often remained elusive.

The starting point is to develop a generic understanding of the essence of irregular warfare and the principles of COIN operations, while remaining cognizant that the devil is in the details of the specific circumstances. The next step is to optimize the use of Air Power in its four major roles: control of the air, airlift and air transportation, ISR and strike.

Advise and Support the Host Nation

The guiding principle is that local problems should be addressed locally. If NATO Member States and Partners decide to get involved in an 'out-of-area' theatre in which insurgents are a threat to the government they seek to support, the preferred method of approach should be to advise and support the host-nation.[14] NATO should focus on *advising, training, educating* and *equipping* the local government and its military forces, and avoid direct combat unless absolutely necessary. NATO advice and support can deter potential insurgents, and could give the indigenous forces the upper hand early in the confrontation, should it come to that.

The US military has some experience in the field. After the Second World War it helped build, equip and train air forces in Greece and the Philippines to oppose major insurgencies. The US strategy was to support allies with advisors, trainers, supplies, and equipment to help them fight their own

wars. The US also assisted in building the South Korean Air Force in the 1950s, and later assisted in strengthening Air Power capabilities for the regimes in Thailand, El Salvador and Colombia. The British in Malaya employed a broad strategic approach that addressed political, economic, and security issues. Having studied seventeen major COIN campaigns, Professor James S. Corum asserts that host nations can employ Air Power with great effectiveness if they get some help. Basic training and simple low-tech equipment are the main assistance requirements for small nations, combined with instructions on how to plan, lead and execute joint campaigns. He identifies six key air missions in which Air Power traditionally has made its mark: surveillance and presence; troop transportation (primarily helicopter transport of light infantry forces); armed strikes (primarily close air support); medical evacuation; liaison; and psychological operations.[15]

Supporting nations must acknowledge the actors and dynamics of the host society in order to facilitate a constructive working relationship among the *government*, its *people* and its *military and security forces*. They should therefore centre on enabling the supported to build capabilities and competencies in accordance with the principles of good governance; engage with the population in rural and urban areas to establish intention, direction, determination and confidence; and conduct comprehensive security sector reforms, focusing on the military, police and the intelligence services. In successful campaigns, military operations have been combined with government reforms, education and propaganda efforts as well as economic programs that addressed the needs of the population and, as a result, won the people over.[16] The military must engage in state-building; developing air forces must be seen as part of this larger enterprise, so that the effort does not detract from, but rather contributes to, the legitimacy of the government.

Providing *aviation advisors*, who are sufficiently culturally aware to work with host nations in the long term to build air and space capabilities, is a

key element of a larger development and stabilization strategy. This approach requires skills and equipment that are transferable to the host nation and calibrated to available resources. It is difficult to build an air force among a population in which resources are limited. It is, of course, necessary to establish what the host nation needs in terms of Air Power capabilities before establishing what can be afforded, and to put people, not technology, first. Since most conflicts now occur in the poorest countries of the world, even limited Air and Space Power capabilities can make a big difference. Some argue that it is expensive and too manpower-intensive to help another state build and maintain such capabilities, but the cost of getting directly involved in combat is more expensive still.

NATO's Partnership for Peace Programme has a scheme that could serve as a generic point of departure for defence and security sector reform. Selected *aviation advisors* need to understand the profession of airmen, have technical, tactical and organizational experience and skills, and a comprehensive understanding of COIN operations and the local conditions in which they operate. Properly implemented advice and support will have a deterrent effect on insurgents and reduce casualties and cost if the situation escalates to extensive violence and armed clashes. Air and Space Power has much to contribute, and, therefore, advising, training and equipping partner air forces should be the major component of NATO's COIN policy and strategy.

The New Role of Air and Space Power

Air Power has traditionally been important in the supporting and facilitating function of gaining and maintaining air superiority. Control of the air is necessary in irregular wars, as in conventional wars, but the lethality and intensity of the threats are often less than in interstate scenarios. If the threats from surface-to-air missiles and anti-aircraft artillery are limited, an active enforcement of no-fly zones might be sufficient.

The value of airlift in irregular warfare is obvious and springs from the in-surgents' dependence on sanctuary. Modern air forces enable fast and timely deployment over huge distances and to remote areas: a critical ad-vantage, especially when the opposition is subject to no-fly zones. Airlift permits rapid concentration of force, and reduces the vulnerability of ground units manoeuvring slowly in uncertain and often unforgiving ter-rain. Airdrops from 24,000 feet and higher – well above the altitude that threatens helicopters – can resupply troops in far-flung places with pin-point distribution. In addition to on-demand airdrop of people, equip-ment, and various supplies, airlift can also evacuate the sick and wounded. Strong airlift is essential to morale and confidence, and by bringing in rested troops where and when needed it reduces fatigue and improves military efficiency.[17] The ability to support the host nation government or own forces with supplies, materiel and aid over long distances, unhin-dered by borders and terrain constraints, with a small military footprint is one of the unique capabilities of Air Power. Airlift can assist in humanitari-an relief operations that are often necessary in war-ridden regions and post-conflict phases, and are frequently executed while the counterinsur-gency is still on going. The airdrops of food supplies to Iraqi refugees stranded on an Iraqi mountain and threatened by ISIS forces in the sum-mer of 2014 are just the most recent example of such humanitarian relief. Airlift is also instrumental in assisting civilian state-building activities, for instance in support of organizing elections.

Intelligence, Surveillance and Reconnaissance

Although control of the air and air manoeuvre remains important, it is the utility of ISR and strike that offers new inroads to dealing efficiently with insurgents. Advanced ISR systems constitute the single biggest advantage of modern air and space systems. With today's technology, ISR provides an unprecedented level of situational awareness for political and military de-cision-makers, from the strategic to the tactical levels of war. The obvious

benefit is that ISR can provide accurate and timely information about who does what, when, where and how. For example, the ability to oversee large areas of ungoverned space, deliver information to police and military forces on the whereabouts of the insurgents, and provide presence and security over critical infrastructure and friendly military positions can increase general population support and undermine the insurgents' cause. Air and Space Power in the reconnaissance and intelligence roles also undermines the insurgents' freedom of movement and perceived sanctuary. The employment of unmanned aerial aircraft increases situational awareness of commanders at all levels. Mastering the high ground offers a bird's-eye view and contributes to information superiority. When coupled with local knowledge of power structures, relations and actions on the ground, the advantage is bigger still. The challenge in the context of irregular warfare is not technological, but conceptual: identifying the bad guys and finding the pressure points that weaken their role without inflicting unintended casualties, thereby gaining the support of the local population.

One of the main challenges for any 'out-of-area' operation is convincing the population that you are doing the right thing, and that military force is necessary. The media are more interested in what goes wrong than what is done well. Air Power can have a brutal face and the media reports accordingly. It is important that any military campaign has a strong media component, to explain properly what is happening. ISR is an incredibly useful instrument for strategic communication because it provides facts and data. It often has 'the evidence,' although there are limits to what kind of information the military will be willing to share at any given point.[18]

ISR also offers an alternative to force-on-force engagement that is often neglected: it can effectively *deny* the insurgents access to funds. Appropriately tailored air and space actions, shifting ever more into the cyber realm, can restrict the opponent's ability to transfer funds electronically.

If insurgents need to rely on piles of hard cash instead, modern ISR capability can then be used to find the money, track its movements, and destroy it (from the air) or guide troops to confiscate it (from the ground). When insurgents cannot buy supplies and weapons or pay their fighters, they lose influence and credibility. Detecting and destroying weapons before they are put to the test reduces fighting capability, initiative and morale. Thus, using the non-traditional tool of cyber attack increases the effectiveness of the more traditional mission of ISR. The combined capability building of *friend* and capability destruction of *foe* can be very powerful when conducted systematically, and with imagination and knowledge of the end-state objective.

Expanding on this thought of using a COIN strategy that integrates the traditional and non-traditional, *denying* the enemy access to funding could be combined with *enabling* a sustainable income for the local population at large. To widen the role of space power, decision makers in intervening countries should consider using sensing technologies, especially hyper-spectral imaging, to help the locals increase agricultural efficiency and output. They could initiate a high-resolution survey of arable landmasses to determine which legal crops might thrive best. Subsequently, friendly actors in the host country could provide seeds and tools or assist with small-scale infrastructure projects, such as irrigation. The intervening entity should refuse to involve any corrupt actors on the ground, thereby avoiding loss of money to graft and allaying the locals' misgivings about such authorities.

