Transforming Joint Air Power

The Journal of the JAPCC

Edition 23, Autumn/Winter 2016

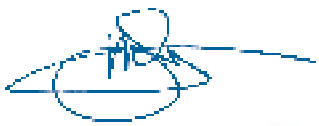
2016 was an extremely fruitful year for the JAPCC. While we continued our core business as NATO's catalyst for the improvement and transformation of Joint Air and Space Power; some significant projects were completed and many new interesting work strands were initiated. Our ongoing efforts to improve cooperation amongst NATO, EU and national air and space organizations continue to bear fruit, evidenced by expanding participation in our annual Think Tank Forum and Joint Air and Space Power Network Meeting. With Denmark joining the team this year, the JAPCC gained its 16th sponsoring nation, which underscores the JAPCC's value to a growing number of Alliance nations.

At the annual JAPCC Conference in October we had great discussions with many distinguished speakers and guests about the future challenges that Allied air and space power may face operating in a degraded environment, a likely scenario raised at the most recent NATO Summit in Warsaw. Another outgrowth of recent NATO summits is the development of a Joint Air Power Strategy (JAPS) for NATO. The JAPCC has been heavily involved this year in Phase I of the JAPS drafting, and the Executive Director initiated a high-level study this fall entitled 'Joint Air Power following the 2016 Warsaw Summit – The Most Pressing Joint Air Power Strategic Priorities', which will be conducted by a team of renowned experts and will influence Phase II of the JAPS development.

It is my great pleasure to present you the 23rd Edition of the JAPCC Journal. Themes that permeated the JAPCC's program of work throughout 2016 include: challenges posed by contemporary and prospective threat environments, the future role of air and space power, and the requirements for developing modern, efficient, interoperable capabilities to include the associated education and training. This range of issues is well reflected in the broad selection of essays provided by external and internal subject matter experts for this Journal issue.

In the opening article of this edition, General (retired) Frank Gorenc, the JAPCC Director from August 2013 to August 2016, shares a few thoughts about the roles of air power, alliances and coalitions in the future, intending to inspire and promote the air power dialogue necessary to achieve future NATO and national aspirations. I am furthermore proud to report that Lieutenant General Michael J. Hood, Commander of the Royal Canadian Air Force (RCAF), gave us an interview in which he explains his five main goals amongst which much importance is attached to NATO integration and coordination.

Thank you for taking the time to read this edition of our Journal. I congratulate the authors on their contributions and I strongly encourage our readers to consider sharing your thoughts as you go forth and advocate for Air Power. The JAPCC team greatly appreciates your feedback and thoughts. Please visit our website at www.japcc.org, like us on LinkedIn or Facebook, or follow us on Twitter to tell us what you think.



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The Journal of the JAPCC welcomes unsolicited manuscripts.
Please e-mail submissions to: contact@japcc.org

We encourage comments on the articles in order to promote discussion concerning Air and Space Power.

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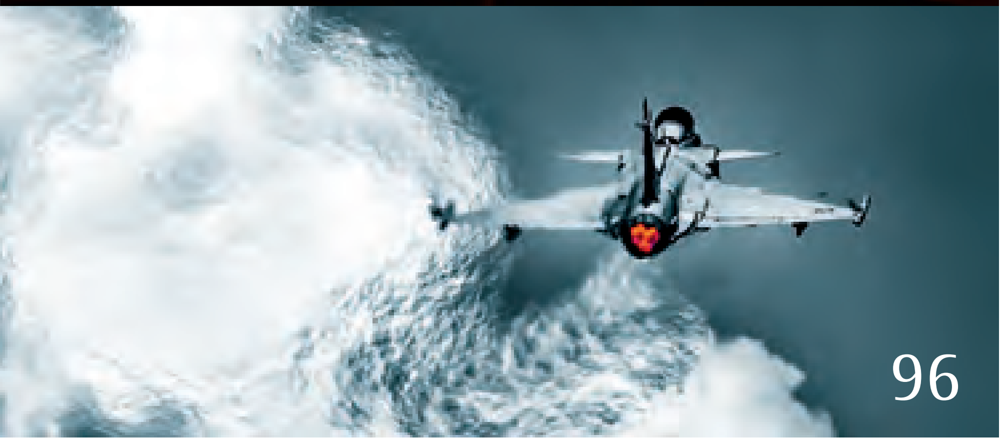

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[M] **Denotes images digitally manipulated**

General Gorenc relinquishes command, handing the AIRCOM flag to General Scaparotti (Supreme Allied Commander Europe), on 11 August, 2016.

NATO Air Power

The Last Word

By General (ret.) Frank Gorenc, USAF

'If we lose the war in the air, we lose the war and we lose it quickly.'
General Bernard Law Montgomery, SHAPE Deputy SACEUR 1951–1958

My three-year tour as the commander of NATO Allied Air Command, US Air Forces in Europe, US Air Forces in Africa and Director of the Joint Air Power Competence Centre has come to a close and I wanted to share a few thoughts about the role of airpower, alliances, and coalitions in the future. From August, 2013 through August, 2016, I had the opportunity to lead and help organize, train, equip, deploy, and employ the US and NATO air component. Hopefully, my thoughts will inspire and promote the air power dialogue necessary to achieve future NATO and national aspirations.

During my tour, unforeseen challenges unfolded across Europe, Africa and the Levant at a speed and intensity that no one could have predicted. When I took command, final planning for the Afghanistan mission transition was in full swing. The shift from

NATO's full combat operations to a train, advise and assist role dominated the conversation for the Afghan mission partners. Most were optimistic that the long awaited transition would allow all services in all countries the opportunity to rest, reconstitute, re-equip and shift focus to regaining full spectrum combat readiness. Unfortunately, that opportunity did not materialize as we hoped. Just a few months later, by April 2014, we were all witness to a resurgent Russia using 'Hybrid' warfare to annex Crimea, a rising ISIS attempting to establish a caliphate across Syria and Iraq, and a deadly Ebola epidemic ravaging multiple countries in Africa. As usual, Air Force capabilities were called upon to meet these challenges.

World events in 2014 inspired the NATO alliance and partner nations to address the endemic erosion of full spectrum military capability and readiness brought on by years of Counter Insurgency/Counter Terrorism operations. As Russia expanded its unique form of aggression into the Donboss region in Ukraine, 'Collective Defence' replaced 'Crisis Response' as the priority focus in NATO's Strategic Concept. NATO's 2014 Wales Summit put in place a set of adaptation and assurance measures to increase alliance readiness and responsiveness. This 'Readiness Action Plan (RAP)', combined with the establishment of a 2% funding goal, 20% of which would be used for modernization, was designed to assure allies and partners.

Wales Summit organizational adaptations brought NATO Response Force (NRF) improvements, including the Very High Readiness Joint Task Force (VJTF). Additionally, NATO Force Integration Units (NFIUs) were established. Wales Summit assurance brought increased NATO Air Policing capacity both in number of locations and aircraft. Assurance in the form of more frequent and comprehensive 'heel-to-toe' joint exercises expanded in both scope and intensity. The need for prudent thinking led to a Graduated Response Plans (GRPs) initiative designed to address security concerns throughout NATO territory. NATO's 2016 Warsaw Summit added enhanced Forward Presence in the north and tailored Forward Presence in the south. While the Wales Summit focused on assurance, the Warsaw Summit expanded the scope of NATO's aspirations, by focusing on deterrence and defence. Partly as a result of these NATO initiatives, the United States significantly invested in infrastructure improvements and more robust training thanks to European Reassurance Initiative (ERI) funding.

All the while, President Putin focused on reaffirming Russia as a 'great power'. Russia's response to NATO included increasing activity in the air, land, sea, and cyberspace domains. Snap exercises, long-range aviation, more frequent intercepts, unprofessional intercepts, and dangerous over-flights became more common. Furthermore, a new 'Iron Curtain' emerged, a string of Anti-Access Area-Denial (A2/AD) environments connecting north to south: from the Barents Sea to the Baltic, Black, and Mediterranean Seas. These constellations of layered, modern long-range surface-to-air missile systems (MLRSAMS) are significant and many spill over into the sovereign airspace of NATO and partner nations. European A2/AD environments are a direct counter to Wales Summit adaptations and undermine NATO deterrence, both conventional and nuclear.

'With air superiority, everything is possible. Without air superiority, nothing is possible.'

In Syria, Russia demonstrated significant air power improvements, proving they learned the lesson of poor performance from the air during their 2008 intervention in Georgia. Additionally, Russian leaders openly discussed nuclear weapon use through their 'Escalate to De-escalate' nuclear strategy. In combination, Russia's increased conventional capabilities combined with a seemingly lower nuclear threshold fuelled concerns worldwide while simultaneously increasing Russian influence in Eastern Europe. In the end, we can argue about 'great power' status, but the Russian military build-up in Crimea and Kaliningrad, the half-dozen or so 'frozen conflicts' [South Ossetia, Nagorno-Karabakh, Transnistria, Abkhazia, Crimea, Lohansk/Donetsk] littering Europe, and an A2/AD expansion combine to challenge the established world order and make Europe less secure and more unstable.

In the north, Russian Arctic territorial claims and infrastructure investment combined with climate change making previously impassable transit routes passable are concerning to all affected NATO allies and partners. In the south, ISIS operations and refugee flow create another significant challenge to security and stability. In the meantime, ISIS-inspired home-grown terror attacks on mainland Europe, and sovereign national issues such as BREXIT and the recent Turkish coup attempt have infused an uncertainly that furthers the anxiety of an already nervous Europe.

So, what does it all mean and what should NATO Airmen do to better posture and prepare for the challenge of a resurgent 'great power' adversary, a significant natural disaster or any other unforeseen event? I have several thoughts:

First: Airpower is Like Oxygen

When you have enough, you don't think about it, when you don't have enough it's the only thing you think about.

NATO Air will always be low density/high demand. It is NATO's asymmetric advantage, and the Alliance must always maintain full spectrum air component capabilities that can deliver the following:

1. Air & Space Superiority

- Fighting with Air Dominance is the NATO/US way of war.

NATO is getting better at ISR collection, such as with the new Alliance Ground Surveillance Capability. However, Processing, Exploitation and Dissemination (PED) requires more consistent national contributions.

- Achieving air superiority is job one! With air superiority, everything is possible. Without air superiority, nothing is possible.

2. Intelligence, Surveillance & Reconnaissance (ISR)

- Joint Force Commanders demand persistent ISR, which is easily accomplished with Air Dominance, but very difficult or impossible in a contested A2/AD environment.

- Amateurs concentrate only on ISR collection; professionals concentrate on Processing, Exploitation, and Dissemination (PED) and fusion to make sense of the data. With NATO AWACS and Alliance Ground Surveillance (AGS), NATO is getting better at ISR collection; however, NATO PED requires more consistent national ISR contributions and improved fusion of all-source intelligence.

- The ability to share data, machine-to-machine, will define the effectiveness of our alliance. Policy, not technology will hinder our ability to share that data.

3. Rapid Mobility

- Speed matters. If you can't get there on time, you can't assure or deter.

- After speed, sustainability matters, and air mobility will be a critical element of all sustainability efforts.

4. Strike

The ability to hold any target on the planet at risk, day or night, in good or bad weather always has been and always will be fundamental to deterrence.

5. Command & Control (C2)

- There is a difference in the air C2 concept between NATO and the US. NATO uses a 'Core' Joint Force Air Component (JFAC) and Air Operations Centre (AOC). The US uses a 'Standing' Joint Force Air Component Command (JFACC) and AOC. I had one of each in Europe and found that both are effective.
  - *A 'Core' JFAC* stands up immediately after a North Atlantic Council (NAC) decision to meet a crisis. A small cadre of AIRCOM 'Core' personnel is in place and are augmented and supplemented in preparation for execution. However, JFAC stand-up takes time because you must install Information Technology (IT), establish communications, and assemble required personnel to achieve maximum effectiveness.
  - *A 'Standing' JFACC* is just that – up and running. The IT, communications, personnel, and processes are fully functional. They are already providing C2 to current operations and can C2 an additional crisis overnight.

'We must develop the capacity to synchronize and integrate more precise kinetic and emerging non-kinetic effects now becoming available in all domains – particularly cyberspace.'

- Wales Summit adaptations will require an early NAC stand-up decision to meet all timelines and requirements.

- Regardless of the C2 approach, we must prepare for multi-domain operations in air, space, and cyberspace.

- We must develop the capacity to synchronize and integrate more precise kinetic and emerging non-kinetic effects now becoming available in all domains – particularly cyberspace.
  - More precise kinetic effects require more precise and sustained ISR.
  - Emerging non-kinetic effects must be completely understood by everyone and will challenge and stress current NATO policy, planning processes and manning requirements.

Second: We Need a Robust NATO

We need a robust NATO, we fight together.

1. Trust and Relationships

You cannot surge trust, you cannot surge relationships. NATO's strength is underpinned by relationships

Policy, not technology will hinder our ability to share collected, processed, and exploited ISR results, or fused and assessed intelligence products.

developed day in and day out and the trust that comes with those relationships.

2. Shared Commitment

- A robust NATO requires shared commitment. Nations must at least meet the Wales Summit 2%/20% goal soonest.

- Modernize or become irrelevant.

- Maintain adequate weapons stockpiles or become irrelevant.

- Airfields are combat platforms – they are weapons systems.
  – A runway is not an airfield.
  – Airfield survival in crisis is critical. This survival will depend on robust integrated air and missile defence, cyber defence for IT and combat systems, and the ability to continue operations during and after attacks.

3. Interoperability

- Interoperability in all things must be pursued and achieved.

- NATO Interoperability will only be achieved with unwavering commitment and consensus to common standards, common Tactics, Techniques, and Procedures (TTPs), and Concepts of Operations (CONOPS).

- Operating common equipment will enhance NATO interoperability and expand NATO effectiveness exponentially. NATO AWACS, NATO AGS, and the Heavy Airlift Wing (HAW) in Papa, Hungary, are examples of operating common equipment with great success. Additional pooling and sharing of emerging capabilities that address documented NATO capability shortfalls must be pursued.

4. Practice, Practice, Practice!

The current NATO exercise schedule must be enhanced to gain the maximum training benefit for

The capabilities of 5th Generation and 4th Generation A/C, such as the F-35A Lightning II and F-16 Fighting Falcon shown in a flight formation in this picture, will need to be integrated.

primary and secondary training audiences and to practice full-spectrum combat.

5. Integrating Alliance Capabilities

- We must work harder to better integrate alliance capabilities, including making necessary adjustments for emerging capabilities.

- 5th and 4th generation aircraft integration must be achieved at first opportunity. The significant advantages of 5th generation stealth and sensor fusion will revolutionize NATO Air combat power.

- Emerging threats will require NATO TTP and CONOPS adjustments to accommodate faster decision-making timelines. Our work to achieve NATO Ballistic Missile Defence Initial Operational Capability (IOC) brought to light some anxieties associated with the agreed-upon defence design and TTPs and CONOPS must continue to be improved.

Third: We Need a Clear Strategy

Effective air power employment demands a clear strategy with clear ends, ways and means.

- The strategy must accommodate the recognized difference between the speed of NATO political versus military decision-making.

- The strategy should commit to winning 100–0, not 51–49 because winning 51–49 will cost lives, delay victory, or both.

- NATO political consensus depends on timely strategic warning. Future adversaries and threats will only work to shorten that strategic warning. We must adjust to this reality or accept the fact that a NATO response may be too late. To compensate for reduced strategic warning, a full set of operationally driven Indications & Warnings (I&W) informed by focused ISR and PED must be developed.

– I&W criteria should reflect NATO political aspiration, military commander intent, and drive execution.
– There must be political consensus on all I&W, pre-crisis.
– I&W should inspire action or in the absence of action, acknowledge acceptance of risk. I&W do not necessarily tie NATO leaders to predetermined or automatic courses of action (COAs). If they subsequently choose not to act based on I&W, they have determined that the risk of action is simply unacceptable – politically or militarily or both.

• Targeting is not strategy (it is part of the Air Tasking Process). Isolated strikes or 'doing something/anything' is not strategy.

• We must better understand deterrence and the relationship between Conventional and Nuclear Deterrence.

• Deterrence is a three-legged stool of capability, capacity, and willingness. With any of these three legs missing, NATO cannot deter.

• Air Defence is a mind-set. Air Policing is not Air Defence
– The transition from Air Policing to Air Defence (AP to AD) must be established, formalized, and exercised routinely.
– Air Policing integrates aircraft, radars, sensors, and C2 nodes.
– Air Defence integrates the above but also includes ground based air defence assets, airspace control measures, and rules of engagement.

• NATO COAs must be joint from the very start. Full integration of air, space, cyberspace, maritime, and ground capabilities (US and multinational) must occur from the very start to exploit NATO's overwhelming military power.

Fourth: The Enemy Has a Vote

The Enemy has always had and always will have a vote.

• Potential adversaries can only overcome the power of NATO by attacking the alliance where it is most vulnerable: the solidarity and consensus needed to declare Article 5 in a timely manner.

• President Putin's 'Hybrid' approach in the Ukraine is an approach representative of a weak nation using ambiguity and uncertainty to drive wedges into NATO solidarity.
– Assessing Russia's power against the traditional elements of national power (location, resources and population) reveals a nation in decline. To reverse this continuing decline, President Putin manipulates as needed the other elements of national power (diplomacy, information, military and economic (the 'DIME')) in non-traditional ways. We have come to know this non-traditional approach as 'Hybrid Warfare', which is an approach that maximizes Russian strength and minimizes Russian weaknesses.
– On the other hand, the US and NATO approach to the DIME is traditional. The traditional approach exhausts most 'D', 'I' and 'E' elements before using the 'M'. This traditional approach reflects US and NATO values, the desire to avoid escalation or miscalculation, promotes NATO consensus and inspires partners to join coalitions of the willing. Unfortunately, the traditional approach is predictable and


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allows weak nations to exert an inordinate amount of regional influence. The transparency and predictability of the traditional approach gives relatively weak adversaries power and advantage, particularly in the area of strategic communication and ability to manipulate the media.

- Russian leaders manipulate and brazenly lie to the media in pursuit of their aspirations. The media appears to accept this as a normal condition and reports it with little challenge or accountability.
- The Russian 'Escalate to De-escalate' nuclear strategy will bolster and underpin Russian world-wide and regional influence despite their conventional shortfalls and NATO's overwhelming power.

• NATO is a defensive alliance and prefers to deter but the enemy always has a vote! What if diplomacy fails? What if economic sanctions fail? What if deterrence fails? If in the end deterrence fails, NATO must possess the capacity, capability and willingness to use all the elements of national power to defend and WIN.

Fifth: Words Matter!

When describing air power capabilities, be precise with your words. Always manage expectations when political aspirations exceed the resources provided.

Avoid using the following terms:

• Efficient: instead use 'Effective'. Since air power is low-density and high-demand, Airmen strive to create effective results using resources as efficiently as possible. Often times, the war fighting pace requires operations that may not be as effective as they could be or resources not being used as efficiently as possible or both. Live with it, and continue to educate the leadership about the dichotomy between war fighting effectiveness and resource efficiency during planning and execution.

• *Massive Aerial Bombardment:* instead use *'Air Strikes',* because we don't do massive aerial bombardments and have not in decades.

General Gorenc opening the JFAC Flag Officers Seminar, on 25 May, 2016, at HQ AIRCOM in Ramstein, Germany.

- *Air Campaign:* instead use *'Small Joint Operation – Air Heavy'* or *'The Joint Force Commanders Selected COA',* because an air campaign alone won't win any conflict any more than a pure ground or maritime campaign will.

- *Drone:* instead use *'Remotely Piloted Aircraft',* because 'drone' implies thoughtless machine driven operations by unguided, uncontrolled vehicles.

- *Unmanned Aerial Vehicle:* instead use *'Remotely Piloted Aircraft'* (see above), because there is nothing unmanned about unmanned aerial vehicles.

- *Autonomous:* don't know exactly what to use here but if you think Drone and Unmanned Aerial Vehicle draw criticism, wait till we unleash 'Autonomous' capabilities implying any sort of man-out-of-the-loop robotic operations.

- *Precision:* instead use *'Near Zero Miss',* because sometimes precise weapons don't hit their intended target, which results in negative press coverage and enemy strategic communication advantage.

- *Zero casualty:* instead use *'Minimum Collateral Damage'.* There is no such thing a zero casualty war. Somebody usually gets hurt, and we hope it is always the enemy.

If the resources provided during NATO Force Generation do not match the political aspirations desired, manage expectations with thorough planning and full transparency with respect to risk.

'If NATO chooses to use military power, air power will be first in, last out, and the key to any victory.'

Conclusion

I started this discussion with General Montgomery's view of the role of air power for a reason. He did not mince words. His message was clear and powerful. His words reflect the fact that the horror of WWII and the fight against a powerful existential threat required dominating air power. It only got worse as the Cold War placed air power into an even more prominent role as nuclear weapons took centre stage for deterrence.

Today, the return of great powers, the rise of non-state actors, and the proliferation of weapons of mass destruction put worldwide security and stability at risk. Enlightened leadership using all the elements of national power will be required to meet future threats. It will not be easy. No one can predict the future, but I do know one thing for sure. If NATO chooses to use military power, air power will be first in, last out, and the key to any victory. NATO Air is NATO's asymmetric advantage and INDISPENSIBLE to any future combat operations.

It has been a pleasure to serve as the senior Airman in Europe for the past three years – it was the highlight of my 37 years of USAF service.

General (ret.) Frank Gorenc

was born in Ljubljana, Slovenia. He has commanded a fighter squadron, an operations group, two wings, the Air Force District of Washington, and a component Numbered Air Force. General Gorenc has served in numerous positions at Air Combat Command, the Air Staff, the Joint Staff, the US European Command/Supreme Headquarters Allied Powers Europe, and at the US Air Force Headquarters, Washington, D.C. In his final position, General Gorenc served as Commander US Air Forces in Europe, Commander US Air Forces Africa, and Commander Allied Air Command, at Ramstein Air Base, Germany, and simultaneously as the Director, Joint Air Power Competence Centre, Kalkar, Germany. The General is a command pilot with more than 4,500 flight hours. He retired from active service in August, 2016.

Canadian CF188 Hornets patrol Icelandic airspace.

The Royal Canadian Air Force and NATO

In Preparing for Domestic and Continental Missions, the RCAF Prepares for NATO Operations

Interview with Lieutenant General Michael J. Hood, Commander, Royal Canadian Air Force

How important is the North Atlantic Treaty Organization (NATO) to Royal Canadian Air Force (RCAF) operations, and what role does the RCAF expect to play in future NATO operations?

RCAF support to NATO is clearly implicit in the Canadian Armed Forces' three enduring roles: defence of Canada; defence of North America in partnership with the United States (which includes North American Aerospace Defense Command (NORAD)); and contribution to international peace and security. A Defence Policy Review is in progress at the highest levels of Government in Canada and, within that review, those roles have been identified as persisting, key priorities. In contributing to international peace and security, the RCAF continues to integrate with organizations such as NATO and operate integrally to NORAD, ready for missions our Government may assign to us.

NATO has been a significant source of deployed operations over the last decade, and if our Government chooses to participate in future NATO missions, I have

The Commander of the RCAF presents his commander's coin to Aviator Marie-Christine Richard in June 2016.

no doubt that the RCAF will be ready. My conviction is borne out by recent successes in providing deployed personnel and air task forces for such missions. For example, the RCAF provided a robust Air Task Force (ATF) commitment to the 2011 response to the popular uprising in Libya against the regime of Moammar Gadhafi. NATO's Operation UNIFIED PROTECTOR was led by Lieutenant General Charlie Bouchard, an RCAF general who exemplified the Canadian leadership skills we can offer to NATO missions. Although Canada also participated with naval assets, the RCAF was well represented with non-combatant air evacuation flights, fighter support, air-to-air refuelling, and airborne sensor assets.

In 2014, the RCAF participated in NATO assurance and deterrence measures in eastern and central Europe, providing six CF188 Hornet fighters, and we periodically contribute to NATO's Airborne Surveillance and Interception Capabilities to meet Iceland's Peacetime Preparedness Needs mission. All demonstrate the RCAF's capabilities and commitment that the Canadian Government can call upon at any time.

I measure RCAF progress through five goals. NATO support is implied in my goal of improving RCAF air power delivery through greater integration and coordination; to that end we will continue to align our doctrine and capabilities with those of all of our allies. My other goals are delivering high-calibre tactical air power, harnessing the RCAF's intellectual potential, enhancing institutional accountability, and ensuring we have adequate airworthiness and safety systems in place. These goals can be best achieved through integration with other nations; this effort takes on additional significance for the RCAF as coordination tends to be a critical factor in all air force operations. Seamless integration and coordination with both NATO and NORAD is fundamental to a globally coherent approach to the contemporary threat.

Are there areas of NATO integration that the RCAF is seeking to improve?

Given the importance of integration and coordination with coalitions (a fundamental conclusion derived from the Afghanistan campaign), there are specific areas in

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A Canadian CH124 Sea King helicopter departs from a Spanish ship during NATO's assurance and deterrence measures in central and Eastern Europe.

which to improve. For instance, the RCAF is addressing integration in the information age to ensure compatible information technology processes and shareable Intelligence, Surveillance, and Reconnaissance (ISR). These areas are important to counter the growing threat that groups – such as the Daesh – demonstrate regularly with tactics such as small aerial drones and the use of social media. It is our view that integrated approaches among allies to counter the threat will become increasingly important to the future success of NATO operations. Any movement we can achieve with coordinated networks, software, and kinetic capabilities will greatly enhance both Canada's and NATO's ability to respond to the growing threat from non-state actors.

We are also addressing a fully integrated joint targeting capability with an end state of seamlessly contributing to future NATO or coalition targeting efforts. We identified this area for improvement during the 2011 Libya campaign, and the RCAF's Major General David Wheeler is standing up a Canadian Armed Forces Joint Targeting Capability Implementation team to finalize the way forward. To achieve any NATO or coalition mission, whether using kinetic or non-kinetic means, targeting must not be tied to specific command and control arrangements. Due to command complications arising during recent targeting efforts, Major General Wheeler's operational fighter and command experience will be essential to developing the Canadian military's way forward. Targeting is about more than dropping bombs and not always about bombs at all; it's a way to think about and focus on what is most important within an operational environment. Thus, the implementation team is critical to our future success.

We are placing a high priority on a NATO harmonization of joint and RCAF terminology and methods involved in the operational use of air power to further enhance our integration into future coalitions.

We must also maintain close ties with partner organizations. We have put considerable effort into supporting NATO's Standardization Office and the Five-Eyes Air and Space Interoperability Council.[1] These organizations are vital to ensuring that how we carry out domestic missions aligns with our operations in a deployed coalition environment. In short, we are working to improve certain specific areas, while maintaining close ties with NATO and Five-Eyes organizations to ensure we maintain situational awareness of current or developing gaps in interoperability.

Noting your requirement to maintain air power for continental and domestic operations, what capabilities do you expect to provide to future NATO operations?

I aim to have deployable combat air forces ready for the use of the Government of Canada, providing for simultaneous lines of domestic, continental and deployed operations. Of course, domestic concerns must be considered first, but we maintain capacity for foreign deployments, dependent on government priorities.

We recently developed our Air Task Force concept with deployable expertise in 2 Wing Bagotville for missions requiring deployed RCAF assets. The Wing's personnel are prepared to deploy immediately on any assigned mission and set up an ATF, based on the specific capabilities required for the mission and consistent with processes and NATO interoperable procedures. The Wing's readiness and focus is an important step forward for the RCAF to seamlessly interoperate in any combined or Joint Task Force (JTF).

The RCAF maintains a number of capabilities to meet Canadian JTF expectations: overland ISR with modernized CP140 Aurora long-range patrol aircraft, battlefield transport with CH147 Chinook and CH146 Griffon helicopters, air-to-air refuelling with CC130H Hercules and the CC150 Polaris tankers, and fighter capability with CF188 Hornets. Support with CC177 Globemasters and CC130J Hercules transport aircraft are critical to

A CH-149 Cormorant helicopter during a joint search and rescue exercise held in Iceland on 12 February 2016.

moving joint Canadian military capabilities to deployed operations quickly; they can also be used singly as needed for scalable operations. The CH148 Cyclone maritime helicopter's reach and power will in time offer increased capabilities from both shore facilities and Royal Canadian Navy frigates. In the future, we expect to bring online additional manned and unmanned overland ISR assets to further enhance our ability to achieve operational integration on the battlefield. All of these capabilities can be used in NATO operations as required.

To ensure these capabilities operate seamlessly in a NATO mission, we previously merged a Canadian JOINTEX with NATO's TRIDENT JUNCTURE in 2015, and will do so again in 2017 with NATO's ARRCADE FUSION. Our Analysis and Lessons Learned Branch within the Canadian Forces Aerospace Warfare Centre takes advantage of these exercises to capture lessons for incorporation in our tactics and doctrine. So you can see that we put a great deal of effort towards NATO, even though our defence priority starts at home with close ties to NORAD.

What changes are you making in the RCAF and how will they affect the capability you can bring to NATO operations?

I would like to return to my five goals for the RCAF to answer this question because everything we are working towards will eventually enhance our ability to support NATO operations when tasked by the Government of Canada. I've already noted greater integration, but our other efforts are to deliver high-calibre tactical air power, harness the RCAF's intellectual potential, enhance institutional accountability, and ensure we continue to have adequate airworthiness and safety systems in place. These will improve all aspects of our operational efforts and the leadership we bring to coalition operations.

