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LESSONS OFFERED FROM THE LIBYA AIR CAMPAIGN



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The Royal Aeronautical Society is a learned society with the principal aim of fostering the general advance of aerospace science and engineering. The Society's Air Power Group (APG) seeks to enhance the understanding of the utility of air power in all domains. The roles of the International Institute of Strategic Studies (IISS) include the study of the causes and courses of those conflicts with a military dimension. Together, the two organisations offer a credible, authoritative, evidence-based and balanced assessment of a striking example of the capability of air power.

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Front cover: An RAF Typhoon on a mission over Libya. Picture taken from an air tanker showing the Enhanced Paveway II bombs plus the air-to-air AMRAAM and ASRAAM missiles. Eurofighter copyright photo.



The first operational mission by Royal Air Force Tornado GR4 aircraft from Gioia Dell Colle, Italy, as part of Operation Ellamy, the UK contribution to help enforce the No Fly Zone over Libya in support of UN SCR 1973. Crown copyright photo.

A Royal Aeronautical Society Air Power Group Paper on the issues and lessons arising from the 2011 Libyan air campaign. It is primarily based on the RAeS — IISS seminar¹ on Operation UNIFIED PROTECTOR² held at No.4 Hamilton Place on 22 February 2012.

HISTORY CONTINUING

"History does not repeat itself but it rhymes." Mark Twain

The 2011 Libyan air campaign lasted for seven and a half months, from the first launch of weapons on 19 March³ to 31 October, and it ended precisely 100 years after the first case of wartime aerial bombing from a fixed-wing aircraft. On 1 November 1911, an Italian pilot dropped four hand grenades on a Turkish Army position during the Tripolitan War. The outcome of the conflict was that the three North African provinces then ruled by the Ottoman Empire were ceded to Italy and on gaining independence in 1951 they became the nation of Libya.

POLITICAL PARTNERS AND HOST NATION HOSPITALITY

In 2011, the British-French bilateral agreement on military co-operation was put to the test in the challenging circumstances of power projection against a nation state. The degree of effective collaboration achieved was a defining

moment in the strengthening links between the two countries and one that offers a firm foundation to build on for the future. France and the UK successfully met the UN call and then led the mission to protect Libyan civilians against the Gaddafi regime. The outcome can be seen as proof of NATO's ability to deal with major world events; the organisation has certainly grown in stature as a result.

The vital importance of coalition help and host nation support was stressed by several delegates. Italy's contribution to the campaign was largely overlooked in the media but it not only flew many attack sorties (releasing over 700 PGM) but provided levels of basing and logistics support that were unanimously described as outstanding. In total, Italy hosted around 200 aircraft from 11 nations on seven airbases and two naval air stations offering extensive logistical and other forms of support.

Though Britain and France were the most prominent nations, the Coalition had a large and varied membership. The initial coalition (and main contributors) comprised Belgium, Canada, Denmark, France, Italy, Norway, Qatar, Spain, the UK and the USA. They were joined by Bulgaria, Greece, Jordan, The Netherlands, Romania, Sweden, Turkey and the United Arab Emirates. Overall, 18 nations provided air or maritime assets and 34 nations provided other forms of support.

LESSONS — THE POLITICAL PERSPECTIVE

The lessons arising from Operation UNIFIED PROTECTOR

¹The seminar was co-chaired by Air Chief Marshall Sir Brian Burrige (RAF retired) and Douglas Barrie, Senior Military Chair of the IISS. All information presented was unclassified and all statements were non-attributable to permit open debate and candour.

²The UK contribution was named Operation ELLAMY and the French involvement was Operation HARMATTAN.

³NATO took over sole command of air operations over Libya at 0600 GMT on 31 March 2011 under Operation UNIFIED PROTECTOR, from US Africa Command. The first air attack was by the French Air Force. <http://www.bbc.co.uk/news/world-africa-12795971>.

were not new⁴ but definitely reinforced those identified from many previous campaigns. The experience serves to emphasise those principles with enduring worth and relevance. These included: the primary importance of effective command and control (C2); the value of information systems of sufficient reliability, security and capacity; the war winning advantage of superior situational awareness⁵ and the great utility of precision guided munitions (PGM).

From the British perspective, the House of Commons Defence Committee (HCDC) noted the decisive role of air power and commended the air units involved in all stages of the campaign from non-combatant evacuation operation (NEO) to combat. The HCDC acknowledged the view of the RAF Chief of the Air Staff (CAS) that both Tornado GR4 and Typhoon FGR4 had performed well; the high reliability of the latter was particularly noteworthy for so new and complex an aircraft. The deployment and use of the AH-64 Apache attack helicopter (AH) operating from HMS *Ocean* was judged to have been successful. However, it remained a sobering fact that the UK still lacks a Joint Personnel Recovery (JPR) capability. Given the pressure on the defence budget it is unlikely that such a capability will be instituted in the foreseeable future. As a result, Britain will remain dependent on allies for this important role. This might be said to be a case where Britain has given up a role by never taking it up.

The accuracy and reliability of the air-to-surface PGM were noted but the committee expressed concern about the shortages of some types especially the dual mode seeker Brimstone (DMSB)⁶. As such, it recommended that the Government should define the nature and scale of the contingency operations it intends to prepare for and then to ensure sufficient UK industrial capacity exists to support the requirements⁷.

APG comment: This is a difficult issue where the options each have distinct drawbacks. Building up a substantial stockpile of weapons enables the support of short notice and long term campaigns but this advantage comes at considerable cost. On the other hand, complex weapons involve long lead items and so cannot be manufactured quickly to meet an unforeseen requirement. Even choosing which types and in which numbers to procure is fraught with challenge owing to the uncertainty of the nature of the operations we may face. DMSB is by all accounts an excellent weapon against armour and moving targets but it is certainly not suited for attacking hardened command bunkers. What is ideal for one type of campaign may be painfully unsuitable for another. As ever, the likely decision will be a compromise with 'a little of everything' being put on the shelf and the front line then doing its best with what is available.

The high cost of PGM was recognised by the HCDC but it was accepted that accuracy (and reliability) was essential in achieving the low levels of collateral damage (CD) now mandated. Indeed, the directive for OUP was that civilian deaths were simply not acceptable in order to maintain the moral

⁴The great majority of lessons are repetitions of those previously experienced. Hence the term 'lessons identified' is more accurate than 'lessons learned' as we seem to rarely learn in full and long term from the majority of cases.

⁵Achieved through Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR).

⁶DMSB was procured for the UK's Afghanistan campaign (Operation HER-RICK) as a limited effects radius (ie low collateral damage) precision weapon. The millimetric wave radar seeker of the original Brimstone was supplemented with a laser seeker to allow the weapon to guide on a target illuminated with a laser designator. It has proven to be highly capable: accurate even against moving vehicles, reliable and effective.

⁷It was observed that PGM cost and availability were not studied in depth following the 2003 Iraq war.