The ISR assets should conduct this operation across the country, so that the aggregate of individual projects has a nationwide impact. Satellites could monitor crops throughout the year to quickly recognize where yields will be high or low, and prepare the host government to address areas of need in those regions were crop yields are lagging. Remote sensing can help local people to get a fair price for their legal products by

protecting trade routes, thus reducing the temptation to grow illegal crops to make a decent living. If the local population can make a legal and safe living, they will be less inclined to support an insurgency that could throw all that into question again. COIN forces must become the arbiter of well-being by providing goods and facilitating growth. Such efforts need to be founded on local ownership of the undertakings and coordination between external actors.[19]

NATO must think 'out of the box' and, amongst other things, include non-kinetic approaches that directly and indirectly restrict insurgents' ability to wreak mayhem. This means depriving them of the ability to move large amounts of money to buy weapons or offer bribes and indirectly lowering the support insurgents receive by assisting the local population to make a better, legal living for themselves. The example is meant to illustrate that with today's ISR capabilities imagination and will is the limit, not technology and ability.

Precision Strikes in Joint Operations

Attack aircraft, manned or unmanned, employed with sophisticated targeting systems markedly reduce the risk of civilian casualties. Combined with a whole family of satellite-guided munitions, aircraft can strike static and moving targets with extreme accuracy in any weather conditions. In addition, new technology in communication offers greater synergy between air and ground forces. Airborne ISR can provide highly precise information about movements on the ground, and confirmation and updates from the units on the scene can be used to ensure that small-diameter precision-guided munitions are accurate and lethal. According to General David Petraeus, who knows well of what he speaks: intelligence on the identity, movements and whereabouts of the insurgents is crucial, so that they can be targeted individually and discriminately, without accidentally hurting civilians among whom they are hiding.[20]

Collateral damage normally does not result from failures of technology but from the impossibility of predicting human behaviour. Damage occurs when innocent people are in the stricken vehicle or building – that is, when intelligence is incomplete. Often, it is also the result of opponents' actions, which deliberately exploit civilian presence to mask capabilities, exposing civilians to high risk. Careful selection of targets and weaponry will mitigate unnecessary civilian casualties, while coordinated efforts with on-the-scene forces will enable engagement of key insurgency targets. Cooperation with the local government and populace is critical to maximizing the benefit of Air Power in the strike role.

ISR also enables the friendly force to follow adversaries back to their safe houses and confront them at the time and place chosen by the friendly force rather than the insurgents. Rather than engaging fighters in built-up and populated areas, the eyes in the sky track them to less populated areas and then direct other assets to attack them there. Precision strikes minimize harm to non-combatants and reduce the need to put ground troops in harm's way. The new ability to target small emerging mobile targets in a timely manner is due to a combination of precision munitions, precision information, much improved air-land integration down to the tactical level and improved air command and control systems.

A key ingredient for successful strikes is constant investment in air-land integration. This allows novel forms of ground operations: distributed operations can cover wider areas than before with lower levels of risk and much lower footprint of boots on the ground. Air Power obviates the need for heavy organic fire support assets that require a huge logistical support infrastructure. Air Power can reduce risks for ground troops because precision Air Power provides for new air support options at much closer distances to friendly ground troops. Moreover, the air weapon is largely under the control of highly disciplined, officer-pilots operating in relative safety above the COIN fray; decisions as to the application of force can be

made without the chaos and enormous pressure a young COIN trooper faces under direct ground attack. This joint model limits the need for ground troops to engage in risky close combat, denying the opponent the opportunity to inflict heavy casualties which in turn could be exploited in the media to undermine public support in NATO nations. Persistent ISR and strike missions have also supported logistical and reconnaissance convoys and patrols in new ways through early detection of road side bombs, improvised explosive devices and early warning of potential ambushes. These new capabilities enable prolonged stability operations in remote areas with small ground troop contingents.

The new precision Air Power capabilities allow for novel forms of intervention in international crises. The old saying – 'if the enemy is within range, so are you' – is no longer true. OPERATION ENDURING FREEDOM saw the employment of small groups of Special Forces assisting indigenous ground units that, in combination with precision Air Power, resulted in the removal of the Taliban. During OPERATION IRAQI FREEDOM, the Unites States employed a similar concept in the north of Iraq, this time pairing Special Forces with Kurdish Peshmerga. Using indigenous forces combined precision strikes and ISR assets, thirteen Iraqi divisions were fixed in the north and largely rendered ineffective. In 2011, in OPERATION UNIFIED PROTECTOR, NATO for all intents and purposes, employed the so-called Afghan Model in Libya. This time, after having blocked the advance of Libyan regular troops towards Benghazi, a small number of Special Forces of various nations trained the Libyan rebel forces. The combination of persistent air surveillance and air strikes was instrumental in avoiding a humanitarian disaster. Eventually, it also resulted in the overthrow of the Gadhafi regime by the rebels, although this was never a NATO objective.[21] In Mali, in OPERATION SERVAL, small numbers of widely dispersed French ground troops combined with aviation and fixed wing air strikes, managed to block the advance of insurgents. In August 2014, US air strikes helped stop the ISIS advance to Mount Sinjar, thus avoiding further slaughter of the Yazidi minority.

Such precision strikes not only offer enhanced and timely protection for small ground units, they also send clear political signals, and have dramatic effects on the functioning of guerrilla and terrorist organizations, as recent empirical research has indicated.[22] Groups like the Taliban, Hezbollah, Hamas and al-Qaeda have unique organizational characteristics that make them susceptible to the regular removal of key leaders in these organizations. These are clandestine and value based violent groups, where charisma is a key feature of authority, as is trust among central figures. Leaders who have been removed are hard to replace. Removal of the leadership also results in loosening of loyalties, which is dangerous for such covert groups, and causes distrust, as no one knows who provided the targeting information that led to the leader's removal. These organizations are resilient and new leaders eventually will replace old ones, but the steady removal of experienced cadre also leads to loss of technical and operational expertise (such as passport forgers, bomb makers, recruiters, and fund raisers).

In addition, removals put stress on the organization, which now has to focus on survival. It disperses such groups, driving them into hiding, seeking sanctuary in remote areas. This forces them to change their behaviour, keeping them preoccupied with survival and hindering their ability to move as well as to plan and carry out operations. These combined effects degrade the strength and effectiveness of such networks, driving down the overall level of violence and decreasing the number and lethality of attacks. The prospect of living under the threat of instant death from above makes recruitment more difficult and keeps operatives from establishing close ties to local civilians, who fear they might also be killed. Fear of detection by airborne sensors forces operatives to avoid using electronic devices or gathering in large numbers. Leaders cannot give orders when they are incommunicado, and training on a large scale is nearly impossible when a precision airstrike could wipe out an entire group of new recruits. From a strategic perspective,

focused air strikes on key members of violent groups are actually quite effective in the long run.

In short, the new role of Air and Space Power offers strategic effects. It is a tool that can disrupt, demoralize and wear out opposing forces and it forces insurgents to adjust, react and adapt. Precision targeting can degrade the morale of combatants, and inflict stress, helplessness and despair. Indeed, the threat of rapid air strikes and awareness of persistent ISR has forced opponents to adopt strategically less effective modes of dispersed guerrilla operations and to rely on the problematic use of improvised explosive devices. Air and Space Power can help achieve ground dominance without substantial physical ground presence. These lessons must be included and expanded upon as part of NATO's *Connected Forces Initiative* (CFI). After the end of the International Security Assistance Force's mission in Afghanistan, CFI will build on NATO's experience – including lessons learned from 20 years of operations – to ensure that its Member States can work even more effectively together and with partners.

However, achieving such dominance presents a perception challenge: the process tends to generate harsh images that are not well-received by the public. To be fully efficient, NATO must think harder about strategic communications. NATO must have a plan of campaign for telling the story – explaining what happens, why and where. Strategic communication is about being the first to tell the truth, and NATO must get better at explaining the rationale for its operations. The public should know what is going on and, with fewer troops on the ground, there will be fewer journalists deployed to the theatre of operations. NATO needs to develop a strong media plan for keeping the public informed about the truth as well as the values and principles it seeks to protect and pursue. Destruction from above is brutal, even when effective; the public needs to be educated and informed on how Air Power contributes to weakening insurgents and strengthening the rule of law.