My goals are clearly focused on the expertise of RCAF personnel. Our airmen and airwomen are our most valuable asset, and improvements in their education and expertise will have effects across all operational environments in which they are assigned. Their expertise is being further expanded by increased efforts towards lessons learned and professional education. Underscoring this emphasis, I have added a focus on air power mastery. New courses on air operations and air command and control will soon offer educational upgrades in both the academic and professional streams to further develop our future operational and institutional leaders.

I am also bringing all RCAF members into the air power conversation, affording direct access to comment on air power discussion papers, and I welcome direct briefs on innovative ideas from throughout the institution. Essentially I am flattening the organization when it comes to innovation.

My goal is developing current and future leaders who are flexible and capable Canadian air power experts. They will offer Canada the option of providing highly-effective command and staff personnel for coalition headquarters positions as well as operational aircraft assets for NATO operations. Thus, the RCAF can maximize all its assets.

The world appears to continue to struggle with the financial crisis from 2008; do you envision challenges that may limit RCAF deployed operations for future NATO missions?

We anticipate stable funding support. Fundamentally, therefore, deployable capabilities are available for NATO operations much as they have been in the past, depending of course on strategic guidance and direction from our Government.

The challenge will be matching the high cost of emerging aviation technology with actual and affordable assets. As we purchase new RCAF aircraft and equipment, we must ensure each platform and asset is leveraged to its maximum extent in a joint and combined operational environment anywhere in the world. The days when a nation such as Canada could afford individual assets for specific missions are gone. We must ensure each asset provides value across multiple mission parameters, at home and abroad.

CP140 Aurora long-range patrol aircraft have provided surveillance services to coalition partners during multinational operations over Iraq and Libya.

To that end, the RCAF envisages working with allied air forces to create an ISR 'system of systems' network to blend the input from space-based assets, aviation resources, traditional sensors, and ground-based sensors. Although that increased interaction will occur more with the United States Air Force as part of daily NORAD responsibilities, elements will carry into our NATO interaction – specifically with the increasing reliance on Combined Air Operations Centres (CAOC) and the synergy between different national capabilities that a CAOC requires to function. Working closely together will ensure that existing air force assets are correctly offered and attached to specific missions. The goal is to employ each nation's strengths for a tailored and combined mission-specific response to NATO or United Nations operations.

As a senior air person with decades of experience, what advice do you have for contemporary NATO personnel?

I would like NATO personnel to understand that NATO's borders extend to North America, but that within North America, the United States and Canada are two different entities with different, but complimentary approaches to operations outside home territory.

As NATO nations all work closely together, it is important to acknowledge national priorities but avoid 'silo' type language when discussing specific capabilities. For instance, the primary mission of our long-range patrol aircraft is maritime sovereignty patrols, but it is equally capable in an overland ISR role. Other platforms are also used in multirole missions that don't always appear congruent with their main role; in this manner that Canada will provide the most synergy possible for future missions. As we continue to refine the way forward, we need to keep in mind that the tools and aircraft that we need for Canada will often coincide with NORAD and NATO's needs, and vice versa. We will all succeed in our tasks if we understand and maximize the strengths that each NATO nation brings to a fight.

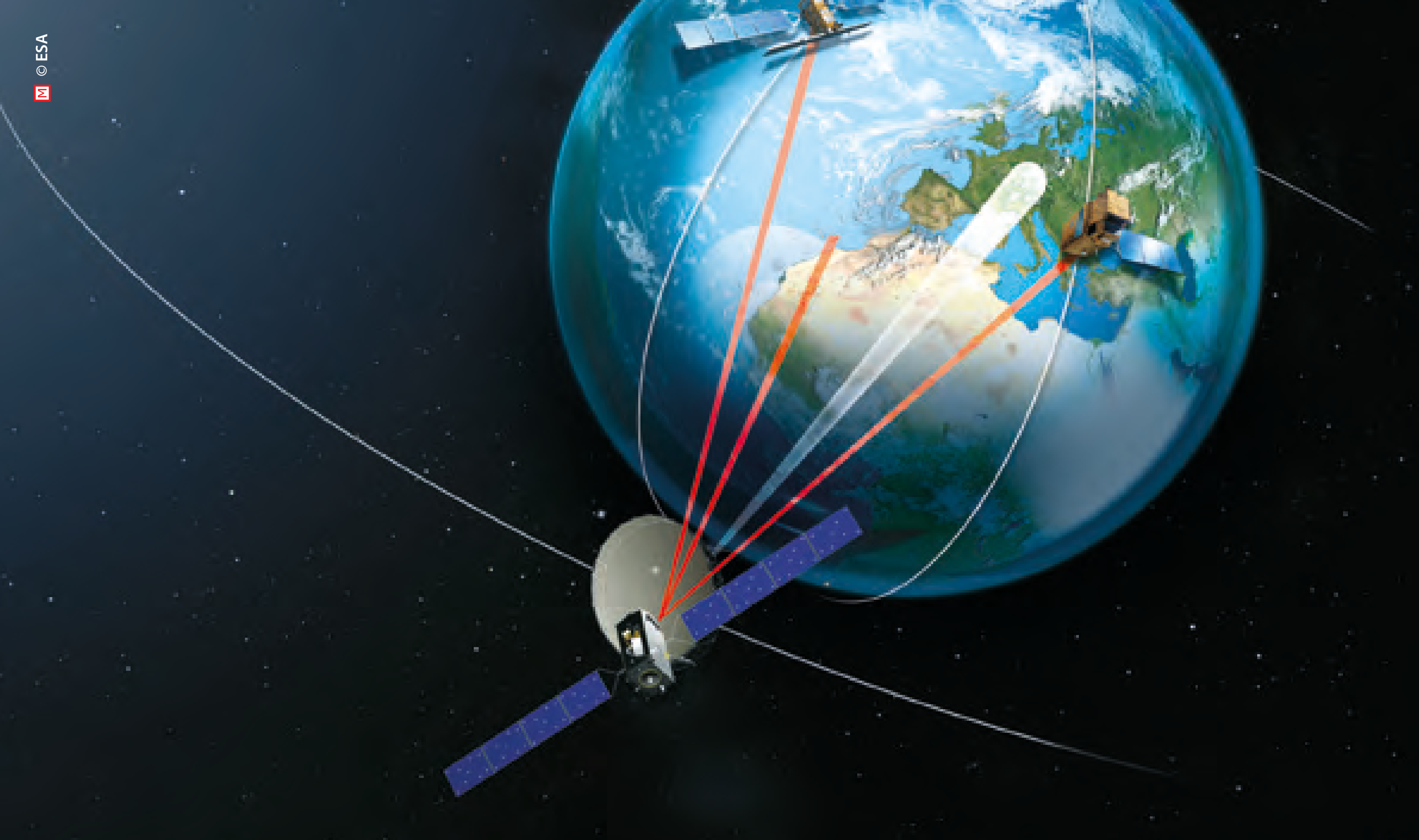
A final word of advice: never stop reading and learning. We can learn so much from our history and heritage that is applicable to the contemporary environment. I have made considerable efforts to ensure learning opportunities are available to all RCAF personnel, and we are making progress in enabling communications engagement across all ranks. Learning from each other is an important part of our professional enhancement throughout our careers and educational opportunities maximize lessons learned. After all, understanding our complex past allows us to adapt to the future with a nuanced and balanced approach. If we all face the future with shared air power fundamentals, we are sure to find ourselves all flying in formation.

Sir, thank you for your time and your comments.

1. The Five-Eyes member nations are Canada, the United States, the United Kingdom, Australia, and New Zealand.

Lieutenant General Mike Hood

received his air combat systems officer (navigator) wings in 1988. Most of his flying career was spent in the tactical airlift role on the CC130 Hercules although he also had a tour as an electronic warfare officer. He commanded two transport squadrons, followed by command of Canada's principle air mobility base from 2007 to 2009. Following a series of staff appointments, he became Deputy Commander of the RCAF in 2012, Director of Staff, Strategic Joint Staff, the following year and took command of the RCAF in July 2015. He is a graduate of Canada's National Security Program as well as the United States Air Force Command and Staff College, and holds a Master's Degree in International Relations from Auburn University in Alabama.



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Optical Data Links for Aerial Applications

Promising Technology for Future RPA Operations

By Dr.-Ing. Wolfgang Griethe, G2Aerospace GmbH, Munich
By Dr.-Ing. Markus Knapek, Vialight Communications GmbH, Gilching

Introduction

Optical fibres move tens of terabits of data every second between cities and across oceans. But for the majority of Earth's surface, where running fibre is impractical physically or financially, communication satellites in space provide connectivity to remote ground users and also to mobile platforms such as aircraft, ships, and even other satellites. These links traditionally rely on Radio-Frequency (RF) communications, which while reliable, are orders of magnitude slower in moving data than optical fibre links, and have issues related to antenna footprint, power requirements, and limited available spectrum. The potential for the laser to overcome these issues in space was realized soon after its invention.[1]

Laser Communication (LaserCom) means communicating with laser beams in near-infrared frequency spectrum (214–400 THz), which allows a user to send a stream of data several hundred times faster while using much less power than today's fastest, strongest radio signals. Such wireless, free-space, optical communication is an emerging practical technology that has been conceptually mature for a long time. In recent years, significant progress was achieved in this field in Europe and especially in Germany. LaserCom has a high priority in the German National Space Program resulting in a well-funded research and development program, supported by the German Space Agency (DLR) and focused on application-mature laser terminals for wideband communications in space.[2] Recent LaserCom research yielded the technical measures necessary to mitigate the susceptibility of laser beams to atmospheric disturbances. This presents the unprecedented opportunity to apply optical communication in and between both outer space and airspace.

A current near-term goal of the German Air Force is the validation of air-to-air as well as air-to-ground LaserCom connections with live experimental verification towards an initial operating capability. This project puts special emphasis on wideband optical data links for the transmission of large-volume Intelligence, Surveillance, and Reconnaissance (ISR) sensor data from aerial platforms, which formerly was realized only via Satellite Communication (SatCom) relays. With Remotely Piloted Aircraft (RPA) being fielded in ever-increasing numbers, and the advance of highly capable ISR sensors placing large data transfer demands on communication systems, such an approach has major significance for the future of military capabilities.

LaserCom Achievements in Space

Although the first LaserCom systems were demonstrated in space in the 1990s, it is only recently that the technology, reliability, and economics of photonic components have reached levels that, combined with the need for more bandwidth, have allowed these systems to be pushed more broadly into operation. The current standard is Tesat Spacecom's Laser Communication Terminal (LCT), which has operated in low earth orbit (LEO) aboard US NFIRE and German TerraSAR-X satellites since 2007.[3] LCT payloads are also embarked on European satellites in geosynchronous earth orbit (GEO) on the Alphasat (Inmarsat-4 F4) since November 2013, and the Eutelsat 9B since January 2016. While the Alphasat LCT is a technology demonstration payload for optical wideband communication LEO to GEO, the Eutelsat 9B (alias EDRS-A) hosts an LCT as data relay payload for the European Data Relay Satellite System (EDRS). Data being collected by LEO satellites will be sent via optical links (laser) to EDRS nodes which will then transmit the data in near real-time via K_a radio band (26.5 – 40 GHz) at 1.8 gigabit per second (Gbps) to Earth.

Quest for Air-to-Air and Air-to-Ground LaserCom

While the aforementioned LCTs provide a well-proven technology for optical wideband communication, it must not be overlooked that they are exclusively designed for use in space, i.e. for transmission between assets deployed above the atmosphere. To date, beyond the line-of-sight (BLOS) communication of aircraft with each other or their ground stations continues to rely on SatCom, i.e. the use of RF links in the K_u band (12–18 GHz).

'A current near-term goal of the German Air Force is the validation of air-to-air as well as air-to-ground LaserCom connections with live experimental verification towards an initial operating capability.'

Although more than 200 deployed satellites practically provide global K_u band coverage, the overall congestion of the K_u band causes problems in particular with regard to unmanned aircraft operation. As a matter of priority, for reasons of air traffic safety, available RF bandwidth must be primarily reserved for Command and Non-Payload Communications (CNPC) i.e. the exchange of flight mission control signals. Parallel and timely transmission of voluminous ISR sensor data is often not possible within the limited K_u frequency range that the responsible authorities – such as the European Air Safety Agency (EASA), the International Telecommunication Union Radiocommunication Sector (ITU-R), and the International Civil Aviation

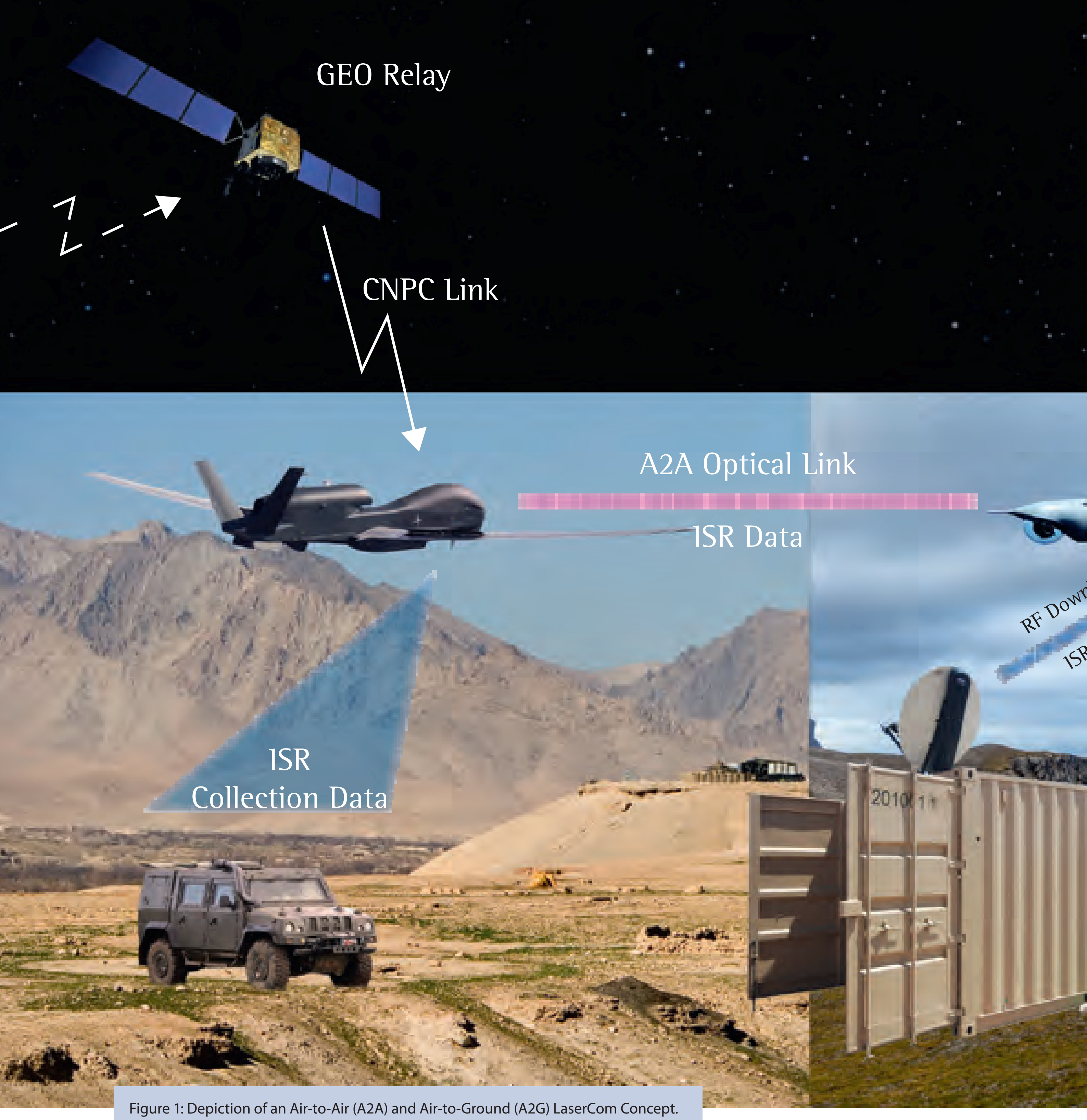
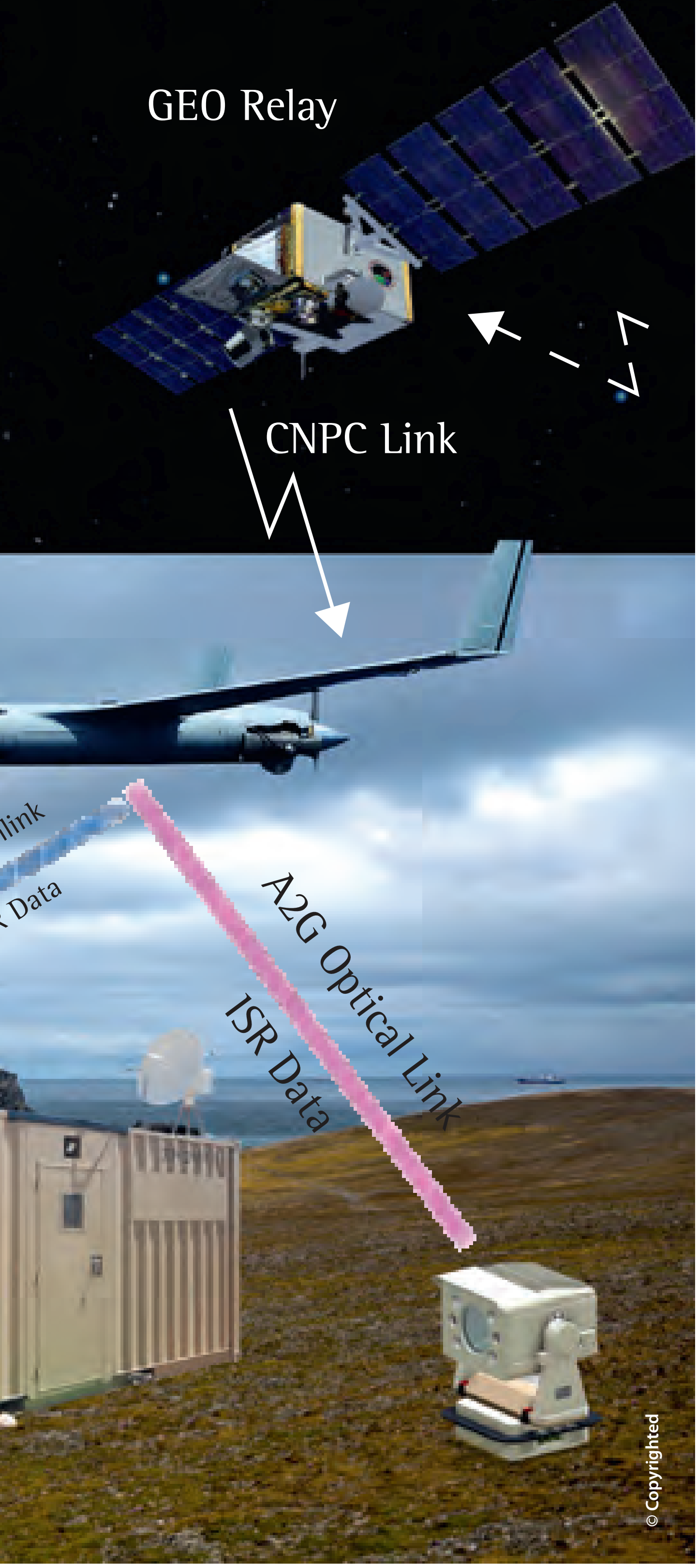


Figure 1: Depiction of an Air-to-Air (A2A) and Air-to-Ground (A2G) LaserCom Concept.

Organization (ICAO) – could usually make available for such operations.

Apart from bandwidth limitations, a second concern is information security of ISR data, since radio transmission uses a segment of the electromagnetic spectrum that is vulnerable to both eavesdropping and jamming. This is not the case with optical communication, which is extremely difficult to intercept or disrupt.

Furthermore, in times of austerity the question arises whether there are more cost-effective ways than the use of expensive satellite communication. For these



reasons the military has a definite requirement for wideband communications not only between spacecraft but also for the interconnection of air assets in a LaserCom network. Wideband optical communication, which links directly air-to-air (A2A) between flying platforms, and air-to-ground (A2G), could be the answer. A potential concept is shown in Figure 1.

Compact Micro Laser Terminal for Aircraft

A2A / A2G LaserCom presumes the existence of aeronautical laser terminals, which have recently been developed. Micro Laser Terminals (MLT) for stratospheric research and aeronautical applications, as well as the corresponding optical ground station, are the result of many years of dedicated research conducted by a German industry partner.[4]

'The military has a definite requirement for wideband communications not only between spacecraft but also for the interconnection of air assets in a LaserCom network.'

The MLT hardware family is comprised of miniaturized optical terminals for the application on a wide range of aeronautical platforms from Medium or High Altitude Long Endurance (MALE/HALE) RPA to stratospheric balloons. The main focus in developing the series was a compact system based on an innovative pointing mechanism, low power consumption and efficient heat dissipation. The terminals are optimized for the dynamic behaviour of agile flight platforms with a high degree of vibrations. In November 2013, an MLT model was successfully tested on a jet aircraft Tornado (see Figure 2). The near-real time transmission of a video stream from a forward facing high-resolution camera on a data link from the aircraft to an optical ground station at 1 Gbps was demonstrated. The maximum link distance was 60 km at an altitude of 7 km and a speed of 800 km/h. This was an extreme test case, as the Tornado is a very rough platform with fast manoeuvres and a high level of vibrations, which were effectively compensated by the MLT's stabilization system. More valuable experience has meanwhile been gained which led to the upgraded model MLT-70. For more technical details see Figure 3.

The current technological development of the MLT product family offers further significant advantages, which predestine MLT devices for A2A applications in the atmosphere, especially for Medium or High Altitude Long Endurance (MALE/HALE) RPA.

Figure 2: MLT as pod integrated solution for Air-to-Ground LaserCom.

Link error correction. MLT devices are equipped with coding transceivers that provide an effective link error correction to mitigate signal fading effects and the risk of data loss caused by atmospheric turbulence in case of long-distance optical communication. Specific Forward Error Correction (FEC) is realized by the so called Laser Aerial Data Interface (LADI) to compensate such scintillation effects.

Eye-safe laser. MLT laser diodes are operated at 1545–1560 nm wavelengths, i.e. within the eye-safe range even at high-power levels. This wideband communication can be deployed inside controlled airspace without inflicting any risk to civil aviation.

Separate bands for CNPC and sensor payload link. Interferences and competition for bandwidth between the CNPC and the payload link, which are typical for radio multi-antenna systems, are excluded. While CNPC would traditionally run as required via RF, ISR data transmission occurs in the optical frequency range and is therefore completely separated. Furthermore, the optical link is not subject to ITU-R coordination. This is extremely beneficial for both reliable aircraft control and flawless payload data transmission. Furthermore, this could become a key factor for RPA certification and their lawful integration into non-segregated airspace.

Payload Interoperability. The MLT optical transfer of collected ISR data to any destination, such as ground stations or other airborne as well as space-based optical communication payloads is technically possible. This is ensured by the Ethernet 10 GBASE-SR data interface, which is international standard that allows for interoperable digital data exchange.

Payload Commonality. The MLT is not designed for a specific aircraft model, instead consisting of standardized mechanical and electrical interfaces that can be accommodated on any aerial platform (manned or unmanned), stratospheric balloons or satellites. See Figures 4 to 6.

Multi-hopping. Multi-Hop Free-Space Optical Communication would allow relayed, BLOS data transfer through a chain of airborne optical links, e.g. several RPA fitted with MLTs and operating at suitable distances.

Space Qualified. The new MLT-70 is compatible to many platforms as well as technically qualified for operation in space, which means it could be deployed

Parameter		Nominal Value	Comment
Terminal Dimensions	HxWxD	530x330x135 (Optics) 310x145x95 (Electr.)	Optical and electronics sub-systems are connected by cables
Aperture Diameter	Ø	70 mm	
Transmit Beam		1545-1560 nm	1 W max optical Tx power
Link Distance		50 km	In combination with a GS-200
Data Rates		10 Gbps	Asymmetric or bidirectional
Weight		<10 kg	Depending on environmental conditions and expected shock loads
Power		88 W	18 to 40 V
Stabilization	Coarse tracking	±40° to nadir	
	Fine tracking	±0.6°	x- and y-axis
Operating temperature	min	-90 °C	
	max	40 °C	
Data Communication Interface		Gigabit Ethernet	Full compliance with the 803.3 IEEE Gigabit Ethernet Standard. Benchmarking by means of the RFC2544.
Latency	min	100 ms	End-to-end
	max	150 ms	

Figure 3: MLT-70 features.[5]

on LEO spacecraft as well as GEO relay satellites. This would even provide a BLOS LaserCom capability for manned and unmanned aerial platforms.

Conclusion and Way Ahead

While LaserCom in space is already mature and applied, the opportunity to provide wideband BLOS communication in the air, reliably, securely, and without the expense required to gain access to a Satcom GEO-relay capacity, makes the MLT technology most interesting for future airpower capabilities. Recent technological advances in that regard are most promising as has been underlined by numerous positive test results specifically about laser-based air-to-ground communication links.

However, never before have laser links A2A been verified under practical flight conditions. That should change now, since the German National Armament Director (i.e. the Director-General for Equipment, Information Technology and In-Service Support of the German Ministry of Defence), who is responsible for the planning, management and supervision of all national and international armaments activities in view of the tasks of the Bundeswehr, intends to conduct a research program in near future that has been proposed specifically for the verification of A2A laser links. The program aims at both testing LaserCom equipment on board flight platforms under practical conditions and gaining clues needed for the development of future operational concepts.

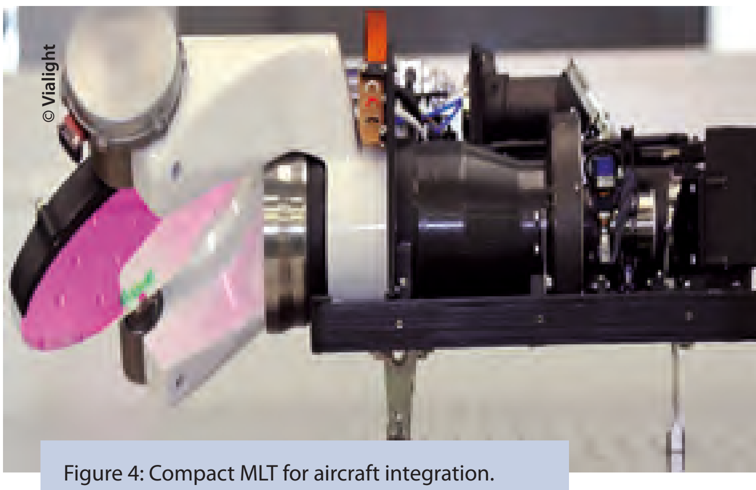


Figure 4: Compact MLT for aircraft integration.

Figure 5: MLT turret version.

Figure 6: A compact MLT Ground Station.

The research program will be performed with support by German industry to achieve synergies and efficient solutions. The objective is to gain an initial operating capability with special attention to the interconnection and interoperability of LaserCom systems. Results may become important for the development of a future European MALE RPA, for which Germany has assumed the lead role according to the German Air Power Development Strategy 2016.[6] Overall, the innovative potential of this new A2A LaserCom technology still tends to be underestimated. NATO or EU nations should therefore begin actively supporting research and development of such applications in order to achieve multinational air power solutions for the benefit the Alliance. ●

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Dr.-Ing. Wolfgang Griethe

studied Electrical Engineering at the Technical University in Dresden, Germany, from 1968–1972 and received his PhD in Engineering in 1982. His space industry career started in 1988 at Kayser-Threde GmbH, Munich, where he had duties in leadership positions as Department Head, Section Head and Vice President, Space Utilization. In 2009 he became Head of Strategy at Tesat-Spacecom GmbH & Co. KG where he promoted synergies between commercial and military space programs as well as initiating and leading Tesat's Airborne LaserCom System (ALCoS) program for RPA applications. In 2013, he founded G2Aerospace GmbH, a medium sized enterprise headquartered in Munich, and has since been its Managing Director. Dr. Griethe is a member of the German Association for Defence Technology (DWT).

Dr.-Ing. Markus Knapek

is the co-founder and CEO of ViaLight Communications GmbH, a Bavarian spinoff of the German Aerospace Center, DLR, specializing in the development and production of wireless laser communication terminals for the aerospace industry. Before founding his company in 2009, he has contributed as a DLR scientist to the development of laser terminals, ground stations and atmospheric channel models. He holds degrees from the Technical University of Munich (PhD) and from the City University of New York.

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An F-35C is taxied to the bow catapults of the USS George Washington during a recent carrier qualification event.

Considerations for Employment of the F-35B in Amphibious Operations

By Captain William A. Perkins, USA N, JAPCC

Introduction

The arrival of the F-35B Lightning-II into the inventory of many NATO nations is likely to fundamentally alter the methods by which NATO conducts air support to amphibious operations. In the past, the amphibious force has not had an asset capable of performing roles such as counter-air, anti-shipping, and traditional Intelligence Surveillance Reconnaissance (ISR), perhaps at all, much less all in one airplane. Amphibious task force commanders and their respective staffs will have to adapt to new capabilities brought by the F-35B and learn other aspects of air warfare at sea. The converse is true as well. Former harrier pilots now flying the F-35 will have to learn overwater Navy operations procedures and roles, again something new to these pilots and the embarked marine staffs, as they have not previously had an airframe with the requisite capabilities to conduct those functions. The JAPCC Journal 22 explored tactical air control in the amphibious environment (May 2015 'Air C2 in an Amphibious Environment'). This article will further explain air support to amphibious operations and discuss specific changes the Maritime component must undergo to fully exploit the F-35B's capabilities in an amphibious operation. The arrival of the F-35 will force a sea change and will require a deliberate effort to break the generational and service mind-set if the future amphibious force is to operate and maintain with a more integrated perspective, fully exploiting the new capabilities.

