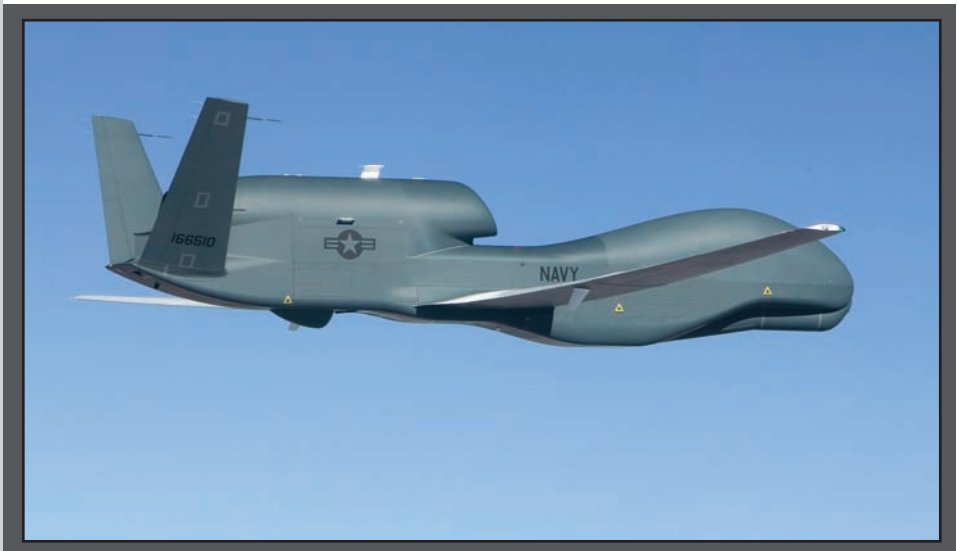
UAVs
Can one size fit all?

Australia will introduce a range of UAVs over the coming decade to cover ADF needs across a spectrum of formal requirements, and there is little doubt that UAVs will become valuable assets in Australia's force structure, as this rapidly evolving technology covers increasingly diverse capability niches. The deeper question underpinning future UAV acquisitions is what kind of UAVs, in terms of sizes and payloads, should the ADF acquire, and what kind of acquisition strategies should be pursued to best integrate UAVs into the force structure. The emerging trend in UAV development is modularity of payloads to facilitate rapid evolution into new operational roles and thus niches. The long term future is almost certainly one of users acquiring UAV airframes to fit specific aerodynamic performance needs in range/payload and survivability, and then equipping these airframes with role specific payloads.

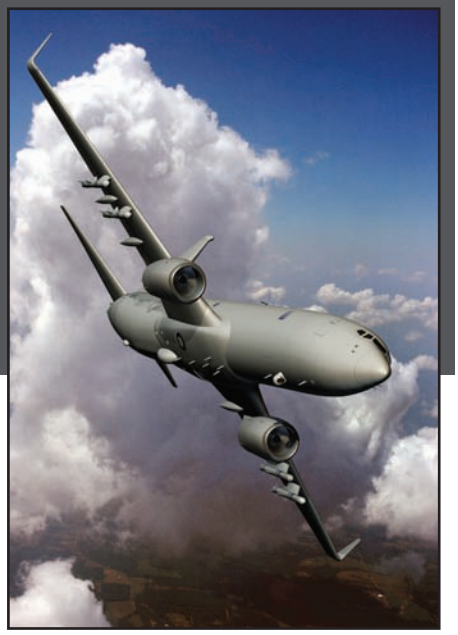
In terms of technological strategic planning for a UAV fleet, this amounts to decoupling of the UAV payload from the airframe. There will inevitably be some payloads which due to weight or power/cooling consumption are restricted to UAV airframes of some minimal size, but in general most typical payloads will be small and light enough to migrate across airframes. We are already seeing this in electro-optical payloads, where a range of diverse systems are available for some specific airframes.

The operational pressures emerging from UAV use in the Global War On Terror indicate that adaptability and the capacity for rapid evolution of payloads is increasingly valuable. As the opponent changes tactics and technique, differently optimised sensor packages and payloads are required to adapt and stay ahead of the threat. In recent years we have observed the MQ-1 Predator A series evolve from a specialised ISR asset to an armed reconnaissance asset, equipped to engage and kill targets of opportunity with precision guided weapons. Flexibility in a design is thus increasingly important, as its capacity to accommodate rapidly evolving roles and missions and resulting rapid evolution in payloads will determine whether it is successful operationally.