Conclusions: The Asymmetrical Advantage of Aerospace Power

The cardinal rule of intra-state conflicts is that military power by an external actor alone cannot secure victory and that local problems must be solved locally: success or failure will be decided by indigenous governments. A NATO-led military campaign must accept this dual premise: it must be designed to help develop legitimate and stable institutions and to give the host enough time to address the *political, economic* and *social* issues that drove the adversary into warfare in the first place. Moreover, visible improvements in the country concerned must take place quickly; otherwise the population will conclude that things were better before the intervention started.[23]

Due to recent experience, new joint tactics and organization and a variety of new technologies, Air Power can play a distinctly more substantial role in a context of irregular warfare than before. Air and Space Power can be applied with both rapidity and scalability. Air and Space Power is most useful in countering insurgents if one distinguishes between *occupation* and *control*. NATO Member States need not occupy territory to exercise influence and control. Rather than place huge numbers of troops on the ground – putting them in range of enemy weapons such as improvised explosive devices and stirring up national hostility by their mere presence – the intervening entity can operate from afar. Air Power becomes even more useful if it includes a range of non-kinetic options in addition to the hard-kill aspect that is most often associated with it. Strikes are tremendously intelligence-intensive across the full spectrum. It is important to keep in mind the overarching purpose of strikes against insurgent leaders and managers: to create strategic breathing space in order to deny the initiative to the opponent and to allow other stabilization efforts to be planted, take root, and grow.

There is nothing honourable about seeking a 'close fight,' engaging the enemy *mano a mano*: the first principle of counterinsurgency should be

'advise and support'; if you need to get directly involved, operating from a 'safe distance' (ISR and strike) is preferable to in-theatre fighting on the ground. Part of the solution is to develop modern COIN theories and doctrines that take air and space power into account in two ways. On one hand, Air and Space Power can contribute to improving social and economic conditions, winning 'hearts and minds' in accordance with the *soft power* principle. On the other hand, Air and Space Power represents effective and efficient *hard power* since it can support the policy of 'search and destroy' through precision targeting. NATO's Comprehensive Approach is a viable point of departure for improving COIN theory and doctrine.[24]

The key to Air Power is targeting, the key to targeting is intelligence, and the key to good use of intelligence is the analysis of effects.[25] Thus, for COIN operations, NATO Member States need a proper analysis of the adversary (intentions, objectives, methods and capabilities) and insight into and knowledge of the specific circumstances (whereabouts). Only with all of that in place should one engage in the process of targeting. The unique characteristics of Air Power – elevation, speed, and range; timely intelligence and precision strike; and the flexibility this combination allows – offer a broad spectrum of military options. Shadowy adversaries are not immune from attacks from above. As one discouraged Afghani told a *New York Times* reporter in the early phases of OPERATION ENDURING FREEDOM: 'these bombs from the sky we cannot fight.'[26]

This chapter does not suggest that Air and Space Power is a tool that offers decisive victories against insurgents of all forms or that it should always be the prime tool for dealing with such hostilities; nor does it suggest that technology is a panacea. It certainly does not encourage NATO Member States to seek opportunities to conduct COIN operations. It does argue that it is a good thing that the agile and creative use of Air and Space Power can substitute in large part for numbers on the ground. It also argues that Air and Space Power can have a more prominent role in facilitating local po-

litical processes and structures, contributing to the objective of establishing a sustainable, legitimate government. Air and Space Power can help set the stage for enduring longer-term societal developments in accordance with the values of democracy, individual liberty and the rule of law.

Recommendations: Give Priority to Counter Insurgency Operations

One of John F. Kennedy's first acts as president was to demand that the American military take COIN far more seriously.[27] With the more recent experiences it is time to take irregular warfare seriously again and to make the most out of the asymmetrical advantage that Air and Space Power has to offer.

Establish advisory and support teams for host nation Air and Space Power capability and competency building. NATO should consider revitalizing the concept of air advisors, with allocated resources for Air and Space Power capability building in partner states. Such an effort can build on burden-sharing principles, such as *Smart Defence,* with or without some states providing specialization. Advising, training and equipping of partner nation police, intelligence and militaries, and mechanisms that strengthen state and government, will be the most effective means of discouraging deterring, degrading and defeating insurgents. Such teams must be joint and combined, and, together with Member States from several agencies and departments, they must operate within the umbrella of defence and security sector reform. The Civil-Military Cooperation Centre of Excellence (CIMIC COE) could serve as a conceptual reachback, especially if it is given responsibility for matching Air and Space Power to security sector reform.[28] Since irregular warfare and Counter Insurgency Operations are civil-military in nature, there is much to be gained from having the Joint Air Power Competence Centre (JAPCC) work more closely together with CIMIC COE.[29]

NATO Member States *should consider investing further in joint air-land integration, to take advantage of the synergy found in accurate ISR and precision targeting.* NATO should give priority to training, exercises and education that strengthen the potential of matching full spectrum Air and Space Power capabilities with small numbers of Special Forces and local forces, founded on the objective and strategy of establishing good governance. Exercises should mirror realities: simulators are often good but cannot be a full-fledged substitute: the principle of 'train as you fight' is just as valid now as it was in the past. A key part of this is finding new and better ways to use human intelligence, and using indigenous forces to help identify entities that should be strengthened (systemic empowerment) and weakened (systemic paralysis).[30] There is a huge potential for strategic effects when combining modern ISR and precision strike with local knowledge on the ground: tailored Special Forces and precision Air Power offers a significant asymmetrical advantage against insurgents.

NATO Member States *should consider conducting a series of studies on the role of Air and Space Power in COIN operations, and develop a theory for such operations.* The role of air and space power in irregular warfare is not well understood. Decision makers and the armed forces need to improve their knowledge of, and insight into, the role of Air and Space Power in combating insurgencies. Adding imaginative and innovative thought to that knowledge could set the stage for a better application of both kinetic and non-kinetic force. NATO's JAPCC would be a good place to conduct air-minded *comprehensive studies* that acknowledge the true role of Air and Space Power in COIN operations, critically and factually. The Centre could also encourage NATO Member States to take such studies more seriously at their command and staff colleges and consider developing a *proper* doctrine for Air and Space Power in such operations. Member States would then need to compare the findings of those analyses to their national doctrine in order to identify gaps before NATO can develop overarching guidance for the entire alliance. There is

a wealth of experience that should be codified from various operations in Afghanistan, Iraq, Libya and Mali.

In summary, this chapter argues that Air and Space Power can play a major role in COIN operations by capitalizing on traditional and non-traditional ISR and highly precise targeting. It suggests that NATO can be considerably more effective and efficient in supporting indigenous forces if such operations encompass air-mindedness rather than remaining ground-centric and battlefield-oriented. Together with indigenous and special forces, Aerospace Power can form a trinity that challenges the old notion of deploying large numbers of troops into the theatre. The new notion should focus on *control* rather than *occupation*, targeting from a safe distance rather than in-theatre fighting, and enhancing local political structures and processes in pursuit of good governance. Aerospace Power should be a major component of a joint, inter-agency plan of campaign, and it can play a dominant role against insurgents if one explores its new potential rather than constrain thinking by looking to the past.

Endnotes

1. The opinions and conclusions expressed in this essay are those of the authors; they do not represent the official position of any government or agency. We are indebted to Etienne de Durand, Peter Engelmann, Richard P. Hallion, James Kiras, Rohan Maxwell, Phillip S. Meilinger and Ephraim Segoli for input to this chapter.
2. It is important to emphasize that NATO as an Alliance did not conceive of OPERATION UNIFIED PROTECTOR as a COIN mission. From beginning to end the Alliance maintained a threefold mission: monitor the arms embargo; enforce the no-fly zone; and protect civilians from attack. All of these were in accordance with the United Nations Security Council Resolution (UNSCR) 1973. This UNSCR was extremely important to the Alliance, and the individual NATO nations, because this was the legal mandate for military operations. For the Alliance OUP could never be about regime-change because such an objective lacked consensus among all 28 nations. Moreover, OUP was not the 'air force' for the Anti-Gadhafi Forces (AGF) that where fighting Pro-Gadhafi Forces (PGF). OUP was to protect civilians from whoever was attacking them. Some individual nations had representatives within the National Transitional Coalition (NTC) of Libya which enabled coordination with the NTC, but those nations did so on a unilateral basis, independently from the Alliance. NATO as an Alliance never coordinated airstrikes, ISR or any matter of combat operations with the NTC or the AGF. Lt. Gen. (ret.), Ralph Jodice, correspondence with authors, 20 Aug. 2014. Jodice was the Air Component Commander for OPU.

3. Greg Mills and David Richards (ed.), *Victory Among People: Lessons from Countering Insurgency and Stabilizing Fragile States* (London: RUSI, 2011), 1.