Although the LHDs and LHAs (USA) are normally capable of simultaneous flight deck and well deck operations (small boats and LCAC), two ships (LHA 6 and 7) will be constructed without a well deck, changing the ship's focus to purely aviation missions.

NATO's Aircraft Carriers

The next few years will see a dramatic increase in the capacity and capability of amphibious forces. The trend begins with the availability of highly capable F-35s on board many NATO amphibious assault ships. Although the USA has also planned to procure the F-35C for use aboard her nuclear-powered aircraft carriers (CVNs), this article is focused primarily on the F-35Bs employment in the amphibious environment surrounding NATO's smaller Short Take-Off Vertical Landing (STOVL) aircraft carriers and amphibious assault ships. Of the NATO F-35 partner countries, the F-35B variant is being planned for use aboard the Amphibious Assault Ships of GBR, ITA, and the USA.[1] Although the numbers are always subject to change throughout the acquisition process, projections indicate that the UK is planning to acquire 138 aircraft split between land and sea-based. Italy is projecting 15 each for land and sea basing, and the US Marine Corps is planning on up to 340. Spreading these aircraft across the Wasp and America class (US), Cavour and Geribaldi (ITA) and the 2 Queen Elizabeth class carriers (UK) will dramatically increase the range of options for the use of air power available to the Maritime Component commander over the 6–10 harriers which were previously based on each of these amphibious assault ships. Additionally, GBR is in discussion with USA regarding the potential of deploying a US Marine Squadron aboard the HMS Queen Elizabeth within the next few years[2], as the UK's F-35 will not be available prior to the completion of sea trials of this new aircraft carrier class.

Furthermore, the US will deploy both LHA 6 (USS America, commissioned in 2014) and LHA 7 (USS Tripoli, projected commissioning in 2018) in the near future. These ships are unique from the others in the WASP class as they are designed without a well-deck for surface craft operations, providing a larger hanger deck with overhead cranes for aircraft maintenance and more aviation fuel bunkering. Although this model provides less overall flexibility to the amphibious force than the other Amphibious Assault Ships (who are capable of simultaneous flight deck and well deck operations), inclusion of this variant will bring a significantly enhanced aviation capability to the maritime commander. Some envision these ships operating as the striking arm of the Task Force (similar to the 'harrier carrier' model used in Operation Desert Storm) while the remainder of the ships and their embarked aircraft would fulfil the traditional roles of supporting Landing Force movement.

Taking into account the increase in aircraft capacity from the QEC Class (GBR) over the Ocean and Illustrious class carriers, and including the addition of the aviation-oriented LHAs (USA) in the future, NATO may have as many as 30–40 more sea-based fighters in a future Amphibious Task Force. This increase in numbers of sea-based strike aircraft available to NATO in the coming years, coupled with the increase in overall mission capability brought by the F-35B over its predecessor means the Commander of the Amphibious Task Force (CATF) will have more aviation capability at his/her disposal than ever before. This will require a detailed review of doctrine and operational employment concepts to fully embrace the capabilities of this next generation aircraft.

Command and Control During Amphibious Operations

Changes brought by these new capabilities even include potential adjustments to the unique relationship of the command structure currently in use for NATO's amphibious operations (as described in ATP-08). It describes a condition comprised of two separate but equal commanders who operate in a mutually supporting role, with one having priority over the other based upon the phase of the amphibious operation. The CATF is the supported commander in the early phases of any operation from arrival into the theatre through the deployment of the Landing Force and is charged with protecting the Amphibious Task Force to ensure safe delivery of the Landing Force to the objective area. The CATF will have to work together with the Commander of the Landing Force (CLF) in a new way, and the embarked pilots will have to learn the roles of each of the air functions described below.

The US will begin deploying the F-35B aboard Wasp Class Amphibious Assault Ships in 2017.

The Role of Air in Amphibious Operations

The Landing Force traditionally contains an air component, comprised of predominantly lift aircraft and strike helicopters for Close Air Support (CAS). It also contains a small element of fixed wing strike aircraft. For many NATO nations this has previously been addressed using variants of the AV-8B Harrier. Regardless of whether the nation chose to retain its Harrier fleet under their Air Component or Maritime Component, the functions the aircraft performed were tailored to its capabilities: CAS and limited strike. The Harrier retained a very limited anti-shipping capability, largely because it lacked a datalink between aircraft and the ship, and tactics for employment in this role were still under development as the airframe approached end of service. Many nations did not retain an air-to-air capability in their Harrier fleet, and Intelligence Surveillance Reconnaissance (ISR) support was limited to non-traditional ISR roles stemming solely from the ability to steer the laser targeting pod to capture imagery for intelligence assessment post-mission. The capabilities of the F-35 will not only eclipse this entire list, but a single F-35 will be able to conduct a large array of functions related to core air power roles and types of air operations identified in AJP 3.3.

'Unlike its Harrier predecessor, a single F-35B will be able to simultaneously conduct a large array of functions related to core air power roles and types of air operations identified in AJP 3.3.'

As the Harrier previously provided an extremely limited capability against surface or air threats, adversary shipping or aircraft, there previously existed limited air support from the Marine component to the Navy component of the Task force, even during the arrival/staging and beach landing phases.

Maritime doctrine says tactical control of overwater missions not specifically supporting logistics movement of the Landing Force is further delineated to the Composite Warfare Commander (CWC) and his subordinates, the Air and Missile Defence Commander (AMDC) and the Anti-Surface Warfare Commander (ASUWC). These roles have always existed but embarked harriers have rarely contributed to this function due to limited capability.

Defensive Counter Air (DCA)

The AV-8B's strengths lie in providing CAS to the Landing Force. Although some nations have equipped the Harrier with an air-to-air capability toward the end of its service life, protecting the Naval Task Force against inbound hostile aircraft was never intended as a principle role. As a multi-role fighter, the F-35B will be equipped with the latest air-to-air missiles, including the AIM 9X Sidewinder, AIM 120C AMRAAM and AIM 132 ASRAAM.[3] Some dispute whether the F-35 is truly suited for this role; however, 'the advanced helmet with 360-degree targeting capabilities and AIM-9X with its extreme off-boresight engagement parameters should ensure that a turning dogfight is an irrelevance'.[4] Any F-35B used for DCA would be under tactical control of the AMDC in the same C2 model used by the nuclear-powered aircraft carrier strike groups to control DCA aircraft. Although the harrier 'could' have been used in a last ditch intercept role, the capability to launch organic air defence stations will be a new concept for the amphibious task force and the mechanics, concept of operations, and procedures must be ratified and adopted by the components of the amphibious task force.

Air Power Contributions to Maritime Operations (APCMO)

APCMO is the AJP 3.3's most recent variation of a term that describes the missions flown in support of the maritime component. Nominally, the maritime component sources organic (embarked) air missions to conduct defence of the force. However, unless an aircraft carrier (USA or FRA) is part of the Task Force, the capability of the embarked aircraft on amphibious assault ships are normally limited to executing small niches of the full spectrum of air power. Therefore, enabling functions must be requested from the Joint

With the combination of Aegis (see picture to the right) with F-35, the sensors are combined into wide area coverage. With a new generation of weapons on the F-35, and the ability to operate a broad wolfpack of air and sea capabilities, the F-35 can perform as the directing point for combat action. With the Aegis and its new SM-3 missiles, the F-35s can leverage a sea-based missile to expand its area of strike. With a combination of the F-35 and the Aegis, the defence of land-bases and sea-bases is expanded significantly.[5]

Force Air Component Command (JFACC) to support the Joint Force Maritime Component Command (JFMCC) and the naval force. This is also the case for Anti-Surface Warfare (finding and destroying adversary ships before they sink friendly ships) missions. In a typical amphibious operation, Maritime Patrol Aircraft (MPA) and armed helicopters may be sourced to fill the anti-shipping mission, but there are often times when an enemy ship must be struck from the air and there is no MPA or properly equipped helicopter available. In this case in the past, Joint Air assets were requested to fill the support requirement. However, this is another area where the F-35B will likely be employed to fulfil the need organically where its predecessor could not.

Not only do the weapons carried by the F-35 facilitate its use in an Anti-shipping role, the sensors and information exchange capability will be a generational leap forward felt across the entire naval force. The F-35 will provide an organic ISR capability to the CATF staff which previously did not exist. Additionally, the Lightning II's missile launch detection sensors will tremendously augment the naval AMDC's capability to defend the force. Previously, the AMDC had to wait until a maritime sensor, usually a ship-mounted radar, detected an inbound aircraft or missile prior to determining the best weapon system to employ for defence. Furthermore, integration of the F-35 and the Aegis weapons system has been discussed and concepts for operation are in development.

Finally, as a Joint Enabler, the F-35 may reduce maritime components' capability shortage for defence of the force, and potentially reduce JFACC support requests. Furthermore, integrating the F-35 from the Maritime Component into JFACC strike packages offers an additional level of synergy between the services not normally achieved without the presence of a nuclear-powered aircraft carrier and her 75 embarked strike aircraft. This will alter the relationship between the JFMCC and JFACC early in any campaign and synergy of effort should be sought out and exploited in this phase of the campaign.

Therefore, it is very probable the F-35 may find itself serving in overwater missions while the Amphibious Task Force arrives into the operations area and begins the process of debarking the Landing Force. This will require a level of education and training for both the CATF Staff and the ex-Harrier pilots in the cockpit of the F-35, both of whom are not used to using embarked organic aircraft in this role. The CATF staff will have to become much more educated in the overwater AMDC responsibilities than has traditionally been the case. The F-35 pilots, used to overland operations and Joint Terminal Attack Control (JTAC) procedures, will have to learn the maritime overwater command and control procedures, including the CWC structure and governing maritime tasking orders). This is a significant departure from the overwater control procedures employed for logistics movement and CAS at the beach roles they have previously embraced.

Summary

The impending arrival of sea-based F-35s offers an opportunity to rethink current approaches for maritime air employment in amphibious operations. Previously, the AV-8B Harrier has not typically been part of any overwater C2 process as it was unable to effectively fulfil any of those roles until the landing operation commenced. The CWC structure in use by the maritime force, and the subsequent supporting elements and control networks/procedures of the AMDC and ASUWC, are traditionally a foreign concept to the pilots embarked on amphibious assault ships, as those missions have not been part of the portfolio of the previous generation of assault support aircraft.

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NATO should begin exploring the cross deck potential of the F-35B aboard other nations aircraft carriers.

'NATO planners should establish a concept for F-35B integration into future amphibious operations.'

NATO planners should establish a concept for F-35B integration into future amphibious operations by reviewing and questioning the old assumptions that drove the creation of today's doctrine. There are currently two appropriate forums to address this upcoming challenge: the Maritime Air Coordination Conference (co-chaired by JAPCC and Commander Maritime Air NATO) or the Amphibious Operations Working Group, both with significant support from and integration with Naval Striking and Support Forces NATO (STRKFORNATO). STRKFORNATO is the NATO entity which oversees operational employment of the unique capability provided by a US aircraft carrier or Expeditionary Strike Group and can serve as either JFC HQ or CFMCC. As the US is likely to begin F-35 deployments to the Pacific on WASP Class STOVL carriers in 2017[6] with NATO and Middle East deployments likely to shortly follow, addressing this issue is growing in importance as the F-35 programme comes online.

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Captain William A. Perkins

graduated in 1994 from Maine Maritime Academy with an Unlimited 3rd Mate's License followed by completion of the Navy's flight training syllabus. Captain Perkins holds a Master's Degree in Strategic Foresight from Regent University and is a graduate of the Joint Forces Staff College. He is designated as P-3 Orion Weapons & Tactics Instructor (WTI) and on his 7 deployments he has flown combat missions in every operational theatre in which the P-3C operates. In 2012, Captain Perkins completed a successful aviation squadron command tour as Commanding Officer of Tactical Air Control Squadron ELEVEN. He recently served as Navigator of the USS George Washington aircraft carrier, homeported in Yokosuka, Japan. He is currently serving as the Maritime Air (FW) including Carrier Operations SME at the Joint Air Power Competence Centre.

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Managing Space Education and Training in NATO

The JAPCC's New Role as the Department Head for Space

By Lieutenant Colonel Andrea Console (ITA AF), JAPCC
By Lieutenant Colonel Heiner Grest (DEU AF), JAPCC

Introduction

On 24 May 2016, the Assistant Director of the JAPCC, Air Commodore Madeleine Spit signed the Appointment Letter officially confirming the designation of the JAPCC as Department Head (DH) for 'Space Support to NATO Operations'.[1] For our Centre of Excellence, this means assuming a leading role with significant responsibilities in ensuring the provision of both individual and collective Education and Training (E&T) for NATO personnel in the field of 'Space'. The assignment is a big achievement and the beginning of an exciting job with many tasks implied.

According to the NATO Education, Training, Exercises and Evaluation (ETEE) Policy MC 0458/3, the DH 'supports Headquarters Supreme Allied Commander Transformation's (SACT) responsibility for translating NATO E&T requirements into solutions for the individual and collective training spectrum'.[2] In particular, the DH assembles a discipline-specific E&T program and is responsible for the coordination of the solutions. Obviously, this is just a general definition, which does not capture the particular duties of a DH to achieve effective and efficient E&T in NATO. This article will, therefore, provide a more detailed description of the current NATO ETEE policy and guidance, including

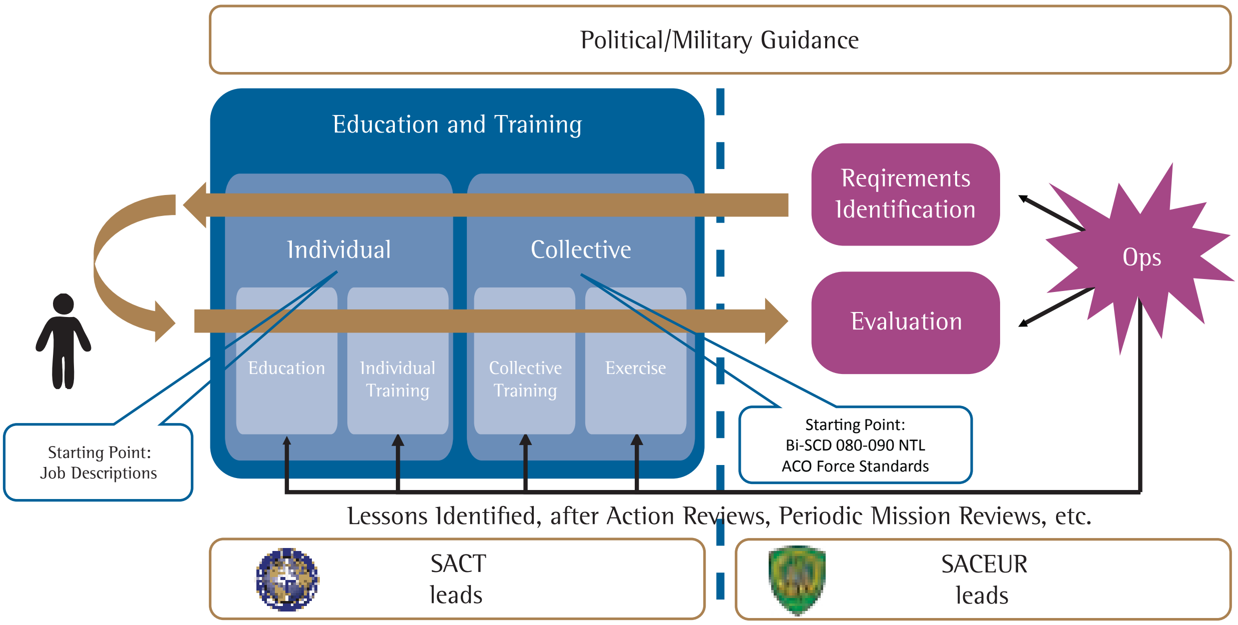

Figure 1: Responsibilities and main steps in NATO E&T.

the concept of Global Programming (GP) for E&T, and explain what this actually means for the work of a DH for Space.

E&T Principles in NATO

'NATO E&T activities are core functions for preparing the NATO Command Structure (NCS) and NATO Force Structure (NFS) for current and future missions in accordance with the Alliance's level of ambition (LOA).'[3]

Headquarters as well as units within NCS or NFS consist of many positions requiring dedicated, specialised personnel to effectively fulfil their duties. As a matter of principle, NATO expects the Nations to send fully qualified individuals to those jobs. The general obligations for prior national training are set by a framework of agreed standards,[4] e.g. the Allied Command Operations (ACO) Force Standards (AFS). For individual positions within the NCS/NFS, specific job descriptions provide the definite requirements. During the first six months on their job, personnel should receive additional NATO training to lift them to the specific Depth of Knowledge (DoK) required for the position.

To achieve those E&T objectives, most Nations can rely on a broad variety of their own internal facilities. However, in order to provide NATO-specific E&T and to make standardized E&T available to all members, the Alliance operates seven NATO E&T Facilities (NETF), 23 Centres of Excellence (COE), and 29 Partnership Training Education Centres (PTEC).[5]

Global Programming – A New Management Approach for NATO E&T

The overall NATO E&T management is based on Global Programming (GP), which was established in 2012. This new approach came about as a result of national observations in 2006, which concluded the NATO E&T system was not working adequately. In 2009 an independent consultant listed 116 recommendations on NATO E&T, accentuating insufficient coordination and oversight, wasteful creation of unnecessary courses, progressive loss of the link between requirements and solutions, inefficient duplication of solutions and inadequate verification of the fulfilment of requirements. In particular, according to the report, the overall strategic picture and management framework was

Domain	Function	Capability Development	Mission Execution Enhancement
• Land Operations	• Intelligence (J2)	• Ballistic Missile Defence	• Building Integrity
• Air Operations	• Meteorology and Oceanography (J3)	• Countering Improvised Explosives Devices	• Counter-Terrorism
• Maritime Operations	• Joint Targeting (J3)	• Federated Mission Networking	• Energy Security
• Space Support to Operations	• Military Police (J3)		• Military Contribution to Peace Support
• Cyber Defence Operations	• Logistics (J4)		• Weapons of Mass Destruction/ Chemical, Biological, Radioactive and Nuclear Defence
• Special Operations	• Medical Support (JMed)		• Gender in Military Operations
• Nuclear Operations	• Operational Planning and Assessment (J5)		
	• Military Engineering (JEng)		
	• Consultation, Command and Control (J6)		
	• Education, Training,Exercises and Evaluation (J7)		
	• Finance (J8)		

Figure 2: Bi-SC List of Disciplines (see separate PPT-slide).

inadequate.[6] GP is SACT's response to achieve a collaborative, unified NATO effort for developing effective, efficient, and affordable E&T solutions. As laid down in detail in the Bi-Strategic Command Directive 072-002 (E&T Directive),[7] GP introduces a holistic, structured and strictly requirements-based approach to NATO E&T management which clearly separates the responsibilities for both E&T providers and clients. In short, GP aims to convert broad political and military requirements into specific E&T requirements and find, or otherwise develop solutions to meet those requirements (Figure 1).

For ease of management, requirements are grouped and categorised into disciplines as per the Bi-SC List of Disciplines[8] in Figure 2. The whole set of disciplines is meant to cover all NATO E&T requirements and is to be reviewed annually.

GP basically consists of three distinct but interrelated components: Governance Structure, Development Methodology, and Production Planning Process, which are further explained in the sections below.

First GP Component – the Governance Structure

Joint Force Trainer (JFT)

The HQ SACT Deputy Chief of Staff Joint Force Trainer (DCOS JFT) – on behalf of SACT – is responsible for the direction and coordination of the whole E&T spectrum. It sets the Governance Framework, updates the relevant documents and coordinates between all disciplines and within one discipline. For each discipline, JFT is supported by a Requirements Authority (RA) and a Department Head (DH) as illustrated in Figure 3.

Requirements Authority (RA)

For each discipline, the appointed RA represents the interests of the end user. For this reason, it is considered the specific operational authority and it is usually chosen within Allied Command Operations (ACO/SHAPE).

Within the specific discipline, the RA is to lead the identification of individual and collective E&T requirements by compiling, defining, and prioritizing these requirements within the range of available political-military guidance. Moreover, the RA provides inputs concerning changes to relevant NATO documents, doctrines, policy, and procedures. In particular, the RA ensures specific direction is contained with SACEURs Annual Guidance for ETEE (SAGE), as necessary.

The RA for Space is SHAPE ACOS J3.

Department Head (DH)

The DH is a volunteer organization with specific experience in a particular discipline and in E&T. It coordinates, under DCOS JFT guidance, identification and development of effective, efficient, and affordable E&T solutions for the requirements provided by the RA.

To this purpose, the DH is to collaborate and coordinate the definition as well as delivery of E&T solutions with designated facilities both inside and outside the military to include NATO's own facilities and national providers.

The DH for Space is the JAPCC (C4ISR+Space Branch. Space Section).

Second GP Component – the Development Methodology

During the subsequent steps of the Development Methodology, the JFT, RA, and DH identify and refine E&T requirements resulting in the definition and delivery of individual and collective training solutions. Embedded within the Development Methodology are the means for sustaining E&T requirements and the associated solutions over time.

Strategic Training Plan (STP)

For each discipline, all identified E&T requirements deriving from tactical, operational, military-strategic, and political-strategic level tasks, are collected in a Strategic Training Plan (STP). This first step is completed by DCOS JFT, mainly supported by the RA.

Training Requirements Analysis (TRA)

Based on the STP, a Training Requirements Analysis (TRA) is conducted to capture all NATO E&T requirements, to compare them with available E&T existing solutions, and to detect gaps or overlaps. The results are published in a separate report. JFT, in close coordination with the RA and DH, is responsible for this step.

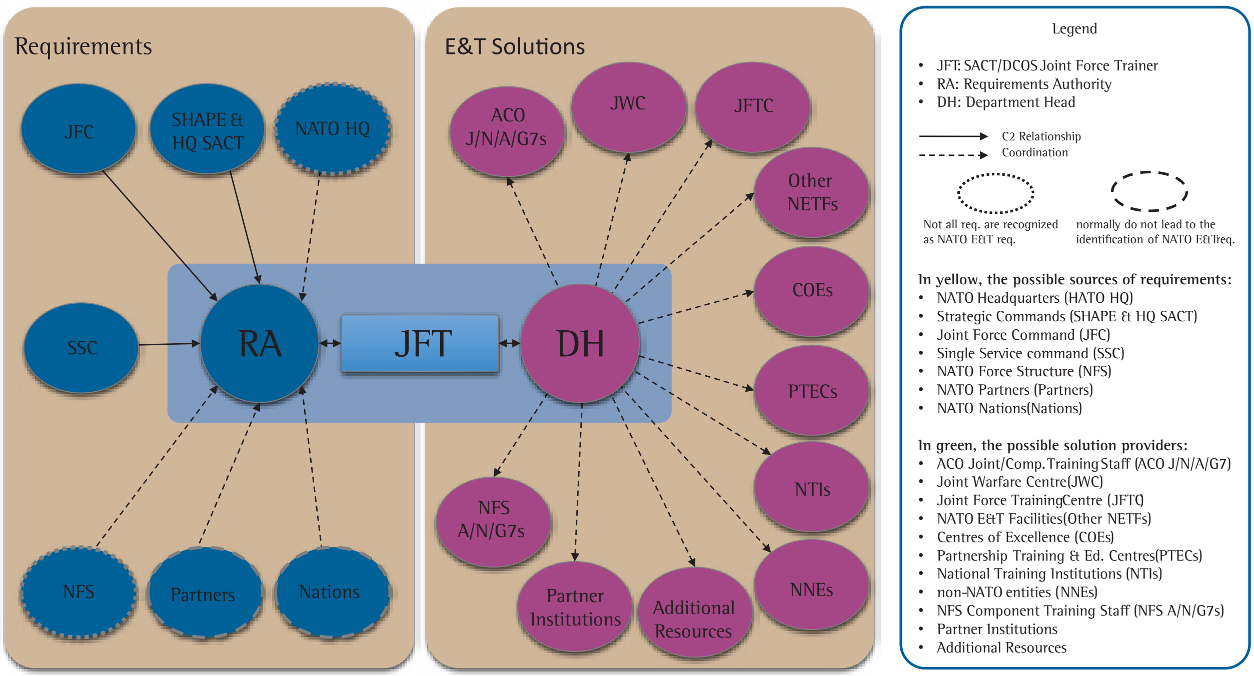

Figure 3: JFT/RA/DH Cluster Framework – illustrates the coordination linkage between JFT, RA, DH, and the supporting/coordinating entities.

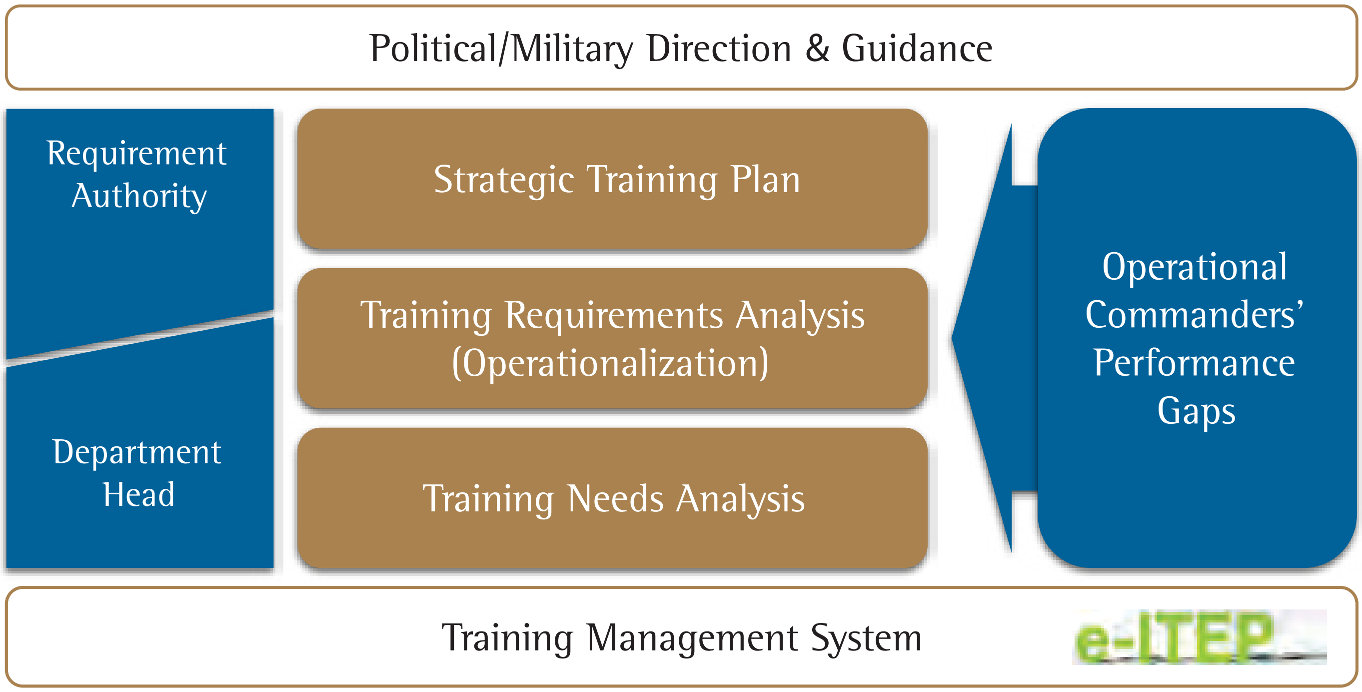

Figure 4: Development Methodology .

Training Needs Analysis (TNA)
E&T gaps highlighted in the TRA-Report are addressed by the DH through one or more TNA turns. Every TNA is conducted in close coordination with E&T providers and all relevant stakeholders. It applies the 'System Approach to Training' methodology, an iterative and interactive process to define, develop, and implement effective, efficient, and affordable solutions. The TNA process is started by the DH, but it requires a close coordination among JFT, DH, RA and the Education and Training Facilities.

Annual Discipline Conference (ADC)
At least once a year, an Annual Discipline Conference is organized and conducted by the DH, on behalf of HQ SACT/DCOS JFT, to review all E&T activities associated within a discipline. The objective of the ADC is to ensure E&T remains aligned with evolving needs, available technology and resources and to determine the way ahead. The results of this conference, including the plan for the follow-up actions, are published in the Discipline Alignment Plan.

Third GP Component – the Production Planning Process

The Production Planning Process is a recurring multidisciplinary process, which helps planning and synchronizing the delivery of individual courses as well as collective training by involving all the relevant stakeholders in various meetings and conferences. The resulting programme of E&T solutions is available on two web-based training management systems: 'e-ITEP' (electronic Individual Training and Education Programme), for the individual courses, and 'MTEP' (Military Training and Exercise Programme), for the collective training opportunities. Both catalogues are accessible from Internet and are password protected.[9]

Department Head – Why the JAPCC?

