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Putting Space into RAAF Aerospace Power Doctrine

by Dominic Sims

FOREWORD

The Royal Australian Air Force acknowledges that doctrine '… must have sufficient stature to command respect and compliance but there must be both formal and informal avenues to challenge the status quo. Indeed, if anything is to be enshrined in our doctrine it must be this principle that our doctrine is open to challenge and review'.

In keeping with this cardinal principle, the current edition (fourth) of the AAP 1000, Fundamentals of Australian Aerospace Power, adopted the term 'aerospace' to acknowledge the growing importance of space to the application of air power. Accordingly all reference to 'air power' was changed to 'aerospace power'. The term aerospace was coined in the late 1950s by the US Air Force Chief of Staff General Thomas White to describe a new construct that depicted air and space as a seamless continuum. It further claimed both parts of the continuum as the Air Force's preserve. Since that time the USAF has clearly established itself as the natural lead agency for space in the US military and prefers the terms air power and space power. The opportunity exists for the RAAF to establish its credentials and take the lead in space for the ADF.

This paper challenges our published doctrine and in particular the use of the term 'aerospace' to indicate both the air and space environment. It proposes a more pragmatic and structured approach to the understanding of the uniqueness of space power. It explains the differences in the two environments and argues for a separate space doctrine to be articulated for the Royal Australian Air Force.

This debate has already had an effect in that Air Marshal Houston has changed the RAAF's Aerospace Centre to the RAAF Air Power Development Centre (APDC). Underlying the discourse is not only the synergy between air and space power but also the importance of space to maritime and land power. One of the first steps in establishing RAAF's space credentials was creating a space cell within the APDC. Amongst the prime tasks of this cell is to propose a space doctrine for the RAAF and influence broader Defence developments. I believe that this paper is an important contribution to a discussion Defence must have on how space capabilities should be managed for the ADF.

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He graduated from ADFA in 1989 and completed an Aeronautical Engineering degree at the Royal Melbourne Institute of Technology in 1990. He spent 1991 completing various Air Force engineering and armament courses and was posted to the Aircraft Research and Development Unit in January 1992 as an armaments test engineer. During his tenure at ARDU he was involved in a number of weapons test programs for F/A-18, F-111 and P-3 aircraft. In 1994 he was posted to the Aircraft Stores Compatibility Engineering area within ARDU where he was responsible for stores certification activity on F/A-18 aircraft.

In late 1996 he was posted to the USAFEX1 exchange position in the USAF SEEK EAGLE Office at Eglin Air Force Base in Florida. During the period December 1996 through December 1999 he managed A-10 and F-15E stores certification activities within the SEEK EAGLE office. He returned to Australia in 2000 on promotion to SQNLDR and was posted as the project engineering manager for the AGM-142E acquisition project. Squadron Leader Sims attended Australian Command and Staff Course (ACSC) in 2002.

Change is the law of life. And those who look only to the past or present are certain to miss the future.

John F. Kennedy

The art of employing troops is that when the enemy occupies high ground, do not confront him.

Sun-Tzu

INTRODUCTION

The conflict in Iraq during the first half of 2003 served to highlight the conventional warfighting supremacy currently enjoyed by the military forces of the United States of America. This supremacy is based on a number of contributing factors. Notable amongst these factors is the considerable and growing use of the enabling services and products of space systems.

While the armed forces of the USA are undoubtedly the premier users of space systems in support of military operations, all modern militaries to some extent have come to rely on the enabling services and products of such systems. This reliance will continue to grow in the foreseeable future. Dependence on satellite-based navigation systems and the use of high-bandwidth dependent warfighting concepts, along with the use of numerous other space-sourced services will drive this increasing reliance. With this increase in reliance, so too will vulnerabilities increase via potential adversarial attacks on these enabling space systems.

The Australian Defence Organisation (ADO) now acknowledges the growing importance of space systems, recognising their potential impact on military operations. At the highest policy level, the Defence White Paper of 2000 made reference to the need to account for the growing availability of space-sourced services as both enablers to our own forces and to the forces of any potential adversaries.[1] Establishment of organisations such as the Directorate of Defence Space, the Space Power Future Concepts office within Air Force Headquarters, and several space-specific acquisition projects reflect a growing commitment to understanding and integrating the capabilities of space systems into the ADO.

Unfortunately, despite high-level guidance, little effort has been applied by any of the services of the Australian Defence Force (ADF) to assess their current reliance on space systems, or to investigate potential benefits for

increased integration of space system capabilities in supporting operations. This is understandable, however, as the space skills and knowledge of the services are confined to relatively small, specialised organisations within the ADO, limiting their ability to support effective integration of space in to operational practices. This has resulted in the wider population of the ADO remaining relatively unaware of the growing importance of space systems to everyday operations.