Another consideration in the UAV game is the cost and volume of supporting assets, especially satellite or other communications required to operate a UAV type. There is a belief in some circles that UAVs are much cheaper to operate than manned platforms. Where the two platforms are comparable in capabilities, usually the UAV is more expensive to operate since there is an additional and often hidden cost burden of high speed digital satellite communications to operate the UAV remotely.



RQ-4B Global Hawk is a much larger, faster, longer ranging and higher flying jet powered airframe, explicitly designed to replace the legacy manned U-2.



The US Navy BAMS (Broad Area Maritime Surveillance) program is intended to provide a UAV to supplement manned Long Range Maritime Patrol (LRMP) aircraft such as the P-3C or the new P-8A MMA pictured.

Emerging ADF UAV Needs vs Requirements

The operational deployment of any capability should be the result of a careful analysis of operational and strategic needs, resulting in a formal capability requirement, which then results in an acquisition cycle and eventual deployment.

Within Defence, difficulties often arise in the definition of capability requirements, especially in the definition of capability needs required to robustly define a requirement. Poorly identified needs result in poorly defined capabilities, which result in the manifold problematic acquisitions seen over recent years. This can be exacerbated by the funding allocation process, which make changes in requirements difficult to effect when the operational need evolves and the requirement must change to adapt.

In the domain of UAVs a range of emerging capability issues need to be addressed over the coming decade with capability requirements and acquisitions.

Strategic Reconnaissance and Surveillance

The increasing complexity of the political and strategic landscape in the Asia-Pacific thus puts increasing value on timely and independent intelligence gathering. This can range from monitoring civil and political upheavals in the 'arc of instability' states, to monitoring the deployment and use of high technology weapons acquired by wealthier regional players, to tracking military activities or operations in progress, and to providing targeting for strategic air strikes. The increasing footprint of military capabilities acquired across the region puts a premium on the capability to surveil and reconnoitre to distances of the order of 3,000 nautical miles, and to do so with enough persistence to cover one or more areas continuously. In this regime of operations, payloads will need to include SAR/GMTI/MMTI radar capabilities (refer NCW 101 Parts 7 and 8), electro-optical sensors (refer NCW 101 Part 5 and 6) and passive ELINT (electronic intelligence) and SIGINT (signals intelligence) sensors. While foreign military and commercial satellites can provide some useful capabilities in this domain, satellites are transient rather than persistent, and access is controlled by third parties. These constraints do not apply to a UAV flying primarily a high altitude mission, often referred to in the US as the 'U-2 Mission'.

Long Range Digital Communications/ Network Relay

An emerging application for UAVs, which DARPA has previously funded, is the use of a UAV as a communications 'pseudolite' or persistent airborne communications relay for air, land and sea assets in an area of operational interest. A UAV performing in this role will carry a specialised payload of VHF, UHF and datalink relay equipment as well as a high speed satellite communications link. Within a 200 nm or greater radius of the UAV it can provide local over the horizon connectivity for ADF assets using a range of different channels, and also provide a long range relay to headquarters over a satellite link. This is a model not unlike the 'smart tanker' scheme, but using a persistent UAV, which provides continuous relay capability in an area of interest. Because the relay is at an altitude of 40 to 60 kft, it can support much faster communications links compared to a geo-stationary satellite system and is deployable on demand unlike a satellite, which is committed to an orbital slot and a fixed antenna footprint. This is primarily a high altitude mission.