4. The most comprehensive study on the role of Air Power in Counter Insurgency Operations is James S. Corum and Wray R. Johnson, *Airpower in Small Wars: Fighting Insurgents and Terrorists* (Lawrence: University Press of Kansas, 2003). They offer eleven lessons: 1) a comprehensive strategy is essential; 2) the support role of Air Power (e.g., reconnaissance, transport, and so on) is usually the most important and effective mission in a guerrilla war; 3) the ground attack role of Air Power becomes more important when the war becomes conventional; 4) bombing civilians is ineffective and counterproductive; 5) there is an important role for the high-tech aspects of Air Power in small wars; 6) there is an important role for the low-tech aspects of Air Power in small wars; 7) effective joint operations are essential for the effective use of Air Power; 8) small wars are intelligence intensive; 9) air power provides the flexibility and initiative that is normally the advantage of the guerrilla; 10) small wars are long wars; and 11) the United States and its allies must put more effort into small wars training. See also Corum, 'Air Power in Small Wars: 1913 to the Present,' in John Andreas Olsen (ed.), *A History of Air Warfare* (Washington D.C.: Potomac Books, 2010), p. 327–350. For further perspectives, see Martin van Creveld, *The Age of Airpower* (New York: Public Affairs, 2011), especially p. 339–422.

5. Colin S. Gray, *Airpower for Effect* (Maxwell, Alabama: Air University Press, 2012), p. 42.

6. James D. Kiras, 'Irregular Warfare,' in David Jordan, James D. Kiras, David. J. Lonsdale, Ian Speller, Christopher Tuck and D. Dale Walton, *Understanding Modern Warfare* (Cambridge: Cambridge University Press, 2008), p. 225–291.

7. Ibid., p. 231.

8. David Galula, *Counterinsurgency Warfare: Theory and Practice* (Westpoint, Connecticut: Praeger Security International, 2006), first published 1964.

9. See for example Kiras, "Modern Irregular Warfare: Afghanistan and Iraq," in John Andreas Olsen and Colin S. Gray (eds.), *The Practice of Strategy: From Alexander the Great to the Present* (London: Oxford University Press, 2011), p. 260–286.

10. See Frank Hoffman, *Conflicts in the 21st Century: The Rise of Hybrid Wars*, Potomac Institute for Policy Studies, Arlington, Va., December 2007. Proponents of the concept of Fourth Generation Warfare, such as William S. Lind and T. X. Hammes, have highlighted this 'blurring' of boundaries. For an assessment of these concepts, see for instance Frans Osinga, 'On Boyd, Bin Laden and Fourth Generation Warfare as String Theory,' in John Andreas Olsen, *On New Wars* (Oslo: Norwegian Institute for Defence Studies, 2007).

11. For a critical assessment of FM 3–24, see Charles J. Dunlap, Jr., *Shortchanging the Joint Fight: An Airmen's Assessment of FM 3–24 and the Case of Developing Truly Joint COIN Doctrine* (Maxwell Air Force Base: Air University Press, 2007).

12. Allied Joint Doctrine for COIN, AJP-3.4.4 (2011), https://info.publicintelligence.net/NATO-Counterinsurgency.pdf, xiii.

13. Roland Paris and Timothy Sisk, *The Dilemmas of Statebuilding* (London: Routledge, 2009), in particular chapters 1 and 13.

14. For excellent insight, see Alan J. Vick, Adam Grissom, William Rosenau, Beth Grill and Karl P. Mueller, *Air Power in the New Counterinsurgency Era: The Strategic Importance of USAF Advisory and Assistance Missions* (Santa Monica, CA: RAND, 2006). It concludes that to enhance its contribution to counterinsurgency, the United States Air Force (USAF) should take the following steps: 1) make counterinsurgency an institutional priority; 2) create organizations and processes to oversee USAF counterinsurgency efforts; 3) develop and nurture counterinsurgency expertise throughout USAF; 4) create a wing-level organization for aviation advising; and 5) enhance USAF combat capabilities for counterinsurgency.

15. Corum, 'The Right Airpower Doctrine for Unconventional Wars,' paper presented at the Turkish Air War College Conference in 2013 and 'The Role of Airpower in Current and Future Small Wars' in James Fergusson (ed.), *Aerospace Power: Beyond 100 Years of Theory and Practice* (Centre for Defence Studies: University of Manitoba, 2005), p. 67–84.

16. See David Petraeus 'Learning from Counterinsurgency: Observations from Soldering in Iraq,' *Military Review* (Jan–Feb 2006), 2–12. He listed 14 'observations:' 1) 'do not try to do too much with your own hands,' 2) act quickly, because every Army of liberation has a half-life; 3) money is ammunition; 4) increasing the number of stakeholders is critical to success; 5) analyze 'costs and benefits' before each operation; 6) intelligence is the key to success; 7) everyone must do nation-building; 8) help build institutions, not just units; 9) cultural awareness is a force multiplier; 10) success in a counterinsurgency requires more

than just military operations; 11) ultimate success depends on local leaders; 12) remember the strategic corporals and strategic lieutenants; 13) there is no substitute for flexible, adaptable leaders; and 14) a leader's most important task is to set the right tone. For further context, see Beatrice Heuser, *The Evolution of Strategy: Thinking War from Antiquity to the Present* (Cambridge: Cambridge University Press, 2010), p. 419–437.

17. For more details, see for example Robert C. Owen and Karl P. Mueller, *Airlift Capabilities for Future US Counter Insurgency Operations* (Santa Monica, California: RAND, 2007).

18. Both Mao Zedong and Vo Nguyen Giap believed that the truly distinctive to their type of guerrilla war was the attention paid to political education and propaganda.

19. We are particularly grateful to Peter Engelmann for these thoughts.

20. Petraeus, 'Learning from Counterinsurgency,' observation number 6.

21. For a detailed analysis of OPERATION UNIFIED PROTECTOR, see Christopher Chivvis, *Toppling Qadaffi* (Cambridge: Cambridge University Press, 2014) and Kjell Engelbrekt et al, *The NATO Intervention in Libya* (London: Routledge, 2014). For reference to the Afghan model, see for instance Erica Borghard and Constantino Pischedda, 'Allies and Airpower in Libya,' *Parameters* (Spring 2012), p. 63–74.

22. For further discussion of these effects, see for instance Patrick B. Johnston, 'Does Decapitation Work? Assessing the Effectiveness of Leadership Targeting in Counterinsurgency Campaigns,' *International Security*, Vol. 36, No. 4 (Spring 2012), p. 47–79; Bryan C. Price, 'Targeting Top Terrorists: How Leadership Decapitation Contributes to Counterterrorism,' *International Security*, Vol. 36, No. 4 (Spring 2012), p. 9–46; Thomas Rid, 'Deterrence beyond the State: The Israeli Experience,' *Contemporary Security Policy*, 33:1 (2012), p. 124–147; Alex S. Wilner, 'Deterring the Undeterrable: Coercion, Denial, and Delegitimization in Counterterrorism,' *Journal of Strategic Studies*, 34:1 (2011), p. 3–37; Alex S. Wilner, 'Targeted Killings in Afghanistan: Measuring Coercion and Deterrence in Counterterrorism and Counterinsurgency,' *Studies in Conflict & Terrorism*, 33:4 (2010), p. 307–329; Amitai Etzioni, 'The great drone debate,' *Military Review*, (March-April 2013), 10; Daniel Byman, 'Why Drones Work: The Case for Washington's Weapon of Choice,' *Foreign Affairs* (July-August 2013).

23. Petraeus, quoted in Heuser, *The Evolution of Strategy*, p. 436.

24. See http://www.nato.int/cps/en/natolive/topics_51633.htm, accessed 15 May 2014, for more on the comprehensive approach.

25. See for example Phillip S. Meilinger, 'Air Targeting Strategies: An Overview,' in Richard P. Hallion (ed.), *Air Power Confronts an Unstable World* (London: Brassey's, 1997), p. 51–82.

26. Barry Berak, 'A Nation Challenged: Death on the Ground,' *New York Times*, 13 Oct. 2001.

27. Lawrence Freedman, *Strategy: A History* (New York: Oxford University Press, 2013), p. 188.

28. See www.cimic-coe.org. At the time of writing the Netherlands are considering re-locating and possible re-naming the Civil-Military Cooperation Centre of Excellence.

29. See http://www.nato.int/cps/en/SID-4D26FFB3 238A5876/natolive/topics_68372.htm, accessed 15 May 2014, for more on NATO's centres of excellence.