In 2002 the RAAF published the fourth edition of its single-Service doctrine, Australian Air Publication (AAP) 1000. This particular edition saw an overt change in the title from *The Air Power Manual*[2] of the previous edition to *Fundamentals of Australian Aerospace Power.*[3] This change appeared to signal that the RAAF now regarded space and any associated activities to be fundamentally linked to air force operations.

Despite the change in scope implied by the change in title, the content of AAP 1000 failed to provide anything bar the most cursory overview of the field of military space operations and the associated generation of 'space power'. What in fact occurred was the arbitrary application of existing air power doctrine to the entire 'aerospace' environment, or 'third dimension',[4] without any real attempt to account for the fundamental differences between the distinct environments of air and space.

This shortcoming is perhaps understandable given the limited availability within the RAAF of experience on space operations able to support the development of robust space power doctrine.

It would appear then that, although the RAAF openly acknowledges the importance of space power, the lack of relevant knowledge, experience and skills continues to inhibit the RAAF's ability to become a competent practitioner of space power. This lack of expertise can only be overcome by a sustained commitment to ongoing education and training in the basic doctrine of space operations.

Scope

This paper will review the current defence guidance that is driving the need for air force doctrinal development to include space power doctrine. Building on this, a brief analysis of current space power doctrine from a number of different sources will follow. This analysis will emphasise current trends in the development of space power doctrine. Based on these trends, a space power doctrine structure will then be proposed as a guideline for incorporation of space power doctrine into future RAAF single-Service doctrine.

Aim

The aim of this paper is to propose an appropriate structure for a space power doctrine that can be incorporated into future RAAF single-Service doctrine.

THE NEED FOR RAAF SPACE POWER DOCTRINE

The utilisation of space systems to provide services to modern militaries has increased at a rapid rate over the past decade. This increasing utilisation is likely to continue in future. The operational concepts and proposed force structures suggested by the ADO *Force 2020*[5] and *Future Warfighting Concepts*[6] documents will ensure that this holds true for the RAAF.

In particular, the RAAF's focus on the use of high technology to leverage warfighting advantage will ensure that enabling space systems will form part of the RAAF support network. Similarly, the stated defence policy of pursuing interoperability with US forces to better support coalition operations[7] will mandate the introduction of technology and practices that will utilise civil, commercial and US military space systems.

The senior leadership of the ADO has observed the ongoing development of space capabilities and recognised the growing importance of space operations. This is apparent via a number of high-level guidance documents, such as the Defence White Paper, that indicate the need for space operations to be included as a factor in guiding future development of the ADO. In the case of the RAAF, this is now openly stated in the latest edition of the Air Force Plan, which states that the RAAF is to be '…capable of achieving the Government's objectives through the swift and decisive application of air and space power…'[8]

If the RAAF is to translate this vision into reality, doctrine describing how the RAAF is to apply this 'space power' as well as air power must be developed. It is through the evolution and expansion of the RAAF's existing single-Service doctrine that this must occur.

Given the dearth of actual experience in space operations within the RAAF, initial development of RAAF space power doctrine will, perforce, be dependent largely on the study of the experiences, capabilities and doctrines of the armed forces of other nations. An obvious starting point is with the doctrine of the current leading space force in the world.

USAF SPACE DOCTRINE

The US Air Force Doctrine Center[9] develops, coordinates and publishes all USAF basic and operational-level doctrine. Air Force Doctrine Document 1 (AFDD 1), *Air Force Basic Doctrine*,[10] describes the role and fundamental principles of the service. It is published as a guide describing how to employ the air and space forces of the USAF. As part of these fundamental principles, AFDD 1 clearly states that the USAF operates in two different 'domains':[11] air and space.

The document is quite clear in emphasising that environmental differences between air and space mandate different operational methodologies. Accordingly it avoids detailing operational-level doctrine, and describes only general strategic level doctrinal principles that are applicable to both air and space power. Air and space power is described in terms of the principles of war. Additionally, the AFDD 1 describes a number of tenets of air and space power that the USAF believes are adjuncts to the principles of war, applicable to air force operations in both the air and space domains. These descriptions are broadly equivalent to the principles described in Australian Defence Doctrine Publication (ADDP-D) *Foundations of Australian Military Doctrine*.[12]

It is in the descriptions of USAF operational functions that we see significant differences between AFDD 1 and AAP 1000. While the 17 air force operational functions presented by AFDD 1 can be related to the aerospace power roles in AAP 1000, a notable difference is that AFDD 1 links these 17 operational functions to both air and space capabilities where appropriate. Thus the higher-level functions are linked to capabilities in both domains, with doctrine for domain-specific capabilities described in a range of subordinate doctrine documents.