Armed Maritime Surveillance and Patrol

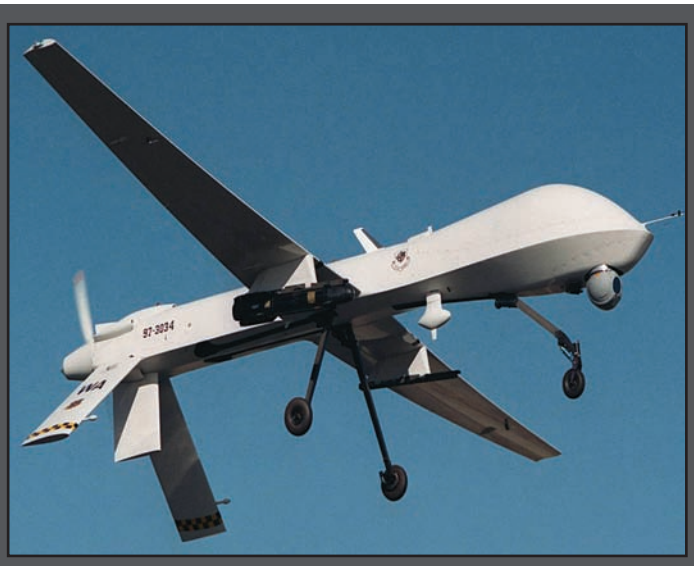
The US Navy BAMS (Broad Area Maritime Surveillance) program is intended to provide a UAV to supplement manned Long Range Maritime Patrol (LRMP) aircraft such as the P-3C or new P-8A MMA. In this role, UAVs will be used as radar, electro-optical and passive electronic surveillance/reconnaissance platforms, with potential for other sensors such as Magnetic Anomaly Detectors (MAD) or LIDAR diesel fume sniffers, with significant capability to persist on station should circumstances require it. By providing this capability, UAVs absorb the hours intensive portion of the LRMP role, shifting the manned LRMP aircraft to predominantly reactive missions, especially those requiring delivery of heavier firepower such as depth charges, torpedos or anti-shipping missiles. UAVs potentially armed with lighter weapons provide a limited capability to engage surface targets. This is a mission requiring operations over a wide band of altitudes.

Coastal Surveillance, Sovereignty Enforcement and Border Control

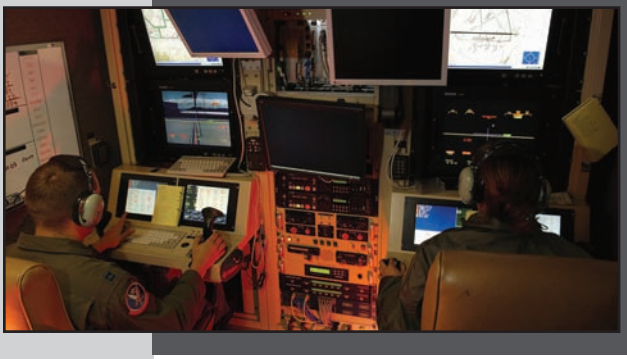
Another emerging role for UAVs, which sits on the boundary of military and law enforcement categories, involves their use for coastal surveillance, enforcement of national sovereignty, border control and related tasks such as fisheries enforcement. In these roles, payloads are primarily maritime surface search radars and electro-optical sensors, which are used to perform wide area and persistent surveillance, and to track infringing ships or light aircraft, and support their pursuit by other law enforcement or military assets such as patrol boats or police launches. This is a mission requiring operations over a wide band of altitudes with a premium on good medium to low altitude performance.

Armed In Theatre Surveillance and Reconnaissance for Land Campaigns

A role in which UAVs are now well established globally is supporting land campaigns with surveillance, reconnaissance and targeting capabilities, for exploitation by Army maneouvre units, air force battlefield interdiction and close air support assets, and special forces tasked with counter-terrorism operations. The US Northrop Grumman RQ-4A Global Hawk and smaller MQ-1 Predator series have both provided exceptional service in this niche, both over Afghanistan and Iraq, and Israeli UAVs have excelled in this area for well over a decade. Payloads vary across UAVs and users, but commonly include electro-optical suites, and SAR or SAR/GMTI radars, accepting that limited power and cooling in most UAVs restrict the useful footprint of the latter. The pioneering used of armed MQ-1 Predator for laser guided Hellfire missile attacks on terrorist targets has expanded this niche further. Other capabilities such as onboard digital databases accessible via infantry handheld terminals trialled on the Global Hawk present further expansion of potential capabilities. Across this spectrum of roles, UAVs of various sizes, speeds, persistence, payloads and altitude capabilities have occupied specific niches.



