

ADF capability snapshot 2015

Part 1—RAAF

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This paper surveys the capability of the Royal Australian Air Force (RAAF). It updates previous reviews in [2008](#) and [2010](#). Other papers in the series update the corresponding reports on Navy, Army and C4ISR (command, control, communications, computers, intelligence, surveillance and reconnaissance) capabilities.

RAAF capability summary

The RAAF is recapitalising essentially its entire fleet of aircraft, from basic flight trainers through to its frontline tactical strike fighters. It's also working up to introduce significant new unmanned aerial systems (UASs), as well as developing its overarching intellectual framework for air operations under Plan Jericho.

When ASPI first took a 'capability snapshot' in 2008, the F-111 strike bomber and 1980s-vintage Hornets were the frontline combat aircraft, airlift was provided by the C-130 Hercules at the strategic level and the Caribou over shorter ranges, the Wedgetail airborne early warning and control (AEW&C) and air-to-air refuelling aircraft approved in the early 2000s were running into development problems, and unmanned aircraft hadn't yet been fielded by the ADF.



A RAAF F/A-18 Classic Hornet (front) and a United States Navy E/A-18G Growler prepare to take on fuel from a KC-30A Multi Role Tanker Transport off the coast of Guam during Exercise Cope North Guam 2015. Photo courtesy Department of Defence.

In contrast, recently a package of Super Hornets, which reached final operational capability (FOC) in 2012 following delivery from 2010 onwards, deployed into theatre in Iraq. They were supported in combat operations by KC-30A Multi-Role Tanker Transport aircraft (MRTTs; yet to reach FOC but expected this year) and E-7A Wedgetail AEW&C aircraft (FOC 2015). Strategic airlift was provided by C-17A Globemaster IIIs (FOC 2011) and the MRTTs. The EA-18G Growler electronic warfare platform is in the early stages of being delivered before being worked up to full capability. And, after a long development period, the Air Force's integrated air picture system, Vigilare, achieved FOC in 2013 and now provides an excellent situational awareness and command and control capability. The F-111 and the Caribou are long gone from inventory, and the Hercules fleet has a much lightened workload. The RAAF operated Heron UASs for four years in Afghanistan, gaining valuable experience in remotely piloted operations.

Looking ahead, there's still plenty of change to come. Australia's first two F-35 Lightning II Joint Strike Fighters have been delivered to the pool of training aircraft in the US, with another 70 to follow progressively between now and 2023. The 'classic' Hornets will be phased out over the same period. Also to arrive in the years to come are a replacement for the 1980s-vintage AP-3C Orion maritime patrol aircraft, in the form of a mix of manned P-8 Poseidons and unmanned MQ-4C Triton long endurance UASs, and a fleet of C-27J Spartan battlefield airlifters to replace the Caribou. As well, the government has approved the purchase of additional MRTTs and C-17s. If that weren't enough, a contract has recently been signed to modernise the RAAF's pilot training, which will include the acquisition of 49 new training aircraft and a contractor-operated flying school.

In fact, the biggest challenge that the Air Force faces is managing the changes that invariably come with a modernisation program of this size. Every new platform type or major system brings with it an overhead of making sure that the 'fundamental inputs to capability' (training, facilities, doctrine development and so on) are all in place. Moving to highly specialised types such as the Growler and Triton, and later the F-35, will also add to the overall workload.

That said, the Air Force is clearly doing a lot right. Its deployment into Iraq went remarkably smoothly, and it has since flown hundreds of combat missions. And, unlike previous coalition contributions, Australia's strike fighter package has provided its own combat support enabling aircraft, allowing Australia to assist coalition partners. The force multiplier effects of the MRTTs and Wedgetails have been appreciated by coalition members—tankers and air-to-air refuellers are usually oversubscribed in air campaigns. As well, the RAAF's air safety record has been spotless for 15 years, representing a significant improvement on its performance in the decade or two before that.