An RAF Tornado takes off for a sortie with a RAPTOR imaging pod. RAPTOR's imaging capabilities meant that such missions were a key part of NATO's intelligence gathering operations. Crown copyright/Sgt Pete Mobbs photo.

authority of the UN action and the support of the Libyan people. The HCDC commended the speed of deployment of force units at the start of the operation but was concerned about a degree of command and control (C2) uncertainty in the early stages. Several delegates confirmed that such had been the case.

CRAFTING THE CAMPAIGN: A VIEW FROM NATO HQ

Some commentators have opined that 2011 was a decade of history in 12 months: the death of Osama Bin Laden, the Japanese tsunami, severe flooding in Australia, riots in Britain, the Eurozone crisis and, not least, the Arab Spring. For NATO, it was a seminal year following the new strategic concept announced at the 2010 Lisbon summit. Afghanistan moved into the transitional phase of transferring security responsibility to the Afghan forces themselves. In Iraq, the NATO training mission for the new Iraqi security forces came to an end while in Kosovo, riots required KFOR action follow-

AMERICAN SUPPORT — THE AIR POWER BEHIND THE THRONE

Though the USA adopted an ostensibly limited involvement in Libya, it in fact provided considerable and arguably crucial support to the campaign. The precursor to the NATO led Operation UNIFIED PROTECTOR was the American dominated Operation ODYSSEY DAWN. One element of this phase was SEAD, the suppression of enemy air defences, a capability that only the USA possesses in quantity in the Alliance. Radar guided surface to air missile (SAM) systems such as SA-2 and SA-3 presented a major threat to NATO aircraft especially the high value asset ISR platforms which were crucial for gaining situational awareness. (See ISR section below). USAF provided SEAD in the form of the F-16CJ cued by tactical ISR assets were invaluable in neutralising this danger. The threat remained throughout the campaign with pro-regime forces attempting to re-deploy such systems from the south of the country to coastal area as late as August and September. Clearly, the supporters of Gaddafi recognised that coalition air out-matched their own fighting power hence the attempt to offer a counter. The loss of a high value asset such as a Rivet Joint or Sentinel would not have resulted in campaign failure but it would have greatly inhibited the use of such aircraft and hence their effectiveness and contribution to success.

NATO: A FLYING START TO THE CAMPAIGN

The fact that the NATO campaign, Operation UNIFIED PROTECTOR did not begin until 31 March (i.e. two weeks after the first use of weapons by the Coalition (19 March) has prompted the criticism from some commentators that the Organisation's response to the crisis was slow. It can be argued that NATO achieved a fast reaction. Protecting the civilian population of Benghazi and elsewhere in Libya was not an operation for which NATO had a contingency plan on the shelf. That it was able to devise an operational concept and detailed plan in three weeks before taking over from the US led Operation ODYSSEY DAWN was a notable achievement.



French Air Force Mirage 2000.

ing the failure of Kosovan and EU units to control the situation. In short, it was a most demanding time for the Alliance.

The Libyan element of the Arab Spring began with an uprising in Benghazi on 15 January and the city was under the control of anti-regime forces by the third week of February. This prompted Gaddafi's notorious threat on 22 February to hunt down and destroy the opposition 'house by house'. For example, the town of Zawiyah (30 miles from Tripoli) was bombed and then captured by pro-regime forces "exercising a level of brutality not yet seen in the conflict"⁸. The deliberate targeting of civilians by pro-regime forces was proven beyond doubt resulting in UN Security Council Resolution (UNSCR) 1970 on 26 February. There were three main parts: it referred Libya to the International Court; it imposed economic sanctions on the regime and an arms embargo on Libya in general. The latter involved a formidable challenge given the size of the country⁹ and its extensive land borders with several other nations (Egypt, Tunisia, Algeria, Niger, Sudan and Chad).

EUROPEAN LEAD — AMERICAN SUPPORT

The campaign was also very important for NATO as it was the first operation for the Alliance where it did not have US leadership nor was America supplying the bulk of the capabilities and strength. An early requirement was the establishment of a non fly zone (NFZ) over Libya so as to deny the regime air-to-surface attack, mobility and ISR. Lacking its own armed forces, the UN looked to NATO to provide the muscle and the first North Atlantic Council (NAC) meeting on Libya was held on 2 March. In a major change from previous contingency operations, the USA declined to take the lead. Robert Gates, then the US Secretary of Defense, proposed "Let's play Libya at arm's length". The Americans put forward three principles to be met before any commitment to action: 1) demonstrable need; 2) unqualified regional support and 3) a sound legal basis. Notwithstanding these initial reservations, the principles were met and UNSCR 1973 was adopted on 17 March with ten nations in favour and five

⁸The Independent, 9 March 2011, p 4.

⁹Six times the size of the UK.

¹⁰For many nations the test to justify participating in military action is the granting of a UN Security Council Resolution. For some nations, and this included the Arab League in the case of Libya, the requirement is that NATO will be involved.

¹¹A seasoned veteran described this as: "Pretty remarkable agility by 28 nations." Cynical commentators have previously suggested that NATO stands for No Action, Talking Only.

¹²Though taking no direct part in the Libya campaign, Germany permitted its crews in NATO's E-3A AWACS fleet to fly missions over Afghanistan. This load sharing enabled NATO to operate some of its E-3A aircraft over Libya.

abstentions (including Germany)¹⁰. The resolution demanded an immediate ceasefire, an end to attacks on civilians and a ban on all flights in Libyan airspace. Crucially, it also authorised the use of 'all necessary means' to protect the civilian population of Libya.

OPERATIONAL OVERTURE — AIMS AND LIMITATIONS

The first attack mission was flown on 19 March by the French Air Force (FAF), in a unilateral national action, while the principal coalition nations were still involved in the Paris Summit. This was followed by a 'febrile fortnight' of political and operational activity. The USA was clear that in order to retain its strategic balance (in particular with Afghanistan as main effort) it would relinquish the operational lead. In the event, very fast agreement was achieved within NATO¹¹. The no fly zone (NFZ) was instituted on 25 March and the arms embargo imposed from the following day. On 27 March, NATO approved the full mission set of Operation UNIFIED PROTECTOR with the Secretary General stating that "NATO will implement all the aspects of UNSCR 1973 — nothing more, nothing less." The Supreme HQ Allied Powers Europe (SHAPE) had overall C2 with the NATO HQ in Naples exercising Joint command. The Air component command was delegated from the NATO Combined Air Operations Centre (CAOC) at Ramstein, Germany to Poggio del Renatico in Italy following an interim placement at the CAOC in Izmir, Turkey. Though a NATO member, Germany took no direct part in the operation but essentially supported the mission aims¹².