This ties in with the USAF basic doctrinal belief that air and space power doctrine, while immutably linked at the strategic level, needs to be clearly differentiated at the operational and tactical level due to the clear environmental divide between the two domains. It is upon this strategic level guidance that the USAF has developed and continues to refine operational space doctrine.

The USAF documents operational level doctrine for space in AFDD 2-2, *Space Operations*.[13] Guidance is provided on fundamental principles of space operations. It also builds on the doctrine presented in AFDD 1, specifically describing how the principles of war, tenets of air and space power and air force functions are tailored to apply to the space domain. AFDD 2-2 provides the fundamental guidance for the USAF on space command and control organisations, and outlines operations planning and execution processes.

AFDD 2-2 also devotes an entire chapter to highlighting the fundamental need for the ongoing development of space professionals. Development of space professionals is described as being dependent on several factors:

a. A structured and on-going system of military and graduate education, supporting the development of a broad knowledge of space operations.

b. Training programs as required to meet specific military requirements.

c. Space career development allowing development of personnel from technical specialist positions to senior leadership positions with operational and strategic understandings of the application of space power.

Overall, AFDD 2-2 is an excellent companion document to AFDD 1 in tailoring USAF basic doctrine for space. It is, however, a little too heavily focused on existing USAF command and control (C2) structures and planning processes to provide sufficient useful material at the level currently required for AAP 1000.

US JOINT DOCTRINE FOR SPACE OPERATIONS

Joint Publication (JP) 3-14, *Joint Doctrine for Space Operations*,[14] appears to provide a better summation of basic space power doctrine. Published under the auspices of the Chairman of the Joint Chiefs of Staff, this doctrine is authored by United States Space Command. In addition to command structure and operational process descriptions, it provides a broad coverage of the characteristics of operations in the space domain. Included in this coverage are aspects such as space and the principles of war, space law, orbital characteristics and general descriptions of typical space operations.

That such a difference between two US DoD doctrines on the same topic, both apparently targeted at describing the operational level of conflict, should exist is surprising. It would appear that the two doctrines have been developed with different basic assumptions about the experience of the reader. AFDD 2-2 seems to assume a basic familiarity by the reader of space operations, with its primary focus on C2 and planning processes supporting USAF space operations.

Conversely, JP 3-14 seems to assume limited familiarity on the part of the reader with operations in the space environment. In addition to providing C2 structures, roles, responsibilities and other material traditionally expected of operational level doctrine, it provides sufficient material to act as a primer to space operations.

JP 3-14 also introduces four 'mission' areas that are used to describe space operations and the generation of space power:

a. Space Control, which is intended to assure freedom of action in space for friendly forces while denying such freedom to adversary forces.
b. Force Enhancement, representing the use of space systems to provide enabling services to friendly forces in all domains of operations.
c. Space Support, involving the operations that allow launching, deployment and sustainment of space systems.
d. Force Application, which is the use of systems either based or transiting through space to apply physical force to terrestrial targets.[15]

The four mission areas are described in detail, with examples of extant and forecast capabilities provided to support these descriptions. Interestingly, it is these joint mission areas, with some amount of tailoring, that the USAF Space Command Strategic Master Plan[16] chooses to use as the basis for its vision of capability development, rather than the air force functions described in AFDD 1 and 2-2.

It must be remembered, however, that all of the above documents are based around ownership and direct control of considerable space capabilities. In refining RAAF Doctrine, it would seem wise to examine how air forces of similar size and capability to the RAAF have approached space power doctrine development.

CANADIAN FORCES DOCTRINE

The Canadian Forces (CF) doctrine structure is based around a hierarchy of strategic, joint and environmental doctrine. CF strategic doctrine focuses on national defence policy issues and as such does not attempt to address space in any great detail. Joint and environmental CF doctrines, however, do address the issue of space power. Based on the doctrine documents available for review, the CF appears to have taken two different approaches to the inclusion of space in these doctrinal writings.

Canadian Forces Aerospace Doctrine

Rather than outline the doctrine of a particular service, CF environmental doctrine is used to describe the utilisation of military forces in three distinct environments—the sea, the land and the aerospace.