An MQ-1 Predator armed with an AGM-114 Hellfire missile. Predator's primary mission is interdiction and conducting armed reconnaissance against critical, perishable targets. (USAF)



A sensor operator of an RQ-1 Predator Unmanned Aerial Vehicle ground control station at Balad Air Base, Iraq. (USAF)

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Unmanned Combat Aerial Vehicles (UCAV)

UCAVs have remained a controversial subject for over a decade, with UCAV advocates making claims to the effect that UCAVs will replace manned fighters in the near future. The types of UCAVs in development today generally straddle the weight and size class of smaller manned fighters, and typically provide more persistence but lesser sensor capabilities than manned fighters. US thinking on UCAVs remains in a state of evolution as the J-UCAS program develops. In practical terms UCAV airframe have clear applications in the 'reusable cruise missile' type role, where fixed targets are attacked, and have potential in suppression or destruction of enemy air defence (SEAD/DEAD) roles where high risk exists to manned aircraft. The principal issue in UCAVs remains the dichotomy between onboard machine intelligence and offboard networking bandwidth to permit the UCAV to be effective in highly dynamic and complex combat situations where human cognitive capabilities remain vital. The current focus in Defence UAV acquisitions straddles two programs, the JP 129 effort to provide surveillance UAVs for land warfare operations, and the AIR 7000 effort to provide a maritime patrol capability to supplement the AP-3C fleet.

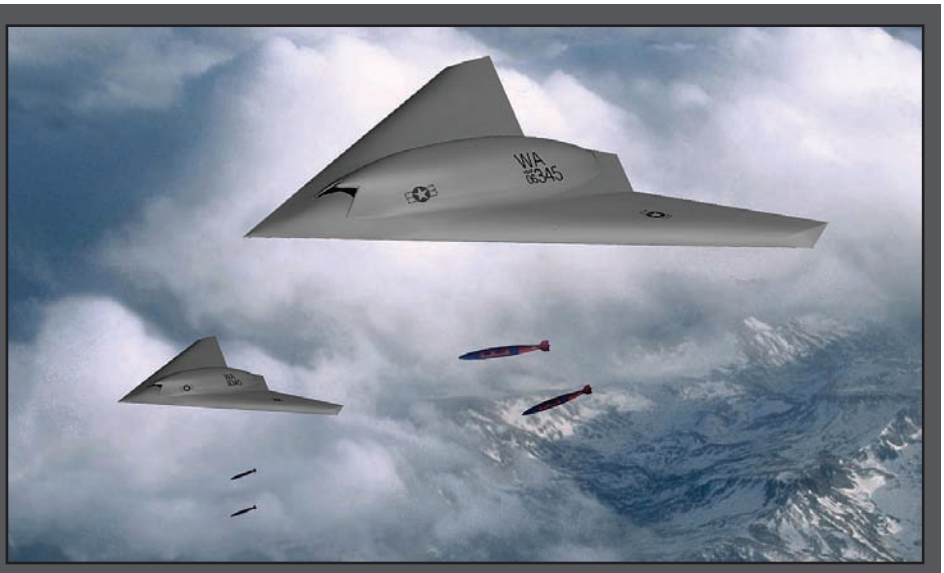
JP 129 is now committed to the IAI/MALAT I-View Tactical UAV System, a 240 kg weight class airframe equipped with a MOSP electro-optical sensor (Multi-purpose Optical Stabilized Payload), shared with the Hunter, Searcher, Heron, Ranger, FireScout, and Hermes 450 UAVs, or an EL/M-2055 SAR/MTI radar.

Latest indications are that the AIR 7000 program will be locked into the US Navy BAMS program and the ADF will then be equipped with whatever vehicle the US Navy acquires.

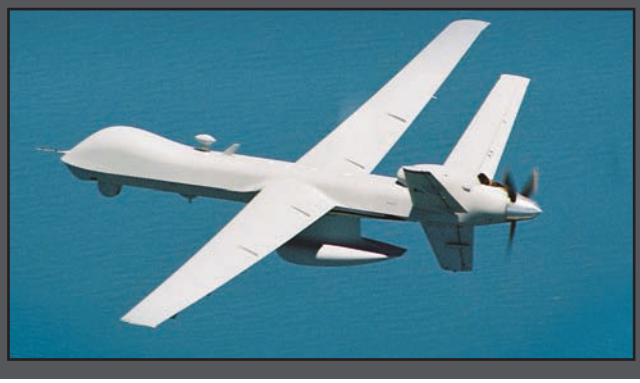
The two contenders in BAMS are variants of the Northrop Grumman RQ-4 Global Hawk and smaller General Atomics RQ/MQ-1/9 Predator B.