On 14 April, the Berlin Conference demanded the following: all attacks on civilians and civilian populated areas must cease; all regime forces must withdraw to their bases; the

immediate and full safe and unimpeded access for humanitarian aid. In seeking to coerce regime acceptance of the demands, NATO set itself challenging limitations: no NATO Land forces would deploy into Libya and NATO was to cause no civilian casualties.

This lack of 'boots on the ground' limited NATO situational awareness making it almost totally reliant on airborne ISR to gain and maintain a ground picture. However, that shortcoming was arguably far preferable to the alternative. Had NATO ground forces entered Libya, it is likely that they would have been seen as invaders not only by the regime but also by many of the Libyan population and even Arab state members of the coalition. It is an interesting fact that people who will strongly resent and even resist foreign ground forces are far less concerned about foreign aircraft operating over their territory. This is, of course, assuming that those aircraft are operated with sufficient care to safeguard the innocent.

Advocating 'non-invasive' intervention through air (and naval) power alone, i.e. no ground force element, may sound like special pleading on behalf of the air force seeking a larger slice of the defence budget. While that may be the case to an extent, the fact is that air power has a unique capability: it can selectively and temporarily intervene and then withdraw. The point was well made by the commentator Elliot Cohen when he remarked: "Air power is the political equivalent of modern courtship in that it offers gratification without commitment." Committing ground troops to an intervention is a truly momentous decision with major implications. Such campaigns are generally very lengthy and very costly in both blood and treasure. The examples of Iraq and Afghanistan are striking. Policing the no fly zones over northern and southern Iraq after the 1991 Gulf War up to 2003 was relatively inexpensive; the invasion and aftermath were anything but that.

Air forces should be ready to emphasise this advantage to the politicians, the public and indeed the other services. Air offers the greatest reach and speed. It is 'tune-able' in the sense that the intensity of activity can (resources permitting) be readily increased or decreased or switched from one area to another or from one role to another. It of course lacks the immediacy of face to face contact with the local population that the army's boots on the ground can achieve and that capability is vital in some circumstances and must not be under-regarded let alone dismissed. Overall, however, air power offers a unique capability for power projection and intervention and advocating this should not be seen as a political action but rather than as a statement of fact.

INFLUENCE, AUTHORITY AND RESOURCES

For some years before Operation ELLAMY, the UK had disinvested in southern NATO and so had no officers of high rank already based in Naples, Poggio or Izmir. Unsurprisingly, this limited the influence that Britain could apply in planning and executing the NATO operation. Not least, it meant that British personnel were at the back of the queue for office space, IT and communications. It had proved a definite false economy to scale back coalition peacetime integration. The clear lesson was that Britain must seek and resource senior command positions in coalition structures. That point prompted the dry observation from a very distinguished delegate: "While I was in MoD, I read that lesson in ten post operation reports." However, the RAF is reducing in size and there is particular attention focused on the number of high ranking officers; many commentators claim that they remain in disproportionate numbers compared to the force size as a whole. It will be difficult to justify maintaining a cadre of sen-



2,000lb Enhanced Paveway III bombs await transportation during Operation ELLAMY on the runway at Gioia Del Colle Airbase in Italy. Crown copyright/SAC Sally Raimondo photo.

ior officers for alliance roles when they could be seen merely as place holders or, worse, as sinecures. The total annual cost of a group captain (full colonel equivalent) is not trivial but the value of gaining influence in international organisations is very high.

NATO as a whole also faced major problems arising from savings measures. It had shortfalls in both platforms and the underlying capabilities vital to operational effectiveness. These included intelligence fusion, target development and dynamic targeting — a far from exhaustive list but one that illustrates that there is vastly more to air power than aircraft and weapons alone. Over its seven-month course, the operation involved over 26,000 sorties of which around 25,000 were flown by fixed wing aircraft with 400 by helicopters and 500 by unmanned air vehicles (UAV). Ordnance released comprised 7,600 precision weapons: 3,600 laser-guided and 3,000 GPS-guided. The headline figures of sorties flown and weapons released tend to mask the huge investment required to achieve high levels of operational capability. Without sufficient appropriate training a fleet of highly sophisticated aircraft will be of little value. It must be recognised that the complete package of air power includes the broad infrastructure of support ranging from spares on the shelf to the practicing of tactics. The total cost is high but it produces a cost effective result. Nothing is more expensive than squadrons of fighters than only have a role at an air show.

'Crater counting' is easy; 'So what?' is the difficult yet essential question. Hitting the target is good but it is even



A Royal Air Force Typhoon takes off on a mission from Gioia del Colle Airfield during Operation ELLAMY. Crown copyright/Sgt Pete Mobbs photo.

better to know that you chose the right target and that you achieved the desired effect. How many of the thousands of weapons released over Libya were assessed in detail post strike? The answer is certainly very few. But the real assessment only begins at the weapon effect on the aim point. The focus should be on the results of the action, that is, the effect on the system of which the aim point was a part. Destroying the bunker containing the adversary's air defence C2 system is clearly desirable. Destroying an empty bunker while the C2 system continues working uninterrupted from an ostensibly commercial office block is clearly a failure. Weapons will have been wasted and aircrew put at risk to no good end. Even worse, we may assume that the threat has reduced when it is unabated so prompting us to take unforeseen and unacceptable risks. In short, we must match our weapon accuracy with accurate intelligence and then with fast, reliable and relevant assessment of the results.

Weapon release is the intermediate step between target selection and effect assessment. With occasional exceptions, what we can see, we can hit and what we can hit, we can destroy. The video footage of a weapon striking a target is dramatic but in some respects this is the most straightforward part of the process. It is essential to understand the adversary in the human terms of their aims, values and resolution. Such situational understanding (complementing the situational awareness provided by ISR) enables effective development of our own strategy from the campaign level down to specific tactical tasks. Well founded and conducted actions will then combine to achieve the required higher level objectives. On the other hand, simply attacking a series of targets that happen to be within our reach and capability is most unlikely to achieve success. The adversary is not a target list and one who is guaranteed to collapse when the last

target has been 'ticked off'. The NATO campaign over Serbia in 1999¹³ arguably fell into that trap. It was assumed that a 'few days of bombing' would be sufficient to force the withdrawal of Serbian forces from the province of Kosovo. This state of mind was almost certainly engendered by the rapid success of NATO's action in 1995 over Bosnia. That bombing campaign lasted only 21 days before the Bosnian Serb leadership capitulated. The error was in failing to understand the cultural importance of the province of Kosovo to the Serbian nation; that is, an importance of a magnitude that would withstand considerable coercive effort¹⁴. In the event, the Kosovo campaign lasted 78 days and the capitulation of the Serbian leadership came about as much from political pressure as from the effects of air power. The Libyan uprising and the threat to the civilian population from the regime was different again in character from the two Balkans cases (and much longer at 227 days). These examples demonstrate the essential need for commanders and planners to complement their knowledge of the tactics and technology of air power with an understanding of the scenario in which they seek to achieve effect.