Out of the Sun[17] is the CF basic doctrine describing operations in the 'aerospace'. Its scope broadly matches that of AAP 1000. One notable difference is that *Out of the Sun* actually provides succinct definitions of two of its key terms. The aerospace is defined as 'the total expanse of air and space above the earth's surface'.[18] Aerospace power is accordingly defined as 'the capability to use platforms for military purposes operating in, or passing through, the aerospace'.[19]

This is a considerably different approach from the USAF. The CF have decided that the aerospace is one domain, and that doctrine can be produced at basic, operational and tactical levels to apply to it. This approach seems, however, to be fundamentally flawed, as the remainder of the document is remarkably similar to AAP 1000 in its description of 'aerospace power' via principles, roles and characteristics based around operations carried out solely within the atmosphere. This has resulted in an aerospace power doctrine that really deals only with air power, and fails to adequately address the differences between air and space power.

Canadian Forces Joint Doctrine

Compared to this, Canadian Joint Doctrine, as described in *Canadian Forces Operations*, describes space as a 'unique medium',[20] presenting a direct contradiction to the 'aerospace' construct of *Out of the Sun*. This description of space as a unique medium is part of a dedicated space operations chapter presented by *Canadian Forces Operations*.

The space operations chapter provides a succinct overview of space operations doctrine that appears to be based on the US JP 3-14 structure. While based on the JP 3-14 doctrine structure, this chapter also acknowledges constraining factors that the CF face in the execution of space operations. In particular it emphasises that while direct CF control of military space assets is limited, the use of allied, civil and commercial space systems forms an essential component of contemporary CF military operations planning.

With this factor in mind, the closing section of the space operations doctrine states that the CF understands that the effective use of space systems and the generation of space power is dependent on the availability of trained space operations personnel. To this end, the doctrine emphasises the critical need for the provision of space operations training 'throughout the spectrum of military training and professional education',[21] in turn combined with effective career management of space operations personnel.

BRITISH AIR POWER DOCTRINE

British Air Power Doctrine[22] (AP 3000) takes yet another approach to the problem of defining air and space power. The doctrine avoids frequent usage of the term 'aerospace power', preferring to refer solely to 'air power'. Air power, however, is defined as 'the ability to project military force in air or space…'[23]

This definition appears to match the RAAF and CF practice of melding the air and space environments into one contiguous whole. This is reinforced in the subsequent discussion of air power defining characteristics, where the 'air and space environments' are emphasised as being different not from each other, but from the land and sea environments.

Despite the clear, if somewhat counter-intuitive, inclusion of military space operations in this air power definition, AP 3000 limits the majority of its doctrinal discussion to operations within the atmosphere. When the document does actually discuss space power, it presents a tautology by way of reference to 'air and space power'.[24]

Space operations are discussed briefly, albeit in more detail than in AAP 1000, in the Information Exploitation chapter of the Core Capabilities section.[25] Space operations are initially tied to the gathering and dissemination of information. The discussion then presents four space roles of Space Support, Force Enhancement, Space Control and Force Application, mirroring the space mission as defined by the US JP 3-14.

Given that the US regards these four space mission areas as the core activities of space operations, it seems inappropriate that the RAF chooses to include them as subordinate aspects of the Information Exploitation capability. If these space missions are core functions, or core capabilities in AP 3000 parlance, they would seem to warrant a higher profile in the doctrine.

Overall, it seems British attempts to incorporate space power doctrine into AP 3000 have been largely ineffective. The body of the doctrine fails to satisfactorily account for the initial doctrinal definition of air power as including space operations. This failing, when combined with the inclusion of US style space operations mission areas at an inappropriate level, suggests that space power doctrine has not been rigorously reviewed prior to inclusion in AP 3000.

British joint doctrine similarly includes consideration of space in a rather perfunctory way, referring to space as component of the air dimension of the battle space,[26] with little further reference to space throughout the entire document.

SPACE DOCTRINE LESSONS

The differences in doctrinal approaches taken by the US military, the Canadian Forces and the British military, combined with a number of apparent inconsistencies within and between aspects of these doctrines, highlight the difficulties encountered when including space in traditional air power doctrine. How then can the best of these different approaches be distilled and utilised while avoiding those aspects of the various doctrines that may engender confusion?