30. See John Andreas Olsen, 'A New Concept for Air, Space and Cyber Power,' in *Air and Space Power in NATO: Future Vector: Part I* (Kalkar, Germany: Joint Air Power Competence Centre, July 2014), p. 95–108.

Assured Air and Space Power

<div style="text-align:right">**VIII**</div>

Entry Capabilities in Denied Airspace Environments

By Air Marshal Graham Stacey

U sing the question 'does NATO have the right capabilities to control and keep situational awareness of the proliferation of anti-aircraft systems to possible future adversaries and terrorist networks' as an example, this paper will consider the wider issue of NATO's required response to Anti Access, Area Denial (A2/AD) capabilities over the next 10 years.

Introduction

In common with the other environments, Air and Space Power will remain of paramount importance to the conduct of NATO's current and future military operations. However, the freedom to deploy and employ this power will be increasingly contested in the future. Longer range and more precise weapons could affect space based platforms, land forces, airbases, capital ships and network infrastructures.[1] Future State adversaries are likely to utilize A2/AD capabilities, indigenously produced or overtly and covertly procured. NATO can expect to see unconventional attacks, cyber attacks, disruption and even orchestrated host nation civil unrest used as methods to reduce its combat, combat support and combat service support capabilities.

Taking the perspective of the Joint operational commander, this paper will argue that, to counter the threat, a comprehensive approach is required, involving numerous agencies operating both within and without the Joint Operational Area (JOA), and will therefore include some capabilities that lie outside the control of the operational commander. As an exempler, and with the aim of promoting debate and discussion on the need for and the NATO approach to assured access, this paper will argue that the vulnerability of air platforms to anti-aircraft systems and more general threats means they must be countered as much as possible before air and space assets are employed in the JOA. It will also argue that the increased cost of air platforms and the defences they need are prohibitively expensive for individual NATO nations and that a fresh approach is required if NATO wishes to maintain an ability to operate in denied airspace environments.

The Threat

Anti-Aircraft Systems. For the purpose of this paper, anti-aircraft systems will encompass the whole range of weapons systems operated on the ground. They are characterized by varying degrees of effectiveness and availability and can be divided into 3 main groups:

- *Small Arms/Ground-to-Ground*. The first comprises small arms and un-guided munitions, which are widely available and impossible to control completely but have limited effectiveness against air platforms.
- *Man Portable Air Defence Systems (MANPADs)*. MANPADs are not as freely available as small arms but do exist in abundance. Although the operator requires a comparatively high level of training, there is a large pool of expertise available from former military and industry personnel. The advantages of MANPADs are they are difficult to detect, they are relatively easy to move and they can be highly effective against air systems without capable Defensive Aid Suites (DAS). In Ukraine, state-backed separatists have posed a serious challenge to the ability of the Ukrainian Air

Force to operate freely and without loss, as was demonstrated by the loss of 49 personnel in a transport aircraft on 14 June 2014, reputedly to MANPADs.[2]

- *Ground Based Air Defence (GBAD) & Integrated Air Defence System (IADS).* These are widely available amongst several nations. Such layered defence is very effective, including against the latest generation of aircraft, but expensive to procure and maintain. Russia continues to be a world leader in air defence systems and has marketed such systems to Iran and Syria, amongst other customers. Recent events have proved that possession of sophisticated long-range GBAD systems is not confined to nation states. At the time of writing, Malaysian Airlines flight MH17 is suspected of having being shot down on 17 July 2014 by an SA-11 system operated by Russian-backed separatists. Whilst the provenance of the system remains disputed, and it was not being operated as part of an IADS, the ability of irregular forces to operate a large, modern weapon system with such devastating effect highlights the vulnerability of unsuspecting and unprotected air platforms.

Future Adversaries. Historically, focus has been on terrorist networks, but, more recently, other groups and organizations have appeared which have the ability to challenge assured access. The Islamic State of Iraq (ISIS, now IS) and the Levant represent a well-armed and capable threat and, in Ukraine, we have seen the ability of state-backed groups to deny freedom of the air. Whilst NATO nations have focused almost exclusively on Iraq and Afghanistan during recent years, other nations have been fielding vastly improved weapons designed to keep western forces at bay.

US forces are now paying much more attention to China and their A2/AD capabilities. However, other nations, such as Russia, North Korea and Iran, also feature heavily in the A2/AD debate. The threat posed by another state or group of states allied together against NATO should not be underestimated. The proliferation among adversaries of double-digit

Surface to Air Missiles (SAMs), stealth aircraft and longer range ballistic missiles was a prominent theme in defence studies before the September 2011 attacks. After that, everything was focussed on the counterinsurgency effort and the US, along with many NATO countries, put the A2/AD threat on the back burner.[3] The USA has woken up to this problem and is now investing time, effort and money into its newly developed Air-Sea Battle Concept (ASB). The ASB Concept is designed to attack in-depth, but instead of focussing on the land domain from the air, the Concept describes integrated operations across all 5 domains (air, land, sea, space and cyberspace) to create advantage.[4] This concept would be equally beneficial for NATO and there is an urgent need for NATO to consider the need for an ASB concept, the level of ambition and how this might work with, or alongside, US capabilities.

Control and Situational Awareness

Current Situation. NATO relies on individual national capabilities to provide shared information and situational awareness, but this is only done on a 'willingness to share' basis. Controlling or maintaining situational awareness of the proliferation of small arms is a notoriously difficult global problem and, in some regions, their presence is so widespread it is impossible to place any limits on their use. MANPAD proliferation is mainly dealt with at a national level and is predominantly led by the USA, which has seen some success. For example, since 2003, cooperation with more than 30 countries around the globe has enabled the US MANPADs Task Force to bring about the destruction of nearly 30,000 excess, loosely secured or otherwise at-risk MANPADs.[5] The developments in other nations' GBAD/IADS capabilities can be controlled somewhat by trade embargoes; however, the truth is that many countries have already made tremendous advances in their capabilities and, regardless of the technological advances made in aircraft technology and defensive systems, there will always be a GBAD system developed to counter them. Whilst the absence of an attack

against an air system might indicate successful control, that in itself does not exclude the possibility that anti-aircraft systems are falling into the wrong hands unnoticed, as the fate of MH17 tragically demonstrates.

Assured Access

Definition. To understand the quandary faced by Air Power, we should understand exactly what assured access means. It has been defined as, 'The unhindered national use of the global commons[6] and select sovereign territory, waters, airspace and cyberspace, achieved by projecting all the elements of national power.'[7] This definition implies that a comprehensive approach is needed to ensure Air Power has freedom of operation, but we need to be clear what type of access we require. Are we seeking to achieve air superiority, or even air supremacy? Or do we only require an ability to operate Air Power in time and space, rather than achieve a permanently sanitized airspace?

Airspace Denial. The interpretation of the threat can have a significant impact on airspace denial and, at times, the question revolves around whether the threat is actual or perceived. The mere presence, or suspected presence, of anti- aircraft systems can be sufficient to deny airspace. One limiting aspect of NATO operations against Serbia in 1999 was the capacity of that country's IADS and the Serbs proved themselves to be very adept at using decoys to limit NATO's freedom of operation. Fear of anti-aircraft systems has continued to be a limiting factor in potential NATO operations ever since. Did the difficulties envisaged in operating Air Power over Syria impact on the willingness of western nations to provide air support to rebel forces in 2013? This is linked directly to the appetite to take losses; the perception of the threat can prevent NATO from acting in the first place.

Afghanistan and Iraq. On the other hand, experience in Afghanistan and Iraq may be lulling western air forces into a false sense of security and un-

reasonably raising expectations of assured access, as in both conflicts the West has enjoyed almost complete freedom to operate. There has been little, if indeed any, use of MANPADS against western air forces, but this has only been achieved through a robust comprehensive approach of all agencies combining to prevent anti-aircraft systems from reaching the JOA. That is not to say there have not been losses in either operational theatre. For example, the USA experience in Iraq on 24 March 2003, when, in one engagement, it lost one Apache and had another 31 damaged to anti-aircraft fire,[8] highlights what can happen when air systems come up against determined or capable opposition. However, the fact that so many aircraft suffered damage to comparatively unsophisticated ground-based defences demonstrates that no air system can ever be truly immune from danger and spending large sums of money on developing the latest technology is no guarantee of safety.