NATO difficulties also included communications with the anti-regime element; initially there were very poor links with the National Transitional Council (NTC). Coalition problems included some process imposed limitations. For example, Sweden provided "absolutely vital ISR" but once the information gained a NATO classification it could not be released to its originating nation. Common sense eventually prevailed in such matters so emphasising that no system will cover every situation without amendment; experience, initiative and especially common sense remain invaluable. As ever, the near traditional shortage of air to air refuelling (AAR) tankers served to limit operational capacity and flexibility. As for any scarce asset, it was essential that the specialist providers were involved in the planning from the start to ensure that the most effective use was achieved. Once again, a distinguished delegate observed dryly that this lesson had appeared in a great many post operational reports. The fact of its regular recurrence proves that we are either failing to

¹³Operation ALLIED FORCE.

¹⁴Robert McNamara (Secretary of Defense to J F Kennedy and Lyndon Johnson) emphasised the essential need to empathise with your adversary, i.e. to be able to see the world from their perspective. See the documentary on McNamara *The Fog of War*.

understand the lessons or choosing to ignore them. Indeed, it is more likely the latter. Most lessons involve considerable cost if the problem is to be rectified. All too often, the decision is a rather unrealistic hope that next time we will somehow avoid the difficulties through working smarter than before.

LESSONS AND OPTIONS — SMART DEFENCE

OUP proved the value of partnership in demanding operations. A successful outcome was achieved despite various shortfalls, in particular those of enablers such as ISR, across the European nations. Even if their 'back seat' approach was not a deliberate test of the rest of NATO by the US, it certainly proved the point that European-NATO is not well resourced. The lack of an American lead does not mean a lack of American participation but ideally Europe should be self reliant or, at least, less dependent. The sixty four billion Euro question is whether those nations will fund the changes required to achieve self reliance. In the current economic circumstances, the answer is a definite negative. There is neither the money nor the appetite to increase defence spending.

One striking option discussed was that in the current cash strapped times, collective Smart Defence is a possible option. No one NATO member (with the exception of the USA) can afford the full range of capabilities so the remainder must seriously consider adopting a degree of role specialisation and then combining their assets to form the complete range of capabilities as well as a greater strength in depth.

Following such an option has major implications. Role specialisation¹⁵ will require a formal structure and discipline if NATO nations are to feel able to rely on other members for providing certain critical capabilities. For Smart Defence to work, the consensus currently required for NATO activity may have to be given up in order to avoid a veto hindering or even precluding the actions of a coalition of the willing. This will be a fundamental change in the Alliance. The role sharing of Smart Defence has potential but there is also the possibility of capability loss if nations see it as a means of cutting defence spending. The aim must be to use at least the same amount of money more effectively thereby enhancing overall capability and efficiency. However, it can be difficult to achieve agreement between the armed forces of a single nation so the challenge of getting several different countries to devise and accept what is in effect a single defence policy is extreme.

NATO must understand the implications of cuts enacted by its members if it is to avoid the appearance of, or increase in capability gaps. The NATO Allied Command Transformation (ACT) is leading Smart Defence and is running a stock-take of all member nations. It is seeking formal national acceptance of leadership in a range capability-based projects. Some of these are relatively simple (e.g. training) whereas others are more challenging (e.g. maritime patrol, AAR and UAV). Smart Defence must achieve cultural and behavioural shift given that there are implications of sovereign capability. That said, it may be inevitable as no one European nation can afford everything. There are political issues including the electoral cycle, governments may be of a single party

¹⁵See *The Aerospace Professional* September 2011 for an APG paper on role specialisation.

¹⁶Operation HERRICK is the UK contribution to NATO's Afghanistan mission.

¹⁷The view was encapsulated by MRAF Tedder's dictum that: "Flexibility is the key to air power." Whether all those who quote it so readily understand the implications is debatable.

or a coalition and vary from right to left wing in outlook and values. These factors along with public opinion make the degree of a nation's altruism and sense of duty to NATO very difficult to predict especially in the longer term.

STABILISATION STAGNATION?

The point was raised that Britain (and some other NATO members) had developed 'Afghanistan myopia', ie becoming overly focused on counter insurgency (COIN) and stabilisation owing to the protracted nature of Operation ENDURING FREEDOM¹⁶. Have air power professionals retained the required breadth in its application? Has the air domain become primarily a targeting organisation — tactically excellent but lacking strategic understanding? Preparation and readiness for Operation ELLAMY was undoubtedly affected by the fact that Afghanistan has been the main effort for years. Indeed, for many people. Operation HERRICK was their only experience and adapting to the Libyan scenario required major changes in the way they did business. One of the most common claims for air power is its agility, i.e. its speed, reach and readiness to change role and effort¹⁷. While the aircraft and systems may offer the potential for agility, it will only be realised if it is complemented by commanders, planners and decision makers who are equally adaptable. This requires an open mindedness and in particular a readiness to accept the need for change, that a previously effective method may not be suitable for the new circumstance.

It has been said that the Cold War 'glue of fear' was most effective in keeping NATO nations focused and committed. However, the motivation to participate in Libya style operations is very different, it being a war of choice rather than one of necessity (e.g. national survival as in WW2). There are also practical issues. Whereas the Cold War was Europe-based, intervention is not and 70% of European ground forces are still not deployable. Thus the first step in modernisation must be to improve NATO's ability to project power to cover a range of varied contingencies. Projection requires more than the initial 'push'; sustaining the fielded force is often the greater challenge and cost. Freedom of movement cannot be taken for granted. Deploying a task force to Sierra Leone in 2000 was relatively simple. This would not be the case for many areas where the adversary would contest both our entry into theatre and our presence there. Anti-access and area denial (A3D) are potential threats that are all too likely to be realised in some future scenarios. Control of the Air has been the standard condition of deployments for so long that some see it almost as routine rather than as the culmination of huge past investment and long practice. To maintain this happy state of affairs into the future will require further significant spending given the proliferation of threats such integrated air defence systems (IADS) and long range surface to air missiles (SAM). Effective power projection does not come cheap and it can be argued that it should either be done thoroughly or not at all. Buying a shallow capability force is a great waste of money.

NATO: NEAT ACTION TIMELY AND OVERWHELMING

The unanimous view of the seminar was that NATO action (including the original French independent action) proved to be essential and effective. Has the campaign not started when it did, it was strongly believed that regime forces would have caused extensive bloodshed in Benghazi (and elsewhere) of innocent lives. It was also considered that without the facilitating support of the US, the campaign would have been possible albeit at a slower pace. Nevertheless, the US withdrawal from the operational lead revealed huge shortfalls in the NATO command structure and in other areas such



Formation of No 51 Squadron Nimrod R1, foreground, and Sentry AEW1 of No 8/23 Squadron, both were based at RAF Waddington in Lincolnshire. Crown copyright.

as ISR. As a result, the command structure is already being revised; this prompted the mordant comment that for the first time NATO will have a command structure resembling a military command as opposed to a politically-based sharing of high level posts.