Towards a Definition of Aerospace Power

It seems clear that a fundamental requirement of doctrine is the use of a clear, useable definition of the environment that a doctrine is intended to apply to. By the use of the title *Fundamentals of Australian Aerospace Power*, AAP 1000 has clearly stated that the environment that it applies to is the 'aerospace'. 'Aerospace', as defined by *The Macquarie Concise Dictionary* is 'the earth's envelope of air and the space beyond'.[27]

Thus, by the use of the term 'aerospace' in the AAP 1000, the RAAF has clearly indicated that it accepts space as a new and important arena of operations. Unfortunately the RAAF has, by this use, also seemed to claim doctrinal responsibility for operations in a complex environment that it has, to date, only made limited progress in understanding. This has resulted in the current inadequacies of RAAF doctrine in describing the fundamentals of space power. It is not that the content of AAP 1000 is in error—it simply fails to provide doctrine that adequately addresses operations in its nominated environment.

This situation is similar to that apparent in both *Out of the Sun* and AP 3000. The 'aerospace' definition provided by the CF, along with the RAF inclusion of air and space in 'air power', has expanded the claimed environmental coverage of their doctrine without adequately expanding the doctrinal content to account for this. Essentially all three services are guilty of the same definitional error. All have attempted to grammatically meld air and space into one homogenous environment—'the unbounded aerospace medium'[28]—without adequately addressing their supporting doctrine.

What has occurred is that existing doctrinal principles applicable to military operations within the air environment have been applied to the 'aerospace', with little modification to account for the differences engendered by operations in space from those encountered during operations within air. With this approach the current iteration of the CF, RAF and RAAF doctrine documents have produced doctrine that appears to be the product of an incomplete transition from air power to aerospace power. The three doctrines alternate between reference to 'air' and 'aerospace', or 'air and space', with all the confusion that this engenders. All the doctrines are clearly the doctrines of experienced air power organisations that are in the first stages of trying to define new doctrine to account for the expansion of their realms of responsibility into space.

'Air and Space' versus 'Aerospace'

The development of doctrine to support operations in a distinct environment is certainly nothing new. Traditionally, the single Services have existed in order to develop environment-delineated expertise and capabilities. Specifically the Navy is the maritime environment expert, the Army is the land environment expert and the Air Force is the air environment expert. Current Australian Navy and Army single-Service doctrine publications, titled *Australian Maritime Doctrine*[29] and *The Fundamentals of Land Warfare*[30] respectively, reflect this single environment focus. Previous editions of AAP 1000 likewise focused on just the air environment, with this focus implicit in the title of *The Air Power Manual*.

It is this single environment focus that the RAAF has attempted to maintain in the latest edition of AAP 1000 via the use of the aerospace construct. This attempt, however, is of questionable veracity.

When compared to operations in the air environment, space operations exhibit characteristic differences at least as significant as those differences that exist between air and land and maritime operations. Orbital mechanics, rather than aerodynamics, govern spacecraft motion. This results in spacecraft having speed, manoeuvrability, range, and endurance characteristics that are vastly different from those of aircraft. When combined with the physical and resource constraints associated with launching, supporting and operating spacecraft, these differences ensure that traditional air power doctrine, such as described in AAP 1000, inadequately describes space power.

It would seem reasonable then that space, being a markedly different environment from the three terrestrial environments should warrant a distinct doctrine that accounts for these differences and the associated impacts on military operations. It is via such doctrine that commanders may gain an understanding of and thus account for these differences during the planning and execution of joint military operations.

This approach is now used by the USAF in its development of doctrine. The USAF has, until recently, also had a considerable number of proponents of the concept of the 'aerospace as a single continuum in the vertical dimension'.[31] In the past few years, however, the USAF has moved away from this concept of aerospace, as have the US DoD and Canadian Department of National Defence judging by their joint doctrines on space power.

As discussed previously, USAF doctrine now clearly states that there are two separate environments to be considered by their doctrine: air and space. Basic doctrine applies principles of war to both environments. Dedicated Space Operations doctrine then expands on this and provides a doctrinal framework for military operations in the space environment.

Space Professionals

Another important lesson apparent from the preceding review of space power doctrine is the doctrinal emphasis of the fundamental importance of the development of space power professionals to enable the ongoing development of space power. The difference in the levels of fidelity in the space power doctrines examined above highlights the need for professional mastery to support success in the field of space power. The scant levels of space power doctrines presented in *Fundamentals of Australian Aerospace Power*, *British Air Power Doctrine* and *Out of the Sun*, combined with the apparent inconsistencies within each, argue strongly that the effective level of space power professional mastery in each of the author service is, at best, low.

This compares starkly with the level of professional mastery apparent within the US DoD. The relatively mature state of US space power doctrinal writings certainly suggests a significant level of professional mastery. In fact, USAF Space Command acknowledges that the development of a skilled work force is essential to supporting space power professional mastery and actively pursues an ever-increasing level of professional development of its personnel.