Table 1: Significant capability changes since ASPI's last update in 2010

Capability	Change	Comment
Control of the air and strike	↑	With the combination of Super Hornet, Wedgetail AEW&C and MRTT tankers, the RAAF now has a near state-of-the-art air combat capability that's unmatched in the region. The addition of Growlers to the mix will further increase this potent capability.
Air mobility	↑	The bedding in and expansion of the C-17A Globemaster III capability has provided Australia with a high-capacity rapid response airlift capability, as demonstrated in the response to the Japanese earthquake-tsunami-nuclear 'triple disaster'.
Intelligence, surveillance and reconnaissance (ISR)	↑	RAAF ISR capabilities have increased dramatically with the introduction of the Wedgetail, Heron and Vigilare and the ongoing development of the Jindalee Operational Radar Network. Further improvements will follow with the development of Distributed Ground Station Australia (DGS-AUS), the introduction of the P-8s and Tritons, and access to space-based capabilities. (See the C4ISR paper in this series for a further discussion.)
Command and control	↑	The E-7 Wedgetail provides a world-class battlespace management capability, and Australian E-7s have sometimes taken the lead in managing the recent air campaign in Iraq. The E-7 can also provide airspace control in areas outside Australia's air traffic control system in support of civilian or other government air movements. The Vigilare system gives the RAAF a single, fused air picture and allows it to allocate and control its own assets effectively. The overall networked capability to share data between platforms and command and control elements has increased significantly with the bedding in of the Link 16 tactical data link across multiple platforms.

Table 2: Capability shortfalls

Capability	Risk assessment	Comment
Air mobility Tactical (battlefield) airlift	Low	There's still nothing in service that adequately replaces the Caribou's ability to operate from short and rough landing strips. The remaining Hercules fleet can operate from some rough strips but isn't as versatile, and the Army's Chinook medium-lift helicopter capability is limited by its range, speed and numbers. This shortfall will be largely remedied with the FOC of 10 C-27J aircraft, now in the early stages of delivery.
Antisubmarine warfare (ASW)	Medium to High	Over the past decade, the RAAF's technical capability and expertise in ASW has declined, due to the diversion of the AP-3C fleet from its ASW role to border protection and surveillance tasks over land, the failure of the lightweight torpedo project to integrate a modern weapon onto airborne platforms, and the obsolescence of other ASW hardware. The introduction of the P-8 Poseidon will provide a technological refresh, but a concerted effort is needed to rebuild operator skills, including joint ASW operations with the Navy. Participation in exercises with the US Navy—which is also relearning ASW after a post-Cold War hiatus—is a helpful step for the ADF. But ADF ASW capability won't reach maturity until the next generation of warships joins the ASW effort. (See the Navy update in this series for further discussion.) Given the proliferation of submarines around the Indo-Pacific, this is a significant shortcoming.
Force generation and sustainment Fuel supply vulnerability	Medium	The RAAF's critical dependence on aviation fuel is a potential capability risk. Australia's refinery capacity has declined markedly in the past five years, leading to a national vulnerability to the disruption of fuel supplies, especially supplies of specialised fuels such as avtur ^a . Fuel stockpiling can help to mitigate the problem but isn't a panacea. This vulnerability is most likely to be felt in a contingency that requires the use of the bare-base airfields in the north for sustained periods.

a A previous version of this paper inadvertently referred to 'avgas'—all current ADF aircraft use avtur.

Because the Abbott government chose to continue to consider and approve projects in parallel to developing its Defence White Paper—thus wisely avoiding the 'famine and feast' model of previous white papers—there isn't a big backlog of air projects in the Defence Capability Plan. Overall, there's been bipartisan agreement about the direction of the Air Force, and both sides of politics have now approved the procurement of various tranches of C-17, F-35, Super Hornet and Growler aircraft, as well as endorsing choices such the P-8 Poseidon and Triton. Table 3 lists project approvals since 2010; Table 4 notes possible future acquisitions.