THE COMMANDING VIEW — ISR: THE VALUE OF INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE

The context and challenges of the campaign from the ISR perspective were unusual. There was limited prior knowledge and, initially, poor situational awareness (SA) — certainly compared to world regions for which the UK (and NATO) had planned contingency operations. Libya itself is a vast nation, the fourth largest in Africa and at 700,000 squares miles, almost three times the size of France or six times Britain. The ground picture was complex with both pro and anti regime forces using the same equipment so making discrimination very difficult. It was also a dynamic scenario with frequent changes of location and activity by dispersed units that generally avoided concentration.

It was war by proxy with the anti-regime forces facing the same adversary as NATO but not co-ordinated with NATO. Thus there was a void of information; an absence of Land-origin ISR so making the Air element essential for NATO commanders' situational awareness and decision support. As ever, ISR was in high demand and short supply. Limits in ISR knowledge was another issue with some commanders lacking understanding of the capabilities of certain platforms and sensors.

An example of achieving SA was that in a contested area, there would be movement in the ground held by the opposing sides but a zone with nil movement was defined by the front lines, the forward edge of the battle area (FEBA). This greatly aided discrimination between and pro and anti-regime forces which otherwise were difficult to distinguish by appearance alone. Ground moving target indicator (GMTI) could be used in a 'historical' mode; playing back the movement of a vehicle allowed its ownership and place of origin to be identified. The importance of the human element of ISR assessment was often proven; technology alone is not enough. Key targets such as SCUD launchers were picked out owing to an operator recognising the convoy character-

istics: vehicle numbers, types and speed. While there may be some potential for automating ISR analysis, the experienced human operator will remain essential through using skill and judgement to pick out the gold from the gravel.

ISR LESSONS

The lessons identified included a reconfirmation (if any was needed) that SA is fundamental to operational success; knowing what is 'on the other side of the hill' remains essential — technology changes but the essence of conflict does not. Attention in ISR often focuses on the platforms and sensors but in fact, collection is the (relatively) easy part; human analysis is vital with expert knowledge combining with an appreciation of the operational context being the key to turning data into understanding. Because of this fact, the balance of analysis between reach-back and forward-deployed (including onboard) must be considered very carefully. The cheaper solution may not be the more cost-effective. For example, the face to face de-briefing of UK fast jet crews by RAF Tactical Imagery Wing (TIW) analysts immediately on landing was seen to have been a significant benefit — one not so easily or readily achievable by reach-back. The use of reservist analysts was recommended as a cost effective means of coping with surge conditions.

UK ISR

The UK contribution was significant. The Boeing E-3D Sentry provided airspace control and co-ordination. Sentinel R1 offered wide area surveillance with synthetic aperture radar (SAR) while its GMTI radar allowed the detection and tracking of multiple vehicles; the RN Sea King Mk 7 also provided GMTI capability. Tornado GR4 proved its multi-role credentials through the use of the RAPTOR reconnaissance pod. Even target designator pods (TDP) such as the GR4's and Typhoon's LITENING III offered useful images though the addition of a data-link to permit real-time sharing would be a substantial gain. In specialist personnel, the UK provided staff to the CAOC and the assessment teams of the ISR Division¹⁸ while the RAF's Tactical Imagery Wing TIW was central to the analysis of ISR products. The Nimrod R1 signal intelligence gathering platform was also involved. One

ISR ASSETS: A SCARCE BUT CRUCIAL COMMODITY

The ISR assets were far from sufficient for the scale of the theatre. For much of the operation there were only two MQ-1 Predator UAVs available so limiting 24/7 coverage to a very small proportion of the potential areas of interest. Moving a Predator from say Misrata in the west of Libya to Brega in the east involved a 400-mile transit and the loss of the asset for four hours. The continuous application of high altitude, long endurance ISR platforms such as Lockheed U-2 and Northrop Grumman RQ-4 Global Hawk (UAV) would have been invaluable. Unfortunately, these types were not invariably available and SA (which benefits greatly from constant presence) suffered accordingly. There were only single examples of the following specialist types available: USAF E-8 JSTARS (surveillance/tracking radar), USAF RC-135 Rivet Joint (electronic intelligence gathering), RAF Sentinel R1 (GMTI) and FAF Atlantique 2 (maritime patrol). No matter how advanced and capable an aircraft may be, it can only be in one place at a time.

¹⁸It was noted that while the US did not take the lead in the campaign as a whole, it dominated the ISR Division.



The Saab Gripens of the Swedish Air Force flew 650 sorties totalling around 2,000 flying hours. Courtesy: Saab, photographer: Katsuhiko Tokunaga.

of the two remaining R1s was deployed to the Libyan theatre only a few weeks before its service withdrawal date of end March 2011. It proved to be a temporary stay of execution and the type finally retired in June 2011. The RAF is now taking a capability 'holiday' in this role until the three Boeing RC-135W Rivet Joint on order enter service in 2014 under the name of Air Seeker.

Sentinel added to its achievements in Afghanistan proving itself to be very well suited to the Libyan theatre. It offered reach and persistence and was resilient operating at high tempo. Its wide area sensors were invaluable in gaining and maintaining SA and the real-time, on-board assessment of the ISR product permitted prompt and effective dissemination. The key output was the support of ground picture understanding; in short, who was where and what were they doing. Change detection was key to maintaining SA. Cross cueing of sensors on other platforms allowed the focus to shift as required from floodlight to searchlight to spotlight. Overall, Sentinel proved to be a force multiplier through enhancing the efficient application of scarce assets over a huge battle-space.

This is a difficult time for UK ISR. The maritime patrol capability was lost in the 2010 *Strategic Defence and Security Review (SDSR)* with the cancellation of Nimrod MRA4¹⁹. The *SDSR* planned for the deletion of Sentinel once its Operation HERRICK role was complete though there are now strong indications that it may be reprieved owing to the uniformly high praise it has received from the Afghanistan and Libyan theatres. Sentinel was key to campaign success. It is likely to be the UK's contribution to NATO's AGS (Alliance Ground Surveillance) system²⁰ to complement Global Hawk (a fleet of five) and the French medium altitude ISR asset. The ISR fusion for this combined fleet will be at Sigonella. However, it was noted that some politicians believe AGS will entirely fill NATO's ISR capability gap; the seminar view was that it will not do so. The fact that it took NATO two decades to procure five aircraft to fill a long standing requirement was also noted.

¹⁹See *Aerospace International*, January 2012, for the APG's review of the UK's future ISR fleet.

²⁰http://www.nato.int/cps/en/natolive/topics_48892.htm?selectedLocale=en
 "AGS: Evolution: On 3 February 2012, the North Atlantic Council (NAC) decided on a way ahead to collectively cover the costs for operating AGS for the benefit of the Alliance. The decision to engage NATO common funding for infrastructure, satellite communications and operations and support paves the way for awarding the AGS acquisition contract by 13 Allies. In addition, an agreement was reached to make the United Kingdom Sentinel system and the future French Heron TP system available as national contributions-in-kind, partly replacing financial contributions from those two Allies."