The aims of the BAMS program are to provide the US Navy with 'maritime surveillance, battle damage assessment, port surveillance, mine warfare, maritime interdiction, surface warfare, battlespace management' military capabilities, and quasi-military capabilities in 'support for homeland security and counter-drug interdiction'. Specific roles identified for the BAMS payloads and airframes include persistent maritime ISR, Overland ISR, Littoral ISR, AsuW and electronic intelligence gathering. BAMS results in a very broad mission spectrum, to the extent that it may be difficult to cover the full range of capabilities robustly with any single type of UAV. Particular dichotomies arise from the need in some roles to fly high altitude profiles using radar for wide area surveillance against other roles demanding much lower altitude profiles, and relying especially on electro-optical sensors. Source selection for BAMS is currently expected in late 2007.

The General Atomics offering for BAMS is the 'Mariner', which is a derivative of the Predator B airframe, with the extended wing designed for the ALTAIR remote sensing UAV, and a mission specific payload. The result is a turboprop vehicle intended to provide up to 49 hours endurance, or 24 hours at 2,000nmi, with a ceiling in the 50kft range. With a 900 SHP engine the Mariner will lift a payload of up to 1.75 tonnes, with a gross takeoff weight of around five tonnes.



Types of UCAVs in development today generally straddle the weight and size class of smaller manned fighters, and typically provide more persistence but lesser sensor capabilities than manned fighters. (Northrop Grumman)



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The competing RQ-4B Global Hawk is a much larger, faster, longer ranging and higher flying jet powered airframe, explicitly designed to replace the legacy manned U-2. The RQ-4A Global Hawk A model flown in Australia five years ago will be supplanted by a production RQ-4B with increased 11.6 tonne gross weight, a 1.35 tonne or greater internal payload, and a 36 hour endurance at altitudes up to 60kft. The enlarged ventral payload bay is sized to fit not only the large MP-RTIP active phased array SAR/GMTI/MMTI radar, but also relatively large legacy search radars with rotating antennas. In practical terms the Global Hawk will be roughly twice the gross weight of the Predator/Mariner variants, and built to fly higher and faster.

At the time of writing a North West Shelf demonstration trial is being flown using the Mariner Demonstrator based on the USAF MQ-9 Predator B/Reaper airframe which has been fitted with the Elta EL/M-2022A maritime search radar, common to the AP-3C, the L-3/Wescam MX-20 Electro-Optical system (FLIR, colour TV, laser), a Euronav AIS receiver for monitoring cooperative maritime traffic, APX-100 IFF, ARC-210 radio, a C-band line of sight datalink, and a Ku-band satcom link, with an Iridium satcom backup channel.

Configuration of the competing RQ-4B Global Hawk derivative has not been disclosed to date.

If current Defence planning is pursued and the BAMS winner acquired to provide the ADF capability, several interesting questions arise. The first is the extent to which the BAMS payload with a maritime patrol optimisation will be suited to performing the strategic surveillance and reconnaissance roles, moreso an issue if the smaller and slower Mariner is selected by the US Navy. If the larger Global Hawk airframe wins BAMS, then the issues of interest will remain in payloads, and also numbers of aircraft to cover both maritime patrol and strategic roles.

Defence has to date been fixated on the idea of 'one size fits all' solutions for capability requirements. This has been observed in the JSF versus F-22A/F-111 debate, and the recent drive to acquire the MRH-90. If Defence opts to pursue a 'winner takes all' acquisition strategy for AIR 7000, and opts for one of the two BAMS contenders, the prospects are a replay of the 'one size fits all' model. Yet looking at the diversity of emerging needs for UAVs, it is clear that this may be a poor fit across the full spectrum of capabilities that Australia needs.

In summary, Defence needs to define a well thought out long term roadmap for UAV acquisitions and clearly identify discrete and unique capability needs, with the expectation that UAV technology will continue to evolve rapidly, and ad hoc solutions may not yield good return on investment.