Centres of Excellence (COEs) are international military organizations – nationally or multi-nationally funded – that offer recognised expertise and experience as well as independent research and analysis in support of the

Alliance in a particular military domain. They have an active role in developing doctrine, identifying lessons learned, improving interoperability and capabilities, and testing and validating concepts through experimentation. Moreover, COEs participate in a multitude of NATO and multinational or national committees, working groups and forums, giving them the opportunity to develop and engage with a broad network of experts, which may reach into the E&T domain. Furthermore, in their significant role supporting the transformation of NATO, COEs have a close relation with SACT and a dedicated interest in providing expert advice in specific training matters. Independence of thought, networking capabilities, knowledge of the matter, and strong connection with HQ SACT are the characteristics that make COEs ideal candidates for the role of DH.

Within NATO, there is no specific COE for Space. However, the JAPCC, being NATO-accredited COE since 2005, holds a section of three dedicated Space experts inside its 'Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance and Space' (C4ISR+S) Branch. For NATO, therefore, it was a logical decision to appoint the JAPCC as the DH for Space Support to Operations.

Current Space E&T Situation

Currently there are very few opportunities in NATO for individual E&T in Space matters. The NATO School in Oberammergau (NSO) offers an 'Introduction to Space Support to NATO Operations' course twice a year. The only additional opportunity is delivered through the 'JFAC Space Cell Course' held at the French-hosted COE 'Analysis and Simulation Centre for Air Operations' (CASPOA). Moreover, the German Bundeswehr Command and Staff College offers a one-week basic course for the military use of Space capabilities, open for all NATO staff officers. By consequence, there is still a huge need for Space instruction, especially for

US Marines conduct radio checks during WTI 1-17.

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advanced individual E&T. For this reason, a request for information has been recently issued to the allied nations, to explore the possibility to accredit more national E&T opportunities for NATO participants.

In addition, Collective Training and Exercises requires some improvement. In the last two years, the NATO Bi-SC Space Working Group have pushed hard to include more Space-related training into major NATO exercises. In particular, for Trident Juncture 2016, Space SMEs have taken part in the exercise scripting from the early stage, thus ensuring a stronger influence in the training objectives. The TRA Report shows there is still margin for further enhancements, mainly in the direction of a deeper integration of Space-related objectives; the process, however, seems on the right track.

Outlook

In summary, bringing E&T for the 'Space Support to Operations' discipline to a satisfactory level is a big challenge and there is still much to do. The latest TRA Report identified several E&T gaps, which the DH has to close in order to improve the individual and collective E&T spectrum.

In this situation, the Allies can contribute in broadening the variety of Space E&T solutions by opening their Space-related courses to NATO personnel. The DH at JAPCC welcomes course offerings within the wide spectrum of Space from all over NATO and partner nations, military schools and academia as well as civil institutes for exploring more E&T possibilities. For further details, please contact the authors of this article.

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2. MC 0458/3, 03. Sept. 2014, p. 10.
3. Bi-SC Dir 075-002, 'Education and Training Directive (E&TD)', 06 Sep. 2016, p. 5.
4. Bi-SC Dir 080-090, 'NATO Task List (NTL)', 16. Nov. 2007.
5. Final Decision on MC 0458/3 – Annex B, List of NETFS, COES and PTECS, Change 1, 8. Jan. 2016.
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9. https://e-itep.act.nato.int and https://emtep.act.nato.int

Lieutenant Colonel Andrea Console

started his military career in 1995, joining the Italian Air Force Academy in Pozzuoli. During his career, he gained specific technical competence in multiple fields related to navigational aids and data transmission. From 2011 to 2015, he served in the Italian Defence Telecommunications Procurement Agency (TELEDIFE) in the Radar and Electro-Optic Space Systems for Earth Observation Section. Lieutenant Colonel Console holds a master's degree in Electronics Engineering and postgraduate II level University master's degree in Advanced Systems for Space Navigation and Communication. He is also officially recognized as a Projects in Controlled Environments (PRINCE2) Practitioner. Currently, he serves as a JAPCC Space Subject Matter Expert.

Lieutenant Colonel Heiner Grest

joined the German Air Force in 1982 as a conscript. After attending Officers School, he studied Economics and Organisational Sciences at the German Armed Forces University in Hamburg. During the following years he hold different positions within Ground Based Air Defence systems HAWK and PATRIOT as Tactical Control Officer, Battery Commander Maintenance and Support Squadron as well as Fire Unit and finally Staff Officer Logistics. Following assignments within Headquarters 4th Air Division and Rapid Medical Reaction Forces Command placed his emphasis on planning and monitoring of stabilisation forces as well as rapid reaction forces. In 2003 Lt Col Grest was deployed to Headquarters ISAF. Since 2015 he has served as a JAPCC Space Subject Matter Expert.

Debris shielding on the US Destiny Laboratory module. Photo taken during Mission STS-98 International Space Station (ISS) Flight 5A Extravehicular Activity (EVA) 2 operations.

Looking Up Together

Multinational Space Surveillance and Tracking Initiatives from a NATO Perspective

By Lieutenant Colonel Andrea Console, ITA AF, JAPCC

Introduction

Modern societies are increasingly reliant on space-based services. Positioning, Navigation and Timing (PNT), satellite imagery, and long-distance communications to include media broadcasting as well as the World Wide Web are only few examples of the wide spectrum of services on which civil and military actors rely. This also means large numbers of related assets are deployed in Space surrounding the globe, which leads to the well-known concern that Space is becoming increasingly 'contested, congested and competitive'.[1]

Developing Space capabilities is usually very time-consuming and costly, turning these space systems into invaluable assets requiring protection against the manifold natural and artificial threats to which they are vulnerable. The safety of satellites and even the long-term sustainability of outer space activities are endangered by the presence of space debris and other objects coming from the space environment. 'Space weather' is another concern, as disturbances stemming from the sun or outer space deliver sub-atomic particles and high-energy electromagnetic radiation that can severely affect the performance of space-based services as well as the functional capability of electronic devices, both in space and on Earth. This amplifies the need for so-called Space Situational Awareness (SSA).

SSA can be defined as prompt and detailed data collection about the space environment and activities to support current and predictive assessment of space systems status and of any potential threat related to Space. Every nation with space ambitions recognizes the requirement for SSA. For this reason, various Space Surveillance and Tracking (SST) facilities are currently in development by the US and European nations, with plans to improve SSA through shared data, information and services. These efforts are critical to NATO as well as to individual member nations and the Alliance should make it a point to get involved where possible.

Space Surveillance and Tracking (SST)

SST is the survey, tracking, analysis, identification, and cataloguing of active and inactive satellites and other man-made debris (fragments of satellites, launchers, junk coming from space missions) that orbit the Earth. The main aim of SST is to detect such objects and predict their trajectory in order to provide an assessment of the risk they pose for space activities. In fact, even a small piece of debris constitutes a considerable threat to space assets, due to the high speed and resultant kinetic energy that makes it a dangerous projectile. SST makes it possible to manoeuvre at-risk space assets out of harm's way, assuming they have the necessary remote steering capabilities.

Besides this kind of *space safety*, SST can also be exploited for additional purposes, such as re-entry prediction. Every space object in lower orbits will eventually fall back to Earth due to the *atmospheric drag*, which is the deceleration caused by the contact with atmospheric molecules. Given this hazard scenario, the ability to forecast the impact zone of larger debris that will not burn up during re-entry can be critical for the population's safety.

Another interesting application of SST is the prediction of satellite overflights. For the military, this is important for planning both intelligence and counter-intelligence operations. Based on the intervals when space-based Intelligence, Surveillance, And Reconnaissance (ISR) assets are expected over an area, intelligence collection can be better managed. Conversely adversary satellite detection of operations in an area can be avoided by scheduling mission execution times accordingly. Yet another possible application, useful for both military and civil actors, is the prediction of Global Navigation Satellite System (GNSS) precision, i.e. of the effect known as Position Dilution of

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Precision (PDOP). In fact, positioning precision strongly depends on the number and the distribution of the GNSS satellites available in a specific area at a specific time.

SST in the US and in Europe

The US has undoubtedly one of the most significant footprints in space. Therefore they need the best possible SSA at their disposal. For this reason, the US invested substantially in SST capabilities to build a Space Surveillance Network (SSN) that spans the globe. Three 1-metre Ground-based Electro-Optical Deep Space Surveillance (GEODSS) telescopes, one 0.5-metre Moron Optical Space Surveillance (MOSS) telescope, one 3.5-metre Space Surveillance telescope, a mechanically steered 27-metre dish antenna radar (Globus II) and several phased-array radars are only a small excerpt of the world-wide US SSN. In January 2014, it was composed of 29 sensors of various types,[2] and an additional 'Space Fence' of radar SST sensors should be in operation by 2018.[3]

For the same reason, several European space-faring countries decided to develop their own SST capability. Today, for example, France uses the bi-static VHF radar GRAVES (Grand Réseau Adapté à la Veille Spatiale – Large Network Adapted to the Space Watch), which has been operational since the end of 2005, for low-orbit space object surveillance. Germany owns a radar-tracking capability based on the 34-metre parabolic dish antenna Tracking and Imaging Radar (TIRA) system, which can precisely determine space object orbits and derive their physical features using high resolution imaging. Finally, Italy has some processing and optical sensor capabilities and it is implementing a complete network of optical and radar sensors for surveillance and tracking covering low, medium, and geostationary Earth orbits (LEO, MEO and GEO), which includes the Matera Laser Ranging Observatory (MLRO). Such facility can measure with remarkable precision the distance to artificial satellites equipped with retroreflectors.[4] Furthermore, based on laser illumination of debris, a fairly new and promising technology, laser ranging will also be capable of accurately determining the distance to other, non-cooperative targets.[5,6]

Sharing is Caring

As the example of the US SSN demonstrates, the acquisition of an adequate autonomous SST capability is a massive and extremely costly undertaking for a single nation. For this reason, many friendly countries seek collaborative solutions aiming at reducing the requirement for new national SST assets through the exploitation of shared data and information that has been collected by already deployed capabilities. Several bilateral data exchange agreements are therefore in place, such as between Italy and the US[7], France and the US,[8] Germany and the US,[9] and France and Germany.[10] Moreover, since 2009, a number of European Member States (currently 18) have combined their efforts for a European SSA project through the European Space Agency (ESA) – an organization coordinating European space research and technology as well as applications.[11] Even the ESA – owning several satellites – has been cooperating with the US since 2014 to solve its SSA data demand through the USSTRATCOM SSA Sharing Program.[12]

EU 'Framework for Space Surveillance and Tracking Support'

It is worth noting an effective SST capability not only involves acquiring data about space objects, but also combining data from different sources (data fusion), analysing that data and extracting useful information (conjunction or re-entry predictions), and disseminating the information, managing the whole process as a service. An example of an additional but still essential SST facility is the Conjunction Analysis and Evaluation Service, Alerts and Recommendations (CAESAR), provided by the French Space Agency based on 'Conjunction Data Messages' distributed by the US Joint Space Operations Center (JSpOC). This service allows the analysis of space conjunctions (foreseen close approaches for active satellites), the evaluation of the relevant risk of collision, and the dissemination of tailored alerts to the satellite owners.

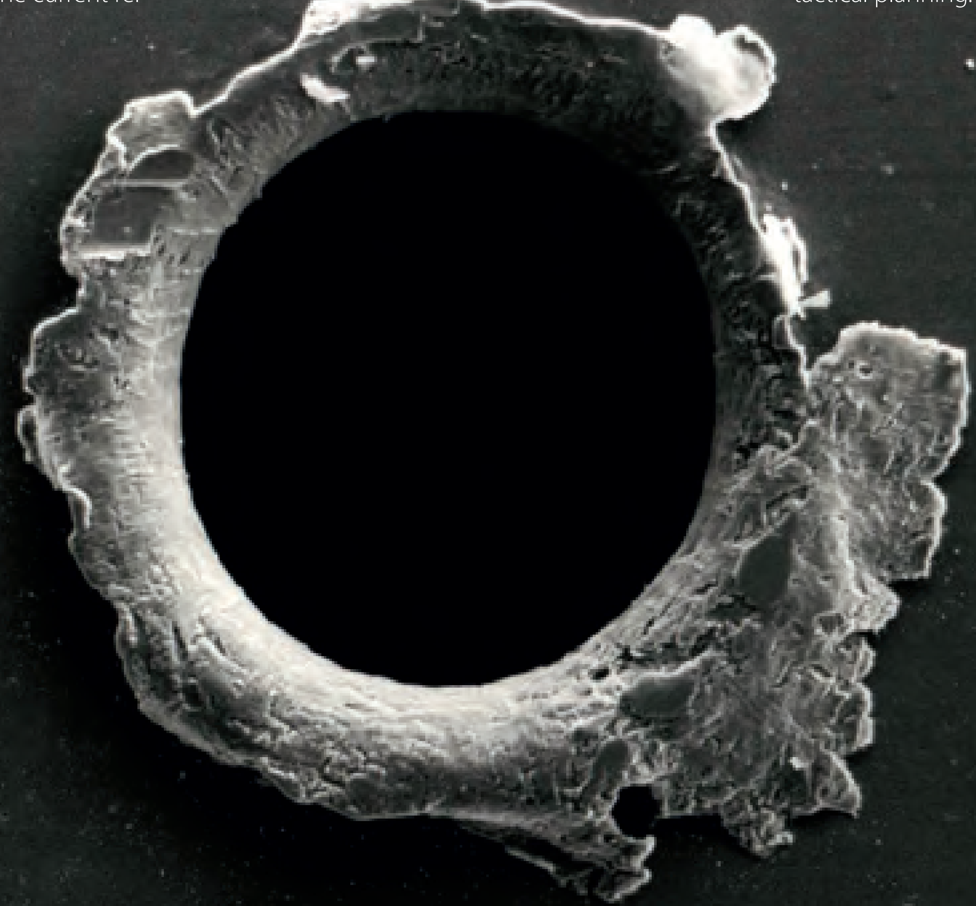
With the goal of developing a holistic approach capable of coping with such complexity, the European Parliament established in 2014 the so-called 'Framework for Space Surveillance and Tracking Support', to 'contribute to ensuring the long-term availability of European and national space infrastructure, facilities, and services, which are essential for the safety and security of the economies, societies and citizens in Europe'.[13] This support framework aims at establishing 'an SST capability at European level and with an appropriate level of European autonomy'[14] through the creation of a European SST sensor network, SST

The dome of a one-meter telescope opens as it prepares to view and track space objects. The telescope is located at the Ground Based Electro-optical Deep Space Surveillance System site in Diego Garcia, British Indian Ocean Territory. The site is responsible for tracking over 2,500 man-made objects in space.

© US Air Force, Senior Airman Brian Ferguson data processing and SST functional services. This framework is not meant to develop new sensors but to integrate the existing ones in order to minimize expenditure and time spent on further capability deployment. The countries participating in the project usually have their national space agencies join the respective SST consortium, which initially consisted of five countries: France, Germany, Italy, Spain, and UK. The European Union Satellite Centre (SatCen), based in Torrejón de Ardoz, near Madrid, will act as the central SST service provider.

Why Would SSA/SST Matter to NATO

The 2014 report on NATO dependencies on space concluded: 'No single NATO operation without Space'.[15] It is a strong statement reflecting the current relevance of space from a NATO perspective. As a matter of fact, space support to operations is today essential, as it is considered 'a potent force multiplier'.[16] Notwithstanding, since 2010, NATO no longer owns any space assets,[17, 18] and it strongly relies on space-based services provided by Alliance Nations on a voluntary basis.[19] However, this does not mean NATO commanders do not need any SSA. Obviously, a commander in operations has no need to know the position of every single piece of space debris, but he definitely should be notified whether any space environment hazard is going to impact the space-based capabilities he relies on, so timely mitigation measures can be applied. Moreover, the detailed Recognised Space Picture, which includes predicted own and adversary satellite overflights (as discussed above), could be indispensable for operational and tactical planning.



View of an orbital debris hole made in the panel of the Solar Max experiment.

© NASA

Conclusion – NATO Perspective

Space is today an essential resource for conducting effective military operations and becoming aware of threats to space-based services as soon as possible can make a difference. Moreover, the availability of a detailed Recognised Space Picture is a significant aspect for military intelligence and commanders' decision-making. For this reason, not only single nations, but also NATO as an Alliance, require SSA, which should be a primary component of a holistic NATO approach to space.

Additionally, since it is unlikely that NATO will develop its own SST network in the foreseeable future, reliance on SSA services voluntarily provided by allied nations will remain the norm. Any effort aimed at developing effective multinational SST networks to enhance SSA, like the European SST project, should be welcomed by NATO. In fact, NATO should make efforts to get involved in any multinational SST project from the outset through its respective Alliance and national representatives, even in projects intended for civilian purposes, to ensure military requirements are appropriately recognized and SST services will be provided to the military as necessary.

Clearly, awareness of the benefits of SSA can be successfully spread via an appropriate NATO Education and Training program. The JAPCC, being the Department Head for Space Support to Operations, will take a proactive and leading role in this activity. In addition to this effort, an overall NATO strategy needs to be discussed and endorsed at the political level to be effectively implemented across the Alliance. This emphasizes that NATO does require political guidance for space-related subjects and, consequently, a NATO Space Policy.

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Lieutenant Colonel Andrea Console

started his military career in 1995, joining the Italian Air Force Academy in Pozzuoli. During his career, he gained specific technical competence in multiple fields related to navigational aids and data transmission. From 2011 to 2015, he served in the Italian Defence Telecommunications Procurement Agency (TELEDIFE) in the Radar and Electro-Optic Space Systems for Earth Observation Section. Lieutenant Colonel Console holds a master's degree in Electronics Engineering and postgraduate II level University master's degree in Advanced Systems for Space Navigation and Communication. He is also officially recognized as a Projects in Controlled Environments (PRINCE2) Practitioner. Currently, he serves as a JAPCC Space Subject Matter Expert.


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NATO Deployable Airbase Activation Modules

Paving the Way Towards a NATO Deployable Airbase

By Lieutenant Colonel Joop Berghuizen, RNLAF, JAPCC

Introduction

While the current Force Planning methodology in NATO is highly consistent and stringent, one significant weakness is the system completely depends on the nations to quickly provide sufficient capability[1] once a planned contingency is activated or an unforeseen crisis emerges. Assuming a Very High Readiness Joint Task Force should be 'ready to move the leading elements within two to three days'[2] to respond to rapidly emerging challenges, it can be argued the current Force Planning and Force Generation process does not support that assumption. In the past, nations have been willing to offer capability during NATO Force Planning Conferences but have subsequently found it difficult to honour their pledges because of the size of commitment required, competing operational requirements, and/or continuing resource constraints. The Afghanistan experience taught us a failure to effectively generate the right forces can lead to NATO filling critical capability gaps on Deployed Operating Bases (DOBs) or Aerial Ports of Debarkation (APODs) with ad-hoc forces not intended for that purpose. It is a matter of luck that our failings to date have neither being exploited by an adversary nor exposed by incident or accident.

In general, very few NATO nations are equipped or prepared to deploy force elements to rapidly establish and operate a multinational DOB or APOD. This is not only because nations do not have the necessary capabilities in their national inventory, but also because the Alliance as a whole lacks a fundamental and underpinning concept of how to rapidly deploy, establish and operate effectively and efficiently, a national or multinational DOB or APOD.

The NATO Deployable Airbase Activation Module (DAAM) concept might help solve this dilemma. The concept is meant to identify and catalogue the full spectrum of capabilities needed to operate a DOB established on a bare base[3] in a complicated and volatile threat environment. DAAM provides a menu of discreet capability modules owned by participating nations from which specific modules may be selected to piece together a complete and cohesive yet lean and efficient base operating support structure at lower cost than recent operations.

Road to DAAM

After the NATO Force Generation challenges experienced during the establishment of APODs at Pristina

[M] © Luftwaffe, Ronja Entreß

(Kosovo) and Kabul (Afghanistan), the JAPCC in 2005 proposed the concept of Deployable Airfield Activation Wings (DAAWs). The concept focused on providing an initial entry or airfield opening capability to rapidly establish a DOB or APOD beyond NATO's territory.[4] The intent was to be able to create a functioning airfield quickly by mitigating against the time-consuming NATO Force Generation process. The second-order effect was to prevent duplication of effort while also preventing omission of any essential capability. The project resulted in the creation of detailed Capability Codes during the Capability Requirement Review (CRR) step of the NATO Defence Planning Process (NDPP).

While these proposed DAAW Capability Codes were not adopted or translated into the NATO Concept of Operations for the rapid establishment of a DOB/APOD, the central idea of dividing the overall capability into 'modules' that could each be satisfied individually by a contributing nation was not dismissed. Indeed, it was this idea that was re-invigorated by the (new) DAAM concept, which was designed in support of the NDPP and paved the way for what is now described as the NATO Deployable Air Base (NDAB) capability. Associated with the DAAM concept is the Italian-led Smart Defence (SD) Project 1.16 which offers the opportunity to create a multinational pool[5, 6] of required NDAB capabilities, for which six nations[7] have so far signed a Letter of Intent.[8] The European Air Group (EAG) also supports this project by drafting the concept and contributing to the planning of exercises. Also worthy of note (but not particularly based on DAAM), is the UK-led SD project 1.18 that looks at Theatre Opening Capability (TOC).[9]

DAAM – What's New?

The most significant innovation of DAAM is the move from a traditional, national-led deployment of a capability – or what happened more often, a combination of disparate or unnecessarily redundant national capabilities – to a more integrated model. It envisages the use of smaller national or multinational modules encompassing all capabilities needed for airbase operations, support and protection, which would come together to create a single NDAB capability. This facilitates rapid activation, deployment, and operation by combining the individual, national force contributions into a predetermined, comprehensive multinational force package. Participating nations will be able to meet their commitments in an effective, efficient manner, while building an effective, efficient multinational NDAB. Thus, the concept could significantly reduce the time gap between Operational Planning, Force Generation, and Deployment phases of an Operation.

The DAAM model, therefore, distinguishes various DOB elements by identifying required 'Capability Modules', which are then subdivided into more specific, thematic components that could be delivered by particular 'Service Teams' (equipment and personnel). Based on this DAAM idea, the current version of the NDAB Concept of Operations outlines six Capability Modules and 19 Service Teams, as depicted in Table 1.[10]

The subdivision into single Service Teams allows smaller NATO Nations to develop partial contributions to an NDAB capability instead of taking on the huge burden associated with providing a fully fledged DOB installation. This will hopefully prompt more Allies to commit in advance through NATO Force Planning and help solve the NDAP capability shortfall. However, based on lessons learned in operations and exercises, the above DOB functional capability requirements should be further refined, since more specific DAAM components (Capability Categories and Service Teams) may boost the willingness for national contribution. For example, Force Protection (FP) capability codes could be expanded to include more detail, as is also requested by recently updated FP doctrine.[12] An analysis of the NATO DOB at Kandahar (during the recent ISAF mission) shows 40 distinct FP capabilities that could be individually described and served.

As with any operation, the eventual activation of the NDAB capability will be based on specific operational planning once NATO decides to commit forces to manage a particular crises. The related Force Generation process will remain the primary means for identifying certain NDAB Service Teams (personnel and equipment) for deployment. Then the operational planning process will tailor them to specific missions.

Officers Commanding[11]	Capability Module	Service Team
Administration	Base Support	Base Support (common administrative and support services)
Force Protection	Force Protection	Command Team
		Chemical, Biological, Radiological and Nuclear (CBRN)
		Active Ground Close Defence
Engineering	Engineering/ Runway Operations	Aerodrome Surfaces (runways, taxiways and aprons) Support and Maintenance Service (including reconstruction)
		Runway Lighting and Approach Lighting systems
		Ground Electrical Support (full power generation)
		Aircraft Arresting Systems
		Snow and Ice removal, de-icing and anti-Foreign Object Damage (FOD) operations
		Petroleum, Oils and Lubricants (POL) (Aviation Fuel Handling and related products)
		Ground Handling/Cross-servicing
Operations	Wing Operations	Aerodrome Operations
		Aeronautical Information Services
		Flight Safety
		Meteorological Services
	Air Traffic Control	Air Traffic Control (ATC) aerodrome, procedural approach and radar approach and precision services
		Navigation Aids
		Communication Services
	Crash Fire and Rescue	Crash Fire and Rescue

Table 1: Capability Modules and Service Teams.

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Apart from an NDAB Cell at Allied Command Operations (ACO) Headquarters, no new standing NATO entity for NDAB will be established. ACO is also responsible for nominating a Lead Nation for the NDAB for each period of the NRF. The NDAB cell will coordinate with the Lead Nation to ensure optimization of DAAM assets in order to enable the initial training of Service Teams. The North Atlantic Council (NAC) agreed to base the NDAB capability primarily on a combination of national means and resources. To further ease the burden for NDAB contributions, the NAC also endorsed the reimbursement of national expenditures for airbase equipment required to remain in theatre after re-deployment of NATO forces.

Additional Requirements

In order to move the DAAM and NDAB concept forward and succeed, the following key issues should be addressed:

- Review and update existing applicable NATO Policy and Doctrine, as they currently do not sufficiently cover NDAB deployment and operation.
- Educate and train personnel of nationally committed NDAB Service Teams in accordance with NATO standards together with Service Teams from different nations to ensure interoperability of both personnel and equipment; a real multinational DAAM-based NDAB has not been seen in exercises.
- Define and agree on criteria for designating a Lead Nation within each Capability Module, and for the overall NDAB.
- Clarify the role and responsibility of 'Lead Nations' in relation to the nationally declared single Service Teams, as far as NDAB activation is concerned. Should only the Lead Nation of a particular NDAB package be triggered for activation, or all single components? Since NATO expects to have more than one declared NDAB in the future, the associated level of coordination required between the foreseen Lead Nations and the diverse Service Teams must not be underestimated.

Conclusion and Outlook

The innovative Smart Defence concept DAAM provides a vehicle NATO can use to advance the development of a viable NDAB capability, delivering a solution that is both effective (the NDAB provides all elements required for reliable and robust function) and resource efficient (there will be no duplication of effort). It will do this by pooling, from multiple nations, the various capabilities required to establish, at short notice, a deployed airbase operating in support of NATO missions abroad. However, at the time of writing this article, only six out of the 28 NATO Nations have signed the DAAM Letter of Intent. Given the statement made at the most recent NATO Summit, that multinational and national initiatives provide an

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important contribution to capability development and our strengthened posture[13], more nations should join the DAAM initiative.

Meanwhile, the basic DAAM idea has to be further developed. Successful DOB installations in ISAF and proven US and UK NDAB models could be used as examples to further refine the list of Capability Codes as well as Service Teams. Furthermore, mission-proven DOB organization charts and detailed operating procedures should be safeguarded in cooperation with the involved NATO Commands in charge.

To make the best use of DAAM-based NDAB packages, Operational Planning, Force Generation, and Deployment processes need to be adopted through revised NATO doctrine. Procedures and standards for Logistics and Command and Control must be reviewed and revised as necessary to support interoperability and cross-service support. Finally, a comprehensive multinational training and exercise programme must be built to develop integration and interoperability of different national combat service support modules, personnel, and leaders, to validate and strengthen the concept.[14]

1. Often referred to as the Troop Contributing Nations (TCNs).
2. NATO (2016) NATO Response Force. [online] NATO. Available from http://www.nato.int/cps/en/natolive/topics_49755.htm?selectedLocale=en# [Accessed 28 Sep. 2016].
3. It is assumed that a bare base would have 0–25 % of the required facilities. As a minimum it should have Aircraft Operating Surfaces (AOS) and airbase lighting. However, access to domestic electrical power and a water supply might not be given. Therefore, the deployment of related logistic capabilities is to be considered and planned.
4. Lt Col Ton Pelser, 'The Deployable Airfield Activation Wing'; The Journal of the JAPCC Edition 1, 2005: p. 18–20.
5. AC/92-N(2012)0018: Smart Defence Proposal – Pooling of DAAM Resources.
6. AC/92-N2012-0009: Air Traffic Management Committee (ATMC) – Smart Defence Initiatives Under the ATMC – DAAM CONCEPT.
7. Belgium, Czech Republic, Denmark, France, Italy, and Spain.
8. Letter of Intent (LOI) for the Pooling of Deployable Airbase Activation Modules (DAAM), dated 28 Aug. 2014.
9. The use of commercial charter and the need to handle strategic airlift means that the APOD will be co-located with an ICAO licensed airfield. SDI 1.18 defines the requirements for the APOD.
10. NATO Deployable Air Base (NDAB) Draft Concept of Operations Jan. 2016; Version 4.1.
11. The individual leading a Capability Modules(s) or a Service Team.
12. NSO(AIR)0482(2016)AO/7217 STANAG 7217 Ed. 1, 'Force Protection Doctrine for NATO Air Operations' – ATP-3.3.6 Edition A.
13. NATO; Warsaw Summit Communiqué. Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Warsaw 8–9 Jul. 2016.
14. Interoperability is the ideal state, Operational Compatibility is essential.

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The Future NATO Rotorcraft Force

Capability Requirements through 2030 and Beyond

By Lieutenant Colonel Miklos Szabo, HUN AF, JAPCC

Introduction

During the Wales summit in 2014, the need for modern, robust and capable forces at high readiness, in the air, on land, and at sea, in order to meet current and future challenges was highlighted. It was stated NATO joint air power capabilities require longer-term consideration and an analyses of the future role of joint air power should be conducted. Following this political guidance, which has implications for the Alliance's Long-term Military Transformation (LTMT) process, the Bi-SC issued the 'Report on Joint Air Power Capabilities' in late 2015.[1] This document sought to provide a strategic vision for the future role of joint air power as well as identifying its capability requirements for the future security environment out to 2030 and beyond. These requirements now have to be considered in different sub-areas, such as rotary wing operations.