²¹The fast jets were likened to a mistress: wonderful but expensive. While a mistress would be happy to go to Italy, a holiday in Afghanistan might be less welcome.

ATTACK: FOURTH GENERATION FIGHTER PERFORMANCE

Tornado, Typhoon and Rafale — winds of change

Prior to operation ELLAMY, the RAF's Typhoon FGR4 had an air-to-air focus with the longer term intention of developing it into a multi-role fighter. Its deployment to theatre was initially for air defence but it was rapidly cleared to deliver air-to-surface weapons as well. Tornado GR4 remained the lead in that respect (regarded by some as the Coalition's attack platform of choice) owing to its greater variety of weapons, the maturity of its systems and the extensive ground-attack experience of the Tornado force. However, Typhoon's initial attack capability proved to be most effective so ably complementing Tornado.

The decision to re-activate the FGR4's dormant air-to-surface capability was made on 31 March, the first multi-role sortie was flown seven days later and the first weapon release made five days after that. This was remarkably fast given the complexity of the aircraft and the demands on the support system arising from the high operational tempo.

A mixed pair with the third generation Tornado leading the fourth generation Typhoon was the standard team, thus limiting the use of the Typhoon's fourth generation aircraft performance, although occasionally it could employ this remarkable performance to good effect. On one occasion a pair was tasked with reaching a possible target 400 miles away "as fast as possible". The Tornado, already carrying 9,000lb of fuel, set off at once. The Typhoon refuelled (after a five minute wait) and then transited high and supersonic, reaching the target location simultaneously with the Tornado and with a similar on-task time available.

Typhoon proved surprisingly reliable achieving a 99% availability rate, somewhat higher than the considerably more mature Tornado. The number of ground crew per aircraft for Typhoon was only 70% that of GR4. In over 3,000 flying hours there was only a single Typhoon engine change and that was precautionary after ingestion of some debris from an AAR drogue — the engine turned out to be undamaged. It was notable that both Tornado and Typhoon went through the campaign without a single urgent operational requirement (UOR) being raised; they were able to cope with a demanding operation using the systems and weapons already provisioned. The cost of UORs is often considerable not only in the initial procurement but also after the operation is over. To take such a system into the core programme is expensive as the whole life cost must be met for a system against which there is no budget provision. To discard it means that its single use was extremely expensive.

The sustainability of complex aircraft when deployed remains a challenge despite the years over which GR4 (and Harrier GR9) has operated in Afghanistan. Operating from a well found base such as Gioia del Colle is one thing; an austere base is more difficult while a bare base will be very challenging²¹. In this respect, carrier aviation has much to offer. The carrier itself is a well found base and one that can be deployed to any scenario with a coastline. While expensive to buy and to operate, that must be compared to the cost of deploying land based air to a host nation and sustaining it there. While a carrier can scale the degree of its presence in theatre and withdraw readily, deploying an air wing to another country arguably involves greater overt political commitment. The decision to deploy will be made more reluctantly but once made the decision to withdraw may be delayed owing to the possible connotation of retreat.

The French Perception

The French Air Force (FAF) view was that the design of the Dassault Rafale²² as an 'omni-role' platform had been proved correct by Operation HARMATTAN. As a long-range, precise, hard-target capable weapon, SCALP (Storm Shadow equivalent) had shown its capability. For short range moving targets, the FAF had noted the utility of the Dual Mode Seeker (DMS) Brimstone. An interesting note was the FAF policy of maintaining the flying currency of aircrew holding staff posts. Though expensive, it offered flexibility in the face of a surge requirement: in effect, 'a reserve within the air force'. The activity of the French Navy carrier group and its use of the Rafale M was worthy of note. The ability of the *Charles de Gaulle* to poise relatively close to the Libyan battle-space (compared to the long transit from Italy) facilitated dynamic targeting (i.e. those with limited windows of opportunity) through shorter reaction times.

The Royal Danish Air Force (RDAF) deployed six F-16 to Italy on 19 March and these aircraft flew 1,283 sorties and almost 4,800 flying hours. An average of eight sorties were flown each day with four aircraft active and two acting as spares. In total, the RDAF F-16 delivered 923 PGM, a significant contribution from a small nation. There was considerable support for the mission from the Danish public and an unanimous vote in parliament for the deployment (even from left wing members). The Saab Gripen of the Swedish Air Force flew 650 sorties totalling around 2,000 flying hours. Eight aircraft were deployed within 24 hours of the decision by the Swedish parliament. (See annex for the Operation UNIFIED PROTECTOR air order of battle (orbat)).

THE KINETIC CAMPAIGN: FAST JET AND ATTACK HELICOPTER

The flexibility of air power was exemplified by a RAF Tornado squadron. It returned from exercise in the USA to Britain on 14 March. UNSCR 1973 was issued on 17 March while the squadron prepared for operations from 16th to 18th. The first Storm Shadow mission (and launches) was flown on 19 March and such sorties continued to the 28th while the first GR4s deployed to Italy on 21 March. In total, Storm Shadows were launched against over 60 targets and the 3,000nm sorties were the first RAF attack sorties flown from the UK since WW2. The Storm Shadow missions included one which was aborted minutes before weapon release owing to collateral damage concerns. A number of international journalists were visiting the target area to view the facilities hit in an earlier attack. The risk was deemed too high and in a display of real time situational awareness, networked capability and timely command, the cancellation order was issued. In seven months of 24/7 operations, RAF Tornados flew 8,000 hours and released around 1,200 weapons. A typical weapon load was two Paveway IV (PWIV) laser/GPS guided bombs, a LITENING III TDP and three DMS Brimstone missiles. Up to five PWIV could be carried but at the cost of the TDP so making the aircraft reliant on cooperative designation or using the weapons on GPS guidance alone. The PWIV fuze delay could be set in the cockpit so allowing optimum engagement of targets of opportunity. In short, it was a highly flexible and effective weapon system.

During March over Benghazi, the GR4s faced dynamic targeting, ie reacting to fleeting chances in a fast changing



An Army Air Corps Apache helicopter takes off from HMS Ocean during Operation ELLAMY. Crown copyright/LA(Phot) Guy Pool photo.



The Charles de Gaulle aircraft carrier. EMA/Marine nationale photo.

environment. There was little ambiguity as the pro-regime forces were still clearly distinct from their opposition. Kinetic actions can have both physical and psychological effects. TDP video showed an attack on a regime self propelled gun (SPG) where its destruction by a PWIV prompted the immediate retreat of the other regime forces in the area. Eventually, Gaddafi's troops abandoned use of tanks and similar weapons presumably counting the loss of capability to be outweighed by the threat (near certainty) of attack and destruction. Thus in April to May, as attention switched to Bregha, Misrata and the Berber Highlands, battlefield ambiguity increased with regime forces adopting the appearance of their opponents.