Table 3: Major Air Force platform and system approvals since 2010

Project	Number	Comment
F-35 Lightning II JSF	72	The purchase of 58 F-35 aircraft, to join 14 previously approved, was announced in April 2014 . The first two Australian aircraft have been delivered to the training pool in the US. Deliveries to Australia will begin in 2018, with the first squadron to be operational by 2021. All 72 aircraft will be fully operational by 2023. An additional squadron is to be considered before the withdrawal of the Super Hornets in 2030.
P-8 Poseidon (manned) maritime patrol aircraft	8 (+ 4)	Approved in February 2014 with a budget of approximately \$4 billion. Initially, eight aircraft are to be delivered from 2017 and operational in 2021. Options on another four are widely expected to be announced in the 2015 Defence White Paper.
High-altitude long-endurance unmanned aerial systems (UASs)	7?	Not 'approved' in the usual sense. Instead, the Abbott government ' committed ' to the acquisition of the Triton UAS, subject to the successful completion of the US Navy development program currently under way. The number is to be determined as part of the Defence White Paper process.
KC-30A Multi-role Tanker Transports	+2	Two additional aircraft were approved in July 2015 at a cost of \$408 million, to bring the total fleet to seven.
C-17A Globemaster III heavy airlifter	+1 +1 +2	One additional aircraft was approved in March 2011, following the initial acquisition of four. Delivered in September 2011 . A sixth aircraft was approved in March 2012 at a cost of \$280 million. Two additional aircraft were approved in April 2015 at a cost of around \$1 billion, to bring the total fleet to eight. There's an option for two more.
Tactical battlefield airlift	10	Approved in May 2012 at a cost of \$1.4 billion, the C-27J Spartan replaces the Caribou light fixed-wing tactical airlift capability. The first aircraft was delivered in July 2015.
EA-18G Growler	12	While 12 of the 24 Super Hornets acquired following the 2006 decision were F+ models capable of being upgraded to electronic attack EA-18G status, the Gillard government announced the purchase of 12 new-build aircraft in the May 2013 Defence White Paper.

Table 4: Future developments and possible acquisitions

Air mobility	The acquisition of perhaps two additional C-130J Hercules to provide extra airlift capacity was included in the Defence Capability Plan for years, but is probably no longer a high priority for conventional airlift since additional C-17s and MRTTs have been ordered.
Strike Armed unmanned aerial vehicles (UAVs)	There has been public discussion for over two years about adding armed UAVs to the ADF's inventory, and a future acquisition seems likely and may appear in the Defence White Paper. The ADF has recently acquired experience with these systems, embedding personnel into a US Air Force Reaper squadron at Creech Air Force Base in Nevada.
Force generation and sustainment training system	In September 2015 , a consortium of Lockheed Martin, Pilatus Aircraft and Hawker Pacific was announced as the successful bidder to supply the RAAF's new basic flying training system. Forty-nine Pilatus PC-21 aircraft and a suite of synthetic training devices will be delivered under the contract, which will also provide training services.

RAAF capability report

The Royal Australian Air Force (RAAF) operates around 100 fast jet fighter and strike aircraft and more than 100 aircraft of other types, including airlift, tanker and maritime patrol aircraft and trainers. Among the air forces of other Asia-Pacific states, those of Singapore and Thailand are of comparable size. The Japan Air Self-Defense Force is larger, and the air forces of India and China are larger still.

The RAAF is in the business of delivering air power as part of the ADF's joint expeditionary capabilities, and also as a strategic asset in its own right, through its long-range airlift, strike and air combat roles. In the maritime domain, its roles include broad area surveillance and anti-submarine and anti-surface warfare. And the effectiveness and survivability of land forces is greatly enhanced by close air support and battlefield interdiction capabilities. Airlift is also an enabler of ADF deployments by allowing rapid movements and resupply of ADF elements, albeit on a relatively small scale even after recent enhancements. Sealift remains the most viable method for delivering large quantities of materiel.

While the discussion below is somewhat platform- and system-centric (which is dictated by the way the Defence Capability Plan is structured), the RAAF's focus today is on the delivery of air power as an integrated whole, and it's going through a root-and-branch transformation under Plan Jericho to achieve that end. In this model, enabling assets such as air bases, air control radars, support groups, sensors such as the JORN over-the-horizon radar and command and control systems are essential parts of the overall capability, along with the Air Force education and training system. Like all the services, the RAAF's most significant enabler is its people.