Vertical lift was amongst the most critical capabilities required in recent NATO-led operations, since it is usually needed quickly and in relatively large quantities. However, a shortage of rotary wing assets hindered ISAF operations when NATO initially assumed command and it took a long time to make them available in sufficient numbers and quality.[2] Explanations for the delay included a lack of helicopter capacity within the Nations aggravated by delays in new deliveries from industry. Such unacceptable conditions should be avoided in the future.

'In many nations, the current military helicopter fleet faces a "cliff edge" that will occur around the 2030 timeframe when the useful life of many systems will be expended. This is both a military risk and an opportunity to shape the future.'[3]

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Today, NATO Nations operate nearly 10,000 rotary wing assets of various types from around a dozen manufacturers.[4] In many countries, replacement or modernization programs are ongoing or planned in the short- and medium-term; however, little has been done to harmonize this effort amongst the Allies as well as their industry partners. Yet, the improvement of NATO's future rotary-wing capabilities cannot be based solely on the acquisition or upgrade of single helicopter models. In the light of recent operational experience, the rapid evolution of technology, and the anticipated threat environment, NATO must formulate a concept for the future employment of rotary-wing assets. This concept should provide a coherent and comprehensive strategy for a widely harmonized helicopter development programme. To this end, broader investigation and analyses are needed to determine the necessary capabilities that best serve the Alliance's future requirements.

Operational Considerations

Since their creation, helicopters have proven to be indispensable on the battlefield and there is a high probability that they will, in some form, be there in the future. The real question is in which form and what kind of tactics, techniques, and procedures (TTPs) will they use? Will they be manned, remotely controlled, or autonomous carriers of personnel, cargo, or weapons? Will there be relatively few robust, durable rotary wing aircraft or a large number of 'disposable' assets? Many similar questions may arise when considering future scenarios and operations. In the context of world-wide, out-of-area missions, the geographical and environmental conditions (including threat) for helicopter operations will potentially differ significantly from case to case. A wide variety of assets designed for different purposes will be needed.

Through at least 2030, it is foreseen that a combination of highly advanced new generation aircraft will operate in parallel with 'legacy' equipment. While many smaller nations will likely fit older helicopter types with advanced flight assistance and weapon systems, it seems obvious that larger and wealthier nations will upgrade to the newest, most advanced technology.

In the meantime, the amount and ratio of rotary-wing remotely piloted aircraft systems (RPAS) will probably increase. Their ground stations may be able to control operations using real-time virtual modelling of the geographical mission area, while highly sophisticated computer and communication systems will allow them to quickly adapt to changing tactical situations.

Such rotary-wing RPAS might also work as decoys in concert with manned, fast platforms such as Vertical Take-off and Landing (VTOL) assets. On the other hand, fast VTOL aircraft may not serve very well in a contested urban environment, where a low signature, high agility, and advanced obstacle avoidance have priority over relatively high speed and range. One could envision a mass of relatively small, remotely piloted or autonomous rotary-wing carriers of high-end weapon or ISR systems, or even personnel, as enablers for operations where speed and surprise coupled with low signature and masked movement are required.

Threat and Vulnerability Considerations

It is almost impossible to formulate an all-inclusive list of threats Alliance rotary wing assets might face on a complex future battlefield. In addition, advanced technology will arise with its own specific vulnerabilities an opponent may seek to exploit, for example total reliance on space assets, radio frequencies or single power sources, as it is indicated in the aforementioned Bi-SC Report on Joint Air Power Capabilities'. This is especially true if we consider near-peer competitors, who have or are acquiring capabilities that could hamper our operations or even prevent aircraft launch and recovery.

However, history has shown even smaller adversaries learn to adapt, sometimes acquiring limited numbers of advanced systems or applying asymmetric tactics that mitigate Alliance advantages. In addition, high-tech systems might have low-tech vulnerabilities. We are unfortunately too familiar with the use of small arms fire or rocket propelled grenades against high-tech helicopters as an example of a low-tech threat impeding mission success. A more modern threat is the use of technologically advanced commercial-off-the-shelf products such as small drones fitted with ordnance or small jammers with relatively high power. In addition, advanced air defence weapons or lighter versions of directed energy weapons might end up in the hands of irregular opponents through proliferation.

In any case, the availability of highly sophisticated self defence systems, both active and passive, is an important factor in maximizing survivability of future systems. Since the old adage, 'the higher your wall is, the longer your enemy's ladder will be' seems to endure throughout history, speed and resolve in decision making about the future helicopter capability will be paramount for success.

Time and Horizon of Capability Planning and Development

"'The future" cannot be "predicted" because "the future" does not exist. However, "futures studies needs to precede, and then be linked to strategic planning"'[5]

Having said this, the intended planning horizon of the current initiative should be critically examined. In NATO terms, 'long-term' is usually understood as 15 years and beyond into the future. This definition aligns long-term with the 2030 timeframe, when much of the current military helicopter fleet will reach the 'cliff edge' of its expected service life. However, if the turn-around time from project initiation to delivery of new systems is taken into account, it is wiser to look further than 15 years ahead. New technology typically spends more than a decade in development. The famous example of this is the US tilt-rotor system, the V-22 Osprey. It was first initiated in 1982 and the prototype was delivered nine years later. It took another 16 years to reach initial operational capability with the US Marine Corps. The origins of the NH90, the pioneer of helicopters using fly-by-wire system and other state-of-the-art developments, date back to the beginning of the 1980s. The first deliveries started in 2006, despite the formal program contract being signed in 1992. Considering helicopters today were designed 30, 40 or even more years ago, armed

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forces today tend to procure equipment for the next three or four decades. This means a 15-year planning period may be too short, especially when it comes to new system development. On the other hand, interim solutions that can be applied on already existing assets may require a shorter timeframe.

Forums Active in Capability Requirements Development

Different aspects of helicopter capability development are currently being discussed across a wide community of interest. At the forefront of concept development, standardisation, and program management, there are a handful of NATO organisations, such as the Science and Technology Organisation, Applied Vehicle Technology Panel, the NATO Army Armaments Group - Joint Capability Group Vertical Lift, the NATO Standardization Office's helicopter-related working groups and panels. And (last but not least) the NATO Helicopter Design and Development Production and Logistics Management Agency, whose mission is the management of the NH90 program. These organisations, along with numerous other NATO and non-NATO organisations, partner nations, academia, and industry are repositories of knowledge and progress in the Alliance's rotary wing capabilities. As personnel move into and out of these entities, the level of corporate knowledge will change (typically decreasing), rendering this a time-sensitive issue in more than one way.

Conclusions

Given a highly uncertain future, a long-term rotorcraft capability development concept must be formulated using the broadest theoretical knowledge base available to the Alliance. The ideas presented by academia, industry, and military experts, including operators, must be fused so the risks of long term thinking can be minimized and the best synergy between operational requirements and technological advances can be created. Allied nations, NATO organisations, agencies, program offices, and centres of excellence, along with operational and tactical commands, have to participate.

Any design of future helicopters needs to be based on a larger strategic concept considering assessed future requirements. In other words, technology pull by the warfighter has to be dominant over technology push

from industry. Optimal solutions have to be developed in order to avoid under- or oversizing capabilities while maintaining cost effectiveness and minimizing logistic footprint. This includes the use and modernisation of legacy equipment delicately balanced with the utilisation of new equipment. The maximum freedom of thinking and creativity is required to develop scenarios in which helicopters may operate in the future, since NATO's future helicopter capabilities will depend on thorough analysis and planning today. The Joint Air Power Competence Centre is strongly committed to foster the development of an overarching future rotorcraft concept and pursue translation from strategic analysis and technological developments into operational concepts and capability requirements for the 2035 and beyond.

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3. Pat Collins, UK Ministry of Defense, United Kingdom; NATO AVT 36th Panel Business Week Prague, Czech Republic, 12–15 Oct. 2015. AVT 245 (Future Rotorcraft Requirement) Specialist Meeting.
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is a 1989 graduate of the Hungarian Defence Forces (HDF) College of Military Aviation. He also holds a Master's Degree from Hungary's National Defence University in Budapest and is a graduate of the US ARMY Aviation Officers Advanced Course, Fort Rucker Alabama. He held different positions at his units as a Mi-8/17 helicopter pilot just as instructor and test pilot, unit flight safety officer, deputy-squadron commander and squadron commander of a transport helicopter squadron, commander of a transport helicopter battalion which, among other regular duties, was in charge of the aerial SAR coverage of Hungary. LTC Szabó filled a staff position at HDF General Staff Operations Division as senior helicopter SME, where among his responsibilities were to develop operational requirements for future helicopter procurement and strategic concepts for the training of future military aviators. His operational experience includes several disaster relief operations at his homeland and Mi-17 Air Advisor tour in ISAF. LTC Szabó is currently the Helicopter SME of the Combat Air Branch at the Joint Air Power Competence Centre in Kalkar, Germany.

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A400M: Europe's Interoperability Poster Child?

A Heavily Critiqued European Program Leads the Way for Allied Interoperability and Crisis Response Capability

By Major Victoria Thomas, USA AF, JAPCC

Introduction

Air-to-Air Refuelling (AAR) has quickly surfaced on the lists of many Nations and multilateral organisations as a major defence capability area needing attention. In 2011, the European Defence Agency (EDA), under the authority of the council of the European Union (EU), identified AAR and Air Transport (AT) in its initial list of the top eleven such areas. Capable of conducting tanker, receiver, and transport operations, the A400M Atlas is expected to be a significant capability gain for mobility fleets in Europe and the Alliance. A400Ms will replace aging mobility aircraft such as the C-160 and C-130H. Over the next four years, the number of A400Ms in Europe is projected to increase ten times with the total hovering between 150 and 200 aircraft.[1]

Despite its promise, Airbus' A400M aircraft program is rarely mentioned as a beacon of success. With planes taking longer than anticipated to roll off the production line and seemingly endless arguments between purchasing nations and the manufacturer about technical and tactical requirements, it is more likely people see the A400M as a poster child for what not to do in

'A400M is meant to be a multi-role aircraft used for delivering goods and personnel and one that can also act as either a receiver or a tanker.'

defence contracting. Those familiar with US military contract woes might consider the A400M the F-35 of Europe. But the programmes created to address the A400M's specific challenges might be exactly the tonic that cures Europe's long-ailing defence procurement woes in general. Various working groups and project teams have evolved from the development of the A400M to allow users to share concerns and solve problems specific to this and other aircraft while also drawing on current operations to address larger scale issues of interoperable capability and bi-lateral clearances. As other aircraft types age out and new aircraft programmes mature, these efforts can be duplicated to ensure a smooth roll out of new technology and seamless integration into the existing fleets.

European Solutions by European Agencies

Unfortunately, transitioning to an entirely new aircraft involves not only the procurement of assets, but everything else that comes with a new aircraft. Development of new ground and air crew training, upgrades to airfields and C2 systems, and new bi-lateral interoperability agreements between nations all carry significant price tags in money and man hours. Multiple organizations have been created by Allied and other multinational agencies to make this process more efficient and effective.

A400M Operational User Group (OUG) – Created by the European Air Group (EAG) and quickly transferred to the European Air Transport Command (EATC) in 2011, the A400M OUG hosts a forum for sharing of best practices, training, and even assets between nations using the A400M to include Belgium, France, Germany, Luxembourg, Spain, and the United Kingdom. In recent meetings, the OUG participating Nations and organizations shared information on programmes like night vision goggle training, aerial delivery methodology, and aircraft procurement timelines. The OUG now seeks to share technical data and testing outcomes, which should be carried into the AAR clearance process.[2]

Project Team AAR (PT AAR) – EDA Member States identified so many AAR initiatives and programmes that in 2012, they organized the PT AAR to focus the efforts. According to the PT AAR Chairman, Lt Col Laurent Donnet (BEL AF), the PT's focus areas (known as pillars) reflect requirements of EDA member states

Display of C-17A Globemaster III, C-130J Hercules, and A400M Atlas aircraft at RAF Brize Norton (UK). The C-130J and C-17A have been part of the RAF's tactical and strategic airlift backbone. The newest addition to that fleet includes the A400M.

and have shifted over the years to maintain relevancy. It now consists of four main pillars and nine sub-pillars covering subjects from the tactical level (training and exercises) to the strategic (KC-46 and KC-767 bi-lateral clearances) and political level (procurement of A400M AAR kit and A330 Multi-Role Tanker Transport (MRTT)).

Global AAR Strategy (GAS) Team – This team of four individuals from the JAPCC, EDA and NATO HQ-International Staff-Defence Investment, began working closely in early 2015 as both a think tank and an executing agency. The team meets three to four times a year to identify shortfalls, share programmes of work, set goals, and combine projects and calendars. At each meeting, a target theme for the year based on current deficiencies is set. The team operates via letters of agreement between the agencies and meetings are kept informal to encourage information sharing and collaboration, which has proved immensely successful.

A common critique of NATO and EU programmes is that duplication of effort runs rampant. But in the areas of AAR and AT, entities are trading in duplication of effort for multiplication of effect. Working groups and teams are cutting unnecessary programs, combining ones already in work and focusing on the success of the Alliance and coalitions rather than the breast-beating of one's own agency. The NATO AAR and Air Transport (AT) Working Groups now host their fall meetings in the same week and city and aim to do so in future with EDA's PT AAR meeting. This seemingly small initiative keeps delegate travel costs down, creates the maximum sharing opportunities, and shows the interdependency of several agencies in addressing NATO and EU budget and capability shortfalls.

Tangible Lessons – Caveats and Clearances

As nations continue to work out the issues with the A400M, the groups above drew on recent operations to ensure the aircraft would meet the current national, Allied and coalition needs.

During the 2011 NATO-led Operation Unified Protector (OUP) over Libya, the need for a multi-use aircraft like the A400M equipped with tanker kits was more than clear. But having a tanker is not the same as being able to use a tanker. Among the nearly fifty different receiver configurations at OUP, fewer than 15 were without caveats like the inability to refuel at night, or with certain equipment, or not being allowed to refuel with particular nations. In all, the OUP AAR planners managed tanking and receiving assets available against a list of 240 caveats making it somewhat of a miracle a single drop of fuel was transferred.[3]

President of the European Council Donald Tusk, NATO Secretary General Jens Stoltenberg and President of the European Commission Jean-Claude Juncker sign a strategic partnership declaration on 8 July 2016. The joint declaration formally recognized the necessity of, and a greater commitment to, collaboration between the EU and NATO.

During the seven-month campaign over Libya, AAR accounted for roughly a quarter of the almost 26,000 sorties flown. However, despite being a NATO-led operation, European assets only flew about 1,200 of the nearly 6,000 AAR sorties. A 2015 EDA Fact Sheet[4] states that AAR in the Alliance is currently 'characterized by an important shortfall' and goes on to criticise a heavy European reliance on the United States for AAR capabilities saying, '80 per cent of sorties over Libya were flown by US assets'. Perhaps this ratio was to be expected given that European nations collectively own 56 tanker aircraft while the USA's tanker fleet consists of over 400 aircraft. But after OUP, NATO set a goal that in future operations no single Nation should provide more than 50 per cent of one capability.

'A tanker without a clearance is not a tanker.'

With this in mind, EDA recognised too few A400Ms had been outfitted with kits to really increase European tanking capability. In January 2016, it was still believed that AAR kits had been purchased for only 18 per cent of A400Ms on order. As such, the PT AAR set this as a priority, with one of its pillars focusing on procuring more kits or exploring possibility of a sharing program where nations could use kits from a future European stockpile. In addition to procurement this also means an increase in the bi-lateral clearances necessary to use those assets.

Towards better AAR Capability – JAPCC-led Clearance Training

The work of all of these groups will be for nought if NATO cannot address clearance issues for the A400M and all other AAR assets. With that end in mind, the GAS team wrote a thought piece entitled 'A Tanker is not a Tanker Without A Clearance'.[5] This paper provides insight in the complex clearance process as well as background on the AAR gaps in Europe and NATO, probable future issues if AAR gaps are not filled, and recommendations for closing the gaps. A draft of the paper began circling among the AAR community in February 2016. In April 2016, it was first delivered to

To help highlight which nations have which clearances, the JAPCC maintains the only global refuelling clearance and compatibility matrix, which is a thorough compilation of nationally reported information. A quick scroll through the matrix will highlight that many nations have made great gains in getting clearances, but also that a very large number report clearances with nations that do not report the same clearances in their own National document. Posted on the JAPCC website, the matrix and the source documents on which it is based are accessible to crews and planners even from their smart phones.

military and industry leaders at the Air Refuelling Systems Advisory Group (ARSAG) Conference and to military and political leaders at the NATO WARSAW Summit in July 2016.

As a result of these discussions, the GAS team has continued to advocate from the tactical to political level about a necessity for more clearances. It is currently supporting a JAPCC-led NATO/EU AAR Clearances Request/Approval Training and Table Top Exercise (TTTEx) which will be held 24-25 January 2017 at the EATC Headquarters in Eindhoven, NLD. Both days will welcome test centre, airworthiness, planning and executing personnel as well as national representatives who have any role in the clearance request/approval process. This TTTEx is open to any nation with receiver or tanker aircraft and the agenda is included below:

Day 1. The first day attendees will learn what is involved in a clearance, why they are necessary and receive an overview of documents they should be using to initiate, grant, and verify a clearance. Publications to be covered include NATO clearance request standardization documents, National declarations, the JAPCC-maintained clearance and compatibility matrix, the ARSAG-initiated standardized test plan and the EDA-initiated Military Airworthiness Certification Criteria (MACC) matrix. The test plan would shorten delivery time and decrease costs of clearances by giving Nations a basic off-the-shelf test plan when creating their own. The MACC would further decrease time and cost by cataloguing tests completed in Europe which nations could choose to accept in lieu of performing their own expensive and redundant testing. It would mean nations could share output without sharing the closely-held, expensive, technical data they review when they conduct clearance testing. Sharing of such data is actually one of the most problematic issues, as experienced in the A400M OUG as well as the EDA PT AAR, where some nations are hesitant to support, or stop supporting altogether, data sharing concepts under development. Day 1 showcases the diversity of organizations contributing tangible products and cross-talk which are already contributing to an increase in AAR clearances.

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A400M touching down on a dirt air strip.

Day 2. The second day of the training will first lead attendees through a notional pairing from request to execution of AAR. After this is complete, participants will engage in a table top exercise where they will simulate readying for an operation that will use a tanker and receiver from different nations. Attendees will need to use the knowledge gained on Day 1 about NATO AAR regulations, the proposed test plan, and MACC and national documents to attempt to coordinate the clearances required to refuel these notional aircraft.

A JAPCC-led, GAS Team-supported, Clearances Seminar conducted during the 2016 ARSAG conference presented different ideas from the USA, AUS and EDA on how to increase the number of clearances. Every seat in the room was filled, and organisers are hoping for the same high interest in the Clearances Request/Approval Training and Table Top Exercise.

Conclusion

AAR is a critical component of future NATO and coalition operations. While opinions vary on the A400M as a solution, the process of introducing the aircraft to the European fleets has yielded many lessons. From the tactical to the political level, several organisations are simultaneously working to get A400M online and lay groundwork for future aircraft turnovers. They have learned from operations where NATO and EU deficiencies affected the fight, and incorporated those into the development and roll out of the A400M. They have also used the introduction of the aircraft as a way to address larger issues such as clearances. As other tanker aircraft are aging out and AAR demand is increasing, an interconnected web of organizations committed to more open forms of sharing is working to increase AAR capability in coalition operations while decreasing duplication of effort. As global fleets introduce new aircraft and technology upgrades, hopefully the diversity of organizations addressing these issues continues to cross-talk and the myriad of lessons identified continues to become lessons applied.

1. EATC Report not publicly accessible, procured through the NATO AAR Working Group for use in this essay, Oct. 2015.
2. The AAR bi-lateral clearance process requires Nations to review five pillars before granting a clearance for assets from two nations to conduct AAR. They pillars are: Operational Compatibility, Technical Compatibility, Legal/Fiscal Agreements, Minimum Crew Training, and Minimum Maintenance. Naturally, this review can become very costly to nations, especially if they are less familiar with the clearance process.
3. Data collected via OUP planning personnel and personnel from NATO's Deployable Air Command and Control Centre (DACCC).
4. https://www.eda.europa.eu/docs/default-source/eda-factsheets/2015-01-26-factsheet_aar_high collected 1 Jan 2016.
5. Turnbull, D., Donnet, L., Rutz, P., Thomas, V. (2016). A Tanker Without a Clearance is Not a Tanker: Food for Thought Paper on AAR Bi-Lateral Clearance Procurement. Not yet available for dissemination.

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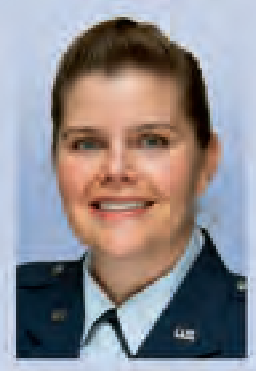
is an Air-to-Air Refuelling (AAR) and Air Transport (AT) Subject Matter Expert (SME) assigned to NATO's Joint Air Power Competence Centre in Kalkar, Germany. Drawing from experience gained during three operational assignments and six combat deployments in USAF C-130H and C-17A aircraft, she is heavily committed to any collaboration that identifies and addresses NATO mobility shortfalls while decreasing multiplication of effort. Major Thomas is a co-chair of NATO's Air Refuelling Working Group, a member the Global Air-to-Air Refuelling Strategy (GAS) Team and an instructor at NATO's Specialized Heavy Air Refuelling Course (SHARC). She has also contributed to Air Transport studies, initiatives and training courses. Major Thomas earned her B.A. in Political Science from Seattle University and her M.A. in Organizational Leadership from Gonzaga University.



The Krasukha-1, built by the Russian firm Kret, is a truck based jammer that has been designed to blind the E-3 AWACS.

Countering Anti-Access/Area Denial

Future Capability Requirements in NATO

By Lieutenant Colonel Andreas Schmidt, DEU AF, JAPCC

Introduction

The term Anti Access/Area Denial (A2/AD) has become noticeably more prevalent in current military documents, articles and assessments over the last two decades. However, does A2/AD constitute a new, unprecedented type of threat to NATO, or is it just a fashionable, new name for a not-so-new way of using existing military means? If it is something new, are NATO's current military capabilities and doctrine sufficient to counter this new threat, or does A2/AD require a paradigm change in how we fight future wars?

Amongst the many facets of A2/AD, this article focuses mainly on the use of symmetric military means. Aspects of asymmetric, hybrid, and cyber warfare (or the like) are outside the focus. Neither will the article discuss the support of A2/AD tactics by purely strategic means like Intercontinental Ballistic Missiles or strategic bombers

To understand the current A2/AD issue, its implications, and why it has, in fact, a new quality, it is useful to first look at a definition of A2/AD. The role of conventional deterrence in the age of nuclear weapons, and the potential explanations for current A2/AD developments are also significantly important.

While NATO has not officially agreed on a definition of A2/AD, a 2016 conference report from the NATO Defence College proposes the following: 'The objective of an anti-access or area-denial strategy is to prevent the attacker from bringing its forces into the contested region (A2) or to prevent the attacker from freely operating within the region and maximizing its combat power (AD).'[1] This explanation seems to characterize A2/AD as mainly defensive in nature. In comparison, in 2003 the Centre for Strategic Budgetary Assessment (CSBA) defined A2/AD as follows: 'Anti Access are enemy actions which inhibit military movement into a theatre of operations, and area denial are operations […] that seek to deny freedom of action within areas under the enemy's control.'[2] This description, offers a more aggressive interpretation of A2/AD. Overall, most A2/AD definitions agree on the defensive character of A2/AD. It has been noted that whatever definition is preferred; A2/AD capabilities might be defensive in the first place but could be employed in conducting or supporting different types of offensive operations, too.

The Emergence of AD in the West

After World War II, the United States published the National Security Council Document NC 162/2 announcing the tenet of 'massive retaliatory damage by offensive striking power', including the use of strategic and tactical nuclear weapons in response to a Soviet aggression. This was the result of the perceived overwhelming conventional threat by the Soviet Union in comparison with the assessed conventional capabilities owned by the US and 'the West'. Later on, diverse studies demonstrated a perceived moral taboo (especially in Western politics) to use nuclear weapons, which reduced their credibility

Russian Federation's regional A2/A2 configurations, likely integrated into rear areas' integrated air defence.

and therefore utility.[3] Furthermore, nations with a nuclear arsenal may feel encouraged to attack with conventional force, by relying on their own nuclear deterrent.[4] This meant that a comprehensive build-up of conventional capabilities, in addition to its nuclear arsenal, was needed for the West, otherwise an early nuclear escalation would have become inevitable for most conflicts. In the 1960s, NATO therefore replaced its previous 'Massive Retaliation' strategy with 'Flexible Response', a more balanced deterrence posture using an arsenal of conventional and nuclear forces. The premise of this strategy was to deter most conflicts by appropriate conventional force, while maintaining the nuclear option as a means of *ultima ratio*.

In the mid-to-late 1970s, the so called 'Second Offset Strategy' came to the US national side, which predominantly emphasized tactical level superior technology in the conventional arsenal. This new strategy focussed on four core areas:

1. New Intelligence, Surveillance and Reconnaissance (ISR) platforms and battle management capabilities;
2. improved precision-strike weapons;
3. stealth technology;
4. the tactical exploitation of space for ISR, communications, navigation and timing.

The US thereby strongly enhanced its capability to achieve 'Deterrence by Denial'[5] and thus added a reliable AD facet to its conventional offensive portfolio as a serious force multiplier. This capability was combined with the US capability of global force projection with, for example, Carrier Strike Groups, strategic airlift, and long-range aviation enabled by air-to-air refuelling. Together, they created a dynamic, mobile 'AD on demand' component, which made conventional deterrence a credible substitute before threatening with the nuclear alternative.

Adversary Reaction to Western AD

In order to counterbalance this higher level of conventional deterrence and maintain military relevance outside the nuclear realm, opposing actors in the global security environment had to develop an adequate response to those new Western power projection capabilities. This required both development of new arms technology and its effective employment with regard to the geographical features of the defended area. Therefore, the characteristics of each A2/AD composition vary by nature in between theatres, pending the assessed capabilities of the potential intruding force as well as the characteristics of the regional environment.

'A2/AD capabilities might be defensive in the first place but could be employed in conducting or supporting different types of offensive operations, too.'

Today, the most significant, regional A2/AD configurations are deployed in the Asia-Pacific region (China)[6] as well as on NATO's eastern and south-eastern flanks (Russia in Kaliningrad, Crimea and Syria)[7], where a blend of state-of-the-art Air Defence Systems (ADS), advanced Offensive Counter-Air capabilities, powerful electronic jammers as well as the newest, most accurate theatre ballistic and cruise missiles prevents third-party military operations. Despite the fact that the effects of such A2/AD are limited to a certain region, their likely integration into overall military organizations and connection to rear areas ('strategic depth') has to be considered as well.

Significant Russian and Chinese A2/AD Capabilities

Russia introduced the term 'Reconnaissance-Fire Complex'[8], describing the US-owned combination of Precision-Guided Ammunition (PGM), ISR capabilities, and automated Command and Control (C2), which needs to be interrupted.

Counter ISR. Since accurate targeting information is crucial for the opponent, the denial of ISR data collection is an efficient solution. This can be done by jamming sensors of land-, air-, sea- and space-based ISR assets in the whole electromagnetic spectrum (EMS). Current jammers are able to effectively deny the use of the EMS up to a range of several hundred kilometres including low-orbit satellites and means of communication for automated C2 systems. A study has shown jamming ISR satellites operating in the visual range of the EMS with laser is possible as well.[9] Also, the kinetic kill of air- and space-based ISR sensors by means of Air Defence or Anti-Satellite Systems is possible. These options would deny an adversary the gathering of necessary ISR data to execute the Reconnaissance-Fire Complex.

Counter PGM. Another option is to destroy the PGM or the carrier itself. ADS can engage targets of various types and at different ranges. The Russian S-300 (SA-20 Gargoyle) or Chinese HQ-9 can provide coverage of up to 200 km, the newly introduced S-400 (SA-21 Growler), up to 400km. This, in combination with other ADS like the Russian Pantsir-S1 (SA-22 Greyhound) or Man Portable ADS (MANPADS), can deny most aircraft the reach of their weapon delivery range, rendering them ineffective while imposing a high risk of attrition. E.g., when attempting to neutralize A2/AD offset-up in the Kaliningrad Oblast, a potential aircraft attrition rate of 20–30 percent is estimated.[10]

S-400 Triumf (SA-21 Growler): Russia's next generation surface-to-air missile system capable of destroying enemy aircraft at extremely long ranges.

Politico-Military Benefit of Implementing Regional A2/AD

Considering no nation wants to start a regime-changing conflict against NATO Nations, the installation of regional A2/AD zones has to be considered defensive in the first place. Hence, A2/AD's main purpose is to prevent a potential adversary from reaching a certain military operational objective. Leaving the defender's strategic long-range (in particular nuclear) weapon arsenal aside, the main benefit of A2/AD appears to be 'Deterrence by Denial' rather than 'Deterrence by Punishment'.[11] This is especially true for nations that do not possess nuclear weapons, like Iran, where regime change is a perceived threat. An implemented A2/AD zone is then merely a fortification of national defence designed to maximize attrition of the attacker. While this is an ancient principle, the availability of modern weapon systems like long-range precision-strike missiles and ADS allows a defender to have deeper coverage inside the adversary's territory or his avenues of approach, and therefore the possibility to affect extended gradual attrition. Furthermore, the denial of precision strike capabilities increases the chance of regime survival for a longer time period.