> 'Our first priority is developing our people to lead us into the future, and educating them through Space Professional Development.'[32]

This understanding of the importance of trained and educated space power practitioners is not just limited to the USAF. The US Army, which does not have any significant level of ownership of space-based assets, has recognised that army operations at all levels are now dependent on space capabilities. This has in turn highlighted the need for trained space operations professionals at all levels of the army. Accordingly, the US Army has established Functional Area 40, a dedicated space operations career stream that now supports training and ongoing development of career space operations professionals to support US Army needs.

This is not to suggest that the RAAF is unaware of the importance of professionalism and professional mastery. Professional mastery is in fact acknowledged in AAP 1000 as a key enabler of success in air operations. As emphasised in the current edition of AAP 1000, doctrine is only effective if applied correctly by expert practitioners.[33] AAP 1000 emphasises that effective doctrine for any organisation must be based on a combination of experience, theory and an understanding of the technology and context that the organisation will operate with and in.

What seems to be absent in the RAAF is any organisational interest or that it needs to, or is in fact able to, support the development of such levels of professional mastery of space power in particular. Anecdotal evidence suggests the reason for this organisational position seems to be a belief that the lack of ownership of space-based assets removes the need for any significant level of space power professional development. This position is surprising, given the importance of space services supporting force enhancement of the RAAF.

To date the RAAF has appeared unwilling to devote the resources required to develop the very 'aerospace' mastery it claims it aspires to. Space training availability is minimal within the RAAF, with little time devoted to basic space awareness training in most education and training courses. Even the development of a small number of expert practitioners is essentially impossible as dedicated space-related postings are regarded as out of category/mustering employment and rarely support promotion. Under current career progression guidelines, the several dedicated space postings required to develop a space operations expert will almost certainly end that individual's ability to progress a career in the RAAF.

Specialist space power knowledge aside, the increasing reliance on Network Centric Warfare (NCW) practices within the RAAF will mandate improved levels of knowledge for all RAAF personnel. Senior commanders operating at the strategic level through to junior members operating equipment at the tactical level must all have the appropriate levels of knowledge to allow them to decide and act effectively. Given the RAAF's increasing reliance on space power, this knowledge must include an appropriate level of understanding of space power capabilities.

RAAF WAY AHEAD

Given the imprimatur implicit in the air force vision statement supporting the development of RAAF space power capabilities and appropriate supporting doctrine, how then does the RAAF incorporate space power doctrine into the current single service strategic doctrine?

The Separation of Air and Space

Assuming that AAP 1000 is to remain as high-level doctrine describing the roles and responsibilities of the RAAF, it must clearly acknowledge that the RAAF now regards space operations as an essential enabler supporting the generation of air power. While not claiming lead-Service status or any right to space as an exclusive air force operational domain, AAP 1000 must state that development of space power and an understanding of the associated capabilities is now a fundamental component of RAAF responsibilities.

Accordingly, the RAAF should doctrinally express that air and space are regarded as two separate environments. This will necessitate acceptance of the fundamental differences in operations between the two domains. With this doctrinal statement will come the requirement to acknowledge the differences between 'air power' and 'space power'.

Training for Air and Space

Accepting that air power skills and knowledge will remain the greater skill base of the RAAF in the foreseeable future, the RAAF must increase its space power knowledge base, with the intent of developing an improved level of professional mastery in space operations. Just as development of an individual's professional mastery of air operations requires ongoing education, training and employment, so too does development of space operations professional mastery.

Development of space operations components for RAAF professional development courses would seem an obvious near-term action that could be used to address this need. This level of training would enable raising the general level of knowledge of space operations in the RAAF workforce. While inclusion of such training will have resource implications, the requirements for this and similar inclusions will almost certainly continue to grow as the move to NCW methodologies demands greater levels of broadening education and learning for RAAF personnel.

Development of a small number of space specialists would also need to occur in parallel with this improved level of general space education. Military space operation specialist training and education will, however, be difficult to acquire. Such specialist skills and training will only be acquired through a commitment to an ongoing program of overseas exchange positions and attendance at appropriate courses. Such a program would in turn need to be related to a structure of appropriate employment positions for foreign exchange officers and RAAF personnel returning from overseas exchanges and training. This would ensure that the skills and experience acquired will be retained and employed, rather than allowed to atrophy as currently occurs with the small number of RAAF personnel with specialist space-related skills.

As an example, a USAF space operations specialist could be employed in the Headquarters Air Command (HQAC) Air Operations Centre (AOC). This exchange officer would provide a direct injection of skills in relation to the use of space operations in support of air operations, and would in turn gain an insight into RAAF air operations practices.