Deep operations were flown by RAF Tornados against targets such as ammunition dumps in the south of the country. A regime C2 target at Sebha was listed for attack with the requirement that it be hit within five hours by 16 bombs which were to strike within a ten second window. It is a tribute to the abilities of all involved that this demanding task was achieved. Great distinction was demonstrated with attacks against snipers shooting from the top floors of buildings. Precision weapons with well understood radius of effect were used to neutralise such snipers with minimal damage to the building and causing no other casualties. High accuracy attack and low or zero CD are now the baseline requirements and the military must accept its responsibility of ensuring that politicians understand the issues and the art of the possible. The term surgical strike has been frequently used and may give the impression to some that guided weapons are accurate to within a millimetre. While accuracy (and reliability) has increased over the years, precision has still not reached such a level.

²²Rafale is the French for a squall, a sudden, sharp increase in wind speed. A typhoon is a mature tropical cyclone that develops in the northwestern part of the Pacific Ocean. A tornado is a violently rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud.

Attack helicopters (AH) also had a role in the campaign with the British Army fielding the AH-64 Apache and the French providing the very similar Tigre. AH-64 flew from the RN's helicopter carrier HMS *Ocean* while Tigre operated from the *Tonnere*. A total of 22 Apache missions (49 combat sorties) were flown with 99 Hellfire missiles fired along with 4,800 rounds of 30mm cannon and 16 CRV7 rockets. Vehicle checkpoints, transmitter masts, C2 nodes and vehicles such as 'technicals' (4x4s carrying heavy automatic weapons) were typical of the 116 targets engaged. Twenty two missions were cancelled with 90% of those owing to a lack of SA as to the relative locations of pro and anti-regime forces — an indication (and cost) of the lack of ISR. Libya was a high threat environment for AH but the risk was considered acceptable as it was believed that their presence achieved considerable psychological effect. The fact that NATO was flying AH at low level over Libya demonstrated capability and, as importantly, commitment. However, the loss of an aircraft might have had significant repercussions so making the risk-benefit assessment a fine balance. Air power intervention is not risk free and this is another area where politicians must be well briefed on the possibility and implications of loss. The use of RPAS is likely to increase partly because they are well suited to the 'dull and dangerous' missions and partly because a loss is less unacceptable than that of a manned aircraft and the crew.

The principal lessons identified were that "AH strike from the sea works" and that the integration of 'fast air' and AH is possible and effective. The combination of, on the one hand, Tornado and Typhoon and, on the other, Apache, offered a wide range of weapon and sensor options to the force commander.

Naval contemplation

The Royal Navy was involved through the provision of HMS *Ocean* for Apache operations and the firing of Tomahawk cruise missiles from the *Trafalgar* class submarine HMS *Triumph*. Interest in land attack capabilities from surface vessels has, unsurprisingly, been spurred by the Libyan experience. The Royal Navy are investigating options of embarked precision attack systems and UAV. One possible option is that of the Lockheed Martin Army Tactical Missile System (ATacMS) which can deliver a 500lb (225kg) warhead around 180 miles (300km). Naval platforms have much to offer in terms of air power capability. Surface ships and submarines have far greater endurance than aircraft; they can adopt the 'poise' role for weeks on end off a coastline or other operational area such as a communications bottleneck. The former can be either covert (over the horizon) or overt for a more direct presence and hence influence. The latter, by their nature, add a considerable degree of uncertainty to the opposition in terms of presence, location and intention. Operating rotary and fixed wing aircraft from carriers offers considerable capability and flexibility. The need for host nation support is much reduced or even eliminated. Transit time to theatre may appear slow (20 knots compared to an aircraft's cruising speed of 400kt) but a carrier's aircraft are ready for action immediately it arrives in theatre. Sending fast jets to a host nation may be 'fast' but the support tail can take time to deploy and then prepare so delaying the start of actual operations. An 'airfield' in the littoral (such as *Charles de Gaulle* and its Rafales) may also offer shorter reaction times than land based aircraft in a host nation. The reach of systems such as Tomahawk (between 700nm (1,300km) to 1,350nm (2,500km)) also compares



A US Air Force C-17 Globemaster III from McChord Air Force Base, Washinton, lands at Aviano Air Base, Italy, in support of Operation Odyssey Dawn 20 March 2011. USAF photo.

favourably with aircraft carried weapons. The drawback is the relatively small weapon load and the specialist facilities required for reloading. As has long been the case, air and naval systems are complementary and together can offer great flexibility and capability in many cases.

Psychological Effect

The value of psychological effect and the difficulty of assessing it were discussed. Napoleon observed that the "moral was to the physical as three is to one" while Trenchard claimed a twenty-times ratio in favour of psychological effect²³. Whichever is correct, it is necessary not only to measure the scale and nature of the initial effect but also (and perhaps more crucially) its duration. No formal assessment was done of the psychological effect achieved by AH though there was anecdotal evidence of its value.

The fast jet domain offered four examples of effects beyond the physical. (1) Pro-regime forces ceased using armoured vehicles after the destruction of many tanks. (2) The use of an inert weapon (for CD prevention reasons) resulted in no further hostile action from the building attacked. (3) Weapons were used to persuade rather than to kill. 'Knocking on the door' (a deliberate near miss) served to scare the targeted individuals and resulted in a break in the C2 chain. (4) The use of the original version of Brimstone destroyed eight regime vehicles in a single attack while ending all use of the surviving units.

CONCLUSIONS

Air power was central to and essential for success in Libya. Highly capable air assets enabled the anti-regime ground forces to overcome an opponent that otherwise greatly outmatched them. The Libyan campaign was markedly different from the COIN stabilisation operations of Iraq and Afghanistan. While it may not be a blueprint for all future use of force it serves to prove that we are highly likely to face a challenge we have not anticipated. Moreover, OUP was pivotal for NATO. The US role in NATO has changed and will continue to change as the focus of America shifts from Europe to Asia-Pacific. The European members must be more ready and more able in future to take the lead and provide the weight of effort required.

Despite the declaration of "Let's play Libya at arm's length", the USA did provide substantial support to OUP though not to the same scale as on previous occasions. In both the 1995 Bosnian and 1999 Kosovan campaigns, Europe was in the embarrassing position of having little ability to project power in Europe such that the USA had to supply the bulk of the combat power and support functions. Sending forces around the world is one thing, but dealing with trouble in your own back yard is quite another. Though located in another

²³It has been said that Trenchard used the word 'moral' because he could not spell 'psychological'.



A Royal Canadian Air Force CP-140 Aurora starts its engines to depart for a functioning flight in Sigonella, Italy, on 29 September 2011. Corporal Mathieu St-Amour, Canadian Forces Joint Imagery Centre photo.