[M] © Sputnik Valery Melnikov, 2015

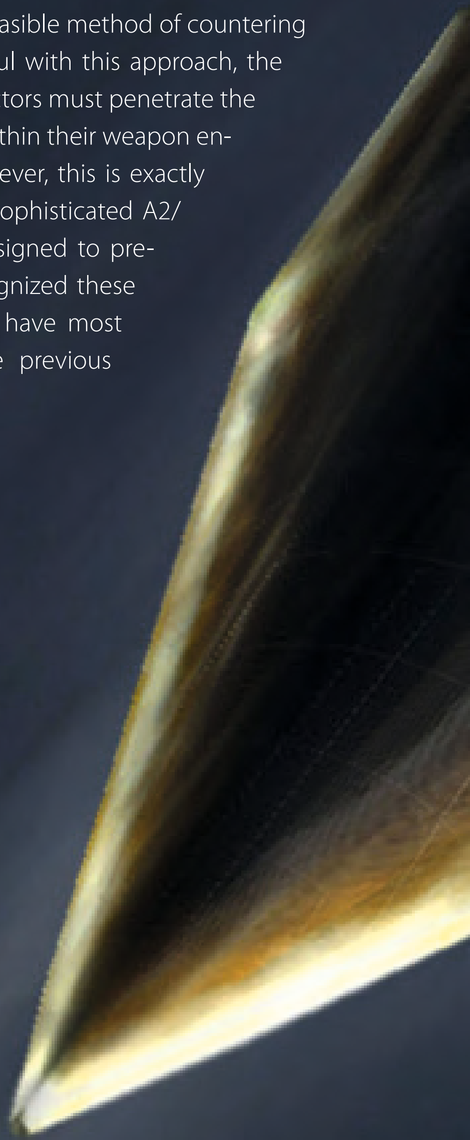
'Modern, highly-sophisticated A2/AD capabilities have most probably reduced the previous advantage of Western arsenals.'

For strong nuclear nations, like Russia or China, the threat of attacks against their territory is actually fairly low, due to their nuclear deterrent. The calculus for establishing regional A2/AD is therefore probably different. China's A2/AD posture In the Asia-Pacific region is often called 'Counter Intervention'[12], which supports this conclusion. As for Russia, too, the concept of securing a 'fait accompli' situation is a more plausible rationale. This concept foresees a military plan executed close to their homeland while timely, third-party intervention is prevented until the mission is complete. Afterwards, when the third party has managed to marshal its conventional intervention force, the nuclear deterrent might serve to discourage further encroachment.

Reflections on Countering A2/AD

Ends. Why would NATO as a genuinely defensive alliance launch military operations against A2/AD structures, such as those mentioned above? Despite the fact that aggression into other countries' sovereign territory is not acceptable in international law, 'fait accompli' conditions such as the Crimean Peninsula and hypothetically emerging in the Baltic NATO Nations, could bring the Alliance into situations where A2/AD bubbles need to be offensively and defensively dealt with in the early phases of an intervention. However, the defeat of an A2/AD zone can only be one objective on the way to achieving the overall mission.

Ways. Fundamentally, there are two main options for countering A2/AD. These are the Inside-Out and the Outside-In approach[13]. Inside-Out is based on a technological advantage which strives for a short, high-intensity conflict, hitting the A2/AD system's centre of gravity with the factor of surprise and thus breaking the obstacle hindering the advance of friendly forces. In contrast, Outside-In chooses the potentially lengthy approach of dismantling the adversary's capabilities layer by layer. This bears the obvious risk of higher attrition and mission fatigue, which generally is not politically acceptable in NATO, and is therefore difficult to sustain. Therefore, Inside-Out seems to be the most logical and feasible method of countering A2/AD. To be successful with this approach, the necessary military effectors must penetrate the A2AD bubble to get within their weapon engagement range. However, this is exactly what modern, highly-sophisticated A2/AD capabilities are designed to prevent. It has to be recognized these significant capabilities have most probably reduced the previous



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Artist impression of a hypersonic High-Speed Strike Weapon (HSSW) vehicle, a joint development of the US Air Force (USAF) with the Defense Advanced Research Projects Agency (DARPA). A demonstration flight is expected around 2020, after which the Pentagon will decide on how best to transition the technology into a hypersonic missile acquisition programme.[18] Used for regional strike, such hypersonic missile could for example cover a target range of 1,000 km within 10 minutes at the speed of Mach 5; this would be hard to intercept even by modern enemy air defence capabilities.

technological advantage of Western arsenals, to include the US resources for global force projection and precision strike.

Means. Consequently, NATO requires the following new capabilities:

- Stand-off strike capabilities with the range to engage from outside, or from the edge of, A2/AD zone in combination with A2/AD-resistant ISR means
- Technology that can successfully penetrate an A2/AD zone and create a desired effect
- New concepts for using existing technology

Counter A2/AD Capability Development – US Example

In the latest 'Third Offset Strategy', the US laid out possible solutions to rebalance conventional deterrence in light of the A2/AD capabilities of potential adversaries. At the forefront are the 'Global Surveillance and Strike Concept' (GSS)[14], the 'Air Force's Global Strike Task Force'[15], and 'Conventional Prompt Global Strike' (CPGS)[16]. A 2010 study from the for Strategic and Budgetary Assessments (CSBA) depicts some elements of a potential long-range strike family.[17] Herein, new standoff munitions are being described which could defeat A2/AD strategies. For example, advanced tactical cruise missiles with a range around 500NM or super-/hypersonic missiles with a range of up to 1000NM could overcome the time/distance limitation of existing subsonic weapons. Also, the development of conventional long-range ballistic missiles, with new supersonic warheads based on the Navy's Trident or the Air Force's Minuteman II or Peacekeeper BM, are mentioned as a way to ensure global conventional strike capabilities. Another proposed technology, which would bring a new quality to the arsenal is a 'New Penetrating Bomber'. This asset should have, amongst others, the following abilities:

- Manned or unmanned
- Unrefuelled range of at least 4000NM
- Broad-band, very low observability
- On-board surveillance and self-defence capabilities to permit independent operations against fixed and mobile targets in degraded C4ISR environments

This would allow this airframe to operate independently in an A2/AD environment with a significant probability of success. Subsequently, air superiority could be increased and temporary control of the air space achieved in order to start the Inside-Out approach.

Since the current US airframes for electronic warfare (EW), like the Growler, Prowler or EC-130H lack the required range, persistence and survivability to handle modern A2/AD environments, the study[17] recommends a new 'Airborne Electronic Attack' Platform (AEA) designed to handle modern A2/AD systems.

Counter-A2/AD Employment/ Deployment Concepts

In reaction to the Ukraine crisis, NATO invoked the Readiness Action Plan (RAP) which enhanced the NATO Response Force (NRF) Concept with the Very High Readiness Joint Task Force (VJTF) and procured the review of Graduate Response Plans (GRPs) in order to reassure Allied Nations. When these plans are executed, adversary A2/AD will target the forces deploying into the theatre. Therefore, NATO will have to achieve certain effects within the A2/AD zone to temporarily generate a favourable air, ground, or naval situation that allows starting the Inside-Out Approach. If this effect cannot be generated from outside of an A2/AD zone, the necessary capabilities need to be already in place (pre-deployed) to create favourable circumstances.

In the example of the Kaliningrad Oblast, a significant amount of Russian ADS create a hostile air space that reaches deep into NATO territory. Furthermore, land-based, anti-ship cruise missiles pose a severe A2/AD challenge to NATO maritime forces far into the Baltic Sea. Pre-deployment of adequate EW equipment (ground-, sea-, or air-based) in operational range to Kaliningrad could generate instant effects allowing for relatively protected mobility. Also, the use of Special Operations Forces could be very effective and precise, however, longer mission preparation and fill-in times would have to be calculated.

In essence, countering A2/AD has to be considered a joint force challenge requiring mission planning and coordination above single-service command levels and the combination of various tactical capabilities across the joint force. Based on experience in the Asia-Pacific arena, this issue has already been addressed in US Concepts such as 'Joint Concept for Access and Manoeuvre in the Global Commons'; formerly known as 'Air-Sea Battle'. The latter outlined solutions to combine and integrate existing capabilities from the services jointly in order to enhance the probability of success against concentrated A2/AD areas.

Conclusion

Despite A2/AD being prevalent in current studies and discussion, it is principally not a new threat. The notion that it significantly changes the way military capabilities are being used is also untrue. It is a mere logical consequence of the conventional arms and technology race which has been ongoing since the end of WWII. Simply put, A2/AD is the response to western force projection, precision strike, and highly-networked C2 capabilities. Greatly advanced features, such as extended detection and engagement ranges in combination with high mobility, low detection probability, and networked redundancy, have created new defence capabilities that need to be addressed. Since attrition warfare must not be the first option for NATO, technical solutions and creative concepts have to be found to assure future mission success. Specific counter-A2/AD capability gaps need to be clearly identified and filled by robust and appropriate means

'Countering A2/AD needs technical solutions and creative concepts to assure future mission success.'

to maintain an acceptable level of conventional deterrence. This must take the immense technological innovation speed of our adversaries into account, demanding faster and more adaptive development and procurement procedures. Also, NATO doctrine should be reviewed in order to reflect the highly integrated joint and combined processes needed in countering A2/AD. ●

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Lieutenant Colonel Andreas Schmidt

joined the German Air Force in 1993. After attending Officers School, he studied Computer Science at the German Armed Forces University in Munich. Since 1998 he built up an extensive background in Ground Based Air Defence, particularly the PATRIOT weapon system. He started as a Tactical Control Officer and subsequently held positions as Reconnaissance Officer, Battery Executive Officer and Battery Commander in various PATRIOT units. Furthermore, he had two non-consecutive assignments in Fort Bliss, Texas. The main task of his first assignment was to conduct bilateral USA-DEU studies of Weapon System behaviour on a tactical level for the German Patriot Office. During his second assignment he was the Subject Matter Expert (SME) on Integrated Air and Missile Defence at the German Air Force Air Defence Centre. In between he had an assignment as the A3C in the former Air Force Division. Currently, he is the Ballistic Missile Defence SME in the JAPCC.


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Preparing for a 'Single European Sky'

Military Prompted to Adapt to Future Air Traffic Management

By Lieutenant Colonel Remus Lacatus, ROU AF, EUROCONTROL

Introduction

Over the last 20 years, the European Union's (EU) liberalisation of the internal market for air services and the substantial growth of demand in air transport have resulted in the significant development of the European aviation sector. The number and frequency of intra-EU as well as international routes flown and the number of passengers have increased substantially.[1] As a consequence, Europe has some of the busiest airspaces in the world, with an average of 33,000 flights conducted every single day. This makes Air Traffic Management (ATM) in this region an extremely complicated business.

Launched in 1999, the 'Single European Sky' (SES) initiative is the European Commission's (EC) reaction to the fragmentation and incapacity of European ATM systems to sustain effectively the competitiveness needs of the Aviation sector. It has been developed on the basis of the regulations contained in two legislative packages adopted by the European Parliament in March 2004 and March 2009. The aim is to create pan-European airspace independent of national borders, to better facilitate predicted future demands of air transport industry regarding safety, capacity, efficiency and environmental improvements.

Meanwhile, defence and security matters remain under responsibility of the sovereign EU Member States.[2] That is why SES is not directly applicable to the military. However, as the new European transportation policy directly impacts airspace organisation, military users' access to airspace will be affected. Therefore, Member States must decide how they intend to align their military aviation with SES developments.[3]

The purpose of this article is to provide the non-expert reader with an overview of civil-military arrangements in the SES domain, challenges for military aviation, and an assessment of the recent military commitment to the overall pan-European effort.

Stakeholders in SES Development

Numerous public and private stakeholders are involved in SES development. Within this article it is impossible neither to list all of them nor to mention the complex structure into which they are mutually interwoven. However, knowledge of the following three main entities that support the EC in SES development matters is essential to an understanding of the challenges:

EASA. The European Aviation Safety Agency (EASA) was established in 2002 in order to promote the highest common standards of safety and environmental protection in civil aviation. To do so, the Agency develops common rules and standards at the European level and monitors their implementation through inspections. The Agency works hand-in-hand with the national authorities who continue to carry out many operational tasks, such as certification of individual aircraft or licensing of pilots.[4] The second package of SES regulation extended the competences of EASA to ATM and thus the weight of rulemaking support has shifted from EUROCONTROL to EASA.

SESARJU. The Single European Sky Air Traffic Management Research (SESAR) is the project designed to deliver the necessary technology and operational concepts required to make pan-European ATM work in practise.[5] Since 2007, SESAR participants are organised in the SESAR Joint Undertaking (SESARJU), consisting of multiple consortia and uniting a total of 70 organisations. Amongst them are a broad range of partners across the aviation community, in particular from various Air Navigation Service Providers (ANSPs); Airspace Users, Airport Operators, Regulators

An operator's screen at Network Manager Operations Centre (NMOC) run by EUROCONTROL, since 2011. EUROCONTROL Network Operations stem from the former Central Flow Management Unit (CFMU), which was created in 1995 as a response to the chronic delays plaguing European air traffic throughout the 1980s.

and Administrators, and the scientific community. This makes the SESARJU a truly international public-private partnership.[6]

EUROCONTROL. The European Organisation for the Safety of Air Navigation, known as EUROCONTROL, was founded in 1960 as an intergovernmental organisation working to achieve safe and seamless ATM across Europe.[7] Although EUROCONTROL is not an agency of the European Union, the EU has delegated to EUROCONTROL parts of its SES regulation responsibilities. It therefore supports not only the EC but also EASA and National Air Navigation Service Providers in their regulatory activities and actively contributes to the SESARJU, which runs under its auspices. Furthermore, EUROCONTROL is the clear front-runner among the international organisations involved in civil-military ATM cooperation by providing a unique platform for Civil-Military ATM Coordination.[8]

Military Aspects in the European ATM Roadmap

On 7 December 2015, the EC adopted a new Aviation Strategy for Europe, aiming, among other top priorities, to solve the European airspace capacity, efficiency, and connectivity constraints. In this regard, the strategy stresses the importance of completing the SES project and recognises its successful implementation will depend on the willingness of all players to collaborate in a coherent and consistent manner. Civil and military authorities will have to coordinate their activities in order to reach a common understanding of the airspace and traffic environment. This is the reason for which national and international military authorities are engaged in the implementation of the aforementioned strategy.

The strategic roadmap to implement the European Aviation strategy is the European ATM Master Plan[9]. Resulting from a strong collaboration between all ATM stakeholders, including European militaries, the 2015 edition of the Plan outlines the vision to achieve 'high-performing aviation for Europe' by 2035 in full coordination with the global developments in this domain.

The Master Plan integrates the following global military performance and operational needs that frame the strategic view on the military integration within the future single European sky:[10]

Advanced Flexible Use of Airspace (A-FUA) explained at the 2015 ATC Global conference, in Dubai. A-FUA aims to provide the possibility to manage airspace reservations more flexibly in response to civil and military airspace user requirements.

- Maintain military mission effectiveness;
- Civil-military interoperability at the lowest cost;
- Unrestricted access to airspace through the concept of Mission Trajectory;
- Improved airspace management through Advanced Flexible Use of Airspace (AFUA);
- Recognition of equivalent performance levels of military communications, navigation and surveillance (CNS) equipment, even when not civil-certified compared to civil equipment standards.

Military Concept in SESAR

SESAR aims to shift the ATM paradigm in Europe from an airspace-centric to a trajectory-centric concept, meaning air navigation services will enable aircraft to fly their preferred routes without being constrained by airspace configurations. The four-dimensional (4D) trajectory is key concept of the future ATM system being developed by SESAR.

Airspace users will agree with Air Navigation Service Providers and airport operators, from early strategic planning to the day of operations the airspace user's preferred trajectory for the flight in four dimensions (three spatial dimensions, plus time), where the various constraints of airspace and airport capacity have been fully taken into account.

While civil aviation develops a trajectory with the most cost-effective routing, the military has a mission objective, prompting the most mission-effective routing and usage of the airspace.

However, the '4D Trajectory Management' will have to take both civil and military flight requirements into account. While civil aviation develops a trajectory with the most cost-effective routing, the military has a mission objective, prompting the most mission-effective routing and usage of the airspace. The most pragmatic solution was to develop the concept of 'Business trajectory' (BT) in the case of civil aviation and 'Mission trajectory' (MT) for military flights as single sources of reference which the airspace user agrees to fly and all the service providers agree to facilitate with their respective services. The MT is expected to provide military missions more flexibility, based on continuous sharing of information and dynamic airspace management in all stages of flight, from initial planning to the execution and post-execution phases.[11]

The major requirements not covered by the BT and where an MT is needed are as follows.[12]

- Airspace Reservation/Restriction (ARES). It will not be possible for future 4D Trajectory management systems to process some parts of MTs (e.g. high-energy flight profiles, dynamically developed missions, or Remotely Piloted Aircraft Systems missions and training). Therefore, the use of ARES will continue to be a main SESAR asset for high-level safety maintenance.
- Trajectory synchronisation between multiple MTs in a complex mission or exercise will be performed in planning and execution phases, so that the MTs will be addressed and prioritized in blocks.
- Military priority flights, e.g. Quick Reaction Alert (QRA) sorties in air policing, Medical Evacuation (MEDEVAC) or any other time- and mission-critical flights, have in common that their MTs cannot be pre-planned in accordance with BT and MT timing requirements (at least not all portions of it). Therefore they can also not be shared with the ATM system as usual.
- Confidentiality. An MT may contain flight data which, due to Operations or Information Security considerations, must not be shared with the ATM. This will be the case for the portions of the trajectory that are executed inside an ARES, either because the trajectory cannot be predicted in advance (e.g. "dynamically developed missions" for combat training) or because the ATM authorities have no need-to-know to perform their function.
- Network security. SESAR envisages net-centric computer solutions that allow all ATM stakeholders to have access to shared data and information. Whilst civil airlines will largely and openly share trajectory data for planning an efficient service at optimal costs, the exchange with military organisations shall be realized by highly secured interfaces.

Having said this, it must be noted the sharing of information on trajectories with the ATM community, from the planning to the execution and post-execution phases, is a main pillar of the MT concept. This requires both willingness to share and the deployment of the right technology, whose provision will be crucial in terms of flexibility (for the military), predictability (for the ATM network), and safety (for all airspace users).

Is Military Commitment to SES and SESAR Sufficient?

The military has been involved in SES and SESAR since their inception, both as a user and a service provider and in some cases even as a regulator. Until 1999 international civil-military cooperation in ATM was ruled by intergovernmental arrangements facilitated through guidance by EUROCONTROL. Since EU has gained ATM rulemaking competences over the civil aviation and the military matters remained national responsibility, amongst the European States the new ATM solutions have been adopted based on the nature of national requirements and the peculiarities of airspace constraints. This has led to fragmented organisations, regulation, service provision, and civil-military coordination arrangements with consequent shortfalls to cross-border operations, exercises, training, and Air C2 arrangements.

Following the mandate given by the Defence Ministers of its Member States, the European Defence Agency (EDA) recently adopted the 'SES Modalities' proposing a comprehensive military engagement in all projects of the initiative starting from legislation, throughout research, to the deployment of technological projects, within a single interface facilitated by the EDA. The twofold goal is to advance consolidated military views from States and relevant international stakeholders to EU institutions, and to inform military planners of the requirements stemming from any civil development.[13]

In following this approach, the military needs to tackle two key issues: (1) Translating national sovereign requirements and joint NATO-EDA-EUMC-EUROCONTROL views into common military positions that reflect both national and collective security and defence requirements at pan-European level, which extends beyond the responsibility of EU; (2) Developing feasible concepts and operational solutions that preserve military mission effectiveness in the future European ATM environment, to include full interconnectivity between civil ATM and future military air C2 actors at all levels (but primarily at the Wing Operations Centre and below).

Currently, three military working arrangements are addressing the related work strands: (1) The Military ATM Board (MAB), enabled by EUROCONTROL, is the pan-European civil-military ATM-CNS focal point; (2) The NATO Aviation Committee (AVC), which is the advisor to the North Atlantic Council and NATO Nations on mitigating the ATM impact on collective defence capabilities; (3) The EDA-enabled SES Military Aviation Board (ESMAvB), coordinator and tasking authority for military consultation within SES.

While consultation between those working arrangements exists, synchronisation is not optimal to develop common military views. Any military position forwarded to SES policy makers will be considered as *'A Military Position'* that does not challenge or replace an individual

EUROCONTROL Headquarters at Brussels.

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State's sovereign prerogative to express its distinct national point of view. Nevertheless, it can be expected that expert influence from EU (EDA, EUMC/EUMS), EUROCONTROL and NATO staff will help frame commonly agreed military positions in the context of SES and SESAR.

Outlook

Future European ATM will have to deal with a congested airspace accommodating constantly growing and sometimes volatile civil traffic flow with an increasing demand for national and cross-border military flight operations. This is why mixed civil-military operating environments will become the norm in European skies. Key to solving this complexity is a common civil-military understanding on how the future airspace shall be regulated, structured, and managed. Consequently, coherent military input is required at the earliest possible stage in all legislative and technological SES projects. The military community in Europe must overcome fragmented opinions and solutions to better cope with the requirements of the future European ATM Network as well as ensuring the interoperability demands of collective security and defence. A 'Strategy for Military Aviation in Europe', as suggested by EUMC in May 2016, could serve as capstone document to help achieve this. As EUMC has no ATM capacities, EDA should be mandated to coordinate the drafting of such kind of strategy.

A joint EUROCONTROL-NATO-EDA support will be mandatory in order to provide appropriate subject matter expertise while agreement amongst the concerned national military authorities should be reached on the strategic level common grounds with regards to the military needs in the future single European sky.

Political support is of utmost importance to safeguard military requirements within the SES implementation process. Key to this political support is ensuring national policy and decision-makers responsible for the air transportation sector understand SES and the importance of ensuring that military operational requirements are considered in its implementation. With such political back-up complemented with a common military position at a pan-European level, it will be difficult for SES policy makers to neglect the stated military requirements. ●

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Lieutenant Colonel Remus Lacatus

is a Romanian Air Force officer who has been a Plans, Concepts, Development and Vision Subject Matter Expert at the JAPCC from 2012 to 2016. His background covers military Air Traffic Control, Air Command and Control, Air Operations Planning, and participation in projects involving overarching concepts related to Joint Air & Space Power.

During the tour of duty at JAPCC Lt Col Lacatus has also fulfilled responsibilities as expert for Air Traffic Management (ATM). In this capacity, he has enabled JAPCC's engagement within the international ATM working arrangements facilitated by NATO/EUROCONTROL/EDA. He also led the JAPCC support to European Air Chiefs in assessing and mitigating the impact of the 'Single European Sky' initiative on national/collective air defence capabilities and resources.

Effective 01 September 2016, Lt Col Remus Lacatus is a Senior ATM Expert in the Civil-Military ATM Coordination Division at EUROCONTROL.

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Instructors and crews participating in the European Advanced Airlift Tactics Training Course (EAATTC) 16-1, in Zaragoza, Spain.

The Value of Common Air Transport Training

A Glance at the European Advanced Airlift Tactics Training Course

By Lieutenant Colonel Roberto Paviotti, ITA AF, JAPCC

Introduction

In a changing and unpredictable security environment, the quest for higher quantity and quality of allied military capabilities is a logical one. However, despite widespread austerity and limited defence budgets, there is a call for rebalancing defence spending and capabilities between European NATO Nations, Canada, and the United States to achieve an equitable sharing of the defence burden. The same applies amongst European Union (EU) Member States with regard to their balanced commitment to the Common Security and Defence Policy. So far, this has led to initiatives such as Smart Defence, the Connected Forces Initiative, and Pooling & Sharing (P&S). The European Defence Agency (EDA), which was founded in 2004, is an EU body whose primary role is to foster European defence cooperation in that regard. It consists of 27 'participating Member States' (pMS). Of the 28 EU Member States,[1] only Denmark does not participate in the EDA.[2] EDA-sponsored defence cooperation is not limited to co-financed purchasing of modern equipment but also encompasses the development of interoperability concepts and common training requirements and solutions.

While there has been cooperation in many areas, airlift training has remained a national responsibility, with rare combined and collective training opportunities focussed on specific Air Transport (AT) mission types only. While the fighter aircraft community has trained for years for complex missions and multinational configurations (e.g. Tactical Leadership Programme, 'Flag' exercises, large NATO exercises in European airspace), the air transport community has generally operated in isolation. In most exercises, AT is only used for real world logistics in support of other exercise participants and lacks operational 'advanced airlift training' because no exercise/training scenario is built for it. However, preparing for contemporary airlift operations requires training in multinational environments with challenging scenarios to simulate the complexities that are to be expected across the full spectrum of future contingencies.

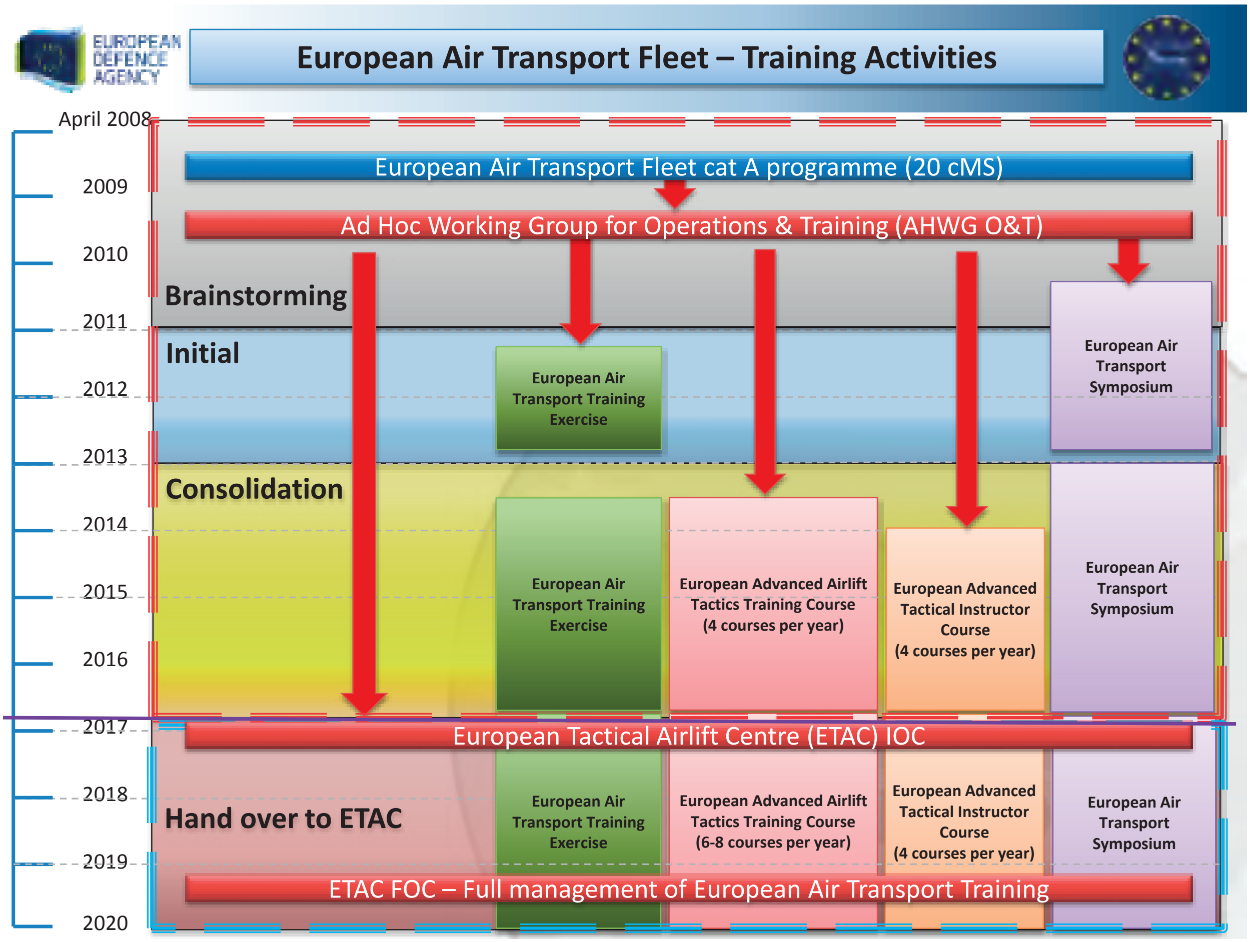
Some nations have been able to send crews to the US Advanced Airlift Tactics Training Course, but, in an era of austerity, doing so is not an option for many militaries. In recent years, European partner organizations have responded to this requirement by developing collective, standardized training opportunities for air crews that enhance collaboration and interoperability of the AT community. Nations have enthusiastically embraced the programs and training opportunities, which, as seen in the European Advanced Airlift Tactic Training Course (EAATTC), are filling the training gap and deepening AT capability. Experts also point to the continued need for developing these courses as airlift capacity expands.