Comprehensive Approach

Prevent, Prepare, Protect, Pursue. A standard counter-terrorist strategy[9] provides a mechanism for how a comprehensive approach could function, following the philosophy of 'Prevent, Prepare, Protect, Pursue'. Air and Space Power have an important role to play, but they are not the only contributors to the comprehensive approach and are increasingly relevant once prevention has failed. Whilst not exhaustive, the following provides some examples of how the approach could fit together:

> *Prevent*. The ability to prevent procurement, training, acquisition of expertise and the movement of systems. It includes intelligence activity (including cyber), STRATCOM, customs, export restrictions, sanctions, industry protocols and counter threat finance.

> *Prepare*. Development of Tactics, Training and Procedures (TTPs) and their practising in degraded operating environments (caused by com-

munications jamming or reduced GPS availability), emergency contingency plans (civil and military), targeted intelligence activity and military procurement activity for DAS, etc.

Protect. Activate contingency plans (civil and military), fit DAS to operational fleets, targeted intelligence activity, Suppression of Enemy Air Defence (SEAD), Special Operations Forces (SOF), kinetic strikes, Electronic Attack, Cyber Attack.

Pursue. Attack the network. This involves a combination of kinetic and non-kinetic activity, military and cross-government, *downstream* in the JOA and *upstream* in the extra-JOA.

Cost-Effectiveness. NATO nations have continued to spend considerable sums of money on a 'last line of defence' by ensuring aircraft operating in Afghanistan have DAS. Politically, it is inconceivable for NATO aircraft to operate in such an environment without some sort of suitable defensive measures, but this raises the dilemma of equipping sufficient airframes in a nation's inventory with the necessary baseline protection. New aircraft may be very capable, but if insufficient DAS can be afforded for the whole fleet, with only a 'select few' protected and others without any DAS, the freedom of manoeuvre of an operational commander will be severely restricted. The balance between operational- and cost-effectiveness may suggest a strategy to upgrade existing fleets across the board, ensuring their widespread employment throughout the JOA, rather than just purchasing new fleets, for which a nation cannot subsequently afford to provide DAS over the long term.

Cooperation and Niche Capabilities. Current NATO projects may provide a template for the future. The NATO Airborne Early Warning and Control (NAEW&C) fleet and the Heavy Airlift Wing programme illustrate that NATO can procure high-end equipment to counter a wide range of threats.

However, the Suppression of Enemy Air Defences (SEAD) is one area that has received comparatively little investment in recent years, as the focus has remained on Iraq and Afghanistan and budgets have come under pressure. Outside the USA, no NATO nation is realistically going to be able to fund its own SEAD procurement programme. This means different methods to gain assured access must be considered, other than using aircraft penetrating hostile airspace. Alternatively, it may be necessary for nations to adopt niche capabilities and for NATO to rely on having a whole air package available once members have committed their forces. Clearly, both these options rely on immense political will and trust, both in terms of a willingness to forgo support to domestic defence industries as well as collectively being comfortable that all nations will deliver what they have promised when a crisis develops.

Tactics, Training and Procedures. Equipment is only half the story. Effective and regular training is critical to NATO's ability to operate effectively. Recent operations have ensured NATO enjoys a high level of interoperability, which must be maintained in the long term. That said, skills that have been neglected need to be retrained and updated in line with new threats. Considering the comments earlier, that Afghanistan and Iraq for the most part have been permissive air operating environments, this is one area in which NATO must invest heavily to ensure it is trained to operate in the most challenging scenarios. Comprehensive and innovative training on less modern equipment may be a more effective way of using scarce resources than investing in modern equipment that is too expensive to train on. This will allow a commander to enjoy the greatest level of flexibility.

Force Build-Up. Assured access must also include any host nation into which NATO forces may be deploying; otherwise, a commander may be severely restricted in his freedom of manoeuvre. Recent large scale military operations, such as both Gulf Wars, have enjoyed unrestricted movement in neighbouring countries as part of the force build-up, but this can-

not be taken for granted. This means NATO must ensure it has strong links to partners and potential allies and an ability to share intelligence and information, which will prepare the way for the safe entry of its forces into the potential basing areas required to react to trouble spots.

Level of Risk. A key consideration for an operational commander is the level of risk he is willing to accept when conducting a mission, balanced against the impact of losing an air system. The loss of an RAF Nimrod over Afghanistan in 2006, admittedly to an aircraft fire rather than enemy action, had a profound effect on UK public opinion. A manned air platform, therefore, may not be the best capability choice to conduct a task, given that its loss may have a greater impact politically than its actual military value.

Options Other Than Gaining Assured Access. Gaining and maintaining assured access is no longer a given, but it may be possible to achieve the effect desired from Air and Space Power by using other systems or methods, which could be more cost-effective as well as acceptable politically. For example, cruise missiles may be able to offer similar capabilities to those provided by deep strike aircraft. Space Power may be able to offset some of the vulnerabilities of Air Power to anti-aircraft systems, by providing Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) capabilities over the JOA. Currently, only superpower nations, such as the USA, can afford to invest in Space Power. However, a jointly-funded Space project by NATO nations is one potential solution to the assured access problem, especially one concentrating on lower cost, lightweight capabilities.

Unmanned Aerial Vehicles (UAV). More affordable ISTAR assets may be able to provide coverage from friendly airspace by 'looking in' over the hostile part of the JOA. NATO is acquiring 5 US RQ-4B Global Hawk high-altitude, long-endurance UAVs, which will provide an organic NATO ISR capability

entitled Alliance Ground Surveillance (AGS).[10] If NATO decided to use armed UAVs in the future instead of putting military people in harm's way, the international legal ramifications would have to be addressed at an early stage rather than in the midst of contingency operations, which could lead to short-term fixes at the expense of long-term strategic solutions.[11] That said, Close Air Support is unlikely to be achievable without using some sort of manned air system, which is operating close to the battlefield and for which a certain level of assured access is required. It is also necessary to ensure a balance between manned and unmanned systems. The use of UAVs in an offensive role has been successfully demonized by the Taliban and the portrayal of 'drones' in the western press is now overwhelmingly negative. A manned offensive air system of some sort is likely to be necessary politically to assure that all is being done to minimize collateral damage.

Conclusions

Air and Space Power play an important, but not exclusive, role in gaining assured access to denied airspace environments. The future threat will be asymmetric and highly capable, as terrorists and insurgents exploit the proliferation of anti-aircraft systems and states such as China develop sophisticated A2/AD capabilities. NATO's response must be part of a comprehensive approach that achieves close coordination and synchronisation between military activity within the JOA and efforts by other agencies, particularly 'upstream' from the JOA. *Prevent* activity includes the successful interdiction of adversary networks to stop the proliferation of anti-aircraft systems from reaching potential adversaries. Such interdiction involves soft as much as hard power. The success of the US MANPAD Task Force in eliminating large numbers of weapons proves what can be achieved. In terms of a comprehensive approach there may be lessons to learn from NATO's involvement in counter-piracy operations in the Gulf of Aden, off the Horn of Africa and in the Indian Ocean, where NATO has built

a successful partnership with the United Nations and the International Maritime Organization, amongst others. Nevertheless, the risk to air systems can never be eliminated, as the ability of the separatists in Ukraine to gain and use sophisticated weaponry has proved so graphically.

NATO will also need to *Prepare*. It will need to plan, equip and train for the worst case environment to ensure it can gain assured access in the future. In the short term, that must be through training and developing new tactics, in particular ensuring that skills that have been forgotten or neglected over the past 10 to 15 years are retrained and refined for today's threats. *Prepare* activity should address the emerging asymmetric threats but must also counter the development of A2/AD capabilities by potential opponents at state level. In this respect, there is an urgent need for NATO to consider the need for an Air Sea Battle concept, the relevant level of ambition and how this might work with, or alongside, US capabilities. For Prepare to be effective, NATO will need to make considerable investment in terms of time and money.

In the longer term, NATO faces some difficult choices as its members decide how they wish to *Protect*. One question is how much independence individual nations wish to retain in the procurement and employment of air systems. The procurement of 5 Global Hawks shows progress is being made, but it will be a bold decision for individual nations to agree to adopt niche offensive capabilities, or for them to join together on offensive air projects, in the way some nations have done for transport and airspace control aircraft. Nevertheless, the cost of developing such systems is increasingly outside the affordability of many, if not all, NATO nations. This means that, to gain assured access, NATO must consider options other than procuring a full range of offensive air systems. There are many possibilities, from a greater use of Space Power, to cruise missile systems, standoff platforms and UAVs, although the political implications of unmanned platforms may restrict their use.

Pursue activity is ongoing in the asymmetric environment, largely as a consequence of NATO's involvement in Afghanistan. Investment in this must endure beyond transition in Afghanistan. Whilst outside the JOA it is conducted primarily on national lines, NATO must be prepared to act collectively to support this activity where it can. Recent events in the Ukraine have provided a stark reminder of the implications of failing to do so. Ultimately, NATO must also be ready to conduct operations in a hostile A2/AD environment.