The Air Force is part way through a period of transition. Most of its frontline fleet will be replaced between 2010 and 2025. (Table 5 shows the RAAF's current roles and aircraft types.) The Wedgetail and Super Hornet's entry into final operational capability has addressed any possibility of a decline in the RAAF's long-held regional qualitative lead in air combat capability for years to come. When Australia's air combat capability was based on the 1960s-vintage F-111 and the 1980s F/A-18 Hornet, other regional nations' acquisitions of advanced fourth-generation aircraft, in some instances accompanied by airborne early warning and control (AEW&C) aircraft and air-to-air refuellers, had the potential to narrow the gap considerably.

For the next decade, the Super Hornet's advanced sensor and electronic warfare systems, operating in conjunction with the Wedgetail and the Growler electronic attack aircraft, will enable the RAAF to meet the enduring requirements for air superiority and maritime strike in Australia's immediate environs. After 2025, as the sophistication of regional forces grows, Australia's capability edge will be maintained through the further transition to the stealthy and sophisticated F-35 Joint Strike Fighter. Strategic strike capability is more problematic due to the relatively short range of the Super Hornet, although the range extension made possible by stand-off weapons and the KC-30A Multi-Role Tanker Transport (MRTT) aircraft will go some way towards mitigating the shortfall. The F-35A has a longer range than the Super Hornet, but the fact is that Australia was spoiled by the long range of the F-111 and there's no aircraft in that class available on the market today.

The RAAF's air mobility capability is in very good shape, thanks to successive purchases of C-17A Globemaster III aircraft (now eight in total) and two tranches of MRTTs. Augmented by the C-130J Hercules, these aircraft provide true global reach to move personnel and equipment. The only current capability shortfall is tactical (battlefield) air mobility, as the retirement of the Caribou some years ago left a gap that won't be filled until the C-27J Spartan is in full operational service later this decade.

In the maritime patrol capability area, the replacement of the current 19 AP-3C Orions with a mixed fleet of (probably) 12 P-8 Poseidons and (possibly) seven MQ-4C Triton UASs would, on paper, be a one-for-one replacement. However, overall fleet capability will be significantly enhanced due to the speed and extended range of the P-8 and the long endurance and capable sensor suite of the Triton. This will allow for both sustained wide-area surveillance over a much larger area than previously possible and a quicker response to events or contacts at sea.

Table 5: Current RAAF aircraft types and roles

Type (Number)	Role
F/A-18F Super Hornet (24) F/A-18 Hornet strike/fighter (71)	Air-to-air combat, tactical air support to land forces, land and maritime strike
F-35A Lightning II (2) ^a	Air-to-air combat, tactical air support, land and maritime strike, advanced tracking and targeting, electronic warfare
EA-18G Growler (1) ^a	Air-to-air combat, electronic warfare (radar warning and jamming, radio frequency tracking), suppression and destruction of enemy air defences
BAE Hawk trainer (33)	Lead-in fighter training, limited air-to-air and land strike capability
Pilatus PC-9/A (64) ^b	Basic training aircraft (60) and ADF Joint Terminal Attack Controllers (4)
AP-3C Orion maritime patrol (19)	Maritime surveillance and reconnaissance, anti-surface and anti-submarine search and engagement, search and survivor supply.
E7-A Wedgetail (6)	Airborne battlespace management, advanced radar, tactical command platform for air, sea and land combatants
C-130 J Hercules (12) C-17A Globemaster III (7) ^b	Strategic airlift, troop lift, transport of materiel and medical evacuation, parachute operations
C-27J Spartan (2) ^b	Battlefield airlift as the 'spoke' part of a hub-and-spokes airlift. The Spartan can operate on shorter airstrips than the Hercules or Globemaster
KC-30A Multi-Role Tanker Transport (5) ^b	Air-to-air refuelling and materiel/troop transport
Boeing 737 (2) and CL-604 Challenger (3)	VIP transport
KA350 King Air (16)	Light utility transport (8) and training aircraft (8)
IAI Heron UAS (2)	Remotely piloted airborne surveillance and reconnaissance

a Two F-35As and one EA-18G have been delivered to the RAAF but are still located in the US for RAAF personnel training. 70 additional F-35As have been approved, and 11 additional EA-18Gs are under contract.

b Additional platforms under contract: Globemaster (1), Spartan (8), KC-30A (2).