Foundation of the EATF Programme

Efforts to address the extensive collaboration requirements related to military air transport began in 2011, when the EDA founded a partnership programme named 'The European Air Transport Fleet (EATF)'. Twenty 'contributing Member States' (cMS) eventually joined this programme and the door remains open for other nations. The vision for the EATF is to implement a flexible and inclusive partnership between national and multinational military air transport fleets and organisations in Europe, aimed at the enhancement of standardised air transport services, accessed through an identified process, and using simplified common procedures. The EATF's long-term vision is the efficient usage of the existing and future assets of various European AT fleets, regardless of type and origin, as they are made available by the cMS for military needs. The desired end state is an efficient Networked Fleet that will satisfy quantitative and qualitative requirements for national and collective military air transport in the EU, including air-to-air refuelling, by the most cost effective use of either nationally owned capacity or pooled, shared, exchanged, or chartered capacity.[3]

That being said, it has to be noted that the EATF does not intend to create a supplementary AT structure in Europe, but to better coordinate and strengthen structure derived from existing or future arrangements.[4] The EATF desires the optimal use of available and future capacity among EATF cMS through wide-ranging coordination and exchange mechanisms. These shall include the exchange of flight hours, air-to-air refuelling, and support services, which will be supported by IT networks linking national and multinational military air transport organisations such as the European Air Transport Command (EATC) or the Movement Coordination Centre Europe (MCCE) for improved operational efficiency and better dissemination of information.[5]

The management and implementation of the whole EATF-programme is achieved by a governance structure consisting of a higher level 'Management Committee' (MC) for strategic guidance assisted by an 'Executive Steering Group' (ESG), which is convened at the discretion of the MC, if necessary. At the lower level, a 'Project Management Group' (PMG) and other ad hoc working groups were created to manage subordinate projects of the overall EATF programme.[6] In that regard, the "à la carte" nature of the EATF is taken into account, whereby cMS may have differing levels of commitment to each subordinate project.[7]



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AT Training Solutions under the EATF Programme

The EATF's strategy is to reach its desired end-state through pursuing the following three objectives: (1) Overall capacity building by P&S and better coordination; (2) Improvement of interoperability through harmonized and simplified rules and regulations as well as common training and exercise; and, finally, (3) Maximised cost effectiveness and service quality through optimal interaction and efficient AT asset allocation using a common IT network. In the EATF Phase 1 (Start-Up), the programme primarily focussed on managing shortfalls by providing tangible deliverables in priority areas. To this end, quick wins were put forward, for instance in the area of Operations & Training (O&T) with the setting up of block-trainings and common exercises.[8] This was the main project for the EATF's 'Ad Hoc Working Group for Operations and Training' (AHWG O&T). Within the EATF Phase 2 (Implementation), the following important training opportunities became a reality:

European Air Transport Training (EATT). The EATT is a multi-national AT event of two weeks which has been conducted annually since 2012. It includes Intelligence, Maintenance, Aeromedical Evacuation, Combined Air Terminal Operations and Cross-Paratroopers training.

European Advanced Airlift Tactics Training Course (EAATTC). The EAATTC is a multi-national AT course of one or two weeks, which has been held several times per year since 2014. It aims to provide air crews with a robust airlift tactics training syllabus to enhance interoperability between European air forces.

European Advanced Tactical Instructor Course (EATIC). The EATIC is a one-week course which has been held several times per year since 2015. It educates the instructors to be employed in the other EATF training events.

European Air Transport Symposium (EATS). The EATS is a yearly meeting focussed on AT operations and training challenges with the ultimate aim of improving interoperability as well as the quality of the upcoming EATF training events.

EAATTC Course of Action

While three EAATTC iterations were held in 2015, four occurred in 2016, with different numbers of Member States, aircraft and crews attending these training events. Each course aimed to achieve a higher level of interoperability between airlift crews through the European training syllabus that was developed based on the combined experiences of instructors coming from Belgium, Germany, Spain, France, Italy, and the Netherlands. The courses are held in several locations: Plovdiv, Bulgaria; Orléans, France; and Zaragoza, Spain. During the curriculum, the difficulty of flight missions increase from low-level flying with air-to-air and surface-to-air threats to 'maximum effort landing'. Three major levels of operational complexity are covered: single ship, multiple ship, and a new training section using night vision devices.

The JAPCC contributed to EAATTC 16-01 in Zaragoza and EATTC 16-02 in Orléans, acting as "Supervisor of Flight." As an example of course conduct, the attending air crews in 16-01 came from Belgium (C-130), Germany (C-160), Poland (C295), and Spain (C-130, C-295). On the arrival day, the participants were immediately provided with a comprehensive introduction briefing, including important instructions such as flight regulations and safety rules. The first full day of the course started off with a full agenda of thorough academics concerning the tactics, techniques, and procedures the crews were to apply during the practical flight. This was followed by mandatory familiarization flights exploring the training area, including the low-level mountain routes and the prepared strips for tactical landing practice. On the second day, crews started to deal with the intelligence scenario that forced them to operate in an increasingly hostile environment. Adversary small arms and hand-held missile surface-to-air fire, electronic warfare and fighter aircraft added a significant threat

A Dutch C-130 performing a tactical low-level approach.

dimension to the training. For those who wanted to go further, the whole scenario could be repeated at night with Night Vision Goggle (NVG) operations. EAATTC 16-01 was the first iteration which offered this opportunity. Overall, the two training weeks were designed to gradually raise the level of stress on the crews, culminating in a "graduation flight," during which the crews were challenged to apply everything they learned during the event.

Conclusion and Outlook

The EAATTC delivers practical field training and provides the European AT community an attractive and cheaper solution to the already existing US AATTC, which had been the only option. While past exercises usually provided neither sufficiently realistic operational scenarios nor multi-national training, EAATTC takes the participating air crews into a deployment scenario which exposes them to realistic air-land and airdrop missions in a tactically challenging environment, while delivering the respective academics and practical flight training to apply the relevant interoperable tactics and procedures. In combination with the other recurring events, the EATF O&T projects proved extremely worthwhile for achieving the programme's overall objectives. In fact, these events are essential to harmonize and streamline European and NATO airlift operations, to improve interoperability amongst airlift crews and, ultimately, to lead to more effective coalition operations. The mentioned courses and training events are becoming more popular within AT community, resulting in an increasing number of participation requests. It is very likely up to six EAATTCs per year will be needed in the near future. The multinational airlift training centre at Zaragoza, which is expected to reach Initial Operational Capability by the end of 2017, will be instrumental to meet that demand. Keeping in mind that new airlift platforms like the A400M, A330 MRTT, C27J, C295 and possibly the KC390 will continue to augment national inventories and substantially increase airlift capability, the importance of such training centres cannot be overstated!

'… the EATF O&T projects proved extremely worthwhile for achieving the programme's overall objectives. In fact, these events are essential to harmonize and streamline European and NATO airlift operations, to improve interoperability amongst airlift crews and, ultimately, to lead to more effective coalition operations.'

1. EU countries are denoted as "Member States", which differs from NATO which calls Alliance members "NATO Nations".
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5. Ibid 3, p.3.
6. Ibid 4, par. 2.1.
7. Ibid 3, p.2.
8. Ibid 3, p.4f.

Lieutenant Colonel Roberto Paviotti

joined the Italian Air Force Academy in August 1995, where he obtained a degree in Political Science. As of 2000, he was a Military Pilot starting at 61st Air Brigade in Galatina (Lecce) and later 46th Air Brigade, 50th Squadron (Air transport), in Pisa, where he became a C-130 Special Tactics Operative Instructor for Transport and obtained 'Combat Readiness' on the C130 aircraft. From 2003, his training was complemented with special skills e.g. airdrop, air-to-air refuelling (for fixed and rotary wings), night vision goggle flight, and assault operations. As a pilot, he was much involved in air support to missions abroad in Kosovo 2002, Afghanistan 2002-2014, Iraq 2003-2007, Lebanon 2006, and Libya 2011. Furthermore, he participated in multinational joint exercises including Special Forces. Since Sep 2015, he serves as in the JAPCC as Subject Matter Expert for Air Transport.

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QRA(I) fighters under NATO control will need to become proficient at low and slow formation flying if they are to identify Remotely Piloted Aircraft Systems (RPAS) using current air policing procedures.

NATO Air Policing Against Unmanned Aircraft

Considerations for a New Approach

By Lieutenant Colonel Yasar G. Ozen, TUR AF; Lieutenant Commander Scott Menzies, USA N; Colonel Yildirim Acikel, TUR AF; Major General Ruben C. García Servert, ESP AF

'When we least expect it, life sets us a challenge to test our courage and willingness to change; at such a moment, there is no point in pretending that nothing has happened or in saying that we are not yet ready. The challenge will not wait.'
Paulo Coelho

Introduction

Air policing (AP) is one of the main activities of NATO Integrated Air and Missile Defence (NIAMD) in peacetime, since even during seemingly calm periods, security threats to nations still exist. The duty of AP is to

enforce each Alliance nation's sovereignty and provide security for its citizens by requiring compliance to national laws inside internationally recognized airspace.[1] These tasks are carried out by Quick Reaction Alert (Interceptor) (QRA (I)) aircraft, the Air Surveillance and Control System (ASACS) and the Air Command and Control (Air C2) structure.[2]

Lately, Remotely Piloted Aircraft Systems (RPAS) have introduced a new challenge to AP missions. With improving technology, reduced costs and widespread availability, there is a 'boom' in the use of these flying devices. In addition to the establishment of rules and regulations regarding personal and commercial use, there is a need for preventive and defensive measures against violation of territorial airspace by non-cooperative civilian and military unmanned aircraft. The mission of AP in NATO must now adapt to respond to this new and challenging technology.

NATO Air Policing Today

The execution of AP involves QRA(I) fighter aircraft from NATO nations available on a 24/7 basis. At the same time, NATO AP requires an ASACS and an Air C2 structure executed by two Combined Air Operation Centres (CAOCs) located in Torrejon, Spain, and Uedem, Germany, under the direction and guidance of the Allied Air Command Headquarters, located at Ramstein Air Base, Germany.

AP procedures are actively implemented daily in response to a variety of peacetime threats. If an aircraft intentionally or unintentionally approaches national airspace without prior permission, or if schedule disruptions take place without any prior notification, a nation has a right to defend its sovereign airspace against all aircraft using AP assets tasked by the NATO Air C2 structure to intercept, identify, and if needed, escort the threat aircraft. Only in the most extreme cases would an engagement take place. An obvious example of when AP assets would be used is when military aircraft from non-friendly nations fly towards a NATO nation's border.

Air Policing Against RPAS Threats Today

AP procedures are used to handle interceptions of non-NATO military aircraft, civilian lost communication events, and the engagements of unidentified RPAS. Once an RPAS is detected, but not necessarily identified, the Air C2 structure must answer difficult questions to determine if it is a threat. Threat determination uses established Rules of Engagement (ROE) and Standard Operating Procedures (SOPs) that were originally written to deal with manned threats. In a situation involving RPAS, the Air C2 structure must quickly and accurately answer these types of questions: Is the RPAS acting like a renegade aircraft thus making it the responsibility of the national authorities? Can it be determined to be strictly military in nature allowing NATO authorities to launch assets against it? Once the alert QRA(I) is launched, how should the situation be handled? Can the fighter aircraft manoeuvre for a visual identification, or is the RPAS flying too low and slow? Is the RPAS even large enough for the pilot in the fighter aircraft to see? Then, if the decision to shoot down an RPAS is made, is the fighter always able to make the kill? While looking for its target, what if the million dollar fighter aircraft collides with and is damaged by an RPAS (that most likely costs less than 1/100 of the fighter aircraft), like the 2011 mid-air collision between a C-130 and an RPAS in Afghanistan?[3] Can ground-based anti-air systems be used instead? Answers to these questions are challenging to determine with the ROE and SOPs in place.

Just as civilian authorities are struggling to come up with a consensus on how to regulate thousands of RPAS flying today, nations are also realizing the enormous issues and potential threats this evolving technology brings to their security. ROE and SOPs focusing on manned aircraft are a good place to start in dealing with RPAS, but they cannot answer all the questions posed by this game-changing technology. NATO must now consider its AP procedures outdated and begin to look at new approaches for dealing with this new generation of threats from RPAS.

New Approaches

The role of AP is to intercept, identify, escort, and if need be, destroy any airborne object violating a NATO member nation's airspace. While significant challenges remain, new approaches for accomplishing each step when dealing with RPAS are within reach. First, AP assets must intercept an RPAS. Currently, NATO AP QRA(I) assets are limited to manned fighter aircraft from member nations. These include F-16s, F/A-18s, Eurofighters, as well as many other types. These aircraft were designed for counter-air missions involving other manned aircraft. The downing of two RPAS over Israel during the 2006 Lebanon War served as a 'benchmark tactical event' for counter-RPAS AP, which demonstrated fighters could potentially target medium- to large-sized RPAS like any other military target.[4] As long as the RPAS is not flying too low or too slow for the QRA(I), there are no changes to the procedures already in place. However, even a seemingly unsophisticated RPAS can have a tactical advantage. QRA(I) fighters were not designed to fly slowly at high angles of attack while intercepting targets, and their radars are not designed for targets potentially as small as birds. In an incident over Israel, a primitive RPAS flew so slowly that Israeli F-16s received stall warnings while trying to reduce their speed to shoot down the intruder RPAS[5]. The issue of a low and slow flying RPAS can be dealt with by another low and slow flier, namely a helicopter. Armed helicopters are the best asset to counter RPAS that cannot be intercepted by fighter jets. Practically speaking though, no nation has enough airframes or bases to cover all of its airspace against RPAS by relying solely on helicopters. There will therefore need to be dialogue between national air defence commands and intelligence services to determine the most likely targets to protect and the most likely areas where RPAS could cross a nation's borders. Then NATO and member nations could set up QRA(I) bases with helicopters to cover these regions. For the areas not covered by these bases, other options for QRA(I) assets could be armed slow movers like a light attack aircraft, which can cover more area than a helicopter, or even another RPAS. In the meantime, NATO could begin training its current QRA(I) assets to deal with low and slow aircraft by practicing intercepts against helicopters to hone the pilots' skills on how to make these difficult intercepts.

Identification of RPAS will always be difficult for fighter aircraft. However, the modern strike aircraft is equipped with brilliant targeting pods. It does not seem beyond the realm of possibility to develop or incrementally improve existing pods to be able to track and give a picture of an RPAS to a pilot orbiting overhead. With this in mind, a NATO-controlled RPAS could have a sensor installed that is able to track and identify another RPAS. These RPAS could be handled like traditional alert forces or could loiter along national borders to help identify threatening RPAS and other low and slow flying unidentified aircraft. Like most changes, these developments rely on adequate time and money, which require a firm commitment from NATO to guarantee success.

When a QRA(I) fighter intercepts and escorts another manned aircraft, certain types of visual communication occur. The pilots often exchange hand signals to communicate intentions, especially during a lost communication situation. The very presence of a fighter escorting a threatening bomber or reconnaissance aircraft sends a message of caution and deterrence.

However, when an intercept of an RPAS by a NATO QRA(I) occurs, the pilot of the interceptor is unable to visually communicate with the unmanned aircraft to tell it to turn around or indicate that there is a problem. An RPAS operator will therefore have no idea that they have been intercepted and are being escorted. For this reason, a method of communication back to the RPAS operators must be found. This could be through normal VHF communications if the RPAS has that ability and the operator is in contact with an Air Traffic Control (ATC) agency. However, the RPAS may not have this ability, so other means must be found. One solution is again centred around the use of a pod on QRA(I) aircraft. These pods could have the ability to hijack the command signals and give the QRA(I) pilot the ability to take control of the RPAS. This would hopefully let the original operator of the RPAS recognize that there is an issue, while giving the NATO Air C2 structure the ability to decide how to direct the RPAS away from a potential hazard. However, if no solution is found in order to communication with an RPAS operator, the only option remaining is to engage the unmanned aircraft.

The final task for AP is the one rarely used. The destruction of an aircraft using NATO assets is always the last resort during peacetime. If the decision to destroy an RPAS is made, then there are several options available. The easiest option is to use existing weapons on QRA(I) aircraft to shoot down the RPAS if possible. If an armed helicopter is available, this would be an even better option. In the future, the development of pods to be carried on QRA(I) aircraft that can directionally jam the signals to and from an RPAS and make it crash might become a viable option. There is also the possibility that lasers can be developed that will be carried in pods and used to shoot down a target. Each of these strategies requires NATO leadership to recognize the need for these technologies and to push member nations toward their development.

Conclusion

NIAMD operates inside a political and legal framework, which evolves with new challenges and is supported by political will. The AP component of NIAMD is responsible for combating threats posed by military and civilian aircraft, to include RPAS, except for situations when an Alliance nation invokes national caveats in the procedural framework and takes back control of its assets assigned to the AP mission. The emergence of RPAS has opened a new era of technological innovation in aviation and presents

Remotely piloted attack aircraft or helicopters (like the MQ-8 Firescout pictured here) would be better assets for intercepting low and slow flying RPAS than current QRA(I) fighters. Another advantage is the ability to carry multiple sensors or payloads which could be used to identify , take control of, or even disable threat RPAS.

The global proliferation of RPAS means that terrorists and non-state actors may be able to acquire systems similar to the one depicted here. The time for NATO to prepare countering these new threats is now, before the weaknesses in our current AP capabilities and procedures are exploited.

'NATO must now consider it AP procedures outdated and begin to look at new approaches dealing with RPAS threats.'

new political, legal, and technological challenges to the current AP framework. With RPAS being used by more than just militaries, and terrorist organizations proving they will use technology in ways nations cannot always imagine or prepare for, the need for robust but cost-effective solutions against RPAS threats has never been greater. Though it is possible to apply current ROE to RPAS, the difficulty lies in adapting the ROE to the potential new situations that RPAS present. Air defence decision makers in NATO must realize the procedures, techniques, and hardware currently in place to handle events with manned aircraft are not adequate to handle future RPAS situations. New solutions must be identified, whether they are similar to those mentioned in this paper, or are a whole new way of thinking in regards to AP. The time to find these solutions is now and not after an RPAS swarm carrying makeshift explosives attack a tourist or military target in a NATO nation.

Opinions, conclusions, and recommendations expressed or implied within this paper are solely those of the authors, and do not necessarily represent the views of NATO, ESPAF, TURAF or USN.

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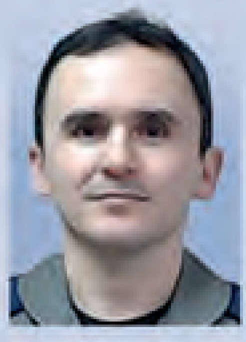
Lieutenant Colonel Yasar G. Ozen

flew the KC-135 and served as a Fighter Controller (FICO) at CAOC-Torrejon from 15 August 2014 to 16 December 2016.



Lieutenant Commander Scott C. Menzies

graduated in 2000 from the United States Naval Academy with a Bachelor of Science Degree in Aeronautical Engineering and holds a Master's Degree in Systems Analysis from the United States Navy Postgraduate School. Following completion of the Navy's flight training syllabus, he was designated as a Naval Flight Officer and flew in E-2Cs with the world famous Screwtops of VAW-123. He has taught Air Defense at Tactical Training Group, Pacific, served aboard the USS Nimitz as a 'Shooter', participated in the Operational Test and Evaluation of the E-2D with VX-1, and was the Operations Department Head at TACRON 11. He is currently serving as the Tactical Data Links Section Head and stands watch as a Duty Controller at the NATO CAOC in Torrejon, Spain.

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joined the Air Force Academy in 1975 and his first assignment was the 31st Wing at Zaragoza, where he served as a Pilot in the period from 1981 to 1985. He continued to serve in different Air Force Units until 1995, when he was assigned to the Air Warfare School as Head of Strategy & International Affairs Department. In the period 2009–2010, he was the Commander of Kabul Airport (Afghanistan). Once promoted to Brigadier General, he was assigned to the Air Force Staff – General Secretary as Chief of International Affairs, until he was promoted to Major General in late 2012 and reached his current assignment as Commander CAOC Torrejon in early 2013. During his career, he has joined different NATO/UN Operations as aircrew: KFOR, ONUSAL, ONUCA and UNPROFOR (ex-Yugoslavia), and got over 6,000 flying hours as a pilot. Major General Servert is the author of several articles and papers: IEEE Opinion Paper no. 3/2010, 'An Insight of Afghanistan: A Chronicle of Spanish Leadership in Kabul Airport', and 'NATO Strategic Concept, a Spanish point of view', among other; and achieved the Bachelors & Masters Degrees in Laws and Political Sciences. He speaks fluently English, French and German.

Swedish Tactical Aerial Reconnaissance and NATO

Past, Present and Future

By Professor Robert Egnell, SWE Defence University
By Major Johan Jakobsson, SWE AF
By Air Commodore (Retd) Garfield Porter, GBR Royal Air Force
By Dag Åsvärn, Spacemetric

Introduction

Swedish Tactical Aerial Reconnaissance (TAR) has, like other parts of Swedish Armed Forces' (SwAF) capability, followed shifts of emphasis in doctrine and practice. In particular, at the end of the Cold War, it moved from a posture focusing on fending off a Warsaw Pact invasion towards greater emphasis on deployed interventions abroad. More recently, contemporary events have also impacted on Swedish thinking, resulting in a renewed focus on homeland defence whilst also recognising the need to act in concert with others. Consequently, interoperability issues will increasingly play a prominent role in Sweden's wider international approach. Indeed, interoperability is high on the current agenda due to both the recently ratified Host Nation Agreement between Sweden and NATO and Sweden's on-going commitment to the NATO Response Force (NRF). Against this shifting backdrop, this article provides a broad outline of both past and present TAR capabilities before considering likely future development, with particular emphasis on interoperability.

History of Swedish TAR

From the '60s through to the '80s, SwAF intelligence requirements placed a strong emphasis on countering an invasion threat.[1] Accordingly, the need to follow regional developments, for example in and around the Baltic seaports, largely governed SwAF TAR[2] capability development. Sweden's main international effort during this period was in the Belgian Congo, where an air presence was deployed, using the reconnaissance version of the iconic SAAB 29 (The Flying Barrel).[3]

Although the invasion threat remained the defining consideration, by the '90s there was also an increasing focus on international operations, mainly driven by events and subsequent SwAF deployments in the Balkans. Whilst no SwAF TAR units were deployed in this theatre, UK Remotely Piloted Aircraft (RPA) assets were used by Swedish troops, generating valuable tasking and user experience.[4] At that time, SwAF RPA capabilities were still under development, mainly within K3, an army regiment in southern Sweden.

In response to this growing emphasis on deployed operations, the Swedish Air Force Rapid Reaction Unit (SWAFRAP) formed in 2000. At first, SWAFRAP's tasks – mainly reconnaissance – were designated to the reconnaissance version of the SAAB AJSF 37 Viggen. The SWAFRAP was, however, never deployed.[5]

Over the next decade, SWAFRAP was re-equipped and replaced by a series of similar, small and agile units equipped for fighter and attack roles as well as for reconnaissance. This included assignments of the unit within the EU Nordic Battle Group Expeditionary Air Wing (NBG EAW). Deployment for a mission abroad did not, however, take place until 2011. Similarly to its assignment to the NBG EAW, since 2014, Sweden has also offered Gripen TAR assets to support the NRF.[6]

In 2011, there were also advances in RPA when Swedish elements deployed to Afghanistan were equipped with the Shadow 200. During this deployment, it became increasingly apparent that organic tactical reconnaissance support was a modern day battlespace necessity. Somewhat later, smaller tactical RPA were also again tested and acquired.

The early part of this century offered few real-world opportunities to test the emerging aircraft TAR capability, but that changed in April 2011, when Sweden deployed a Gripen unit (equipped with eight aircraft) to participate in the NATO-led Operation Unified Protector (OUP) over Libya. Notwithstanding the organisational preparation that had taken place over the years, this was the first Swedish expeditionary experience with combat aircraft since the Congo deployment half a century earlier.

Since Libya, the Gripen contingency commitment to the EU NBG EAW[7] has been sustained, although the unit has not deployed. Sweden, however, is currently contributing some 250 troops to the ISR Task Force (equipped with Shadow 200 and smaller tactical RPA) as well as to the Multinational All Sources Information Fusion Unit, in Mali.[8]

Organisationally, SwAF TAR has continued to revolve around three formations; F17, F21 (both Air Force wings) and K3 (Army regiment). F17 and F21 each comprise two squadrons, all of which undertook TAR. However, in early 2016 the fixed wing TAR role was allocated solely to F17. At K3, TAR is organized within the regiment's Intelligence Battalion, which among other capabilities comprises two Shadow 200-equipped companies. Furthermore, each of the eight Swedish ground forces battalions is equipped with organic RPA assets.[9]

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SwAF TAR in OUP

The Swedish Libyan mission was divided into two rotations. First, from April to June 2011, the unit was tasked to provide Defensive Counter Air (DCA) and TAR in support of the No Fly Zone (NFZ). Notably, the ratio of pure DCA to mixed DCA/TAR was 1:11; however, most of the latter was purely reconnaissance.[10] The second rotation, from June to October 2011, expanded the mission to cover TAR across the full spectrum of UN-mandated tasks – going well beyond those related to the NFZ by including the enforcement of the arms embargo and, most importantly, the protection of civilians. In total, the Swedish operation contributed over 570 missions and about 1,770 flight hours; from a TAR perspective, around 2,770 reconnaissance exploitation reports (RECCEXREPs) were sent to higher command. In fact, during the second rotation, Gripens conducted a third of all OUP TAR assignments.

From these statistics, it is clear that Sweden's predominant contribution – beyond that of political support to the operation – was TAR. It is fair to say that initially Sweden's involvement was probably seen as politically useful, but it did not carry particularly high expectations of operational utility. Such scepticism quickly transformed into praise after the reconnaissance missions and imagery provided by the Swedish contingent consistently proved their worth. A RUSI report on the international intervention in Libya concluded:[11]

'The Gripen aircraft and the Swedish pilots and support staff proved outstanding in [the reconnaissance] role and outstripped other combat assets with the quality of its tactical ISR (intelligence, surveillance and reconnaissance).'

OUP Lessons Learned on Interoperability

Whilst the Swedish contribution to OUP was in many ways a success, the operation also revealed a number of important challenges, which would need to be addressed to improve operational effectiveness in future coalitions. Upon deployment, it became clear that the Swedish communication systems, despite years of working on interoperability, could not be fully integrated

into the NATO C2 systems. First, and most importantly, as a partnership country, Sweden had no access to the NATO Secret network from the outset, and obtaining a license initially proved difficult. Second, despite having made the Gripen's Link 16 compatible shortly before deploying, a crypto key had to be obtained, which also was a difficult and lengthy process. Not providing early access to a substantial troop contributor was an unnecessary weakness, and the Alliance has been critical of its handling of this issue.[12] In short, these matters highlighted the importance of interoperability – both politically and technically, particularly when they impact on speed of information transfer and analysis – the key in TAR to operational effectiveness.

Interoperability with NATO Joint ISR today

The primary NATO initiative driving Sweden's focus on TAR has been Joint Intelligence Surveillance and Reconnaissance (JISR).[13] Essentially, this initiative shifts the focus from collecting intelligence to streamlining the collection process and ensuring subsequent products are stored and shared in a timely and efficient manner with minimal obstacles between the command chain and contributing/user forces. In many ways, it is dependent on building a network of Coalition Shared Data (CSD) servers which allow unhindered and timely transfer of products generated by those on the network, as well as the potential to transparently tap into the collection management process. As this initiative gains traction (the underpinning doctrine, AJP 2.7 JISR, was published on 11 July 2016), nations will need to decide the measures necessary to ensure adequate interoperability both in terms of process and CSD capability. Given that this process will most likely form the basis of any coalition activities, potential partners, like Sweden, will also need to make suitable contingency arrangements to avoid interoperability speed bumps on contributing elements.

The Swedish government has explicitly directed its military to maintain interoperability with NATO and actively transform towards NATO compliance. Although Sweden has no formal STANAG ratification

A pair of Saab JAS 39C Gripen jet fighters from 171 Fighter Sqn, Swedish Air Force, sweeping across the Baltic Sea. The nearest aircraft is carrying the SPK39 V reconnaissance pod on the centerline station. To cover the long Swedish coastline is a challenging task, and thus identifying foreign vessels at sea is a typical and common mission, where the SPK39 is a very useful tool.

process, many relevant standards (both procedural and technical) have been implemented. In particular, with regard to TAR capabilities, the Swedish Armed Forces will continue to comply with the requirements of STANAGs 3377 and 3596[14] for reporting methodology and RECCEXREP. However, when it comes to other JISR standards, Sweden, having not been part of the Multi-Intelligence All-source Joint ISR Interoperability Coalition (MAJIIC) community[15], and with some of the MAJIIC technology work patterns not yet published as STANAGS, is understandably lacking some JISR-specific solutions. Nevertheless, Sweden is following the current NATO JISR initiatives closely, and has decided to become a NATO FMN (Federated Mission Networking) participant.

The Coalition Shared Data Challenge for Swedish TAR

Sweden bases its interoperability requirements on NATO's Partnership for Peace Planning & Review Process goals and the Allied Command Operation Directive 80-096 on the NATO Response Force (NRF). Neither document currently includes any specific JISR technology guidance, for example on CSD servers. Consequently, CSD interoperability has no priority on the current SwAF agenda. However, the need to share and collaborate in this manner is well understood and accepted, leading to increased discussion regarding CSD issues. Nevertheless, the lack of formal guidance has to date stymied any CSD initiatives by the Swedish Defence Materiel Administration on behalf of the SwAF.

In recent years, there have only been minor changes to equipment. Consequently, Gripen's reconnaissance pod lacks a downlink capability, meaning data is only available to interpreters for exploitation post-landing. However, a software solution is in place allowing the image interpreter to almost immediately start producing the RECCEXREP, while the entire mission data set is still being downloaded. Nevertheless, a CSD solution for sharing raw or exploited data is currently neither available aboard Swedish reconnaissance aircraft nor at the respective ground stations.