A reciprocal position could be established within a similar USAF organisation, such as the 14th Air Force's Space AOC, which provides space operations support to air operations. This would allow the development of space operations skills and knowledge in the RAAF exchange officer, whose Return to Australia posting into the HQAC AOC would ensure the retention and application of such skills. Needless to say the contacts and knowledge developed by both officers will support improved interoperability in between the two organisations in any future coalition operations.

Accordingly, a decision to pursue development of a meaningful and useful level of space power professionalism within the RAAF will necessitate that senior leaders support a commitment to developing space operations career opportunities within the RAAF. This decision must be reflected in RAAF personnel policy as well as being expressed doctrinally.

RAAF Space Power Doctrine

A proven way to approach the doctrinal description of space power and associated space operations aspects would be to mimic the US approach, albeit on a reduced scale. While USAF basic doctrine acknowledges space power, no detailed attempt is made to examine space operations required to generate space power. Such examination and description is reserved for a separate operational doctrine, the AFDD 2-2. This approach would seem to offer merit and could be replicated by AAP 1000 by the inclusion of a separate chapter or section that would provide space power doctrine.

SPACE POWER DOCTRINE STRUCTURE

In developing doctrine for space power, it must be emphasised that, while it is likely that RAAF ownership of space-based systems will almost certainly remain minimal for some years to come, RAAF generation of space power is possible now. There is a considerable body of space power operations within the terrestrial realm that could be carried out by the RAAF with existing equipment capabilities and improved space operations education and training. These operations include attacks on ground segments of adversary space systems, jamming of link segments, or the use of countermeasures to defeat adversarial space-based intelligence, surveillance and reconnaissance (ISR) capabilities. Similarly, possible integration of allied, civil and/or commercial space capabilities into current RAAF operations also offer the potential for improved space power generation by the RAAF in the near term.

However, even accepting current options for space power, any space power doctrine must provide some level of basic education as to fundamentals of space operations. This is especially pertinent given the limited scope of space operations experience in the RAAF. Most importantly, a discussion on why the utilisation of space has become so important is required.

Why Space is Important

Space, like the air environment, is not of intrinsic value itself. For the foreseeable future space will remain a means to an end. The military interest in space is accordingly focused on space as a location that supports the enabling of terrestrial operations.

Thus, perspective is the primary advantage offered by the space environment. Just as aircraft offer a means by which greater areas may be observed and accessed than by surface-based observers, space offers the ability to place systems at even higher altitudes allowing vast fields of view and areas of effect when compared to terrestrial systems. Similarly, as with all capabilities that offer a military advantage, it is reasonable to expect that adversaries will contest such use of space, seeking to assure their own access to such advantages and the associated denial of the same to their opponents if possible.

Environmental Aspects of Space Operations

Following on from this discussion, a basic overview of the space environment must be provided in order to highlight the environmental constraints associated with space operations. One of the most fundamental issues to be addressed will be a discussion of where space commences.

There is currently no widely accepted definition of where the space environment commences. Current convention regards space as commencing at that altitude where a vehicle's motion is determined by the laws of orbital mechanics rather than aerodynamics. As such, there is a general acceptance that an approximate altitude of 150 km represents the commencement of space, this being the lowest practicable altitude for enduring satellite orbits.

Once the boundaries of the space environment are defined, a broad description of the space environment and how it impacts the design and operation of space systems needs to be provided. This should include an overview of basic orbital mechanics, describing the general classes of orbits and the advantages and disadvantages associated with each class.

Space Systems Description

A space system is defined as any system that has one or more components operating in the space environment. This space-based component is thus the means by which the system provides the advantages offered by operations in the space environment. Likewise, it is the avenue by which the system is subject to the hazards and restrictions associated with those same operations in space.

This description must also emphasise that the space component of a system is dependent on the terrestrial system components and the communications links between these components.

Space Power Characteristics

Having reviewed the physical differences associated with space operations that are driven by the constraints of the space environment, characteristics of space power should be posited. This will also, as an aside, highlight similarities and differences in the characteristics of air versus space power.