The command, control, intelligence and surveillance data collection and networking capabilities provided by platforms such as the Wedgetail, Super Hornet, Growler, P-8 and Triton (most with advanced networking 'off the shelf', courtesy of their US Navy heritage) will make excellent contributions to the networked force. The F-35 will be a quantum leap due to the information it will collect and generate from its sensors and data fusion capabilities—to the point where managing the volume of available data will be a challenge. Similarly, supporting a dedicated electronic warfare capability will stretch the RAAF's ability to collect, process and disseminate electronic intelligence, and it will have to work closely with the Australian Signals Directorate as the national authority for such data. Plan Jericho was motivated in part by recognition that the ADF needs to develop these enabling C4ISR capabilities in order to exploit its advanced sensor and network capabilities. (ADF C4ISR capabilities are discussed further in a separate paper in this series.)

Since the 2010 edition of this report, a couple of significant capability shortfalls have been resolved—most notably the lack of air-to-air refuelling capability and the maturation of the Wedgetail AEW&C system. Provided that all of the current plans deliver the promised capability, the RAAF won't have any notable platform capability shortfalls in the longer term. However, there are a couple of capability shortfalls in the short to medium term (Table 6). The noted vulnerability to fuel supply interruption is actually a national problem to some extent, as refinery capacity has steadily fallen over the past decade and reliance on imported refined fuel has increased. In a contingency, the national fuel supply can probably be carefully managed for a while, but the vulnerability to interruptions of supply of specialised fuels is probably more acute.

Table 6: Capability shortfalls

Capability shortfall	Notes
Tactical airlift mobility	Following the retirement of the Caribou, short/rough field airlift can't be provided with current aircraft types. New aircraft are being delivered and will provide the desired capability.
Anti-submarine warfare (ASW)	This is an ADF-wide problem. It's the result of at least two decades of neglect across the board and the diversion of ASW assets such as the Orions for border protection and land operations support. The P-8 Poseidons will provide advanced ASW capability, but it will take time to build the required expertise. The situation is slowly improving, but several important naval systems will await the next generation of surface combatants sometime next decade.
Force generation and sustainment Fuel supply vulnerability	The RAAF's critical dependence on aviation fuel is a potential capability risk. Australia's refinery capacity has declined markedly in the past five years, leading to a national vulnerability to the disruption of fuel supplies, especially supplies of specialised fuels such as avtur ^a . Fuel stockpiling can help to mitigate the problem but isn't a panacea. This vulnerability is most likely to be felt in a contingency that requires the use of the bare-base airfields in the north for sustained periods.

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Tactical air operations

Despite much platform-based public commentary on air combat (often framed as one-on-one encounters), air combat capability isn't simply measured by the performance parameters of tactical fighter and strike aircraft—although those do matter. Modern air combat capability emerges from the interplay of sensors, electronic warfare, the weapons fit and networking capabilities of the tactical aircraft and the support provided by a networked command and control capability and other aircraft types, such as AEW&C and tanker aircraft. The Air Force has recognised these interactions—hence its instigation of Plan Jericho, which is designed to transition the force to an 'integrated air and space power capability'. And, as with all advanced military capability, the development and retention of adequate numbers of skilled personnel is critical to getting the best from the assets on hand.

For the purpose of this public discussion paper, tactical air operations are broken down as:

- air superiority
- maritime strike
- long-range strategic strike
- offensive air support
- close air support.¹

At the moment, the upper end of Australia's air combat capability is provided by the F/A-18F Super Hornet, of which 24 are in service. The F-35 Lightning II Joint Strike Fighter project is expected to deliver aircraft in numbers from 2018 onwards, with the first of three squadrons expected to be declared operational in late 2020—not quite a full decade later than initially planned. The 1980s-vintage F/A-18 Hornet is still a competitive platform, thanks to a significant upgrade program that's been completed recently, and has performed well in an admittedly relatively permissive environment in the recent deployment to Iraq and lately Syria.