So, if the SwAF were to embrace NATO JISR, particularly CSD, how could that be done? As a start, it is possible to rapidly create a solution for archiving, cataloguing, and retrieval with CSD interoperability simply by deploying a CSD server alongside a Gripen unit. The Gripen unit could then publish data to the CSD server via an air gap. From this 'outside' CSD server, data can be published to a Mission Network via Swedish BICES[16]. With some advice from the NATO Communication and Information Agency (NCIA), both short-term plans to integrate Gripen with CSD, and longer-term solutions, are currently under discussion within the SwAF.

In the same manner, demands for video archiving, cataloguing and retrieval with CSD interoperability are beginning to be felt within the SwAF Tactical RPA community. The latest development of NATO JISR doctrine and procedures clearly point to the need for common methods and messages in regards to JISR operations; moreover, the requirement to make RPA video available to partners is a distinct challenge. However, there are at present no plans to CSD-ify SwAF Tactical RPA.

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Swedish Army version of the RQ-7 Shadow-200 with optical payload used for TAR.

Conclusion

Operationally, interoperability issues could be quite significant going forward. Could SwAF TAR today offer the same utility as it did in OUP? The current inability to provide a CSD-driven approach would most certainly impact on its utility in time-sensitive terms. In today's more sensor-rich environment, the chief effect of this would be that Swedish intelligence products, not being available via CSD, would take longer to access than products available from CSD-capable nations. Because of this, it is assessed that, should something akin to OUP happen today, Swedish assets would be used less, and would be given lower priority tasks with less important time constraints. Notably, the lack of CSD architecture also means that SwAF units cannot access the vast archives of imagery that would most likely be generated, or receive time-sensitive data from other coalition assets, to the detriment of their own effectiveness.

TAR will inevitably play a prominent part in Swedish defence planning, which perhaps is natural for a small, non-aligned nation with limited resources and a strong focus on homeland defence. This TAR emphasis has been strengthened by the recent good use made of such capabilities in international missions such as Libya and Mali. It would therefore be surprising if SwAF TAR resources were to be further diminished, despite current economic strains. That said, just like the rapid rise of RPA at the turn of the century became a necessity, interoperability and sharing will likely make similar demands on any nation, in or out of NATO, wishing to contribute to collective missions downstream. So, given that the NATO JISR initiative, particularly its sharing philosophy based on exploiting CSD, could well become the operational norm, the timely codifying of what an alliance/coalition contributor needs to achieve in terms of interoperability would be a significant step forward, if not an essential precursor, to successful operations.

1. Grahn, J-O, Om Svensk underrättelsetjänst. Medströms bokförlag, 2016, p. 232 ff.
2. For the purpose of this article, unless otherwise stated, tactical RPA are included in the concept of Tactical Aerial Reconnaissance
3. https://sv.wikipedia.org/wiki/Svenska_flygvapnet
4. Personal experience as Head Intel Section (S2) at the Swedish Second Kosovo Battalion (KS02) in 2000
5. Flygvapennytt nr 4 2003, p. 24 ff.
6. The NRF comprises four elements: Command & Control element based on a deployable Joint Task Force HQ; Very High Readiness Joint Task Force (VJTF); Initial Follow On Forces Group (IFFG) and, a Response Forces Pool (RFP). The Swedish contribution would be to this latter category.
7. http://www.forsvarsmakten.se/sv/aktuellt/2014/11/peter-basar-over-ett-miniatyrflygvapen-i-nordic-battlegroup/
8. http://www.forsvarsmakten.se/sv/var-verksamhet/internationella-insatser/pagaende-internationella-insatser/mali-minusma/
9. These are AeroVironment Puma and AeroVironment Wasp III, in Sweden together referred to as UAV 05.
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12. Matthew P. Hill, "Operation Unified Protector", Unclassified EUCOM briefing, November 2, 2011.
13. NATO JISR background can be found in 'How NATO makes the Unknown Known' by Robert Murray, Hd of ISR, NATO HQ in JAPCC Journal Ed 22.
14. Reconnaissance and Intelligence Report Form / Air Reconnaissance Requesting and Targeting Reporting Guide
15. MAJIIC was a NATO-led, 9-nation programme to provide procedures, a service-orientated architecture and the understanding to allow compliant systems to interoperate thereby allowing collaboration on a broader and timelier scale. It also supported the development of Coalition Shared Data (CSD) platform.
16. Battlefield Information Collection and Exploitation systems. Joint US/NATO project to integrate current and future intelligence networks. BICES is intended to coordinate and exploit battlefield intelligence gathering among all NATO commands and participating nations.

Robert Egnell

is a Professor of military sociology and head of the department of Security, Strategy, and Leadership at the Swedish Defence University. He earned his PhD from the Department of War Studies at King's College, London (2008). Between 2012 and 2015, he was on leave as a Visiting Professor and Director of Teaching with the Security Studies Program at Georgetown University, Washington D.C. Robert is also a Captain in the Swedish Army Reserve with international experience from the first Swedish battalion in Kosovo 1999-2000.

Air Force Major Johan Jakobsson

is a Swedish Intelligence Officer, currently stationed at the Intelligence and Security Centre in Uppsala. With a background in image and signals intelligence with the Viggen (SAAB 37) squadrons, Major Jakobsson has spent the last 15 years working with research and development in the Swedish Intelligence and has been the national representative to the NATO Joint Intelligence Working Group (JINTWG) for more than ten years. He is currently working with the revision of the national intelligence publications and with intelligence C2 systems interoperability requirements.

Air Commodore (ret.) Garfield Porter (RAF)

has flown as a navigator, crew captain, flight commander and squadron commander on the Nimrod MPA. He also commanded RAF Kinloss in 2002 and, in 2006, completed an operational tour as the UK Air Component Commander Middle East. He was then Director Air & Space at the UK's Doctrine, Concepts and Development Centre, before serving as Assistant Director Transformation at the JAPCC until he retired from the RAF in 2010. Since then, he has continued to work on Air & Space/ C4ISR matters, sat on the UK Lib Dem Defence Policy Working Group, and consults on defence matters with a number of UK and international companies.

Dag Åsvärn

is a biologist and remote sensing specialist working as Operations Manager at Spacemetric, the Swedish company providing image handling capacity to both Gripen and the Swedish tactical RPA currently deployed in Mali. For many years, he served as a Swedish Commando Reserve officer, primarily in intelligence-related positions, and still belongs to the Reserve. After several appointments to various HQs in Sweden and service in both Kosovo and Afghanistan, he rose to the rank of Lieutenant Colonel. Prior to joining Spacemetric, he worked as a consultant for the Swedish Armed Forces, with – amongst others subjects – specific focus on intelligence method development.

Defending NATO's Aviation Capabilities from Cyber Attack

By Alexander DeFazio and Michal Kalivoda,
NATO HQ International Staff, Defence Investment Division

'Cyber-attacks present a clear challenge to the security of the Alliance and could be as harmful to modern societies as a conventional attack. We agreed in Wales that cyber defence is part of NATO's core task of collective defence. Now, in Warsaw, we reaffirm NATO's defensive mandate, and recognise cyberspace as a domain of operations in which NATO must defend itself effectively as it does in the air, on the land, and at sea.'[1]

The world is becoming ever more digitized and societies' daily activities are ever more dependent on the digitized infrastructure. Cyber is already an integral part of conflicts in today's world. Contemporary conflicts and future crises are likely to contain a cyber element. NATO operations rely heavily on cyber-enabled networks; therefore, taking cyberspace into consideration when building and maintaining security is an essential requirement. The implications of recognizing cyberspace as its own domain has shifted the Alliance's focus from one of 'information assurance' to one of 'mission assurance'.

Cyber defence is understood too often as a standalone approach to security and warfare. The Ukrainian crisis has shown cyber defence needs to be integrated into a broader strategic and operational concept. The Ukrainian crisis is a showcase of this kind of strategic

A NATO E-3A aircraft taking off from Oerland Main Air Station, Norway, during the Joint ISR Trial 'Unified Vision 2014'. Like all modern weapons systems today, NATO's Airborne Warning and Control System (AWACS) aircraft exist simultaneously in both the physical and cyberspace domains making them vulnerable to cyber-attacks through numerous access points.

integration, called hybrid warfare. The approach combines conventional military forces with information, operations, provocateurs, cyber, and economic measures.

The protection of national aviation systems from cyber threats is a state prerogative and responsibility. However, its international dimension demands the development and implementation of policies, guidelines, and procedures which could facilitate a seamless resilience of the global aviation system.

The global aviation system is one of the most complex and integrated systems of information and communication technology in the world. It is recognized as a critical infrastructure and potential target for cyber-attacks. Cyber-based threats to aviation are evolving and growing, and these threats can come from many sources, including criminal and terrorist groups, foreign nations, insiders, and others. It needs to be understood the growing interconnectivity among information systems presents increasing opportunities for cyber-attacks.

It should also be noted the interdependencies between civil and military aviation users and stakeholders increase the necessity for trust between them as the ability of the Air Traffic Management (ATM) system to defend against cyber-attacks is only as good as the weakest link in the network. Any potential cyber-attack on the ATM system would not only hamper the safe conduct and management of civil and military flights but could also undermine the trust in the overall security and resilience posture of the Alliance and its member States.

This article will describe the cyber defence aspects of aviation, identify NATO's aviation capabilities and systems potentially vulnerable to cyber-attack, and propose how NATO should defend those capabilities and systems.

Cyber Defence Aspects of Aviation[2]

NATO operations heavily depend upon freedom of action within the cyberspace domain. Unfortunately, most of the weapons and mission systems in use today were designed for a pre-Internet world. The implicit assumption was our systems would operate in a fundamentally permissive cyberspace environment. Many of our systems were designed decades ago and it is certainly not surprising no one was able to predict the explosive growth and importance of the cyberspace domain. When system architects considered

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some form of information security for weapons systems, engineers normally assumed border network defences would keep out adversaries so the environment seen by the weapons system would still be permissive and protected within network defences. These implicit assumptions have proven to be false. NATO's aviation capabilities and systems are no longer safe as the pace of cyber-attacks increases daily across the military, government, and civilian sectors.

Since all modern weapons systems (such as NATO Airborne Early Warning and Alliance Ground Surveillance systems as well as upgraded air and ground legacy systems) exist simultaneously in both the physical (air, land, and sea) and cyberspace domains, cyber-attacks directly affect warfighting systems in the physical domains as well. There are numerous access points through which adversaries can attack these systems via cyberspace. Any physical connection that passes data, or any antenna with a processor behind it, is a potential pathway for an attacker. Obvious examples include maintenance and logistic systems, radios and datalinks, and other systems that connect operators and platforms (i.e. aircraft, pods or weapons). To make things even more complex, these vulnerabilities are not static, but change constantly. Every software update, every new capability, and every new piece of equipment can introduce new vulnerabilities. To increase complexity further, many critical mission dependencies will lie outside military influence in commercial systems. Since the range of vulnerabilities is so overwhelming, we must start by determining what is most important.

NATO's Aviation Capabilities and Systems

In order to protect NATO capabilities and systems from a cyber-attack, it is important to identify, as a first step, which ones are susceptible to a cyber-attack. The following military capabilities and systems, amongst others, should be taken into account when attempting to identify NATO's aviation capabilities and systems susceptible to a cyber-attack:

- National capabilities and systems used in NATO operations and missions
- NATO Air Command and Control System (ACCS)
- Navigation Warfare (NAVWAR)
- Digital Aeronautical Flight Information Files
- Air C2 Information Services
- Airborne Early Warning and Control (AEW&C) Systems
- NATO Airlift Management Programme[3]
- Integrated Air and Missile Defence
- Alliance Ground Surveillance (AGS)

Because of the interdependencies between civil and military aviation systems, a cyber-attack cannot be defended against by either in isolation. An attack on the civilian aviation sector will also affect NATO's military capabilities and thus requires a comprehensive response. The North American and European ATM systems are in the process of transitioning from radar to satellite-based systems. This change in the civil aviation operational environment is occurring rapidly and significantly, with the development of

An RQ-4 Remotely Piloted Aircraft connected to a maintenance terminal. Alliance Ground Surveillance RPAs are not only vulnerable to cyber-attack via its online command and control systems or data links, but may also be infected by malware introduced through other access points such as maintenance and logistic systems.

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NATO Secretary General Jens Stoltenberg, at the NATO Summit in Warsaw, announces the decision of Alliance Heads of State and Government to recognise cyberspace as a domain of operations in which NATO must defend itself effectively as it does in the air, on the land, and at sea.

new advanced technologies and communication systems shifting from manual processes to more efficient automated processes, communications, and storage. These technological developments will increase the capacity of the air traffic control system and improve safety. However, the following civilian capabilities will also raise significant cyber defence concerns and, when interconnected, will impact NATO's operational capabilities:

- System Wide Information Management (SWIM) and Networks
- Electronic Flight Bags (EFB)
- Global Navigation Satellite Systems (GNSS)
- Aircraft Communications and Reporting System (ACARS)/Controller Pilot Data Link Communications (CPDLC)
- Instrument Landing Systems (ILS)
- Automatic Dependent Surveillance – Broadcast (ADS-B)
- Global Flight Tracking Technologies

Defending NATO's Aviation Capabilities and Systems[4]

Before deciding on how NATO should defend its aviation capabilities and systems, it is helpful to categorize cyberspace assets into the following three broad areas:

Traditional IT: includes Internet Protocol router networks as well as IT-based weapons systems including NATO's Combined Air Operation Centres and other personnel and logistic systems;

Operational Technology (OT): refers to computer-controlled physical processes or other types of control systems such as building automation or Heating, Ventilation and Air Conditioning (HVAC) systems;

Platforms: includes aircraft, ships, tanks, and any other weapon system operated by the Alliance and its members.

While cyber defence experts are familiar with the defence of traditional IT systems and are beginning to focus on the defence of OT, the work on securing platforms has yet to be investigated.

With this in mind, the best way to effectively defend NATO's aviation capabilities and systems from cyberattack is through a combination of defence in depth, resiliency, and advanced defence measures. Each approach (further described below) is necessary and none is sufficient on its own. Therefore, NATO and its members should combine them into a coherent whole for maximum effectiveness.

Defence in depth presents multiple barriers that an adversary must get through, provides the initial defence, and blocks most of the less sophisticated attacks. There are several components of a good defence in depth. The first is a border defence to keep out the low-level attacks accomplished by unskilled attackers who use pre-packaged tools to execute them. A good defence should have numerous borders configured to prevent lateral movement, privilege escalation, and exfiltration of sensitive data. Vulnerability management across enterprises is also a good part of defence in depth and defenders should not just close vulnerabilities but also shut down unnecessary processes and applications to eliminate large sections of attack surface.[5] Accomplishing this requires effective and secure systems' engineering that considers cyber defence throughout the design process. For critical systems, an extreme version of defence in depth is an air-gapped system. However, in most cases, 'air-gapped' systems are not truly air gapped because updating or changing them requires other systems to be connected to them. Finally, it is worth mentioning many cyber assets need their own defence in depth system and should not have to rely on the defences of a particular host network, as in the case of highly mobile systems like aircraft where operators and maintainers plug into it with different networks.

A C-17 from the Heavy Airlift Wing at Papa Air Base in Hungary. The civilian airspace and Air Traffic Management systems used by NATO aircraft are also subject to cyber-attack as European and North American Air Traffic Management transitions from radar to satellite-based systems.

Resiliency keeps adversaries from achieving their objectives when attacking NATO and Member States' systems. Resiliency in defending NATO and its members' aviation systems will require flexibility, reducing attack surfaces, and reacting dynamically to cyber-attacks. A flexible global aviation system will require excess capacity to provide the redundancies associated with flexibility. It will also need to be a heterogeneous system broken down into defensible enclaves. To react dynamically to cyber-attacks, defenders of the global aviation system need to develop better situational awareness of their own networks and develop intelligence capabilities to understand what potential adversaries are planning.

Advanced defence measures make it difficult for an attacker to stay in systems long enough to inflict damage by finding and defeating sophisticated manoeuvring adversaries. It is important to note they do not always imply real-time monitoring and manoeuvre, but may also rely on periodic checks for some types of systems where real-time monitoring is not practical or desirable. Advanced defence measures are composed of three components: manoeuvre forces, sensors, and tools. Manoeuvre forces are the trained personnel needed to successfully implement active defence. They must not only understand traditional IT systems but must also be knowledgeable in OT and platform systems. Developing this manoeuvre force is needed but we must also provide them with the sensors needed to find the hidden cyber attackers. These sensors will need to go beyond standard Intrusion Detection Systems. Once an attack is detected, manoeuvre forces will need the required tools to allow them to defeat the intruder.[6]

Finally, consideration should be given to aviation safety and the processes that ensure aeronautical products, parts, and appliances are airworthy. Much like the military and civilian systems listed above, the equipment used in airworthiness certifications is also subject to cyber-attacks. Therefore, the cyber defence measures proposed in this paper should also apply to airworthiness processes.

Conclusions

The current changes to the civil aviation operational environment are resulting in highly integrated and interdependent computer and digital networks, both on board aircraft and in air traffic control facilities, which creates inherent security vulnerabilities.

NATO therefore needs to defend its aviation capabilities and systems from cyber-attack through a combination of defence in depth, resiliency, and advanced defence measures. Furthermore, since an attack on civil aviation systems also affects military aviation, a comprehensive solution is required.

As NATO shifts its focus from 'information assurance' to 'mission assurance', its members should consider categorizing their cyberspace assets as either Traditional Information Technology, Operational Informational Technology, or Platforms in order to better defend them from cyber-attack as proposed in this article.

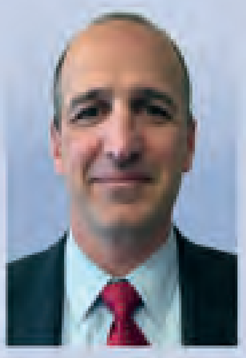
Currently there is no common vision, strategy, goal, standard, implementation model, or international policy defining cyber defence for aviation. Ensuring a secure aviation system and staying ahead of an evolving cyber threat is a shared responsibility amongst all stakeholders including governments, airlines, airports, and manufacturers.

'… the best way to effectively defend NATO's aviation capabilities and systems from cyber-attack is through a combination of defence in depth, resiliency, and advanced defence measures.'

Next generation and upgraded legacy systems will only add to future cyber defence concerns as they become increasingly network dependent. It will therefore be critical that cyber defence testing be part of the airworthiness certification process for NATO and its member States. ●

1. Paragraph 70 of the Warsaw Summit Communiqué issued by the Heads and State of Government participating in the meeting of the North Atlantic Council in Warsaw 8–9 Jul. 2016.
2. The ideas presented in this section come primarily from two articles written by Col William Bryant, Deputy Director of Task Force Cyber on the US Air Staff. The first is titled 'Mission Assurance through Integrated Cyber Defense', which was published in the Winter 2016 edition of Air and Space Power Journal and the other is 'Resiliency in Future Cyber Combat', which was published in the Winter 2015 edition of Strategic Studies Quarterly.
3. The NATO Airlift Management Programme is part of the NATO Support Agency and supports a fleet of three C-17 aircraft of the Heavy Airlift Wing at Papa Air Base in Hungary.
4. The ideas presented in this section come primarily from the same two articles written by Col Bryant listed in endnote 2.
5. In cyberspace terms, the attack surface is made up of all the potential access points available to an attacker.
6. In other words, to prevent the intruder from achieving their objectives. This could also include disrupting, denying, or deceiving the intruder.

Michal Kalivoda



Alexander DeFazio

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are staff officers in the Aerospace Capabilities Section of the Defence Investment Division for the International Staff at NATO Headquarters. Mr Kalivoda has been with NATO since 2002 with 24 years experience in the Air Force of the Czech Republic as a GBAD officer. Mr DeFazio has just joined the International Staff after 28 years as an F-15E Weapons System Officer in the USAF to include 6 years working at the US Military Delegation to NATO and the International Military Staff. The authors are currently involved in all aspects related to NATO aviation safety and security.

Development of a NATO Joint Air Power Strategy

Following the JAPCC Future Vector Project (2013) and other projects and conferences regarding NATO's future capability challenges, the North Atlantic Council (NAC) requested a study on Joint Air Power Capabilities to determine NATO's Air Power shortfalls and current capabilities. The JAPCC was one of the driving forces in this study, which was completed in December 2015. After reviewing the findings, the Bilateral Strategic Commands (Bi-SCs) were tasked to write a NATO Joint Air Power Strategy (JAPS) as well as define the term 'Joint Air Power'. Allied Command Transformation (ACT) was assigned to lead the effort with contributions from the JAPCC (amongst others).

The development of the JAPS is split into two phases. In the first phase (until Nov 2016), the Ends and Ways will be described, along with a definition of Joint Air Power. ACT briefed the Nations on the progress of the JAPS in September at NATO HQ. JAPCC participated in three writing workshops and the draft of the phase 1 product entered Bi-SC staffing in October of this year.

To date, the efforts have focused on linking overarching political guidance (NATO's Core Tasks) with NATO's Strategic Military Effects to achieve NATO's political ends, which are translated to air activities to achieve those effects (the Ends, Ways, and Means concept). The Phase 1 portion of the Strategy should be approved in January 2017.

In the second phase (initiation through November 2017), the Means of Joint Air Power will be defined and the two developed documents combined, resulting in a complete NATO Joint Air Power Strategy. JAPCC will participate in three additional writing workshops during this phase. ●


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Reactivation of Aircraft Cross-Servicing

In the decades following the conclusion of the Cold War, the need for several capabilities ceased in the European theatre. One of them, Aircraft Cross-Servicing (ACS), has been inactive since 2007. However, in the current international environment, Allied Air Command (AIRCOM) faces challenges to deliver Air Power to the Alliance. The ACS concept presents an opportunity to increase flexibility, to deploy, operate, recover, and generate tactical aircraft for operational missions from bases other than their main operational bases, and act as a potential force enabler for NATO air forces.

ACS, as it is was formerly defined, was a capability providing service, not maintenance, to an aircraft by an organisation other than that to which the aircraft is assigned, on a base that is not its main operation base.

The service levels were defined in three different stages: enabling an aircraft to be flown in another mission without change of weapon configuration, enabling an aircraft to be flown on a subsequent operational mission, and enabling an aircraft to continue to its final destination.

To reactivate the ACS program, JAPCC is supporting AIRCOM in a complete review of the ACS program. The main objective will be to provide guidance and recommendations on the most effective and efficient way to rebuild the ACS capability in the area of processes, organisational structure, and documentation, and to assess potential ACS capability options for future employment to enhance this operational capability. Products are programmed to be delivered in 2017. ●

Future Unmanned System Technologies

Legal and Ethical Implications of Increasing Automation

The number of unmanned systems in NATO nations' military inventories has grown rapidly and is still increasing in many service domains, in particular with regard to Unmanned Aircraft Systems At the same time, the level of automation built into these unmanned systems has not only increased significantly, but has also reached a level of sophistication at which they are seemingly capable of performing many tasks 'autonomously' and with no necessity for direct human supervision. International law, as well as NATO doctrine, does not currently address the potential legal and ethical issues which may arise from the use of highly automated weapon systems nor do they provide a common definition of what an autonomous weapon actually is.

The JAPCC has produced a White Pater titled 'Future Unmanned System Technologies – Legal and Ethical Implications of Increasing Automation'. Based on detailed research into International Humanitarian Law (IHL), this White Paper outlines the potential legal implications when introducing highly automated unmanned systems to the national inventories of NATO members and partners. It also highlights some of the major technical challenges for 'autonomous' systems to meet IHL's legal requirements to guide future developments. It recommends a generic set of terms for automation levels, which may be used as a common baseline within NATO to define what autonomy actually is, where it begins and how it is to be delineated from automation. Finally, the study briefly discusses the ethical implications of using highly automated systems in military operations and gives an assessment of what may or may not acceptable in NATO.

Publication of this White Paper is foreseen for the end of 2016.

Joint Air & Space Power Conference 2016

Preparing NATO for Joint Operations in a Degraded Environment

The JAPCC's 2016 Joint Air and Space Power Conference was held from 4 through 6 October in Essen, Germany. It considered whether the uncontested and uncongested environment in which NATO airpower has operated for the past two decades has resulted in a reduced level of preparedness – both doctrinally and in terms of training – for alliance airpower to be utilised optimally in a degraded environment. Whilst myriad individual lessons and ideas fell out of the discussion, with more likely to come as the follow up dialogue continues, there were four primary and interlinked themes which repeatedly arose in discussion:

1. Preparedness and Training,
2. Deterrence,
3. Communication between senior military and political leaders, and
4. Mission Command.

These four themes provide NATO with a set of strong starting points from which to embark on a journey to a guaranteed capability to operate in a degraded environment, no matter the domain involved (air, land, maritime, space or cyber). In his summation of the Conference, which is conducted under Chatham House Rules, a NATO senior air leader undertook to deliver on that resolve. Underlining the above points, he noted these are all areas in which NATO must act if it is to continue to deliver safety and security for the Alliance, challenging all present to initiate change where appropriate as a result of discussions held during the Conference. A full set of Conference-related publications, including the Read-Ahead, Special Conference Edition Journal, and Conference Proceedings, are available at www.japcc.org/conference.

The 2017 Joint Air and Space Power Conference will be held from 10–12 October 2017 in Essen Germany, with the overarching topic of 'Deterrence'. Further details information will be announced in due course and registration information will be made available both in the Spring/Summer JAPCC Journal and online at www.japcc.org/conference. ●

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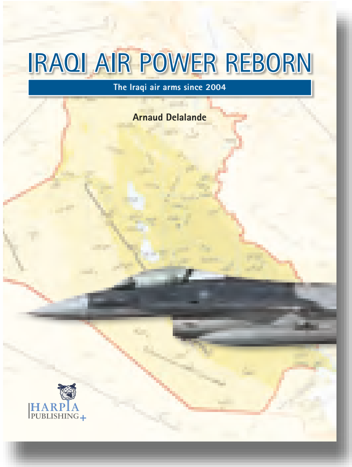
'Iraqi Air Power Reborn – The Iraqi Air Arms Since 2004'



By Arnaud Delalande,
Houston, TX,
Harpia Publishing L.L.C., 2016
Reviewed by:
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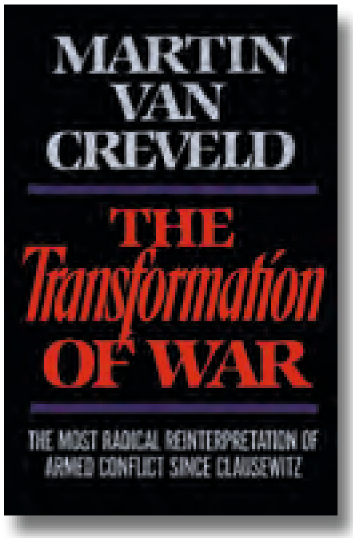
'Iraqi Air Power Reborn – The Iraqi Air Arms Since 2004' describes the evolution of the Iraqi Air Force (IQAF) from its early start as Royal Iraqi Air Force, in 1931, until now. This development is paralleled by the overall Middle East history, in which Iraq was involved in wars against neighbouring states, Israel, and Kurds as well as against US-led alliances until the Hussein regime was toppled. Today, the IQAF as well as the whole Iraqi Army Aviation (IAA) are no longer involved in combatting neighbouring states but have to fight against domestic insurgency on behalf of an elected government. The book consists of five chapters starting with a short introduction about the 'old' air force and its involvement in the Arab-Israeli wars, the war against Iran, invasion of Kuwait and the following US led interventions. The subsequent chapters provide insights into the build-up of today's air power capabilities, a description of present IQAF and IAA equipment, ongoing procurement, and eventually the current counter-insurgency and counter-terrorist operations inside the country. The book concludes with an overview of today's IQAF/IAA order of battle to include confirmed recent attrition rates.

Within less than 80 pages, the book author manages to provide a solid summary of Iraqi air power evolution. Most interestingly, the story reveals how the new IQAF cooperates with various world powers including former opponents, especially in terms of arms procurement from the US, Russia and China to reduce dependency from only one supplier. This book is not only written for military analysts and subject matter experts but is valuable for anyone interested in air force history.

'The Transformation of War'

Written in 1991 one could easily believe that the scenarios and tendencies discussed in this book would be obsolete by now. However, 'The Transformation of War' discusses different reasons for the resurgence of low intensity conflicts, and many of those reasons still ring true today. The book starts boldly by stating that contemporary strategic thought around the fundamental questions of warring is imperfect, as future conflicts would no longer be inter-state wars. As stated in the book's subtitle it may be the most radical reinterpretation of armed conflict since Clausewitz. Van Creveld supports his argument by debating the subject of war throughout the seven chapters of the book, addressing what war is all about, by whom it is fought, how, and why, before he shares his thoughts on future forms of warfare. Van Creveld forcefully argues that future conflicts will not necessarily be fought between states, and also claims that technology and military superiority do not guarantee victory in these conflicts.

Even though the book was written 25 years ago it continues to be thought provoking. Looking at the conflicts that occurred during the recent decades, one could hardly argue van Creveld's assumption that future conflicts will mainly occur between state and non-state actors was wrong. Those having interest in the impact of technology on warfare, the emerging trend of globalization, or strategy in general should read this book and consider its implications for anticipating conflicts yet to come.



By Martin van Creveld,
Free Press/Simon & Schuster
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Intelligence