Finally, NATO nations must balance the need to replace platforms with the option of upgrading them. The prohibitive cost of providing DAS across a new fleet of aircraft, and then subsequently upgrading it, invariably results in a 2-tier force, where the operational commander's freedom of action is restricted. A better option may well be to upgrade current fleets comprehensively, rather than to invest in new air systems that the nations cannot then afford to equip adequately with a baseline DAS and support through the aircraft's life. Whatever method NATO adopts to ensure assured access, it will be done against increasingly stressed defence budgets. It will have to balance the ability of nations to afford new air systems against other options, particularly those that may be cheaper. Prevention is invariably better than the cure.

Endnotes

1. Air Sea Battle Office. Service Collaboration to Address Anti-Access & Area Denial Challenges, unclassified summary (May 13) p. i.
2. Stern, David. Ukraine crisis: Military plane shot down in Luhansk, BBC, 14 Jun. 2014.
3. Tirpak, John A. Fighting for Access, AIR FORCE Magazine (July 2013) p. 25.
4. Air Sea Battle Office. Service Collaboration to Address Anti-Access & Area Denial Challenges, p. i.
5. Shapiro, Andrew. Addressing the Challenge of MANPADs Proliferation.
6. Areas of air, sea, space and cyberspace that belong to no one state.
7. Joint Operations Access Concept (JOAC), US Secretary of Defence, 17 Jan. 12, p. 1.
8. Schechter, Erik, Choppers on the Chopping Block, Jerusalem Post, 13 Jun. 2003.
9. CONTEST, the United Kingdom's Strategy for Countering Terrorism, 12 Jul. 2011.
10. Lekic, Slobodan. NATO to buy 5 Global Hawk drones. Air Force Times, 15 Feb. 2012
11. Jacobson, Dr Mark R. The advent of the 'Armed drones', The Imperatives of the NATO Alliance, JAPCC Journal Edition 18, Autumn/Winter 2013, p. 54.

Annex A

Core Team – Biographies

Project Lead: Lieutenant General (ret.) Frederik H. Meulman

Lieutenant General (ret.) Frederik H. Meulman graduated from the Royal Military Academy in the Netherlands in 1979, after which he held a number of positions with the fifth Guided Missile Group in Germany. He attended the Advanced Staff Course (1988–1990), after which he studied Strategy and Air Power at the Air University/College for Aerospace Doctrine, Research and Education at Maxwell Air Force Base in the United States. Subsequently, he was posted to the Netherlands Defense College as a faculty member. Thereafter, he worked alternately in conceptual, operational and policy positions both at the Ministry of Defense (MOD) and the Air Staff. From 1998 to 2000, Colonel Meulman was Commander of the Netherlands Guided Missile Group. In 2000, he returned to the MOD/Defense Staff as Head of the Military-Strategic Affairs Division. In 2001, promoted to Air Commodore, he assumed the position of Deputy Director of the Military Intelligence and Security Service. In 2003, Major General Meulman became Deputy Commander of the Combined Air Operations Centre (CAOC) in Uedem. From June 2004 to the end of 2006, he was the Deputy Commander of the Royal Netherlands Air Force. From January 2007 until February 2008, Meulman fulfilled the position of Deputy Commander Air at the ISAF Headquarters in Kabul, Afghanistan. March 2008, Major General Meulman was appointed Deputy Chief of Defense and promoted to Lieutenant General. From April 2010 till May 2013, he was the Netherlands Permanent Military Representative to NATO and the EU in Brussels. He retired per 1st of June 2013. Lieutenant General (ret.) Meulman is married to Nanette, they have two sons and one daughter.

Dr. Hans Binnendijk

Is a Senior Fellow at the Center for Transatlantic Relations at Johns Hopkins University's School of Advanced International Studies (SAIS), and at RAND. Until July 4, 2012 he was the Vice President for Research and Applied Learning at the National Defense University and Theodore Roosevelt Chair in National Security Policy. He previously served on the National Security Council staff as Special Assistant to the President and Senior Director for Defense Policy and Arms Control. He also served as Principal Deputy Director of the State Department's Policy Planning Staff and Legislative Director of the Senate Foreign Relations Committee. He has received three Distinguished Public Service Awards. In academia, he was Director of the Institute for the Study of Diplomacy at Georgetown University and Deputy Director at London's International Institute for Strategic Studies. He has written widely on US national security issues, on NATO and on Asia. He serves as Vice Chairman of the Board of the Fletcher School and as Chairman of the Board of Humanity in Action.

Daniel P. Fata

Is a Vice President at The Cohen Group, a Washington, D.C.-based strategic advisory firm, where he focuses on Europe, Eurasia, Afghanistan, and Canada. He previously served as the US Deputy Assistant Secretary of Defense for European and NATO Policy. Prior to DoD, he was Policy Director for National Security and Trade on the Senate Republican Policy Committee. He is a fellow at the German Marshall Fund of the US Mr Fata earned a B.A. with Honors in Political Science from the University of Connecticut and a M.A. in International Relations from Boston University.

Camille Grand

Director of the Fondation pour la recherche stratégique, the leading French think tank on defense and security, since 2008. He was also part of the NATO Group of Policy Experts on the Transatlantic bond in 2014 and served as civilian adviser to the Group of Experts led by Madeleine Albright on the Strategic Concept in 2009–10. He has previously held senior positions in the French MoD and MFA, and was a researcher with several Paris-based think tanks. Camille Grand is also teaching graduate courses at Sciences Po Paris. His numerous publications include En vol vers 2025: réflexions prospectives sur la puissance aérospatiale [Towards 2025, Prospective Thinking on Air and Space Power], La Documentation française, 2011, he co-edited with G. Boutherin.

Lieutenant General (ret.) Ralph Jodice

Ralph commanded NATO's Allied Air Command, Izmir, Turkey, and was the Combined Forces Air Component Commander for OPERATION UNIFIED PROTECTOR. He has over 3,500 flying hours in the F-111A/E, T-38A, F-15E and UH-1N. He commanded an F-15E fighter squadron and group. He was: a division chief on the USA Joint Staff, J-3; the commander of the 80 Flying Training Wing's Euro-NATO Joint Jet Pilot Training Program; the USA Defense Attache, China; the Deputy for USA AF International Affairs; and the Commander of the Air Force District of Washington. He is a graduate of the USA National War College.

Professor Dr. Phil. Holger H. Mey

Began his professional career in 1986 as a Research Associate at the Stiftung Wissenschaft und Politik. From 1990 to 1992, he served as a Security Policy Analyst on the Policy Planning Staff of the German Minister of Defense. In 1992, he founded the Institute for Strategic Analyses (ISA) and served as its President and CEO. He conducted over 30 studies for various Ministries and Government Agencies. In 2004, Prof. Mey became Head of Advanced Concepts, Airbus Defence and Space. Over many years, he was a frequent TV and radio commentator, publisher, and lecturer. Prof. Mey is a Honorary Professor at the University of Cologne, Germany.

171

Air Commodore Professor Dr. Frans Osinga

Air Commodore Dr. Frans Osinga (1963) is Professor in War Studies, Head of the Military Operational Art and Science Section, and Chair of the War Studies Program, one of the three BA-level programs taught at the Faculty of Military Studies of the Netherlands Defence Academy in Breda, the Netherlands.

His previous assignments include a tour at NATO Allied Command Transformation (Norfolk, Virginia.) from 2005–2007 as the Liaison Officer for the Germany-based newly-established Joint Air Power Competence Centre. Prior to that he was the MoD Research Fellow at the Clingendael Institute of International Relations, the premier think tank in the Netherlands on international security. He was director of the Air Power and Strategy Department of the Netherlands Defence College from 1999–2000 and lecturer in Air Doctrine at the same institute from 1997–1998. He has held a number of staff positions at the Netherlands Air Force Air Staff. From 1987–1994 he served in a various NF-5 and F-16 squadrons, also as an F-16 instructor.

He is a graduate of the Netherlands Defence Academy and the Netherlands Defence College. From 1998–1999 he attended the School of Advanced Airpower Studies at Maxwell AFB, Alabama. He holds a PhD in political science from Leiden University.