The stated capability goal is to maintain four operational squadrons of strike fighters at all times (around 100 aircraft). Over the past five years, that's been managed by acquiring 24 Super Hornets to replace a similar number of F-111s. As they reach life-of-type in the early 2020s, the Hornets will be progressively replaced by F-35s, while the Super Hornets may be replaced in the late 2020s. While 12 of the 24 Super Hornets are capable of being upgraded to Growler status, that won't happen; 12 new-build aircraft are being acquired instead (the first was delivered to the RAAF in July this year).

On balance, the Super Hornet and ‘legacy’ Hornet, when combined with the Wedgetail and air-to-air refuelling, will fulfil successive Defence White Papers’ aims for Australia’s air combat capability to retain a capability edge over credible regional adversaries for the next decade (which means in practice any of them but Singapore, the only peer competitor). The number and capability of Australia’s air combat aircraft will overmatch the piecemeal, smaller and less well supported fleets of nearby nations. As well, in any defence of Australia scenario, the geographical advantages of operating from home or bare bases means that the RAAF should be able to establish local air superiority and run sea denial operations against even a major power adversary. Projecting power over long distances against a continent, such as Australia, remains a formidable task.

If there’s any cause for concern, it’s that a major strength of the Super Hornet (and the F-35 to come) is in its sensor and electronic warfare systems, because history shows that such advantages tend to be ephemeral. However, the US Navy plans to retain the Super Hornet in inventory well beyond 2030, meaning that there’s a capability growth path, and the Growlers will further enhance the fleet’s electronic warfare capability.

The F-35 will result in a further capability boost from 2021 onwards. The development program seems to have turned the corner, with cost growth and schedule slippage problems mostly behind it. None of the recent reviews of the program has identified any shortcomings in the warfighting capabilities to be delivered, despite a lot of poorly informed public criticism of the F-35s ‘dogfighting’ capability. Previous ASPI capability reviews observed that the F-35 performance metrics were largely based on modelled performance and were yet to be demonstrated in hardware. Today, the first mission-capable aircraft is flying—although it’s still well short of the full capability that will arrive only in later software loads. The non-delivery or under performance of that software remains the highest risk in the program.

Maritime strike capability is currently provided by stand-off and gravity weapons capable of being delivered in various combinations by Hornets, Super Hornets and Orions. They include laser-guided bombs and the AGM-84 Harpoon missile. The RAAF’s Super Hornets have demonstrated the capability to launch the AGM-154 JSOW-C against fixed land targets. The weapon has a range of up to 140 km. Presumably, the –C1 version with moving target capability against ships will follow into the RAAF after it becomes operational next year. The maritime strike capability of the F-35 will be provided by a similar range of weapons, and it will eventually have a dedicated anti-shipping missile in later blocks. Until the F-35 is fully capable in the role, a combination of Super Hornet and Growler will provide an adequate maritime strike capability against most conceivable regional threats.

In short, the RAAF’s air combat capability remains in a state of transition, but the ‘interim’ configuration of the Super Hornet plus the enabling capabilities provided by the Wedgetail and the MRTTs is performing well.

Joint operations

Australia’s continental size and the geographical extent of the ADF’s primary operating environment identified in previous Defence White Papers makes sustaining manned air cover over large areas practically impossible for a force the size of the RAAF.

In particular, providing sustained air cover for deployments of ADF land forces could be challenging unless they are near to available airfields. Limitations in the Army’s own ground-based air defence and command and control systems (discussed in the Army and C4ISR capability review papers in this series) mean that the ADF can’t field a persistent, effective and coordinated battlefield air defence system that can operate against the full range of land and air threats to deployed forces.