A Qatar Emiri Air Force Mirage 2000-5 flies its first mission 25 March 2011, in support of Operation Odyssey Dawn. USAF photo.

continent, Libya is still relatively close to Europe with all the facilities of the southern NATO countries to hand. Should Europe have to project military power to a truly out of area location then this will be a very significant challenge indeed. Britain will not have fixed-wing carrier aircraft until 2020 at the earliest. In the interim, Europe's capability in this area will be limited to the Rafales of the *Charles de Gaulle* and the Harriers of the Italian and Spanish navies. Both of those countries face major financial difficulties so the readiness and even the continuance of those assets is somewhat uncertain.

The value of ISR and PGM were again proven beyond all reasonable doubt. However, the aircraft and the systems alone can only realise their full potential when complemented by experts who possess a sound grasp of the scenario, the campaign aims and (never forget) an understanding of the utility of air power: capabilities and limitations. People are more important than process and this must be recognised through achieving and maintaining the required levels of education and training required to form the foundation of success. Modern equipment is highly capable but requires high levels of support. As such, deployed forces benefit hugely from an equally capable and well motivated host nation; Italy's huge contribution to the campaign deserves far more recognition than it has generally received.

The observation was made that: "No one had trained specifically for Libya but they were ready for it". Being prepared for any contingency and eventuality was dependent on good training and also an agility of approach; the 'mind-flex' required of the modern era not the mindset of the past.

In his book *Waging Modern War*, General Wesley Clark²⁴ commented on the tedious and difficult process of targeting endured during Operation ALLIED FORCE (Kosovo 1999) that had so inhibited NATO's freedom of manoeuvre. Air power has made huge progress since those days. Within a generation, the speed, flexibility and capability of air power have all been greatly enhanced. In short, for the Libyan campaign, air power can close the log book entry with Duty Carried Out. But there are no grounds for complacency. If NATO and especially the European nations (of either NATO or the EU) are to ready for future contingency operations then further investment is required. That is not a 'nice to have' but a necessity. Notwithstanding the 'arms length' posture of the USA in Libya, American forces provided critical assets to the coalition. This happy state may not be repeated in future as American impatience with European dependence is only likely to increase. Europe must procure such capabilities as SEAD and persistent multi-spectral ISR and do so in sufficient numbers to achieve some strength in depth if it is

to attain its aspiration for real influence and to be a force for good in the world.

ANNEX

ALLIED AIR COMMAND²⁵ OPERATION UNIFIED PROTECTOR AIR ORDER OF BATTLE (ORBAT)

Belgian Air Component

- 6 x F-16AM 15MLU fighter aircraft operating from Araxos Air Base, Greece

Royal Canadian Air Force

- 6 x CF-188 Hornet multirole fighter jets
- 2 x CC-177 Globemaster strategic transport aircraft
- 2 x CC-130J Hercules tactical transport aircraft
- 2 x CC-150 Polaris air-to-air refuelling tankers
- 2 x CP-140 Aurora maritime patrol aircraft
- Joint Task Force 2 (Canadian Special Operations Forces Command)

Royal Danish Air Force

- 6 x F-16AM 15MLU fighter jets operating from Sigonella Air Base, Italy
- 1 x C-130J-30 tactical transport aircraft

French Air Force (transferred from Opération Harmattan)

- 8 x Rafale fighters
- 8 x Mirage 2000-5 fighters
- 6 x Mirage 2000D fighter-bombers
- 2 x Mirage F1CR reconnaissance aircraft
- 6 x C135 aerial refuelling aircraft
- 1 x E-3F AWACS aircraft
- 1 x C-160G SIGINT electronic surveillance aircraft
- Commando Parachutiste de l'Air companies 20 and 30 forward deployed to Solenzara Air Base, Corsica[

Hellenic Air Force

- 4 x F-16 fighter jets
- 1 x Embraer R-99 early warning and control aircraft

Italian Air Force

- 4 x Tornado ECR SEAD aircraft operating from Trapani Air Base
- 4 x Eurofighter Typhoon fighter jets operating from Trapani Air Base
- 4 x Panavia Tornado IDS started air attacks against military targets in Libya with Storm Shadow Missiles and smart bombs JDAM and Paveway in 28 April, fighter jets operating from Trapani Air Base
- 4 x AMX Ghibli fighter jets operating since 25 July

NATO

- E-3 airborne early warning and control (AWACS) aircraft operating from Forward Operating Base Trapani

²⁴NATO Supreme Allied Commander (SACEUR) in the 90s.

²⁵http://en.wikipedia.org/wiki/Operation_Unified_Protector

Royal Netherlands Air Force

- 6 x F-16AM 15MLU multi-role fighter jets operating from Decimomannu, Sardinia
- 1 x McDonnell Douglas KDC-10 aerial refuelling aircraft, until 4 April

Royal Norwegian Air Force

- 6 x F-16AM 15MLU fighter jets operating from Souda Air Base, Crete (until July 2011)
- 2 x C-130J-30 tactical transport aircraft supporting the Norwegian forces. (until July 2011)

Qatar Emiri Air Force

- 6 x Mirage 2000-5EDA fighters jets operating from Souda Air Base, Crete
- 2 x C-17 Globemaster III strategic transport aircraft

Spanish Air Force

- 4 x EF-18AM Hornet fighters jets operating from Decimomannu Air Base, Italy
- 1 x Boeing 707-331B(KC) tanker aircraft
- 1 x CN-235 maritime patrol aircraft

Royal Swedish Air Force

- 5 x (reduced from 8) JAS 39C Gripen fighter jets operating from Sigonella Air Base, Italy
- 1 x Lockheed Tp-84T C-130 Hercules configured as aerial tanker
- 1 x Saab 340 AEW&C (pledged, but not yet deployed)

United Arab Emirates Air Force

- 6 x F-16E/F Block 60 Falcon fighter jets operating from Decimomannu Air Base, Italy
- 6 x Dassault Mirage 2000 fighter jets operating from Decimomannu Air Base, Italy



F-16s of the Hellenic Air Force. Hellenic Air Force photo.

Royal Air Force

- 16 x Panavia Tornado GR4A
- 8 x (originally 10) Eurofighter Typhoons
- 2 x VC-10 tanker aircraft
- 4 x AgustaWestland Apache attached from the Army Air Corps (United Kingdom)
- 3 x E-3D Sentry surveillance aircraft
- 1 x Sentinel R1 surveillance aircraft

Royal Jordanian Air Force

- 6 x F-16 MLU fighter jets operating from Aviano Air Base, Italy

United States Air Force

- Unspecified units including KC-10A, KC-135R, EC-130J Psychological Warfare aircraft, E-8 and U-2S reconnaissance aircraft, F-15 and F-16 fighter aircraft, EA-6B electronic warfare aircraft and MQ-1 Predator.