Topics of his presentations include NATO, ESDP, defence policy, terrorism, air power, statebuilding, irregular warfare, coercive diplomacy, contemporary military operations, strategic theory, international security and military technological developments and military innovation. He is member of the editorial board of the journal Vrede en Veiligheid and Vice-Chairman of the KVBK, the Netherlands Royal Society for War Studies. He recently designed and developed the Master program in Military Strategic Studies which is scheduled to commence in 2013.

Colonel Professor John Andreas Olsen

John Andreas Olsen is deputy general director in the Norwegian Ministry of Defence, colonel in the Royal Norwegian Air Force, and visiting professor at the Swedish National Defence College. Recent assignments include tours as deputy commander at NATO HQ, Sarajevo (2009 to 2012), dean of the Norwegian Defence University College (2006–2009), and student at the German Command and Staff College (2003–2005). Professor Olsen is the author of Strategic Air Power in Desert Storm and John Warden and the Renaissance of American Air Power. He is the editor of 'A History of Air Warfare', 'Global Air Power', 'Air Commanders and European Air Power'.

Lieutenant General (ret.) Stefano Panato

Lieutenant General Orazio Stefano Panato retired in 2013 as president of CASD: the Italian Ministry of Defense post-graduate Institute for global strategy and security open to senior national and international officials. He was also Deputy Chief of Staff of the Air Force; Deputy Director of the Italian agency for foreign intelligence, AISE; military adviser to the Italian Permanent Delegation to NATO. During his 4.000 flying hours he piloted a variety of aircraft: mostly jet fighters, but also transport aircraft and helicopters. In addition he qualified as a test pilot at the Empire Test Pilots' School in the UK.

Lieutenant General (ret.) Friedrich W. Ploeger

Lieutenant General Friedrich Wilhelm Ploeger retired 2013 as Deputy Commander and acting Commander of Air Command Ramstein. He is a fighter controller by origin. His military career includes high ranking NATO and national positions in the fields of planning and military policy, i.a. as Director Military Policy and Arms Control and Disarmament in MoD Berlin. He also commanded from unit to division level and beyond. Before coming to Ramstein, he held a triple hatted position as Commander of the German Air Force Air Operations Command, Combined Air Operations Centre Uedem and as Executive Director of the Joint Air Power Competence Centre.

Air Marshal Graham Stacey

Air Marshal Stacey is a senior level commander with extensive experience in the multinational and joint operational environment. His operational experience includes deployments to Bosnia-Herzegovina, Kosovo, Kuwait, Iraq and Afghanistan. His current appointment is Deputy Commander, NATO Joint Forces Command Brunssum. Air Marshal Stacey has been supported by the following members of the Brunssum team: Colonel Kris Chafer GBR A, EXO to DCOM; Group Captain Sean O'Connor GBR F, Branch Head J35; Wing Commander Alex Grun GBR F, Integrated Analysis Team; Wing Commander Allan Steele GBR F, LEGAD; Wing Commander Phil Hateley GBR F, MA to COM; Wing Commander James Lafferty GBR F, J2 ISR; Lieutenant Colonel Daniel Coe USA F, J35; Mr Andy Ormerod, GBR Consultant.

Annex B

Advisory Team

1. General (ret.) Stéphane Abrial

2. Lieutenant General (ret.) Veysi Agar

3. General (ret.) Mieczyslaw Bieniek

4. General (ret.) Vincenzo Camporini

5. Lieutenant General (ret.) Leandro De Vincenti

6. Lieutenant General (ret.) David Deptula

7. Major General (ret.) Tom Knutsen

8. Major General (ret.) Charles W. Lyon

9. Diego A. Ruiz Palmer

10. Lieutenant General (ret.) Friedrich W. Ploeger

11. General (ret.) Egon Ramms

12. Lieutenant General (ret.) Dr. Dirk Starink

13. Major General Dr. Victor Strimbeanu

14. Air Marshal (ret.) David Walker

Annex C

List of Acronyms

A2/AD	Anti Access/Area Denial
A&A	Advisory and Assistance
ACCS	Air Command and Control System
ACT	Allied Command Transformation
ADS	Air Defence System
AGF	Anti-Gadhafi Forces
AGS	Alliance Ground Surveillance
Air C2	Air Command and Control
AIRCOM	Air Command
AOC	Air Operations Centre
AOD	Air Operations Directive
AOR	Area of Operational Responsibility
ASB	Air Sea Battle
ATO	Air Tasking Order

BDA   Battle Damage Assessment

BMD   Ballistic Missile Defense

C2   Command and Control

CAS   Close Air Support

CAOC   Combined Air Operation Centre

CDE   Collateral Damage Estimate

CFAC   Combined Forces Air Component

CFI   Connected Forces Initiative

CIMIC COE   Civil-Military Cooperation
Centre of Excellence

CIS   Communication and Information Systems

CJSOR   Combined Joint Statement of Requirements

COD   Combat Operations Division

COEs   Centres of Excellence

COIN   Counter Insurgency Operations

CMO   Crisis Management Operations

CONOPS   Concept of Operations

COTS	Commercial Of-The-Shelf
CPD	Combat Plans Division
DACCC	Deployable Air Command and Control Centre
DAS	Defensive Aid Suites
DCDC	Defence Concepts & Doctrine Centre
DGIMS	Director General of the International Military Staff
EADTF	Extended Air Defense Task Force
EDA	European Defence Agency
EM	Electro Magnetic
ESA	European Space Agency
EU	European Union
EW	Electronic Warfare
FMN	Federated Mission Networks
FMV	Full Motion Video
GBAD	Ground Based Air Defense
GEO	Geostationary

HA/DR	Humanitarian Assistance/Disaster Relief
IPOE	Intelligence Preparation of the Operational Environment
ISA	Institute for Strategic Analyses
ISAF	International Security Assistance Force
ISIS, IS	Islamic State of Iraq
ISR	Intelligence, Surveillance and Reconnaissance
ISRD	ISR Division
ISTAR	Intelligence, Surveillance, Target Acquisition and Reconnaissance
JAPCC	Joint Air Power Competence Centre
JCB	Joint Coordination Board
JFAC	Joint Force Air Component
JFACC	Joint Forces Air Component Commander
JISR	Joint Intelligence, Surveillance and Reconnaissance
JOA	Joint Operational Area
JOAC	Joint Operations Access Concept

JTF	Joint Task Force
LEO	Low Earth Orbit
LIVEX	Live Exercises
LNOs	Liaison Officers
LoA	Level of Ambition
MANPADs	Man Portable Air Defence Systems
MAOP	Master Air Operations Plan
MEDEVAC/ CASEVAC	Medical and Casualty Evacuation
MilSpec	Military Specification
MJO	Major Joint Operation
MOD	Ministry of Defense
MOU	Memorandum of Understanding
NAEW	NATO's Airborne Early Warning
NAEW&C	NATO Airborne Early Warning and Control
NATO	North Atlantic Treaty Organization

NATO CCD COE   NATO Cooperative Cyber Defence
Centre of Excellence

NCS   NATO Command Structure

NDPP   NATO Defence Planning Process

NFS   NATO Force Structure

NICs   National Intelligence Centers

NORDEFCO   Nordic Defence Cooperation

NRF   NATO Response Force

NTC   National Transitional Coalition

OAE   OPERATION ACTIVE ENDEAVOR

OEF   OPERATION ENDURING FREEDOM

OOD   OPERATION ODYSSEY DAWN

OUP   OPERATION UNIFIED PROTECTOR

PED   Production/Exploitation/Dissemination

PGF   Pro-Gadhafi Forces

PGM   Precision Guided Munitions

PID   Positive Identification

PNT	Positioning/Navigation and Timing
ROE	Rules of Engagement
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft System(s)
SACEUR	Supreme Allied Commander Europe
SADCs	Standing Air Defense Centers
SAM	Surface to Air Missile
SAR	Search and Rescue
SCAR-C	Strike Control and Reconnaissance Command
SEAD	Suppression of Enemy Air Defence
SJO	Smaller Joint Operation
SJO-AH	Smaller Joint Operation-Air Heavy
SOF	Special Operations Forces
SPINs	Special Instructions
SSA	Space Situational Awareness
STRATCOM	Strategic Communication

TBMD   Theatre BMD

TIC   Troops in Contact

TST   Time Sensitive Targeting

TTP   Techniques, Tactics and Procedure

UAV   Unmanned Aerial Vehicles

UCAV   Unmanned Combat Aerial Vehicle

UNSCR   United Nations Security Council Resolution

US   United States

Notes

Notes

Joint Air Power Competence Centre

von-Seydlitz-Kaserne
Römerstraße 140 | 47546 Kalkar (Germany) | www.japcc.org