The Super Hornet, with its advanced sensors and data links and US Navy lineage, has improved interoperability between the RAAF and the Royal Australian Navy. The Super Hornets can collect intelligence, surveillance and reconnaissance data and exchange it in real time with surface units. (The Hornets have similar, though less extensive, capabilities.) The 2009 Defence White Paper flagged the possibility of the Wedgetail platform being fitted with the Cooperative Engagement Capability (CEC) that would allow it to exchange situational awareness and targeting data with the three Hobart-class air warfare destroyers (DDGs) currently under construction. That capability would allow the DDGs to exchange tracking and targeting data with the Wedgetail, allowing targets identified at long range by the aircraft (well beyond the DDGs’ radar horizon) to be engaged with the ships’ 375-km range SM-6

missile. Little has been said publicly about that idea in recent years, and with the substantial delay in the delivery of the DDGs it's likely that it will now be part of a future mid-life upgrade of the Wedgetail.

An important but little noted part of the nation's air combat capability is the networked communications and data fusion capability. The Link 16 tactical data link enables similarly equipped aircraft, ships and ground stations to exchange considerable volumes of very complex radar and electronic warfare data in real time. Link 16 is used to send radar and electronic intelligence data from Wedgetail and other platforms down to the Vigilare ground control station, where it's fused with data from warship- and ground-based radars and other sensors, and integrated into the so-called 'recognised air picture'. The picture can then promulgated back via Link 16, providing constantly updated situational awareness for the air combat fleet.

The Air Force has the ability to integrate ADF air, land and maritime force elements. An important element of that capability is 4 Squadron, which is responsible for both Joint Terminal Attack Controller (JTAC, formerly known as Forward Air Controller) *ab initio* training for the ADF, the training and provision of Air Force combat controllers in support of land forces and the delivery of JTAC with other ADF and multinational partners. Combat controller personnel from 4 Squadron deployed with ADF special forces in Afghanistan to coordinate air support to the land battle and direct air strikes. As well, the continuing development of the ADF's amphibious capability with the delivery of the two Canberra-class LHD amphibious ships includes the embarkation of airspace control personnel and the evolution of an ADF amphibious operation doctrine based on a US Marine Corps construct that integrates land, sea and air elements.

Coalition operations

The RAAF has a high level of capability to participate in coalition operations. As demonstrated in the Middle East over the past 12 months, the Super Hornet and classic Hornet can strike land targets in a coalition operation and are capable of close air support to land operations and battlefield interdiction. The Wedgetail and MRTTs deployed to theatre have provided a valuable service to coalition partners and represent a high 'value add' from Australia's contribution. In the future, the same enablers, with F-35s delivering the terminal effects, will be a similarly valuable contribution to coalition operations.

The major limitation of manned tactical aircraft in extended air strike campaigns are reach and persistence if forward airfields aren't available. Fast jets are also a relatively expensive way to provide strike capability against targets with low levels of air defence capability. Armed UAVs could provide a more persistent and cost-effective strike capability in permissive environments.

The RAAF has committed specialist personnel to the US Air Force's 609th Combined Air and Space Operations Center, in both embedded and liaison capacities. That has provided a sound understanding of the operational-level command and control of air and space power effects as practised by the US.

Airlift

The delivery of the C-17A Globemaster III strategic airlifter, augmented by the capability of the MRTT to move personnel and materiel over long distances, has markedly expanded the ADF's airlift capability. Most of the long-haul airlift is today provided by the C-17s; the C-130J Hercules fleet mostly flies short-haul intra-theatre missions and delivers tactical air mobility in contested environments. In a hub-and-spokes model, the RAAF can now move large loads over long distances via C-17, split them into smaller loads (one-third or less) for movement within theatre by C-130 and, once the C-27J capability is functional, will be able to further break down loads for 'battlefield' resupply over shorter distances.

However, even the much-improved ADF airlift capability isn't suitable for moving and resupplying large forces. The relatively small fleet sizes mean that deployments will be practically limited in size to battalion level or below once vehicles and initial supplies are taken into account. Larger deployments will still require multiple airlifts, possibly augmented by commercial charter aircraft and with sealift for the bulk of their supplies.

Maritime patrol

The RAAF's maritime patrol capability will be replaced over the next decade. The replacement of the current fleet of 19 AP-3C Orion aircraft will be a two-step process under project AIR 7000, which will deliver a fleet of MQ-4 Triton UAVs and P-8 Poseidons (based on the Boeing 737 airliner). That's the same mix selected by the US Navy for its broad area maritime surveillance capability and will allow Australia to participate in an alliance maritime surveillance architecture.