Space Power Roles

An overview of space power roles, adapted from the US space mission areas, will then enable a description of the outputs of space power. Space power roles are as follows:

a. **Space Support.** This comprises functions such as launch and operations support from ground stations, enabling the deployment, sustainment and utilisation of the space components of space systems.

b. **Force Enhancement.** This includes the provision of services such as satellite communications, navigation and ISR that enable or value-add to terrestrial operations.

c. **Space Control.** Space control, which includes functions such as Space Situational Awareness (SSA) and counterspace operations, is intended to allow friendly freedom of action to effectively utilise space while denying the same to adversaries. Counterspace operations are enabled by SSA, and can range from actions such as the use of camouflage to defeat surveillance by satellites, through jamming of satellite communication links, to destruction of any or all of the components of an adversary's space systems.

d. **Force Application.** This role is the ability to apply force in the terrestrial realm via space systems, and includes nuclear strategic strike, ballistic missile defence and conventional terrestrial strike.

Space Law

A continuously evolving body of international law is applicable to the space environment. As an example, accepted international conventions do not extend the concept of national sovereignty into space. This allows for legal overflight by spacecraft of any portion of the surface of the earth. Attempts to apply the Law of Armed Conflict (LOAC) to space operations also present a number of problems when compared to LOAC in the air operations environment. When combined, these legal aspects of space operations present a considerable departure from the established legal conventions associated with air operations.

Personnel

The need for increased emphasis on space power education and training of RAAF personnel is required to support the development of space power professional mastery. Initial focus will need to be on general education of fundamental principles via the inclusion of space power in existing air power components in the syllabi of initial and ongoing professional development RAAF courses, including recruit training, NCO, SNCO and WOFF PROMEXs, OTS, ADFA, SQNLDRs course and ACSC.

Building on this increased level of general education, the requirement to develop a cadre of space operations professionals within the RAAF must be doctrinally acknowledged. As an essential aspect of developing this cadre, the requirement for the establishment of space operations careers must be recognised, without which space professional development will be extremely restricted.

Additionally, development of an understanding of the operational employment of space power should be pursued and included in RAAF operational training and practices. Development of this experience will be difficult and will be most likely dependent on experimentation and training exercises. Utilisation of allied experience, education and training courses and exchange position personnel offer the only practical means to accelerate this process.

JOINT IMPLICATIONS

The scope of this paper limits discussion to the incorporation of space power doctrine into RAAF single-Service doctrine. This incorporation of space power doctrine is intended to initiate education and debate within the RAAF community to better appreciate operations in a domain of growing military importance. Due to this single-Service focus, inclusion of space power doctrine in AAP 1000 is deliberately aimed at describing space power as applicable to the generation of air power.

Just as space power is increasingly impacting the way the RAAF goes about its primary duty of air power generation, space power also influences maritime and land operations. The space power doctrine concepts described in the preceding pages, when tailored appropriately, would be just as applicable to other Services and joint operations.

Incorporation of space power into Army and Navy doctrine is certain to be as, if not more, problematic than its incorporation into Air Force doctrine has proven to be to date. This does not mean that space power doctrine should not be available to these Services. Rather, it suggests that the ADF Warfare Centre should pursue development of joint space power doctrine, ensuring that future ADF operations better account for the impact of space power on the operations of all services.

CONCLUSION

As stated in ADDP-D, doctrine is a body of thought on the nature, role and conduct of conflict. It is developed from a number of contributing sources including the lessons of history and reasoned extrapolation of the theory of conflict. It attempts to account for contemporary and emerging factors, such as technology developments and cultural changes, which will alter the context of these lessons. The RAAF is well aware of the growing impact of space on Air Force operations. This is amply demonstrated by the very overt usage of the expression 'Aerospace Power' in the latest edition of AAP 1000.

Debate on space power and what it means to the RAAF is still in its infancy. The information provided above and the following recommendations are an attempt to push the debate on the impact of space operations on RAAF doctrine just one step further. The domain of operations being discussed is far more expansive than any the RAAF has ever even considered in previous experience, with the RAAF's limited experience and capability with space operations to date complicating this consideration.

This limited experience currently does not mean that the RAAF will not increasingly pursue operations linked to the space environment in future. Nor does it mean that potential adversaries will not either. The more effort the RAAF puts into understanding this emerging field today, the better prepared it will be to meet the challenges of the future.

RECOMMENDATIONS

Recommendations from this paper are that the RAAF should introduce a doctrinal description of space power in the next edition of AAP 1000 via the following steps:

a. Emphasise that AAP 1000 is Air Force doctrine rather than doctrine for the 'aerospace' domain.

b. State that the RAAF regards 'air' and 'space' as two distinct environments.

c. State that while the RAAF will retain its focus on air power, the growing importance of space power has mandated that the RAAF commence developing its ability to generate space power to complement the generation of air power.

d. Provide space power doctrine as an independent chapter in AAP 1000, summarising current and theorised space operations and associated space power doctrine, and discussing the requirements for the development of space power professional mastery.

ENDNOTES

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