Plans for this mixed replacement have changed a couple of times, and it remains to be seen exactly what the final numbers of each type will be. The 2009 Defence White Paper listed seven Tritons and eight P-8s, but the government may soon be considering options for another four P-8s. That's based on the argument that, while the range and speed of the P-8 will give it greater effectiveness in the response role, concurrency is important for surveillance operations, and eight aircraft will simply not support as many simultaneous missions as 19 previously did. The wide area surveillance capability of the Triton, with its 24-hour-plus endurance and greater operating altitude (and hence greater field of view), will be an important component of the overall maritime patrol capability.

The arrival of the P-8 will also help address—but will not by itself alleviate—a capability shortcoming in anti-submarine warfare (ASW). In many ways, the P-8 represents a technological refresh compared to the P-3, not least in its acoustic sensor suite and its modern airborne lightweight ASW torpedo. After the failure of the project to integrate the European-sourced MU90 torpedo onto ADF fixed-wing aircraft and helicopters, the current AP-3C weapon is the essentially obsolete Mark 46, which performs poorly in shallow water and is unsuitable for use against the fast nuclear submarines now being fielded in increasing numbers. The P-8 will be able to deploy the Mark 54 torpedo, which is a more modern and better performing weapon in most circumstances. (A more complete discussion of ADF ASW capability will appear in the Navy paper in this series.)

Deployed operations

The RAAF has an expeditionary combat support wing that enables deployed operations. 95 Wing is responsible for a wide range of services required for the operation of aircraft from forward bases. Its roles include command and control, airbase security and defence, supply and flightline services. The level of support required will vary with the size and nature of deployments, but the Air Force prepares for operating from one main operating base and two forward deployments simultaneously in support of operations planned by the Joint Operations Command.

Greater levels of concurrency would require the expansion of the support wings. Possible operating locations include the bare bases in the north of Australia, although there would be logistic difficulties in sustaining operations from those locations for long periods. In particular, the resupply of fuel in times of conflict could prove problematic: Australia's low fuel holdings in the domestic system and much-reduced refinery capacity provides little resilience to interruptions to our fuel supply.

The RAAF also has a number of deployable tactical air defence and air traffic control radars. They allow it to support deployments of its own aircraft or those of coalition partners. For example, RAAF personnel operated the control and reporting centre at Kandahar Air Field in Afghanistan from August 2007 until August 2009. That deployment had organic connectivity for battlespace management and deployed its own tactical radar units. It had primacy for the whole Afghanistan theatre and was responsible for the deconfliction of some 12,000 aircraft movements a month, including UAVs and tanker aircraft. More recently, the RAAF has provided similar operational support in operations in the Iraq/Syria theatre.

Humanitarian assistance and disaster relief operations are perhaps the ADF's most common deployed operations. RAAF-provided airlift can rapidly transport critical aid, medical personnel and facilities or specialist disaster recovery equipment. The RAAF can also provide expeditionary air base support for civil and military aircraft, including deployed air traffic control. Recent deployments included assistance to the Philippines (Typhoon Haiyan, 2013), Japan (earthquake, tsunami and nuclear accident, 2011) and Haiti (earthquake, 2010).

Notes

- 1 In RAAF doctrine, there are two air combat roles: *control of the air* and *strike*. The subordinate missions are offensive counter air, defensive counter air, strategic attack, close air support, air interdiction, ASW, anti-surface warfare, electronic warfare and information operations. Although these are distinct and specialised tasks, a breakdown to this level of detail isn't the aim of this paper.

Acronyms and abbreviations

ADF	Australian Defence Force
AEW&C	airborne early warning and control
C4ISR	command, control, communications, computers, intelligence, surveillance and reconnaissance
FOC	final operating capability
MRTT	Multi-Role Tanker Transport
RAAF	Royal Australian Air Force
UAS	unmanned aerial system
UAV	unmanned aerial vehicle

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